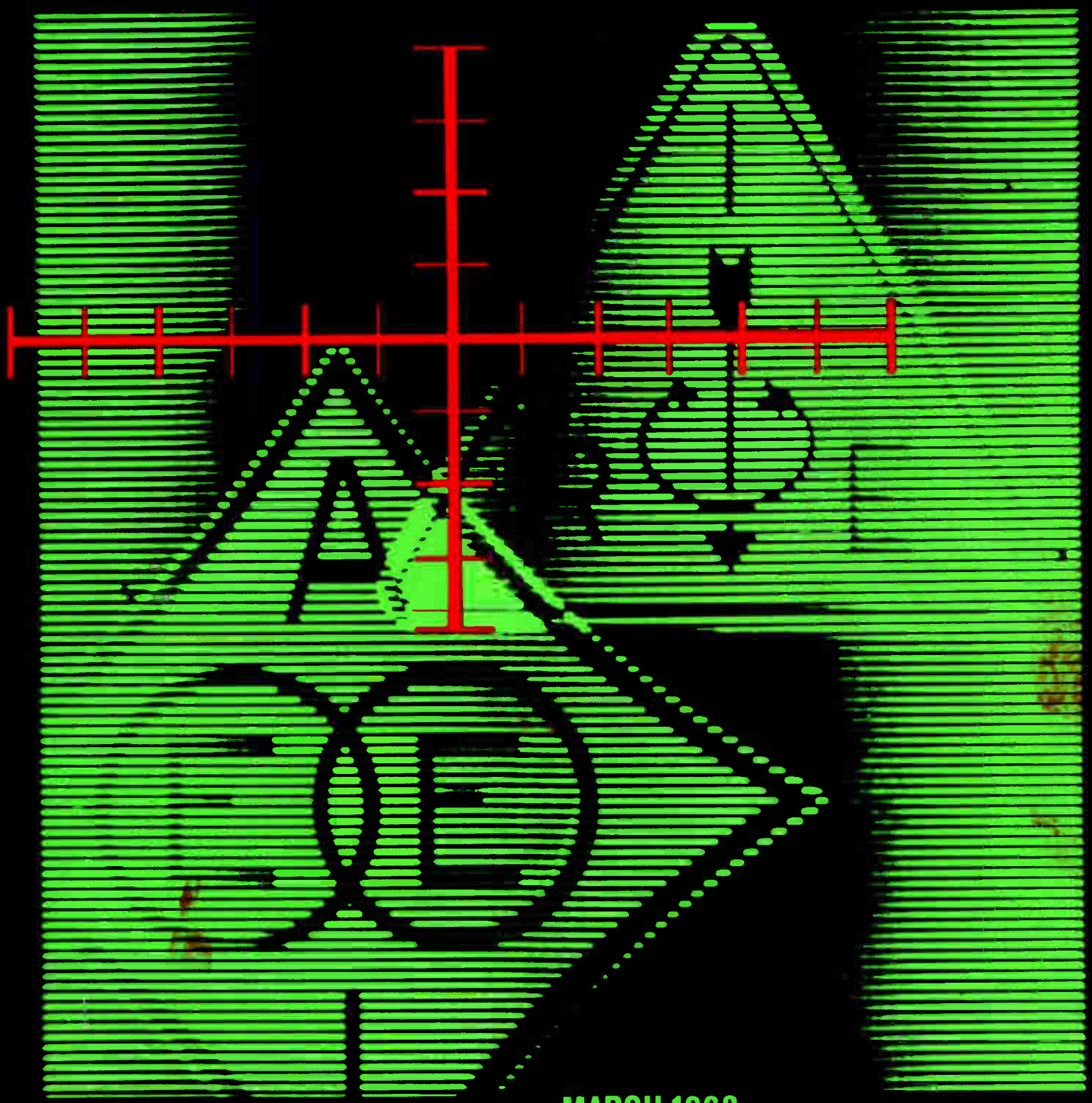
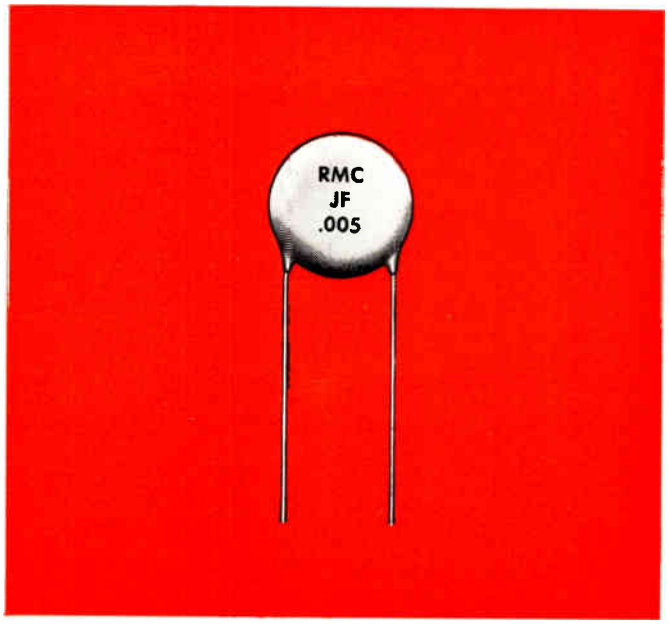
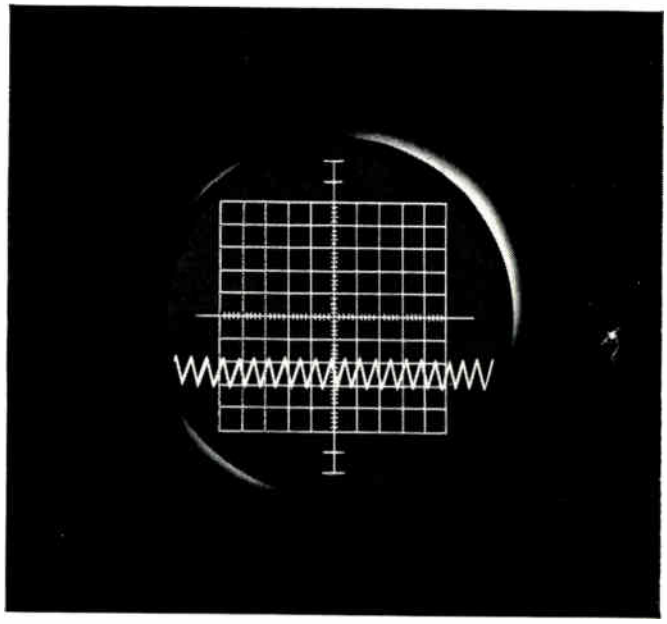
ELECTRONIC INDUSTRIES



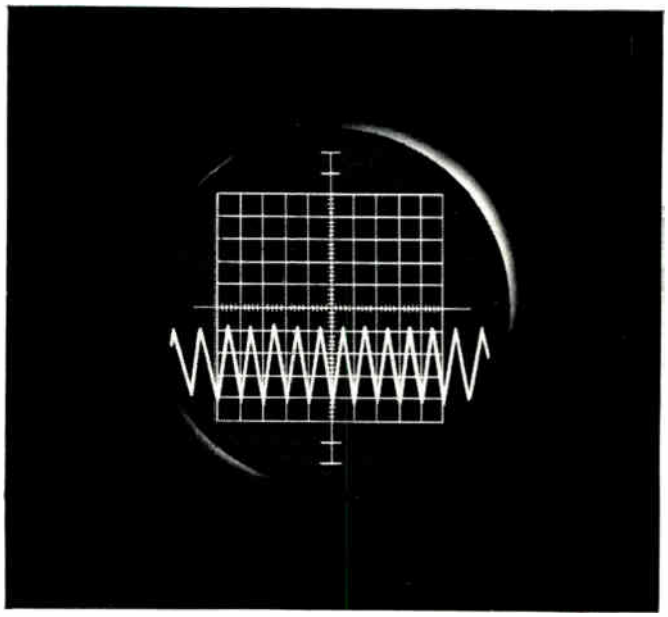
MARCH 1963
IEEE SHOW ISSUE



An RMC "JF" discap



...can go through phase



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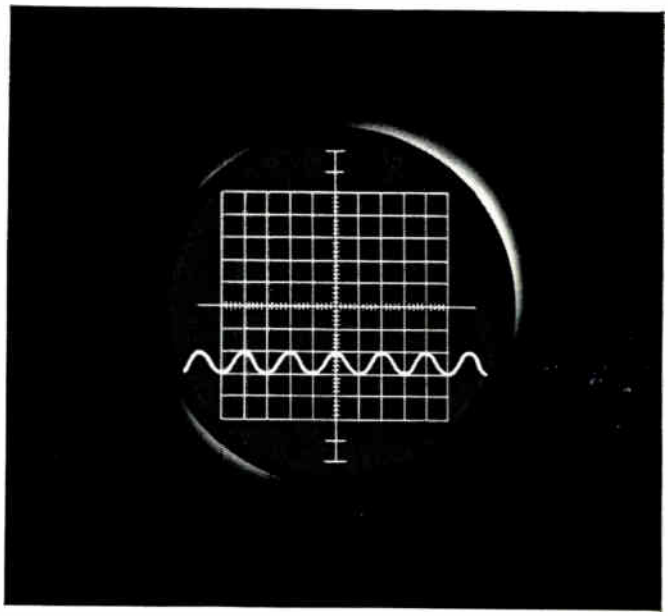

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RMC Type JF DISCAPS exhibit superior stability in applications where a wide range of frequencies is present. Rated at 1000 V.D.C., these capacitors are manufactured in capacities between 150 MMF and 10,000 MMF.

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ELECTRONIC INDUSTRIES

LOOKING AHEAD!

This guest editorial by Patrick E. Haggerty, President of Texas Instruments Incorporated, and retiring President of the Institute of Radio Engineers, is a bright forecast for the year ahead, with some thoughts on future growth.

GROWTH OF THE ELECTRONIC INDUSTRY in 1963 will continue at a faster rate than that of the national economy, with gains occurring in the government and industrial markets and present high levels continuing in the consumer and replacement markets for an over-all percentage increase from 1962 of nearly 5%.

Total industry sales, which approximated $13 billion in 1962, are expected to reach around $13.6 billion in 1963 under the impact of (1) increased defense and space exploration spending and a higher electronic content in the procurement dollar, (2) continued broadening of the use of electronics in all industry, including data processing, and (3) an almost doubling of the market for color television sets over 1962, increased demand for portable radios and demand for automobile radios approaching the high 1962 level.

Government expenditures for electronics are expected to rise to $8 billion in calendar 1963 from $7.5 billion in 1962; the industrial market will grow to approximately $2.4 billion from 1962's $2.3 billion; and consumer electronics and replacement sales are expected to continue in 1963 at their present high levels of $2.2 billion and $1 billion, respectively.

The Federal government continues to be the electronic industry's largest customer, accounting for over half its sales. It also represents the market least vulnerable to any temporary fluctuations in the general economy. It appears at this time, however, that over-all business activity throughout 1963 will be at a level at least as high as in 1962, with a possibility of some gains in specific areas. Thus the industry's other major markets should each realize their projected sales expectations.

The accelerating acceptance of integrated circuits for use in major new defense equipment programs was a most noteworthy development as 1962 drew to a close and one which will have an increasing impact on the entire electronics industry in 1963 and subsequent years.

Looking ahead, we must have a more adequate supply of trained scientific and supporting personnel. Another challenge is the urgent need for qualified management talent. To convert these forecasts to reality, we will need even more managers with the unique combination of technical knowledge *together with* all the management skills required for effective direction of research, development, marketing, finance and human relations.

ELECTRONIC INDUSTRIES

Vol. 22, No. 3 March 1963

MONTHLY NEWS ROUND-UP

EDITORIAL FEATURES

DEPARTMENTS

ELECTRONIC INDUSTRIES, March, 1963. Vol. 22, No. 3. A monthly publication of Chilton Company. Executive Editorial & Advertising offices at Chestnut & 56th Sts., Phila. 39, Pa. (Area Code 215) SHerwood 8-2000. Controlled circulation postage paid at Philadelphia, Pa. $1 a copy; Directory issue (June), $5.00 a copy. Subscription rates U. S. and U. S. Possessions; 1 yr. $10.00; 2 yrs. $18.00. Canada 1 year, $12.00; 2 yrs. $20.00. All other countries 1 yr., $18; 2 yrs. $30.00.

HIGHLIGHTS

of this issue

Oceanography & Anti-Submarine Warfare page 38

The secrets of the seas are being probed as an aid to anti-submarine warfare. Much of this probing will be accomplished using the latest electronic instrumentation techniques and data handling systems. The information gleaned from this probing will lead to better submarine detection techniques and equipment. This special report indicates the magnitude of the task and points out many of the existing problems.

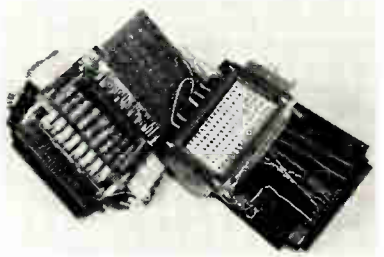
Oceanography & ASW

Expect Record Attendance at First I.E.E.E. Convention page 57

The First International Convention of the newly formed Institute of Electrical and Electronics Engineers may well be the biggest engineering convention ever. Over 75,000 engineers are expected. It will be held March 25-28 at the New York Coliseum and Waldorf-Astoria.

All-Magnetic Content Addressed Memory page 92

An extended application of All-Magnetic Logic is found in the design of this Content Address Memory. It has a retrieval time of ten microseconds using commercially available ferrites. The functional possibilities of CAM's and their closely related kin, Associative Memories, are discussed.



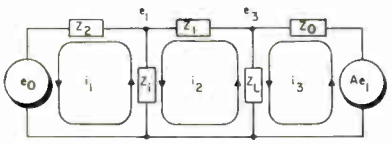
Content Addressed Memory

Characteristics of Unipolar Field-Effect Transistors page 99

For design engineers, answers to these questions: What are the significant dc and ac parameters? How are channel dimensions related to electrical characteristics? The UNIFET is considered as a 3-terminal network, characterized by four small-signal ac parameters.

The Node Method of Circuit Analysis page 102

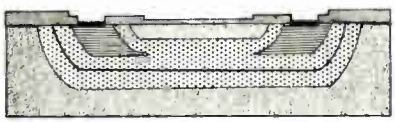
It appears that the Node Method of circuit analysis is not used as often as it should be in many instances. The Node Method saves time and gives an insight into the circuit that the Loop Method will not. An active feedback amplifier is analyzed here by the two methods so that a comparison can be made.



Node Method of Circuit Analysis

New Flip-Flop Design Improves Efficiency page 107

Complementary-symmetrical transistor applications can yield advantages not found in more conventional approaches. Here is an unstable multi-vibrator which uses this method to feature high power efficiency, low interference and small size.



Unipolar Field-Effect Transistors

Designing Wide Pulse-Width Modulators page 109

Newer microwave tubes place high requirements on the pulse modulator such as wider pulses, higher duty cycle, and sharp, clean pulses. Some of the modulator design problems are discussed and the engineering solutions described.

Job Hunting

Synthesis of an Active Chebyshev Filter page 112

For the low pass band, passive RCL filters have disadvantages of size and nature of components. The active RC filter, using semiconductors, eliminates most of these problems. A network synthesis is developed here, with details on how to specify and design.

RADARSCOPE

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

EFFICIENT LASER PUMP

Dr. Henry Minden of Sperry Rand Research Center, Sudbury, Mass., watches emission from gallium arsenide diode in liquid nitrogen as experiments progress on the use of the diodes as pump sources for lasers. Sperry scientists claim that they are close to achieving laser output efficiencies as high as 85% employing the diodes.

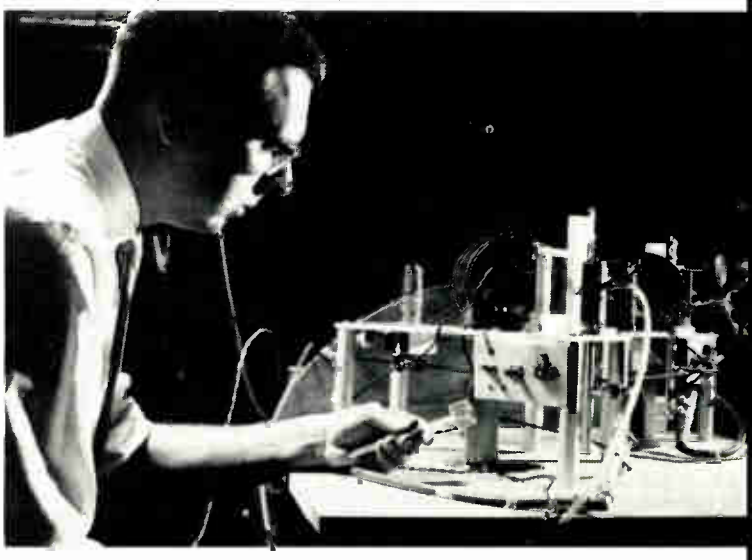
THE CHIEF INDUSTRY PROBLEM today is not technology, but management. On page 1 of this issue, TI's Patrick E. Haggerty gives his opinion on this subject. At the same time J. Donald Rauth, Vice President, Martin Co.'s Denver Div., has pointed out the same thing to Air Force representatives and TITAN suppliers. Describing the recent overhaul of Martin's management concepts, he pointed out the changing needs of industry. He cited several management concepts that must be installed to enable firms to compete in the new environment: adding such management tools as input, output efficiency ratings and PERT time and cost systems; centralizing configuration control under the contracts department merging the project concept—essential to getting complicated jobs done well and on time—with central functions concept to provide support for existing projects.

MICROMINIATURE COMPONENTS twice as small as today's components are essential to successful long duration space missions. This is the opinion of H. R. Brown, of North American Aviation Autonetics Research Ctr. He said that while many believe that micro research already has moved too far ahead of application techniques, actually much more must be achieved for far away space assignments. Size and weight must be reduced to conserve space loads while increasing computer speed, intelligence and reliability. Brown, referring to "a coming revolution in space micro-electronics," said scientists in the next six to ten years will produce highly reliable components in one or two orders of magnitudes smaller than present ones.

SIGNIFICANT NEW BILL has been introduced in the Senate which has strong implications for the electronic industry. The bill specifically would exempt the University of Colorado from paying customs duties on microcalorimeter now in use at the University. The instrument is manufactured only in France and was imported into this country last year. It was purchased by the University with funds made available under a grant from the U.S. Public Health Service. The Senators who are proposing the bill expressed the thought that it was somewhat ridiculous for the government on one hand to grant funds for a piece of equipment and then with the other hand charge the University a substantial sum as duty on the import of the equipment.

NUCLEAR GYRO

Dr. James Simpson, senior scientist at GPL Div. of General Precision Inc. inspects fuel cell which is to be inserted into new nuclear gyro shown in center of photo. The nuclear gyro has no moving parts, requires no warm-up time, has indefinite life and is unaffected by severe vibrations, accelerations and shocks.



FIBRE OPTICS is being used to aid high-speed photography. Bell Labs. has developed a fibre optic image dissection camera. It can take a sequence of 75 X-ray pictures at a speed of 400,000 frames per second with good resolution. Where conventional high-speed cameras are limited by the speed of mechanical shutters, the Bell Labs. camera utilizes the image dissection which can be created by a fibre optic bundle plus a continuous movement of the film plate. Fibres are coated at one end with a phosphor that converts X-rays to visible light.

TYPE-SETTING BY COMPUTER was demonstrated to 150 newspaper executives at Palm Beach, Fla., by RCA. At the plant at the Palm Beach Post-Times, the newsmen watched an RCA 301 computer set type automatically. The Palm Beach newspaper is the second of the country's newspapers to adopt automatic type-setting. The Los Angeles Times also employs a 301 EDP system.

GROWTH OF THE JAPANESE ELECTRONICS INDUSTRY and enactment of the Trade Expansion Act will confront the U.S. electronics industry with strong competitive challenges during the remainder of the 1960's. W. F. E. Long, EIA marketing services director, points out that many electronic products fall into the category for which the act authorizes 100% tariff reductions—those items that the U.S. and the Common Market nations do 80% or more of the world's trade in them. Japan is the strongest competitor for the U.S. electronic industries. The 44¢/hr. Japanese wage cost provides a significant cost advantage over the $2.41 American equivalent.

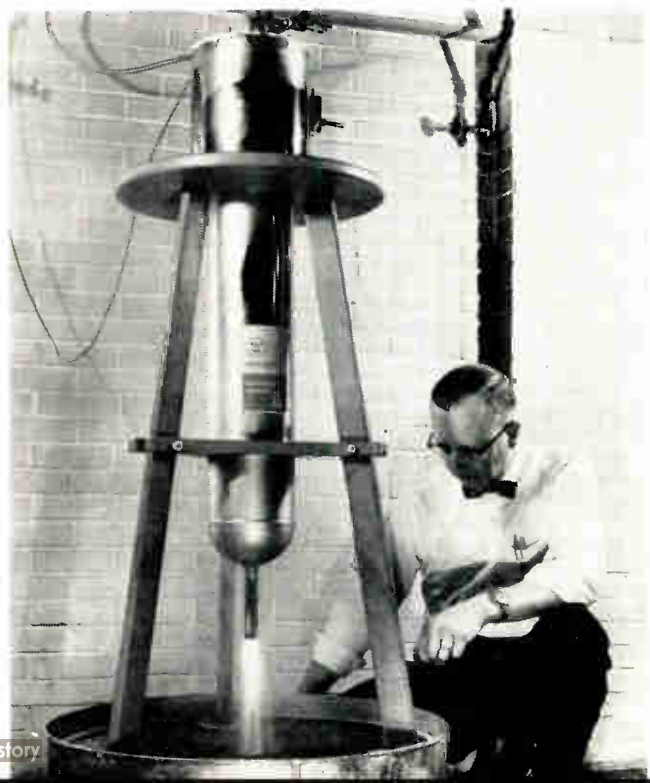
A RADICALLY NEW VACUUM TUBE which has no heater, and is capable of operating at room temperature, is under study at GE's Receiving Tube Dept. The tube has a higher tolerance to ionizing radiation than thin film or other microminiature devices based on semiconducting materials. The tube operates on the phenomenon called tunnel emission. Electrons flow from a cool substrate metal layer through an insulator which may be only a few tens of atoms thick to a thin counter electrode which is a few volts positive with respect to the substrate. If the second layer is "thin" enough, some of the tunneling electrons pass through and away from it without losing energy by collision with other electrons. Such electrons are emitted and the device becomes a cathode.

WIDE RANGE OF CONSUMER PRODUCTS is expected to result from the government's massive space program. Republic Aviation's Mundy I. Peale points out that a preliminary survey by NASA has already uncovered 145 examples of products and processes that can be directly traced to some part of the space effort. Among the items that he foresees are: rooms illuminated by glowing walls, worldwide TV and telephone systems, accurate weather forecasting, weather control and a wide range of new materials.

TROUBLE SHOOTING CIRCUIT BOARD FAILURES through use of a unique computer simulation program was described at the National Winter Convention on military electronics. H. T. Breen, of North American Aviation, explained that the program was designed to correlate the failure systems of an electronic circuit with the cause of the failure. Correlation is established by simulating component part failures and source failures for the circuit within the computer and then observing the effects of these failures on a number of selected test point values. Each part and source failure will cause each of the test point readings to rise or fall as the case may be. A record is kept of each test point reading and the failure responsible for it.

SUPERCONDUCTING MHD GENERATOR

Combining in a single device two new developments—superconducting magnets and MHD power generation—the first superconducting MHD generator goes into operation at Westinghouse Research Labs. The tank houses a superconducting magnet, in liquid helium. The white-hot gases pass through to convert heat directly into electricity.



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CAST MICA CAPACITORS FEATURE:

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- ✓ **Cooler Operation**

For application engineering assistance without obligation, write to Mica Capacitor Section, Field Engineering Dept. For complete technical data write for Engineering Bulletins 1230 and 1240 to Technical Literature Service, Sprague Electric Company, 233 Marshall Street, North Adams, Massachusetts.

- SOMETHING NEW and important has happened to transmitter-type mica capacitors! In place of the old-fashioned, bulky assemblies you've had to use in the past, Sprague now offers modern, miniaturized Cast Mica Capacitors—30% smaller in size, 30 to 40% lighter in weight, available in new shapes and mountings for liberal new design possibilities.

- Encapsulated in high-temperature epoxy resin by a patented process, Sprague Cast Mica Capacitors will operate at temperatures to 125 C *without derating*—greatly in excess of the 70 C or 85 C limits of conventional capacitors. This exclusive construction also provides superior thermal conductivity—far better than with porcelain—enabling these capacitors to carry higher r-f currents.

- Unlike older units with fragile insulating housings, Sprague Cast Mica Capacitors are rugged. Their tough epoxy resin encapsulation, with improved hermetic seals, eliminates use of potting waxes which tend to melt and cause damage to electron tubes and other components.

- Sprague Cast Mica Capacitors, designed not only to meet but *exceed* MIL Specifications, are made in both the familiar cylindrical as well as a new rectangular shape, with female threaded terminals on opposite ends. Although smaller in size than conventional capacitors, Cast Micas can be procured—for interchangeability—with one or two aluminum plates having the same center-to-center mounting holes as standard types. Where space is critical, they may also be mounted or stacked without plates by means of dual-ended headless screws.

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AS WE GO TO PRESS

"WHICH WAY IS UP?"

Ceiling walker shows how new Westinghouse magnet combining advantages of permanent and electromagnet works. It can be turned on and off, allowing steps to be taken. Magnet has a "memory," exerting pull in same direction until reversed. Ceramic magnet is between 2 soft steel layers. Electrical connection at one pole causes flux transfer, reversing polarity. Shoe's pull is 30-50 lbs.

RCA DEVICE CAN REPLACE TRANSISTOR, VACUUM TUBE

RCA has developed a silicon transistor element that combines the flexibility and simple circuitry of vacuum tubes with the low operating power, small size and long life of transistors.

Called a metal oxide semiconductor transistor, the very small solid-state device can be fabricated into large interconnected arrays. Each one can replace transistors and vacuum tubes.

An integrated circuit using the devices is made by producing conducting paths in a slice of high-resistivity silicon. Gaps are left wherever an active circuit element is wanted. An insulator is produced by simply oxidizing the silicon over the gap.

A metal electrode or "gate" is deposited atop the insulator and connected into the circuit. By applying proper voltage on the insulated gate, the gap becomes conducting and the circuit is closed.

By varying input voltage, this field-effect device can be made to switch at high speeds, amplify or otherwise regulate its current output as does a pentode vacuum tube.

Both positive and negative devices have been made. Other characteristics: temperature range −80° to +190° C.; switching speed, 10 to 20 nanosec.; and radiation resistance, about 10 times that of conventional transistors.

SPERRY USES LASERS TO DO WORK OF GYROS

Sperry Rand has developed a simple ring laser that promises to perform the functions of a gyroscope at as little as one-fifth the cost.

Developed by the Sperry Infrared/-Optics/Laser Group, the device is based on the constant velocity of light.

Three of the systems are needed to make a complete three-axial "gyro" system.

Counter-rotating light beams are whirled around a square "ring" as the ring rotates within a vehicle. The light beams are then picked off through a transparent mirror. The difference in wave lengths and frequencies of the two light beams is proportional to the vehicle's rotation rate.

The device has already been used to sense rotation rates of down to 2 deg./min. Higher rotation rates would be less of a problem due to the corresponding difference in the measured light wave lengths.

Use of the laser is important because the high frequencies involved make measurement of frequency differences easier.

In developing the device Sperry achieved a fully coherent laser beam. Considerable optical and laser research is still going on at Sperry to perfect the device and "put it to work," now that the principle has been proved.

Sperry scientist checks ring laser setup.

The present model is 1 m. sq. It uses four neon-helium gas laser tubes for gain purposes, though one would suffice. Gas tubes have been developed by the company and will soon be tried out in the new system.

The objective is to achieve perfect guidance with the system, eliminating the gyroscopic "drift" problem. Angular measurement can now be made accurate to within 1/15,000 deg.

GT&E DEVELOPS SIMPLE HIGH-SPEED DATA SYSTEM

A technique which allows data to be transmitted at 3,200 words/min. by a comparatively simple, reliable binary system has been developed by Lenkhurt Electric Co., Inc., a General Tel. & Electronics subsidiary.

Called "duobinary coding," it doubles to 2,400 bits/min. (3,200 words/min.) the information that can be sent by a standard binary system. This is done by coding the signal at the transmitter.

Advantage is that a typical binary system requires only half the transistors of a typical multiphase, multilevel modulation system transmitting as fast.

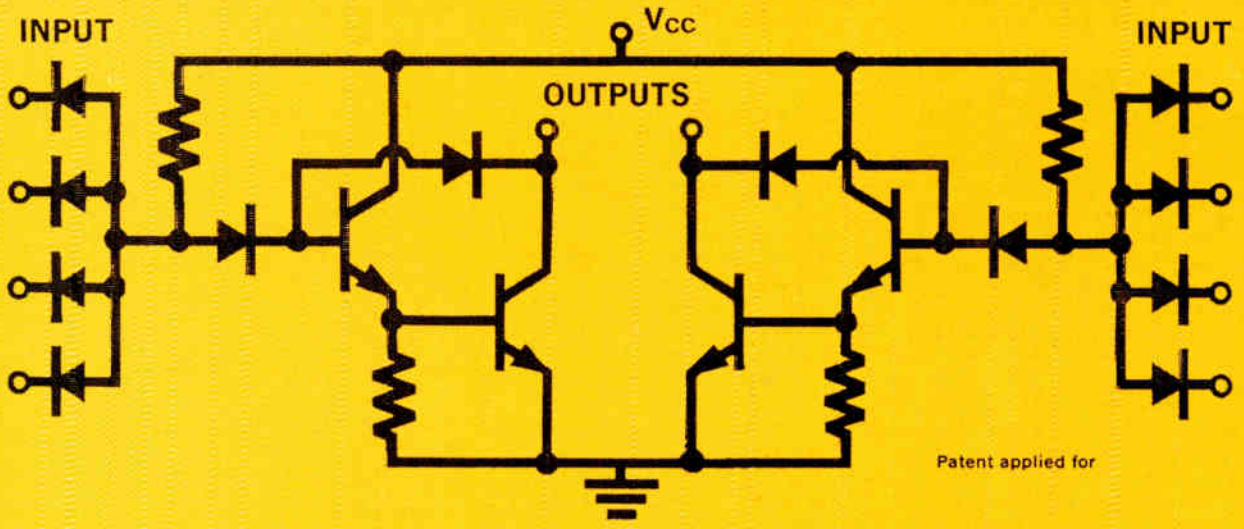
The need for customary error-detection will also be eliminated in some systems using the new technique—error detection is included in the coding process. The duobinary system will, on the average, make 1 error per million bits.

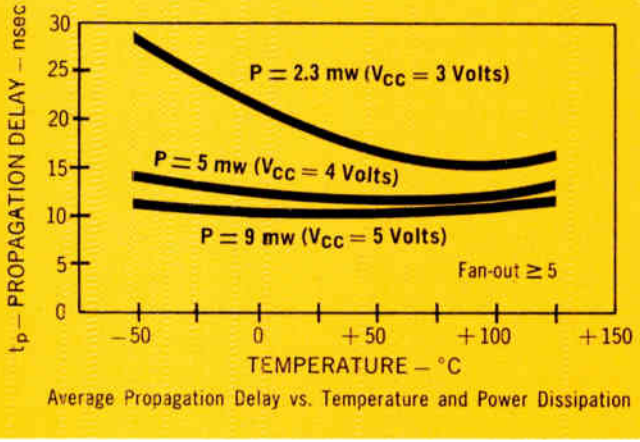
"FLUID FLYWHEEL"

Mercury circulated through this tubing creates a force which G.E. says can be used to solve the problem of how to stabilize space vehicles on long flights away from earth. Normally, spacecraft are stabilized by jets expelling fuel in a direction opposite the erratic movement. Engineer R. E. Tompkins assembles a development model of the "fluid flywheel" at company's lab.

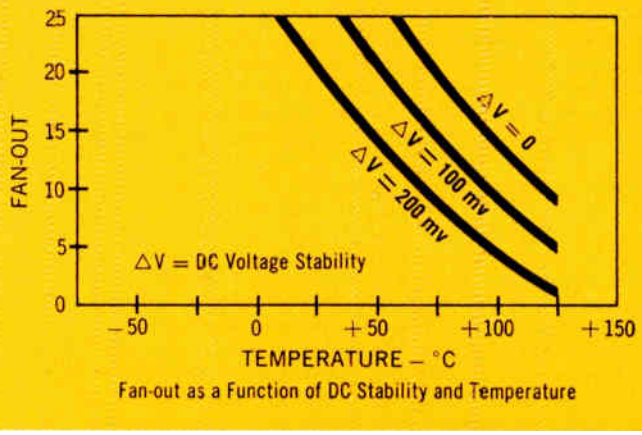
More News on Page 9

The Siliconix 12 nsec 5 mw Dual NAND Gate





Average Propagation Delay vs. Temperature and Power Dissipation



Fan-out as a Function of DC Stability and Temperature

THIS PLANAR SILICON INTEGRATED CIRCUIT HAS A LOWER POWER-SPEED PRODUCT (60 PICOWATT-SECONDS) AT HIGHER FAN-OUT THAN CONVENTIONAL DIODE-COUPLED NAND GATES BECAUSE OF:

a. The unique emitter-follower diode-clamp circuit . . .
b. Small geometry which minimizes capacitance . . .
c. Epitaxially grown collectors.

PROPAGATION DELAY VARIES LESS THAN ±7.5% FROM −55°C TO +125°C WITH V_{CC} 4 TO 5 VOLTS. USE THIS GATE AS A NAND, NOT AND-OR, BISTABLE FLIP-FLOP, OR HALF ADDER. ANOTHER EXAMPLE OF THE WAY SILICONIX COMBINES CIRCUIT AND SEMICONDUCTOR TECHNOLOGIES INTO DIGITAL AND LINEAR INTEGRATED CIRCUITS AND COMPONENTS. WRITE FOR DETAILS.

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INTEGRATED PHONE EXCHANGE

In Chardon, Ohio, near Cleveland, engineer inspects Stromberg-Carlson Register-Sender. It can be gradually integrated with existing electro-mechanical equipment to provide electronic switching advantages, including push-button dialing.

RADIATION INCREASED AFTER HIGH SOVIET BLASTS

Telstar detected large radiation increases between the two Van Allen belts after the Russian high-altitude nuclear blasts of Oct. 22 and 28.

Bell scientists say Telstar showed that the Oct. 22 blast nearly filled the "slot" between the two radiation belts. The number of electrons increased 100 to 1,000 times. They decreased in the center of the slot by 50% per day —but much more slowly elsewhere. The Oct. 28 blast again nearly filled it. The number decayed at the same rate.

Findings regarding the U. S. high-altitude nuclear blast July 9 are not so clear. After Telstar was put in its 600-3,500 mile high orbit July 10, it measured an electron intensity in the slot higher than that measured after the Soviet blast. But large fluctuations occur naturally. So it is not known how much intensity was produced by the U. S. blast.

Telstar's elliptical orbit carries it through both Van Allen belts.

BURROUGHS, IBM AGREE TO SHARE PATENTS

Burroughs Corp. and International Business Machines Corp. have concluded a licensing agreement under which each makes available to the other for five years its patent rights on data handling systems.

The agreement is to let each firm develop and make its own systems free from concern about infringing on the other's patents.

(*More News on page 11*)

ELECTRONIC SHORTS

TV system that operates in near total darkness has been developed by G. E. for air surveillance. Designed around GE's ZL-7806 image orthicon, the lightweight all-transistor camera chain, Model HTC-1, generates 300-line TV picture at 10^{-6} ft.-candle.

New FAA report system details failures and "outages" of air control and navigation equipment. Action to repair/replace items, plus general information on breakdowns of certain types of equipment will result.

High-powered airborne communications set, 70% lighter, much smaller than present ones, is being developed by RCA for Navy. The SSB, h-f receiver-transmitter is part of BuWeapons plan to introduce solid-state microcircuitry into its avionics gear.

Librascope Div. of General Precision's Information Systems Grp. has received large Douglas Aircraft contract to design and produce airborne digital computer system for Army tactical aircraft. Lightweight system will be computing center of cockpit display system Douglas is developing for Army.

Air Force has awarded contract for advanced nuclear gyro to Arma Div., American Bosch Arma Corp. Arma has developed and produced gyros for Atlas ICBM, other missile and aerospace uses, subs and surface ships.

Laser Systems Ctr., Lear Siegler, Inc., Ann Arbor, Mich., has developed a new high-power coherent green light source. This is considered essential by Navy for important experimental work in underwater communications and surveillance techniques.

Russians reportedly have small walking-talking robot which guides visitors through Moscow Polytechnics Museum's telemechanics section. Radio-guided robot gives explanations from special tape recorder and answers questions. Its brain can be seen "ticking" inside transparent head.

Contract to develop test model of expendable space structure—able to increase in length like a telescope—has been awarded to Martin Co.'s Denver Div. by AF Systems Command. Results will be used to make an actual space structures based on this principle.

The U. S. Information Agency now has what is described as the free world's most powerful complex of radio transmitters—a 5-million watt, $23 million complex recently dedicated at Greenville, N. C. Prime contractors were Ling-Temco-Vought and Alpha Corp. of Texas. Philco Corp. built a 250-mile microwave link between the complex and Washington.

X-ray equipment being distributed by Picker X-Ray Corp., White Plains, N. Y., has less than 2-in. dia. grounded rod anode tubes. The shockproof tube with a 360 deg. beam is designed to fit through narrow openings and into tight places. Up to 40 in. long, it can be inserted in holes or poked through small ports in pressure vessels.

A thinner-base computer tape, with almost 50% more tape on the same size reel, has been introduced by Audio Devices, Inc. Called "Extra Length Computer Audio-tape," it uses 1-mil DuPont base material, Mylar T, instead of standard 1.5 mil polyester films. This thinner—but stronger—material enables nearly half again as much tape to be wound on a given sized reel.

A telescope which can record accurately the parallactic orbits of white dwarf, red dwarf and sub-dwarf stars, a rocket-mounted TV camera for detailed viewing of the moon's surface and a spectrometer with a luminosity greater than that of those now used, are described in the Jan. issue of *Applied Optics*, a publication of the Optical Society of America.

The Laguna Indian Tribe is building an electronics plant for Burnell & Co., Pelham, N. Y., at the Laguna-Pueblo Indian Reservation near Albuquerque, N. M. It will be occupied under a 25-year lease, providing employment opportunities for members of the tribe.

AS WE GO TO PRESS

TINY COMPUTER

Univac Microtronic Aerospace Computer, occupying .15 cu. ft., is checked by project engineer Ted Sammis. 17-lb. computer of magnetic thin films and semiconductor integrated circuits which has expandable 74,000-bit memory.

DOD INCREASES CONTROL OF TECHNICAL INFORMATION

All technical information handled by the Dept. of Defense will be coordinated under two new programs.

The key aim is to eliminate duplication of effort and resources.

The Director of Defense Research and Engineering will coordinate all individual scientific and technical information programs. The Assistant Secretary of Defense (Installations & Logistics) will coordinate flow of production engineering and logistical data.

The order affects information exchange within DOD, between DOD and contractors, DOD and other agencies and their contractors, and between DOD and the scientific and technical community.

The directive calls for "vigorous, well-organized, thoroughly coordinated, comprehensive technical information programs." It states exchange of technical information between DOD and the scientific-technical community should be "to the maximum extent permitted by security."

MEDAL WINNER ANNOUNCED

Dr. Theodore von Karman, famous aerodynamicist and a founder of Aerojet-General Corp., has been selected as the first to receive the National Medal of Science, established by Congress three years ago.

ENGINEERS DO PROGRAM FOR HONEYWELL COMPUTER

A digital programming system that lets engineers do their own programming is being used at Honeywell Electronic Data Processing.

The system, called PARTNER (Proof of Analog Results Through a Numerical Equivalent Routine) lets engineers write programs quickly in language they can understand. This avoids extensive and complicated preparation.

PARTNER is a series of subroutines. Each represents a certain transfer function or nonlinearity. They are combined into the program the problem calls for. Only one instruction is required per function. The program solves the problem on a point-by-point basis with output appearing as a listed time history of the selected variables.

PARTNER, written for the Honeywell 800 computer, can solve very large and nonlinear problems. It has been used for control system problems on the Apollo and X-20 Dyna Soar projects among others.

It was first developed to obtain easily programmed digital check-solutions for analog computer problems. An important aspect was to provide a PARTNER solution to a given problem prior to its analog simulation. This allowed much better analog scaling, less problem checkout time, and gave more confidence in analog results.

GE DATA SYSTEM SCANS 600 INPUTS

General Electric Co. has developed a data acquisition system that automatically scans 600 instruments.

The solid-state system converts analog voltages of any combination of the inputs into digital data. Scan timing can also be controlled. Data can be recorded at once on punched paper tape and a digital printer, or fed into a digital computer.

The system will print, punch, or print and punch at up to 40 points/sec. Scanning of 60 points/sec. can be obtained when system is hooked into a computer.

The data logger can test analog outputs such as thermocouples, pressure transducers and strain gauges. It can thus be used to test engines, space simulators, airplanes and rockets. It may also be useful in the chemical, petroleum and utility fields.

TWIN ANTENNA

Above twin tracking antenna is one of two that Motorola built to test range and range-rate equipment it is making for NASA's Goddard Space Ctr. Twin antennas are at Motorola military test center, Scottsdale, Ariz. One "dish" transmits. One receives.

MULTIPLE-BEAM KLYSTRON PRODUCES 40 KW OUTPUT

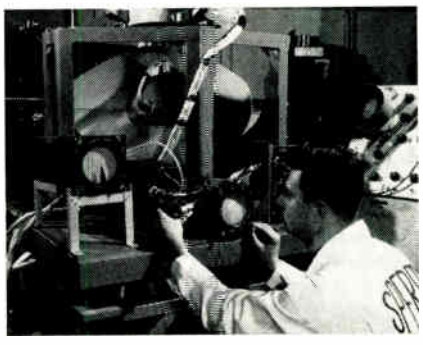
A new, very high power multiple-beam klystron has been introduced by the General Electric Co.

The factory-built tube is rated for an X-band CW power output of 40 KW. Frequency range is 8.3 to 8.5 GC. Tuning range is 80 MC.

Designated ZM-6600, it provides high r-f power with low thermal densities. High effective perveance (8 micropervs) permits high power with only 12 KV operating voltage. Typical operating conditions include a nominal gain of 45 db. Nominal efficiency is 34%.

The tube combines 10 conservatively designed individual beams phase-locked in a multiple-beam structure. Disadvantages of external paralleling are eliminated.

RADAR TEST



Sperry Gyroscope Co. technician Conrad Hansen performs tests on one of a number of radar sets being made for Air Force. Called the APN-59, the radars can handle search surveillance, storm detection and other all-weather navigation work.

STEVENS *Certified* THERMOSTATS
for electronic and aerospace applications

■ If smaller size, lighter weight, utmost reliability and realistic costs are part of your product cosmos, take a long, hard look at Stevens *Certified* Thermostats.

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

■ And we back Stemco Thermostats by Applications Engineering Service that's right out of this world. A card or call will bring our representative on the double.

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

STEMCO®

THERMOSTATS

Type MX Hermetic
Snap-acting to open on temperature rise only. Copper housing responds more readily than steel types. Standard tolerances ±3°F with 2 to 6°F differentials; 1 to 4°F differentials on special order. Temperature 10° to 260°F. Various terminals and mounting brackets. See Bulletin 6100.

Type AX Hermetic
Similar to Type MX but to close on temperature rise. Wide selection of terminals and mounting provisions, highly responsive non-ferrous metal housing. 2 to 6°F differential. Bulletin 3200.

Type C Hermetic
Field-adjustable, positive-acting. Electrically independent bimetal strip type for operation from —10° to 300°F. Nickel-silver case with or without plating, depending on specifications. Turret terminals or wire leads. For ratings, etc., Bulletin 5000.

Type A Hermetic
Electrically independent bimetal disc and high-response brass case for quick, snap-action control from —10° to 300°F. Various non-ferrous metal enclosures, wide variety of terminal arrangements and mounting provisions, including brackets. Bulletin 3000.

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

A-7222A

COMING EVENTS

...in the electronic industry

MARCH

Mar. 11-15: 1963 Nat'l. NACE Conf.; Americana Hotel, New York, N. Y.

Mar. 13-14: 13th Nat'l. Conf. on Instrumentation for the Iron & Steel Ind., ISA; Pick-Roosevelt Hotel, Pittsburgh, Pa.

Mar. 15: 10th Annual Quality Control Clinic, Milwaukee Sec., ASQC; Milwaukee Inn, Milwaukee, Wisc.

Mar. 15-16: Information Processing Conf., Computing Devices Committee, IEEE; Calif. Inst. Tech., Pasadena, Calif.

Mar. 15-17: Michigan State Conv., ARRL; Saginaw, Mich.

Mar. 16: Annual Quality Control Seminar, S. Conn. Sec., ASQC; Univ. of Bridgeport, Bridgeport, Conn.

Mar. 18-20: Workshop-Seminar on Quality Control Mgmt., ASQC Inst., Boston Sec., ASQC; MIT Faculty Club, Cambridge, Mass.

Mar. 18-22: 1963 Spring Conv., Soc. for Nondestructive Testing; Ambassador Hotel, Los Angeles, Calif.

Mar. 18-22: ASM Western Metal Exp. & Cong.; Ambassador Hotel and Pan-Pacific Audit., Los Angeles, Calif.

Mar. 20-22: Spring Conf., EIA; Statler-Hilton Hotel, Washington, D. C.

Mar. 20-29: Symp. — "Quantitative Spectroscopy at Elevated Temperatures and Selected Applications in Space Science," AFOSR, AF Cambridge Res. Labs., ARPA, NASA, Inst. Def. Analysis, ONR, Calif. Inst. Tech.; Calif. Inst. Tech., Pasadena, Calif.

Mar. 23: Annual Nat'l. Conv., Intercollegiate Broadcasting Syst.; New York Univ., Univ. Hts., New York, N. Y.

Mar. 24-30: ACSM-ASP Annual Mtg.; Shoreham Hotel, Washington, D. C.

Mar. 25-27: Space Testing & Support Mtg., AIAA; Cocoa Beach, Fla.

Mar. 26: 12th Annual Dinner & Hamfest, SSB Amateur Radio Ass'n.; Statler-Hilton Hotel, New York, N. Y.

Mar. 26: 19th Annual Quality Control Conf., Rochester Sec., ASQC; Univ. of Rochester, Rochester, N. Y.

Mar. 26-28: American Power Conf., Ill. Inst. Tech., ASME, others; Sherman Hotel, Chicago, Ill.

Mar. 27: Spring Mtg., Ultrasonic Mfrs. Assn.; New York, N. Y.

Mar. 30: Quality Control Conf., Battle Creek-Kalamazoo Sec., ASQC; Univ. Ctr., W. Mich. Univ., Kalamazoo, Mich.

Mar. 31-Apr. 3: 41st Annual NAB Conv. & 17th Annual Broadcast Eng. Conf.; Chicago, Ill.

Mar. 31-Apr. 5: Nat'l. Spring Mtg., AChS; Los Angeles, Calif.

APRIL

Apr. 1-3: "Pressure Vessels for Aerospace Applications," 4th Annual Structures & Materials, Conf., AIAA; Palm Springs, Calif.

Apr. 1-5: 1st Annual Dallas Ind. Trade Fair, State Fair of Texas; State Fair Park, Dallas, Tex.

Apr. 4-6: Mtg., Southwest Sec., ASEE; Rice Univ., Houston, Tex.

Apr. 6: 5th Annual Quality Control Conf., Akron-Canton Sec., ASQC; Sheraton Hotel, Akron, Ohio.

Apr. 6: Mtg., Michigan Sec., ASEE; Gen. Motors Inst., Flint, Mich.

Apr. 10: 8th Annual Materials Handling & Packaging Conf., Soc. of Packaging & Handling Engrs., Amer. Materials Handling Soc.; Wheeler Hall, Univ. of Calif., Berkeley, Calif.

Apr. 10-11: 4th Symp. on Eng. Aspects of Magnetohydrodynamics, IEEE (PTGNS), AIAA, Univ. of Calif.; Univ. of Calif., Berkeley, Calif.

'63 Highlights

IEEE Int'l. Conv., Mar. 25-28; Coliseum and Waldorf-Astoria Hotel, New York, N. Y.

ICEAS, Int'l. Conf. & Exh. on Aerospace Support, Aug. 4-9, IEEE, ASME; Sheraton-Park Hotel, Washington, D. C.

WESCON, Western Electronic Show and Conf., Aug. 20-23, IEEE, WEMA; Cow Palace, San Francisco, Calif.

NEC, National Electronics Conf., Oct. 28-30, IEEE; McCormick Place, Chicago, Ill.

NEREM, Northeast Research and Eng. Mtg., Nov. 4-6, IEEE; Boston, Mass.

Apr. 14-19: Spring Mtg., Electrochemical Soc.; Penn-Sheraton Hotel, Pittsburgh, Pa.

Apr. 16-17: 1963 Ohio Valley Instrument-Automation-Electronics Exh. & Symp., ISA, SESA; Cincinnati Gardens, Cincinnati, Ohio.

Apr. 16-18: 10th Cleveland Electronics Conf., IEEE, ISA, Cleveland Physics Soc., Case Inst. Tech., Western Reserve Univ.; Sheraton-Cleveland Hotel, Cleveland, Ohio.

Apr. 16-18: "Optical Masers," 13th Annual Polytechnic Int'l. Symp., IEEE, OSA, AFOSR, ONR, ARO, Microwave Res. Inst., Brooklyn Polytech. Inst.; United Eng. Ctr., New York, N. Y.

Apr. 17-19: 15th Annual Southwestern IEEE Conf. & Electronics Show; Dallas Mem. Audit., Dallas, Tex.

Apr. 17-19: 1963 Tech. Mtg. & Eqpt. Exp., Inst. Env. Sci.; Statler-Hilton Hotel, Los Angeles, Calif.

Apr. 17-19: 1st Int'l. Conf. on Nonlinear Magnetics, IEEE (PTGEC, PTGIE); Shoreham Hotel, Washington, D. C.

Apr. 18: "Plastics for Electronics," Tech. Conf., SPE; Syracuse Univ., Syracuse, N. Y.

Apr. 19-20: AMS Mtg.; Chicago, Ill.

Apr. 20: Mtg., Missouri-Arkansas Sec., ASEE; Washington Univ., St. Louis, Mo.

Apr. 21-24: 2nd Annual 3-Day Seminar, Ass'n. of Electronic Parts & Eqpt. Mfrs., Univ. of Ill.; Monticello, Ill.

Apr. 21-26: 93rd SMPTE Conv.; Traymore Hotel, Atlantic City, N. J.

Apr. 22-23: Maintenance & Plant Eng. Conf., ASME; Indianapolis, Ind.

Apr. 22-23: APS Mtg.; Sheraton-Park Hotel, Washington, D. C.

Apr. 22-25: Nat'l. Packaging Exp., AMA; McCormick Place, Chicago, Ill.

Apr. 22-24: 3rd Annual San Diego Symp. for Biomedical Eng., IEEE; Del Webb's Oceanhouse, San Diego, Calif.

Apr. 22-24: 2nd Manned Space Flight Conf., IAS; Dallas, Tex.

Apr. 22-26 44th Annual Mtg. & Welding Exp., AWS; Sheraton Hotel, Trade & Conv. Ctr., Philadelphia, Penna.

Apr. 23-25: 11th Nat'l. Conf. on Electromagnetic Relays, NARM, Okla. St. Univ.; Student Union Bldg., Okla. St. Univ., Stillwater, Okla.

Apr. 23-25: Hypersonic Ramjet Conf., ASME; Naval Ordnance Laboratory, White Oak, Md.

Apr. 24-26: Power Ind. Computer Application Conf., IEEE; Westward-Ho Hotel, Phoenix, Ariz.

Apr. 24-26: IEEE 6th Reg. Tech. Conf.; San Diego, Calif.

Apr. 24-26: Cellular Plastics Tech. Conf. & Div. Mtg., SPI; New York Hilton Hotel, New York, N. Y.

Apr. 24-26: IEEE Southeast-South Central Dist. Mtg.; John Marshall Hotel, Richmond, Va.

Apr. 25: "New Trends in Vinyl Plastics in Def. & Ind.," SPE; Cherry Hill Inn, Haddonfield, N. J.

Apr. 25-26: Soc. Amer. Value Engrs. Nat'l. Conv.; Americana Hotel, New York, N. Y.

Apr. 25-26: Railroad Conf., ASME, IEEE; Biltmore Hotel, Atlanta, Ga.

Apr. 25-26: Mtg., Southeastern Sec., ASEE; Ga. Inst. Tech., Atlanta, Ga.

Apr. 26-27: AMS Mtg.; New Mexico St. Univ., Univ. Park, N. Mex.

Apr. 26-27: Mtg., Pacific Northwest Sec., ASEE; Oregon St. Univ., Corvallis, Ore.

Apr. 26-27: Mtg., Allegheny Sec., ASEE; Univ. of W. Va., Morgantown, W. Va.

Apr. 26-28: New England Div. Conf., ARRL; Swampscott, Mass.

Apr. 27: Mtg., Rocky Mountain Sec., ASEE; Univ. of Utah, Salt Lake City, Utah.

Apr. 28: 65th Annual Mtg., ACS; Penn-Sheraton Hotel, Pittsburgh, Pa.

Apr. 29-30: Electro-Nuclear Conf., IEEE; Richland, Wash.

Apr. 29-May 1: 9th Nat'l. Analysis Instrumentation Symp. & Exh., ISA; Rice Hotel, Houston, Tex.

(Continued on page 14)

COMING EVENTS

Apr. 29-May 3: Annual Conf., SPSE, Army Res. Ofc.; Ambassador Hotel, Atlantic City, N. J.

Apr. 29-May 3: AMS Mtg.; New York, N. Y.

"CALL FOR PAPERS"

Cryogenic Engineering Conf., Aug. 20-22, 1963, Boulder, Colo. Deadline for abstract (200 words) and preliminary manuscript is *May 1 1963*. Send them to: K. D. Timmerhaus, Secretary, Cryogenic Engineering Conference, Chemical Engineering Dept., Univ. of Colorado, Boulder, Colo.

1963 Western Electronic Show & Conv., Aug. 20-23, 1963, Cow Palace, San Francisco, Calif. Send following by *April 15, 1963*: 3 copies of 100-200 word abstract; 3 copies of 500-1,000 word summary of paper. Summaries should identify related work, new contributions of paper and IEEE professional group area involved. This aids in sorting. Send to: Dr. Jerre D. Noe, Technical Program Chairman, 1963 Wescon Suite 2210, 701 Welch Rd., Palo Alto, Calif.

ENGINEERING EDUCATION

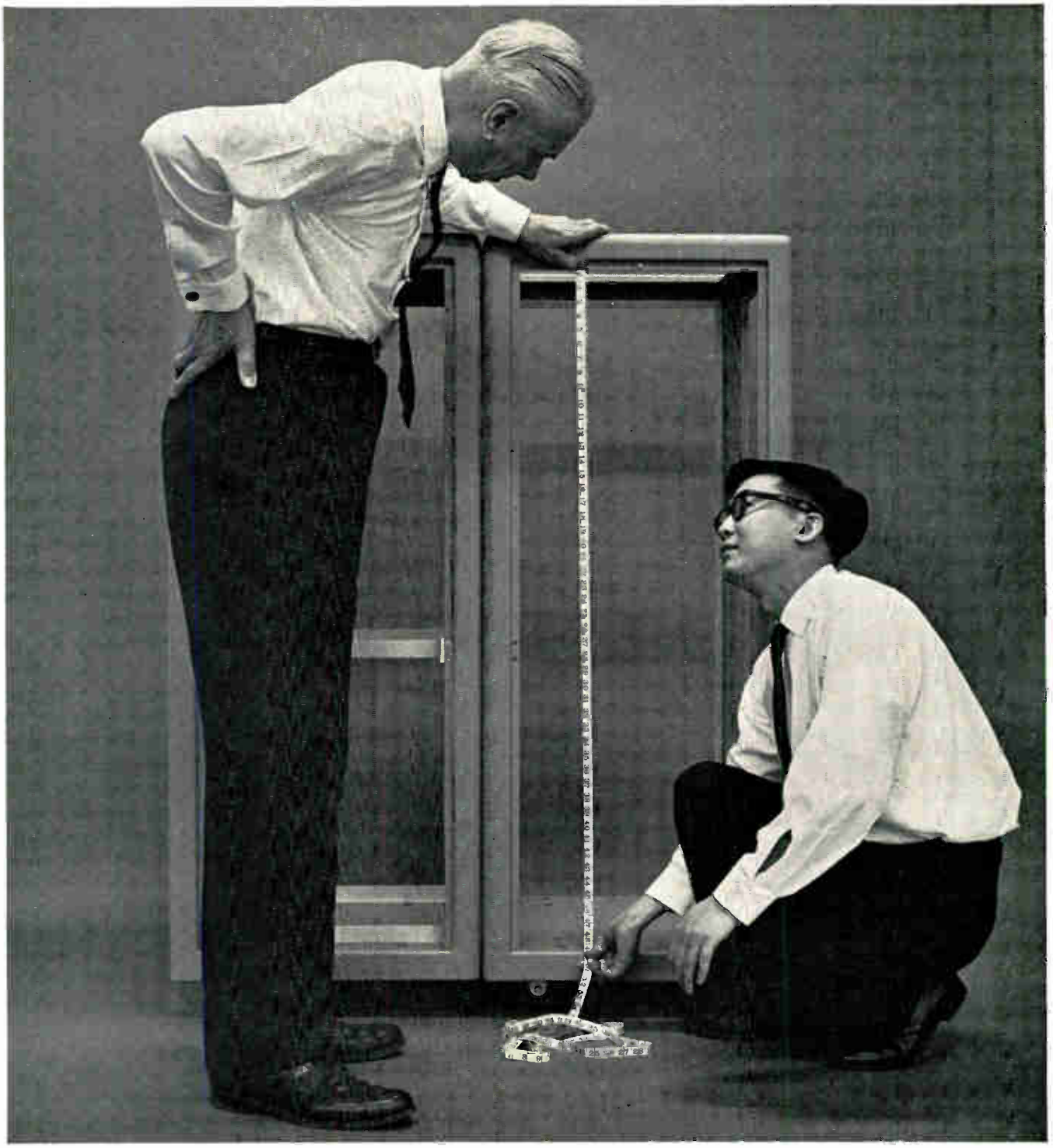
Short Courses of Interest to engineers

Frequency Control

The 17th Annual Frequency Control Symp. will be held by the *Solid State and Frequency Control Div., U. S. Army Electronic Research & Development Laboratory* at the Shelburne Hotel, Atlantic City, N. J., *May 27-29, 1963*. Technical sessions to cover such subjects as piezoelectric resonators, fundamental quartz properties, crystal oscillators and filters, masers, gas cells, atomic beam devices and applications of atomic frequency standards. General discussion periods will be on quartz crystals and circuitry. For information, write: SELRA/PF, Headquarters, U. S. Army Research and Development Laboratory, Ft. Monmouth, N. J.

NAM HOLDS INSTITUTE

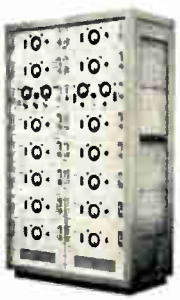
The 35th Institute on Industrial Relations sponsored by the National Association of Manufacturers convenes March 24 for a 5-day session at the Arizona Biltmore Hotel near Phoenix. It is for industrial relations officers and other corporate executives.



Can Hugo (6'3") and Joe (5'6") put 25 KW into 4'8"?

They can, and they did! Unheedful of the head shaking of those who said it couldn't be done, Hugo Romander (a high power engineer) and Joe Wu (a really solid circuit man) tackled it without a moment's hesitation. The assignment: to build a unique transistorized VLF amplifier for a fixed station installation, to fit it into a compact, reliable package capable of putting out 25 KW continuously in the region between dc and the broadcast band.

Before you could say "silicon transistors in unique circuit arrangements" the Sierra team came up with the answers. The resulting hardware was a delight to Hugo, Joe, and especially the customer. And as for those who said it would never fly . . . they'd be really impressed by the flight time which that original "ground" unit has racked up during the past year aboard a flying test bed.



Assignments such as this one, from VLF to X-band, from 1 to 500 KW, are all in the day's work for Sierra's engineering team. If you have a challenging RF amplifier requirement you'd like us to reduce forthwith to hardware, contact your Sierra representative or call Sierra direct.

SIERRA ELECTRONIC DIV.
OF
PHILCO
A SUBSIDIARY OF Ford Motor Company
3885 Bohannon Drive / Menlo Park 2, California

By DICK HAHN
Syracuse, N. Y.
District Office
Non-Linear Systems, Inc.

Solving special temperature measurement problems with a digital voltmeter...

How standard instrumentation and standard methods were utilized by General Electric Company could be of interest to anyone involved in temperature measurement.

THE BASIC PROBLEM

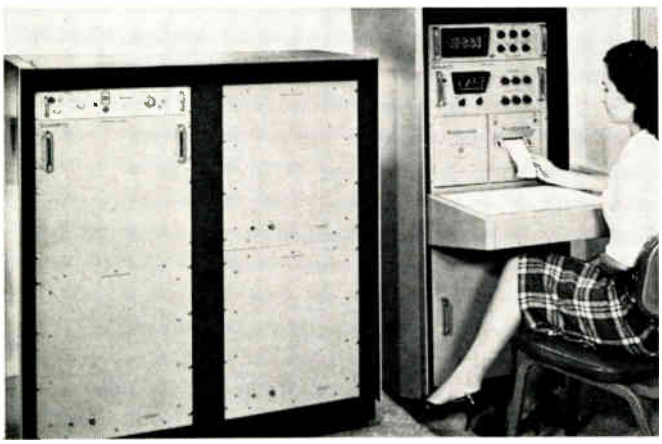
These were the requirements faced by GE and NLS engineers:

- Measure 300 temperatures quickly, approximately 2 seconds per measurement.
- Maintain a resolution of ±10 microvolts, which is ±0.02% of full scale, and an accuracy of ±(0.05% of reading ±10 microvolts) for thermocouple voltage measurement, up to ±55.00 millivolts.
- Provide instantly available data in printed form.
- Measure several voltages as great as 300 volts.
- Provide operating simplicity in instrumentation.
- Separate operator's control portion of the system from the area where measurements are generated.

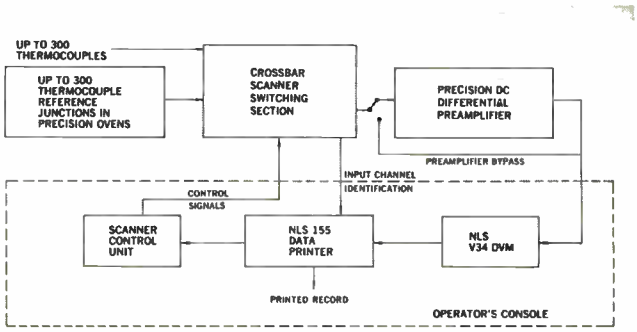
These requirements were met by a remote control data system formed primarily of standard instruments, including an NLS digital voltmeter for voltage measurements and a precision DC preamplifier for millivolt measurement.

FEATURES REMOTE CONTROL

Basically, the system is a two-unit setup connected by a 30-conductor cable 150 feet long. Installed in a cabinet in a hazardous area near the thermocouples are the preamplifier, the switching section of a crossbar scanner, and the temperature-controlled thermocouple reference junctions (±0.1°F). In the operator's console are an NLS V34 Transistorized Digital Voltmeter, an NLS 155 Transistorized Data Printer, and the control section of the crossbar scanner.



This data system, incorporating a digital voltmeter and other standard instruments, measures and records up to 300 widely varying temperatures.



Simplified functional chart of the system.

Without this remote control feature, it would have been necessary to run 600 relatively expensive thermocouple wires 150 feet.

One of the major advantages of the system for this type of application is related to the resolution of the digital voltmeter. Input voltage changes of 0.02% of full scale are instantly recognizable. This means that the numerical display of the DVM will change to a new number for an input voltage change of 10 microvolts. Unlike a strip chart recorder or moving pointer meter, a digital voltmeter eliminates any doubt concerning small input changes. Also, the digital display of a DVM can be read instantly, from close up or 30 feet away.

SYSTEM VERSATILITY

System control is extremely versatile. The input scanner can be set to sample any group of consecutive input channels continuously; stop after one sampling cycle; or sample any single input channel once or continuously upon command. Also, the system can, while monitoring one input channel continuously, record data only when the input voltage changes.

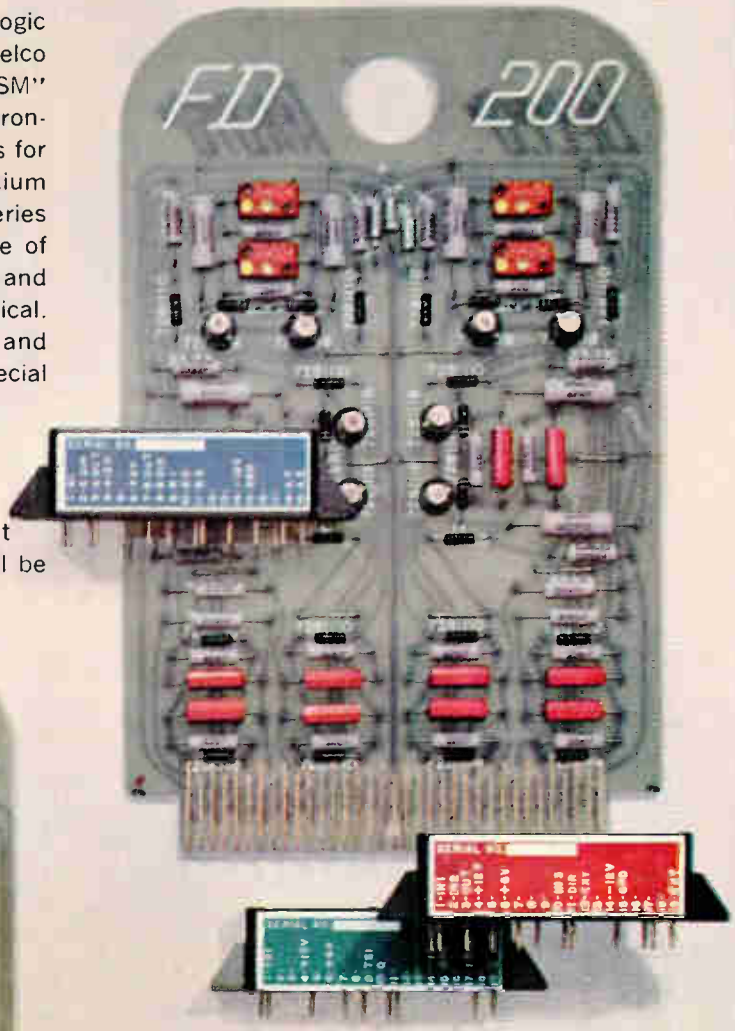
Similar systems are available with a wide variety of options, including more or fewer input channels... strain gage measurements... higher speed voltmeters and recorders... electric typewriters, tape or card punches, magnetic tape recorders... digital clocks for time data... digital comparators for warning or go/no-go tests... AC/DC converters for precise AC measurements... resistance measurements.

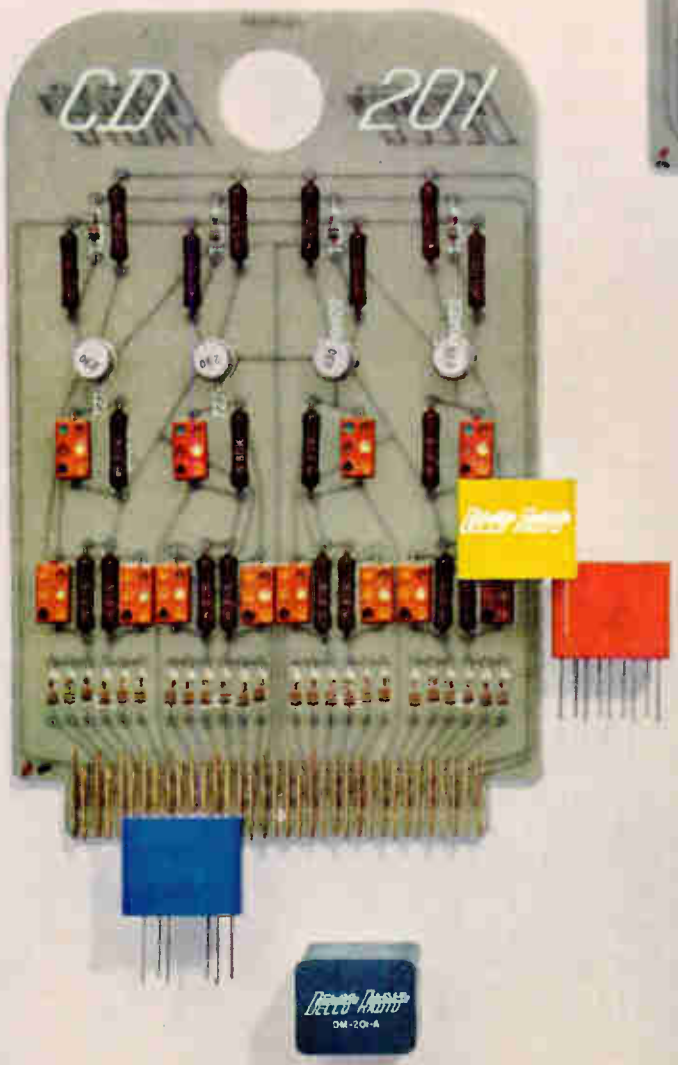
For additional information or competent advice on digital measurements, please circle the reader's service number or contact one of the 19 NLS factory offices located throughout the U.S., or write Non-Linear Systems, Inc., Del Mar, Calif.

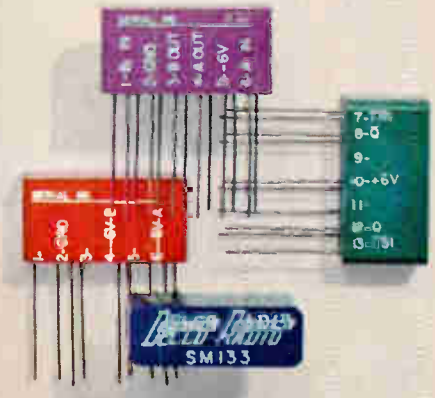
There's logic in Delco's line of digital circuits and equipment

Check it yourself. A large variety of standard logic functions are available in three series of Delco circuit modules: the extra low power 100 KC "SM" series for extreme light weight and wide environmental applications; the 200 KC "DM" series for ultra reliability circuits in the low and medium speed range; the high speed "FM" silicon series operates from DC to 10 MC in a wide range of environments. Circuit cards of 200 KC, 5 MC and 10 MC are available where size is less critical. Digital support equipment includes standard and special power supplies, card racks and special circuits. Delco Radio digital cards, modules and support equipment are available now to reduce component and design time costs in your digital systems.

Contact our Military Requirements Department for more data and our new low prices. You'll be convinced of the logic in the Delco line.







DELCO RADIO

Division of General Motors
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Kokomo, Indiana
Phone GL 2-8211 • Area 317

See our display at the IEEE Show—Booth 1423.

finally available

a True Darnell Specification for Capacitor Reliability

Extravagant promises of high reliability, based on low failure rate claims, often fall short of the mark!

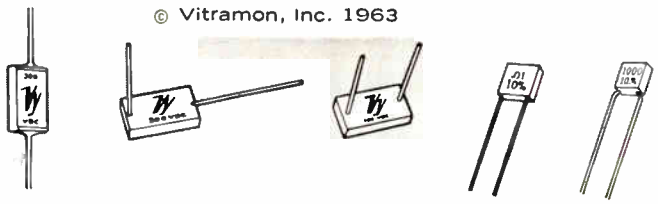
The reason is that either measurement and testing methods used are inadequate or that liberal assumptions are applied in the extrapolation of test data, resulting in an impressive but invalid low failure rate.

While others prove their reliability levels at derated conditions, Vitramon proves theirs at full rating (125°C and 150% rated voltage). With this conservative approach, a failure rate of 1% per 1000 hours at a 90% confidence level can now be guaranteed for "VY" Capacitors. This has been statistically demonstrated in the "Vitramon" sequential testing program (based on the Ad Hoc Committee Report) as described in "High Reliability Specification S-1002B."

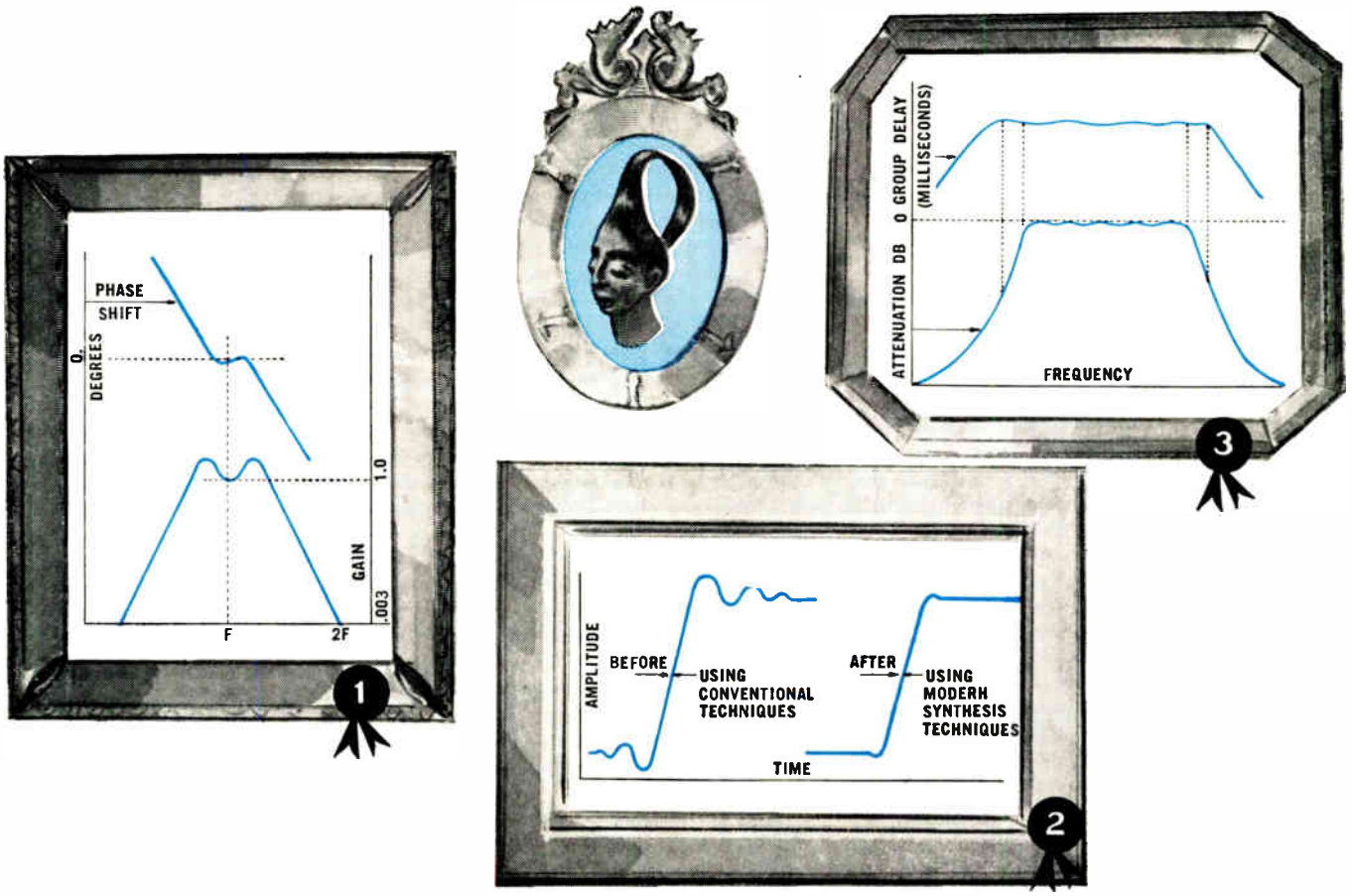
This is valid reliability — and because a conservative assumption is used, the expectancy of a lower failure rate is high. Further test hours will undoubtedly prove this to be true. At derated conditions, for example, a failure rate of 0.0001% per 1000 hours can be statistically demonstrated!

All "VY" Procelain Capacitors ordered under S-1002B Specification provide this reliability assurance for less expense than any comparable capacitors available today. Write for "High Reliability Specification S-1002B" for the complete story.

at the I.E.E.E. Show Booths 2406-2408



Vitramon
INCORPORATED
Box 544 • Bridgeport 1, Connecticut



Burnell advances the state of the art with three new filter families

If you are concerned with new systems development, and would like to take advantage of advanced technology and the kind of sophistication that will improve transient response and eliminate obsolete circuitry . . . then here are three new filter families, that have advanced the state of the art, which you can immediately incorporate in your network designs – exclusive from Burnell. Call or write today for literature and technical assistance.

Burnell offers the most complete line of communications network components available to the electronics industry, with a versatility of experience unmatched in the production of filters, delay lines and toroids for interpretation of *complex signals*. Burnell will custom design filter networks to your specifications which may include special delay, attenuation, and transient response, involving precisely specified rise time, overshoot and ringing.

1

ZERO PHASE FILTERS

Impedance 1000 ohms/Grid 400 cps Center			
ATTENUATION & PHASE CHARACTERISTICS			
OP SERIES	OP400 L	OP400 M	OP400 H
Pass Band (3 DB)	±20 cps	±20 cps	±20 cps
Harmonic attenuation 2nd harmonic and all higher frequencies			50 DB
Harmonic attenuation (2nd)	>15 DB	>25 DB	
Harmonic attenuation (3rd)	>40 DB	>60 DB	
Max. phase ±20 cps	±1°	±1°	±1°
Max. phase ±30 cps			±5°
Phase shift at Center Frequency	0°±½°	0°±½°	0°±½°
Gain =	UNITY	UNITY	UNITY
60 cps equivalent filters are also available having a pass band of ±5% with phase of ±1°.			

For the Servo Engineer . . .
By specifying Burnell's new line of Zero Phase Shift networks, it is possible to recover, without phase shift, the fundamental frequency from any periodic wave form without using complex squaring circuitry. This advancement in the state of the art is accomplished by combining zero phase shift in the vicinity of the center frequency — with high attenuation in the stop bands.

2

LOW PASS FILTERS WITHOUT DISTORTION

This family of filters is designed with modern synthesis techniques to have specified transient characteristics such as fast rise time, low overshoot and ringing.

60/3 DB Shape Factor	Ringing (over/undershoot)
2:1	<5%
3:1	<2%
4:1	<1%

3

This is part of a family of constant delay band pass filters of unusual characteristics, for example:

1—Group delay is constant well into the stop band!

2—Matched delay—as an example of delay matched band pass filters, we have produced a set of four filters having the same band widths of 500 cycles at 1½ DB with center frequencies ranging from 680 cycles to 2720 cycles; having a 20 DB band width of 710 cycles with group delay constancy of ±3½% over the pass band and between channels.

3—Constant flat delay band pass filter.

Frequency	Attenuation
5210 cps to 8336 cps	< .5 DB
1,000 cycles & below	>20 DB
10,000 cycles & higher	>20 DB
Delay: Group delay constant ±1% from 3,500 cps to 9,900 cps.	

Burnell & Co., Inc.

PIONEERS IN miniaturization OF TOROIDS, FILTERS AND RELATED NETWORKS

EXECUTIVE OFFICE AND PLANT
DEPT. EI-33
PELHAM, NEW YORK
PELHAM 8-5000
TELETYPE PELHAM 3633

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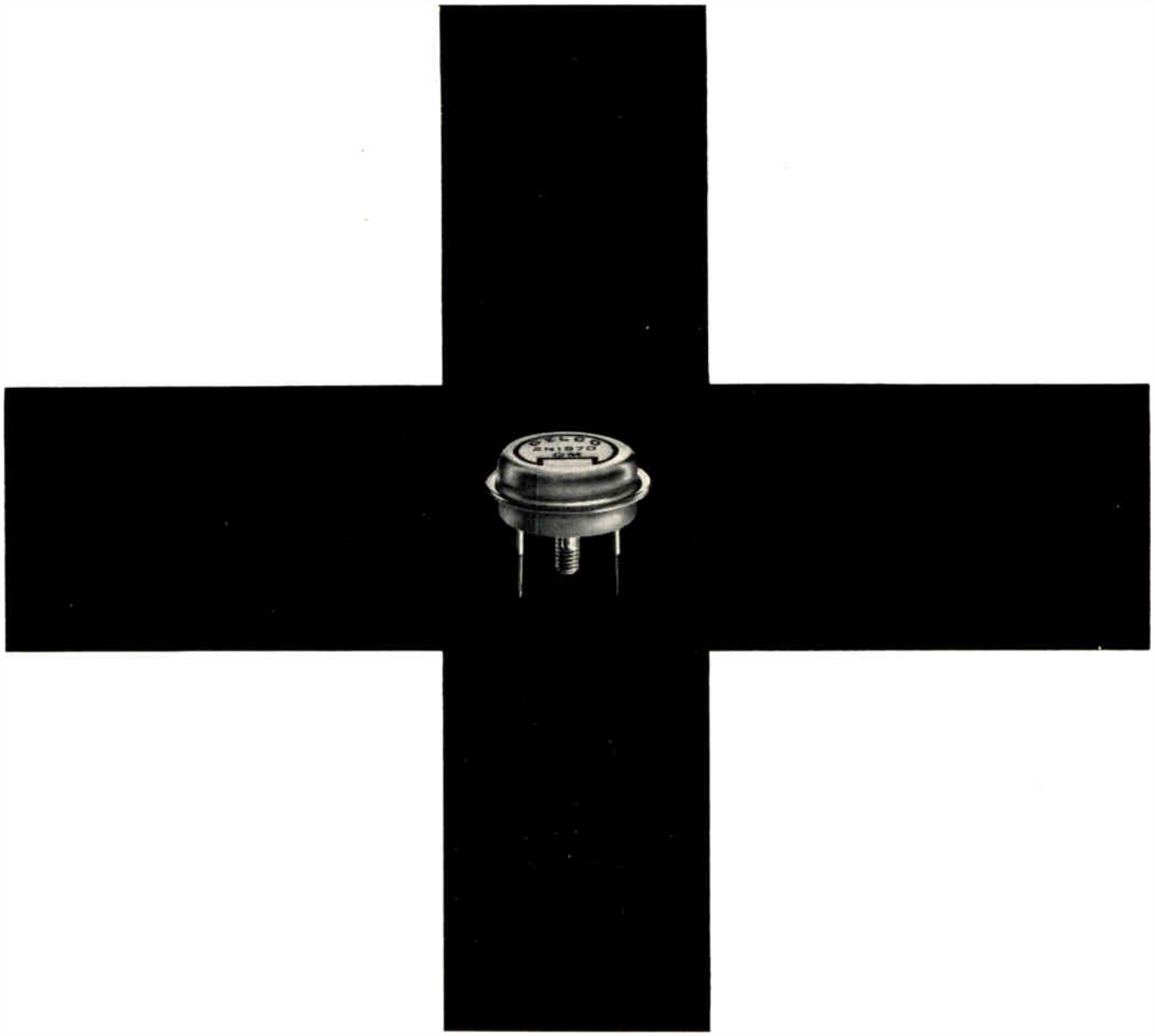
WELLINGTON 2-6774

SUBSIDIARIES: Groy & Kuhn, Inc., Pelham, New York • GLP Electronics, Inc., Bristol, Conn.



Any resemblance to 12 other power transistors is purely economical

Delco Radio's 2N1970 is a high-amp., low-gain, high-voltage, low-cost power transistor that you can substitute for any of 12 other higher priced power transistors.

The 2N1970 can directly replace the 2N442, 2N443, 2N2077, or 2N2490—at a cost savings!

With minor circuit modifications, the 2N1970 can also replace the 2N2075, 2N2076, 2N2080, 2N2081, 2N173, 2N174, 2N278, or 2N2491—at a cost savings!

Reduce production cost without sacrificing product quality. Place your order for Delco's 2N1970 at one of our Sales Offices listed below. Or phone your nearby Delco Radio Semiconductor Distributor.

Ic (MAX.)	Vcbo (MAX.)	Vebo (MAX.)	Vceo (MAX.)	Sat. Voltage @ Ic (MAX.)	Gain Min./Max. @ Ic	Thermal Resistance (MAX.)
15A	100V	40V	50V	1.0V @ 12A	17/40 @ 5A	.5°C/watt

Sales Offices

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
5151 N. Harlem Ave.
775-5411
AREA CODE 312

DELCO RADIO
DEPENDABILITY
RELIABILITY

General Sales Office: 700 E. Firmin, Kokomo, Ind., Gladstone 2-8211—Ext. 500 • Area Code 317

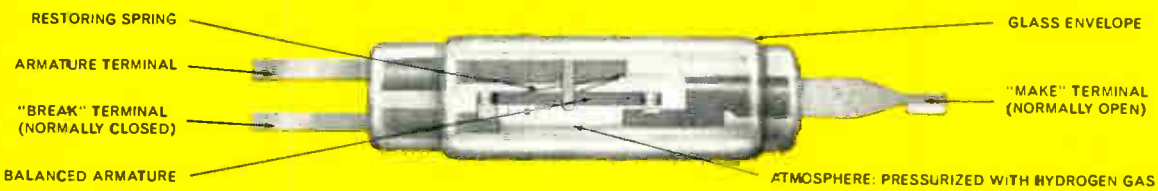
Division of General Motors • Kokomo, Indiana

Clare now offers...

the Type BA Relay

with Vibration Resistance:
100g through 4000 cps!
Shock Resistance:
125g for 11 milliseconds!
and remarkable reliability!

FROM LEFT:
BA6A Six-pole round relay can
BA1B Single-pole round relay can
BA1C Single-pole printed circuit board module



Meeting or exceeding any known specifications for shock and vibration resistance, and offering reliability of a very high order, Clare Type BA Relays can meet your most exacting design requirements.

Precise balancing of the armature in each BA Switch Capsule makes possible vibration and shock resistance characteristics greater than 100g through 4000cps, and greater than 125g for 11ms, when hard mounted.

The remarkable reliability of the Type BA Relay is directly attributable to the fact that each switch is assembled in a super-clean atmosphere and sealed in glass under pressure to guarantee a true hermetic seal, thus eliminating the possibility of contact contamination.

Circle 17 on Inquiry Card

Three packages (6-pole round enclosure, single-pole round enclosure, and single-pole module for printed circuit board application) are available.

For detailed problem analysis and engineering assistance, write Group 3D7, Application Engineering, C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Ill.

For comprehensive design data sheet on Clare Type BA Relays, write for Data Sheet 753, or use Reader Service Card.

IEEE Booth Nos. 2218-2220

CLARE®
Relays and related control components

50% more capacity per unit volume, 30% more capacity per unit weight than any comparable nickel-cadmium battery — rechargeable thousands of times — these are features you may need now for transistorized field pack radios or radio telephones, rescue beacons, unmanned remote stations, test equipment, low-noise preamps and other long-life, low-rate-discharge applications.

Added to the voltage stability, rechargeability and low-temperature performance of nickel-cadmium, these cells offer exceptional efficiency — made possible by a space-saving rectangular shape and Sylvania's film forming process. Cell plates are made by casting and sintering nickel to form a self-supporting, porous film, and then loading this "sponge" with chemicals. The usual plate backing is thus eliminated, and efficiency is increased.

Cells are hermetically sealed and available in a wide choice of sizes with capacities from 50 mA hrs. to 4 Amp hrs. Easily stacked in a variety of arrangements, they are strapped and jacketed in plastic to form a battery that meets shock and vibration requirements of MIL-B-55118 (Signal Corps).

To crystallize some of the advantages of Sylvania bat-

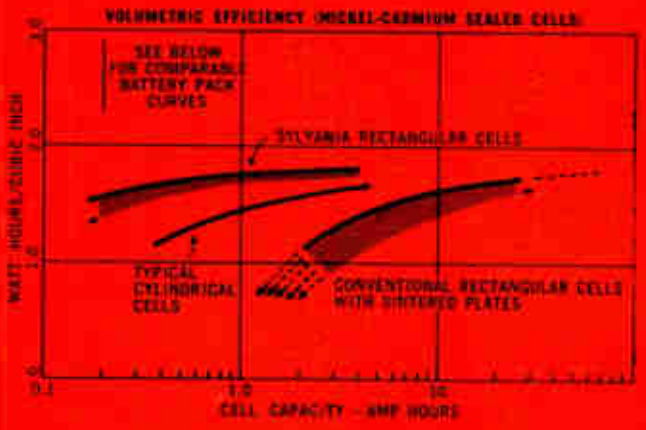
Design small, design light—new Sylvania are up to 50% more efficient

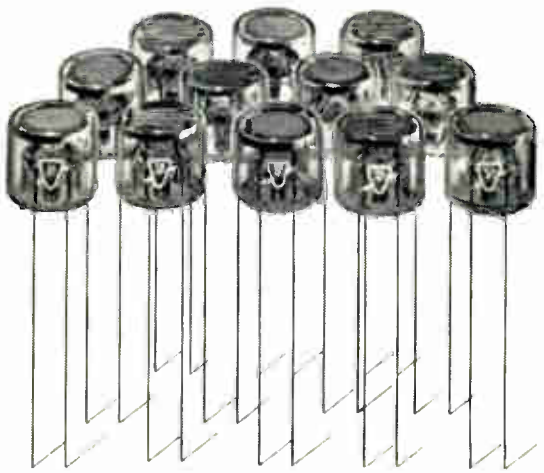
Typical plastic-jacketed 12-volt battery—only 5.5 cubic inches, with 500 mA hr. capacity. High efficiency comes from rectangular cell shape and film formed plates shown in cutaway—sheets of porous nickel impregnated with chemicals.

teries, here is a partial description of the typical 10-cell pack illustrated below:

TYPE SRB 3428	
Dimensions (approx.)	3⅛ x 2⅛ x 1 1/16 in.
Volume	5.5 cu. in
Weight	.5 lb
at .2C_5 rate:	
Capacity (nominal)	500 mA hrs
Average Operating Voltage	12 Volts

Ni-Cd batteries than any others





BROADEST LINE OF T-4 CdS PHOTOCONDUCTORS AVAILABLE

400 V, 300 mW ratings...hermetic seal with blue-dot proof!

Photocell circuit designers can now have cells exactly suited to streetlighting, flame-out alarms, remote control devices and other applications—choosing from the Sylvania line, ranging from 750 ohms to 16,000. Now rated at 400 volts, with 300 mW dissipation, these photoconductors also have reliability insurance—a true hermetic seal verified by a blue dot that immediately signals the presence of as little as .02% water vapor.

Among T-4 cadmium sulfide cells, only Sylvania offers such a broad range plus these high voltage and dissipation ratings. And watch for future developments: smaller size, photoconductors for high power and ultraviolet.

Type	2 Ft.-Candle Resistance (ohms)	Min. Dark Resistance After 10 Sec. in Complete Darkness (ohms)
8345	750	75,000
8142	1,500	200,000
8346	3,000	300,000
8100	5,000	500,000
8143	9,000	900,000
8347	16,000	1,600,000

For more information on these two new developments from Sylvania, write Electronic Tube Division, Sylvania Electric Products Inc., Box 87, Buffalo, N. Y.

SEE THEM AT IEEE—BOOTHS 2322-2332 and 2415-2425

SYLVANIA

SUBSIDIARY OF

GENERAL TELEPHONE & ELECTRONICS

NEW CAPABILITIES IN: ELECTRONIC TUBES • SEMICONDUCTORS
MICROWAVE DEVICES • SPECIAL COMPONENTS • DISPLAY DEVICES

Circle 12 on Inquiry Card

NEWS BRIEFS

EAST

RIXON ELECTRONICS, INC., Silver Spring, Md., has doubled the size of its plant facilities with the opening of a new 29,000 sq. ft. addition.

VECTROL ENGINEERING, INC., Stamford, Conn., a wholly owned subsidiary of **SPRAGUE ELECTRIC CO.**, No. Adams, Mass., has merged into Sprague. VecTrol will operate as a corporate division.

MILO ELECTRONICS CORP. (AMEX), New York, N. Y., has changed the name of its recently-formed subsidiory, **ELECTRONICS RELIABILITY CORP.**, to **AEROSPACE ELECTRONICS TECHNOLOGY, INC.**

HANCOCK TELEPHONE CORP., New York, N. Y., has established a new instrument division. It is called the **DATAMETRIC DIV.** and will operate from the company's plant in Old Greenwich, Conn.

STEVENS PRODUCTS INC., E. Orange, N. J., has completed installation of additional press equipment for laminated coil form tubing. The presses represent a 50% increase in positions for molding coil form tubes. Also included in the expansion are hydraulic press facilities for special molding applications.

DATA-CONTROL SYSTEMS, INC., Danbury, Conn., has delivered to the Lincoln Laboratory of Massachusetts Institute of Technology, a data acquisition and playback system. The equipment will be used for aerospace applications.

AIRCRAFT ARMAMENTS, INC., Cockeysville, Md., has announced completion of construction on a 44,840 sq. ft. manufacturing addition to its main plant. Occupancy is scheduled for this month.

D. G. O'BRIEN, INC., has moved into new manufacturing facilities located at 17 Erie Drive, East Natick Industrial Park, Natick, Mass.

LORAL ELECTRONICS CORP., Bronx, N. Y., has acquired **LERMER PACKAGING CORP.**, Garwood, N. J. The acquisition was made for cash.

INTERNATIONAL BUSINESS MACHINES CORP. and **TELEREGISTER CORP.**, Stamford, Conn., have entered into an agreement for the exchange of licenses under specified patents for data processing devices. The agreement is non-exclusive, so that each party retains freedom to license others under its own patents.

AEROSPACE RESEARCH, INC., has moved to larger quarters at 130 Lincoln St., Boston 35, Brighton, Mass. The new location, 15,000 sq. ft., houses laboratory, production, and office facilities.

UNIVAC DIV., SPERRY-RAND CORP., Washington, D. C., has formed a new Defense Marketing Organization. The organization is designed to serve defense and aerospace customers in the fields of Command & Control and Data Systems.

SINGER MFG. CO., Bridgeport, Conn., has reached an agreement to purchase, for cash, the assets and assume the liabilities of **SENSITIVE RESEARCH INSTRUMENT CORP.**, New Rochelle, N. Y. Plans call for moving Sensitive operations to the Singer Metrics Div. in Bridgeport. Purchase price was not disclosed.

SYLVANIA ELECTRONIC SYSTEMS, a div. of **SYLVANIA ELECTRONIC PRODUCTS INC.**, Buffalo, N. Y., has announced plans to expand its research and development facilities in the Buffalo area. Sylvania has leased 37,000 sq. ft. of office space in Cheektowaga, approximately 3 miles from the operation's 5 laboratories in nearby Williamsville.

AEROTEST LABORATORIES, INC., Deer Park, N. Y., has acquired **NORTHEASTERN TESTING LABORATORIES, INC.**, Queens, N. Y. Northeastern will operate as a subsidiary of Aerotest.

POWER DESIGNS INC., Westbury, N. Y., has acquired 95% of the stock of **CARAD CORP.**, Palo Alto, Calif.

POLARAD ELECTRONICS CORP., Long Island City, N. Y., has announced the formation of 2 new divisions. They are **POLARAD ELECTRONIC INSTRUMENTS**, and **RADIOMETRICS**. Electronic Instruments will be responsible for all aspects of the Catalog Microwave Test Equipment line. Radiometrics will be concerned with defense electronics research, development, and production efforts.

NATIONAL SEMICONDUCTOR CORP., Danbury, Conn., and **CLARK SEMICONDUCTOR CORP.**, Clark, N. J., have agreed to merge. Clark Semiconductor will be operated as a division of National.

PHILCO CORP., LANSDALE DIV., Philadelphia, Pa., has disclosed details of a $7 million modernization and expansion program planned for the division over the next 4 years. Some $3.9 million will be spent on manufacturing equipment for the production of silicon semiconductor products, mainly silicon planar transistors.

TRANSMAGNETICS, INC., has moved to new facilities at 134-08 37th Rd., Flushing, N. Y. The new plant more than triples the space of previous facilities.

BUDD ELECTRONICS, DIV. of THE BUDD CO., Long Island City, N. Y., has received a $2,600,000 contract from the U. S. Army Electronics Materiel Agency, Philadelphia, Pa., for 4,700 RT-67 and RT-68 small, short-range mobile radio receiver/transmitters for ground-to-ground communications.

LEEDS & NORTHRUP CO., Philadelphia, Pa., has received two orders valued at approximately $125,000 from the USAF for some 183 K3 potentiometers to be used for calibration checks on instruments at missile bases.

MELPAR, INC., Falls Church, Va., has received a $300,000 contract, for a speech compression system, awarded by the Army Signal Corps.

ELECTRONIC MODULES CORP., has announced the addition of 5 000 sq. ft. to its existing plant in Timonium, Md. The addition, the second in six months, more than doubles the company's facilities.

AMERICAN RECTIFIER CORP., New York, N. Y., has acquired the name and operating assets of **RICHARDSON-ALLEN**, College Point, N. Y., from the **KOLLSMAN INSTRUMENT CORP.**, L. I., N. Y.

COMPUTER INSTRUMENTS CORP., Hempstead, L. I., N. Y., has leased an 18,000 sq. ft. building at 82 Madison Ave. in Hempstead directly adjacent to its current facilities. The building will be used for expansion of sales and engineering facilities.

AMERICAN ELECTRONIC LABORATORIES, INC., Colmar, Pa., has announced completion of the second segment of its expansion program by the opening of a new 36,000 sq. ft. addition on its 55 acre site at Colmar.

SQUIRES-SANDERS, INC., Plainfield, N. J., has been formed by former employees of Lockheed Electronics Co. Headquarters for Squires-Sanders will be located at 475 Watchung Ave., Watchung, N. J.

MID-WEST

RADIATION COUNTER LABORATORIES, Skokie, Ill., has purchased **RELIANCE GLASS WORKS**, Wauconda, Ill.

BURROUGHS CORP., Detroit, Mich., has announced that various Burroughs facilities and activities have been placed in an integrated, corporate-wide operation to be called **DEFENSE** and **SPACE GROUP**. The group will include **BURROUGHS LABORATORIES, DEFENSE** and **SPACE SYSTEMS MANAGEMENT DIV., MILITARY ELECTRONIC COMPUTER DIV., MILITARY FIELD SERVICE DIV., CONTROL INSTRUMENT DIV., DEFENSE** and **SPACE SYSTEMS MARKETING**, and **CONTRACTS ADMINISTRATION**.

NUCLEAR-CHICAGO CORP., Des Plaines, Ill., has announced merger with **RADIATION INSTRUMENT DEVELOPMENT LABORATORY, INC.** Under the Agreement of Merger, Radiation Instrument will merge into Nuclear-Chicago and will operate as a division.

DOW CORNING CORP., Midland, Mich., has completed organization of its new **ELECTRONIC PRODUCTS DIV.**, Hemlock, Mich. The division will develop, manufacture and sell semiconductor materials and silicone dielectrics for electronic and related applications.

WEST

SERVONIC INSTRUMENTS, INC., Costa Mesa, Calif., has acquired the business and assets of **DYNAMIC MEASUREMENTS CO.**, Willow Grove, Pa. While Dynamic Measurements will be liquidated, it will continue as the eastern facility of Servonic Instruments.

GENERAL COMPUTERS, INC., has opened a new plant at 5990 W. Pico Blvd., Los Angeles 35, Calif. The plant houses all operations of the company.

TEXAS INSTRUMENTS INCORPORATED, Dallas, Tex., has announced the beginning of construction on a 290,000 sq. ft. multi-purpose building to be located on its 350 acre site on North Central Expressway in Dallas. The cost of the building will amount to more than $4 million. The major portion of the building will be used to consolidate some of the electronic and electro-mechanical systems design and manufacture now conducted by TI's **APPARATUS DIV.** in numerous locations in the Dallas County.

HI-REL MICRO-CIRCUIT CO., Anaheim, Calif., has changed its name to **HIGH RELIABILITY CIRCUIT SYSTEMS.** The company is a subsidiary of **INTERNATIONAL ELECTRONIC RESEARCH CORP.**, Burbank, Calif. The name was changed to avoid conflict with several similar trade names and trade marks in High Reliability's product area.

MARK SYSTEMS, INC., Los Altos, Calif., has started construction of a 16,000 sq. ft. facility near Sunnyvale's International Science Center. Mark Systems, a subsidiary of **ALLIED RESEARCH ASSOCIATES, INC.** of Boston, Mass., was organized recently to concentrate on the development of advanced electro-photo-optical products.

G. L. COLLINS CORP., has opened its new $1 million facility at 59th and Obispo St., N. Long Beach, Calif.

LEACH CORP., will open a new corporate headquarters in San Marino, Calif., April 1. The new offices, housed in an 18,000 sq. ft. building, will place administrative company functions midway between the Leach **AVALON** facility in Los

Angeles and its **CONTROLS DIV.** at Azusa. The building is located at 405 Huntington Dr., San Marino.

CUSTOM COMPONENT SWITCHES, INC., has moved into its new 30,000 sq. ft. manufacturing facility in Chatsworth, Calif. The new plant is four times as large as the company's previous building in Burbank and is located at 21111 Plummer St., Chatsworth.

OAK MFG. CO., Crystal Lake, Ill., has acquired **MARCO INDUSTRIES CO.**, Anaheim, Calif. The purchase was made for an undisclosed amount of cash. **OAK ELECTRONICS CORP.**, subsidiary of Oak Mfg., Culver City, Calif., has been dissolved and its operations moved to the Anaheim plant where it will be operated as a division of Marco. Later this year Oak plans to build a larger plant in Anaheim to house both operations.

SCIENTIFIC DATA SYSTEMS, Santa Monica, Calif., and **MINNEAPOLIS-HONEYWELL REGULATOR CO.**, have concluded an agreement under which SDS will provide general purpose digital computers for integration by Honeywell into high-speed process computer control systems.

INDUSTRIAL ELECTRONIC ENGINEERS, INC., No. Hollywood, Calif., has purchased all Digilite tooling, drawings and other assets for an undisclosed amount of cash from **CONTROL CO. OF AMERICA**, Folcroft, Pa.

ANGSTROHM PRECISION INC., has completed moving to new headquarters at 7341 Greenbush Ave., No. Hollywood, Calif. The new quarters contain office, laboratory and manufacturing facilities, and represent a 5-fold expansion of Angstrohm's previous space.

DOUGLAS AIRCRAFT CO., Santa Monica, Calif., has announced the construction of a center for advanced research in the sciences basic to aircraft, missile and space systems. The $2 million **ADVANCED RESEARCH LABORATORY** will be located on a 10-acre tract in Huntington Beach, Calif.

SCIENTIFIC DATA SYSTEMS, INC. have moved their engineering and administrative staffs into a new 19,000 sq. ft. 2-story building at 1649 17th St., Santa Monica, Calif.

LEAR SIEGLER, INC., has announced completion of a new 5,000 sq. ft. addition to the existing **MICROELECTRONICS LABORATORY** facility at Santa Monica, Calif. The new addition increases the research laboratories' total area to 17,000 sq. ft.

BABCOCK ELECTRONICS CORP. has changed the name of its **MILITARY PRODUCTS DIV.**, to the **AEROSPACE DIV.**, Costa Mesa, Calif.

RAYTHEON CO.'S SEMICONDUCTOR DIV. has transferred its Marketing headquarters to Mountain View, Calif.

GENERAL CONTROLS CO., Glendale, Calif., has announced agreement to merge its operations with those of **INTERNATIONAL TELEPHONE AND TELEGRAPH CORP.**, New York, N. Y. General Controls will continue to operate autonomously in all locations exactly as at present.

CENTURY GEOPHYSICAL CORP. has combined all of its domestic divisions and subsidiaries in a new $850,000 building in Tulsa, Okla.

FORD MOTOR CO.'S AERONUTRONIC DIV., Newport Beach, Calif., has expanded its off-site production capability by consolidation of all electrical and electronic fabrication under one roof at the Division's Santa Ana facility, Santa Ana, Calif.

NEW PHILCO PLANAR 40 V_{CBO}, 20 V_{CEO} 500 mc f_T SWITCH

NEW PHILCO 2N2710
Interdigitated Epitaxial Silicon Planar NPN Transistor, in TO-18 Case.

Only Philco gives you so much design margin in so many parameters—with proven planar reliability. The new Philco 2N2710 presents industry's best combination of speed, voltage, and beta. It also is specified for leakage current an order of magnitude lower than I_{CBO} specifications of other 500 mc f_T switches. Every 2N2710 parameter is outstanding. Get samples today from your Philco Industrial Semiconductor Distributor. Write for complete data. Dept. EI1363.

PHILCO 2N2710 CHARACTERISTICS

V_{CBO}	40v min	V_{CEO}	20v min	h_{FE}	40 min	t_{ON}	20 nsec max	t_{OFF}	35 nsec max
V_{CES}	30v min	V_{EBO}	5v min	I_{CBO}	30 na max	t_S	15 nsec max	f_T	500 mc min

CONSULT PHILCO SEMICONDUCTOR ENGINEERS AT I.E.E.E. BOOTHS 1302-1308

PHILCO®
A SUBSIDIARY OF Ford Motor Company

LANSDALE DIVISION, LANSDALE, PA.

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SOLID-STATE U.S.A. CENTER™

MARKETING

Facts and Figures Round-Up

R&D FUNDS FOR 1963 TO EXCEED $17 BILLION

Total 1963 expenditures for research and development in the U. S. will be slightly more than $17 billion—about one billion more than is believed spent in 1962. So say economists Dr. George W. James and Carol F. Van Alstyne of Battelle Memorial Institute, Columbus, Ohio.

They predict that industry will spend almost $5 billion; government, almost $12 billion; colleges and universities, about $230 million; and other non-profit institutions, about $180 million.

The estimate for industry—$5 billion—would represent a gain over a virtual plateau of spending from 1960 to 1962 of about $4.5 billion, they report. Their forecast is derived from a study of cash flow as distinguished from the standard surveys of industry spending plans. This approach is based on the observation that management views spending for research as an investment. Because funds for investment in research cannot ordinarily be obtained from outside sources, these funds must be generated within industry from cash flow, i.e., retained earnings and depreciation. For this reason, James and Van Alstyne consider cash flow a good indicator of industry's future support of R&D.

Since the cash-flow approach can be applied only to industrial research, more conventional methods of forecasting were used in predicting expenditures by government, academic institutions, and other non-profit organizations.

Taking a longer view of research expenditures—past and future—James and Van Alstyne observe that, in the past 7 years, R&D has grown at a rate of more than 15% per year. A change in this rate—up or down—of only 2 percentage points over the next 7 years to 1970, would make an $11 billion difference in R&D spending.

GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government agencies in January, 1963.

Air Traffic Control Central	1,281,680
Amplifiers	66,680
Analyzers	548,795
Antennas & Accessories	1,836,694
Batteries	935,410
Cable	922,176
Capacitors	107,112
Communications Equipment	16,068,824
Computers & Accessories	697,291
Connectors	243,756
Counters	325,887
Data Handling Equipment	725,241
Data Plotter System	28,934
Data Transmission System	74,877
Decommutation Systems	54,640
Digital Modules	37,843
Display & Turning Units	27,343
ECM Equipment	1,665,057
Film Data Analyzers	45,480
Fire Control Systems	1,640,968
Frequency Comparators	69,795
Generators	119,210
Gyroscopes	804,378
Handsets	151,421
Instruments	39,532
Interphone Control Units	210,456
Interrogator Sets	918,850
Loudspeakers	70,409
Machine, Numeral-Controlled	811,248
Magnetometers	41,324
Magnetrons & Klystrons	142,282
Meters	98,398
Microphones	208,115
Microscope, Electron	32,867
Navigation Equipment	4,067,793
Oscillators	505,773
Parametric Amplifier System	91,485
Power Supplies	591,457
Pressure Pickups	85,184
Pulse Analyzers	31,243
Radar Sets	377,591
Radio Sets	259,141
Radio Test Sets	30,338
Receivers	59,278
Receivers, Radio	2,566,562
Receivers, Telephone	38,500
Receivers-Transmitters	845,925
Recorders	73,374
Recorders/Reproducers	416,314
Relays	394,051
Resistors	57,390
Resistors, Variable	48,576
Semiconductors	94,363
Servo Actuators	27,569
Signal Generators	422,887
Signal Monitors	293,240
Sockets, Miniature	25,528
Solar Cells	190,000
Sonar Equipment	1,346,226
SSB Equipment	380,649
Storage Systems	42,772
Spectrometer Systems	28,047
Spectrophotometer, Recording	31,094
Switches	61,300
Synchros	37,887
Tape, Magnetic	1,383,785
Tape Recorders & Access	299,403
Telegraph Equipment	2,334,036
Telemetry Equipment	346,537
Telephone Equipment	167,990
Test & Calibration Panel	120,600
Test Equipment	1,377,353
Transmitting Sets	205,041
Traveling Wave Tubes	227,891
Transducers	39,332
Transformers	234,045
Tubes, Electron	7,530,628
Tube Shields	37,412
Ultrasonic Cleaners	82,479
Video Equipment	1,123,659
Voltage Regulators	180,749
Voltage Standard/Multiplier	27,040
Voltmeters	252,429
X-Y Recorders & Access.	100,000

AIRBORNE EQUIPMENT

The International Civil Aviation Organization (ICAO), reports that air traffic in 1962 topped an all-high peak, returning the traffic growth rate to satisfactory levels after a bad year in 1961. Its 98 member-nations carried 123,000,000 passengers in 1962, an 11% rise over the 1961 figure—plus 81.5 billion passenger-miles, a 12% rise over 1961.

Electronic equipment manufacturers are well aware of these developments, as well as appreciating that international aircraft markets contain English, French and other foreign manufacturers of aircraft as well as airborne electronic equipment. Moreover, some of the U. S. resistance to foreign-made electronic equipment may be wearing off. In this super-safety-conscious industry, conservatism and safety outrank "price" of hardware. Perhaps the widest-open market exists among the dozens of new airlines growing up in newly-liberated lands as well as other foreign countries which have neither aircraft nor electronic industries.

MARKET GROWING

The market for ground safety installations is getting bigger, but not necessarily better. Increased size and speed of military and civilian aircraft make the need for safety even greater while the situation becomes more complex. In addition to complex ground traffic electronic gear, markets here include tele-communications equipment for ground-to-ground sites, as well as ground - to - aircraft communications. And, for some electronic firms, their problem of profits parallels that of aircraft manufacturers and airline and aircraft operators: how to make profits out of fewer (though more complex) electronic airborne systems and equipments.

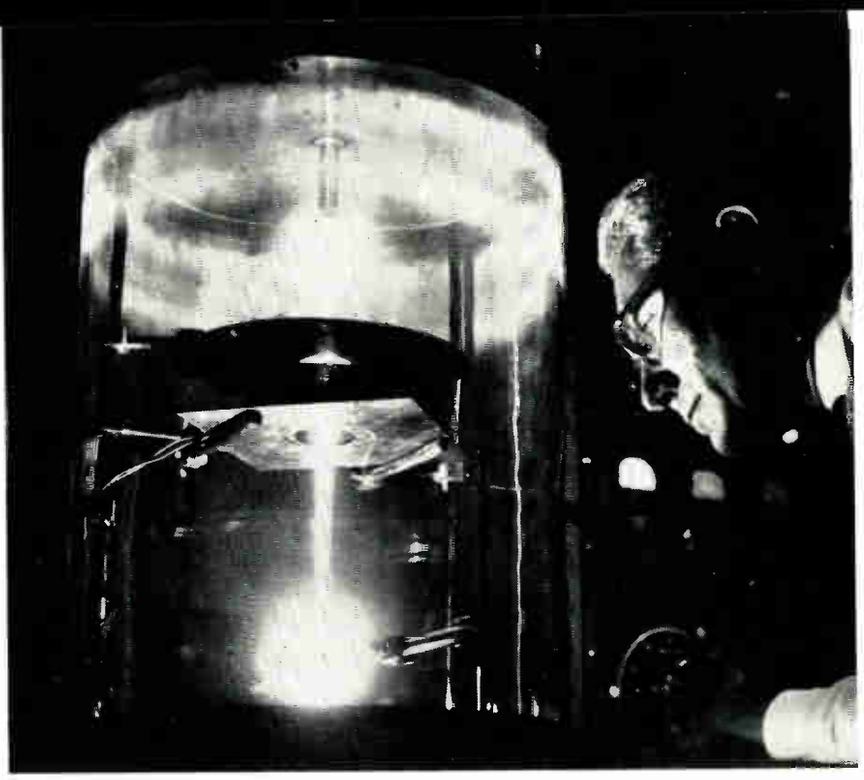
BUDGET BOOK AVAILABLE

Year after year marketing men, market researchers, market planners and others, send checks and money orders to the Government Printing Office to buy "The Budget of the United States Government," currently for Fiscal Year: 1964.

This book spells out the ±$99 billions in goods and services that Uncle Sam will buy from his own taxpayers. Of electronics interest, over half that budget—+$50 billions—goes to the Dept. of Defense, NASA and AEC. In turn, allowing for servicemen's payrolls (recently increased), some $9 billion will go for military electronics in FY 1963-1964. Actually, the bill may run higher, as the Govt.'s non-military uses of electronics increase.

CONTROL SYSTEMS

Numerical control system for machine tools is assembled at Thompson Ramo Wooldridge plant in Michigan City, Ind. The TRW-3000 3-axis controls are all-transistorized, operate from std., 1 in. punched paper tape at 400 characters per second and provide a cutting accuracy that is as great as ±0.0001 inch.



ELECTRON GUN

Dr. L. H. Stauffer, G.E. project engineer, operates self-focusing electron gun. G.E. says it is the first which can function effectively at low temperature and low pressure while maintaining constant focus over a wide voltage range. It was developed by Co.'s Advanced Technology Services, Schenectady, N.Y.

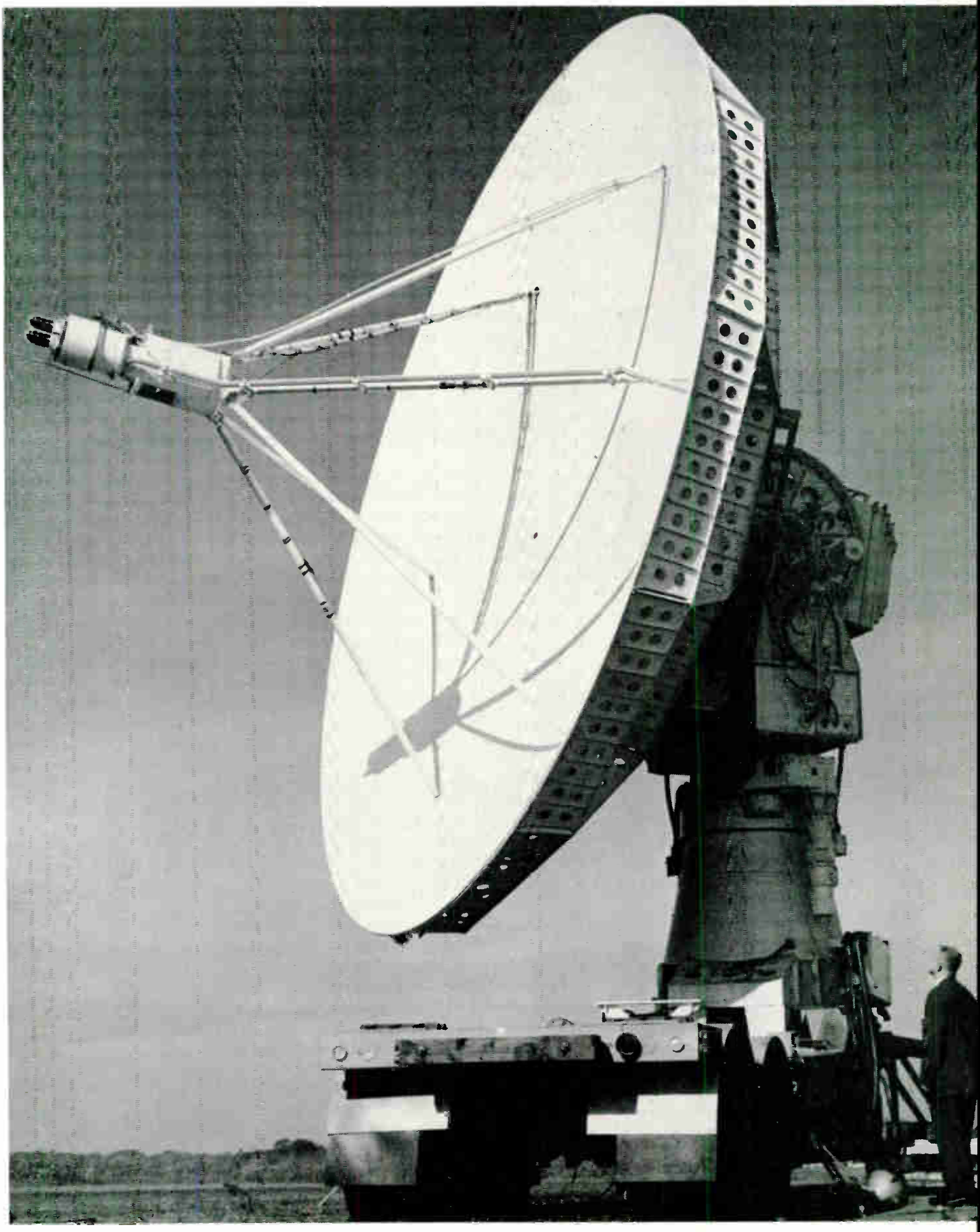
SNAPSHOTS... OF THE ELECTRONIC INDUSTRIES

TEST RANGE

New antenna test range at General Dynamics/Pomona, Pomona, Calif., allows angular measurements accurate to within 5 seconds. The range also provides outstanding stability and maximum isolation. Main function of the new range will be testing of missile antennas.

APOLLO COMMUNICATIONS

Traveling-wave tube amplifiers are inspected by Dr. L. M. Field, Hughes Aircraft Co. (Culver City, Calif.) vice president and director of the microwave tube division. The amplifiers, to be used in the deep space communications system for the Apollo three-man lunar vehicles, are being checked for life test results.



SYNCOM ANTENNA

This 30 ft. diameter antenna is capable of pinpointing a 28 in. diameter satellite 22,300 miles away. It was developed by Goodyear Aircraft Corp., Akron, Ohio, for the Defense Satellite Communications Program and the SYNCOM satellite communications system.

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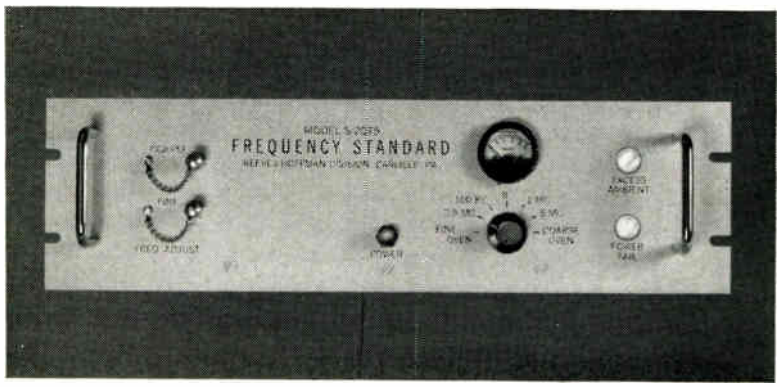

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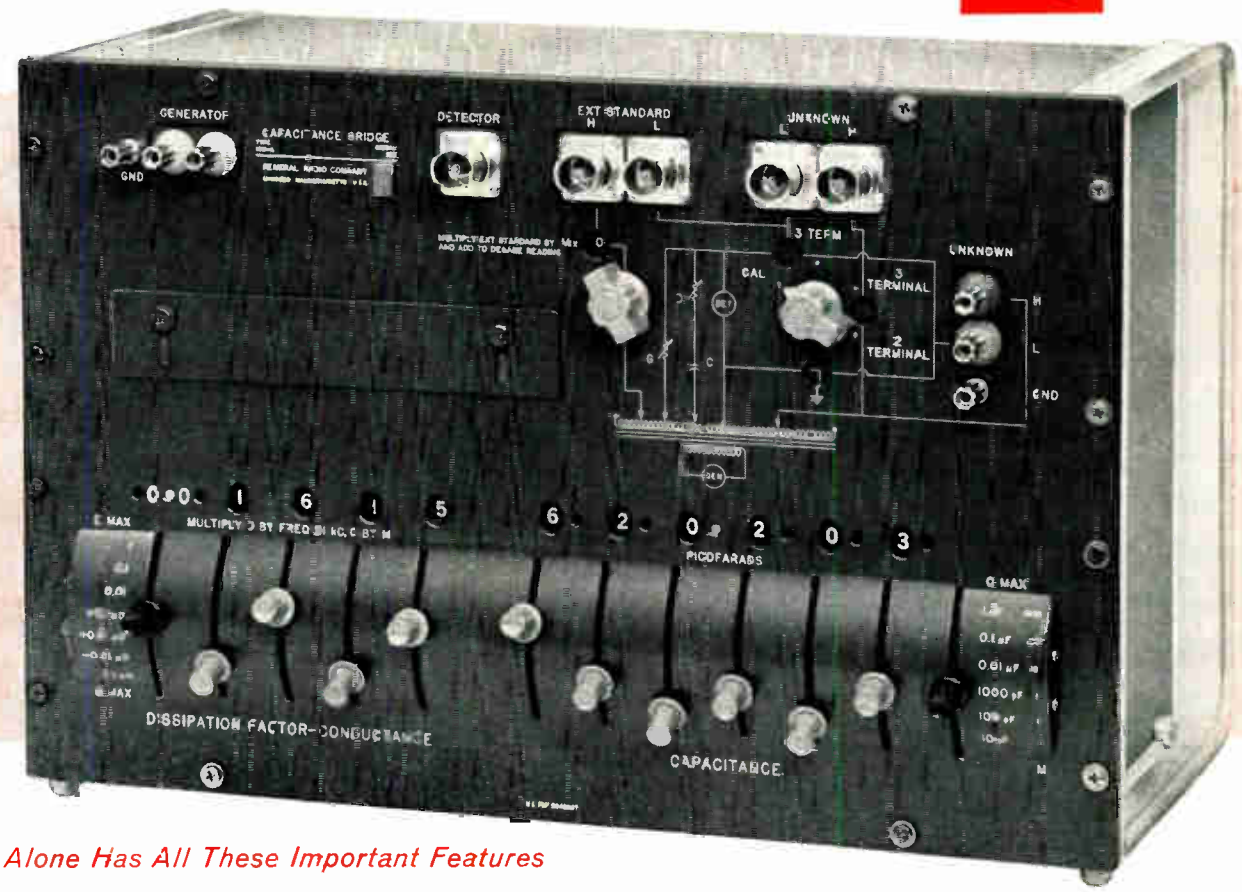
Type 1615-P1 Range Extension Capacitor, **$35.**



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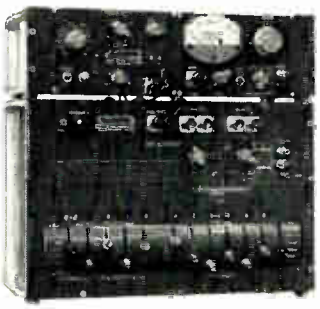
6. **Ideal for Intercomparison Measurements** . . . Fast, one-step intercomparisons of three-terminal capacitors differing in value by as much as 10,000 to 1 can easily be made.

NEW **1000-pf THREE-TERMINAL REFERENCE STANDARD CAPACITOR**

Same Invar-alloy construction as in the 1615-A Bridge. Sealed in dry nitrogen to eliminate effects of altitude and humidity. Adjusted to ± 5 ppm of nominal value at 23°C and 1000 cps to NBS calibrated standards. Temperature coefficient is 2 ± 2 ppm/°C from −10° to 60°C. D is less than 1×10^{-5}.

Type 1404-A, $225



Complete **CAPACITANCE MEASURING ASSEMBLY.**

Type 1620-A . . . includes the Type 1615-A Bridge; Type 1232-A Tuned Amplifier and Null Detector, a low-noise high-gain instrument with a 20-c to 20-kc range and a full scale sensitivity of 1μv; and the new Type 1311-A Bridge Oscillator, with 11 fixed frequencies from 50c to 10 kc. Price for the complete assembly is $2065.

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Circle 26 on Inquiry Card

WASHINGTON NEWS LETTER

UNIONS MAY LOSE PRIVILEGES—Growing number of congressmen who want to end special labor union privileges and immunities backs bill of Sen. Barry Goldwater (R., Ariz.). His measure would "restore a more reasonable and workable balance in the nation's labor-management relations." While some of labor's special advantages were justified when the union movement began, Goldwater says, "their continued existence and expanding scope in today's era of monopolistic union power can no longer be justified." Main provision calls for new "strike vote" procedure. This would make strike unlawful if a notice of intention were not given to all concerned at least 30 days ahead.

ASK END TO CONTRACT MEDDLING—Legislation is being pushed to bar federal officials from using government contracts to pressure business. Sen. Frank J. Lausche (D., Ohio) wants it made illegal for federal agency or official to withhold or threaten to withhold contracts from companies which don't comply with administration policy. Bill grows out of threats by the Kennedy Administration to withhold contracts during last year's hassle over steel prices and more recently in the aerospace industry labor dispute.

NEW MINIMUM WAGE DRIVE UNDERWAY—Kennedy Administration is readying new drive to raise the federal minimum wage and extend coverage. President calls for "improvements" in federal wage-hour law. Secretary of Labor W. Willard Wirtz reports that the 1961 minimum wage increase had little impact on industries affected. He says the 1961 increase, which hiked minimum to $1.15 an hour, amounted to $500 million a year wage boost for 2.5 million. But Wirtz says it had no inflationary effect on wage levels generally; did not hurt employment level. He noted employment in the industries affected actually rose. Also he says workers not covered did not benefit from spiraling wages.

HELP AIMED AT 'LITTLE GUYS'—Small electronics firms may have Uncle Sam's help to get them some business from the new Communications Satellite Corp. Group of small business supporters in Congress, headed by Sen. John Sparkman (D., Ala.) is sponsoring bill to force CSC to give them "equitable" share of both prime and subcontracts. Measure would require SBA to develop program to help small firms in bidding.

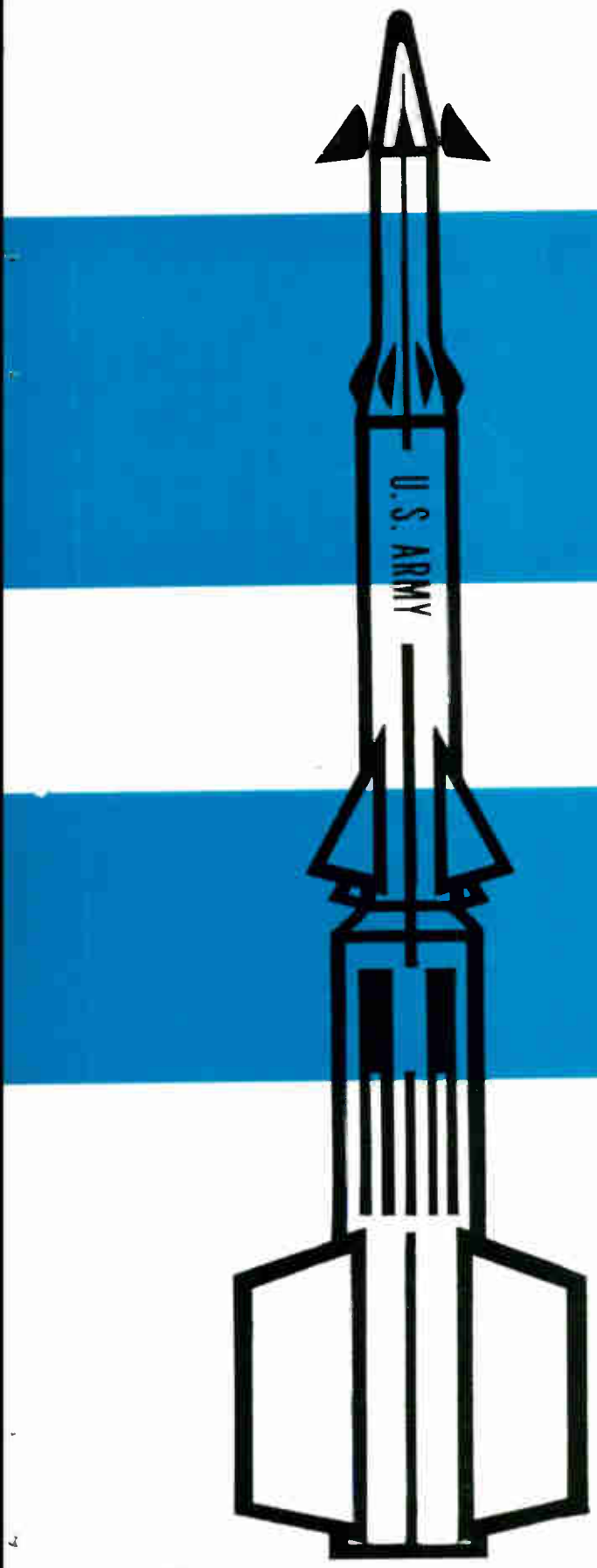
PUSH PATENT PROTECTION — Firms whose patents are being stolen, pirated, or copied without permission by foreign manufacturers may get some help in their fight from Congress this year. New move is underway to give U.S. firms weapon to help stop these abuses. Rep. Richard L. Roudebush (R., Ind.) has introduced bill to forbid Government from buying anything from foreign manufacturer who produced his product from stolen or pirated U.S. patents. Rep. Roudebush claims "illegal use of American patents has become big business" abroad. Similar move last year died in committee when Congress adjourned.

MEASURE PLANET TEMPERATURES — Scientists at the National Radio Astronomy Observatory in West Virginia didn't need the Mariner space probe to tell them Venus is hot. Using their radio telescopes, group measured surface temperature of Venus at 340°C., and that of Saturn at well below the freezing point of water, National Science Foundation reports.

METRIC SYSTEM AGAIN STUDIED—Congress again this year will consider putting the U.S. on the metric system. New drive, with more force than ever, is pushing for change. Legislation to make the switch has been introduced by Rep. George Miller (D., Calif.), Chairman of House Science and Astronautics Committee.

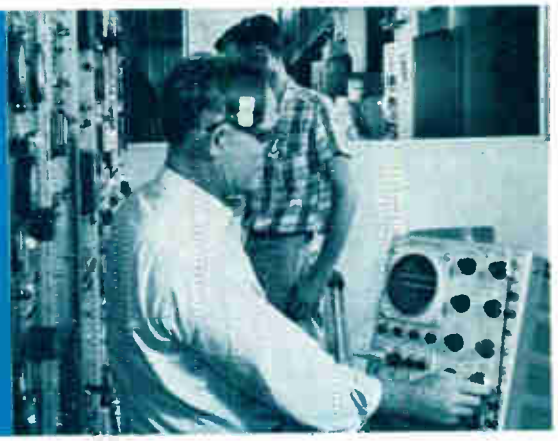
ELECTRONICS VS. THE WEATHER—Federal weathermen want to pull out all stops this year to improve weather warning services and perhaps even weather itself. Electronic devices ranging from new radar and computing machines to infra-red cameras are on shopping list. President has asked some $377 million, $22 million more than last year. Development of weather satellites alone will cost $68 million. Military services want more computers to speed up weather forecasting techniques. Some 14 federal agencies are involved in one or more weather projects ranging from forecast transmission to projects aimed at controlling amounts of rainfall and intensity of severe storms.

RADIATION-PROOF SOLAR CELLS URGED—Panel of government scientific agencies urges more use of radiation-resistant solar battery cells in space satellites to prevent communications failure. Joint report issued by the AEC, NASA, and DOD said that although the artificial belt is deteriorating faster than expected at lower (312 miles) altitudes, it will remain intense for several years at greater altitudes. The belt was caused by last summer's 1.4 megaton nuclear blast set off by the U.S. over Johnson Island. Communications aboard three U.S. satellites were knocked out when radiation from the artificial belt damaged electric solar batteries. Report predicted that the belt could survive for several years, barring "pronounced magnetic storms or other perturbations."



EYES AND EARS FOR MISSILE DEFENSE

Nike-Zeus Acquisition Radar Transmitter



Utilizing new radar techniques, Continental's super power transmitter gives Nike-Zeus, the U. S. Army's anti-missile missile defense system now under development, an effective range heretofore thought to be impracticable or impossible. It is a significant achievement

of the Zeus program. Western Electric Company is prime contractor for the Zeus program. ■ Developed under subcontract to Bell Telephone Laboratories, responsible for overall system design and development, this transmitter, used in the research and development models of the Zeus Acquisition Radar, is an outgrowth of Continental's AN/FPT-7 transmitter supplied to the three BMEWS installations. It represents another contribution to our country's defense from the specialists in super power transmitting equipment.

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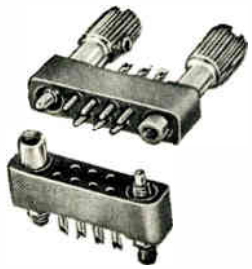

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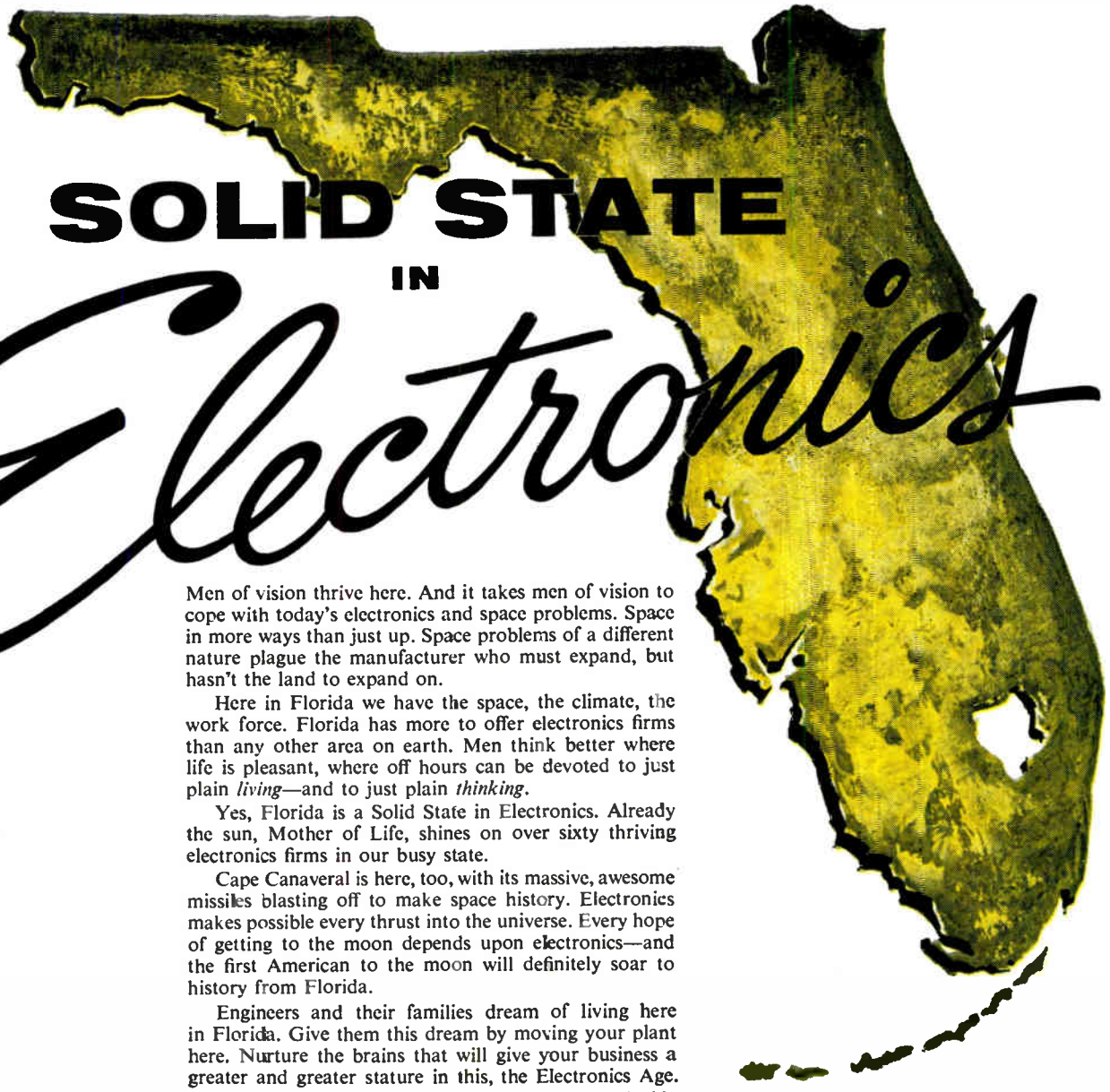

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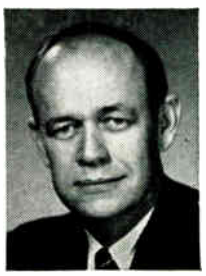

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OCEANOGRAPHY & ANTI-SUBMARINE WARFARE

The secrets of the seas are being probed as an aid to anti-submarine warfare. Much of this probing will be accomplished using the latest electronic instrumentation techniques and data handling systems. The information gleaned from this probing will lead to better submarine detection techniques and equipment. This special report indicates the magnitude of the task and points out many of the existing problems.

Destroyers dropping depth charges has been our major submarine killer since WW I, and over the years has remained in this position.

THE SEVEN SEAS offer the latest arena of conflict between the U.S. & Western Alliance and the U.S.S.R. & Satellites Alliance. This struggle on the high seas between East and West, complementing the similar struggles on land and in outer space, centers on the relatively peaceful science of oceanography, and in the military ways of undersea warfare. Here electronic equipment and systems play dual roles, serving as eyes, ears and voices, for both our oceanographic researches and our undersea warfare studies and operations.

Underlying the East-West conflict over, in, on and under the seas are these prime reasons:

1. About 70% of our world's surface is covered with ocean waters.

2. The lifelines of the Western Alliance—shipping and communications—depend upon free access and control of the oceans of the world.

3. About 90% of the world's shipping is controlled by the Western Allies.

4. The U.S. Navy says the Soviets well understand this situation and are bent upon pursuing a "denial-defensive mission: to deny the Free World use of its vital sea lanes, and to defend her coastal flanks against projection of Free World naval power."

5. Geographically, however, Russia and her Allies are land-linked across the solid land-masses of Europe and Asia (Eurasia). Russia appreciates that the Western Allies are naval powers linked by the seas. Russia believes she can destroy the Western Alliance by severing its binding sea links by using the largest submarine fleet in history.

6. Not only does Russia have the world's biggest submarine fleet (some 465 submarines, according to the latest 1962-1963 issue of "Jane's Fighting Ships") but Russia also has the world's largest oceanographic fleet of some 145 vessels (most of them prying for ocean secrets, including information about fishes, while some of them may be used for spying on Western oceanographic, submarine and space-missile test shots and atomic tests, it is believed.)

These six factors pose the Russian threat, which in turn highlights the needs of the U.S.-Western Alliance, and encourages the dual markets for equipment and systems in oceanography and undersea warfare, more specifically known as ASW: Anti-Submarine-Warfare.

Piecemeal Funding

The precise focal point of all these oceanic and naval needs is The Congress, from which all funding flows. Here perhaps the most vital current consideration is the question of whether oceanography is a civilian or military matter. Actually, it is both and inseparable, since the oceans which constitute a medium of transportation to shipping interests, and a medium of fishing to fishing interests, also represent a medium of protection and, if necessary, warfare to the U.S. Navy. The Navy is most concerned with the mission of containing and coping with the Russian submarine threat.

Whereas oceanographic interests still are funded piecemeal, although efforts have and will continue to be made for an overall program, the ASW need has been well funded and consistently increasing in the U.S. Navy Budget thus:

U. S. Navy Budget Requests	Fiscal Years (Dollars in Thousands)		
	1962	1963	1964
Aircraft for attack, ASW, tactical support, Polaris missiles	$2,680,888	$3,034,660	$3,066,000
ASW Equipment	$852,012	$903,600	$1,208,000

Through the years, the Navy has devoted some of its funds to studies and researches in science, as well as equipment and instruments, conducted chiefly by:

a. The U.S. Navy Oceanographic Office, formerly the U.S.N. Hydrographic Office;

b. A group of Navy in-house laboratories and non-profit laboratories closely active in these fields. Around 1961, the Navy moved to enhance the overall understanding and integration of these somewhat compartmentalized researches into the Undersea Warfare Research and Development Planning Council, comprising the heads of Navy and non-profit research groups.

Furthermore, "with the strong encouragement of Congress," other steps taken to help consolidate the broadly diversified efforts of ASW include the planned establishment of the job of Director of Anti-submarine Warfare, to be handled by Rear Admiral Edwin B. Hooper, U.S.N.

Meanwhile, back on Capitol Hill, the final session of the 87th Congress passed a compromise bill proffered by the Senate Commerce Committee and the House Committee on Merchant Marine and Fisheries under the title: Oceanographic Act of 1962, to establish a 10-year program of oceanographic research.

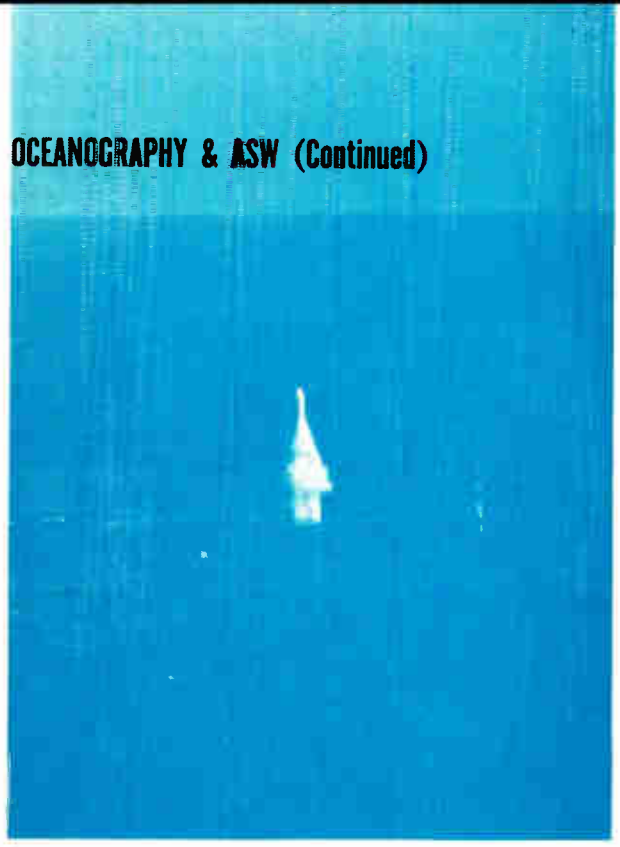
But President Kennedy pocket-vetoed this Oceanographic Act, apparently because it had been too watered-down and made insufficient to meet its vast actual needs. The Senate bill sought to establish a 10-year research program, authorizing $70 million annually—about 5% of the then-current NASA space program—adding up to $700 million from 1963 through 1972. Of this sum, two big allocations would have been some $270 million for 70 new research and survey ships, built specifically for oceanographic needs (not the usual run of converted ships designed for other purposes), and $100 million for new devices and instruments, heavily electronic, for marine research.

When this bill came out of House and Senate conference it was shorn of its funds but left with its grandiose title. Legislation for a uniform civilian oceanography program has been introduced, yet waylaid, in Congress since 1959. It will be reintroduced in the 88th Congress which convened in January 1963. The 1962 bill specifically stated it would neither interfere nor discontinue "any existing sound (oceanographic) program."

Seven Agencies in the Field

Some seven other U.S. agencies are involved in parts and pieces of oceanography activities. These program budgets, by Federal Agency and by Func-

A Nansen bottle is being lowered into the sea to capture a water sample at a predetermined depth. Bottle will also disclose water temperature and pressure at desired depth.



The capability of launching nuclear missiles from submerged submarines makes the problems of ASW extremely pressing. Here, a Polaris long range missile is being launched from a sub.

tion, are as follows for Fiscal Years 1960-1962, to the extent that these figures are available:

Oceanography Budget

Federal Agency	(In Thousands of Dollars) Actual FY 1960	Est. FY 1961	Est. FY 1962
Defense	$23,003	$22,729	$32,837
Commerce	6,202	11,389	24,691
Interior	6,723	8,704	15,472
Nat'l S. Found.	7,833	9,148	19,607
A. E. C.	1,708	2,207	3,610
H. E. & W.	340	698	1,150
Treasury	134	134	134
	$45,943	$55,009	$97,501
Summary By Function			
Research	$26,577	$31,883	$40,794
Ship Construction	13,533	13,975	37,050
Surveys	4,168	7,117	8,725
Facilities	1,370	1,768	10,422
Data Center	295	266	510
	$45,943	$55,009	$97,501

Notes. Coast & Geodetic Survey is in Department of Commerce
Bureau of Commercial Fisheries is in Department of Interior
U. S. Coast Guard is in Department of Treasury
Training of Oceanographers is involved with work of Dept. of Health, Ed., Welfare

An integral part of the overall oceanographic task, which is world-wide in nature, is the National Oceanographic Data Center, which began its first full year of operation in 1962. This Center, which depends in large part upon inputs from ships and stations of countries in the Western Alliance, uses computers. The Center, NODC, will make available to the scientific community oceanographic data collected throughout the world.

Another newly-organized operation is the Instrumentation Center of the U.S. Naval Oceanographic Office. It will concentrate men and equipment to carry on an expanded instrument program—largely involving electronics. This new Center, situated in the Old Navy Yard, in Washington, D. C., is headed by Gilbert Jaffe, director, who seeks new and improved instruments to help unlock the secrets of the seas.

In effect, this new Instrumentation Center will be in the forefront of experiments to probe the Seven Seas of the world which involve several levels of concurrent and inter-related activities and systems. Thus, considerations here begin with the sun's heat and light and their effects upon the winds that beat the seas; then the lunar ebb and flow influencing the tides; the atmosphere, air, winds whipping calm or glassy sea surfaces into waves and influencing currents; actual currents that are "rivers running in oceans" (such as the Gulf Stream); the very layers of hot, warm, lukewarm, cool, cold, icy waters—influenced by polar waters—running into hot waters flowing from equatorial areas; the chemical and salinity content and temperature of these layers of moving waters and currents; the varied, moving animal life and the stationary and moving sea plants and weeds; the actual ocean floor and crusts and valley and peaks under the oceans; the pincers effects between the weather beating down upon the oceans and inter-relating with the waters, and the vast-reaching isostatic rents in the ocean floor causing tidal wave upheavals—all these, and more represent the environment of the sea in which man must cope with nature, as well as other mortal men as potential enemies.

Four Areas of Instrumentation

As Mr. Jaffe compactly envisions his "tools of the oceanographic research trade," he has four broad areas of instrumentation activities:

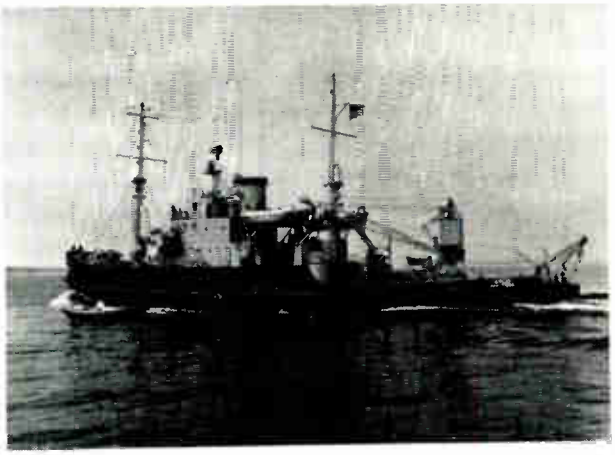
1. Specially-designed survey ships, completely instrumented for special tasks.

2. Ships instrumented for synoptic research: the use of many ships over a wide area to afford a general view of the meteorology above and the ocean below, thus yielding a distribution of conditions over a broad area at a given time.

3. Moving "platforms," to carry or contain research instruments, such as buoys or aircraft or lighter-than-air-craft, or surface ships.

4. Stationary "platforms" such as Texas Towers, located off the East and West Coasts, as permanent stations for systematic soundings.

Here, succinctly, are some of the considerations



Plans for the next ten years call for 70 vessels especially designed for oceanography. Up to now, most of the research ships have been other craft modified in an attempt to do the job, such as the rescue and salvage ship shown.

and parameters affecting work by the Instrumentation Center, as cited by Mr. Jaffe:

1. There is no big supply of "off-the-shelf" electronic or other hardware. It may be that some aerospace or other existing instrumentation may be adapted to oceanographic use.

2. Many instruments that are available have been "unreliable" for long, hard, rugged sea use.

3. Where instruments are available, and somewhat physically reliable, their measurements may be incorrect or erroneous.

4. Further, much remains to be done to combine several sensors into one recording mode which can be made in quantity to serve as a system.

5. Apparently, since there is such a vast amount of data to be dredged up from the sea, it could be assimilated only through automatic data processing. This suggests that electronic instruments could best supply automatic data inputs. This is particularly the case for the electronic bathythermograph for electronic digital recording of sea temperature and depth. A number of these instruments will be used aboard Coast Guard ships in connection with the Anti-Submarine Environment Prediction System, called ASWEPS. However, the electronic bathythermograph is an improvement in the state-of-the-art, but "future devices of this type must be more rugged, more reliable, and tow to depth at high speed."

6. A sonic device to measure wave height is being evaluated.

7. The Oceanographic Office developed an airborne radiation thermometer, installed in an airplane, to determine sea surface temperature below.

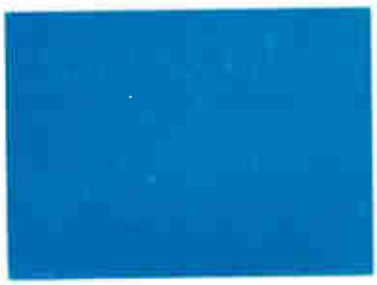
8. Buoys, as noted earlier, offer a platform to carry instruments. The Oceanographic Office is working with the U.S. Census Bureau on FOSDIC: Film Optical Scanning Device for Input to Computer, which is being "taught" how to read photographs of electrical meter movements to find speed of current, direction, and temperature of water. Although ships were cited here earlier as part of synoptic experiments, it is much cheaper and easier to build and equip large numbers of low-cost buoys for large-range simultaneous readings over a broad area. Specifications here call for:

a. Reliable and low cost buoy.
b. "Acceptable" communications system between buoy to center data-gathering source.
c. Dependable, long-life power source.
d. Reliable electronic gear to avoid countless trips to read or maintain electronic devices and buoys.

Oceanography Instrumentation & Organization

It has been noted that both the "instrumentation" and the oceanographic "organization" must be synoptic. There must be standards of operation and reporting. Mr. Jaffe observes there is need for a laboratory, to calibrate and evaluate the growing

(*Continued on page* 43)

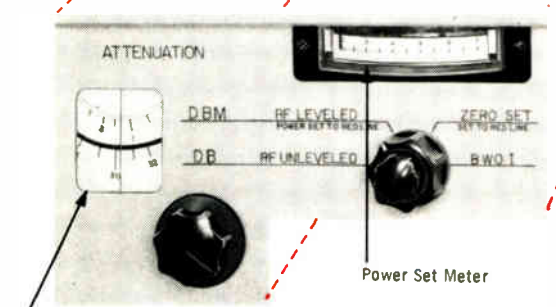


Helicopters are proving effective in detecting submarines. They can hover in one spot and lower a listening device. Copters have phased-out the blimp and can cover more area than a ship in the same amount of time. But their time in the air is a limiting factor in their use.

This is not a microwave sweep oscillator

This is the first microwave sweep signal generator

HERE, IN ONE COMPACT PACKAGE, is the microwave industry's first electronically swept **signal generator.** Alfred's new 630 Series now provides **precise** frequency tuning **PLUS** known absolute power output over a 60 db range, calibrated in dbm, all during **swept or CW** operation. Note these special features:



FLAT OUTPUT—Feedback leveler holds power variation to less than ±0.5 db at rated output over each range. Variation in any 100 Mc range is less than ±0.1 db. Accuracy ±1 db at rated power output.

TRANSISTORIZED — 10½" panel height — lightweight — low power consumption — only five vacuum tubes used.

STABILIZED POWER OUTPUT—Balanced bolometer assures constant power output over wide temperature range.

AVAILABLE IN THREE RANGES—1 to 2, 2 to 4 and 4 to 8 Gc. Frequency is continuously adjustable over entire range with direct calibrated dial (1% accuracy).

ADJUSTABLE FREQUENCY MARKERS—Each unit has two time-saving indicators of band limits and two additional frequency markers.

KEY SPECIFICATIONS FREQUENCY RANGE: Model 631, 1 to 2 Gc; Model 632, 2 to 4 Gc; Model 633, 4 to 8 Gc. RF POWER: At least 1.0 mw. Continuously variable over 60 db range. Greater power output available unleveled. RESIDUAL FM: Less than 0.003% peak of highest frequency. DRIFT: ±0.01% per hour. SWEEP WIDTH: Continuously adjustable from 0 to any part of the entire frequency range. Symmetrical Sweep: 0 to ±5% of range about any center frequency. SWEEP TIME: CW operation, 100 to 0.01 second. Square Wave Operation, 100 to 0.5 second. AMPLITUDE MODULATION: CW, square wave or external.

COMPLETE DATA AVAILABLE—Alfred's policy is to publish complete specifications and guarantee them as stated. For detailed information on Series 630 Sweep Signal Generators, contact your Alfred engineering representative or write to:

IEEE Booth #3039

ALFRED ELECTRONICS

Stanford Industrial Park • 3176 Porter Drive • Palo Alto, California
Phone: (415) 326-6496

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(*Continued from page* 41)

number of present and future instruments, and a field-test program to assure reliability, uniformity and validity of purpose, inputs, and results.

The new Instrumentation Center is one step toward serving these needs. There is also a need for two other services in which electronics can play roles. The Center, for example, has to simulate the genuine ocean environment with the "pitch, roll and heave" of actual ships. This "information" could be magnetically tape-recorded aboardship for playback in the laboratory to evaluate instruments, and for other uses.

In other areas, "simulation" plays a big role in training. Simulation can be useful to help train electronic engineers, for example, who must learn whether they can withstand the seasickness they will face out at sea. Or, if such engineers learn they cannot live down the sea, they well could be washed out and not given such assignments.

Simulation also is useful in training the men who will conduct the experiments on oceanographic scientific ships, or men who will man the weapons on Navy ships to fight enemy submarines. One such system is the Navy's ASROC: AntiSubmarineROCket. It is an anti-submarine missile guided to target position, then eased into water by parachute, to find the target and destroy it. It uses solid propellant and active sonar to locate target. ASROC replaces RAT, is 15 feet long, has 1000-lb launch weight, 8 nautical mile range, speeds at nearly Mach 1, operational since 1961.

Thus, not only does Minneapolis-Honeywell have the $65 million ASROC prime contract, but it also has received $1 million to build the Navy's ASROC trainer-simulator system now installed at Norfolk Navy Base. There, at the Naval Training Device Center, Navy missile men wage "realistic" practice battles with enemy submarines—but without ships, missiles or submarines. Here, again, electronics has an add-on market, as well as add-on duties.

Inextricably-Related Fields

A sea gull's-eye-view of what is happening in the combined, complex and inextricably-related fields of anti-submarine warfare and oceanography appears to be this:

1. Man is preparing to deal with the vastness of the seven seas, the relationship of our U.S. submarines and enemy submarines in this ocean environment.

2. Organizationally, political and organizational man is working to deal with other men dealing with the problem of ASW and oceanography. In addition to inter-Navy operation and organization

(*Continued on page* 45)

DESPITE THE HIGHLY-CLASSIFIED NATURE OF ASW projects, these systems generally are named and known, though their contents may be secret:

ASROC: Anti-Submarine Rocket: ASW missile guided to target position, then eased into water by parachute, seeks out target, destroys same. Solid propellant. Uses active sonar to locate target. Operational 1961. Prime contractor: Minneapolis-Honeywell. (Navy).

ARTEMIS: Exploratory effort to track submarines, very long range, by high-powered sonar transducers with high-gain receivers and data-processing equipment. Active sonar used here is ASW system. Tests transducer suspended under a ship to produce high-intensity sound. In R&D. Is part of TRIDENT (see below). Columbia University, Hudson Laboratories. (Navy).

ATLANTIS: Covers group of ASW surveillance systems, including ARTEMIS, plus broad administrative functions associated with ASW projects. Includes R&D for 5,000-mile-range, solid-propellant ballistic missile if mounted on surface vessels. If mounted on submarines and fired underwater, range would be reduced. (Navy).

JEZEBEL: Uses buoys in conjunction with airborne detection system, JULIE. (See below.) Locates submarines by triangulation. Lockheed - California. (Navy).

JULIE: Used with Jezebel, releasing explosive charges from buoys to echo reflection from submerged submarines. Airborne. Long range advantage. Technique is called: EER: Explosive Echo Ranging. Advanced development by Bell Telephone Laboratories and Daystrom. (Navy).

CUTWATER: Studies non-acoustic ways to detect submarines, such as: Infra-Red, electromagnetic, radio, radar. Hypothesis: field strength of radio waves or radar returns diminish on ocean surface above a submerged metallic object. (Navy).

DASH: Drone Anti-Submarine Helicopter: Unmanned, remote-control drone helicopter, to be flown from destroyers, drops payload on submarine target, then returns to parent launch-vessel. Gyrodyne. Designation: DSN 1,2,3 for drone helicopter. Uses radar/sonar guidance system. (Navy).

MAD: Magnetic Anomaly Detection gear installed in several hundred aircraft by Grumman Aircraft Engineering Corp. over past decade. These devices detect changes in earth's magnetic field resulting from submerged submarine. It possesses positive classification and is invulnerable to jamming, but is limited to short range. (Navy).

LULU: Air-to-surface or ASROC-launched depth charge (Nuclear). Operational. General Mills/Naval Ordnance Laboratory, prime. (Navy).

MK-37-1: Surface and submarine guided anti-submarine torpedo.

MK-46: Lightweight, high-speed, homing, anti-submarine torpedo.

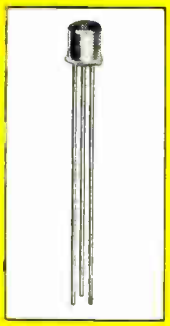
SUBROC: Underwater-to-underwater, or surface-to-underwater rocket torpedo launched from nuclear submarine to intercept another submarine. Contractors for Navy: Goodyear Aircraft: prime; Thiokol, propulsion; Kearfott, guidance.

SUBIC: A study of a submarine-integrated control system.

SURIC: A study of a surface-ship integrated control system.

TRIDENT: Exploratory project to develop system evidence on validity of ATLANTIS study, equipment for shore-based ocean surveillance. In R&D. Other aspects include: ARTEMIS: long-range sonar detection; CAESAR: passive system; FISHBOWL: active system.

Note: In addition to various Navy in-house and non-profit educational institutions active in ASW & oceanography work, Raytheon Company in July 1960 opened first U. S. integrated industrial electronic ASW and sonar center at Portsmouth, R. I. Through its Italian subsidiary, Raytheon also manages the nine-nation NATO anti-submarine warfare research center in La Spezia, Italy.



- Operation to 150°C Ambient
- 300 Nanosecond Turn-on Time
- High Gate Sensitivity

NEW SILICON PLANAR CONTROLLED SWITCHES

Transitron announces a new series of low current silicon planar controlled switches in the TO-18 package with specifications and ratings exceeding anything now available. The stepped-up performance of these premium devices makes possible many new applications for controlled switches, especially where temperature and switching speeds are critical.

Now in full production, this series, 2N2679-2N2682, features 150°C ambient temperature operation with no voltage derating; 300 nanoseconds total turn-on time; extremely hign gate sensitivity; plus the added feature of having all key parameters specified @ —65°C and 150°C wherever applicable.

Furthermore, the planar construction features extremely low leakage — 100 nanoamperes @ 25°C, 100 microamperes @ 150°C — thereby offering increased reliability. These new switches also offer increased current-carrying ability of 350 mA @ 55°C ambient and 75 mA @ 130°C ambient.

For further information, write for Transitron's "planar switch" bulletins.

2N2682 — 200 Volt Type[1]				
Specification	Symbol	Min.	Max.	Units
Forward Breakover Voltage @ 150°C[2]	V_{BO}	200	—	volts
Reverse Voltage @ 150°C	V_R	200	—	volts
Forward and Reverse Currents @ 25°C[2]	I_D, I_R	—	0.1	μA
@ Rated Voltage @ 150°C[2]		—	100	μA
Gate Current to Fire @ 25°C	I_{GF}	—	20	μA
@ —65°C		—	100	μA
Gate Voltage to Fire @ 25°C	V_{GF}	—	0.7	volt
@ -65°C		—	0.9	volt
@ 150°C		0.2	—	volt
Holding Current @ 25°C[2]	I_H	—	0.5	mA
@ 65°C[2]		—	2.0	mA
Forward Voltage @ 200mA @ 25°C	V_F	—	1.25	volts
Turn-On Time @ 25°C	$t_d + t_r$	—	300[3]	nanosecs

1 30, 60, and 100 volt types are also available as the 2N2679, 2N2680 and 2N2681 respectively.
2 With 10K ohm bias resistance between gate and cathode.
3 For maximum limit of 300 nanoseconds, add suffix /A to type designation. For example 2N2682/A.

MEET US AT IEEE
Booths 1720-24

Transitron
electronic corporation
wakefield, melrose, boston, mass.

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OCEANOGRAPHY & ASW (Continued)

Core samples of frozen sea water are taken from the frozen wastelands. These are examined and analyzed in our search for more knowledge about the seas.

already mentioned, the Navy cooperates in a National Oceanographic Program, coordinated and directed by the Interagency Committee for Oceanography which deals with the seven Federal government agencies mentioned here earlier. The Navy also has its Ten-Year Oceanography Program in cooperation with civilian agencies through the Committee on Oceanography of the National Academy of Sciences in Washington, D. C. Equally, the Navy, and all other oceanographic operations are conducted in cooperation with non-profit organizations, already noted, as well as profit-minded trade associations, such as the National Security Industrial Association's ASW Committee, and the Electronic Industry Association's Military Marketing Data Committee which tries to keep its fingers on the pulse of this throbbing market.

3. Meanwhile, virtually all funds for oceanography and all funds for ASW derive from Congress which has yet to legislate to coordinate a Ten-Year Oceanography Program, as noted here earlier.

4. The President, who is vitally interested in our Naval and commercial supremacy, maintains liaison with ASW and oceanography through: a. DOD, as Commander in Chief of the Armed Forces. b. The Office of Science and Technology which advises and assists the President in areas of science and technology (and which also works with the Interagency Committee and Oceanographic Program Review Program). c. The Bureau of the Budget.

Thus, in effect, the Navy and other oceanographic programs originate with agencies in touch with the President's scientific-technical and financial-and-political sources, which are funneled to Congress, then routed back to the President for approval or pocket veto, as happened in October, 1962.

In effect, the presence of the armed Russians and the omnipresence of the seas around us generate the need and the market, which the electronic industries, among others, seek to serve. The EIA Military Marketing Data Committee classifies electronic equipment for USW activities, thus:

1. Detection, classification, or identification of submarines and underwater weapons including mines.
2. Control of underwater weapons (submerged phase only for Polaris).
3. Guidance and electric propulsion of underwater weapons and auxiliary vehicles.
4. Underwater ECM and simulators.
5. Underwater communication and communication through the air-sea interface.
6. Oceanographic exploration and measurements.
7. Arming and disposal of mines.

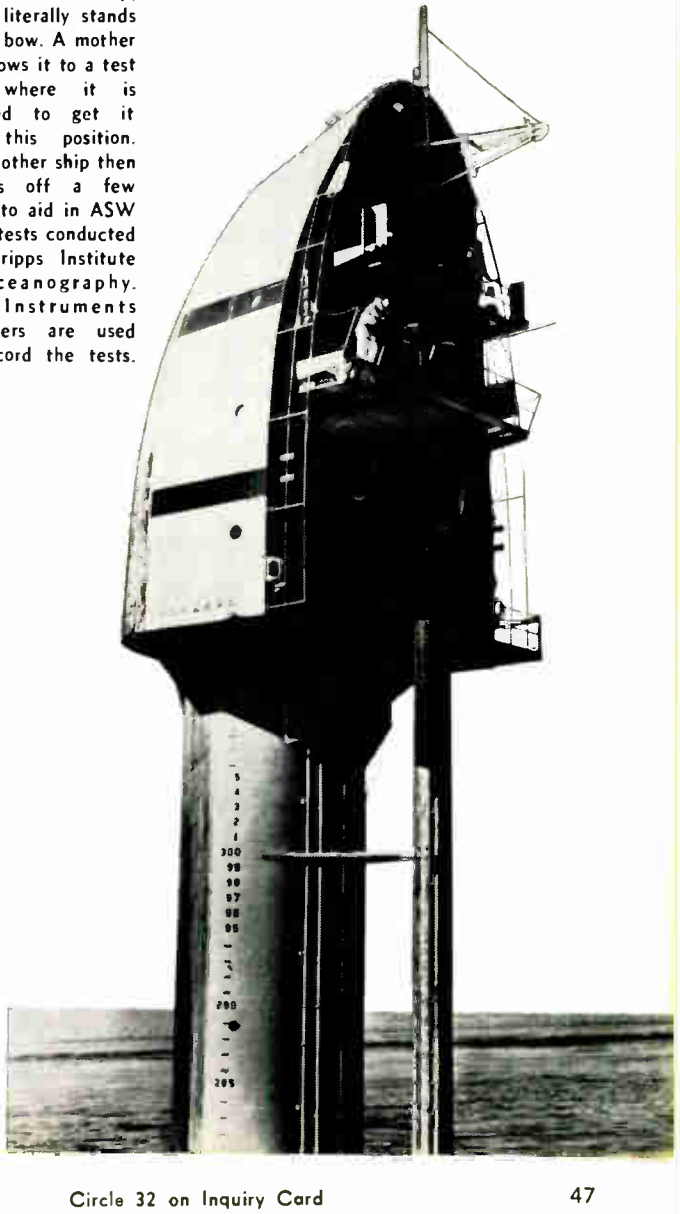
Needs in Oceanography and ASW

As broad and as promising as these needs and requirements are, so difficult and puzzling can the problem be. Here, Admiral Hooper points up some of our growing needs in oceanography and ASW:

1. How best to use the speed and potentially wide areas of coverage of the airplane.
2. How best to use the endurance and capacity of the surface ship and its interface, where it can use sensors and information links above and below.

(*Continued on page* 168)

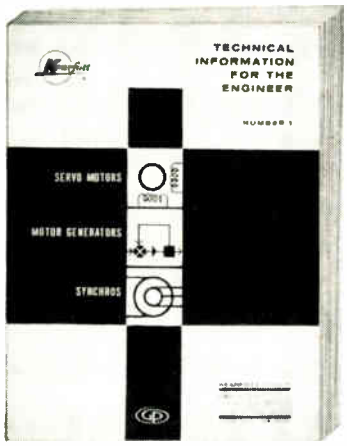
This 355 ft ship, FLIP, literally stands on its bow. A mother ship tows it to a test site where it is flooded to get it into this position. The mother ship then steams off a few miles to aid in ASW sonic tests conducted by Scripps Institute of Oceanography. Brush Instruments recorders are used to record the tests.



New DPDT TRIMPOT® Relay:

kearfott technical information report

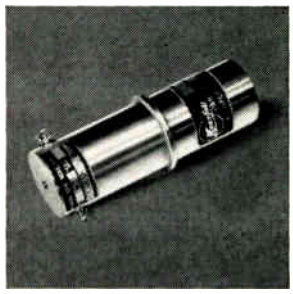
SERVO



Our publication "Technical Information for the Engineer" Number 1 was written and published for two major reasons. First, as the nation's leading innovator and producer of precision components, we wanted to sell more of them and secondly, some time ago we recognized that although textbooks on servomechanisms were very complete, the field suffered through a lack of uniform terminology and tests methods.
We attempted to cover the theory lightly in our book with major emphasis on terms, applications and component behavior from the user's point of view. You may obtain a copy of this 60 page booklet simply by writing to us.

ComPac 8 SERVO ASSEMBLIES. Kearfott's advanced Size 8 component designs have made possible the most complete variety of in-line servo assemblies available. The ComPac 8 units, ¾" in diameter, provide high performance "closed end" devices incorporating a wide range of driving and driven elements coupled through precision single or dual speed gear reducers.
System designs based on the ComPac configurations benefit from high packaging density, and elimination of provisions for the multiple mounting of independent elements and gear-trains. A typical ComPac consisting of a servomotor – gear reducer resolver and potentiometer combination measures only 3 inches long and weighs 3 ounces.
Size 8 components available for ComPac assemblies:

- ☐ Motors – Servo, Stepper, Braked, Inertial and Viscous Damped.
- ☐ Motor Generators and Tachometers.
- ☐ Synchros and Resolvers – Transmitters, Transformers, Differential Transmitters, Resolvers, Linear Synchros, 4 wire Synchros.



SIZE 8 COMPENSATED RESOLVERS. Winding compensated Size 8 and 11 resolvers and matching Size 11 buffer amplifier are also available from Kearfott for high precision computing resolver chains. Trimmed for unity transformation ratio, the resolver-amplifier combinations provide TR of 1.0000 ± 0.0017 over the temperature range of −55 to +125°C, frequency variation of 400 ±20 cps and voltage variations from 0.5 to 20 volts or simultaneous combinations of these variations. When used with size 8 resolvers, the servo mounted size 11 buffer can be installed adjacent to the resolver. A "Piggy-Back" tandem assembly of the Size 11 resolver and buffer amplifier is available as well as separate Size 11 resolver and servomounted Size 11 buffer. Additional characteristics of the combined buffer-amplifier assemblies are as follows:

Size 8 Resolver Phase Shift* (Rotor/Amp in.)	Function Error	Rotor Amp in.
0.00° ± 30′	±0.1%	0.5 — 9.0v
Size 11 Resolver		
0.00° ± 12′	±0.1%	0.5 — 20.0v

*This value constant over wide temperature, frequency and voltage range.

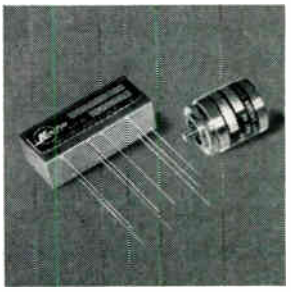
COMPONENTS

4 WIRE SYNCHROS. High system accuracy using Size 8 components is made possible through Kearfott's 4 wire synchros. Wound as resolvers, but with appropriate electrical characteristics to permit their use as transmitters, differentials or control transformers, these components can be directly applied in feedback loops without the use of special buffer amplifiers. Features individual component accuracy of 3 minutes of arc from electrical zero, when these components are used in a typical 3 component string, overall accuracy will be approximately 5.2 minutes of arc from EZ. Designated RX, RDX and RC corresponding to transmitter, differential and control transformer respectively, the application of these components to your analog computation devices will contribute to increased accuracy, while reducing volume and weight. Units for high vibration (2000 cps 20 g's) and high temperature (200°C) environments can be provided on special order.

STEPPER MOTORS. Size 8 stepper motors provide non-ambiguous shaft position corresponding to a sequentially pulsed digital input. Positive positioning of shaft through a magnetic detent rather than mechanical devices contributes to the reliability and performance of these motors by eliminating shock loading and mechanical wear. Accurate and positive shaft position makes this unit ideal for application in counting, positioning and switching mechanisms and in applications involving the use of two motors in a self-synchronizing manner. The latter application permits a form of closed loop servo operational from a digital input.

Typical characteristics include: 400 pulses/sec response rate; 0.80 in. oz. holding torque; 0.30 gm cm² rotor moment of inertia; 28V excitation, other values available. Overall dimensions; ¾" diam x 0.875" long; weight 1.5 oz.

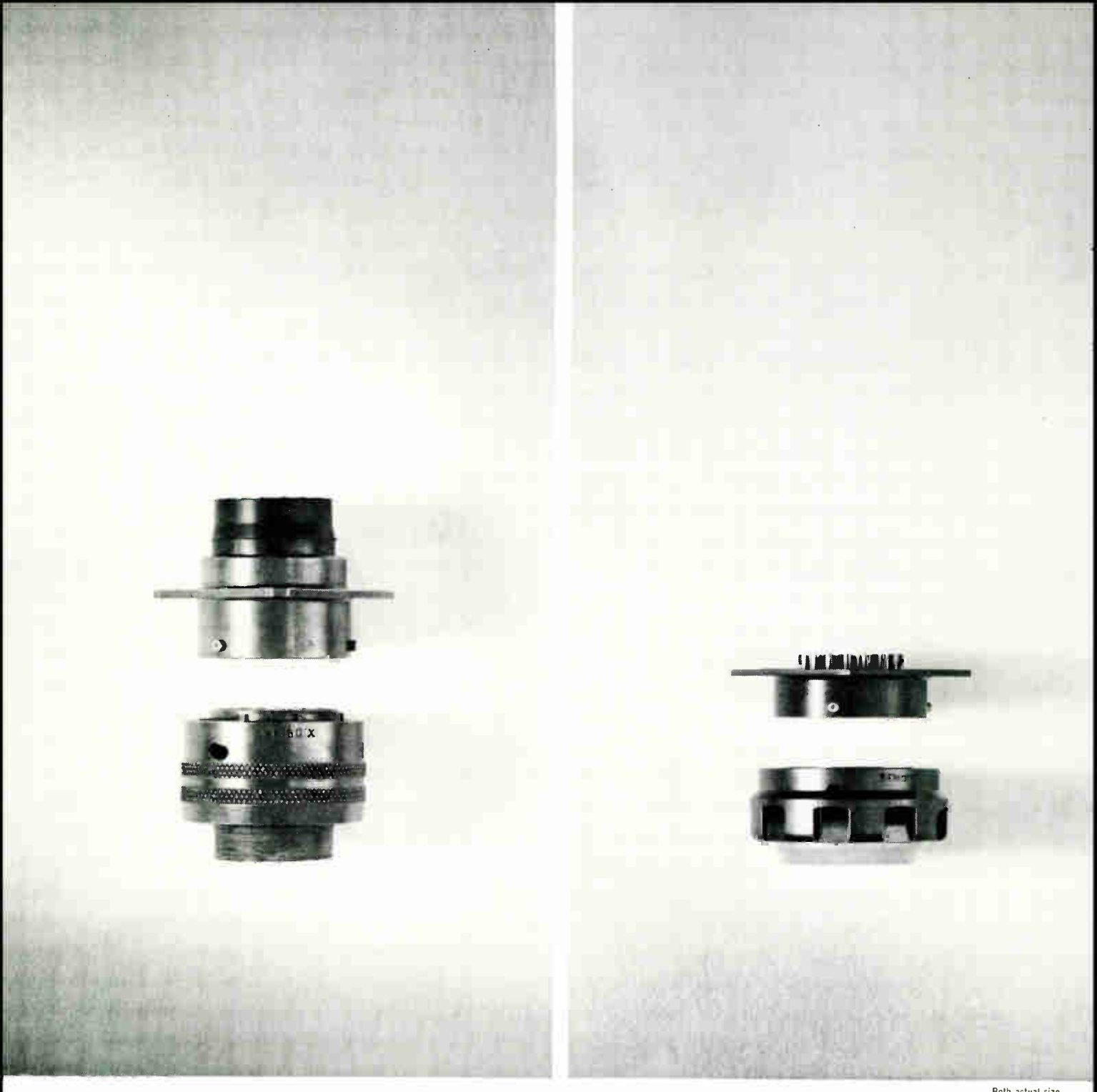
Compatible welded electronic switching assemblies can be provided for driving these stepper motors. Other motors in various frame sizes are also available.



AND ELECTRONICS. Complimenting Kearfott's wide range of wound components, a complete family of high density, transistorized servo and buffer amplifiers, pre-amplifiers and power supplies can be provided featuring welded or soldered construction. Servo amplifier voltage gain is variable through the use of external resistors. Phase shift networks matched to some of our servo motors have been included in the amplifier assembly. One representative amplifier, C70 3146 001 is an all-welded unit occupying one cubic inch, provides a 5 watt output.. This amplifier is suitable for driving any size 5, 10 or 11 motor manufactured by Kearfott. Also available: Single and dual channel buffer amplifiers matched to larger diameter compensated resolvers; pre-amplifiers and quadrature rejection circuits for use in high performance tachometer integrating loops.

GENERAL PRECISION AEROSPACE

KEARFOTT DIVISION
LITTLE FALLS, NEW JERSEY
GENERAL PRECISION, INC.



Both actual size

When there's not even room for a Pygmy, reach for our brand-new Pancake.

That's the nickname we've given a new line of connectors that we've just finished designing. They're the Junior Tri-Lock or JT connectors, and they're about half the size and weight of our standard Pygmy® connectors. Quite a feat, especially since mounting dimensions stay the same. This makes the new pancake connector adaptable to present equipment.

A few of the features include: a clocked coupling nut eliminating rotation of the coupling nut prior to actual mating; fluting of the coupling nut permits easy grasping and/or use of an extension spanner assist for hard to reach locations; contacts are molded into a glass-fiber-impregnated epoxy hard dielectric insert.

In the planning stages for this remarkable connector are styles and insert arrangements for a complete line of designs for many applications. Currently, jam-nut receptacle, box-mount receptacle, and straight plug are available in solder termination with potting provision. In addition, glass seal receptacles, crimp and grommeted versions are being developed. All this plus the dependable electrical performance of our present Pygmy line. For more information, write us in Sidney, New York.

Circle 34 on Inquiry Card

Scintilla Division

THE Bendix CORPORATION

Now—3/8"-Square Potentiometers In Wirewound or RESISTON® Carbon Models

Measuring just ⅜" x ⅜" x 13/64", these TRIMPOT® potentiometers embody the performance and features of units occupying twice the volume. The unique central mounting hole makes this improvement possible—in both wirewound and RESISTON carbon versions. It permits the same size resistance elements as those used in ½"-square potentiometers and the same high power ratings—1W @ 70°C for wirewound and 0.50W @ 50°C for RESISTON carbon. Both models offer 25-turn screwdriver adjustment with positive end-stops. A special clutch feature eliminates the possibility of damage from forced adjustment.

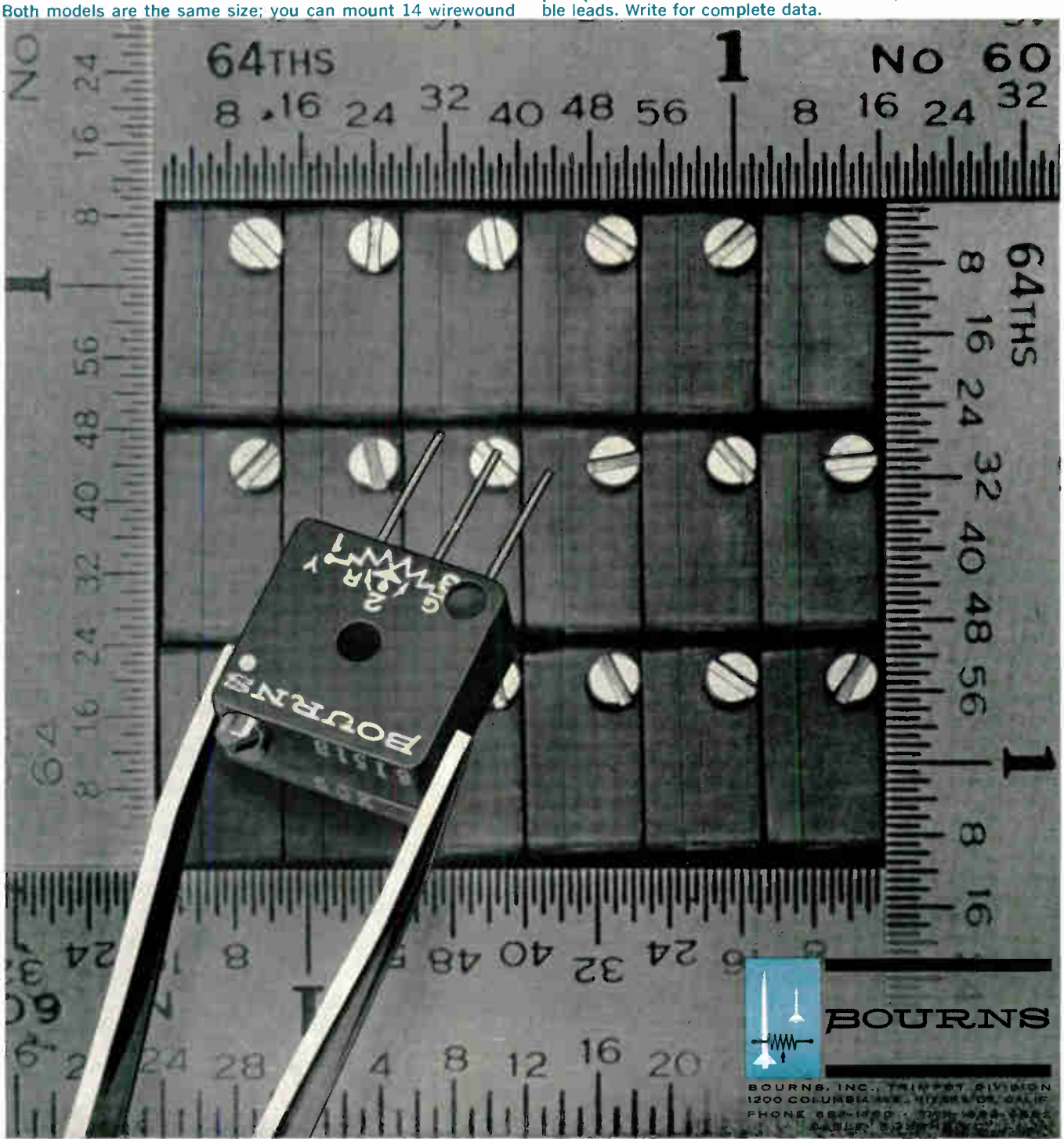
The infinite-resolution RESISTON carbon models extend the resistance range of Bourns ⅜"-square potentiometers to 1 megohm, and offer a maximum temperature coefficient of just ±0.03%/°C from −65° to + 150°C.

Both models are the same size; you can mount 14 wirewound or 14 carbon units in one square inch of circuit-board space. The procedure is simple and sure. Stacking tabs on the cases ensure proper alignment and prevent rotation. A sealed case contributes to the reliability of these units, which meet or exceed applicable Mil Specs.

	MODEL 3280 (wirewound)	MODEL 3281 (RESISTON® carbon)
Max. Oper. Temp.:	175°C	150°C
Power Rating:	1W @ 70°C; 0.5W @ 125°C	0.50 @ 50°C; 0.25W @ 100°C
Resistances:	100Ω to 50K	20K to 1 Meg.
Humidity:	MIL-STD-202B, Meth 106 (cycling)	

ACTUAL SIZE

Units are available immediately with printed circuit pins (from either narrow or flat side of case) or flexible leads. Write for complete data.

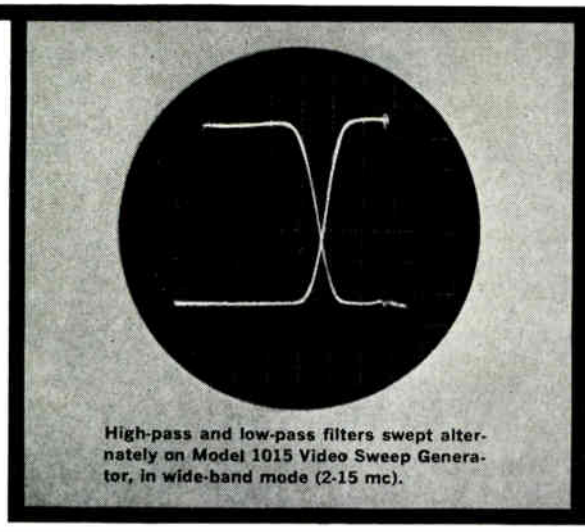


Manufacturer: TRIMPOT® potentiometers; transducers for position, pressure, acceleration. Plants: Riverside, Calif.; Ames, Iowa; and Toronto, Canada

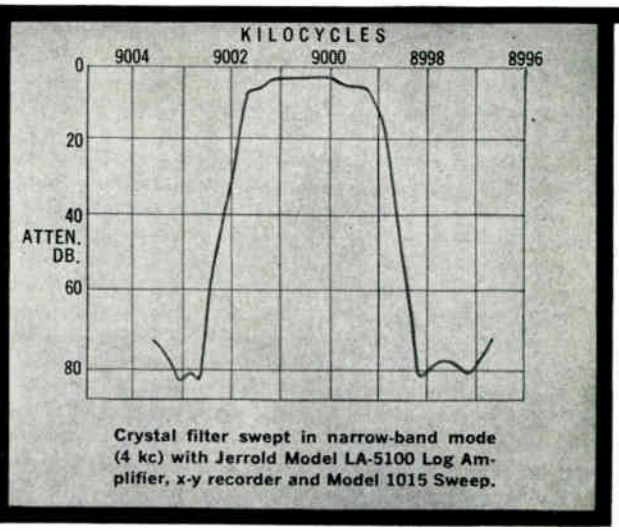
SEE BOURNS PRODUCTS IN BOOTHS 1429-1431 AT THE IEEE SHOW

ANNOUNCING
THE VERSATILE NEW JERROLD
VIDEO SWEEP GENERATOR
MODEL 1015

for both wide- and narrow-band
response testing from **1 kc to 15 mc**



High-pass and low-pass filters swept alternately on Model 1015 Video Sweep Generator, in wide-band mode (2-15 mc).



Crystal filter swept in narrow-band mode (4 kc) with Jerrold Model LA-5100 Log Amplifier, x-y recorder and Model 1015 Sweep.

Jerrold is proud to introduce this versatile, highly stable video sweep generator as the latest in its growing line of sophisticated measuring instruments.

Engineered to combine characteristics of a very stable narrow sweep (20 cps residual FM) and a very wide sweep for video applications (10 kc to 15 mc), the Model 1015 provides narrow-band, wide-band, and continuous-wave output modes. Automatic or manual sweeping is provided by a front-panel selector switch. Center frequency is continuously variable from 1 kc to 15 mc in all three modes. In addition to a built-in marker generator on the wide-band range, provision is made for connecting two external marker generators.

For fast quantitative measurements of response that otherwise would involve hours of tedious point-by-point compilation, it will pay you to investigate this stable new video sweep generator. Write for complete specifications. **$2,540**

FEATURES:

- **Wide-band, 0-15 mc; narrow-band, 0-400 kc; CW**
- **Excellent stability in both narrow and wide modes**
- **Better than 2v metered output in both modes**
- **Low residual FM (20 cps on narrow band and CW)**
- **Continuously variable sweep rate from 60/sec. to 1 per 2½ min.**
- **Built-in high-output birdie-type marker generator**

JERROLD ELECTRONICS CORPORATION
Industrial Products Division — Philadelphia 32, Pa.

JERROLD ELECTRONICS
A subsidiary of THE JERROLD CORPORATION

SEE US AT IEEE BOOTH 3904-08

News from Bell Telephone Laboratories

WE'RE "FINGERPRINTING" VOICES...TO FIND BETTER WAYS OF TRANSMITTING THEM

Acoustics scientists at Bell Telephone Laboratories study voices to learn how one voice differs from all others, what makes yours instantly recognizable to friends and family, and what the elements of a voice are that give it the elusive qualities of "naturalness."

To enable us to examine speech closely, we devised a method of making spectrograms of spoken words. We call them voiceprints. They are actual pictures of sound, revealing the patterns of voice energy. Each pattern is distinctive and identifiable. They are so distinctive that voiceprints may have a place, along with fingerprint and handwriting identification, as an important tool of law enforcement.

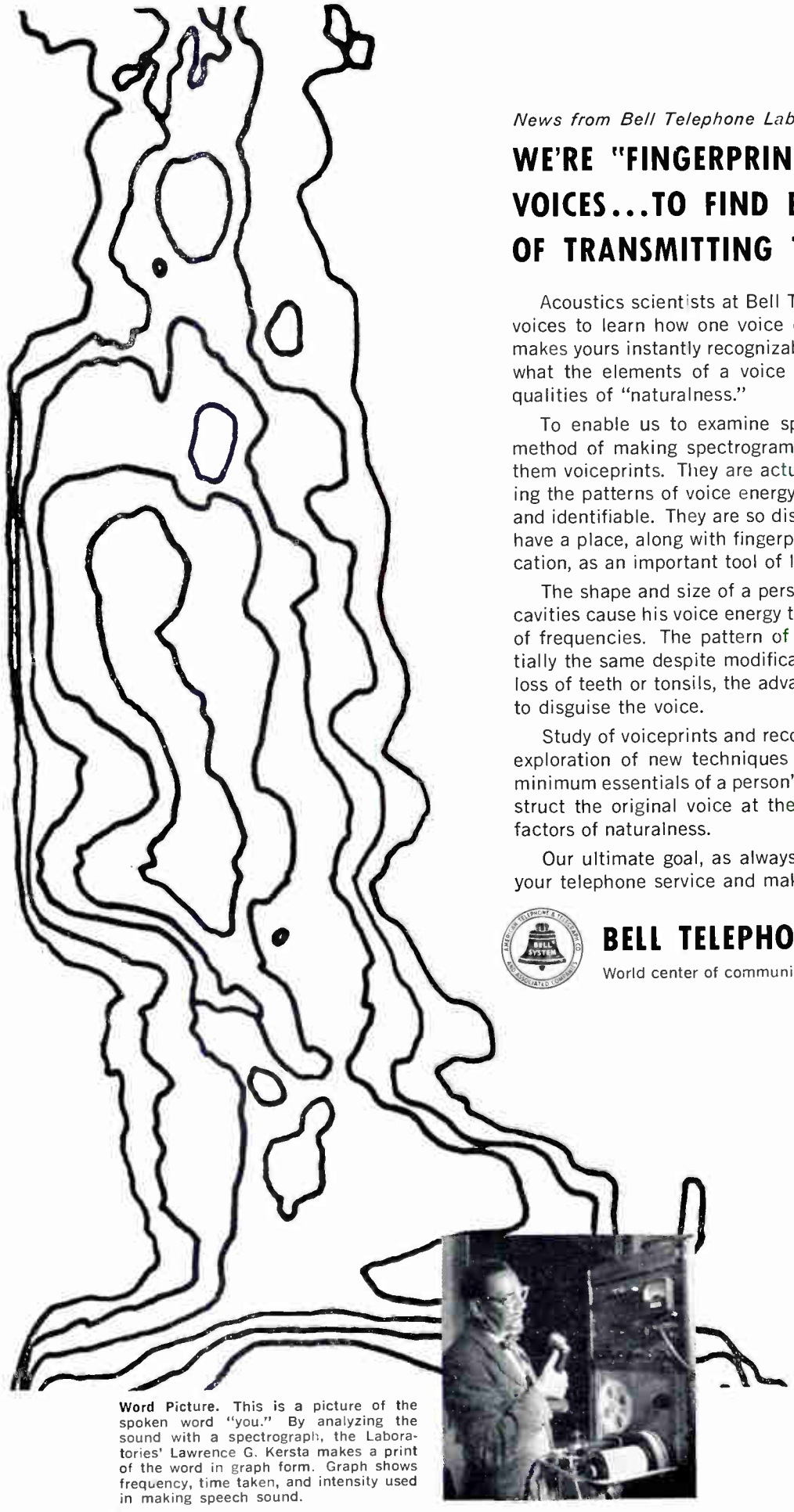
The shape and size of a person's mouth, throat and nasal cavities cause his voice energy to be concentrated into bands of frequencies. The pattern of these bands remains essentially the same despite modifications which may result from loss of teeth or tonsils, the advancement of age, or attempts to disguise the voice.

Study of voiceprints and recognition factors is part of our exploration of new techniques to extract and transmit the minimum essentials of a person's voice and from these reconstruct the original voice at the receiving end, retaining its factors of naturalness.

Our ultimate goal, as always, is to learn how to improve your telephone service and make it a better value.

BELL TELEPHONE LABORATORIES

World center of communications research and development



Word Picture. This is a picture of the spoken word "you." By analyzing the sound with a spectrograph, the Laboratories' Lawrence G. Kersta makes a print of the word in graph form. Graph shows frequency, time taken, and intensity used in making speech sound.

eight component lines . . .
one standard of excellence

every OHMITE component reflects the controlled quality which has made OHMITE products worthy of your confidence

RHEOSTATS
RESISTORS
VARIABLE TRANSFORMERS
RELAYS
TANTALUM CAPACITORS
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PHONE: (312) ORchard 5-2600

DROPOUT PROTECTION

MINCOM SERIES CM-100 RECORDER / REPRODUCER

Data loss from dropouts is practically eliminated in the CM-100, due to this unique system's predetection recording capability. In ordinary post-recording, a dropout more than 6 db down is generally considered a data loss; the CM-100's operational predetection performance retains such signals through superior phase characteristics and extended bandwidth. **Mincom's CM-100 Recorder/Reproducer,** performing longitudinal recording with fixed heads up to 1.5 mc at 120 ips, also offers 7 or 14 tracks, trouble-free dynamic braking, complete modular plug-in assembly, built-in calibration, instant push-button selection of six speeds. Versatile, reliable, a model of simple maintenance and operation, the CM-100 is tops in its field. Write today for detailed specifications.

Mincom Division 3M COMPANY

Los Angeles 25, California • Washington 4, D.C.

← Circle 37 on Inquiry Card

The First International Convention of the newly formed Institute of Electrical and Electronic Engineers may well be the biggest engineering convention ever. Over 75,000 engineers are expected. It will be held March 25-28 at the New York Coliseum and Waldorf-Astoria.

EXPECT RECORD ATTENDANCE AT FIRST I. E. E. E. CONVENTION

FIRST CONVENTION OF THE NEWLY FORMED IEEE, world's largest engineering society, will also feature the largest attendance of any engineering convention ever—over 75,000. It will be held March 25-28 at the Waldorf-Astoria Hotel and Coliseum in New York City.

Some 850 exhibitors will vie for attention of the engineers attending with over 250 technical papers presented at 54 sessions.

Outstanding speakers will discuss details of the IRE-AIEE merger. They will go over the myriad of problems still facing the youthful organization at the IEEE Banquet Mar. 27.

Social events, special events for the ladies, more international flavor, recognition of over 150 IEEE Fellows at the banquet—all these and many more things will make this the biggest convention ever.

Papers Program

The comprehensive technical papers program will cover such interesting and far reaching subjects as lunar surface communications, human engineering factors, mobile whip antennas, oceanography and anti-submarine warfare, pellet microcomponents, electronic self-repair procedures, power supplies, lasers, semiconductors, RFI, management control, amplification, microwave, delta modulation, patents, nuclear instrumentation and the sonar equipment of a bat.

More detailed reviews of key papers on these subjects, as compiled by EI's Editors, begin on page 58. The sessions begin at 2:30 p.m. March 25 and run from 9:45 a.m. to 5 p.m. every other day through March 28. They will be held at both the Waldorf-Astoria and the Coliseum.

Exhibits will fill the four floors of the Coliseum at 8th Ave. and 59th St. (Columbus Circle). Components will be on floors 1 and 2, Systems and Instruments on floor 3, and Production Equipment on floor 4. *Detailed descriptions of the most important new product exhibits begin on page 61.*

IEEE Banquet

The IEEE Banquet will be a gala affair. It will be held at 6:45 p.m. on March 27 in the Grand Ballroom of the Waldorf. This will also be the scene of the IEEE Cocktail Party, from 5:30 to 7:30 p.m. on March 25.

Banquet speakers will be: Ernst Weber, President, IEEE, and President, Brooklyn Polytechnic Institute; Warren H. Chase, Past President, AIEE, Director, IEEE, and Vice President, Ohio Bell Telephone Co., and Patrick E. Haggerty, Past President, IRE, Director, IEEE, and President, Texas Instruments Incorporated.

They will discuss problems of the new organization, formed Jan. 1 by the member-approved merger of the IRE (97,000 members) and the AIEE (66,000 members). (*Continued on page* 58)

Ernst Weber
IEEE President

B. Richard Teare
IEEE Vice President

Bernard M. Oliver
IEEE Vice President

W. R. Clark
IEEE Treasurer

Haraden Pratt
IEEE Secretary

John D. Ryder
IEEE Editor

IEEE CONVENTION (Continued)

These problems include what to do with the former IRE professional groups and AIEE technical committees, and what to do about the numerous—and often conflicting—specialized technical, regional and national conventions and meetings inherited from both bodies.

Awards Presented

Many highly coveted awards will be given and 155 new IEEE Fellows recognized at the banquet. Winners of former IRE (now IEEE) awards are: John Hayes Hammond, Jr., and George Clark Southworth, Medal of Honor; Frederick Emmons Terman, Founders Award; Ian Munro Ross, Morris Liebmann Memorial Prize Award; Chih-Tang Sah, Browder J. Thompson Memorial Prize Award; Allen H. Schooley, Harry Diamond Memorial Prize Award; Leonard Lewin, W. R. G. Baker Prize Award, and Philip J. Rice, Jr., and William E. Evans, Vladimir K. Zworykin Prize Award.

Of the 155 new Fellows who will be honored, 76 are from the former IRE and 79 from the former AIEE. Most will be present.

In addition, two principal award winners of the former AIEE, not yet named, will be announced and recognized.

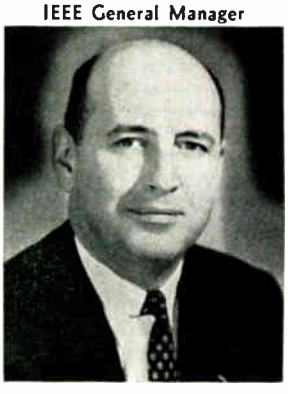
The Ladies' Program will include an entertaining round of tours and shows for the wives of members, who are also invited to the cocktail party and IEEE Annual Banquet. The Ladies' Headquarters will be in the Regency Suite, 4th Floor, of the Waldorf-Astoria.

New Feature

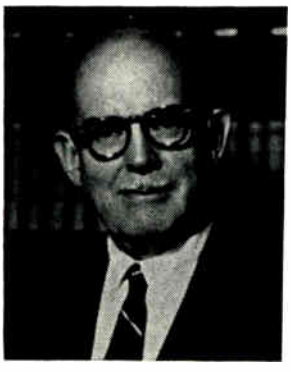
A new feature of the convention is the creation of an International Reception Room. This will recognize the truly international character of the convention and the IEEE. Convention Committee members will greet all IEEE foreign members in Room 4M of the Waldorf. It is hoped this new feature will help the members from abroad feel at home during their stay in the U. S. Several thousand IEEE members from over 40 countries are expected to attend.

IEEE members may register any day of the Convention at either the Waldorf-Astoria or the Coliseum beginning at 9 a.m. Official Convention activities begin at 9:45 a.m. each day and last until 9 p.m. Unofficial ones, of course, last for hours after that. The registration fee is $1 for IEEE members and $3 for non-members.

Donald G. Fink
IEEE General Manager



George W. Bailey
Convention Chairman



Technical Papers Highlights

A comprehensive program of 54 technical sessions will attract at least 75,000 members of the Institute of Electrical and Electronics Engineers. Some of the sessions will be held at the Waldorf-Astoria Hotel and some at the New York Coliseum. At times there will be as many as nine sessions going on simultaneously.

One of the opening sessions on Monday afternoon will feature a paper by M. Chomet, J. Ferrara and S. Gross of Airborne Instruments Lab. titled "Optimum Frequencies for Lunar Surface Communications." This paper points out that the absence of an atmosphere, the lack of appreciable ionosphere, and the small radius of the moon present problems that are not common to earth **communication systems.** An approach is given to solving these problems and should be of interest to communications engineers.

During the last ten years, the problem areas of interest in **human factors** in electronics have been enlarged due to a rapidly developing and expanding technology. Man-computer relations, automated teaching devices, and space vehicles are representative of today's problems. A panel discussion taking place on Monday afternoon will discuss these fields, present a status report, and indicate the types of answers which may be expected in the next two years.

There is a large amount of interest in **oceanography** and **anti-submarine warfare.** Recently, this has been a very hot subject. To a great extent these two subjects are very closely tied together. The paper "Trends and Problems in Sonar Transducer Design" by Ralph S. Woollett, U. S. Navy Underwater Sound Lab. is very timely. Anyone interested in this field should attend this session. This Tuesday morning paper will discuss the latest thinking in transducer designs.

IEEE's new emblem will be prominent at scene of exhibits above at New York's Coliseum and IEEE Banquet Mar. 27 at Waldorf. Over $15 million worth of latest electronic equipment will be shown by 850 exhibitors at Coliseum.

Advantages such as design flexibility, reasonable cost, and adaptability to mechanized production have aroused much interest in the use of **pellet microcomponents**. A panel representing prominent user companies will discuss the applications and assembly techniques which are under investigation. This discussion, "The Application and Assembly of Pellet Microcomponents" will give engineers an opportunity to obtain up-to-date and availability information concerning a rapidly growing microminiaturization concept. This session will take place on Tuesday morning.

When electronic equipment fails, how many people wished that it would "fix itself"? This may not be too far fetched. The main objective of the paper "Self-Repairing Procedures" by David H. Kramer, MB Electronics, is the investigation of known and new techniques which can be applied to **self-repair procedures for circuits and components**. This paper is being presented on Tuesday morning. Another paper along the same lines, "The Need and Means for Self-Repairing Circuits" by James B. Angell, Stanford University will be presented on Thursday afternoon.

The **transmission of information via light beams** is a hot subject. Many papers have been delivered describing and discussing lasers. A new area of interest is the use of solid state diodes. The paper "Infrared and Visible Light Emission from Forward-Biased P-N Junctions" by R. H. Rediker, Lincoln Lab., MIT, discusses the use of gallium arsenide as the source of light. The use of this type of device has the advantage that modulation is easily accomplished by merely varying the input current. This is being presented on Wednesday morning.

The semiconductor device, in general, is the most **radiation sensitive component.** As a result its radiation behavior has received much attention in the past few years. The paper "Radiation Damage in Semiconductor Devices" by J. W. Easley, Sandia Corp., being given on Wednesday morning, will discuss the problem.

Are you a manager? Do you understand the **delegation of authority?** According to G. R. Desi, Westinghouse Electric Corp., in his paper "Delegation of Authority in Management," the trend is to under-delegate authority rather than over-delegation. He feels that under delegation is inefficient while over-delegation can be quickly

IEEE CONVENTION (Concluded)

noticed and remedied. The complete topic of delegating authority will be discussed on Wednesday morning.

Even if you are not now contemplating **applying for a patent** the paper, "What Engineers and Engineering Management Should Know About U. S. and Foreign Patents" by Bernard Olcott should be of great interest. There is a better than even chance that any engineer will, at sometime, have an idea or invention he will at least consider patenting. Hence, he should have the facts.

Conventional **parametric amplifiers** have been severely limited by the practical need of pump frequencies at least twice as high as signal frequencies. The paper "New Class of Parametric Amplifiers Enables Below-Signal Pumping" by H. B. Henning, LFE Electronics, discusses parametric amplifiers which circumvent this limitation. This Wednesday afternoon session should be a must for microwave engineers.

Another paper of interest to microwave engineers is "High Power Microwave Tubes" by Morris Ettenberg, Polytechnic Institute of Brooklyn. The varieties of **high power microwave tubes** available will be reviewed, compared, and contrasted during this Thursday morning session.

Good **nuclear instrumentation** has been a problem. A possible solution is offered in the paper, "A Transistorized Modular Instrumentation System for Nuclear Research" by C. E. L. Gingell, Yale University. Mr. Gingell describes a system which comprises a wide variety of completely transistorized modular components for nuclear research.

A very interesting study was conducted by Louis J. Cutrona, Conductron Corp., and described in his paper, "A Comparison of the Bat's Sonar Equipment with that Built by Human Engineers." This Thursday afternoon microwave paper describes the techniques used to check-out the bat's system. The findings show that the power generation of the **bat vs. man** are equal if normalized by weight or volume. The bat outperforms radar systems by his ability to operate in highly jammed situations. Also, his signal analysis equipment is much smaller in weight, volume, and needs for power than equivalent radar equipment.

TECHNICAL SESSIONS PROGRAM

	WALDORF - ASTORIA						NEW YORK COLISEUM		
	Starlight Roof	Astor Gallery	Jade Room	Sert Room	Empire Room	Grand Ballroom	Faraday Hall	Marconi Hall	Morse Hall
MONDAY, MARCH 25 2:30–5:00 P.M.	SESSION 1 Data Processing and Acquisition	SESSION 2 Engineering Writing and Speech	SESSION 3 Geoscience Electronics	SESSION 4 Point and Counterpoint of Engineering and Education	SESSION 5 Computer Components		SESSION 6 Human Factors in Electronics – A Technical Status Report	SESSION 7 Analytical and Statistical Techniques in Reliability Analysis	SESSION 8 Vehicular Communications
TUESDAY, MARCH 26 10:00 A.M.–12:30 P.M.	SESSION 9 Information Processing and Telemeter Systems	SESSION 10 Circuit Theory I	SESSION 11 Ultrasonics Engineering I	SESSION 12 Components for Miniaturized Electronic Assemblies		SESSION 13 * Modern Applications of Computers	SESSION 14 Semiconductor Devices	SESSION 15 Reliability Techniques in Components Application and Evaluation	SESSION 16 Aerospace Electronics I
TUESDAY, MARCH 26 2:30–5:00 P.M.	SESSION 17 Antennas and Propagation	SESSION 18 Circuit Theory II	SESSION 19 Ultrasonics Engineering II	SESSION 20 Electron Devices			SESSION 21 Military Electronics	SESSION 22 Fabrication Techniques, Theory and Application of Electronic Component Parts	SESSION 23 Aerospace Electronics II
TUESDAY, MARCH 26 8:00–10:30 P.M.						SESSION 24 Panel: Lasers – Workhorse or Playboy			
WEDNESDAY, MARCH 27 10:00 A.M.–12:30 P.M.	SESSION 25 Array Antennas	SESSION 26 Measurement Devices and Techniques	SESSION 27 Communication Networks	SESSION 28 Broadening Device Horizons		SESSION 29 * Information Processing Techniques	SESSION 30 Radio Frequency Interference	SESSION 31 Engineering Management I	SESSION 32 Communications Systems
WEDNESDAY, MARCH 27 2:30–5:00 P.M.	SESSION 33 Antennas and Electromagnetic Waves	SESSION 34 Space and Propulsion Instrumentation	SESSION 35 Transmission in Processing of Information	SESSION 36 Microwave Devices and Techniques			SESSION 37 Broadcasting	SESSION 38 Engineering Management II	SESSION 39 Communications Transmission
THURSDAY, MARCH 28 10:00 A.M.–12:30 P.M.	SESSION 40 Biomedical Electronics– The Scope of Life Science Engineering	SESSION 41 Space Phenomena and Measurements	SESSION 42 Status Session on Theory and Application of Optimal Control	SESSION 43 Microwave High Power	SESSION 44 Industrial Electronics Around the World		SESSION 45 Broadcast and Television Receivers	SESSION 46 Audio	SESSION 47 Digital Modulation
THURSDAY, MARCH 28 2:30–5:00 P.M.	SESSION 48 Biomedical Electronics	SESSION 49 Nuclear Instrumentation and Measurements	SESSION 50 Automatic Control	SESSION 51 Microwaves			SESSION 52 Symposium on the Impact of Microelectronics on Circuit Theory	SESSION 53 Machine Processing and Generation of Sound	SESSION 54 Advanced Techniques in Product Engineering

* Sessions 13 and 29 terminate at 12:00 Noon.

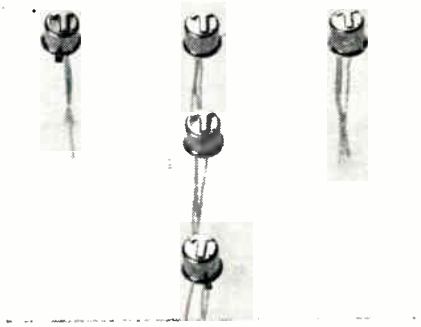
At I.E.E.E. . . .

NEW PRODUCTS

...for the Electronic Industries

SILICON SWITCHES

Series rated for operation to 150°C ambient in TO-18 case.

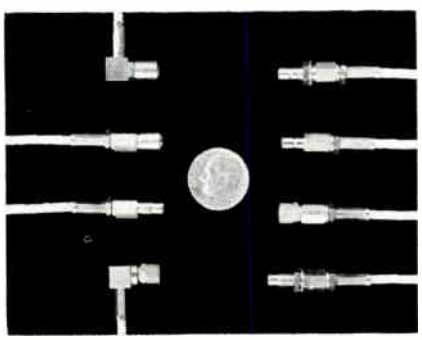


These silicon planar controlled switches have a low leakage of 100na at 25°C and 100μa at 150°C. Other features include: high gate sensitivity with a maximum of 20μa at 25°C; faster switching speeds, 300nsec. turn-on time; and key parameters specified at −65°C and 150°C wherever applicable. The switches have current-carrying ability of 350ma at 55°C ambient and 75ma at 130°C ambient. All units are in TO-18 packages with ratings of 30, 60, 100 and 200v. Transitron Electronic Corp., 168 Albion St., Wakefield, Mass.

Circle 200 on Inquiry Card

COAXIAL CONNECTORS

Matched impedance units in both straight-through and right angle designs.

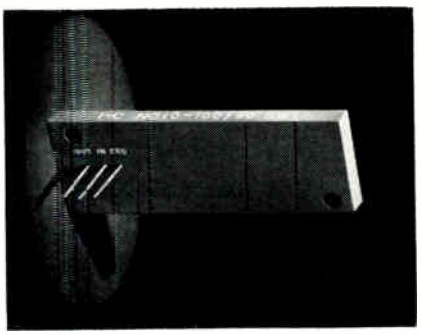


The connectors, whose mating characteristics conform to Mil-C-22557, are the crimp type designed for rapid assembly on cables such as RG 174, RG 188, and RG 196. These 50Ω connectors are available in snap-on or screw-on male and female designs. NEMA voltage rating is 500v. Flashover at sea level is rated at 2000v min., and at 70,000 ft. 1,000 min. They are corona-free to 1000v. Voltage drop does not exceed 5mv at 1a including mating connector. Micon Electronics, Inc., Roosevelt Field, Garden City, N. Y.

Circle 201 on Inquiry Card

LC DELAY LINE

A 100 nanosecond LC delay line in 2 cubic inch package.

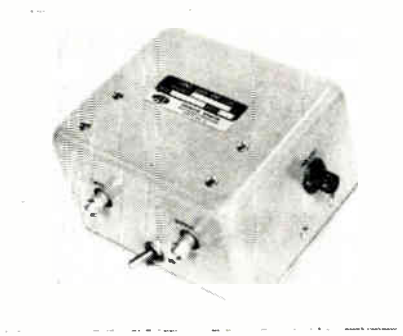


This 100 nanosecond delay with 10 nanosecond rise time is supplied in a miniature (2⅜ x 1½ x 9/16 in.) lumped constant delay line package. Characteristic impedance of the PIC #NS10-100/50SW, is 50Ω. The unit has a total volume of only 2 cu. in. It can also be supplied, with no change in dimensions or impedance, with a 50 nanosecond delay time and 5 nanosecond rise time, or with a 200 nanosecond delay and 20 nanosecond rise time. Polyphase Instrument Co., Bridgeport, Pa.

Circle 202 on Inquiry Card

TUNNEL DIODE AMPLIFIER

Compact Tunnel Diode Amplifier gives 8db system improvement.

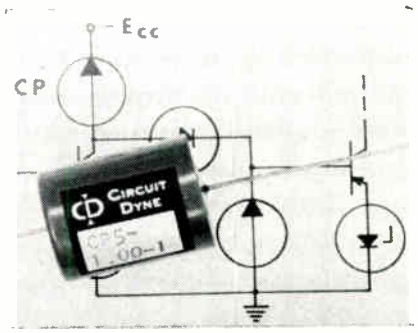


The Model NC-2101-B gives a system noise figure of less than 4db for a second stage of up to 12db. Amplifier gain is greater than 20db. It is narrow band unit with a 30MC bandwidth centered at 2115MC and operates from 15vdc of 5% regulation at 12ma. The Model NC-2101-B is single stage amplifier using a Gallium Antimonide Diode. Total weight of the amplifier, including the power supply is 4 lbs. Its over-all size is slightly less than 6 x 5 x 3 in. Micro State Electronics Corp., 152 Floral Ave., Murray Hill, N. J.

Circle 203 on Inquiry Card

CONSTANT CURRENT DIODE

Miniature, constant current diode for industrial uses.



The CP-5 "Currector" current regulator is a 2-terminal, solid state component, capable of maintaining a current value within ±2% of its rated value up to 25v. The CP-5 is a polar type; a non-polar version, the CN-5 is also available. It is available with current ratings from 1.0 to 20.5ma in 5% increments. Measures 0.8 in. dia. x 1.05 in. long and is packaged in a rugged epoxy-filled dp case. Leads may be specified axial or single-ended. CircuitDyne Corp., 480 Mermaid St., Laguna Beach, Calif.

Circle 204 on Inquiry Card

NOVAR SOCKETS

Complete line of tube sockets for either novar or magnoval tubes.

Consists of types (l-r) with metal saddles, Series 482,491) for either top or bottom mounting, printed circuit (Series 495), and all-molded (Series 440) types. All are available in either general purpose or low loss phenolic or glass filled alkyd insulating materials. Sockets conform with E.I.A. standards with spring brass, phosphor bronze or beryllium copper contacts and plated with cadmium, electro-tin and solder, silver or silver-plated gold flash. Connector Corp., 6025 N. Keystone Ave., Chicago 46, Ill.

Circle 205 on Inquiry Card

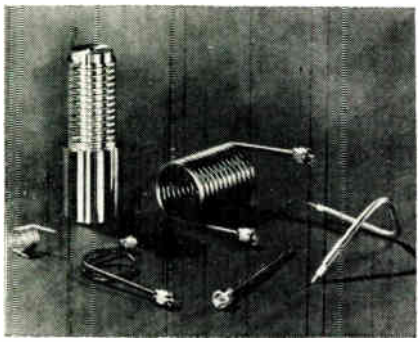
At I.E.E.E. . . .

NEW PRODUCTS

...for the Electronic Industries

COAXIAL CABLES

For microwave transmission, delay lines and high speed computer leads.



MICROCOAX Cables feature: low loss, total shielding: at or near theoretical values; easy to strip, easy to connect: no frayed ends, solderable; close tolerance construction: consistent uniformity; and mechanically and electrically verified quality. Characteristic impedance is 50Ω, outer jacket is solid copper; dielectric is Teflon (TFE); temp. range is −60°C to +86°C; and velocity ratio is 0.690 (0.679 ft./nsec.). Uniform Tubes, Inc., MicroDelay Div., Collegeville, Pa.

Circle 206 on Inquiry Card

BOBBIN WINDER

Automatic machine for winding bobbin or spool wound coils.

No. 116 features labor-saving devices to reduce handling costs from 66 to 75%. Such operations as taping the start lead, taping or waxing the finished coil, cutting the wire, ejecting the coil and sorting 2 different coils are all automatic on the No. 116. All the operator has to do is load the coil and attach the wire. The Automatic Bachi Bobbin Winder is manufactured with 6, 8, 10, or 12 individually operated winding heads. Leesona Corp., 333 Strawberry Field Rd., Warwick, R. I.

Circle 208 on Inquiry Card

MULTI-FUNCTION METER

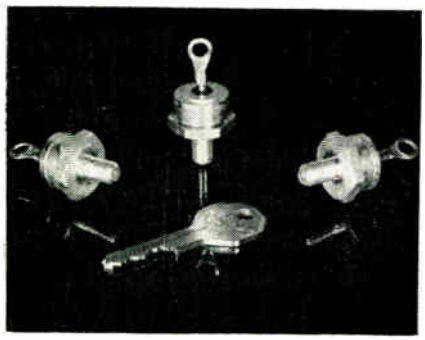
No zero adjustments required for measurements.

Model 410C will measure dc voltage (±2%) from 1.5mv to 1500v; dc current (±3%) from 0.15na to 150ma and resistance from 0.2Ω to 500megs. With an optional plug-in probe, ac voltages (20CPS to 700MC) from 50mv to 300v may be measured. Floating dc voltages to 400v above instrument ground measured with complete safety. High sensitivity and low noise permit use as a preamplifier for analog recorders. Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, Calif.

Circle 210 on Inquiry Card

RECTIFIERS

Basic current rating averages 15A from −65° to +150°F.

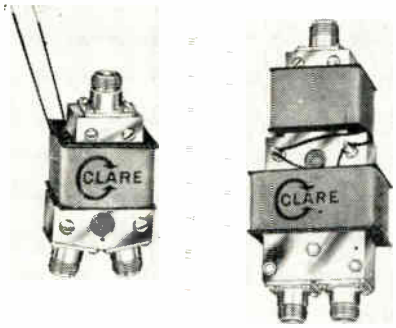


The family is the 1N3208 to 1N3211 series and has a basic current rating averaging 15a over a temp. range of −65° to +150°C. The rectifiers maintain full rated reverse voltage to +175°C which extends through the forward current derating range of +150° to +175°C. Max. peak reverse voltage ratings available from 50v to 300v. Dimensions are 1.6 in. max. overall height, stud length is 0.44 in. and hex size is 0.6875 in. across flats. Delco Radio Div., General Motors Corp., Kokomo, Ind.

Circle 207 on Inquiry Card

COAXIAL RELAYS

For reliable, high quality switching to 700MC.

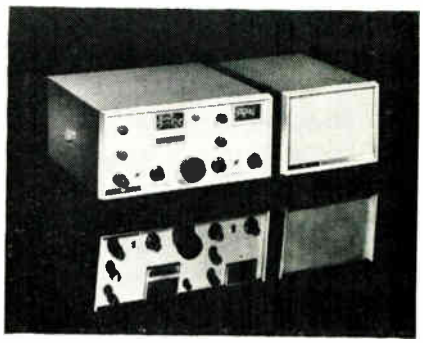


Display very low crosstalk, vswr, and insertion loss for a variety of switching operations, at freqs. up to 700MC, applications include: i-f switching in microwave networks; transmit-receive antenna switching in the uhf range of 100-500MC; and switching PCM data in telemetering systems without deterioration of square wave form. Two types are available—the HGS2C (left) coaxial relay displaying crosstalk isolation of 80db min. C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Ill.

Circle 209 on Inquiry Card

TRANSCEIVER

SSB, AM and CW coverage of the 80, 40 and 20 meter bands.



The NCX-3 has a r-f power input of 200w SSB PEP, 180w CW and 100w AM. R-F power output is 120w SSB PEP, 108w CW and 30w AM. Freq. stability is 400CPS long-term after warm-up. Suppression carrier −50db; unwanted sideband −40db. Receiver sensitivity is 1.0μv for 10db S/N ratio. Selectivity is 2.5kc at 6db. Receiver audio output is better than 2w; 3.2Ω. The NCX-3 measures 6 x 13⅝ x 11⅝ inches and shipping weight is 20 lbs. National Radio Co., Inc., 37 Washington St., Melrose 76, Mass.

Circle 211 on Inquiry Card

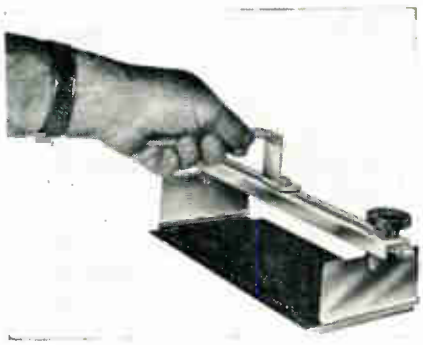
At I.E.E.E. . . .

NEW PRODUCTS

...for the Electronic Industries

DIP SOLDER BOARD HOLDER

Holds circuit boards from 1 to 10 in. wide; up to 12 in. long.

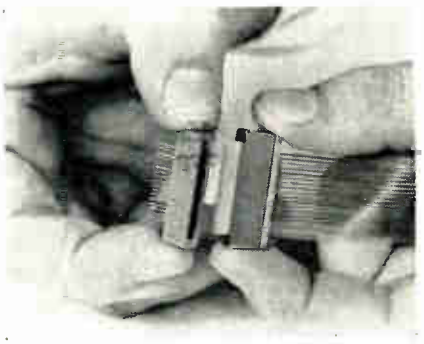


With use of accessories capacity can be increased to 24 in. in length. It features quick, easy-loading. Spring clamps of polished 304 stainless steel prevent contamination of solder bath and solder accumulation on fixture. Large easy-to-use knobs adjust for different board sizes, and the handle rotates to most convenient working position. Available with either 2½ in. or 4 in. wide board clamps. Technical Devices Co., 11242 Playa Court, Culver City, Calif.

Circle 212 on Inquiry Card

FLAT CABLE CONNECTOR

TAPECON™; no preparation or stripping of cable before using.

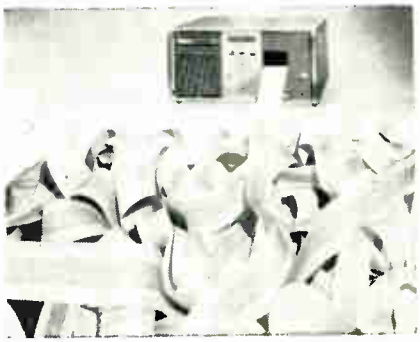


Developed for sizes of cable in accordance with the IPC standard, this connector allows 19 connections to be made in 19 sec. This connector has been designed specifically for use with flat flexible cable. The TAPECON connector has designs for use in applications for tape-to-wire, tape-to-tape, tape-to-miniature round (Mil-C-26482) connector, and tape-to-printed circuit board. Contact in the connector is accomplished through insulation "milling." Burndy Corp., Norwalk, Conn.

Circle 214 on Inquiry Card

DIGITAL PRINTER

Prints up to 20 columns of decimal digits at a speed of 40 lines /sec.

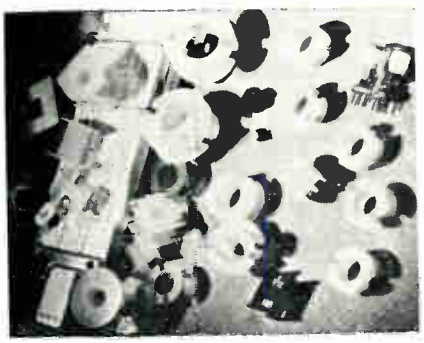


The printer accepts any input code and operates from digital voltmeters, scanners, digital clocks, decade scalers, freq. counters, and similar devices having digital outputs. Standard features include a permanently lubricated construction except for the drive motor which requires 2 or 3 drops of oil a year; all solid-state modular construction; and 11msec. print time and 14msec. data acquisition time/cycle. Franklin Electronics, Inc., E. 4th St., Bridgeport, Pa.

Circle 216 on Inquiry Card

MOLDED BOBBINS

For ferrite cup core assemblies for filter networks.



A complete line of precision-molded coil bobbins for "International Standards Series" cup cores. These bobbins, standard sizes with choice of 2, 3 or 4 flanges are molded in Delrin (duPont's acetal resin) to precise tolerances and exact specs. in one automatic operation. Delrin is used for this application because it offers high strength and stiffness at elevated temps., plus high dielectric strength (822v/mil, 0.050 thickness) and low dielectric constant (3.7 @ 60 cycles, 73°F). Gries Reproducer Corp., New Rochelle, N. Y.

Circle 213 on Inquiry Card

VOLTMETER

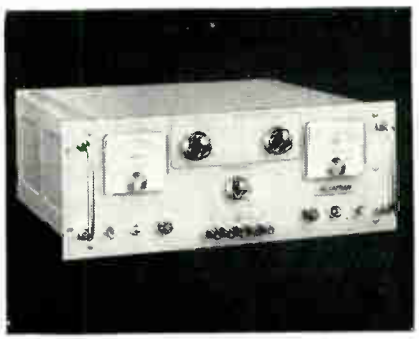
Accuracy ±2% of indicated value, freq. range to 1500MC.

Type 1806-A Electronic Voltmeter also has ac and dc voltage ranges to 1500v. As an ohmmeter it measures resistances from 0.2Ω to 1000megs. Input impedance for dc measurements is 100megs; for ac, 25megs in parallel with 2pf, except 25megs in parallel with 15pf on highest 1500v range. Open-grid dc measurements possible up to 150v. Includes a new, small-sized probe for use in limited space. For quickest readout, only 2 voltage scales appear on large panel meter. General Radio Co., W. Concord, Mass.

Circle 215 on Inquiry Card

POWER SUPPLIES

Series PV units are constant-voltage/constant-current supplies.



Outputs are wide range, 0-32, or 0-60v, at 0-5, 0-10, 0-15, or 0-30a. Features include auto-crossover from constant-voltage to constant-current or vice versa, with adjustable limiting in either mode inherent in operation. Other features include programmability in c-v or c-c output modes; Mhogrammability, the conductance-programming technique; master-slave series or parallel operation; 0.01% or 2mv line or load regulation in constant-voltage. Electronic Measurements Co., Eatontown, N. J.

Circle 217 on Inquiry Card

At I.E.E.E. . . .

NEW PRODUCTS

...for the Electronic Industries

DIGITAL VOLTMETER

Portable, battery-operated unit with high common mode rejection.

The RV2 also offers high speed, automatic range and polarity changing, and the reliability of hermetically-sealed reed relays. Speed is 4 readings/sec., average. Ranges of the DVM are ±9.999, 99.99, 999.9v. Accuracy is ±(0.01% of full scale +1 digit), and resolution is ±1 digit. Input resistance is 10megs. Input circuits are completely isolated from the chassis. An LC filter attenuates input signal noise. Non-Linear Systems, Inc., Del Mar, Calif.

Circle 218 on Inquiry Card

HIGH Q SILICON DIODES

Voltage ranges from 25 - 100; leakage current 0.5μa max.

Specs. for the VA-series of diodes extend from 25 to 100 max. working voltage. Low leakage current of 0.5μa max. is specified at the max. inverse working voltage (MWV). Capacitance range is from 6.5pf to 47pf at −4v with min. Q of 100. Nominal capacitance tolerances are ±20% with ±10%, ±5%, and matched pairs also available. Power dissipation is 0.5w at 25°C. Crystalonics, Inc., 147 Sherman St., Cambridge 40, Mass.

Circle 220 on Inquiry Card

MICA-BONDED MICA

A dense, rigid, completely mica insulator for high temp. uses.

Micaceram retains its properties in applications where temperatures go as high as 1800°F. One of its outstanding features is the ease of machining this material. It is either purchased in a slab and machined by the customer, or M.D.I. will machine it. The material is then purchased in its final form and no firing is necessary after machining. It has a low loss factor and is non-out gassing. Molecular Dielectrics, Inc., 101 Clifton Blvd., Clifton, N. J.

Circle 222 on Inquiry Card

COLORED LAMP FILTERS

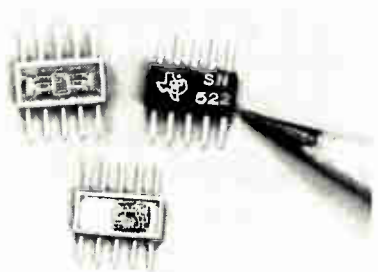
Changes any clear incandescent miniature lamp to color.

Line of elastomeric lamp filters easily slip over clear incandescent lamps to change their color. The filter caps produce colors which conform to the limits as specified in Mil-C-25050 (yellow, red, blue, green, lunar white), Mil-L-25467 (instrument lighting red), and Mil-L-27160A (instrument lighting white). Made of APM RubRglas™, the lamp boots have high uniformity and stability of color. Temp. range from −160° to +500°F. SILIKROME Div., APM-Hexseal Corp., 41 Honeck St., Englewood, N. J.

Circle 219 on Inquiry Card

INTEGRATED CIRCUITS

Line of linear amplifiers in integrated circuit form.

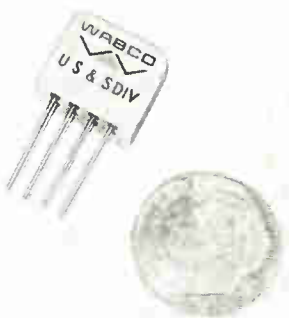


SOLID CIRCUIT™ semiconductor networks, designated "Series 52," are TI's first linear versions of fully integrated circuits to be in full production as catalog items. "Series 52" line consists of the SN521, a basic dc operational amplifier; and the SN522, essentially the same amplifier with an emitter-follower output. Typical characteristics: open-loop voltage gain—SN521, 62db, SN522, 62db; and common-mode rejection — both 58db. Texas Instruments Incorporated, Semiconductor Div., 13500 N. Central Expressway, Dallas, Tex.

Circle 221 on Inquiry Card

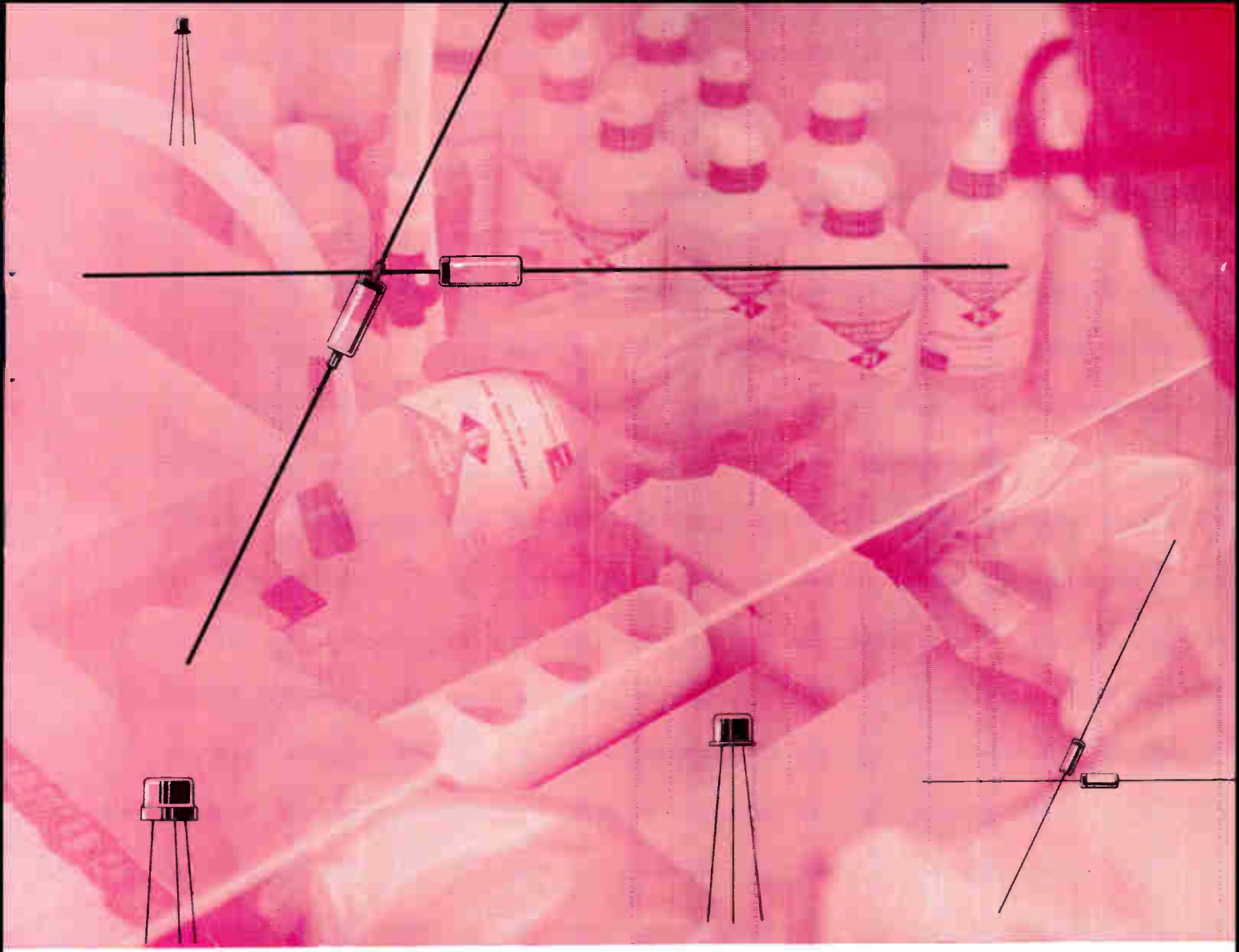
1/6TH CRYSTAL CASE RELAY

Designed to meet or exceed the critical parameters of Mil-R-5757D.



Model 901 2PDT 1/6th size Crystal Case Relay is ideal for use in all uses requiring minimum operating power, extreme compactness and high reliability. It features a balanced, rotary-type armature to provide max. immunity to severe shock, vibration and acceleration forces. The 0.1 in. grid-spaced terminal configuration allows plugging into standard printed circuit boards with no special clips or mountings required. Union Switch & Signal Div., Westinghouse Air Brake Co., 1789 Braddock Ave., Pittsburgh 18, Pa.

Circle 223 on Inquiry Card



through fluorine chemistry...new dimensions in electronics:

HOW HF IMPROVES SEMICONDUCTOR RELIABILITY

If you etch or wash semiconductor components, you know how the least impurity or variance in HF affects rate of reaction and electronic reliability.

Because of this, General Chemical has worked closely with semiconductor manufacturers to develop Baker & Adamson "Electronic Grade" HF, the purest HF ever available. *It holds impurities down to the lowest levels ever attained*—beyond detection by ordinary wet chemical analysis.

As the nation's leading producer of chemicals for the electronic industry, we offer similarly high levels of purity in a broad product line, including acetone, methyl alcohol, iso propyl alcohol, carbon tetrachloride, anhydrous ether, hydrogen peroxide (30%, and 30% stabilized), trichloroethylene, acetic, nitric, sulfuric and hydrochloric acids, manganous nitrate, and potassium and sodium hydroxides.

We'll be happy to discuss your chemical needs with you. Just drop us a card.

"Electronic Grade" Hydrofluoric Acid
49.00 ± 0.25%

Maximum Limit of Impurities

Fluosilicic Acid	0.010%
Residue after Ignition	0.0005%
Chloride	0.0005%
Phosphate	0.0001%
Sulfate	0.0001%
Sulfite	0.0002%
Arsenic	0.000005%
Copper	0.00001%
Heavy Metals (as Pb)	0.00005%
Iron	0.00005%
Nickel	0.00001%
Boron	0.000001%
Lead	0.00001%

BAKER & ADAMSON®
"Electronic Grade"
Chemicals

Allied Chemical

GENERAL CHEMICAL DIVISION
P.O. Box 353, Morristown, N. J.
Please send export inquiries to: Allied Chemical International
40 Rector Street, New York 6, N.Y.

Circle 42 on Inquiry Card

At I.E.E.E. . . .

NEW PRODUCTS

...for the Electronic Industries

TOGGLE SWITCHES

Line of 3-6-5-10 single pole, single throw ac toggle switches.

For use in electronic apparatus, test instruments, and communication. The Bulletin 7516 and 7517 feature plug-in terminals, for rapid connection by merely inserting the wire into switch body. Other standard features include: 1 hole insulated mounting with nylon threaded bushing; bussing connection; and semi-dusttight construction. Rated 3 and 5a at 250v, and 6 and 10a at 125v. Cutler-Hammer, 315 N. 12th St., Milwaukee 1, Wisc.

Circle 224 on Inquiry Card

POWER TRANSISTORS

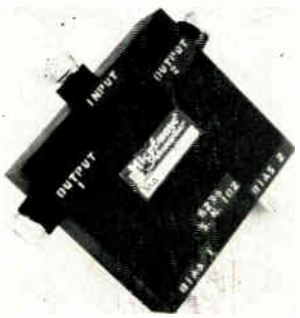
Triple-diffused, silicon planar, NPN, 10a power transistor.

Packaged in a 11/16 inch hex double-ended, gold-plated case, the 10 amp series is offered in two voltage and two gain ranges. BV_{CBO} is 100 or 80 min. BV_{CEO} is 80 or 60 min., gain is 20 - 60 or 40 - 120. BV_{EBO} is 8 min., V_{CE} (sat) is 0.5v max. and V_{BE} (sat) is 1.2v max. @ I_C=5A for all four types. Minneapolis-Honeywell Regulator Co., Semiconductor Products, 2747 Fourth Ave. So., Minneapolis 8, Minn.

Circle 226 on Inquiry Card

COAXIAL SWITCH

Solid State unit (5350—5950MC) for high speed antenna switching.



The MA-8305-2C2N coaxial type, SPDT switch has an insertion loss of less than 1db; isolation is in excess of 30db throughout the entire freq. range. Switching speed is in the order of 30μsec. with a max. drive power of 150mw. For uses such as antenna switching, signal modulation, pulse shaping or time techniques, and wherever reliable, high speed r-f switching requirements exist. Microwave Associates, Inc., Burlington, Mass.

Circle 228 on Inquiry Card

FUNCTION GENERATOR

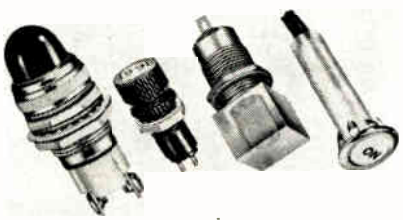
Simultaneous output of sine, square and triangle from 0.001CPS to 10KC.

The dc reference level is adjustable + and — over a 30v range. The Type 240 Function Generator's main output is 5 to 25v P-P. Impedance is 200Ω (cathode follower). Current is —3 to +15ma max. Squarewave rise-time is 5μsec. or faster with a 99% symmetry. Overshoot and drop are 1% max. Triangle linearity is 99.5% and symmetry is 99%. Sinewave total distortion is less than 2%. Power requirements: 105-125/210-230vac, 50-400CPS, 125w. Weight is 16 s1b. Exact Electronics, Inc., 455 S. 2nd Ave., Hillsboro, Ore.

Circle 225 on Inquiry Card

INDICATOR LIGHTS

A side variety of units for a range of applications.

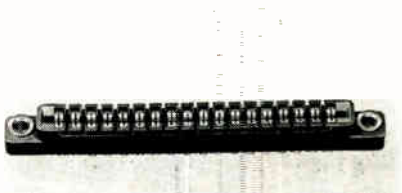


The "Glo-Lite" (right) is a simplified low cost, one-piece, nylon body and lens for use in instruments. An indicator light with a rectangular lens for midget flange base lamps, the "MF" indicator lights are used in missile and electronic equipment. The "Bi-Pin Cartridge" lamps and lampholders are replaceable from the front of panel. The "Deluxe Molded" indicator light is a refined version of the Drake 101N, giving improved appearance, electrical and mechanical properties. Drake Mfg. Co., 4626 N. Olcott Ave., Chicago 31, Ill.

Circle 227 on Inquiry Card

PRINTED CIRCUIT CONNECTOR

Feature polarizing slots integrated into the molding.

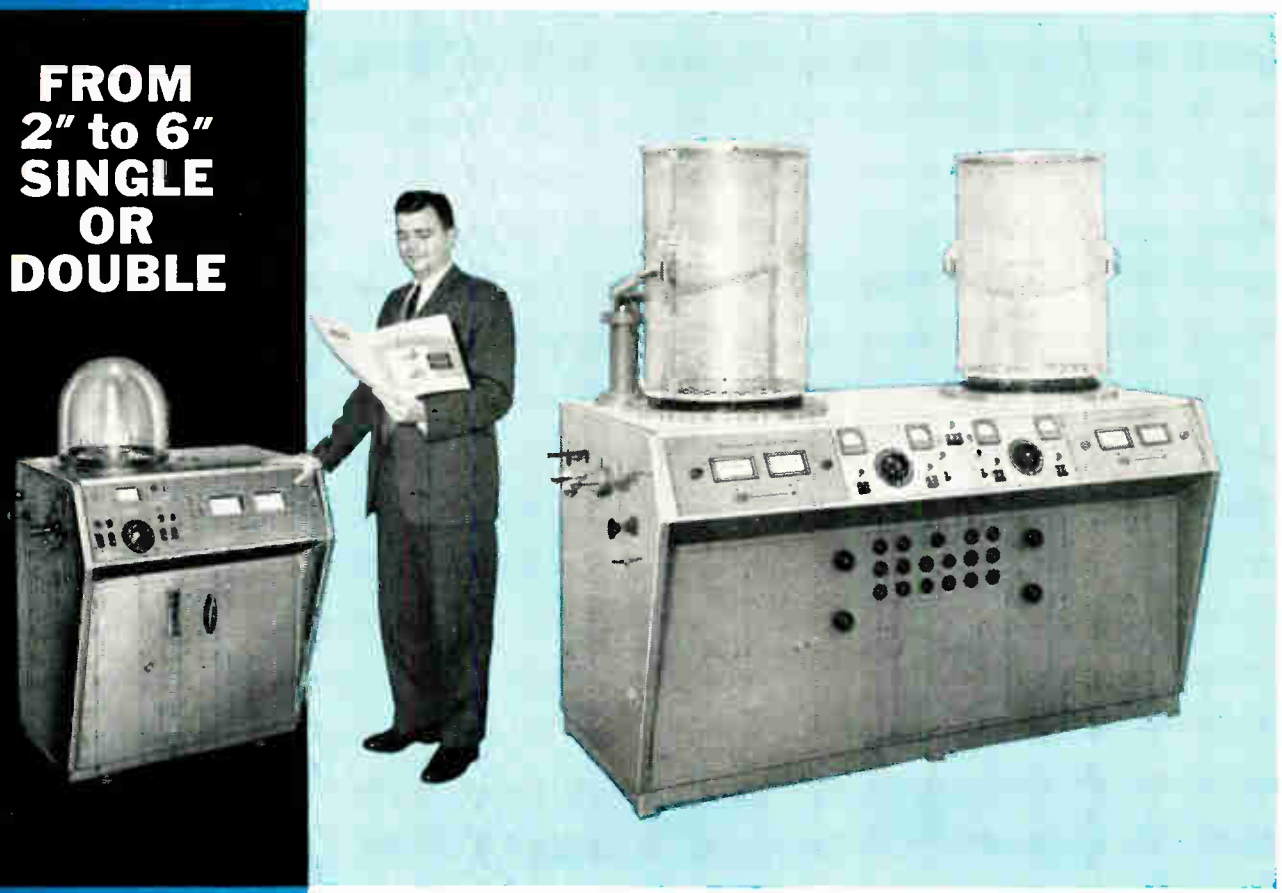


Series 600-123 features polarizing slots accommodating a polarizing key in any desired location. Eliminates sacrificing any contact position for polarization. Eighteen beryllium copper contacts with gold plate over silver plate have solder lug terminations, and accept a 1/16 in. printed circuit board. Molding material is glass filled Diallyl Phthalate per Mil-M-19833, Type GDI-30. Optional mountings include through hole, threaded insert or floating bushing type. Continental Connector Corp., 34-63 56th St., Woodside 77, N. Y.

Circle 229 on Inquiry Card

KINNEY EVAPORATORS

FROM 2″ to 6″ SINGLE OR DOUBLE



MEET ALL VACUUM REQUIREMENTS

Kinney Evaporators are designed for laboratory, pilot plant or production applications where versatility, dependability, and speed are required. These evaporators offer rapid evacuation and ultimate pressures as low as 5×10^{-7} torr when using liquid nitrogen. They are furnished complete with filament power supplies and vacuum gauges. Utilizing dependable Kinney components, each system is housed in a compact, functionally designed cabinet finished in hammertone grey enamel and topped with a durable formica work surface. All electrical controls and meters are grouped on a sloping console for optimum operator control and visibility. Its versatility is enhanced by a complete line of Kinney accessories. Kinney's standard models include 2″ to 6″, single and double evaporators; custom-designed systems can be built to your specifications.

KINNEY . . .

EVERYTHING

IN VACUUM

KINNEY VACUUM

DIVISION THE NEW YORK AIR BRAKE COMPANY

3529 WASHINGTON STREET

BOSTON 30, MASS.

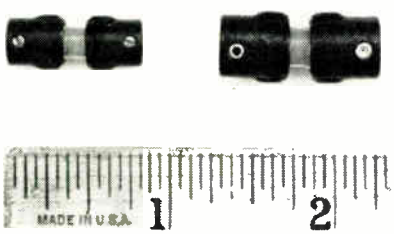
At I.E.E.E. . . .

NEW PRODUCTS

...for the Electronic Industries

MINI-JOINT COUPLING

Low cost component eliminates need of precise shaft alignment.

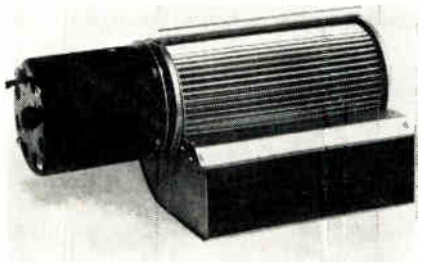


A constant velocity assembly which permits axial, radial and lateral errors in shaft alignment without introducing loads or acceleration errors, for smooth, high speed operation. Ends are made of stainless steel with 2 cylindrical raceways diametrically opposite, parallel to the axis of rotation. Connecting is a nylon body with 2 steel balls at each end, engaging the raceways. Standard bore sizes are 3/32, ⅛, 3/16, and 5/16 in. Falcon Machine & Tool Co., Inc., 150 Ballardvale St., N. Wilmington, Mass.

Circle 236 on Inquiry Card

COOLING BLOWER

Transverse-flow units feature high-pressure coefficients.



The Torrington Crosstlo transverse-flow blower, 4 in. unit, is one of 3 sizes of hand-made models (other 2 sizes have 2 in. and 3.15 in. impeller dia.) now available for engineering evaluation of the transverse-flow principle. Particularly useful in electronic cooling because of their relatively high pressure coefficients, an inherent ability to produce thin bands of air flow, and unusual flexibility in selecting the orientation of air inlet and discharge. The Torrington Mfg. Co., Torrington, Conn.

Circle 238 on Inquiry Card

SYNCHRONOUS MOTOR

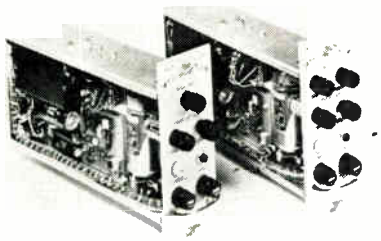
Type SS25 is for ac synchronous operation or dc stepping.

This permanent magnet Slo-Syn Synchronous Motor's ratings and specs. are: input 120v, 50/60cps, 1 ϕ, 0.1a max. current (at 60 cps); 72rpm output speed at 60cps without gears; 25 oz.-in. torque. Weighs 1¼ lbs. Starts, stops or reverses within approx. 1.5 cycles. Stops in less than 5° of shaft rotation; no need for mechanical or electrical braking. When used for phase-switched dc stepping, motor takes 200 incremental steps to make 1 revolution. Rotation is bidirectional. The Superior Electric Co., Bristol, Conn.

Circle 240 on Inquiry Card

INPUT CONDITIONER

The Model IC1601 for use with variable resistance transducers.

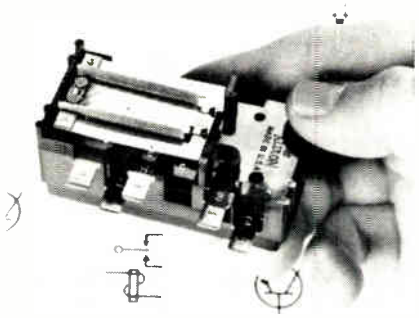


The Model IC1601 Conditioner accommodates conventional strain gage transducers as well as transducers that undergo changes in resistance, such as temperature probes, potentiometers, and semiconductor strain gages. Constant sensitivity can be maintained in a 4-wire system regardless of cable length and resistance change. The output impedance is at least 2megs; the current will vary less than 2 parts in 10,000, even if a 350Ω bridge is shorted. B & F Instruments, Inc., 3644 N. Lawrence St., Philadelphia, Pa.

Circle 237 on Inquiry Card

THERMAL SWITCHING RELAY

Performs in any position without contact chatter or other noise.

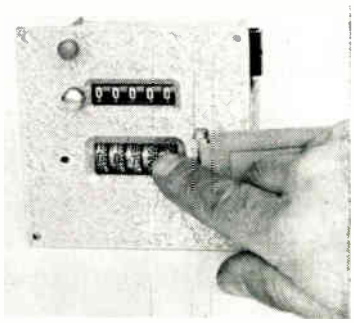


Now being used in time delay systems for electronic tube protection and alarm systems. The KLIXON® 59000 Series is available with SPDT or SPST switching and has an average inherent response time of 26 sec. (ON) and 50 sec. (OFF). It handles 25a, 240v; 120v resistive load, and costs less than magnetic relays. It is sensitive to low-power output of transistors, rectifiers, thermistors and other sensors. Metals & Controls Inc., Div. of Texas Instruments Incorporated, Attleboro, Mass.

Circle 239 on Inquiry Card

DIGITAL CONTROLLER

Counts up or down; accepts simultaneous add or subtract pulses.



This is a differential impulse counter capable of counting up or down and accepting simultaneous adding or subtracting pulses at a rate up to 15/sec. with push button reset. It has 2 sets of contacts, one of which is closed when the counter passes through 0 and one at a variable pre-set point. Pre-setting may be any number within the total 5 digit capacity of the unit. Front panel dimensions are 3¾ x 3¾ x 3½ in. deep. Presin Co., Inc., 226 Cherry St., Bridgeport 5, Conn.

Circle 241 on Inquiry Card

...comes through head heat unscathed!

Higher and higher recording speeds mean instrumentation progress—and *problems!* Increased speed and tension on tape generates friction that concentrates heat around recording heads and can make ordinary tape unreliable. Signal dropout or distortion can result when this localized, high-temperature build-up separates recording oxides from tape backing.

"SCOTCH" BRAND Heavy Duty Instrumentation Tapes carry signals coolly through head-heat environments. They withstand temperatures from −40°F up to +250°F. They last *at least* 15 times longer than ordinary tapes. Their heavy duty oxides and binders are formulated to resist heat extremes, minimize ruboff. Exclusive Silicone lubrication eases head wear, tape wear. They offer 1000 times more conductivity than ordinary tapes to drain off dust-gathering static.

16 different "SCOTCH" Heavy Duty Tapes are available in 3 series. Polyester backings offered are .65, 1 and 1.5 mils. Choice of coating thicknesses includes .18 and .43 mils. "*400*" *series:* excellent high and low frequency resolution. "*500*" *series:* smooth, sharp resolution for broad band, other high frequency uses. "*900*" *series:* ultra-smooth surfaces for predetection recording systems, critical wide band needs.

TECHNICAL TALK Bulletin No. 3 explains temperature effects on recording tape, discusses heavy duty oxide and binder combinations. Free. Just write 3M Magnetic Products Division, Dept. MBR-33, St. Paul 19, Minn.

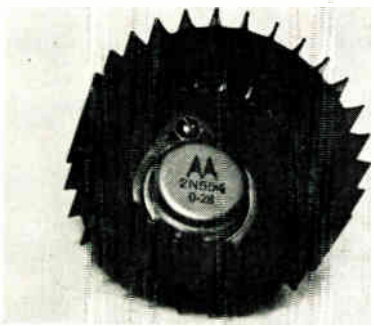
At I.E.E.E. . . .

NEW PRODUCTS

...for the Electronic Industries

HEAT DISSIPATOR

Series CFQ 100 and 200 provide high efficiency heat dissipation.

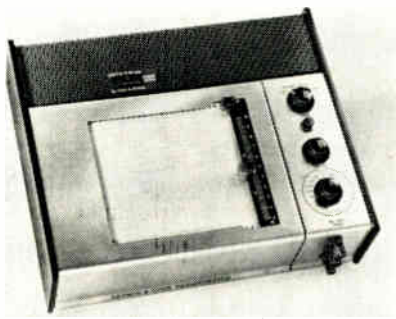


These Heat Dissipating Devices for semiconductors are constructed of aluminum alloy. Both series are finished in black anodize. Other finishes are also available. Standard hole patterns per E. I. A. specifications. Units are available from stock. Cool-Fin Electronics Corp., 1717 No. Potrero Ave., So. El Monte, Calif.

Circle 230 on Inquiry Card

CHART RECORDER

Records multiple inputs directly without external converters.

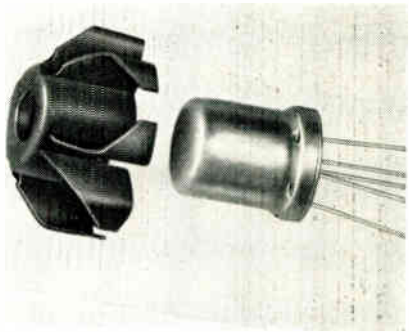


The V.O.M.—5 Strip Chart Recorder can record multiple inputs directly, dc volts, ohms or milliamps, without the use of external converters. A lightweight (16 lbs.), compact unit, the flexibility of the V.O.M.—5 is illustrated by the fact that it can operate in 3 positions: flat on lab table, at a 30° desk tilt, or on wall mount. Bausch & Lomb Inc., Rochester 2, N. Y.

Circle 232 on Inquiry Card

HEAT DISSIPATORS

Low cost units designed for a wide range of uses.

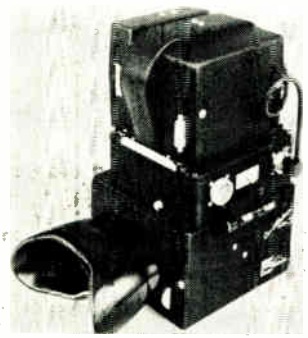


Model 9036 Radiator Holders for R.C.A. Nuvistor satisfies need for high efficiency heat dissipator (36°C/watt). In applications where nuvistors are mounted on printed circuit boards, the use of a heat dissipator is essential for maximum efficiency and longer life. They are available from stock. Augat Inc., 33 Perry Ave., Attleboro, Mass.

Circle 234 on Inquiry Card

O-SCOPE RECORDING CAMERA

A 35mm system with automatic film advance, and binocular viewing.



The Beattie-Coleman Oscillotron KD-5 features direct viewing of the CRT while recording, without parallax, by using a large dichroic mirror. Shutter is electrically actuated. Pulse is 1/50th sec. for use with single-frame magazine. The KD-5 clamps onto bezel of any standard 5 inch o-scope and does not need external support. The camera is hinged to permit easy access to lens for focusing and aperture setting. A 38mm f/19 to f/22 Wollensak Raptar lens is standard. Beattie-Coleman, Inc., 1000 N. Olive St., Anaheim, Calif.

Circle 231 on Inquiry Card

VOLTAGE COMPARATOR

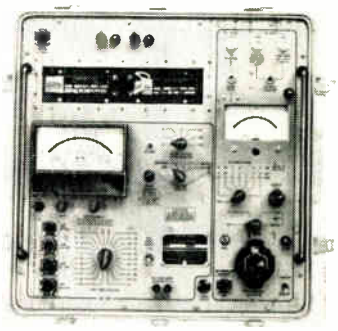
For precise measurement of absolute ac voltage.

The Model VC-1 True RMS Voltage Comparator is also for accurate adjustment of unknown ac voltage and recording of ac power supply stability. Input voltage range is 4 to 1000v, input current is 6 to 7ma. Freq. range is dc and 30cps to 10kc. Absolute transfer accuracy is ±0.02% of reading with resolution of comparison of 0.005% of reading. Other features include recorder provisions and automatic self standardization. Size is 19 x 12 x 18 in. rack mounted; weight—40 lbs. North Hills Electronics, Inc., Glen Cove, L. I., N. Y.

Circle 233 on Inquiry Card

COMPACT MULTI-TESTER

A portable, lightweight multi-test r-f power and test point monitor.



Designed for all standard communications, navigation, and interrogation equipment, as well as general purpose testing. Weighing 45 lbs., the unit has a transistorized voltmeter and r-f power meter which each operate off a 24v nickel-cadmium battery, and it is capable of testing IFF transponders. The set also has a built-in calibrated attenuator and a charging circuit for recharging batteries. Applications include as an integrated electronic control for aviation, aero-space, or laboratory work. Instruments For Industry, Inc., Hicksville, L. I., N. Y.

Circle 235 on Inquiry Card

WHERE THE HIGHEST CIRCUITRY PERFORMANCE IS VITAL. For applications requiring reliable performance under severe environmental exposure, consider Miniature Pyle-Star-Line®, Mercury Series, Connectors. They have not only met but amply exceeded rigorous MIL-C-26500 B specifications. Their capabilities have been ably demonstrated for airborne electronics; checkout, test, and ground support equipment.

Design and material features which determine the performance of these connectors include: stainless steel shells for great strength, resistance to wear and corrosion, and unique contact retention system with collet fully supporting and positively retaining contacts in rigid insulators. Resilient insulator components provide resistance to most corrosive fluids and oils, complete sealing, and resistance to temperatures up to 392°F.

Available with threaded or bayonet shells, these connectors are offered in a wide range of insert configurations. Miniature connectors are also available hermetically sealed, and with shell accessories for RFI shielding.

Send for complete information on the Miniature Pyle-Star-Line connectors by requesting the newly up-dated M101 brochure. For consultation on applications, design ideas, reliability in performance, and promptness of delivery, The Pyle-National Company is the organization to contact.

CONNECTOR DIVISION, THE PYLE-NATIONAL COMPANY, 1334 NORTH KOSTNER AVENUE, CHICAGO 51, ILLINOIS

ALSO MFG. IN CANADA BY: PYLE-NATIONAL (CANADA) LTD., CLARKSON, ONTARIO

Pyle-National

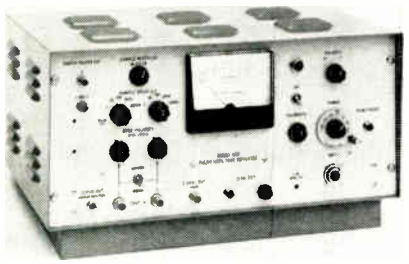
At I.E.E.E. . . .

NEW PRODUCTS

...for the Electronic Industries

PULSE AMPLITUDE INDICATOR

Measures amplitude at any point in pulse or irregular wave shape.

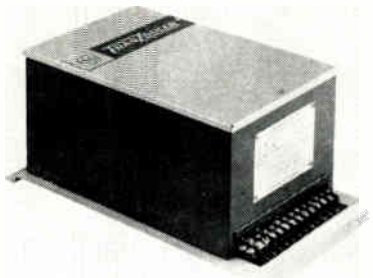


Useful in the microwave area for measuring the gain of pulsed tubes and the power levels in pulsed r-f systems. Model 405 is also useful in metering pulse droop in microwave systems or absolute pulse levels in digital systems. Instrument is furnished with a flat crystal detector which monitors the r-f power by means of its detected output. The sampling time is set by means of a variable sampling delay circuit. Wiltron Co., 717 Loma Verde Ave., Palo Alto, Calif.

Circle 242 on Inquiry Card

TRANSDUCERS

Convert electrical physical quantities to high-power dc outputs.

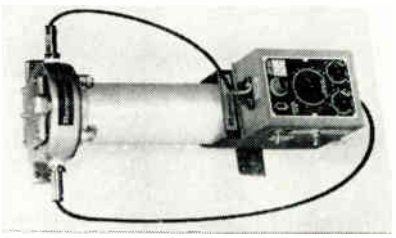


The transducers are designed to convert temp. freq., ac watts, power factor, and ac voltage and current. The temp. transducer is basically a Wheatstone-bridge circuit with a 10 copper resistance-temp. detector as a variable resistance in one of the bridge arms. It is rated for 120v, 60CPS operation, with continuous 20% overload capacity. A watt to dc transducer is for applications requiring dc millivolts. General Electric Co., Instrument Dept., West Lynn, Mass.

Circle 244 on Inquiry Card

REPURIFICATION SYSTEM

Continuous system for cooling circuits of uhf power tubes.

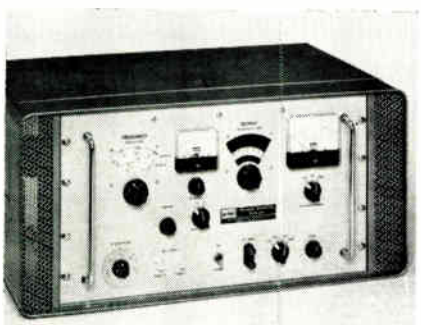


Model PL-½ Repurification Loop is a compact model designed for smaller cooling systems that hold up to 150 gal. of coolant. The Barnstead PL-½ loop continuously repurifies the coolant while the tube is in operation and prevents build-up of scale, copper oxide, carbon dioxide, oxygen, organics and other impurities which cause corrosion or impair heat transfer and needlessly curtail tube service life. Barnstead Still and Sterilizer Co., Boston 31, Mass.

Circle 246 on Inquiry Card

FM SIGNAL GENERATOR

For highly accurate alignment and measurements.

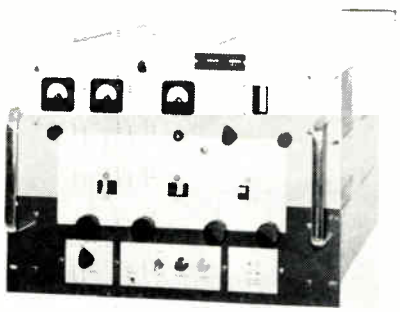


Measures bandwidth, sensitivity, and distortion of FM telemetry receivers in the 225 to 800MC range. AMI Model 303 FM, features a carrier freq. tunable from 225 to 800MC in 2 bands with freq. stability of ±0.005% and calibration accuracy of ±0.5% receivers. Three FM deviation ranges are: 0-30, 0-100, and 0-300kc, with ±5% FSD on all ranges from 225 to 400MC, and ±10% FSD from 400 to 800MC. Advanced Measurement Instruments, Inc., 109 Dover St., Somerville 44, Mass.

Circle 243 on Inquiry Card

FREQUENCY SYNTHESIZER

The LA-74 Synthesizer features a range of 2 to 10MC.

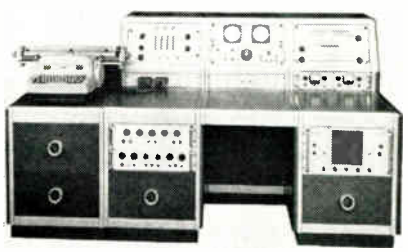


It has continuous tuning across its entire freq. range. Automatic alarm circuit prohibits generation of non-synchronized freqs. A special synchronization disabling switch allows fast scan of the entire range for laboratory measurements. Specs: freq. range is 2-10.1mc in 3 bands of 2-3.4, 3.4-5.9, and 5.9-10.1; stability of 1 part in 10^8/day. Input power is 115v, 200w, 50-60CPS, and dimensions are 19 x 14 x 22 in. Lavoie Laboratories, Inc., Matawan, Freehold Rd., Morganville, N. J.

Circle 245 on Inquiry Card

RADIATION PRINTER

Antenna patterns numerically recorded in angular grid form.



It is fully automatic operation when used with Scientific-Atlanta positioner programmer. Gives relative power in decibels on all amplitude increments. Model RDP-1 plug-in encoder adapts to all S-A antenna pattern recorders with logarithmic pen response, permitting patterns to be recorded simultaneously with radiation distribution printing. Requires only 5¼ in. of rack space (8¾ in. if front-mounted connector panel is desired). Scientific-Atlanta, Inc., P. O. Box 13654, Atlanta 24, Ga.

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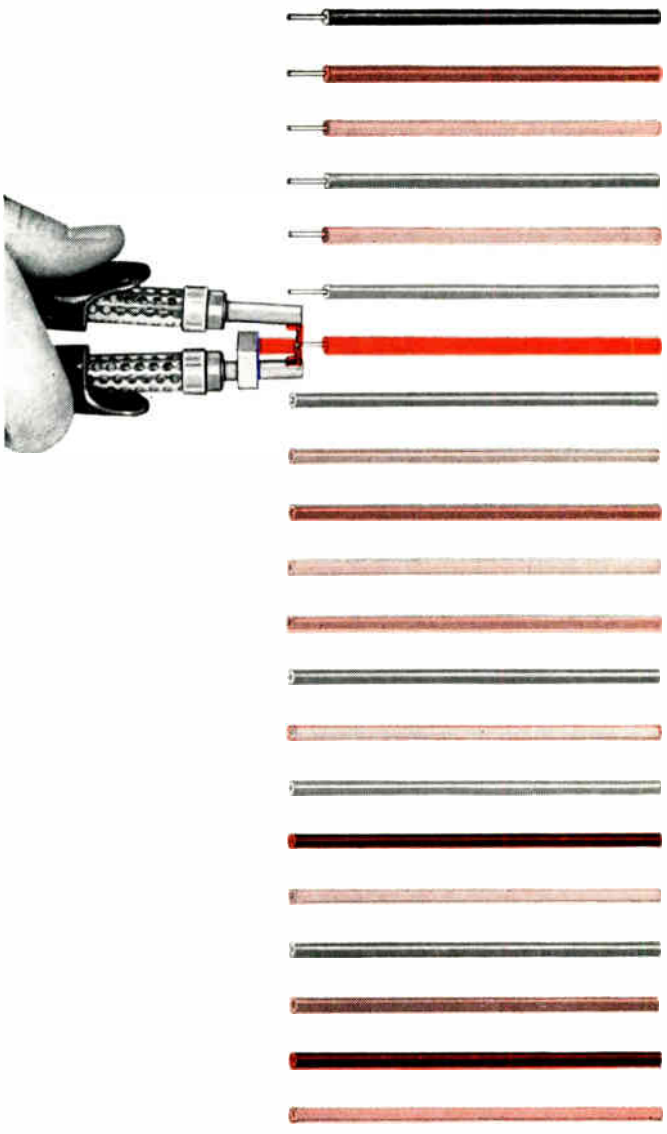

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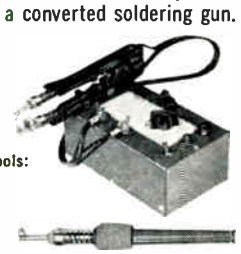

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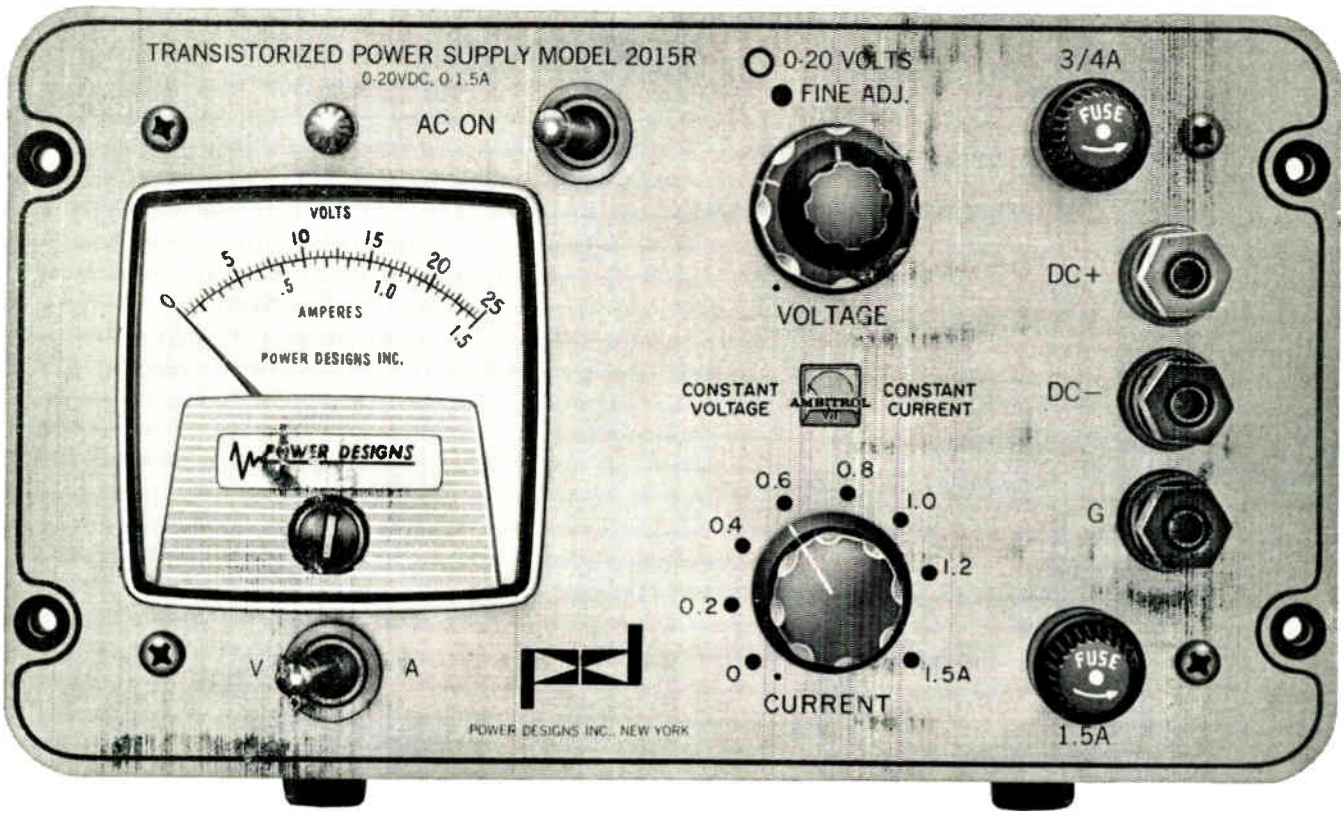

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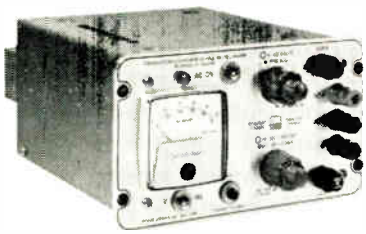

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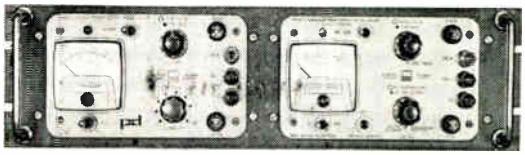

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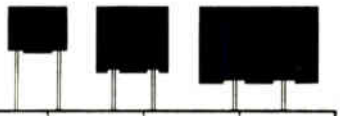

CASE SIZE	H.	L.	W.
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Y	.325	.360	.170
Z	.375	.600	.195

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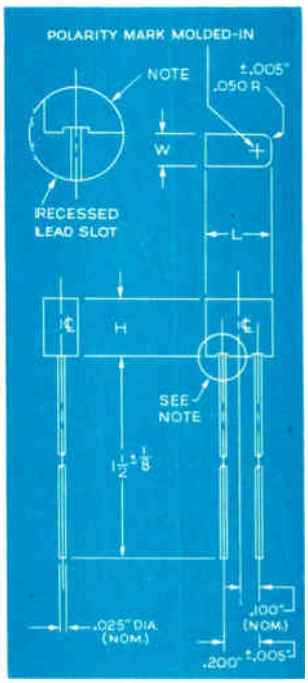

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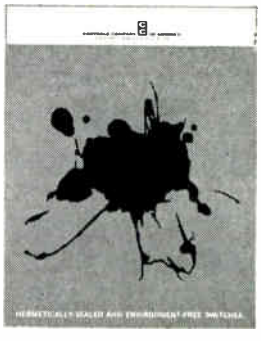

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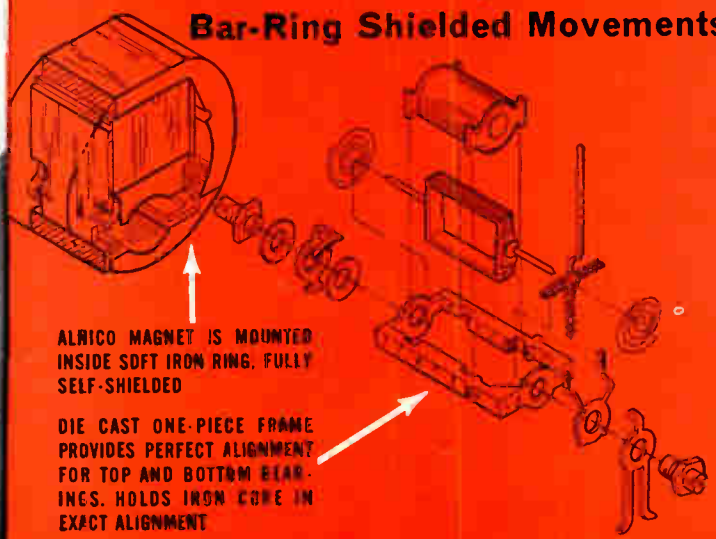

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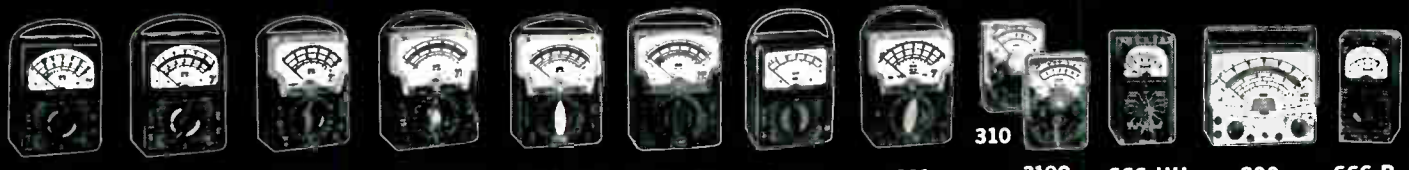

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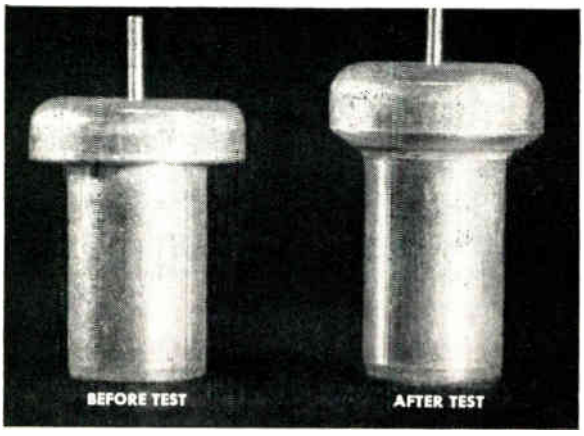

Crimp-sealed Fansteel tantalum capacitors stay leak-proof* even in outer space

Fansteel Type CL44 and 45 tantalum capacitors are crimp-sealed by a patented process that produces a virtually hermetic seal, even in the vacuum of outer space encountered by modern spacecraft.

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*This photo (twice actual size) shows a Fansteel "PP" type tantalum capacitor before and after being subjected to internal pressures of 600 psi. As shown, the test resulted in a stretching and deformation of the silver case, *but no failure or leakage whatsoever in the seal.*

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WHAT'S NEW

MAGNETIC FIELD ROTATES ULTRASONIC WAVES—NEW DEVICES POSSIBLE?

A NEW FAMILY OF ULTRASONIC DEVICES, such as circulators and isolators, now appears possible because of recent experiments at Bell Telephone Labs. Scientists rotated the direction of polarization of a transverse ultrasonic wave traveling in a crystal, by causing the wave to interact with a magnetic field. The rotation is non-reciprocal. When the wave is reflected at the end of the crystal, it does not rotate back to its original direction of polarization as it travels back to the input.

Scientists H. Matthews and R. Conway LeCraw bonded a quartz disk to one end of a cylinder of single yttrium iron garnet. They applied a dc magnetic field parallel to the axis of the cylinder. The magnetic moments of the iron atoms in the garnet lined up parallel to the field.

They then applied a pulsed r-f field to the quartz disk, generating (piezoelectric effect) an ultrasonic wave pulse. This 500MC pulse was polarized parallel to the quartz axis. The pulse, traveling down the garnet cylinder, strained the crystal lattice. The iron atoms were alternately pulled apart and squeezed together, in a direction perpendicular to the magnetic field.

Straining the atoms created a second magnetic field. This r-f field varied with the frequency of the pulse; and was perpendicular to the applied magnetic field. A component of the r-f field interacted with the lined-up iron atoms. It changed the direction of their magnetization.

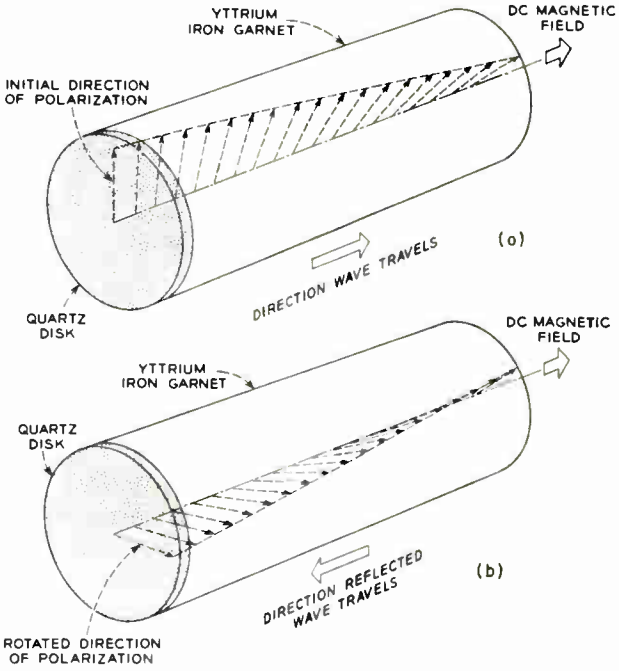
This is the opposite of magnetostriction, where ferromagnetic materials, such as iron, elongate in the direction of a dc magnetic field and contract in a direction perpendicular to the field.

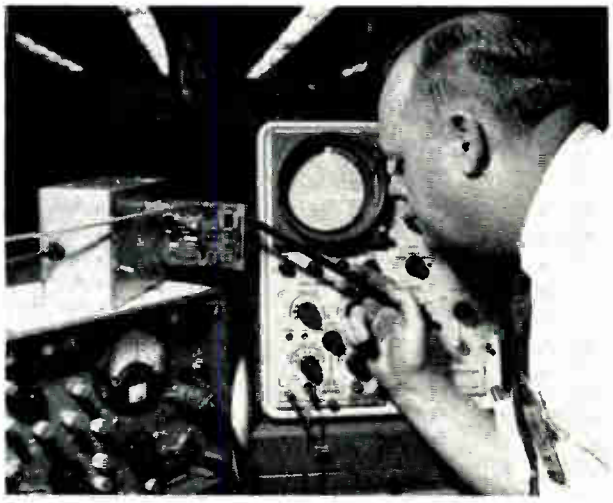
The change in the direction of the magnetic moments of the iron atoms affected the direction in which they moved, as the pulse strained the YIG lattice. (The motion of the iron atoms was linearly polarized in a plane perpendicular to the wave's direction of travel.) The initial group of iron atoms moved up and down in this plane. The next group of atoms moved at an angle to the previous group, in the perpendicular plane. This rotation was caused by interaction of the r-f field and the lined-up iron atoms (analogous to the Faraday rotation of electromagnetic waves in ferrites). Each group of atoms was strained at an angle to the previous atomic strain. The direction of motion was rotated continuously.

When the wave was reflected at the end of the YIG cylinder, rotation of the strain polarization continued in the original direction. The interaction between strain and lined-up iron atoms was independent of the direction in which the wave traveled. The amount of rotation depended upon the distance the wave traveled and the strength of the dc field. The experiment grew out of previous Bell Labs work. This showed yttrium iron garnet to have the lowest acoustic loss of any known material (an ultrasonic pulse can make many trips between cylinder ends before complete attenuation).

An ultrasonic isolator would work something like this. An ultrasonic wave leaves the input of a system and travels through the isolator. The direction of wave polarization is rotated 45°. When the wave is reflected back to the isolator it is rotated another 45°. A device in the isolator absorbs the energy of waves polarized at 90°. The reflected wave is prevented from reaching the input of the system.

In "A", quartz launches ultrasonic wave pulse (piezoelectric effect). Pulse traveling down yttrium iron garnet cylinder interacts with dc magnetic field. Interaction rotates direction of polarization and wave arrives at end of cylinder rotated 45 degrees. In "B" the same pulse is reflected back toward quartz disk. Wave again interacts with dc field. Polarization is rotated and wave reaches quartz disk rotated an additional 45 degrees in the same direction.





Radio Frequency Fault Detection testing of an F-104 sub-assembly card. Engineer Frank Hagert taps card making fault more apparent. O-scope shows intermittent r-f noise from a faulty diode on card.

RELIABILITY INCREASED BY R-F DETECTION

How to catch potential circuitry failures? Thousands of man-hours are being spent to answer this question. Engineer Frank Hagert at Minneapolis-Honeywell's Military Products Group, Aeronautical Div., Minneapolis, Minn., has come up with a test that spots potential failures unseen by conventional tests. It is called Radio Frequency Fault Detection (RFFD).

RFFD is based on the principle that certain types of circuitry failures consistently generate detectable r-f noise. Such failures are usually not found until system-failure—sometimes months after installation. Erratic semiconductors and vacuum tubes, poor solder-joints, and improper junctions between dissimilar metals generate r-f noise easily detectable at approximately 25mc with an r-f receiver.

Taking only about 2 minutes, RFFD can be used on components, sub-systems, and entire systems. Minneapolis-Honeywell has statistics showing conventional test (such as X-ray) pass as perfect, the same elements that RFFD proves faulty. The method is so successful testing production components for F-104 flight control systems, that it will be used on systems going into Gemini and Apollo spacecraft.

RFFD, while increasing product reliability, is relatively simple and inexpensive. It can be done by one semi-skilled technician, using readily available, uncomplicated test equipment.

NEW LASER "DWARFS" MOON MODEL

Everyone wants higher laser outputs for higher signal-to-noise ratios. Raytheon Co.'s latest creation delivers a coherent light beam 700% stronger than that used to hit the moon last year. The LHM-4 Ruby Laser, developed by their Laser Advanced Development Center at Waltham, Mass., delivers 350 joules (a joule is one watt-second of energy) with a 1° beam spread.

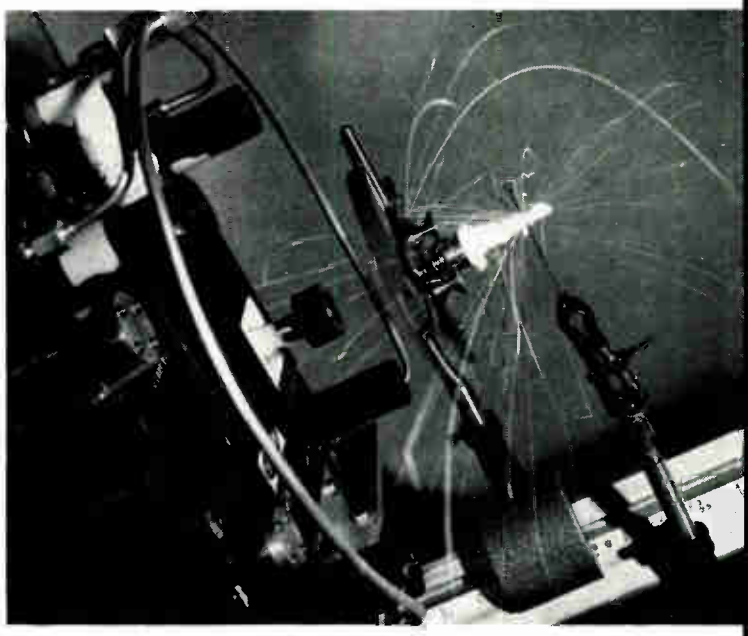
The LHM-4 looks the same as the moon model, outwardly. It has a 4-barreled head. The difference is inside. Input is 32,500 joules to 4 lamps, each rated at 10,000 joules. Recent tests at Waltham had the laser delivering various power outputs. Efficiency ranged at about 1%.

Fed 7,500j, it delivered 55 joules. At 14,700 joules the result was 140. With 19,200 in, the output was 205; at 24,300 the output was 262. The 32,500 resulted in 350 out.

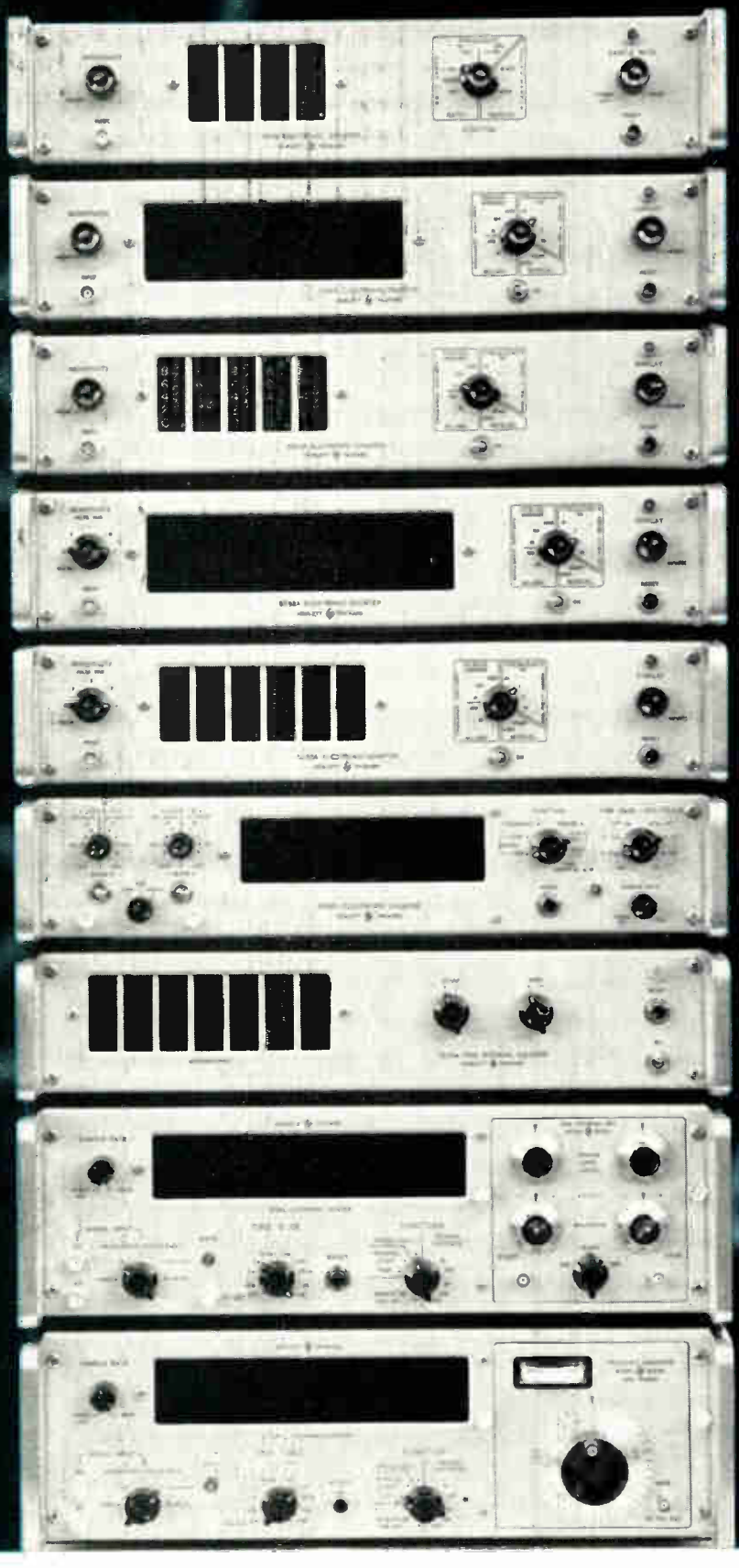
Beam width stayed narrow as the output increased. This contrasts with the glass type laser heads (10° diversion). LHM-4 diversion at 100j out was 0.6°; 200 resulted in a spread of 0.750°; 300j output was 0.9°; and the 350 was 1°.

The company plans to show the LHM-4 in action during the IEEE Show at the Coliseum, March 25 to 28.

The 50-joule moon shot laser used by Raytheon-MIT team last year. The new LHM-4 looks outwardly the same as this LHM-1, which is burning a hole in a strip of steel. The sparks are white-hot molten metal. Liquid-nitrogen cooled ruby is 6⅝ by ⅝ in.



time related measurements with 9



solid state counters!

From precision high speed measurements to economical production testing, one of these counters is right for your job. You can measure frequency, period, multiple period average, ratio, multiple ratio, and time interval.

The advanced line of Hewlett-Packard solid state counters incorporates as standard such features as display storage (continuous display of the most recent measurement until the count actually shifts), higher sampling rates (the time between counts is independent of gate time), —20 to +65° C operating range, and BCD output for recorders, systems.

Hewlett-Packard modular construction introduces counters that are bench and rack mount models in a single instrument, front panels are only 3½″ or 5¼″ high. Operation is simple, straightforward, making every human-engineered instrument in the line easy to use, even by untrained personnel.

Check the brief description of individual models here. Then check your nearest representative or contact Hewlett-Packard direct for full information and demonstration of the instrument designed specifically for your job:

5245L — Makes more measurements with greater accuracy than any other counter available today: Measures frequency, time interval, period, multiple period average, ratio, multiple ratio, scales by decades. Measures to 50 mc directly, 100 mc and 512 mc with plug-in converters. Additional plug-in permits time interval measurements. Time base stability, 3 parts in 10^9/day. 8-digit resolution in rectangular, close-spaced numeric indicator tubes. Remote programmability of time base and function controls. 5245L 50 MC Counter, $3,250.00. 5251A Frequency Converter, to extend counter frequency to 100 mc, $300.00; 5253A Frequency Converter, to extend counter frequency from 100 to 512 mc, $500.00; 5262A Time Interval Unit, 0.1 μsec resolution, $300.00.

5243L — Identical to 5245L, but measures directly to 20 mc, $2,950.00.

5233L — This 2 mc counter measures time interval, frequency, period, multiple period, ratio, and multiples of ratio. Featuring 6-digit resolution in an in-line display of rectangular digital in-line tubes and superior trigger, level controls. Price, $1,850.00.

5232A, 5532A — These 1.2 mc counters measure frequency, period, multiple period average and ratio. Offering 6-digit resolution, they are identical except for readout. The 5232A provides display in improved neon columns, while the 5532A provides display in long-life numeric indicator tubes. Operating temperature range, as with the other solid state counters, is —20 to +65° C. 5232A, $1,300.00; 5532A, $1,550.00.

5212A, 5512A — Five-digit resolution is provided by these counters, which have a maximum counting rate of 300 kc. They measure frequency, period, multiple period average and ratio. The two instruments differ only in display, the 5212A presenting neon columnar readout, and the 5512A offering digital in-line tube readout. 5212A, $975.00; 5512A, $1,175.00.

5211A, B — These counters use line frequency as a time base and measure frequency directly to a maximum counting rate of 300 kc, and they also measure ratio. They furnish 4-digit resolution with neon columnar display. The 5211A offers gate times of 0.1 second, 1 second, and manual. The 5211B offers an additional gate time of 10 seconds. Otherwise, the instruments are identical. 5211A, $750.00; 5211B, $825.00.

5275A — This counter measures time interval 10 nsec to 0.1 sec., with 10 nanosecond resolution. The instrument counts 100 mc by a 100-to-1 multiplying circuit. Seven-digit display is in neon columns. Separate 1 mc time base, such as 101A required. 5275A, $3,250.00; 101A, $500.00.

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

HEWLETT PACKARD COMPANY

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8130

40mm Single Silicon Crystals

A NEW SILICON PRODUCTION PROCESS has resulted in single silicon crystals with 2¼ times the surface area previously available through zone-refining. It is said to be the first combination of large diameter slices (previously possible only with the Czochralski method) with the uniform resistivity and high crystallographic perfection of float-zoned material.

The process, announced by Dow Corning Corp., takes high-purity hydrogen, produced in a completely closed electrolytic cell operating at about 30 atmospheres pressure, and combines it with distilled, high-purity chlorine. The anhydrous hydrogen chloride (hydrochloric acid) is then applied to metallurgical-grade silicon to produce trichlorosilane. The trichlorosilane is then refined and evaluated for purity and high quality characteristics.

High-purity hydrogen is again added for reduction of the trichlorosilane, required for silicon production by the Siemens-Westinghouse process. The polycrystal silicon produced is marketed in 2 forms. (1.) Cut into one piece crucible charge of precise weight for those who "pull" crystals in Czochralski growers. (2.) Supplied in rod form to semiconductor manufacturers for further processing into single crystal by zone refining.

Further zone-refining of the polycrystal silicon, by vacuum zone refining deposited polycrystalline rods, produces single-crystal silicon. The large diameter float-zoned crystals measure 40mm or 1⅝ inches in diameter. Largest previous zone-refined crystals available were only about 1.0 inches or 26mm. The new crystals have properties similar to the previous crystals. Using phosphorous or boron, the crystals are doped to resistivities between 1.0 and 200 ohm-cm. This is uniform in *both* axial and radial directions.

Although previous work with zone-refined crystals indicated decreasing crystal perfection with increasing diameter, the new process produces an entirely different set of crystal characteristics than indicated. The average dislocation density is approximately 30,000/sq. cm—a number typical of the smaller diameter crystals currently in use. No loss of vital semiconducting properties occurs. Lifetime and resistivity were improved.

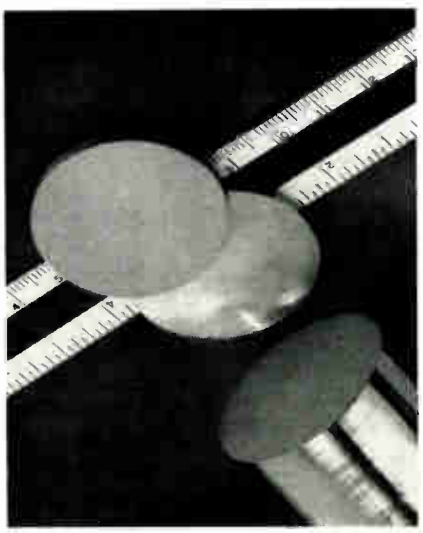
In large area power devices, such as power diodes and silicon controlled rectifiers, the new crystals allow uniform junction and ohmic contact. At present silicon rectifiers for high power use (megawatt range) are usually made up from a group of silicon diodes with 250a ratings. These are made from ⅞ in. dia. material. With the new 1⅝ in. material, power diodes with current ratings up to 1,000a. are possible.

Another major application is in the manufacture of small signal semiconductors (transistors and low power diodes). Competition between manufacturers is so stiff that mass production is essential. Manufacturing costs must be kept low. One of these costs is in the diffusion process. Slice diameter lowers the cost. (It has been said that the savings in cost by using a 1⅜ inch slice from a Czochralski crystal was so great, that ⅞ in. diameter float-zoned crystal supplied free of charge could not be economically justified).

The large diameter, with its uniform characteristics, allows more units per slice. This brings the price of these devices to a competitive level, and includes greater uniformity (where devices must meet narrow specifications).

The 40 mm diameter slice contrasted with a slice of material currently in use for microelectronic devices. More devices per slice with equal specs., make for major cost savings.

This 40 mm diameter single crystal silicon prepared by float-zoning provides about 2¼ times more surface area than previously available slices with equal specs., on the market.



COMPUTER SPEEDS WIRING

PREPARING COMPUTER WIRING lists, printing markers, then marking the wires takes a good deal of time. This method reduces preparation time; simplifies printing and marking. It combines all of these into one smooth operation. Standard data processing equipment is used.

Litton Industries' A. Kimball Co., and the Guidance and Control Systems Div. have proved its efficiency. It is used to prepare wiring lists without going through the schematic and wiring-diagram phases of bringing a complex digital computer from development to production.

The design engineers use standard terms to designate the terminal point for each wire in the system. These points are identified by the signal function.

This information is punched onto tabulating cards. A sorter compiles all cards having a common signal. This "string list" will reveal any errors in circuit construction or computer logic. It can also be used for system checkout and maintenance. By re-arranging the card order, the data processing equipment can also compile lists of signal "from" and "to" data on each terminal. Each item on the wiring list is then printed onto individual Kimball tags with the same data processing equipment. Hand-pressure will fix these tags to each wire.

"Functional Signal Nomenclature," as it is called, is a long name for a shortened process. List compilation and computer manufacturing time are saved.

Wires are labeled by signal function. The labels are attached by hand pressure.

An example is Litton's A2F DLANE airborne central management computer system. The 17,000 tab cards, for the wiring lists, were made up in 2 man-months. Former methods needed an estimated 14 man-months. All low-cost identifying tags, for a typical assembly, can be printed in 15 minutes.

MADE—For Ultra-High Speed Low Level Logic Circuits

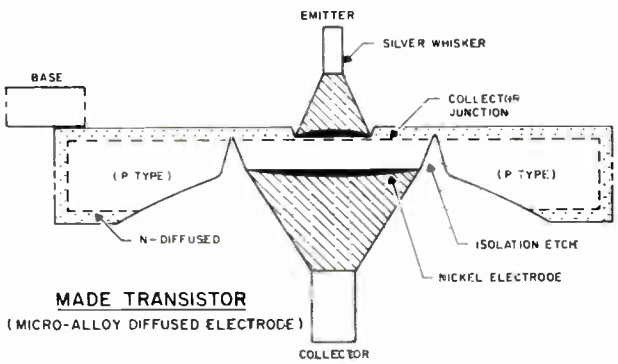
COMBINING MADT AND MESA CHARACTERISTICS—results in MADE. This germanium transistor combines a micro-alloy emitter junction (MADT types) with a diffused collector junction (MESA types). Called MADE (micro-alloy diffused electrode), it offers designers of ultra-high speed low level logic circuits an avalanche resistant 150mw transistor with a BV_{ebo} of 4v, and a guaranteed BV_{ceo} of 8v.

The MADE design uses a diffused collector junction (electrode) formed by diffusing an N-dopant into P-type germanium. This forms a P-N junction within the dice. Junction area is restricted by an isolation etch. This results in an isolating moat around the nickel collector electrode, extending into the N-type base region.

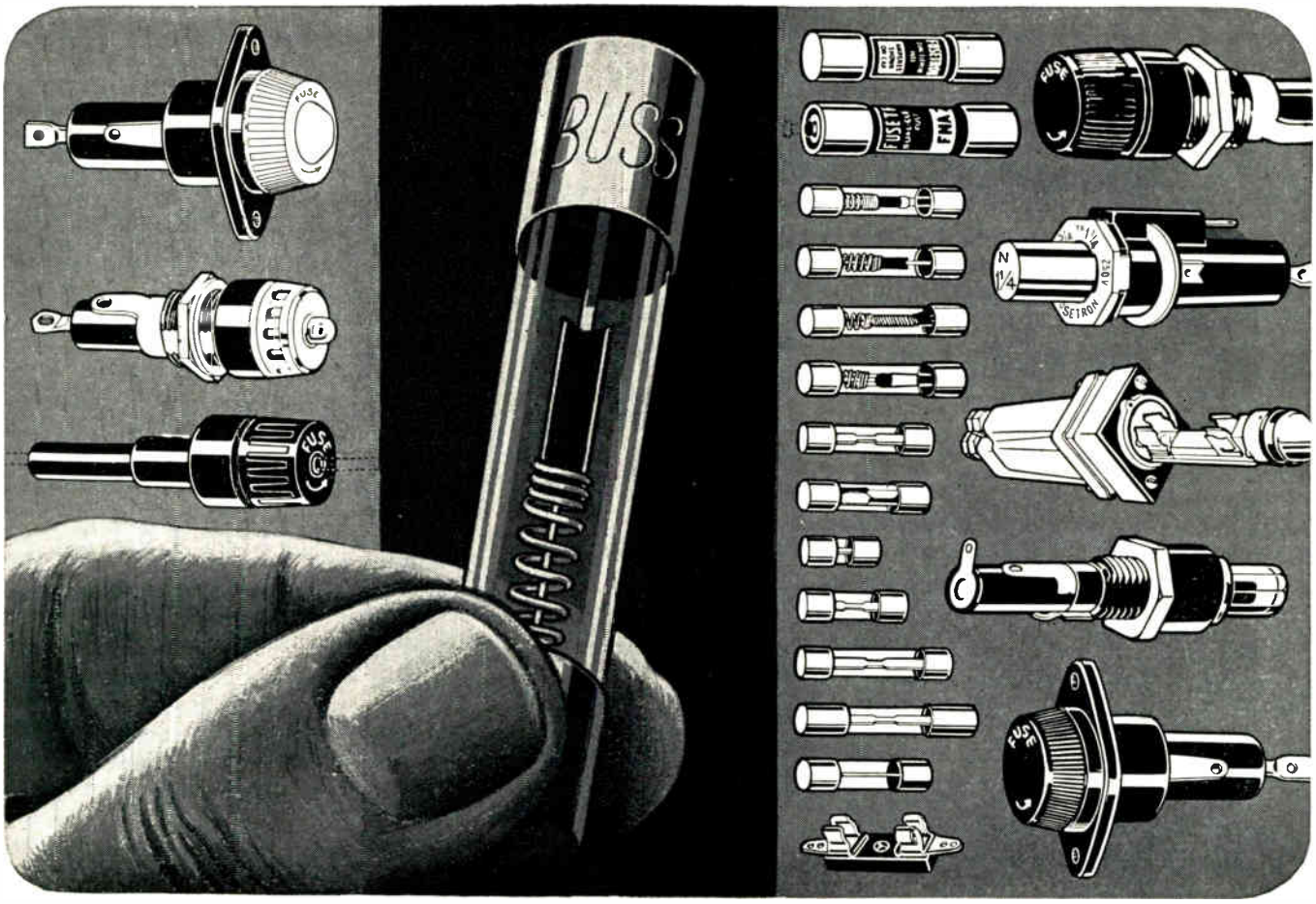
Chief result of the MADE process is a thick mechanical basewidth for high power dissipation capabilities and a narrow electrical basewidth allowing high speed performance.

A product of Philo Corp.'s Lansdale Div., the MADE has a C_{ob} of 3.5pf max., at 10v. Its V_{be} is tightly specified at 150mw at 10ma I_e, 1ma I_b.

Designated the 2N2699, it is ruggedized by use of an organic coating over collector and emitter junctions. It also uses a low thermal-drop potting compound to insure heat dissipation.



More WHAT'S NEW on page 162



For Every Electrical Protection Need

there's a safe and dependable BUSS or FUSETRON Fuse!

BUSS fuse engineers have consistently pioneered the development of new fuses to keep pace with the demands of the Electronic industry. Today, the complete line includes:

Single-element fuses for circuits where quick-blowing is needed;—or single-element fuses for normal circuit protection;—or dual-element, "slow-blowing" fuses for circuits where harmless current surges occur;—or indicating fuses for circuits where signals must be given when fuses open. Fuses range in sizes from 1/500 amperes up—and there's a companion line of fuse clips, blocks and holders.

If you have a special protection problem

The world's largest fuse research laboratory, plus the experience gained by solving many, many electrical protection problems is on call to you at all times. Our engineers work with yours and can help you save engineering time and trouble.

For more information, write for BUSS bulletin SFB.

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

FUSETRON BUSS McGRAW EDISON

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

762

WHAT'S NEW IN MAGNETIC MATERIALS?

SEE THE ARNOLD EXHIBIT AT THE IEEE

YES, IT'S NEW . . . Technical data on an improved grade of Alnico, of special engineering interest for its design potentials in the direction of miniaturization. Data on developments in soft ferrite cores. Marketing developments of importance in the field of nickel-iron and cobalt-iron laminations.

All these items of news interest will be on tap for you at the Arnold exhibit in the IEEE Show, Booths 2315-2319 in the Coliseum. Other Arnold materials exhibited will include Silectron C, E and O cores; tape wound cores of Deltamax, Square Permalloy, Supermendur and other high-permeability alloys; Mo-Permalloy and iron powder cores; transformer cans, magnetic shields and other products from our Pacific Division plant.

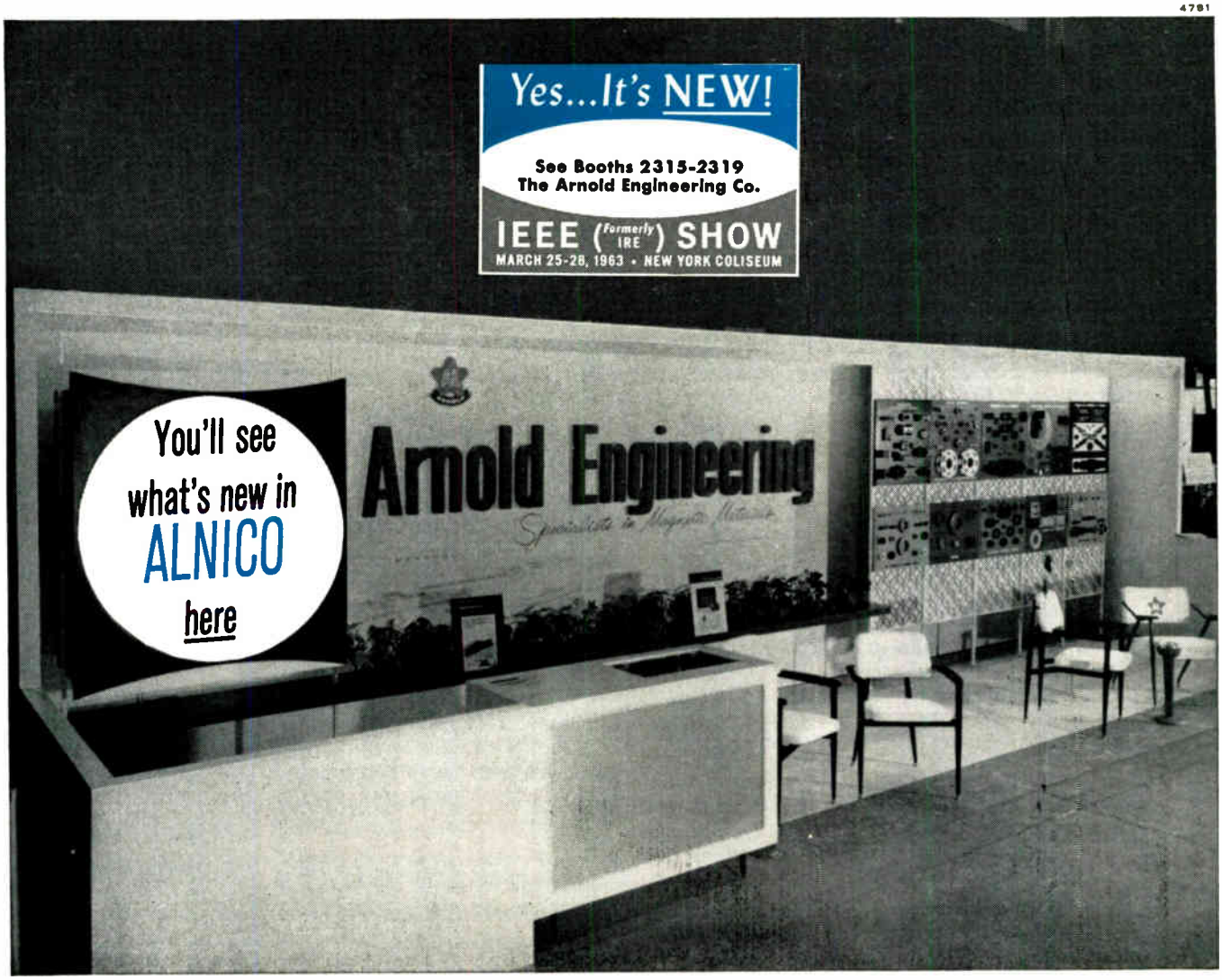
• We'll look forward to your visit. If you're not going to the Show, let us send you bulletins on the products in which you're interested. *The Arnold Engineering Company, Marengo, Illinois.*

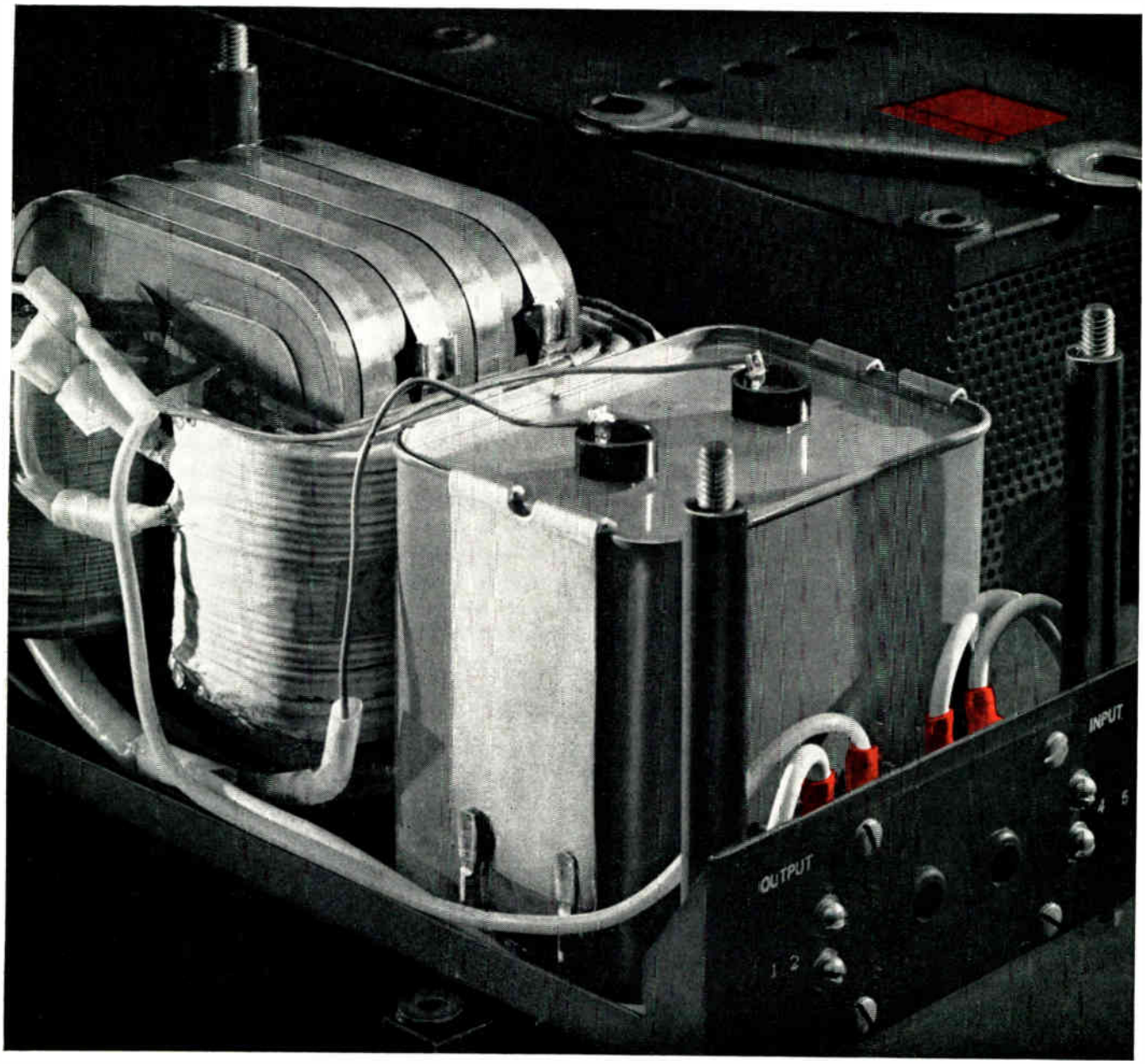
ARNOLD

SPECIALISTS in MAGNETIC MATERIALS

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

4781





See the wrench?

Visit us at the IEEE Show
(formerly IRE)
Booths #2527-31 and #2837
March 25-28, 1963

The wrench is on the black box. It is an ordinary wrench.

The black box is an ordinary box. Commonplace. *Everybody* has one. That's why we used the wrench. We took the black box off.

Now you can see our new constant voltage transformer. See. It is small (13⅛" x 5⅞" x 6"). It is sturdy (Note construction). It is efficient (±1% line regulation). It is reliable (we never put the trademark CAPITRON on anything that isn't).

You can't buy a better constant voltage transformer anywhere. It's so good, you'll probably never have to take it out of the black box. That's why you won't get a wrench when you order but you *will* get:

- all solid state components (no moving parts)
- input voltage—95—135 VAC
- outpower —1450 VA
- Current limiting to 20 amps under short circuit conditions
- output current—12 amps
- line regulation—±1%/load regulation—±2%
- input frequency—60 CPS
- output voltage—120 VAC

We'll take the wraps off additional information, test data and other pertinent facts when you send for full details on the CAPITRON* Constant Voltage Transformer. Send today!

AMP INCORPORATED | *CAPITRON DIVISION*
155 PARK STREET, ELIZABETHTOWN, PA.

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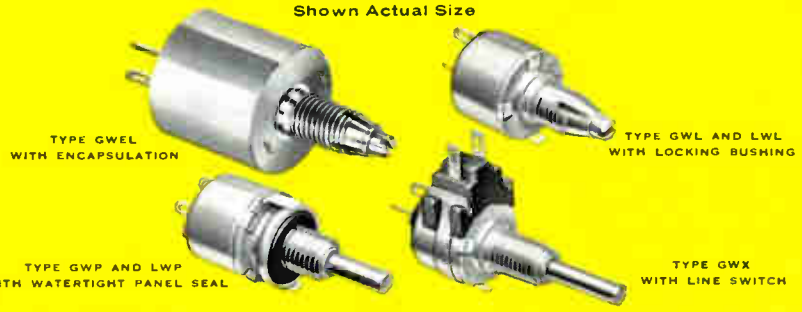
ALLEN-BRADLEY TYPE G HOT MOLDED VARIABLE RESISTORS

Shown Actual Size



in national defense—the words "reliability" and "necessity" are synonymous

■ With the Strategic Air Command at *instant readiness*, any break in communications could seriously impair its total defense capability—and possibly also our national survival. To achieve the unusually high reliability demanded in this critical military application, Electronic Communications, Inc., uses Allen-Bradley Type G controls in the airborne transmitters they build for the SAC.

In the Type G control, the solid resistance element, collector track, terminals, and insulating material are hot molded into a single, solid structure that—for all practical consideration—is indestructible. In addition, molded contact brushes are used—no sliding metal contacts. This design assures a low initial noise factor, which actually improves with use. There's virtually infinite resolution—so control is always smooth and completely devoid of sudden changes in resistance during adjustment.

A-B Type G potentiometers are rated 0.5 watt at 70°C, and will operate reliably in ambient temperatures from −55°C to +120°C. Also, the operational life exceeds 50,000 cycles with less than 10% resistance change. They can be furnished in maximum resistance values from 100 ohms to 5 megohms. For full details on these quality controls, please write for Technical Bulletin B5201. Allen-Bradley Co., 222 West Greenfield Avenue, Milwaukee 4, Wisconsin. In Canada: Allen-Bradley Canada Ltd., Galt, Ontario.

Electronic Communications' AN/ART-42 UHF 1 KW AM/FM Transmitter in service with the SAC, and internal view showing use of A-B's Type G controls.

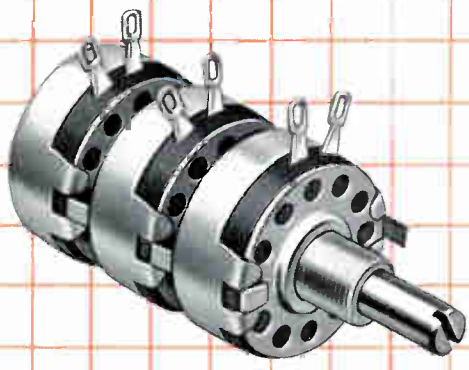
37-63-E

ALLEN-BRADLEY

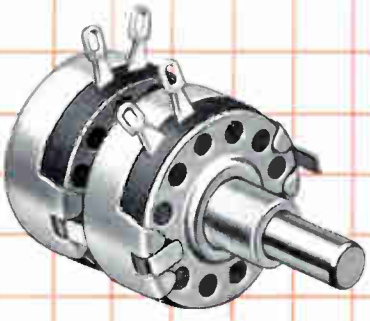
QUALITY ELECTRONIC COMPONENTS

Visit us at the INTERNATIONAL RADIO ENGINEERING SHOW
Booth 2134-2138, March 25-28, New York Coliseum

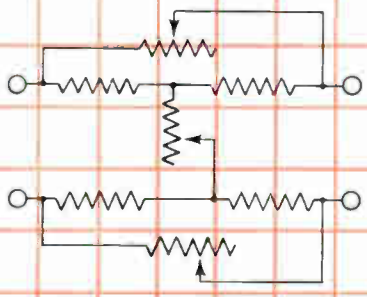
Allen-Bradley Type J Variable Resistors used in constant impedance attenuators provide quiet, smooth control...at low cost!



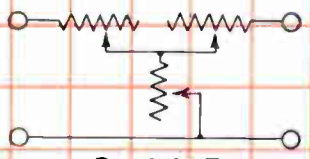
Type JJJ
Actual Size



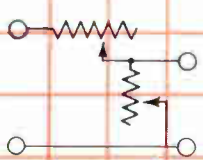
Type JJ
Actual Size



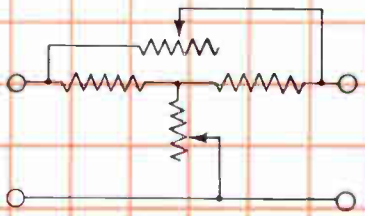
Bridged H



Straight T

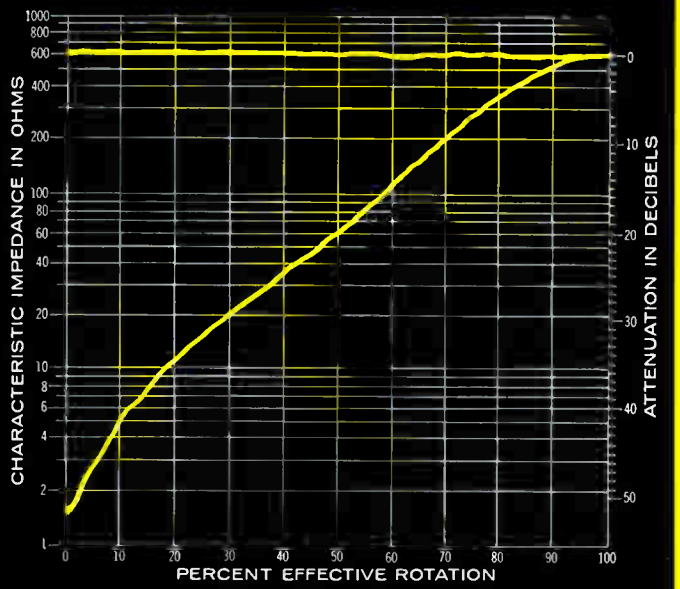


Standard L



Bridged T

Reproduction of actual machine plot of Allen-Bradley 600 ohm Bridged T attenuator, showing the uniform attenuation and constant characteristic impedance obtainable with such Type J variable resistors.



■ In attenuators, which of these characteristics is most important to you—stability, or smooth control, or constant impedance? Not only will Allen-Bradley Type J variable resistors give you all of these . . . but also long life and a high wattage rating in a remarkably compact structure.

The famous Type J solid resistance element—made by A-B's exclusive hot molding process—provides smooth control at all times—you'll never experience an abrupt change in impedance or attenuation during adjustment.

Allen-Bradley's control of the resistance-rotation characteristics during production assures the desired attenuation—approaching calibration accuracy. And, the characteristic impedance can be held to 10% *throughout* rotation—end to end! The discrete steps inherent in all wire-wound units are eliminated. Don't forget—freedom from inductance insures excellent high-frequency response.

The Allen-Bradley Type J variable resistors are available in dual or triple units for use in attenuators rated up to 5 watts. For more complete information on these Type J controls, please send for Technical Bulletin B5200B. Write: Allen-Bradley Co., 222 W. Greenfield Ave., Milwaukee 4, Wis. In Canada: Allen-Bradley Canada Ltd., Galt, Ontario.

QUALITY ELECTRONIC COMPONENTS

ALLEN-BRADLEY

ELECTRONIC INDUSTRIES

Coming Next Month

FUNCTION GENERATION THROUGH ACTIVE NONLINEAR ELEMENTS

Describing a non-linear circuit that was built to make possible the addition of the two time-varying orthogonal components of a vector which requires the squaring of the magnitudes of the components and extraction of the square root of the sum of the squares.

CIRCUIT REALIZABILITY CRITERIA

This article will approach circuit design through "modern network synthesis" or "exact network design." This approach replaces earlier design techniques based on image-parameter theory. Two fundamental questions are posed: Is the network specification given as a physically realizable rational function? If the answer is "no," is an approximation available which will permit development of a usable physical network?

THERMISTORS FOR TEMPERATURE STABILIZATION OF TRANSISTOR CIRCUITS

Often it is possible to compensate for the temperature effect of a transistor circuit with a single thermistor; sometimes it is necessary to shape the thermistor characteristic with a fixed shunt and/or series resistor. Depending on the transistor and other circuit components used, temperature range involved and variation in output level, a greater or lesser degree of temperature stabilization may be achieved.

CONNECTORS—AND TERMINATIONS

The fast-moving technology has been responsible for many improvements in the connector art. This article will present a state-of-the-art in connector design and production. Included will be a summary of the newest types of connectors, finishes, and applicable MIL specifications. The different types of connections—soldering, wrapping, welding, etc.—will be discussed. Finally, predictions of the future trends in connectors will be analyzed.

WHAT ENGINEERS THINK OF CONVENTIONS—

Following up on ELECTRONIC INDUSTRIES' two comprehensive studies on the personal characteristics of electronic engineers ("Today's Electronic Engineer," in March, 1959 and March, 1962) this survey investigates the influence of technical societies. Four specific questions were asked of 210 engineers: 1. Whether they belonged to technical societies or associations. 2. Whether they attended any national or major regional conferences. 3. Their reasons for attending national or major regional conferences. 4. Their opinions on conferences.

PLUS ALL OTHER REGULAR DEPARTMENTS

Our regular editorial departments are designed to provide readers with an up-to-the-minute summary of world wide important electronic events. Don't miss Radarscope, As We Go To Press, Electronic Shorts, Coming Events, late Marketing Statistics, Snapshots of the Electronic Industries, El International, News Briefs, Tele-Tips, Books, Representatives News, New Products, Industry News, Personals, Systems and Circuits, etc.

WATCH FOR THESE COMING ISSUES:

***JUNE**
Annual All-Reference Issue

***AUGUST**
WESCON Show Issue

***NOVEMBER**
Annual MICROWAVE Issue

An extended application of All-Magnetic Logic is found in the design of this Content Address Memory. It has a retrieval time of ten microseconds using commercially available ferrites. The functional possibilities of CAM's and their closely related kin, Associative Memories, are discussed.

ALL-MAGNETIC CONTENT ADDRESSED MEMORY

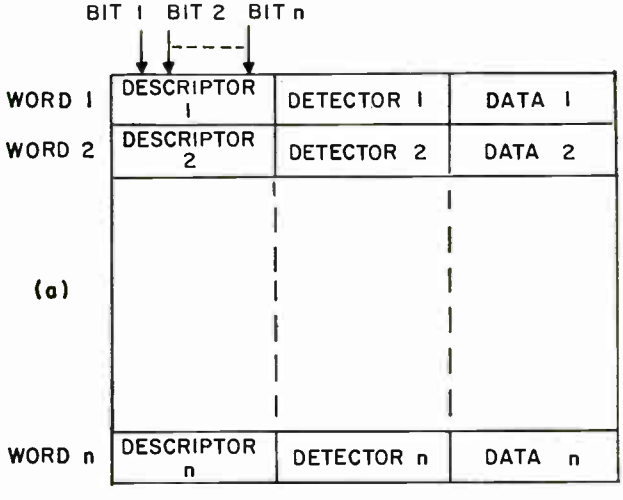
INDUSTRY HAS BEEN ACQUAINTED with the concepts of Content Addressed Memories (CAM) for a number of years. The endeavors of Newell[1], Gray[2], and their associates, to organize conventional memories, and the work of Slade and McMahon[3] to develop novel CAM hardware, are a few examples of efforts in this field. Hardware implementation of CAM, however, is far from full system use.

CAM locates and retrieves items as a function of their content and independent of address location. The entire memory can be queries, in *one* access time. As such, these memories find ready use in sorting and information retrieval. The military will find them adept for command and control, real time applications, armament deployment, tactical battle conditions, symptom-cure checkout of orbital systems, and weather, where up-to-date knowledge of specific local conditions are needed by the decision maker. Possibilities exist for CAM in commercial and government information processing such as personnel files and inventory statistics. Rapid access content query, ease of information up-dating and deletion, and freedom from planning specific memory locations should find use of certain programming and instruction methods[4]. For example, a small CAM could efficiently compile and perform table look-up functions[5].

Until now, the memory hardware approaches have primarily centered around magnetic and cryogenic systems. This article deals with a magnetic logic approach. The system needs are such that the entire search function, both storage and detection, are comprised solely of commercially available magnetic devices. With this need, the resultant high ratio of magnetic components to semiconductors fully exploits the proven high reliability of magnetic ferrite, particularly in adverse environments. The total retrieval time of the system as shown by an operational model can be less than 10 μsec.

Fig. 1: (a) Memory arrangement—each column is an item (word) section. (b) Truth table—search, storage and detector output.

(a)



(b)

SEARCH	STORAGE	DETECTOR
0	0	1
1	0	0
0	1	0
1	1	1

Content Addressability

The performance of a Content Addressed Memory differs from the normal direct addressed memory in that a stored word (item) may be located and re-

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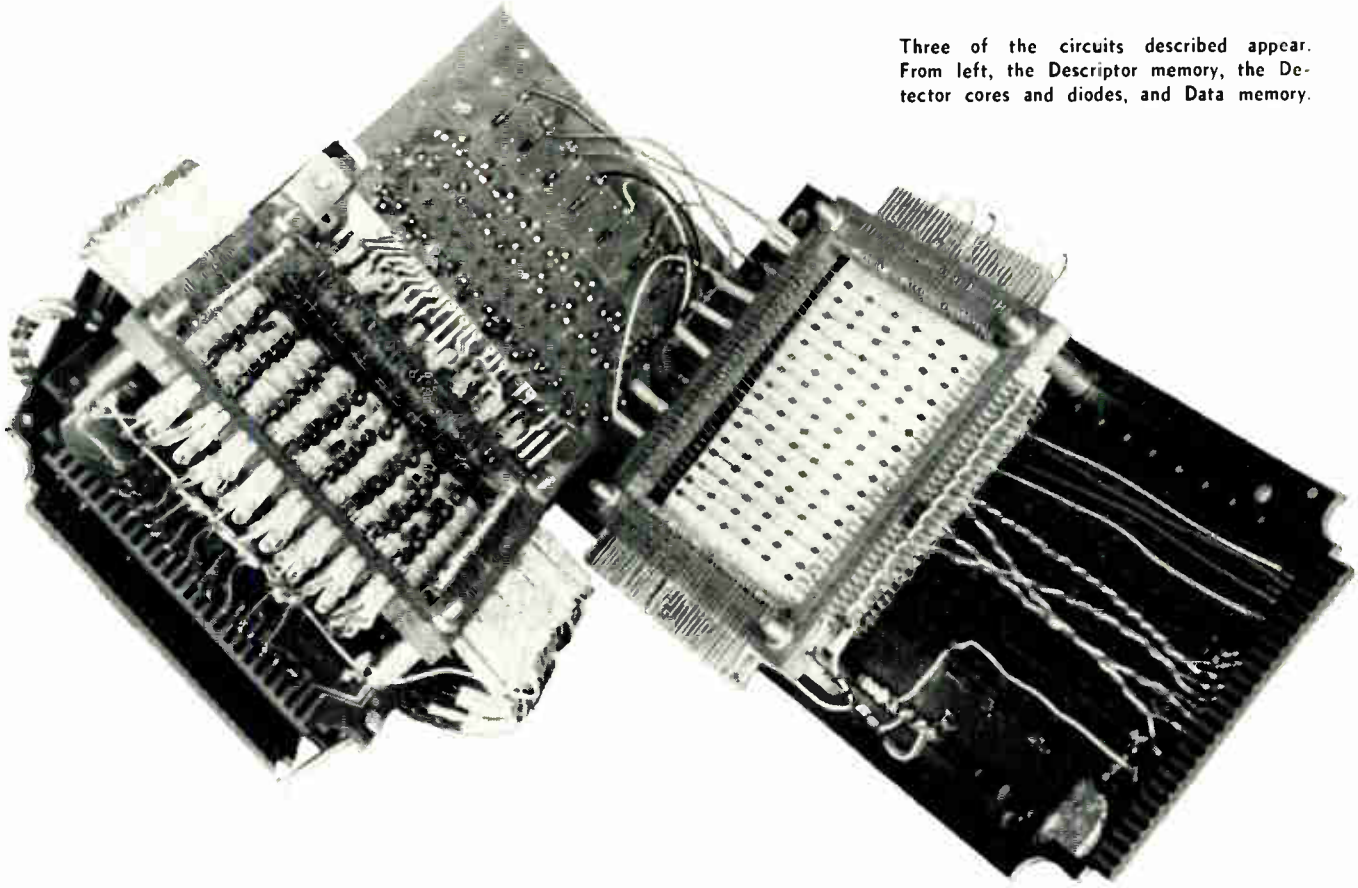

Three of the circuits described appear. From left, the Descriptor memory, the Detector cores and diodes, and Data memory.

trieved from some predetermined function of its content. The word address location is an addenda to the retrieved information rather than the search criteria itself. For example, given a portion of an item (we refer to this portion as the descriptor) the memory is interrogated to find if similar descriptors exist and, if so, where they are located. Thus descriptor matching provides yes-no responses to item associations of a list together with possible addended information.

CAM necessitates an interrogation by bit rather than by word. All words are interrogated in parallel. Bits may be interrogated serially or in parallel. Therefore, a completely parallel CAM interrogates the entire memory at one time. The need for nondestructive storage elements in CAM is obvious.

There is some conflict in the nomenclature of such systems. Some refer to the above description as an Associative Memory. We shall define content addressability as the locating of a *single* item via its descriptor, so that a unique solution results in the address location of the match. This is analogous to the retrieval of a single item via its address in conventional memories. Associativity shall imply the location of *all* items related to the descriptor in some prescribed fashion.

We shall now consider the logic of the CAM. The memory is composed of items, each item consisting of three sections (Fig. 1a). The first section is the descriptor. Interrogation is made of the bits in this section. The second section is the detector, which accumulates the results of the interrogation. The third section is data addended to the descriptor. A successful search will locate the item address so that the associated data content may be retrieved.

Our system can provide masking (non-interrogation) of certain bits in the Descriptor section. Another stipulation insists on the presence (Ones) of certain bits and the absence (Zeros) of other bits. Interrogation of both Ones and Zeros, therefore, is essential. Fig. 1b shows a truth table for storage and search. A true output or match condition requires the matching of all bits searched. One or more mismatches represents a false search.

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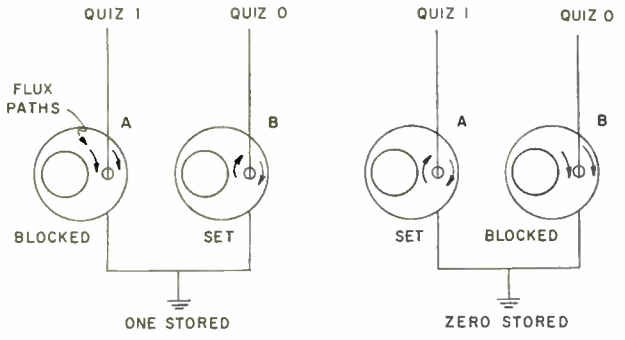


Fig. 2: Basic memory storage device for the non-destructive interrogation of a stored One or Zero. The transfluxor can be interrogated in one of two stable states, blocked or set.

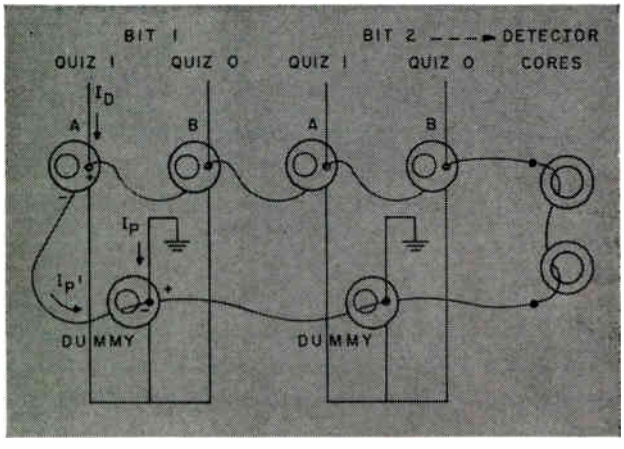
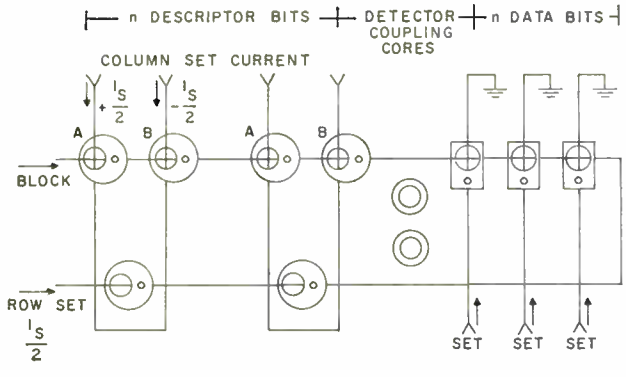


Fig. 3: Descriptor memory has separate drive windings for the transfluxors, but a single output winding in the word direction.

Fig. 4: Descriptor-Data memory with Write-In currents. First, transfluxors are blocked with current to all bits in an item.



The system contains two separate memory units; one stores the descriptor bits, the other the data. The Descriptor memory consists of nondestructive readout elements; is electrically alterable; and is capable of parallel bit interrogation. The Data memory works in a normal direct addressed manner, but is also electrically alterable, and has nondestructive readout. Detector coupling exists between the two memories to provide retrieval of data addended to the descriptor in one access time.

A choice lies in the form of this detector coupling. Voltage detection with a transistor blocking oscillator has been described in the literature[6]. However, increased circuit economy and reliability are possible with magnetic detection and current steering. It is this choice which accommodates our system as being all magnetic. This system uses one detector per item. Matrixed detectors (X plus Y detectors for XY items) are also possible.

Memory Operation and Design

The storage device used in this Content Addressed Memory is a multi-apertured ferrite capable of nondestructive interrogation, a transfluxor. The transfluxor can be interrogated in one of two stable states (Fig. 2). In the blocked state, the flux around the small aperture is saturated in the downward direction. Current pulses of either polarity through the small aperture now can cause no flux reversal with no resultant output signal. In the set state, the flux around the large aperture is in a clock wise direction at radial distances beyond the small aperture and counter-clockwise in the area between the two apertures. The flux, with reference to the small aperture now is in one direction—clockwise. A prime current pulse, I_p, resets the flux around the small aperture to the counter clockwise direction. See Fig. 3. A drive current pulse, I_d, then returns the flux to the clockwise direction.

Both signal outputs derived by I_p and I_d are used to alter the state of the detector cores. For a thorough treatise on transfluxor operation, see Rajchman and Lo[7].

We shall define a match or true condition to exist if the input interrogate information is in agreement with the stored information. A mismatch or false search results if the interrogate information does not agree with the stored information. Further, a match condition shall be represented by no output (interrogation of a blocked transfluxor). A mismatch will produce an output (reject) signal since a set transfluxor was interrogated.

To provide solution when interrogating both Ones and Zeros each bit is composed of two storage de-

vices. Transfluxor A blocked and B set is defined as a One; the inverse is a Zero (Fig. 2). Separate drive windings are provided for the two transfluxors but they have a single output winding oriented in the item (word) direction (Fig. 3). A matching Zero condition will result when interrogating a B blocked transfluxor; a matching One will occur when interrogating a blocked A transfluxor. In either case, no outputs will result on the output winding. When interrogating the two mismatch conditions, outputs will be induced on the output winding.

Write-In

Writing into the Descriptor memory is done with row and column currents (Fig. 4). Row Block current I_b is applied to all bits in an item, blocking all transfluxors. Row half-set current $I_s/2$, opposite in polarity to the block current, is then applied to the item. Coincident with the row half-set current is the column half-set current. To write a One, a positive column half-set current adds to the row set current in the B transfluxor and subtracts from it in the A transfluxor, thereby leaving A blocked and setting B. To write a Zero, negative column half-set current is applied.

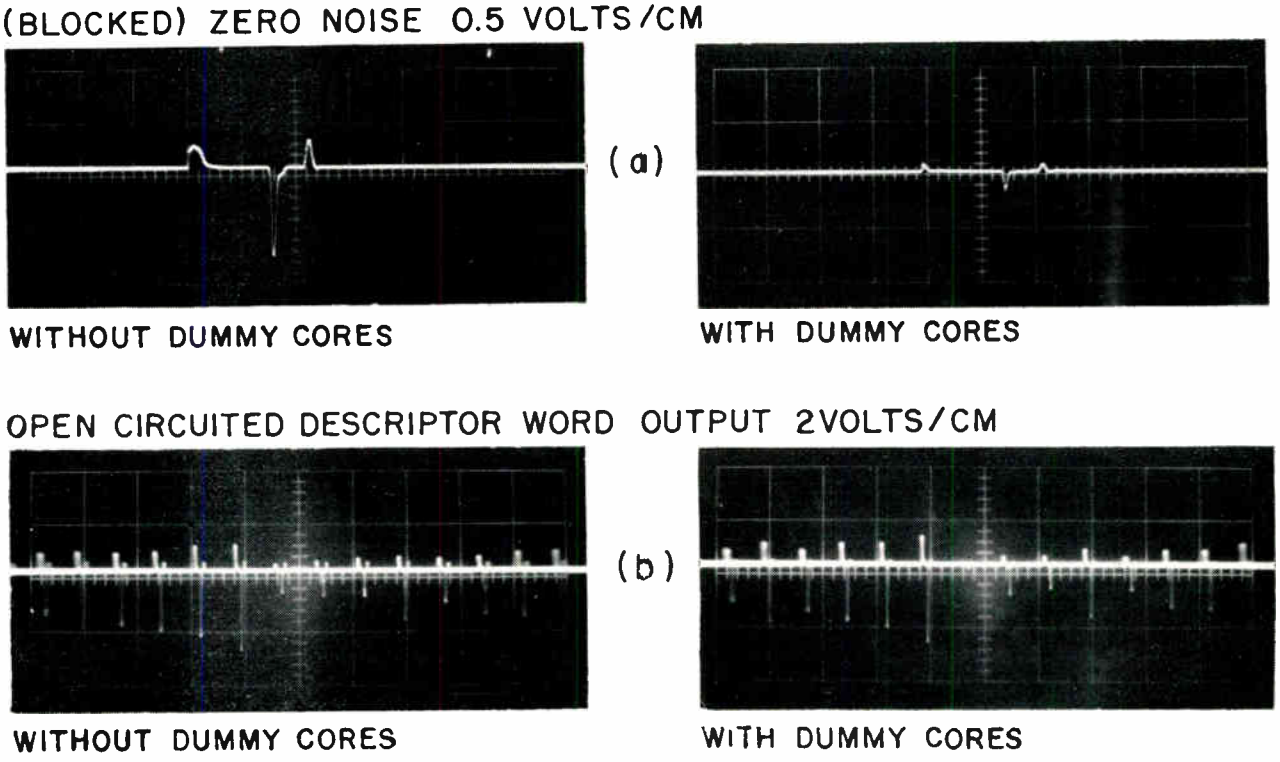
Blocked Noise

Toroidal transfluxors, lacking perfect flux path geometry, have some elastic flux when in the blocked state[8]. This coupled with material non-squareness amounts to a finite (blocked) noise output for long item lengths. When n such noises occur for a true search, the signal to noise ratio reduces. To avoid this difficulty, a blocked dummy transfluxor per bit (Fig. 3) is added with the sense of its output winding oppositely wound so as to oppose and cancel the matched blocked noise (Fig. 5a). Fig. 5b depicts the signal to noise ratio on an open-loop output winding for a true or matching condition for both cases—with and without dummies. Here the only true or matched pulse is the one located nearest and to the left of the crossing of the grid lines with subdivision marks.

The Detector Coupling Circuit

The Detector Coupling Circuit (Fig. 6) consists of two ferrite square loop cores per item. All output cores are initially cleared to the Zero state by I_c current into a non-dot winding. A threshold current pulse, I_T, provides biasing current in the One direction and occurs in coincidence with prime and drive currents applied to the transfluxors in the Descriptor memory. The induced prime loop current, I'_p, switches core A from the Zero to the One state while canceling currents leave the B core in the Zero state. Induced drive loop current, I'_d, together with I_T switches the B core while the canceling currents leave

Fig. 5: Using a blocked dummy transfluxor to cancel matched blocked noise output. In (a), effective canceling of noise from a blocked Zero. Similarly, for a descriptor word output, in (b), having only one true pulse, as explained in the text.



the A core in the One state. Design is such that interrogation of only one set transfluxor in the Descriptor is enough to change the state of the A and B cores. Thus, a false search in the Descriptor memory causes the two detector output cores to switch from the cleared Zero state. The interrogation of the Detector Circuits, I_i, then switches the true detector core pair to the One state and the induced emf steers read current to the corresponding Data memory word. The opposing wiring sense of the closed-loop output winding in the detector cores is advantageous since it isolates the Descriptor memory storage from Detector Circuit interrogation. Current steering with a square loop ferrite core has been discussed in the literature[9]. The pulse sequence for memory operation is shown in Fig. 8.

Loop Loading

The Detector Circuit places a ferrite core load on the Descriptor word output winding. In any closed loop magnetic circuit, flux gain must exist from the transmitting core to the receiving core to overcome the resistive loop losses.

The loop current, I_L, needed to switch the output core must be less than the threshold current of the transfluxors. Otherwise, the non-interrogated set transfluxors would switch, produce a back emf, and attenuate the loop current. A worst case exists where only one interrogated set transfluxor must provide the gain to fully switch the output core. In this case,

$$N_T \frac{d\phi}{dt}\,(\text{transfluxor}) = N_C \frac{d\phi}{dt}\,(\text{core}) + I_L R\,(\text{loop})$$

$$N_C I_L = F_s\,(\text{core}) - N_C I_T$$

For a constant primary drive current, I_D, into a transfluxor, the current available to switch the transfluxor is I_D-I_L. As the number of interrogated set transfluxors in a given word are increased, the loop current increases slightly. The flux switched by each transfluxor decreases slightly (I_D-I_L decreases). Also, the total flux switched is slightly greater than that for a single transfluxor (the additional flux being absorbed by the product of the increased loop current and the loop resistance).

The maximum loop current increase occurs in going from the interrogation of one to two set transfluxors. The absolute limit to this loop current increase (infinite set transfluxors interrogated) is governed by an I_D-I_L which is slightly greater than the threshold of the transfluxor's small aperture. This loop current increase, though noticeable, does not limit the word length. It does, however, specify a minimum loop resistance so that non-interrogated blocked transfluxors are not disturbed.

Data Memory

The Data memory is a word organized array of smaller transfluxors (Fig. 7). An interrogating current pulse steered through the data transfluxors will cause outputs for those written in the One state and no outputs in the Zero state. This steered current pulse will be in the drive direction and must overcome dc (prime bias) current applied to all the Data memory transfluxors.

The steered current needed to switch the data transfluxors within a known switching time of the output detector core is (refer to Fig. 6),

$$N_i I_i = N_b I_b + \frac{S_{wt}}{T_s} + N_t I_t$$

where

$N_b I_b$ is the applied prime bias mmf in the data transfluxors

$N_t I_t$ is threshold mmf for data transfluxors

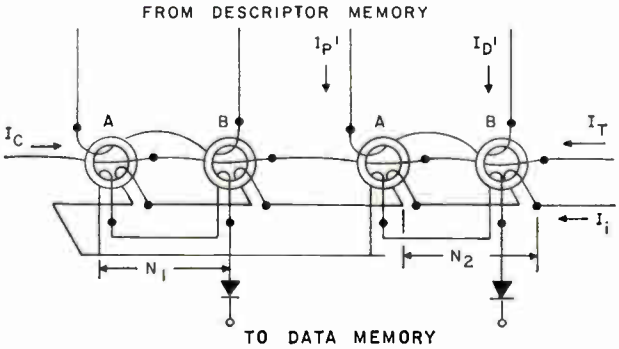
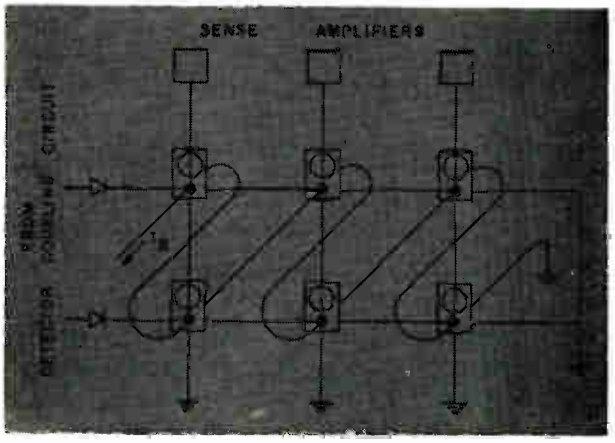


Fig. 6: Detector Coupling Circuit further provides isolation of Descriptor memory storage from Detector circuit interrogation.

Fig. 7: The Data memory is a word organized array of transfluxors. Interrogating steered current pulse overcomes dc prime bias.



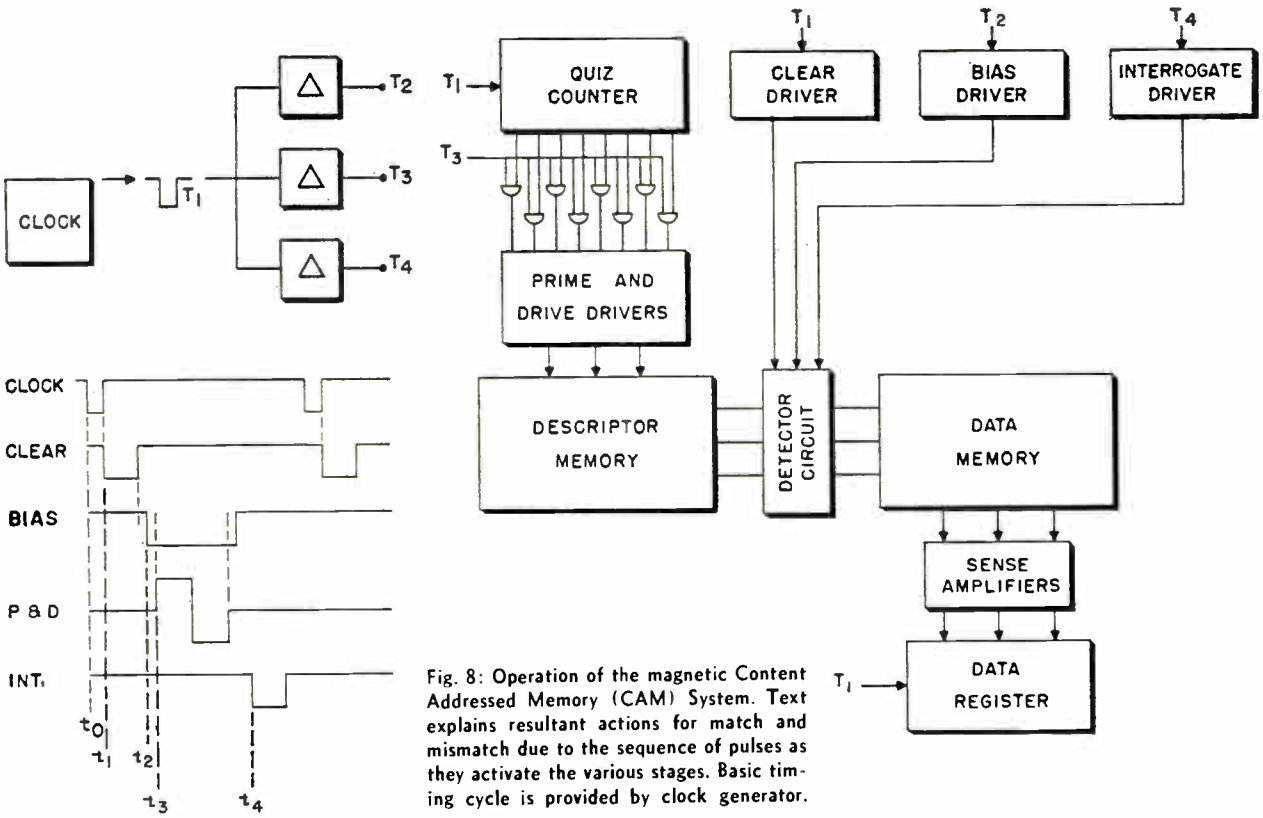


Fig. 8: Operation of the magnetic Content Addressed Memory (CAM) System. Text explains resultant actions for match and mismatch due to the sequence of pulses as they activate the various stages. Basic timing cycle is provided by clock generator.

S_{wt} is the switching time constant of the data transfluxors (ampere-turn-sec.)

T_s is switching time

The current applied to the output cores so that these cores switch in equal or greater time than the data transfluxors is:

$$N_2 I_i - N_1 I_i = \frac{S_{wc}}{T_s}, \text{ where } S_{wc}$$

is the switching time constant of the output detector cores. Additionally, the detector core flux-turns must be greater than the load placed across it, the load being the appropriate Data memory word.

$$N_1 \Phi_{core} = V_{Load}\, T_s$$
$$= \left(V_{Diode} + n \frac{N_t \Phi_t}{t_s} + I_i R_{Data\ wire} \right) T_s$$

where n is the total number of data bits. All requisite terms may then be calculated.

CAM System

The working model of the Content Addressed Memory described above consists of eight words of four bits each in the Descriptor memory and an equal number of words and bits in the Data memory. Since the most salient feature of the CAM system is the search operation, a description of only this portion of the system, will be given (Fig. 8).

The clock generator provides the basic timing cycle for the system. These clock pulses have a period variable from 5 to 15 μsec. At time T_1 the output Data Register and the Detector Circuits are cleared and the Quiz Counter is set to the first of 16 possible positions. Eight of these positions match a unique stored item in the Descriptor memory; the other 8 positions have no corresponding Descriptor storage counterpart. At T_2 the Bias Driver is activated to place all Detector cores near their switching threshold. The prime and drive drivers, activated as a function of the One and Zero outputs of the Quiz Counter, are turned on at T_3, and are bracketed by the T_2 Bias drive pulse. Only one of two Prime and Drive Drivers per bit are activated as a function of the Quiz Counter.

At T_4, the interrogation drive pulse is applied to the detectors. This current switches the true detector core pair, if present, and steers read current into the corresponding Data memory word. If no match exists, the interrogation current is divided among all the Data memory words. This division of current, for a minimum of four words, is well below the Data transfluxor threshold.

The outputs of the Data memory are applied, via sense amplifiers, to the output Data Register.

Since the Data memory storage is identical to the Descriptor storage, the Data Register and the Quiz Counter will be in agreement for 8 settings of the

ALL-MAGNETIC MEMORY (Concluded)

counter, and in disagreement for the other 8. The Data Register indicates all Zeros for the no match condition.

The next output of the Clock generator steps the Quiz Counter to its next position and the search operation is repeated.

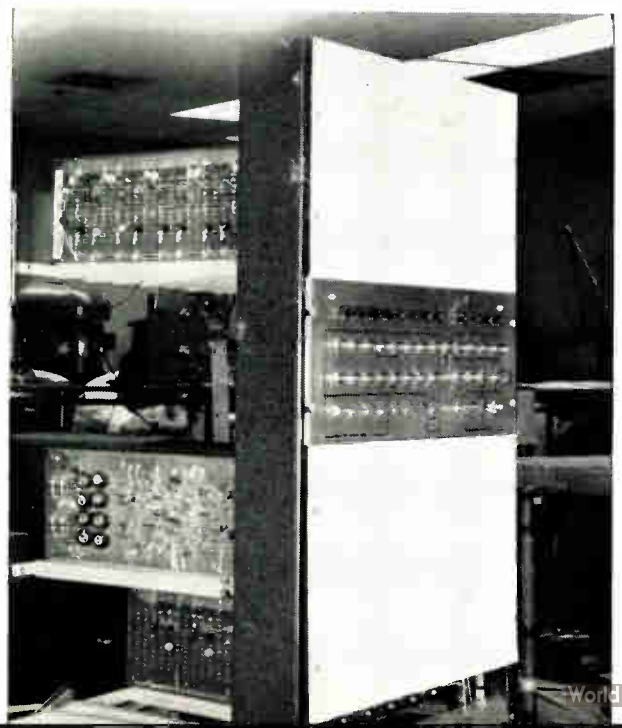
Results

The eight-item magnetic CAM is presently operating as a demonstration unit. Transfluxors with 0.2 in. OD are used for the Descriptor memory while smaller rectangular ones are in the Data memory. The detector cores are standard ferrites with 50-80 mil OD. A prime current of 470 ma and a one amp drive current are used to search the memory. The detector bias current is 300ma and an interrogate current of 500ma is steered into the Data memory. Signal to noise ratios of 2 to 1 or greater at the output detector cores are observed. This is enough to allow current steering to the Data memory. Increasing the Descriptor storage element size (flux switched upon interrogation) or reducing the Detector and Data element sizes would result in greater signal to noise ratios.

Logical Extensions

The restriction placed on CAM, that it provide for a unique solution to search, simplifies the Detector Circuit. To handle multiple solutions, the detector interrogate current must be able to retrieve solutions serially and bypass all mismatch solutions. Also, once a solution has been interrogated, it must then be removed from participating in succeeding interrogation pulses. This requires the addition of at least one more core per detector—an isolation core. If the detector represents a true solution, the isolation core is not set and the interrogation pulse is not transmitted beyond that detector. For a false solution, the isolation core is set and the interrogation pulse passes on the next true solution. Upon interrogating a true solution, the isolation core must then be set so that succeeding pulses are not inhibited at this detector location.

Operating demonstration model of Content Addressed Memory System. Peripheral circuitry includes Quiz Counter, sense amplifiers, Data Register and write-in and Detector drivers.



One method, which might provide for solutions to searches of "greater than or equal to X." and "less than or equal to X." requires that all bits in an item be connected to form a pseudo adder. The item, when interrogated, must not change or shift its bit information but must be able to propagate the carry signal. A carry signal propagated to the end of an item will set the Detector Circuit. To illustrate, in searching for all items "greater than or equal to X." the search is made with the 2's complement of X, for binary storage. All items equal to or greater than X will provide a carry signal from the most significant bit. If X is a power of two, the simple masking of insignificant bits will provide the desired result. Mechanization of the above logical extensions is a definite step toward associativity in CAM.

Removal of the magnetic constraint at the Detector Circuit has an advantage of increased speed. Retrieval time in the order of 5 μsec or less, for the above-mentioned associative logic functions, is not too unreasonable. However, the above move is not taken without an increase in cost, as several flip flops and logical gates are needed per word-item. Design, component, and fabrication costs increase with each additional logical requirement. However, Content Addressed and Associative Memories do give the systems engineer a powerful tool in the solution of certain problems. For a particular application, increased costs versus rapid problem solution must be given due thought.

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For design engineers, answers to these questions: What are the significant dc and ac parameters? How are channel dimensions related to electrical characteristics? The UNIFET is considered as a 3-terminal network, characterized by four small-signal ac parameters.

CHARACTERISTICS OF UNIPOLAR FIELD-EFFECT TRANSISTORS

UNIPOLAR FIELD-EFFECT TRANSISTORS (UNIFETs) are available in production quantities, but there is little information on their electrical characteristics.

Here we will discuss a diffused-channel, diffused-gate UNIFET structure and its dc, and small signal ac characteristics.

The UNIFET may have either an N-type channel or a P-type channel. From a circuit point of view the structures are the same except that the terminal voltages and currents are of opposite polarities. This discussion will be limited to the P-channel structure.

In Fig. 1, the P-channel device is comprised of a P-type region diffused into an N-type substrate. Subsequently an N-type gate is diffused into the P-type region leaving a relatively thin channel. The important channel dimensions are its effective thickness T, length L and width W. These dimensions have a direct bearing upon the electrical characteristics of the UNIFET. Under conditions of zero applied voltages the conductance of the channel is given by:

$$G_0 = \sigma_a \frac{WT}{L} \qquad (1)$$

where σ_a = average conductivity of channel.

As shown in Fig. 1, the thickness T is the distance between two "transition regions" which exist at the P-N junctions. At the transition regions there is a "depletion layer" void of free, mobile carriers. The depletion layer width can be increased by using a reverse bias across the P-N junction (i.e. positive gate voltage). This decreases the effective channel thickness T as shown in Fig. 2 and results in a reduction in channel conductance G. Fig. 3 shows channel conductance as a function of gate-to-source voltage V_{GS}. If the initial channel thickness T is small enough, the depletion layer will extend deep enough to "pinch-off" the channel as shown in Fig. 2c, and reduce G to almost zero. The gate-to-source voltage needed to do this is called the "pinch off voltage" shown in Fig. 3 by the symbol V_P.

If the gate-to-source voltage is kept at zero and the drain-to-source voltage is made negative, the channel will assume a wedge shape as shown in Fig. 4a. This is merely the result of a wider depletion layer at the drain end of the channel. Fig. 4b shows the result of an increase in drain-to-source voltage V_{DS} to a value about equal in magnitude to V_P, hence the two depletion layers just meet.

At this point, the incremental impedance of the channel becomes quite high. At higher voltages, as shown in Fig. 4c, there is little change in the channel shape but the depletion layers extend further into the drain region. In Fig. 4d the gate-to-source voltage V_{GS} equals $\frac{1}{2} V_P$ and the drain-to-source voltage equals $\frac{1}{2} V_P$. Since V_{GS} is positive and V_{DS} is negative, the gate-to-drain voltage equals V_P, hence the drain end of the channel is just pinched off as in Fig 4c. Fig. 5 shows the I_D -vs. V_D characteristic curve.

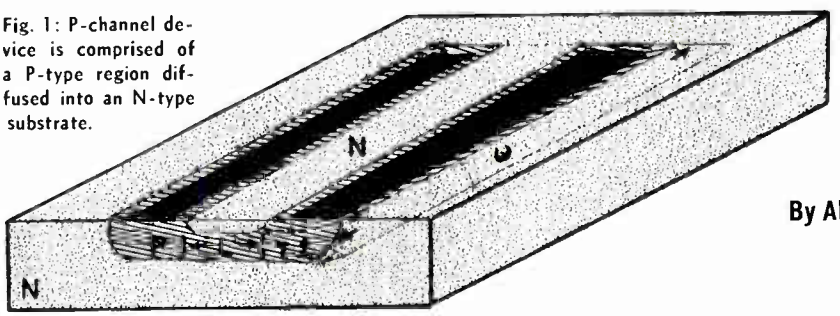

Fig. 1: P-channel device is comprised of a P-type region diffused into an N-type substrate.

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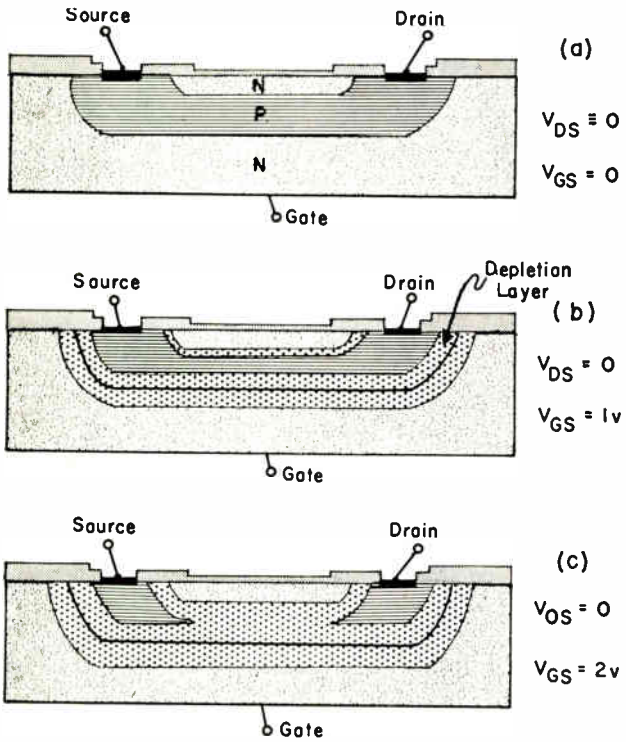


Fig. 2: Increasing the depletion layer width decreases the effective channel thickness T, and reduces channel conductance G.

Notice that at a drain voltage about equal to the magnitude of V_P, the drain current becomes nearly saturated. This is called the drain-saturation current and is shown in Fig. 5 by the symbol I_{DSS}.

Avalanche Breakdown

As the drain voltage increases, the electric field in the depletion layer increases until "avalanche breakdown" occurs. Beyond this voltage, the drain-to-gate current increases very rapidly. Note that this is a drain-to-*gate* breakdown, not a drain-to-*source* breakdown.

In the most common mode of operation, the gate is kept in the zero or reverse-bias condition. That is, for the P-channel device the gate-to-source bias V_{GD} will be zero or positive, and the drain-to-source bias V_{DS} will be negative. Fig. 6 shows the static characteristics of a P-channel UNIFET. Fig. 6a presents the drain current I_D as a function of drain-to-source voltage V_{DS} for constant values of gate-to-source voltage V_{GS}. These curves show that the saturated value of drain current is a function of V_{GS}. The value for $V_{GS} = O$ is I_{DSS} as was shown also in Fig. 5.

Fig. 6b shows the gate-voltage-drain-current transfer characteristic for constant values of drain voltage V_D. These curves are a different way of presenting the data contained in Fig. 6a. Note the similarity of these I_D -vs.- V_G characteristics to the G-vs-V_G curve of Fig. 3. Fig. 6c shows the gate-current gate-voltage characteristic. This curve shows that the dynamic conductance of the gate is very low in the region between $V_G = O$ and $V_G = BV_{GSS}$. The gate current

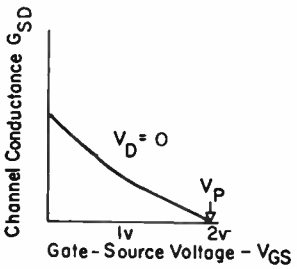


Fig. 3: Channel conductance varies with gate-to-source voltage.

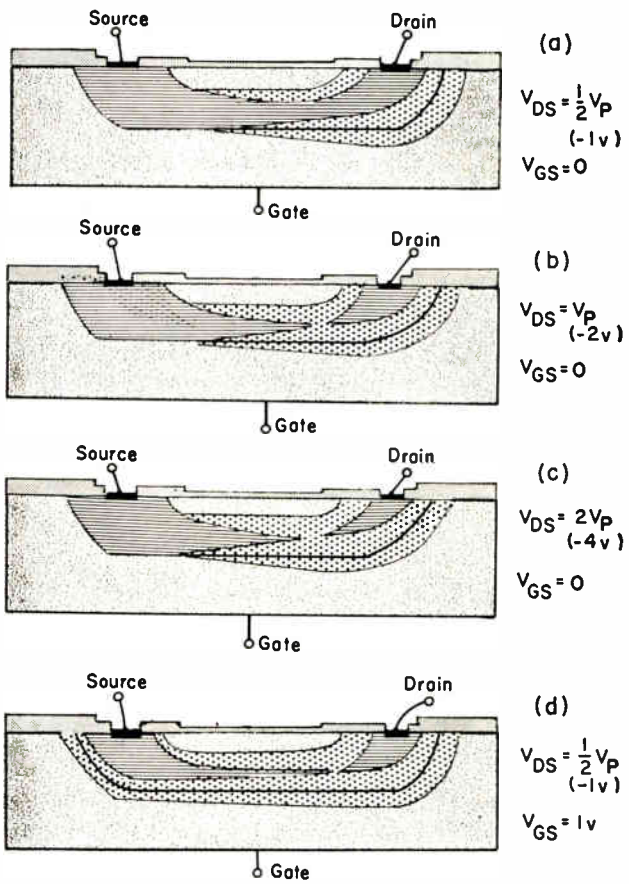


Fig. 4: Effects of varying gate-to-source and gate-drain-to-source V.

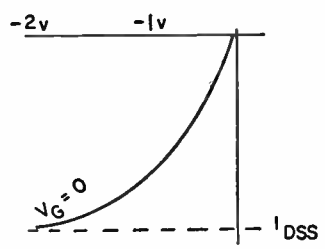


Fig. 5: Drain saturation current.

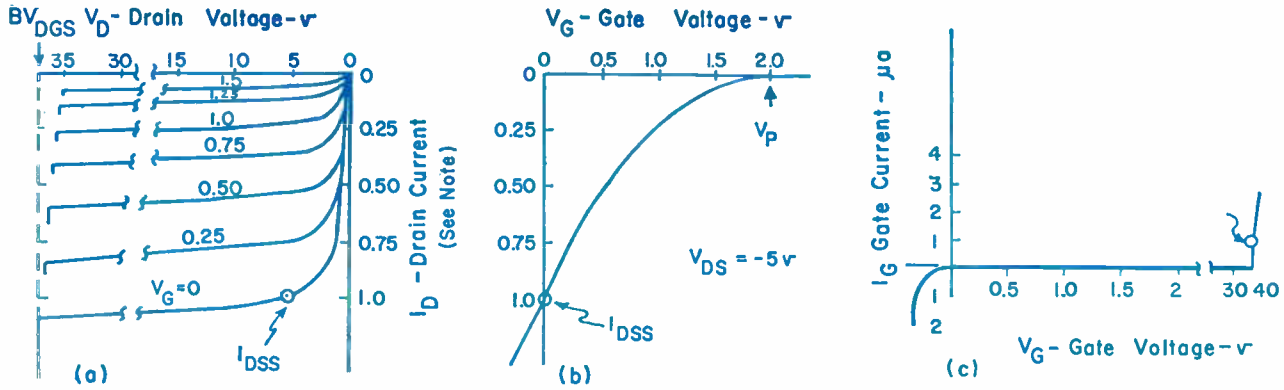


Fig. 6: (a) I_D as a function of V_{DS} (b) Gate voltage-drain-current characteristic (c) gate-current-gate-voltage characteristic.

I_{GSS} in this region may range from 10^{-10} to 10^{-8} amps, depending on the size of the device.

The UNIFET dc characteristics could be given by graphs as was done in Fig. 6; however, it is better to use *static parameters*. The most useful *static parameters* I_{DSS}, V_P, I_{GSS}, BV_{GSS} are given above in the discussion of Fig. 6.

Common Source Configuration

For linear small-signal operation, the UNIFET will be biased to an operating point. For normal operations the common-source configuration is probably the most common. An ac input signal will be applied to the gate and an output signal taken from the drain with the source being common to the input and output. Thus the UNIFET can be considered as a three-terminal network characterized by four small-signal ac parameters. Because of the nature of its characteristics, i.e. high input and output impedances, use of the admittance parameters is recommended. They are defined by the equations:

$$\begin{aligned} i_i &= Y_{is}\, V_{gs} = Y_{rs}\, V_{ds} \\ i_o &= Y_{fs}\, V_{gs} + Y_{os}\, V_{ds} \end{aligned} \qquad (2)$$

The basic two-generator equivalent circuit, based on the use of these parameters is shown in Fig. 7.

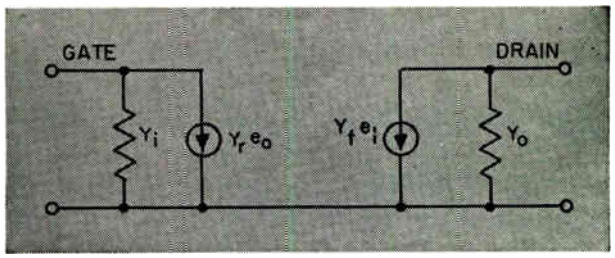
Values of the small-signal parameters in the equivalent circuit may be found with a conventional admittance bridge. They are a function of the bias voltages and currents as shown in the curves of Fig. 6. For example, the small-signal output conductance, g_{os} decreases as V_D is increased. Principal capacitance associated with UNIFETs is depletion-layer capacitance. Since the depletion layer widths are a function of voltage, the capacitances are voltage sensitive. Tranconductance, g_m, is a measure of the effect of gate voltage upon drain current. Its magnitude is a function of drain current.

One problem facing the designer of electronics circuits is that of obtaining enough data on a new device to use it to its full potential. Parameters selected by the manufacturer often are not coordinated with the needs of the circuit designer. A small signal parameter value at unlikely bias conditions may be of little value. Gate capacity of field-effect transistors, for example, may be minimized by increasing the gate bias V_{GS}. This can result in a gate capacity specification that "looks good" on a data sheet, but if the value of V_{GS} exceeds pinch-off voltage, this would be an unlikely bias condition for an amplifier.

What are the small-signal data needed by the circuit designer? Under what bias conditions should these data be obtained? How should parameter variations or spread be expressed? On what parameters should minimum or maximum limits be applied? The answers to these questions are important to both the circuit designer and the manufacturer. They have an effect on the usefulness and cost of the device. By the careful choice of a relatively few static and small-signal parameters specified as control parameters, and by giving information concerning the distribution and interrelation of "controlled" and "uncontrolled" parameters, the data needed for many applications may be provided.

The static parameters shown on the curves of Fig. 6 represent a reasonable set of "controlled" static parameters. When values for these parameters and small-signal parameters are specified on a data sheet, test conditions should also be given. These test conditions should be such that the user can duplicate them without too much difficulty.

Fig. 7: Basic two generator equivalent circuit.



THE NODE METHOD OF CIRCUIT ANALYSIS

It appears that the Node Method of circuit analysis is not used as often as it should be. In many instances, the Node Method saves time and gives an insight into the circuit that the Loop Method will not. An active feedback amplifier is analyzed here by the two methods so that a comparison can be made.

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IN THE ANALYSIS of any circuit three laws are used —Ohm's Law and Kirchhoff's Laws.

Kirchhoff's Laws are:

(1) "Around any closed path in the network the sum of the instantaneous voltage drops in a specified direction is zero."

(2) "In the branches connected to a common node the sum of the instantaneous currents in the direction away from (or into) this node is zero."

Kirchhoff's first law leads to the Loop Method of circuit analysis while the second law leads to the Node Method of analysis. Both methods have advantages. However, it appears that many times the Loop Method is used where the Node Method is far superior.

To demonstrate the Node Method, an active feedback amplifier will be analyzed. The Loop Method will be presented so that a comparison can be made.

Fig. 1 presents the circuit to be analyzed. The amplifier has a gain of A, infinite input impedance, and zero output impedance. Fig. 2 is the equivalent circuit for using the Node Method of analysis. From this equivalent circuit the circuit equation may be written:

$$\frac{e_0}{Z_2} + \frac{Ae_1}{Z_1} = e_1\left(\frac{1}{Z_1} + \frac{1}{Z_2}\right)$$

$$\frac{e_0}{Z_2} = e_1\left(\frac{1-A}{Z_1} + \frac{1}{Z_2}\right)$$

$$e_2 = \frac{AZ_1\, e_0}{(1-A)\,Z_2 + Z_1}$$

or to put the equation into a more familiar form:

$$e_2 = \frac{-\frac{Z_1}{Z_2}\, e_0}{1 - \frac{1}{A}\left(1 + \frac{Z_1}{Z_2}\right)}$$

Equivalent Circuit

Fig. 3 is the equivalent circuit used in the Loop analysis of the amplifier. The equations for this circuit are:

$$i = \frac{Ae_1 - e_0}{Z_1 + Z_2} \qquad e_1 = e_0 + iZ_2$$

$$e_1 = e_0 + \frac{(Ae_1 - e_0)\,Z_2}{Z_1 + Z_2}$$

$$e_1\left(1 - \frac{AZ_2}{Z_1 + Z_2}\right) = e_0\left(1 - \frac{Z_2}{Z_1 + Z_2}\right)$$

$$e_1 = \frac{Z_1 e_0}{-AZ_2 + Z_1 + Z_2} \qquad Ae_1 = \frac{-\frac{Z_1}{Z_2}\, e_0}{1 - \frac{1}{A}\left(1 + \frac{Z_1}{Z_2}\right)}$$

The amplifier used in the above example is of a

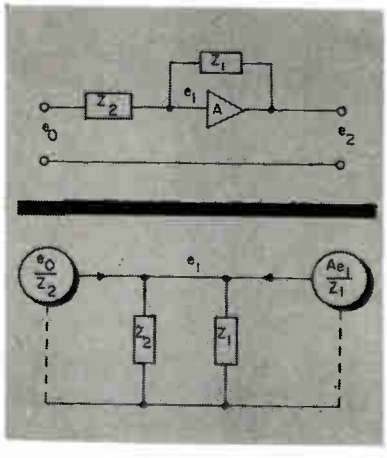


Fig. 1: Amplifier with feedback

Fig. 2: Node equivalent circuit

very special type with infinite input impedance and zero output impedance. The circuit in Fig. 4 uses an amplifier with a gain of A, an input impedance of Z_i ohms and an output impedance of Z_o ohms. This amplifier is loaded with a load of Z_L ohms. The equivalent circuit used for the Node analysis is shown in Fig. 5. From this equivalent circuit the network equations are:

$$\frac{e_0}{Z_2} = e_1\left(\frac{1}{Z_1}+\frac{1}{Z_2}+\frac{1}{Z_i}\right) - \frac{e_3}{Z_i}$$

$$0 = -e_1\left(\frac{1}{Z_i}+\frac{A}{Z_o}\right) + e_3\left(\frac{1}{Z_i}+\frac{1}{Z_L}+\frac{1}{Z_o}\right)$$

solving for e_3

$$e_3 = \frac{\begin{vmatrix} \frac{1}{Z_1}+\frac{1}{Z_2}+\frac{1}{Z_i} & \frac{e_0}{Z_2} \\ -\left(\frac{1}{Z_i}+\frac{A}{Z_o}\right) & 0 \end{vmatrix}}{\begin{vmatrix} \left(\frac{1}{Z_1}+\frac{1}{Z_2}+\frac{1}{Z_i}\right) & -\frac{1}{Z_i} \\ -\left(\frac{1}{Z_i}+\frac{A}{Z_o}\right) & \left(\frac{1}{Z_i}+\frac{1}{Z_L}+\frac{1}{Z_o}\right) \end{vmatrix}}$$

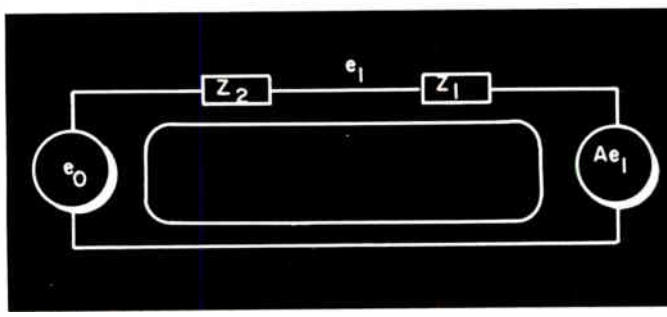


Fig. 3: Equivalent circuit used in the Loop analysis

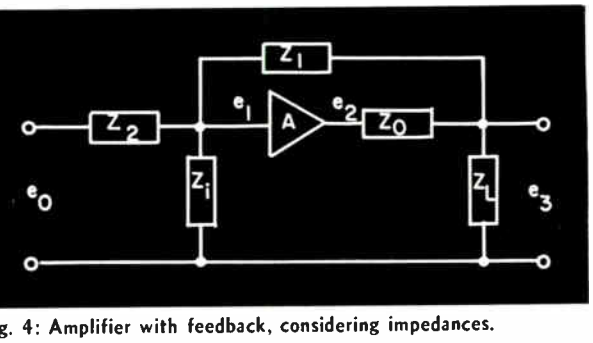


Fig. 4: Amplifier with feedback, considering impedances.

after solving the above determinants;

$$e_3 = \frac{-\frac{Z_1}{Z_2}\left(1+\frac{1}{A}\frac{Z_o}{Z_1}\right)e_0}{1-\frac{1}{A}\left(1+\frac{Z_1}{Z_2}+\frac{Z_0}{Z_L}+\frac{Z_0}{Z_2}+\frac{Z_0}{Z_i}+\frac{Z_1}{Z_i}+\frac{Z_i}{Z_2}\frac{Z_1}{Z_L}+\frac{Z_0}{Z_i}\frac{Z_1}{Z_L}\right)}$$

The Loop equivalent circuit is shown in Fig. 6. The equations for this network are:

$$e_2 = Ae_1 = A\,(i_1 - i_2)\,Z_i$$
$$e_0 = i_1\,(Z_i + Z_2) - i_2 Z_i$$
$$0 = i_1 Z_i + i_2\,(Z_i + Z_1 + Z_L) - i_3 Z_L$$
$$0 = i_1 AZ_i - i_2\,(Z_L + AZ_i) + i_3\,(Z_0 + Z_L)$$
$$e_3 = Z_L\,(i_2 - i_3)$$

$$i_2 = e_0\frac{\begin{vmatrix} Z_i & Z_L \\ AZ_i & Z_0 + Z_L \end{vmatrix}}{\Delta}$$

$$i_3 = e_0\frac{\begin{vmatrix} -Z_i & Z_1 + Z_L + Z_i \\ AZ_i & -(Z_L + AZ_i) \end{vmatrix}}{\Delta}$$

$$e_3 = Z_i Z_L\left[\frac{\begin{vmatrix} 1 & Z_L \\ A & Z_0 + Z_L \end{vmatrix} - \begin{vmatrix} -1\,(Z_1 + Z_i + Z_L) \\ A - (Z_L + AZ_i) \end{vmatrix}}{\Delta}\right]$$

where

$$\Delta = \begin{vmatrix} (Z_2 + Z_i) & -Z_i & 0 \\ -Z_i & Z_i + Z_1 + Z_L & -Z_L \\ AZ_i & -(Z_L + AZ_i) & (Z_0 + Z_L) \end{vmatrix}$$

after solving these determinants

$$e_3 = \frac{-\left(\frac{Z_1}{Z_2}\right)\left(1-\frac{1}{A}\frac{Z_0}{Z_1}\right)e_0}{1-\frac{1}{A}\left(1+\frac{Z_1}{Z_2}+\frac{Z_0}{Z_L}+\frac{Z_0}{Z_2}+\frac{Z_0}{Z_L}+\frac{Z_1}{Z_i}+\frac{Z_0}{Z_2}\frac{Z_1}{Z_L}+\frac{Z_0}{Z_i}\frac{Z_1}{Z_L}\right)}$$

Analyzing a Notch Filter

In order to show the superiority of the Node Method of analysis for this type of problem a specific circuit will be analyzed. This circuit is an active notch filter shown in Fig. 7. The equivalent circuit is shown in Fig. 8. The frequency response of this filter is given in Fig. 9.

From Fig. 8 the network equations are:

$$\frac{e_0}{R} = 2\left(\frac{1}{R}+SC\right)e_1 - \left(\frac{1}{R}+2ASC\right)e_2$$

$$0 = \frac{e_1}{R} + \left(\frac{1}{R}+SC\right)e_2 - SCe_3$$

$$SCe_0 = 0 - \left(SC+\frac{2A}{R}\right)e_2 + 2\left(SC+\frac{1}{R}\right)e_3$$

The output voltage $A\,e_2$ is

$$e_{out} = A\,e_2 = \frac{\begin{vmatrix} 2\left(SC+\frac{1}{R}\right) & \frac{e_0}{R} & 0 \\ -\frac{1}{R} & 0 & -SC \\ 0 & SCe_0 & 2\left(SC+\frac{1}{R}\right) \end{vmatrix}}{\begin{vmatrix} 2\left(SC+\frac{1}{R}\right) & -\left(\frac{1}{R}+2ASC\right) & 0 \\ -\frac{1}{R} & \left(\frac{1}{R}+SC\right) & -SC \\ 0 & -\left(SC+\frac{2A}{R}\right) & 2\left(SC+\frac{1}{R}\right) \end{vmatrix}}$$

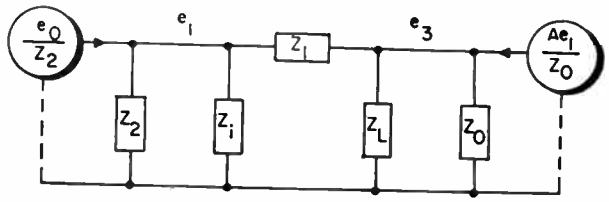


Fig. 5: Node equivalent circuit

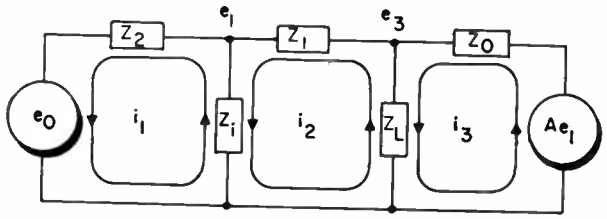


Fig. 6: Loop equivalent circuit

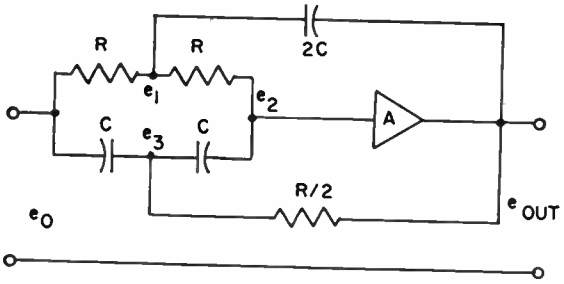


Fig. 7: Active RC notch filter

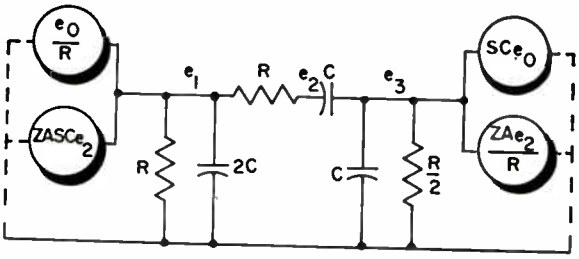


Fig. 8: Node equivalent circuit of the circuit above

NODE METHOD (Concluded)

after solving these determinants

$$e_{out} = \frac{A\left(S^2 + \frac{1}{R^2C^2}\right)e_0}{S^2 + \frac{4(1-A)}{RC}S + \frac{1}{R^2C^2}}$$

let $W_0 = \frac{1}{RC}$ and $W_L W_h = W_0^2$

where W_L is the lower 3 db point and W_h is the upper 3 db point and W_o is the point of maximum rejection.

$$e_{out} = \frac{A(S^2 + W_0^2)e_0}{S^2 + (W_h - W_L)S + W_0^2}$$

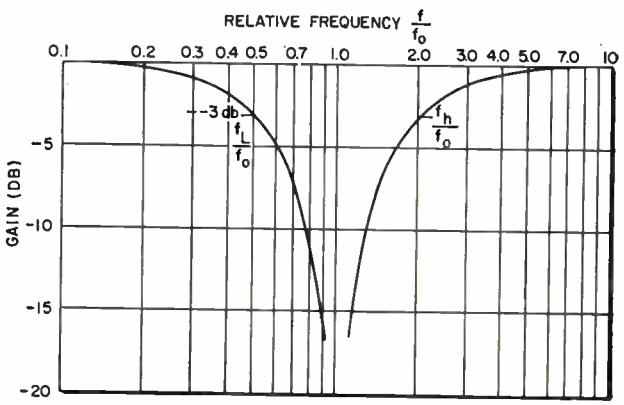
for a given bandwidth $(W_h - W_L)$

$$A = \frac{4W_0 - (W_h - W_L)}{4W_0}$$

for a given A

$$W_h - W_L = 4(1 - A)W_0$$

Fig. 9: Frequency response of the filter



EMERGENCY NAME PLATES

HERE'S AN IDEA that may be beneficial to numerous engineers and others who may have use for small odd-size labels for various electronic gear.

Most engineers who don't have access to a tapewriter, or who can't use its label in certain places, probably have the makings for a custom label in their shirt pocket.

Take the foil wrapping from a pack of cigarettes, roll it into any typewriter, and type on the information desired, using heavy strokes. Red ribbon seems to show up the best, but a few experiments can quickly determine whether red, black, or stencil setting suits the individual.

Then, trim the foil to size with a pair of scissors, and coat the paper side with Pliobond Cement, and stick it on the equipment.

This makes a nice-looking, quite durable label for many types of electronic equipments. Satin or smooth surfaces seem to work best, although a wrinkle finish will also work.

It's cheap, quick, and very versatile. Try it.

Submitted by BEN DEKINDER, Chief Engineer, KWCO, Chickasha, Oklahoma.

#66 PARALLEL-RESISTANCE NOMOGRAPH

THE NOMOGRAPHS SHOWN IN FIGS. 1 AND 2 permit quick evaluation of parallel resistances, series capacitances, or any quantities governed by the following expression:

$$\frac{1}{R_z} = \frac{1}{R_x} + \frac{1}{R_y}$$

$$R_z = \frac{R_x R_y}{R_x + R_y}$$

These nomographs provide the following advantages:

(1) Any parameter ratio of practical interest can be evaluated.

(2) All scales are linear for ease of reading and interpolation.

(3) Construction is simple; custom made nomographs can be easily made to suit individual needs.

If any two of the parameters are known, the other can be found on a constructed line at the point of intersection with the scale for the unknown. Scale changes are made by multiplying all scales by the same factor.

The nomograph shown in Fig. 1, which was designed for an optimum ratio of R_x:R_y of 10:1, accurately covers a range of ratios from 1:1 to 100:1. Although higher ratios can be found, a point is reached at which the difference between the result and the smaller parameter becomes negligible and can not be resolved. For ratios greater than 100:1 this difference is less than 1%. The nomograph shown in Fig. 2 was optimized for a ratio of 2:1 and is accurate over a range of ratios from 1:1 to 30:1.

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Engineer, Product Development
Receiving Tube Application Laboratory
Electron Tube Division
Radio Corporation of America
Harrison, N. J.

Construction

Because of its simple construction, this type of nomograph may be readily modified to suit individ-

Fig. 1: Nomograph was designed for an optimum ratio of R_x:R_y of 10:1, but accurately covers a range from 1:1 to 100:1.

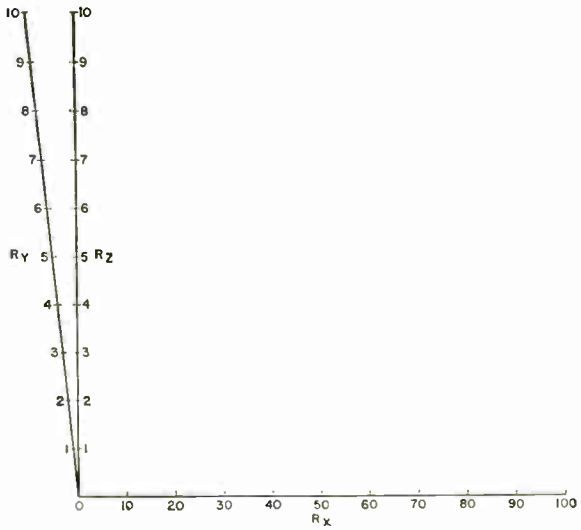
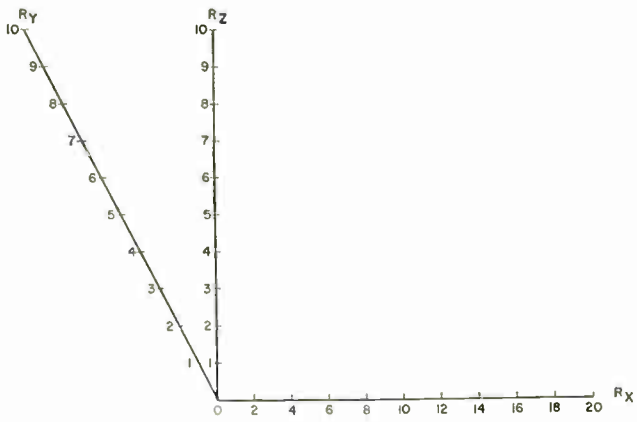


Fig. 2: The nomograph shown here was optimized for a ratio of 2:1 and is accurate over a range of ratios from 1:1 to 30:1.



RESISTANCE NOMOGRAPH (Concluded)

ual needs. On rectangular coordinate paper, the abscissa is marked as the R_x scale and the ordinate as the R_z scale to any convenient proportions, as shown in Fig. 3. Line *ab* is then determined by joining two points having equal values of resistance on the R_x and R_z scales. The R_y scale is obtained by drawing a line parallel to *ab* which passes through the origin; the R_y scale is graduated by projection of the R_z scale along lines parallel to the R_x scale, as shown at points *c* and *f* in Fig. 3.

The angle between the R_x and R_z scales need not be 90°; the same procedure may be used with other angles provided the projections from the R_z scale are drawn parallel to the R_x scale for determination of the R_y scale.

In some cases, it may be more desirable to start with the R_x and R_y scales. The R_z scale is then determined by the intersections of projection lines from equal-magnitude points on the R_x and R_y scales drawn parallel to the opposite scales, as shown in Fig. 4.

The following examples illustrate the use of Figs. 1 and 2 for some typical determinations of parallel resistance and series capacitance.

Example 1

Determine the parallel resistance of 82,000 and 3300 ohms. Use Fig. 1 and assume all scales are multiplied by 1000. A line connecting 82,000 ohms on the R_x scale with 3300 ohms on the R_y scale intersects the R_z scale at a value of 3170 ohms.

Example 2

Determine the combined series capacitance of 100 pf. and 150 pf. Use Fig. 2 and assume all scales are multiplied by 10. A line joining 150 on the R_x scale with 100 on the R_y scale intersects the R_z scale at a value of 60 pf.

Example 3

Determine the parallel resistance required to reduce 56 ohms to 50 ohms. Use Fig. 1 and assume all scales are multiplied by 10. A line extending from 56 on the R_y scale through 50 on the R_z scale intersects the R_x scale at a value of 467. This value may be rounded off to 470 ohms with little error.

Fig. 3: Modified nomograph starts with the abscissa marked as the R_x scale and the ordinate marked as the R_z scale.

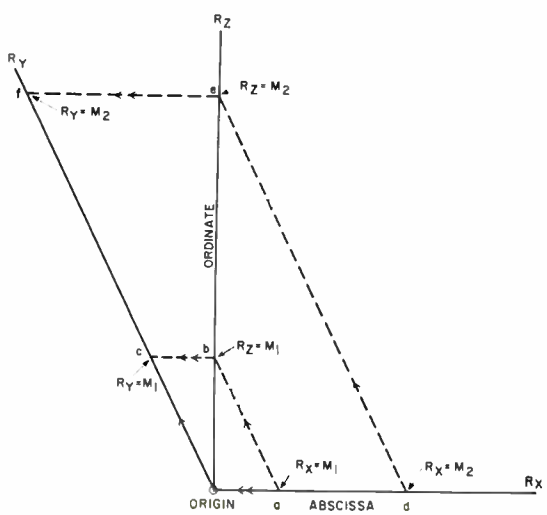
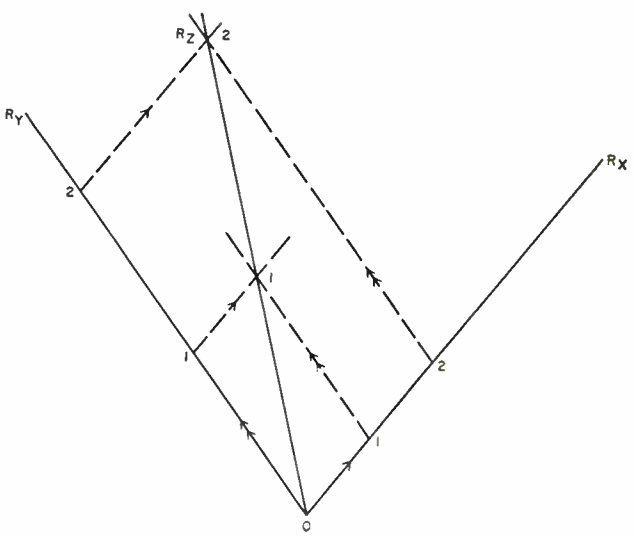


Fig. 4: In some cases it may be more desirable to start the nomograph with the R_x and R_y scales as shown in this diagram.



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$$$ for Circuit Designs

Have you come up with any simple or unique circuit designs lately? Do you think that they would be useful to fellow engineers? If so, why not send them to us for possible publication? We pay our usual space rates for those accepted. Please keep them as concise as possible and send to: Circuit Design Editor, ELECTRONIC INDUSTRIES, 56th & Chestnut Sts., Philadelphia 39, Pa.

NEW FLIP-FLOP DESIGN IMPROVES EFFICIENCY

Complementary-symmetrical transistor applications can yield advantages not found in more conventional approaches. Here is an astable multivibrator which uses this method to feature high power efficiency, low interference and small size.

A COMPLEMENTARY-SYMMETRICAL ASTABLE MULTIVIBRATOR can be used as the source of a bipolar square wave carrier to drive a chopper in a dc carrier amplifier.

In Fig. 1, a comparison is made between conventional and complementary-symmetrical astable multivibrators.

Portions of both multivibrators serve the same function. Specifically, transistors Q1 and Q2 are regenerative switches, capacitors C1 and C2 are the voltage commutators, and resistors R1 and R2 provide the required biasing for transistors Q1 and Q2.

The disadvantage of the conventional astable multivibrator, Fig. 1a, when used as a source of bipolar square waves, is that the collector resistors R3 and R4 must be in series, alternately, with the load. Hence, power efficiencies are relatively low.

This disadvantage does not exist in the complementary-symmetrical astable multivibrator, Fig. 1b. Here, the collector load resistors R3 and R4 have been replaced with a current commutating circuit. This circuit consists of transistors Q3 and Q4, complementary and symmetrical to transistors Q1 and Q2, and their biasing resistors R5 and R6.

Circuit Operation

Here's how the circuit works:

a. If the initial state is changed from power off to power on, both transistor pairs, Q1-Q4 and Q2-Q3, will try to bottom out. But, only one pair or the other will succeed. We will assume that pair Q1-Q4 bottoms out initially.

b. In the first transitory state, the base and collector currents of Q1 and Q4 increase; those of Q2 and Q3 decrease.

c. In the first quasi-stable state, Q1 and Q4 are bottomed out and their collector currents are limited by the load impedance. Q2 and Q3 are cut off. The load current flows through Q4, the load, and Q1, Fig. 2a.

d. In the second transitory state, the conditions begin to reverse. The base and collector currents of Q1 and Q4 decrease towards cutoff, while those of Q2 and Q3 increase towards bottoming.

e. In the second quasi-stable state, Q2 and Q3 are bottomed out; collector currents are limited by the load impedance. Q1 and Q4 are now cut

(*Continued on the following page*)

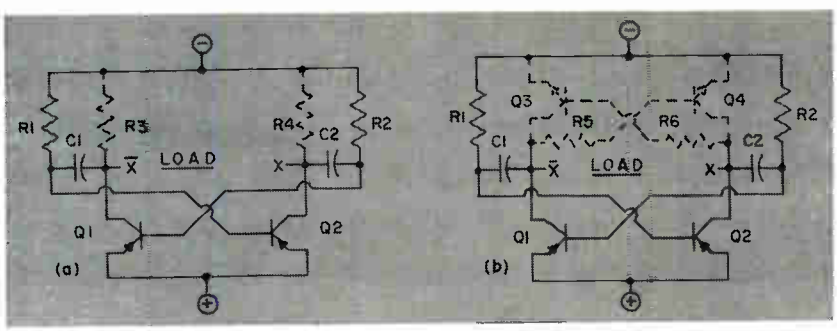

Fig. 1: The component parts common to both the (a) conventional astable and (b) complementary-symmetrical astable multivibrators: R1, R2, C1, C2, Q1 & Q2.

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MULTIVIBRATOR (Continued)

off. The load current now flows through Q3, the load, and Q2 Fig. 2b.

f. This establishes the sequence of operation through one cycle. The sequence is repeated at a rate determined by the time constant of the commutating capacitors C1 or C2 and the biasing resistors R1 or R2.

Relative to interference, there are no inductive elements, with their attending magnetic fields. The average supply current is essentially constant and requires very little decoupling.

Power losses are limited to the biasing requirements of the alternate transistor pairs, plus the power lost in the saturated transistors, i.e., $I_c \times V_{ce(sat.)} \times 2$. Total power losses can be held to 5% (approx.) of the input power.

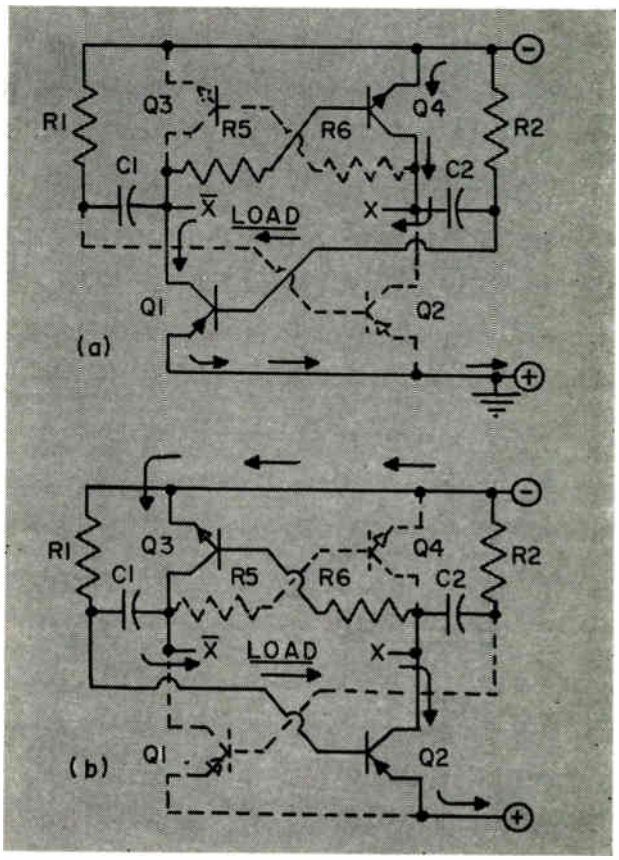


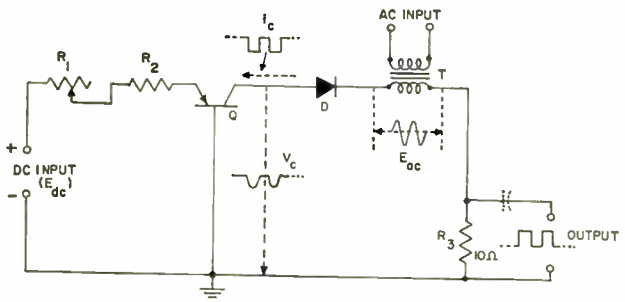
Fig. 2: The load current flows through Q4, the load, and Q1 in the first quasi-stable (a); in the second quasi-stable state (b), the current flows through Q3, the load, and Q2.

DC-TO-SQUARE WAVE CONVERTER

The very flat $v_c i_c$ constant current characteristic of the common-base transistor circuit may be used to form square waves when the collector potential consists of half-sinusoids. Because of the flatness of this characteristic, the ac supply voltage, from which the half-sinusoids are derived, can vary over wide limits without affecting the square wave amplitude. However, the square wave amplitude may be controlled by varying an applied emitter-base dc voltage.

Fig. 1 shows the circuit. A silicon diode, D, blocks the positive half-cycles of applied ac voltage but transmits the negative half-cycles (v_c) to the collector. The flatness of the collector conduction characteristic causes the collector current to level off at a magnitude governed by the applied emitter-base dc voltage, E_{dc}, and thus to flow as square waves (i_c). These current pulses develop a square-wave output voltage across the low resistance R_3.

Fig. 1: The dc-to-square wave converter is simple to design.



If the circuit is used as a sinusoidally excited square-wave generator, a fixed E_{dc} may be used and R_1 adjusted for desired output amplitude. But if the circuit is used as a converter, a varying voltage is presented to the dc input terminals, and R_1 and R_2 reduced to the minimum safe resistance for emitter current limiting. In either case, E_{ac} must be chosen such that its peak value will not exceed the maximum permissible collector voltage of the transistor. The output then will have an amplitude proportional to E_{dc} and a frequency equal to that of E_{ac}.

This circuit has the feature that large excursions of the ac supply voltage do not change the output square wave amplitude. Further, R_1 provides smooth control of the output amplitude without the disadvantages of an attenuator in the output (the 10-ohm output impedance thus is maintained), and the circuit may be set up to provide as much or as little power as needed simply by proper selection of transistor Q, diode D, E_{ac}, R_1, and R_2.

Submitted by RUFUS P. TURNER, Consulting Electronic Eng., 122 E. Mariposa St., Altadena, Calif.

Newer microwave tubes place high requirements on the pulse modulator such as wider pulses, higher duty cycle, and sharp, clean pulses. Some of the modulator design problems are discussed and the engineering solutions described.

DESIGNING WIDE PULSE-WIDTH MODULATORS

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WITH SOPHISTICATED MICROWAVE TUBES such as the klystron, traveling wave tube and carcinotron, there has been a change in the modulators and power supplies needed to power these tubes. These changes are evident for CW operation, as well as pulse. Fifteen to twenty years ago, when the magnetron was the main source of r-f power in radars and was the only tube available for radar, a typical set of modulator specifications looked like this:

Pulse width—2 microsec.
Pulse repetition rate—500 pulses per sec.
Pulse rise time—10% of the pulse width.

There was nothing sophisticated about these specifications such as calling for fast fall times, minimum droop, high repetition rate, etc. The modulator operated into this fixed load under constant conditions.

The soft tube modulator using hydrogen thyratron switch tubes, with the associated pulse forming network as the storage device, served this modulator requirement admirably and economically. As the present day microwave tubes were developed, the single pulse width modulator at the 0.001 duty cycle became obsolete.

As wide pulse widths became fashionable and as the duty cycle approached 10% and more, the hard tube modulator approach became necessary. High vacuum switch tubes using thoriated tungsten filaments allow millesecond pulses at duty cycles of 0.1 or higher. In addition to the wide pulse and high duty cycle, present day r-f tubes allow other radar applications such as pulse coding, fast rise times and exotic pulse shapes. Also, the modulator has to be concerned with ripple, droop, rise and fall times, regulation and crowbar action. When this equipment is translated into military gear with the parameters of temperature, vibration and altitude added, today's modulator needs "state of art" design in each application.

Modulator Specifications

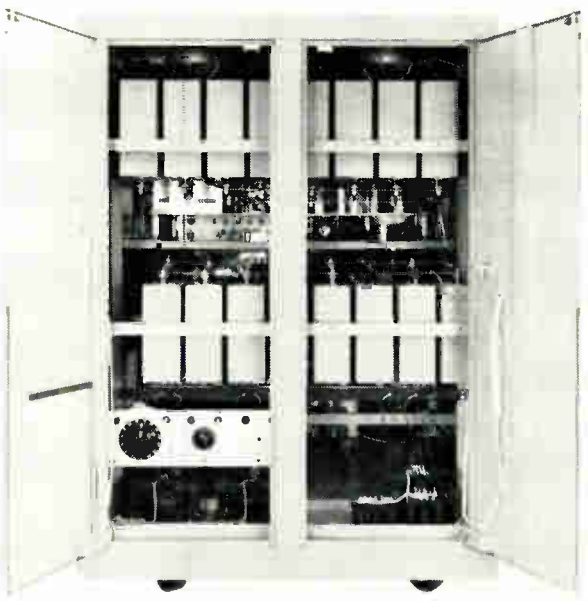
This article concerns the approach and technique of building a test modulator to power TWTs needing extreme pulse fidelity. The test modulators to be described were designed to meet the following specifications:

Output pulse voltage: 0 to −16 kv

Load impedance: $Z = \frac{1}{ke^{1/2}}$ where k ranges from 1.5 to 3.3×10^{-6}

Note: Maximum load capacitance 50 $\mu\mu f$.

Fig 1: An entire pulse modulator, including power supply, capacitor bank, controls and metering are housed in cabinet.



PULSE MODULATOR (Continued)

Pulse width:	1 microsec. to 1 millisec.
Pulse time jitter:	Less than 1% of pulse width.
Pulse repetition rate:	20 to 10,000 pps
Duty cycle:	0.1 max.
Maximum average output power:	10 kw
Maximum peak power:	100 kw
Pulse rise time from 20% to 90% voltage points:	0.25 μs up to 50 μs pulse width with a linear degradation beyond to a maximum of 5 μs at 1,000 μs pulse width.
Pulse fall time from 90% to 20% voltage points:	0.25 μs up to 50 μs pulse width with a linear degradation beyond to a maximum of 5 μs at 1,000 μs pulse width.
Pulse droop:	2% maximum for any pulse level and width.
Deviation from flatness:	1% maximum except for possible initial over-shoot which shall be 1% maximum and must not extend beyond 10% of the pulse width measured at the base of the spike.
Pulse to pulse amplitude jitter:	1% maximum
Maximum swing:	3% maximum.

In addition to the above, there were requirements regarding synchronization, delays, filament and magnet supplies, metering and monitoring of pulse shape.

Hard Tube Modulator

The salient problems regarding the modulator described above lie in the rise and fall time, droop and deviation from flatness specifications and their compatibility with a wide pulse output. The first problem to be decided is the hard tube modulator circuit. Fig. 2 shows two possible circuits for a hard tube modulator which would approach the outline above. Both circuits could be used for wide pulses up to the order of milliseconds as needed in this case. Fig. 2a has the switch tube and load referenced to ground, with the energy storage capacitor C floating at high voltage. This circuit has a disadvantage. The stray capacitance of the storage capacitor to ground does not allow a fast fall time unless a parallel pre-load resistor is used across the output to reduce the time constant. This resistance causes an additional power burden on the modulator.

Thus for $C_s = 150\ \mu\mu f.$

$\Delta v = 1600$ v.

$\Delta t = 0.25$ microsec.

$$i = 150 \times 10^{-12} \times \frac{16 \times 10^{3}}{0.25 \times 10^{-6}}$$

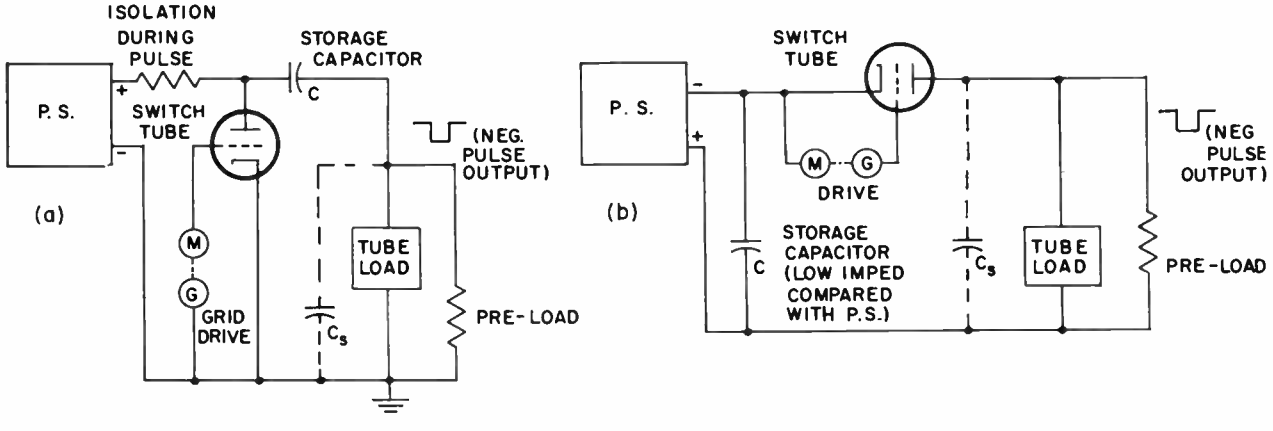
$i = 9.6$ Amp.

This does not consider the load current taken by the tube-under-test, nor the pre-load resistor needed to obtain the fall time.

The circuit shown in Fig. 2b has the capacitor bank and load referenced to ground, with the switch tube mounted in the output portion of the modulator. This circuit has the advantage that the stray capacitance of the capacitor bank contributes to the energy storage, without degrading the rise or fall time. The disadvantage, of course, is that we now have to contend with a switch tube at high voltage. Further this means that the grid bias, the screen voltage, and the grid drive all have to be referenced to the dc power supply deck. This is the price we pay to minimize the rise and fall times economically.

To achieve good pulse shape a tetrode is chosen. The screen grid helps to eliminate the Miller effect, which, in the case of a triode, slows up the rise time due to the effective capacitance increase. The tetrode chosen here was the 4-1000A. Four of these tubes are operated in parallel for the needed current capacity and the rise time. The rise time current require-

Fig. 2: Two possible circuits for hard tube modulators are shown. Circuit Fig. 2a has a disadvantage because capacitor is floating.



ment, resulting from the capacitance only, is found as follows:

$i = C_s \frac{\Delta v}{\Delta t}$ where C_s is the total to be charged up to a voltage given by Δv in a time Δt.

Energy Storage Bank

The next major component is the energy storage bank. The value of C needed is set by the maximum allowable droop over the longest pulse width. The same basic relationship between current, capacity, and rate of change of voltage is used in computing the capacity of this storage bank. We thus have, for the case of a 1000 μsec. pulse width with a 10 ampere load and a 2% droop, the following:

$$C = \frac{i\,\Delta t}{\Delta v} = \frac{10\text{A} \times 1000 \times 10^{-6}\ \text{sec}}{320}$$
$$= 31\ \mu\text{f}$$

Before deciding the final value of C, we must consider the fall time of the pulse. Since the TWT presents a rather high impedance load at low voltages and looks like about 2500 ohms at 16 kv, its operating point, we must provide a parallel impedance or pre-load to insure the specified fall time. To calculate this pre-load, one estimates the stray capacitance of the circuit along with the capacitance of the TWT load, its heater supply and metering. Great care is needed in laying out circuitry of this type to minimize the stray capacitance. It is conceivable that the total capacity on the output of a modulator of this type is about 100 μμf. If we take the fall time of 0.25 μs and let that equal two time constants, we can then arrive at a reasonable value for the pre-load. Thus $t_f = 2RC_s$

$$\text{and } R = \frac{0.25 \times 10^{-6}}{2 \times 100 \times 10^{-12}} = 1250 \text{ ohms}$$

This pre-load has to be considered as an additional load on the modulator during the normal pulse interval as well.

Pulse Fall Time

To obtain a fall time completely dependent on the stray capacitance and pre-load only, we must have the grid pulse to the 4-1000A switch tubes ring down completely, and this is done by the following method. The grid of the switch tube is driven through a pulse transformer that is incompletely damped. A value of the damping resistor across the pulse transformer is chosen such that a negative swing is achieved on the grid pulse without any additional positive pulse ringing, see Fig. 4. In this fashion a steep negative going edge is applied to the switch

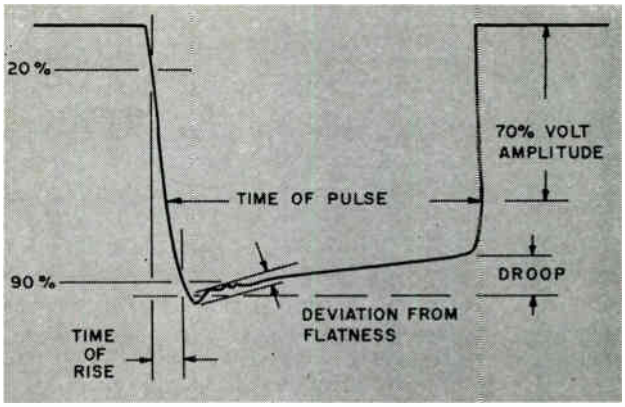


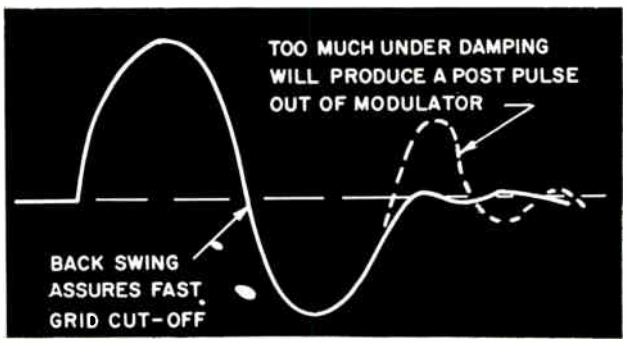
Fig. 3: Typical modulator pulse shape characteristics.

and since the screen voltage is keeping the tube "hot," a fast falling edge on the output pulse is achieved.

After designing the power supply and modulator, we must be sure to swing the grid of the switch tubes very hard in both directions to achieve good pulse fidelity. In the forward direction it is important to drive the grid so that a sharp rise and flat pulse top is achieved.

The drive circuit for the grids of the 4-1000A switch tube consisted of a multivibrator and amplifier located on the high voltage deck. The timing circuits and synchronizing signals were fashioned in a trigger generator referenced to ground. The signals are fed to the high voltage multi-vibrator through a pair of 30 kv blocking capacitors. The pulse width range from 1 to 1000 μs was achieved in 6 discrete steps. A fine control adjustment on the front panel filled-in the ranges. The amplifier stage consisted of a pulse transformer in the plate of a 304TL tube. Two pulse transformers were used to cover the 6 ranges. Although the pulse transformer did not give a flat top drive pulse on its own, this pulse was clipped and furnished enough drive when coupled into the 4-1000A grids. This method allowed for the back edge swing needed in obtaining the fast fall time.

Fig. 4: Grid drive wave shape with very little ringing.



For the low pass band, passive RCL filters have disadvantages of size and nature of components. The active RC filter, using semiconductors, eliminates most of these problems. A network synthesis is developed here, with details on how to specify and design.

SYNTHESIS OF AN ACTIVE CHEBYSHEV FILTER

THERE IS A CLASS OF FILTERS that will uniformly pass certain frequencies and will provide a minimum attenuation for another group of frequencies. The transition from the pass band to the cutoff (attenuation) band should require the minimum number of elements.

Gain, input impedance, output impedance and stability are further constraints upon the performance.

Such a filter may be explicitly synthesized.

Generally, an m-pole n-zero Chebyshev (Cauer) filter is worth investigating.

Realization of a given network by RCL elements requires stabilized inductances in order that linearity may be maintained. Consequently, active R-C realizations offer advantages, especially in the low pass case. Resistive and capacitive elements are cheaper, simpler and more nearly ideal than are inductors.

Amplitude Characteristic

The filter amplitude characteristic can be typically related to the implicit specifications defined by Fig. 1. Examination of the limits of the unshaded areas of Fig. 1 yields the following:

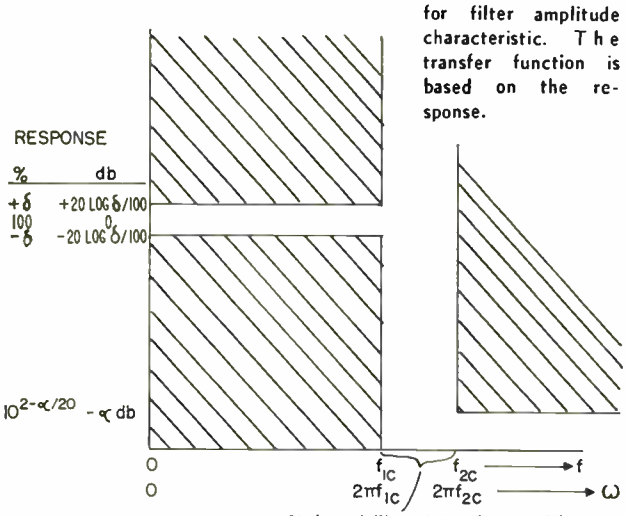


Fig. 1: Specifications for filter amplitude characteristic. The transfer function is based on the response.

Choice of filter determines position of $\omega_c = 2\pi f_c$, the corner frequency of the actual response.

1. δ% transmission inaccuracy from dc (0 CPS) to f_{1c} CPS.

2. α db attenuation above f_{2c} CPS.

δ represents percent deviation from normalized unity transmission in the pass band. f_{1c} is the frequency that defines the upper limit of the pass band where dc is assumed as the lower limit. (See Fig. 1.) α represents the minimum amount of attenuation, in db, required in the stop band. f_{2c} is the frequency that defines the lower limit of the stop band, where the upper limit is assumed infinite.

The parameters α, δ and f_{2c}/f_{1c} determine the form of the equation that is used to represent the response curve. Whether the response curve will be a transfer function of impedance, voltage, or current depends on other factors.[1]

Response Function

If we assume a transfer impedance, Z_{12}, the equality, $|Z_{12}|^2 = 1/[1 + F^2(\omega)]$, may be useful. Here $F^2(\omega)$ oscillates about a value of 0 below f_{1c} and about infinity above f_{2c}. Z_{12} is the ratio of the output voltage to the input current, where the voltage measuring circuit defines no current to be drawn from the circuit. Depending upon the source and load conditions, alternative parameters such as gain or transfer admittance may be of interest.

If $\delta/100 = 10^{-\alpha/20}$, the function that will be proposed for $F(\omega)$ will be satisfactory. If the pass band tolerance, δ, is less than $10^{-\alpha/20}$, an adjustment factor η can be used,[2] so that $|Z_{12}|^2 = 1/[1 + \eta^2 F^2(\omega)]$.

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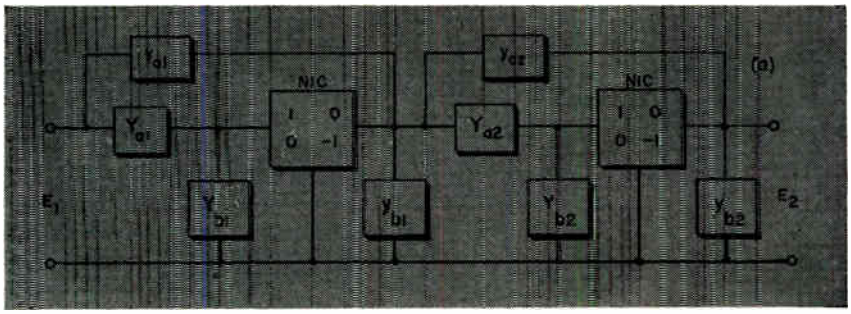

$F(\omega)$ may be either even or odd, and $F(1/\omega) = 1/F(\omega)$.

If even,

$$F(\omega) = \frac{(\omega_1^2 - \omega^2)(\omega_3^2 - \omega^2)\cdots(\omega_{2n-1}^2 - \omega^2)}{(1 - \omega_1^2\omega^2)(1 - \omega_3^2\omega^2)\cdots(1 - \omega_{2n-1}^2\omega^2)}.$$

If odd,

$$F(\omega) = \frac{\omega(\omega_2^2 - \omega^2)(\omega_4^2 - \omega^2)\cdots(\omega_{2n}^2 - \omega^2)}{(1 - \omega_2^2\omega^2)(1 - \omega_4^2\omega^2)\cdots(1 - \omega_{2n}^2\omega^2)}.$$

The value of n determines the degree of freedom of $F(\omega)$ and the number of elements required for a given realization.[3] The degree, n, may be resolved in several ways. From Saal and Uhlbrich,[4] n may be computed with the aid of Glowatzki's tables.[5] Alternately, the curves of Saal and Uhlbrich and curves in ref. 6 may be used.

A Simple Example

A relatively simple example will be used to illustrate some of the above points and to extend the argument. Assume the following:

1. $\delta = 10$, or the reflection coefficient is approx. 10%.
2. $\alpha = 20$ db.
3. $f_{1c} = 1$ kc; $f_{2c} = 2.35$ kc.
4. The rise time, t_r, *is* considered.
5. A voltage transfer.

Let $A = E_1/E_2$, so that, $1/A^2 = 1/[1 + F^2(\omega)]$.[2] A is a transmission parameter that numerically equals the ratio of input voltage to output voltage. The gain, $G = 1/A$. Consulting the curves for $n = 2$ yields the possibility of a 4 pole-4 zero filter. Since $F(\omega)$ is even, the ω_v are given by $\omega_v = k^{1/2}\ \mathrm{sn}\ u_v$ for $v = 1,3$. v is terminated at $2n$-1. sn u is the elliptic function where sn u = sin ϕ and

$$u(k, \phi) = \int_0^{\phi} \frac{d\alpha}{\sqrt{1 - \kappa^2 \sin^2\alpha}}$$

Also, for $\phi = \pi/2$, sn u is determined by $u = K$.[7] K is the complete elliptic integral of the first kind, or

$$K = u\left(k, \frac{\pi}{2}\right) = \int_0^{\pi/2} \frac{d\alpha}{\sqrt{1 - k^2 \sin^2\alpha}}$$

and u is the argument of the Jacobian elliptic functions.

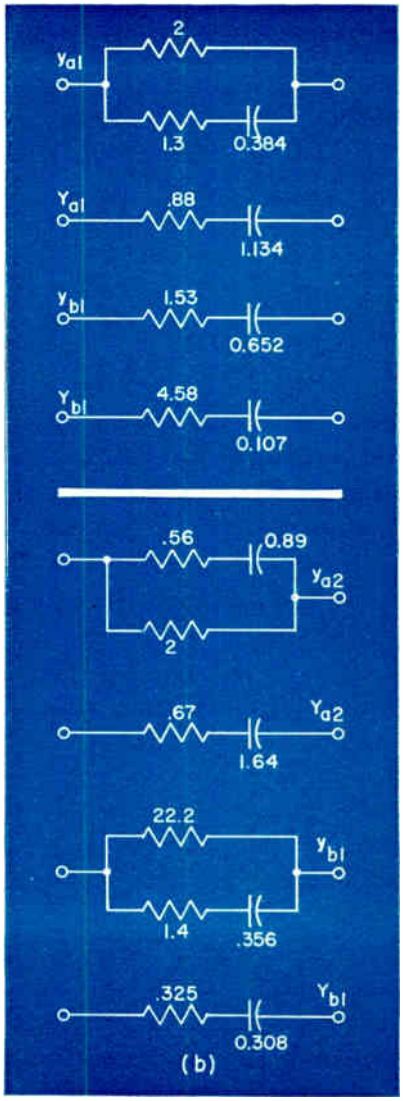

Fig. 2a (above): The complete active filter diagrammed. Arrangement of admittances to realize by synthesis.

Fig. 2b (right): Scheme of resultant values of components required in corresponding admittances shown in (a).

The points of maximum deviation in the pass band are given by $P_v = k^{1/2}\ \mathrm{sn}(vk/2n)$, where $v = 0,2,4$. P_{2n} determines the highest frequency in the pass band that meets the δ criterion. $P_v = k^{1/2}\ \mathrm{sn}(k)$ is the highest frequency in the pass band that satisfies the δ% transmission accuracy requirement. The frequencies are normalized so that the cutoff frequency $\omega_c = 1$. ω_c lies between the normalized values of f_{1c} and f_{2c}. One degree of freedom exists in the set of interrelated equations. Let $k = 0.7$, then $K = 2.075$ and $\omega_1 = 0.398$ and $\omega_3 = 0.809$. $\delta = (\omega_1\omega_3)^2\ 100 = 10.38$. The values that follow are based on a value of k that satisfies the first assumption, $\delta = 10$ or less. For $\delta = 8.58$, ω_1 becomes 0.3652 and ω_3 becomes 0.80155.

Then $F(\omega) = F(s = j\omega)$ and $F(s) = \dfrac{(s^2 + 0.1335)(s^2 + 0.6424)}{(0.1335\ s^2 + 1)(0.642\ s^2 + 1)}$

Selecting Poles

We then seek the roots of $1/[1 + F^2(s)]$ and

CHEBYSHEV FILTER (Continued)

select the appropriate left plane poles. Thus, $(1 + jF)(1 - jF) = 1 + F^2(s) = 0$ is the equation that defines the poles of our assumed function $G = 1/A$.[2] In order to obtain a realizable function for the resultant A, the poles must all lie in the left half of the s plane, the real of the pole must be negative. Thus,

$$1 \pm jF = 0 = 1 \pm j\frac{(s^2 + 0.1335)(s^2 + 0.6424)}{(0.1335\,s^2 + 1)(0.6424\,s^2 + 1)}$$

yields the poles of the function and the resultant denominator may be found by simply multiplying out the polynomials that define the proper pole positions. Note that the numerator of the assumed transfer function will simply be the denominator of $F(s)$.

To continue, $1 \pm jF = (0.0858 \pm j)\,s^4 + 0.7759(1 \pm j)\,s^2 + (1 \pm 0.0858j) = 0$. This equation is a quadratic in s^2 of the form $as^4 + bs^2 + c = 0$ and

$$s^2 = (-b \pm \sqrt{b^2 - 4ac})/2a.$$

Since a, b, and c are complex numbers, assume $s^2 = \tau\,\varepsilon \pm j\pi/\mu = \tau\,\varepsilon \pm j\pi\,(1/\mu + 2\Omega)$, where Ω is any integer. Then $s = \tau^{1/2}\,\varepsilon \pm j(\pi/2\mu + \pi\Omega)$ and Ω need only take the values 1, 2. $\tau^{1/2}$ is the distance from the pole to the origin. The angle defined by $(\pi\Omega + \pi/2\mu)$ must lie between 90° and 270°. Thus from $\pm$ and Ω, two pair of complex conjugate pole positions are formed in the left half plane. The solution for s is then, s_1, s^*_1, s_2, s^*_2. Our denominator that is desired for the chosen transfer function is the product of $(s^2 + s\,s^*_1 + s\,s_1 + s_1\,s^*_1)$ and $(s^2 + s\,s_2 + s\,s^*_2 + s_2\,s^*_2)$

The performance of these steps should yield,

$$\frac{E_2}{E_1} = \frac{1}{A} = \frac{(s^2 + 7.489)(s^2 + 1.557)\,0.0858}{1.0858\,(s^2 + 1.516\,s + 1)(s^2 + 0.214\,s + 1)}$$

In the above equation, the numerator was the denominator of F; and the denominator is formed from s_1 and s_2.

This expression may be realized as a transfer impedance of a passive cascaded constant resistance lattice.

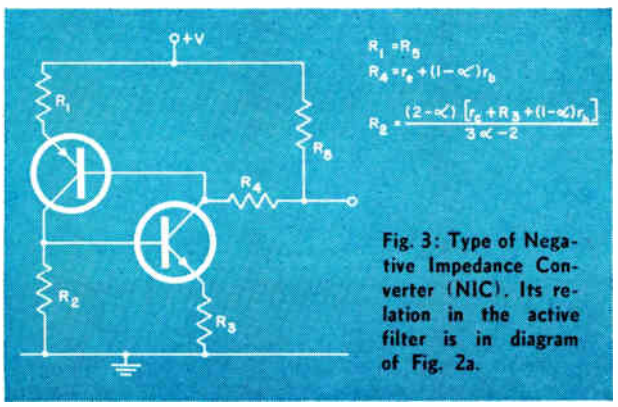

Fig. 3: Type of Negative Impedance Converter (NIC). Its relation in the active filter is in diagram of Fig. 2a.

Active Circuit Realized

There are several methods of active realization. A few are proposed by:

1. Kinariwala,[8]
2. Yanagisawa,[9]
3. R. E. Thomas.[10]

The method of Thomas generally requires floating negative impedance converters (NIC),[11] which are disadvantageous in certain applications. The method of Kinariwala leads to a set of linear inequalities that may be tedious to solve. The method of Yanagisawa similarly requires estimation of pole positions from complicated sets of programmed equations. Yanagisawa's method will be illustrated.

Fig. 2a shows the arrangement of the admittances to be realized. We let $A(s) = E_1/E_2 = (N_1/D_1)(N_2/D_2)$. Then,

$$\frac{N_1}{D_1} = \frac{(s^2 + 1.516\,s + 1)}{(s^2 + 7.489)\,0.1335} \text{ and}$$

$$\frac{N_2}{D_2} = \frac{(s^2 + 0.214\,s + 1)\,1.0858}{(s^2 + 1.557)\,0.6424},$$

from the preceding.

In accordance with Yanagisawa, but in part arbitrarily, we form $K(s) = (s + 1)(s + 2)$. $K(s)$ reflects a degree of freedom. However, a source of trouble arises in reaching a solution. We note that $N/D = (D + N - D)/D$. $K(s)$ may be reduced in complexity, if we let $K(s) = s + s_1$, but this would result in greater difficulty of adjustment.

We form $y_{an} - Y_{an} = D(s)/K(s)$ and $y_{bn} - Y_{bn} = [N(s) - D(s)]/K(s)$. (See Fig. 2.) If these expressions will only permit realization of a 2-terminal R-L admittance, a multiplier of s/s is introduced to allow an R-C realization.[12]

Then,

$$y_{a1} - Y_{a1} = \frac{0.134\,s^2 + 1}{(s + 1)(s + 2)}$$

$$= \frac{0.134\,s^3 + s}{s\,(s + 1)(s + 2)} = s\left(\frac{0.5}{s} - \frac{1.134}{s + 1} + \frac{0.768}{s + 2}\right);$$

and

$$y_{b1} - Y_{b1} = \frac{0.866\,s + 1.518}{(s + 1)(s + 2)}$$

$$= s\,\frac{0.866\,s + 1.518}{(s + 1)(s + 2)\,s} = s\left(\frac{0.652}{s + 1} - \frac{0.214}{s + 2}\right).$$

The second cascade circuit, when similarly treated, has the resultant values shown in Fig. 2b.

The sensitivity is a function of the relationship of $(Y_{a1} + Y_{b1})K$ and N. If the ratio of the respective coefficients for a given power of s is near unity, it is easy to adjust the circuit.

With $Y_{a1} = 1.134s/(s + 1)$, $Y_{b1} = 0.214s/(s + 2)$, and $K(s) = (s + 1)(s + 2)$, we have $(Y_{a1} + Y_{b1})K = [1.134s(s + 2) + 0.214s(s + 1)]K = 1.346s^2 + 2.482s$ and since $N = s^2 + 1.516s + 1$, so

(*Continued on page 120*)

Cinch ELECTRONIC COMPONENTS

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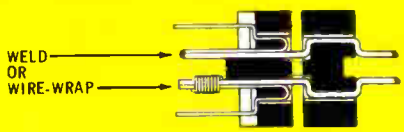

CUTAWAY VIEW

The ultimate in connector reliability has been achieved with the new Cinch ULTREKON. This unique connector is designed to meet rigid military and aerospace reliability requirements. It is equally useful in computer and other high reliability applications.

The ULTREKON is a connector that combines the advantages of a plug and socket device with the reliability of a permanent connection. It provides a *basically* reliable connection by just mating the halves. For ultimate reliability, the mated contacts are bonded together by wire-wrapping or welding. With the contacts bonded, *reliability is of the same order of magnitude as that of an uninterrupted conductor.*

The ULTREKON achieves its maximum versatility by serving first as a conventional connector for test and checkout purposes, and then after testing, with the leads bonded, as a permanent unit. The leads may be unbonded later and used again. When welding is used, the contacts can be clipped and rewelded twice, after the original welding; with wire-wrapped leads the connector can be reused many times.

The ULTREKON is available in both miniature and subminiature sizes, with the contact and leads spaced for welding or wire-wrapping. Leads also can be adapted for printed circuit, module or flat cable connection.

Type	Contacts (Double Row*)	Spacing	Size
Miniature Type 1	34	.100	2.420" x .750"
Miniature Type 2	18	.200	2.420" x .750"
Subminiature Type 3	34	.050	1.502" x .400"
Subminiature Type 4	18	.100	1.502" x .400"

*Single row versions also available.

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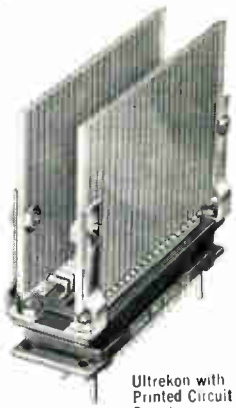
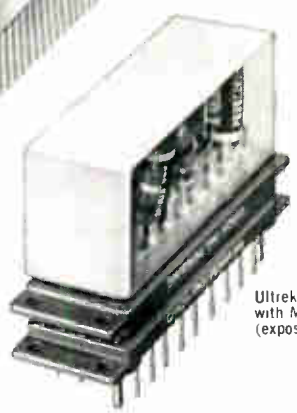
Type 3
Actual Size



Ultrekon with Printed Circuit Board

Ultrekon with Flat Cable



Ultrekon with Module (exposed view)

See the ULTREKON and other Cinch connectors at the IEEE Show—Booths 2537-2540

CM-6303

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Circle 40 on Inquiry Card

INTERVIEW WITH A LEADING MANUFACTURER OF MILITARY COMMUNICATIONS EQUIPMENT

"What", we asked ourselves, "is Manson Laboratories doing with *three* of our SSB-3b Spectrum Analyzers?" We hurried over to the Hallicrafters subsidiary at Stamford, Conn. to have a look. What we saw was a study in smart analyzer usage.

One of Manson's engineers on the Navy's Single Sideband HF Communications System took us in tow. He wheeled the cart-mounted analyzer over to a Manson Model 508 Exciter (AN/URA-39)—a synthesizer-disciplined SSB transmitter signal source developing 300 million discrete channels, each with a frequency stability spec of 1 part in 10^8 per day.

"We test the whole gamut of Army, Navy, and Air Force specs," he said, switching in the analyzer's integral two-tone AF generator for an IM distortion test. The two audio tones were fed into the input of the exciter and resulted in an RF output which appeared on the analyzer screen as twin pips 20 db above full scale log. We studied the IM third order distortion discernible at 60 db down.

"We've used three different makes of analyzers and recommend the PANORAMIC instrument without hesitation," said Manson's spokesman. Its compactness and portability make it especially convenient and the console is well planned for a variety of uses."

We discussed this last point as he ran through a series of transmitter performance tests: spurious signal suppression, audio modulator distortion, vestigial sideband and carrier levels, heterodyne oscillator rejection, harmonics . . .

"The analyzer is low in hum and has excellent skirt selectivity," he said, switching to the preset 150 cps narrow sweep width. "Stability? Outstanding! Steady as a rock. Dynamic range is excellent, too. It was about —70 db when we first got the instrument from Hallicrafters...still around —65 db.

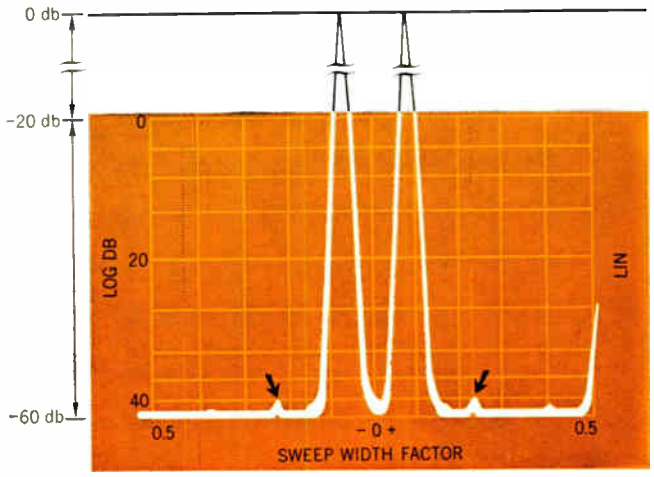
"And reliability is very important," he continued. "The SSB-3b is almost entirely self-checking anyway, and with the confidence we have developed in the instrument, there's rarely any need to apply an outside reference.

"The integral two-tone audio generator is a great convenience, and we like the well-calibrated tuning dial which directly reads-out the frequency of the signal under test."

Elsewhere we saw an SSB-3b testing a Single Sideband Conversion Kit Manson is developing for the Air Force. Later, we were told, the analyzer would check out the prototype transmitter. Tests included observation and measurement of heterodyne oscillator rejection, carrier suppression, and IM of both audio and RF portions. Individual circuit analyses were also being made on exciters and transmitters for the Navy — units that will be tuned automatically from remote locations for point-to-point communications.

A busy shop, Manson, packed with the kind of sophisticated equipment that warms the heart of an engineer . . . especially when his own test gear is giving it a workout!

Hallicrafters' Manson Laboratories is just one of scores of users who find the PANORAMIC *SSB-3b an ideal spectrum analyzer for adjusting, monitoring, and trouble-shooting their SSB and AM equipment. Our applications engineers will be glad to discuss your requirements at your convenience and without obligation.*



CRT detail of SSB-3b Analyzer shows two-tone test signals deflected 20 db above full scale. Third order IM products at arrows are seen to be 60 db from sideband level.

Description: Model SSB-3b Single Sideband Spectrum Analyzer is an automatically scanning instrument similar to AN/URM-134A, consisting of:

- Model SB-12bs Panalyzor
- Model RF-7a Tuning Head, 2 to 40 mc
- Model TTG-2 Two-Tone Audio Generator, 100 cps to 10 kc
- Model PRB-2a High Impedance Probe
- Model REC-1 Range Extending Converter (optional), extends range down to 10 cps for base band and receiver audio and IF output analyses
- Model TTG-5 Two-Tone RF Generator (optional), for receiver testing with five crystal-controlled output pairs centered at 3, 6, 12, 21, and 30 mc, up to 10 kc separation. Also single output frequencies
- Model MMD-1 Cart Mounting (optional)

Specification Highlights

- Frequency range: 2 to 40 mc; down to 10 cps with Model REC-1 Range Extending Converter. 1% tuning dial accuracy. Search-and-fine vernier tuning dial ranges (10:1 ratio)
- Frequency response: ±3 db, 10 cps to 40 mc
- Dynamic range: all odd-order IM products at least 60 db down; 65 db upon request
- Sweep width: "Variable" mode, 0 to 100 kc adjustable; 0 to 2 kc AFC stabilized narrow band; "Preset" mode 150 cps and 500 cps, with AFC as well as 3.5 kc, 7 kc, and 14 kc; all with automatic optimum resolution
- Resolution capability (150 cps sweep width): 10 cps resolution 3 db. Skirt selectivity: 50 cps bandwidth, 60 db down enables precise measurement of power line hum sidebands
- Sensitivity: less than 2 mv for full scale log deflection
- Integral Two-Tone Audio Generator: Model TTG-2; each audio frequency variable from 100 cps to 10 kc. Digital frequency selection. Accuracy, ±2% (±1% optional). Output may be from either oscillator or mixed. 600 ohm balanced and unbalanced outputs. 0 to 100 db attenuator, adjustable in 1 db steps. Output amplitude adjustable from 2 to 4 volts per tone (metered). Hum, noise, microphonics, odd-order and harmonic distortion at least 60 db down.

For complete details and specifications write for 6-page Bulletin on Model SSB-3b and PANORAMIC *Analyzer Number 3 on SSB measurements.*

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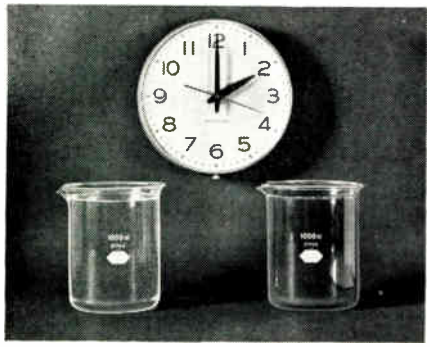
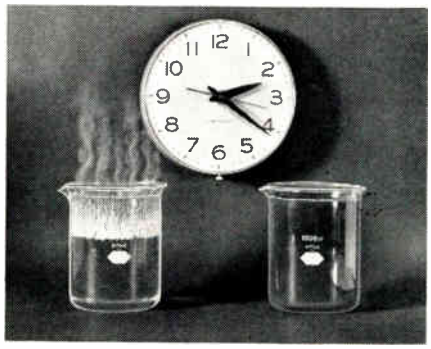
Choose the ideal resin for your needs from the complete family of "Scotchcast" semi-flexible Room-Curing resins below. And for specific assistance see your 3M "IQ" Man.* "Scotchcast" Resins are also listed in VSMF.

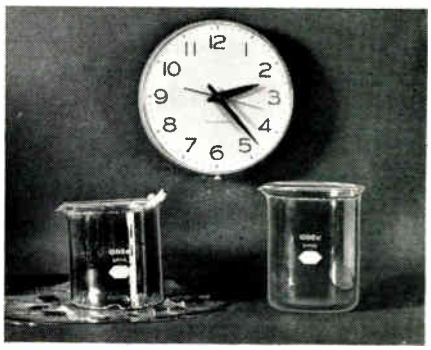
*"IQ" means Insulation Qualified. Your 3M Man is trained and qualified to help you with your electrical insulation problems. Call him, or write: 3M Co. Bldg. 220-5W, St. Paul 19, Minn.



Both resins (1,000 gram quantities) are room-curing epoxies. "Scotchcast" No. 8 is at right, ordinary epoxy resin is at left.



After 20 minutes, evidences of heat build-up and stresses are visibly apparent in the ordinary epoxy resin.



At 23 minutes, ordinary resin shatters the glass container. "Scotchcast" No. 8 remains stress-free, assures longer pot life.

BASIC CHARACTERISTICS—"SCOTCHCAST" SEMI-FLEXIBLE ROOM CURE RESINS

	UNFILLED	FILLED	THIXOTROPIC	FLAME OUT FILLED
PRODUCTS	8	9	10	XR-5059
DESCRIPTION	Low viscosity. Excellent wetting and adhesion for impregnation of fine wire coils.	Medium viscosity. Extreme low exotherm. Excellent shock resistance. Better heat transfer.	Ideal sealing and patching epoxy. Spreads like peanut butter. Won't sag. Apply by spatula or extrusion.	Like No. 9 but with immediate flame out characteristics.
MIXING RATIO A TO B Wt. or Vol.	1 to 1			
SPECIFIC GRAVITY	1.11	1.50	1.52	1.40
INITIAL VISCOSITY	5700 cps	25,000 cps	PASTE	18,500 cps
POT LIFE MIXED RESIN	1 to 2½ HOURS (depending on mass)			
CURE CYCLES	72°F for 24 hours Or 140°F for 2 hours			
LINEAR SHRINKAGE DURING CURE	Less than 1%			
HARDNESS SHORE D	70	75	75	80
GUIDE TO AIEE TEMP CLASS	B	B	B	B

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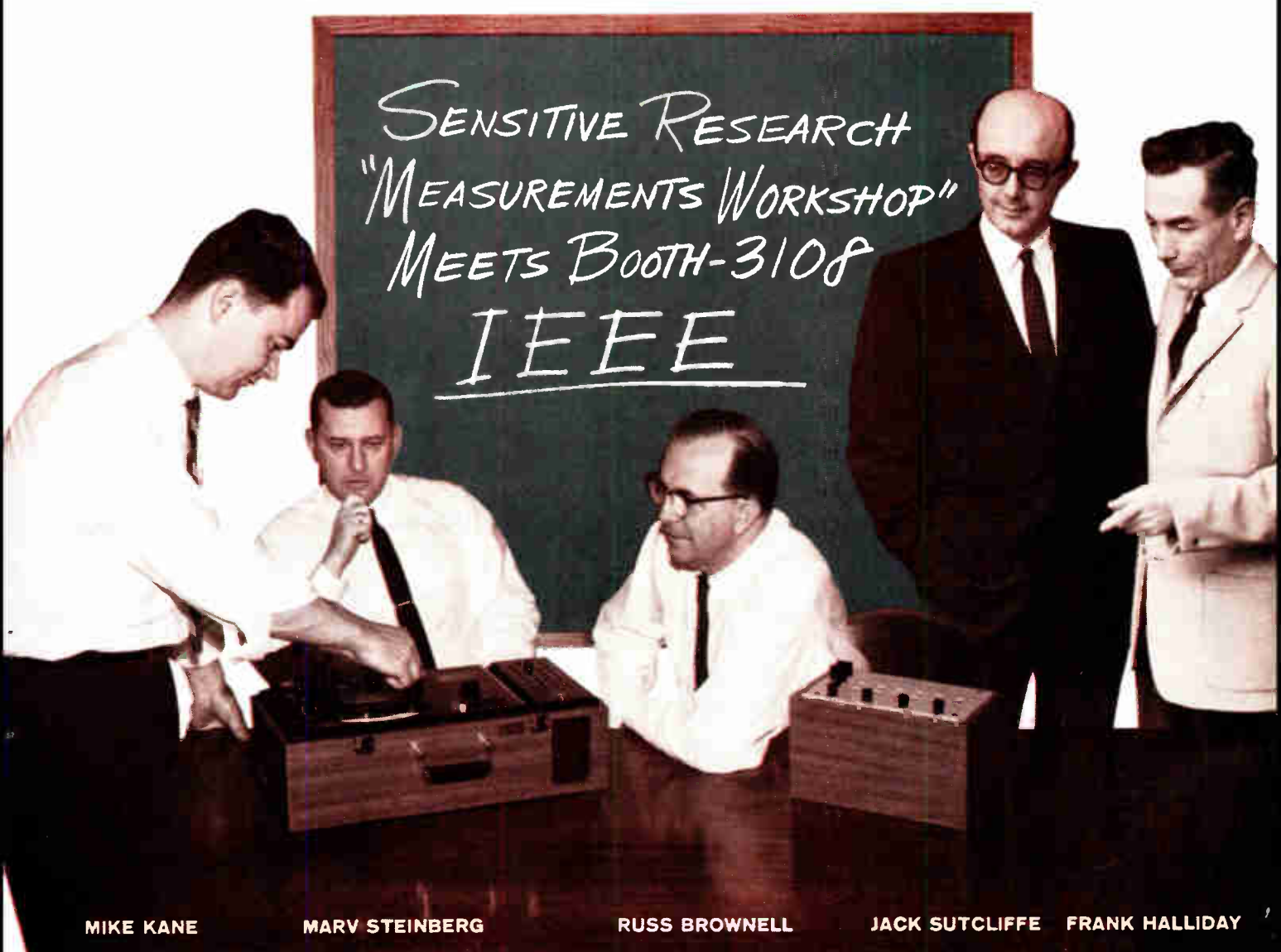

CHEBYSHEV FILTER (Concluded)

that the ratio of the respective coefficients is near unity.

Fig. 3 shows a type of negative impedance converter (NIC) proposed by Yanagisawa. Properly, the given values must be frequency transformed impedance.[13]

The step function response of the filter from $t = 0$ is measured at the time the response envelope is within the δ tolerance. This duration is approximately 250 msec., or approximately ¼ of a cycle of f_{1c}.

Active vs. Passive

The cost is competitive with a passive realization. For low frequencies the cost of passive realization tends to be dominated by the price of shielded linear transformers. The cost of active realizations is dominated by the availability of required power.

If the accuracy requirements are modest, as in the above example, and there is no common mode problem,[14] then the additional power supply cost may be distributed over the number of signal channels. If additional plugs and leads constitute the only increase in power supply cost, the active realization may be quite economical.

As the accuracy requirements grow tighter and the f_{2c}/f_{1c} ratio grows smaller the cost of active realization may become exorbitant. Usually one of the three realization techniques mentioned, (refs. 8, 9, 10), can be used to realize a relatively stable structure. For example, in the text the $K(s)$ chosen influences cost. The degree of $K(s)$ chosen in the text was greater than need be in the interests of stability. The actual cost increment, assuming cascade realization, was not great.

For general areas of accuracy, attenuation and cutoff ratios; a set of difficulty-complexity, price-complexity and stability-complexity curves may be extremely useful. Such curves are somewhat tedious in developing for the various methods involved.

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    Guillemin, E. A., *op. cit.*, Chapter 4.
13. Cauer, W., *op. cit.*, p. 301.
14. Morton, W., "Quiet Wiring," *Electro-Technology*, Mar., 1961.

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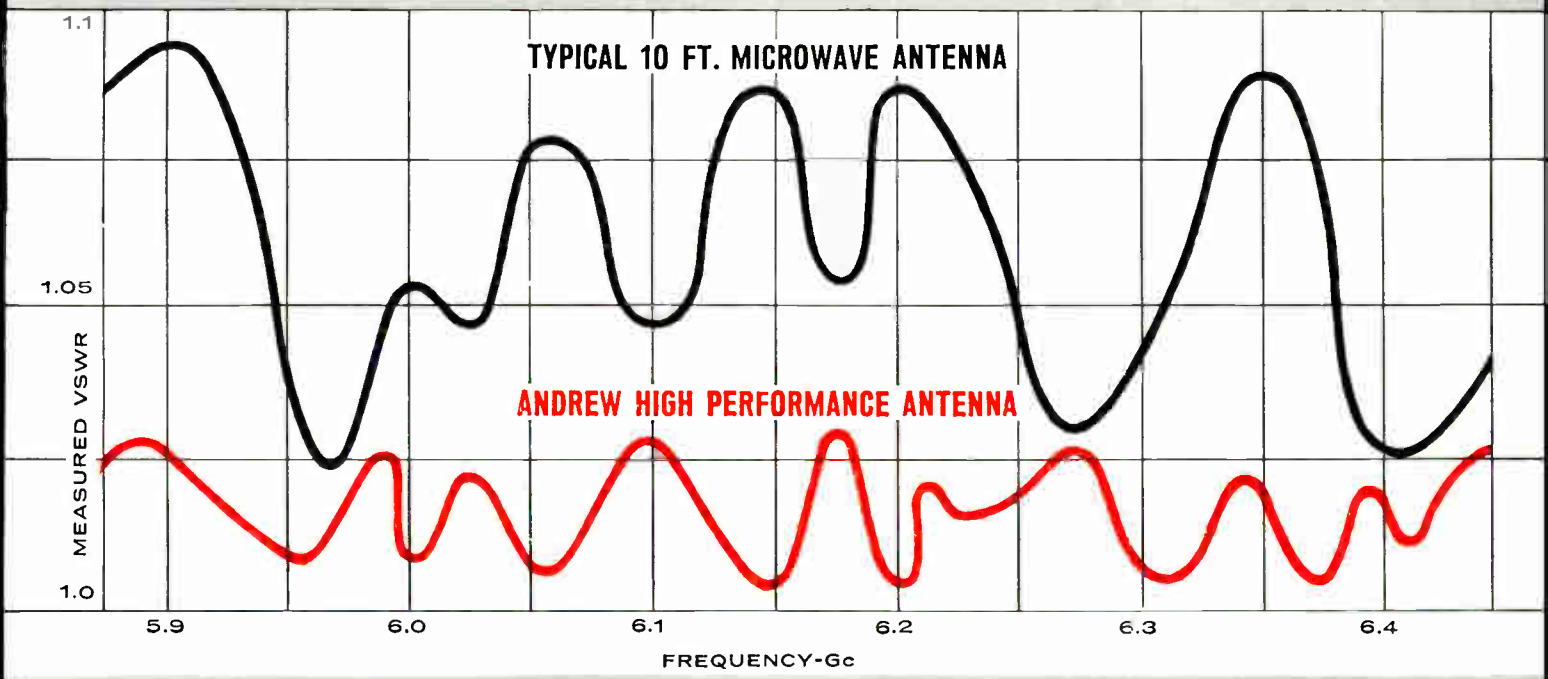

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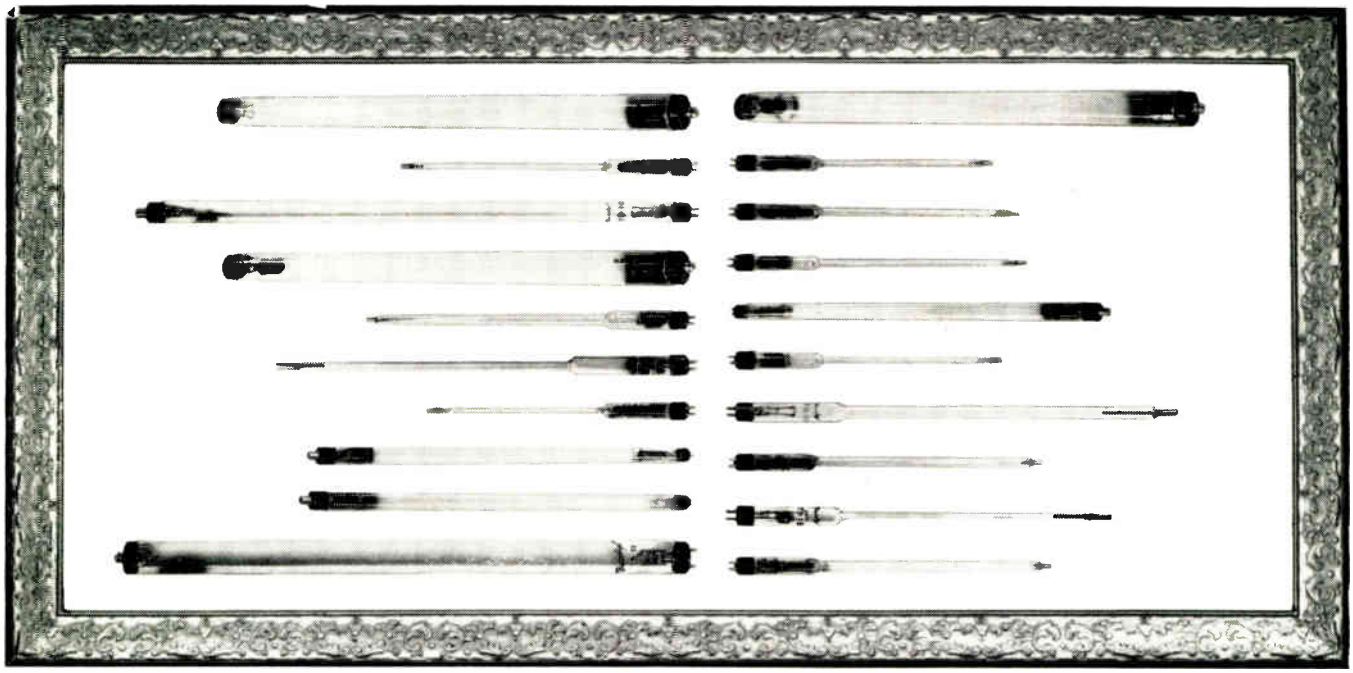
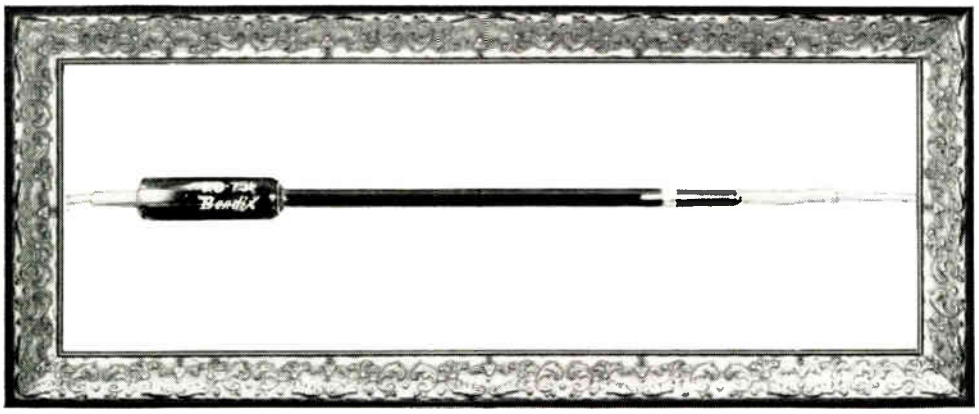


Our gas-noise tubes are free from ambient temperature variations, are durable and dependable, and can be matched to your applications. One of our family is missing from this picture.



He took the Venus trip with Mariner II.

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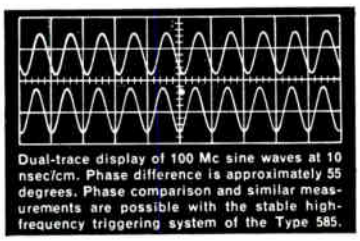
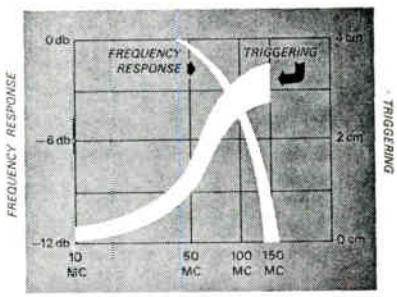
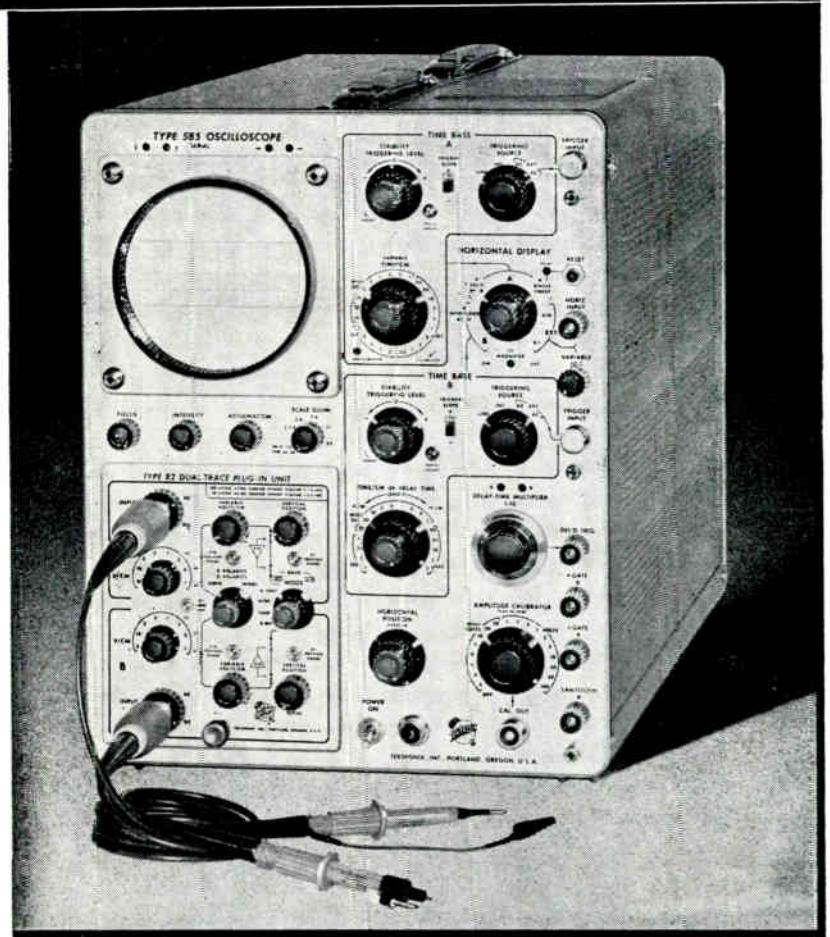
Tektronix Type 82 Plug-In Unit in a Type 581/585 Oscilloscope



Dual-trace display of 100 Mc sine waves at 10 nsec/cm. Phase difference is approximately 55 degrees. Phase comparison and similar measurements are possible with the stable high-frequency triggering system of the Type 585.



Typical frequency response and triggering characteristics of 580/82 combination—showing minimum number of centimeters necessary for triggering.



Supplied small size passive probes provide high input impedance characteristics. Probes increase input R to 10 megohms and decrease input C to approximately 7 pf.

Risetime (of supplied probe, plug-in unit, oscilloscope) at overall sensitivity of 0.1 v/cm is approximately 5¼ nsec.

OTHER CHARACTERISTICS of plug-in and oscilloscope

- RISETIME — nominally 4.3 nsec at 10 mv/cm and 4.0 nsec at 100 mv/cm.
- CALIBRATED STEP ATTENUATION—variable between steps.
- 4 OPERATING MODES—with independent controls for each channel for individual attenuation, positioning, inversion, and ac or dc coupling as desired.
- INTERNAL AND EXTERNAL TRIGGERING—to beyond 100 Mc.
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- SINGLE-SWEEP PHOTOGRAPHY—at 10 nsec/cm for recording fast transients.
- CONVENTIONAL PASSIVE PROBES—for measurement convenience.
- COMPATIBILITY WITH .17 LETTER-SERIES PLUG-INS—to permit differential, multi-trace, sampling, other laboratory applications—when used with Type 81 Adapter.
- BRIGHT, HIGH RESOLUTION DISPLAY—with small spot size.

Call your Tektronix Field Engineer for a demonstration of the new dual-trace unit in a Type 581/585 Oscilloscope.

Type 82 Dual-Trace Unit . . . . . $ 650
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Type 581 Oscilloscope (without plug-in) $1425
Type 585 Oscilloscope (without plug-in) $1725

Type 585 Oscilloscope has 2 modes of calibrated sweep delay—either triggered or conventional—ranging from 1 μsec to 10 seconds.

TYPE 81 ADAPTER enhances versatility of the oscilloscope

The Type 81 Adapter allows insertion of Tektronix letter-series plug-ins. Bandwidth (up to 30 Mc) and Sensitivity depend upon plug-in used.

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Circle 65 on Inquiry Card ➔

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

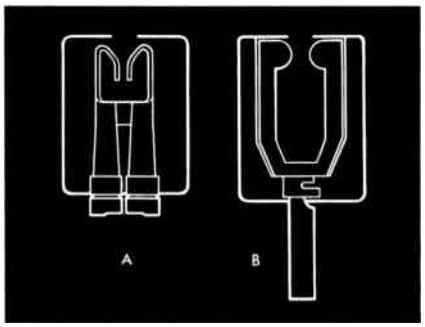
"How to connect connectors to the rest of the system" also merits a good deal of consideration. In some cases, hand soldered terminations will do just fine. In others, higher volume requirements call for high production rate methods like dip soldering and wire-wrapping. Some engineers prefer taper pin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

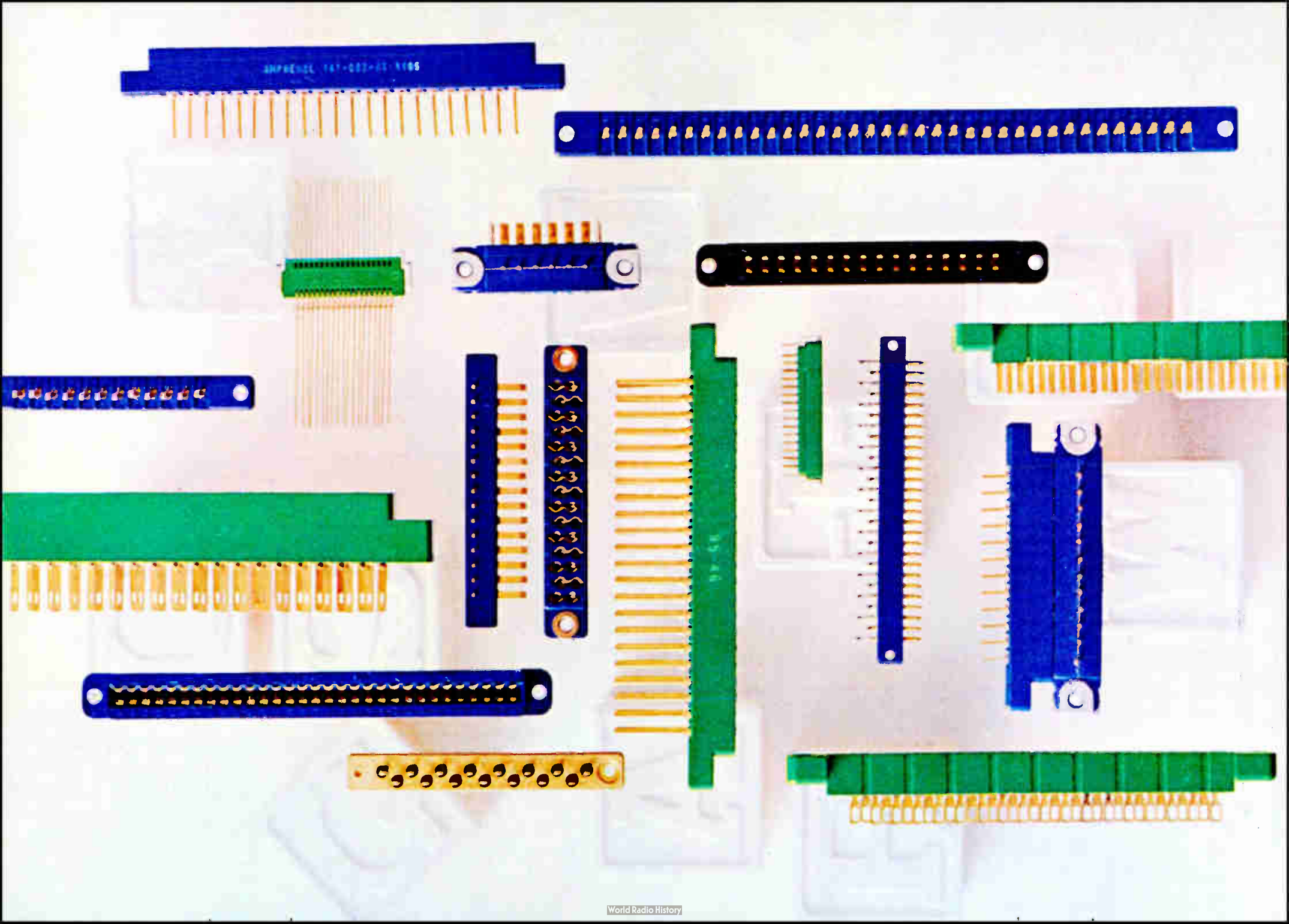
Any Amphenol Sales Engineer or authorized Amphenol Industrial Distributor will be happy to discuss printed circuit connectors (ours) with you. Or, if you prefer, write directly to Dick Hall, Vice President, Marketing, Amphenol Connector Division, 1830 S. 54th Avenue, Chicago 50, Illinois.

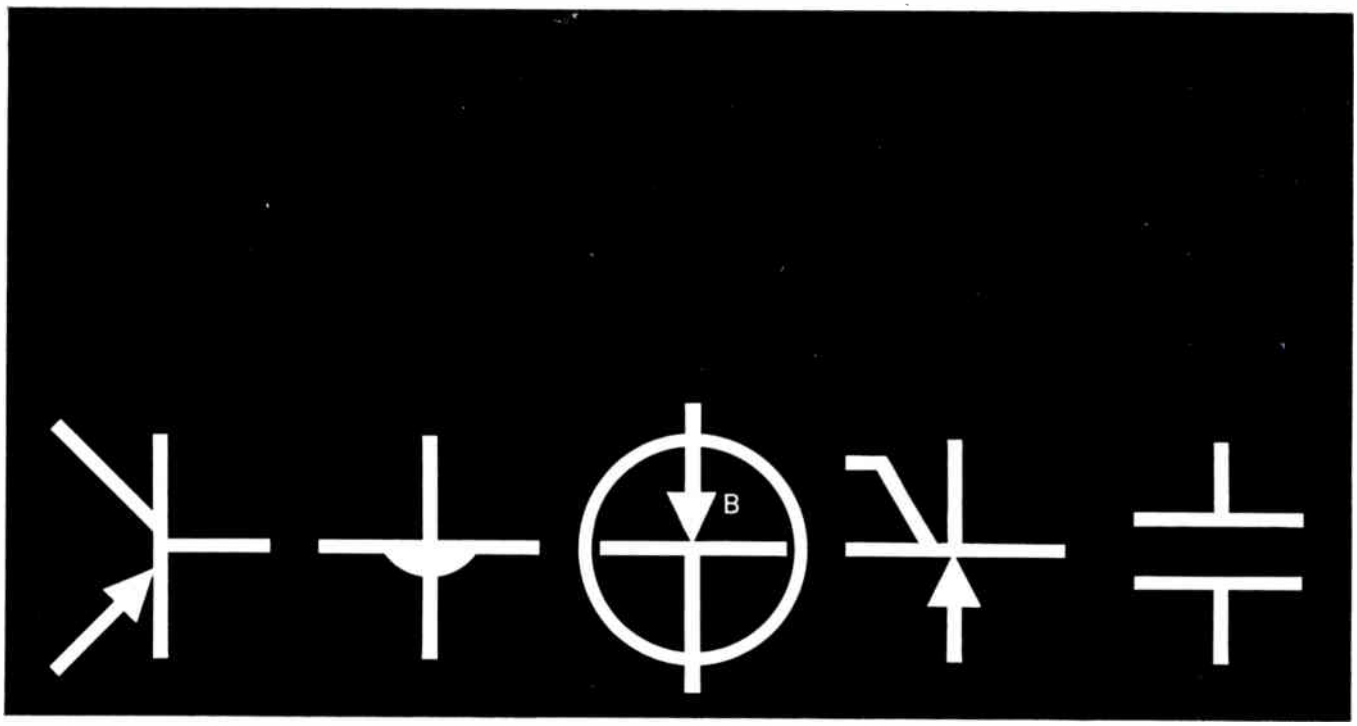
*T.M. Amphenol-Borg Electronics Corp.

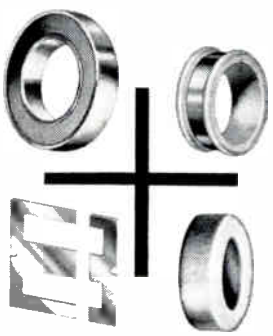


Wedging action of Amphenol ribbon-type (A) and long spring base of Amphenol Prin-Cir connectors (B) assure firm printed circuit board retention, whether board happens to fall at low (.055") or high (.073") end of thickness tolerance.

AMPHENOL **Connector Division** / Amphenol-Borg Electronics Corporation







Want component compatibility in complex circuits? Get more from magnetics

THE CORE: properly matched with transistors, tunnel diodes, or Zeners, tape wound cores of Orthonol or Square Permalloy 80, for example, have the square loop characteristics that make for highly efficient converters/inverters, timing elements, or circuits for long time delay. In the latter, circuit output can be used to drive high impedence relays or SCR's. The compatibility of linear permalloy powder cores and polystyrene capacitors makes for frequency stability over a wide range of temperatures in audio filter networks. How do you capitalize on the advantages of 8 material types in tape cores, the 60 mu to 200 mu range of powder cores, the 550 mu characteristic of flake cores, or the alloy vs shape advantages of laminations? Simple. Ask the *man from Magnetics Inc.* for specific information next time he's around.

THE MORE: using tape cores with transistors to achieve time delay, for example, often results in greater accuracy and simplified circuitry. Combining conventional components with high mu laminated cores instead of ordinary steel lams in filter circuits often means better frequency control, greater efficiency and smaller over-all size. We design, produce and stock hundreds of powder cores with 60 to 200 permeability, tape cores in 8 material types, flake cores, and laminations with dozens of shapes and sizes. And we've spent a lot of time learning what's most compatible with what, as a matter of good business (yours and ours). Helping you select what's right for your application is the service offered by the *man from Magnetics Inc.* Problems can't wait? Write details on your letterhead to Magnetics Inc., Butler, Pennsylvania.

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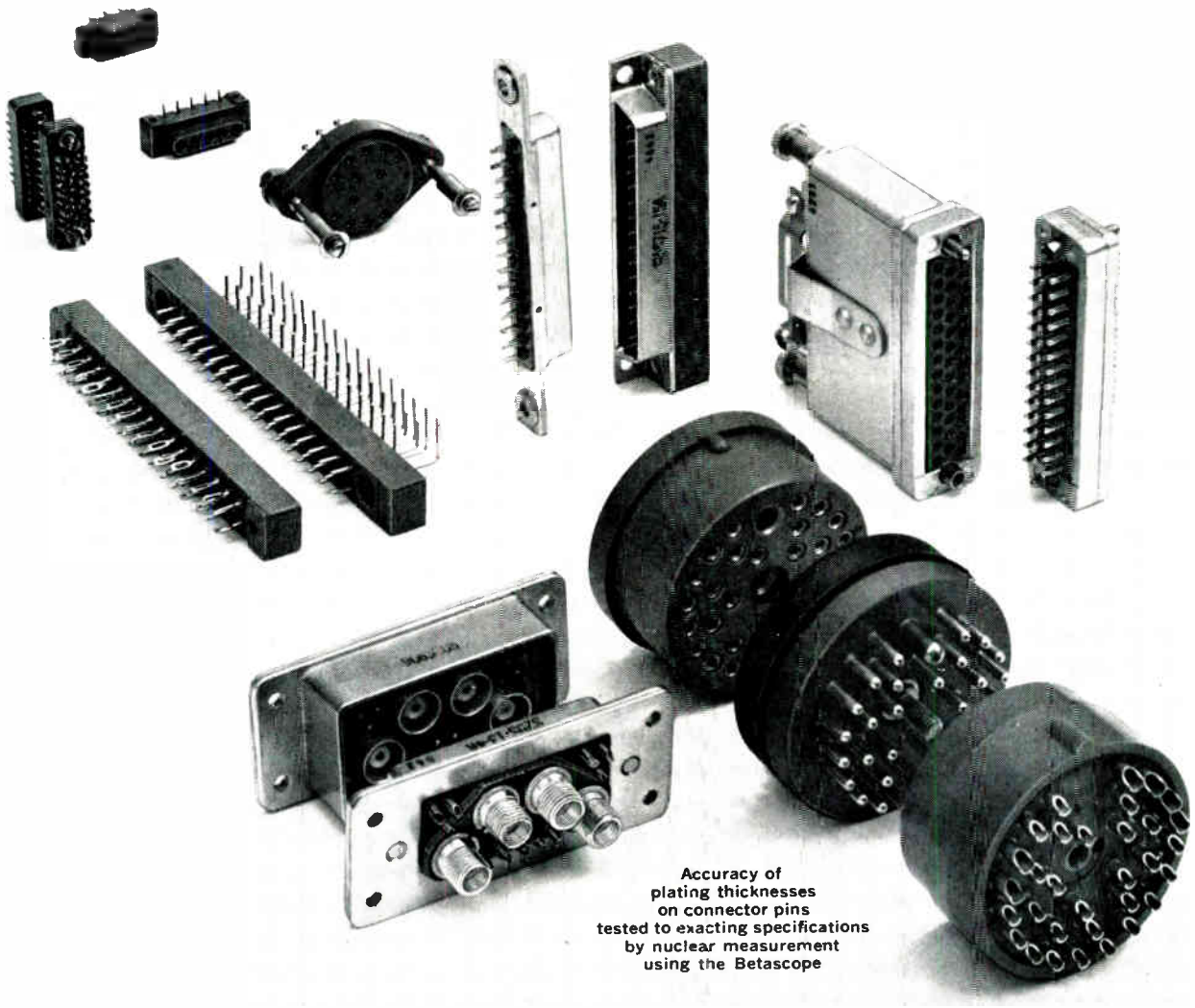
MAGNETICS inc.

LIONEL CONNECTORS



Accuracy of plating thicknesses on connector pins tested to exacting specifications by nuclear measurement using the Betascope

SPECIFIED TODAY — DELIVERED TOMORROW

Project Engineers are specifying LIONEL Connectors for applications ranging from their most demanding aircraft and missile requirements to their simpler needs, where pennies count—and find them delivered fastest. ■ LIONEL's extensive connector inventory covers a wide range of types, sizes and configurations, meeting applicable MIL specs or designed for optimum efficiency in commercial uses. ■ Whether your connector need is simple or complex — or compounded by environmental problems of temperature extremes, vibration, moisture or the atmosphere — call LIONEL. ■ For your most exotic or sophisticated connector applications, rely on the years of LIONEL-ANTON connector know-how and ingenuity. Our custom design service always available to meet new challenges.

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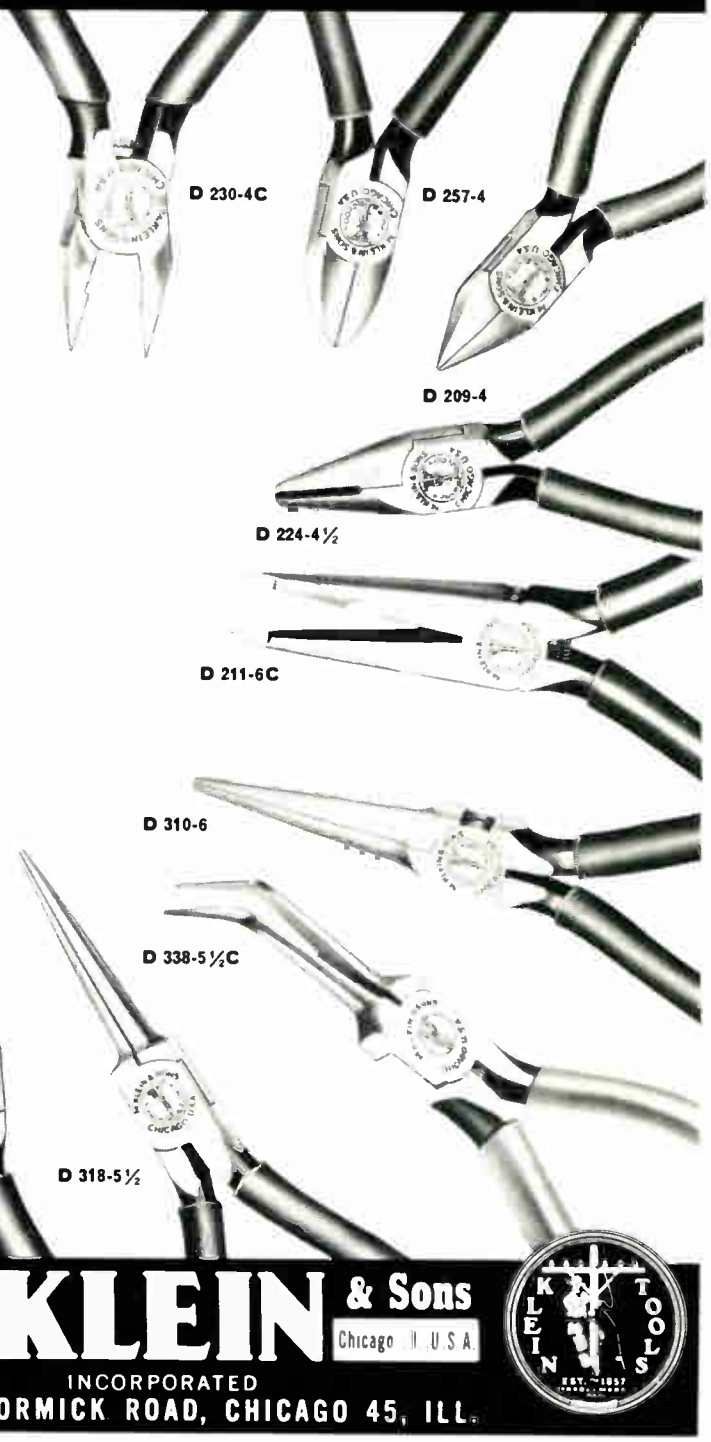
MORE THAN 100 KLEIN PLIERS SPECIALLY DESIGNED FOR THE ELECTRONIC FIELD

Special skills are important in the wiring of today's sophisticated assemblies for electronic and telemetry systems. Klein has developed special pliers to assist in solving difficult assembly problems.

- For instance, there is a plier with a blade as hard as a file for cutting nickel ribbon wire (No. D230-4C).
- For instance, there is an oblique cutter, specially designed for printed circuits . . . it cuts and crimps the end to hold wire in place for soldering. (D 052-C).
- For instance, there is a needle nose plier with the tip bent to facilitate reaching into confined spaces. D 338-5½ C.

In all, there are over 100 different styles and sizes of pliers available from stock. Klein will be glad to discuss with you the development of a special tool to solve a particular problem you may be facing.



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The Klein Plier Catalog illustrating and describing the complete Klein line of pliers is available on request.

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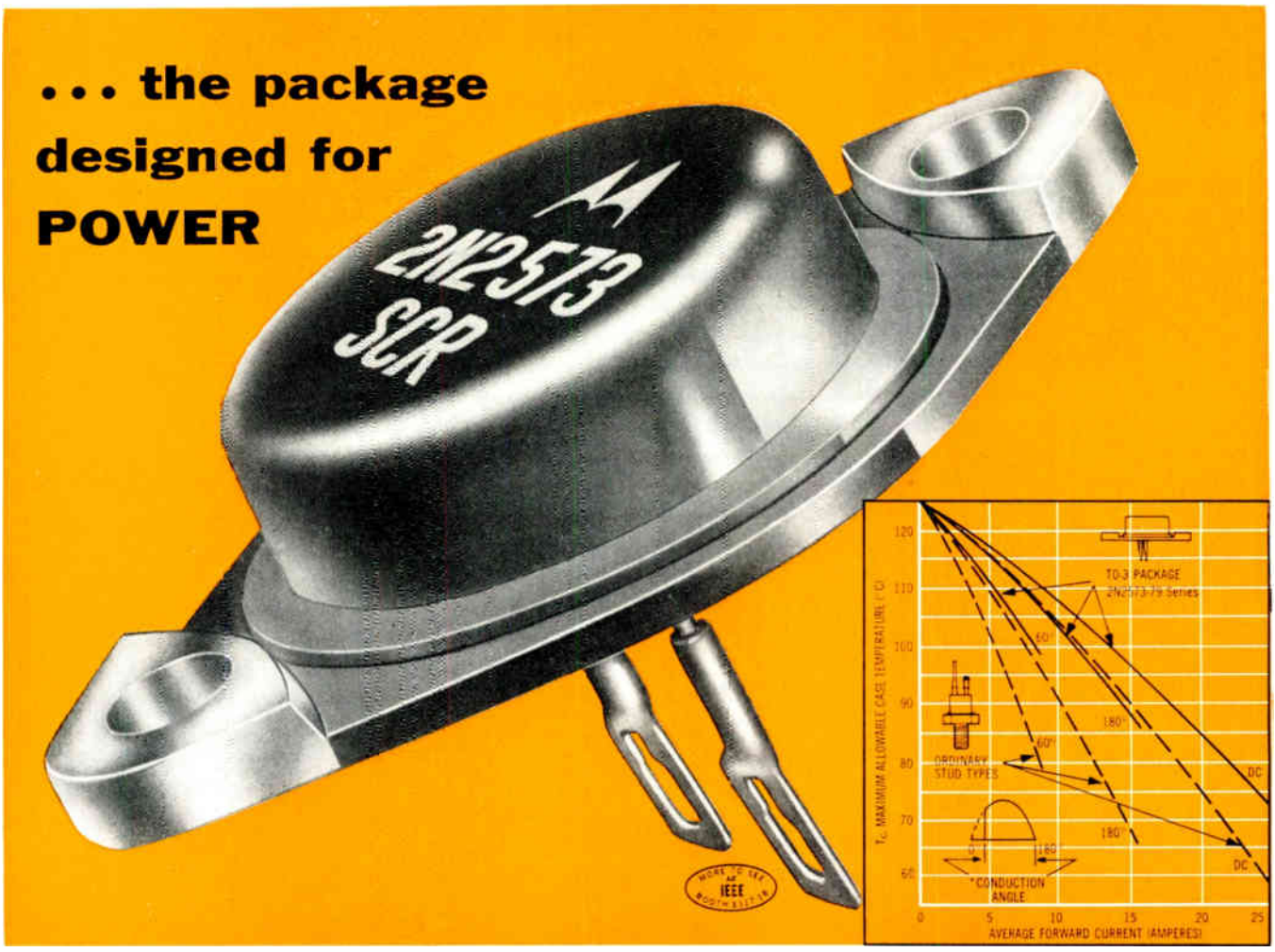
ANOTHER SCR PACKAGE FROM MOTOROLA FOR YOUR CONTROL APPLICATIONS



MOTOROLA'S NEW 25-AMP SILICON CONTROLLED RECTIFIER GIVES YOU FULL POWER AT HIGHER TEMPERATURES

These new Motorola 25-amp silicon controlled rectifiers (types 2N2573-79), electrically equivalent to the 2N681-9 series stud-type SCR's, utilize the natural power operation advantages of the TO-3 package design to give improved performance over stud-mounted devices in areas such as:

- **Higher DC current output — 25 amps @ 71°C**
- **Higher surge current — 260 amps at rated load @ 125°C**
- **Lower thermal resistance — 1.5°C/W**
- **Freedom from failures due to excessive stud torquing**
- **Lower vertical dimension — only .41"**

With the low forward voltage drop (only .7 volts @ 16 amps full cycle average, 180° conduction angle, $T_J = 125°C$) plus the low thermal resistance of the TO-3 package, you can operate at higher current levels for any given case temperature . . . or in applications with lower current requirements, you can reduce the heat sink area required for your equipment.

Find out for yourself how the TO-3 package provides you with highest performance silicon controlled rectifiers at lowest cost for *your* equipment applications!

D-13 014

LOOK AT THESE PERFORMANCE ADVANTAGES

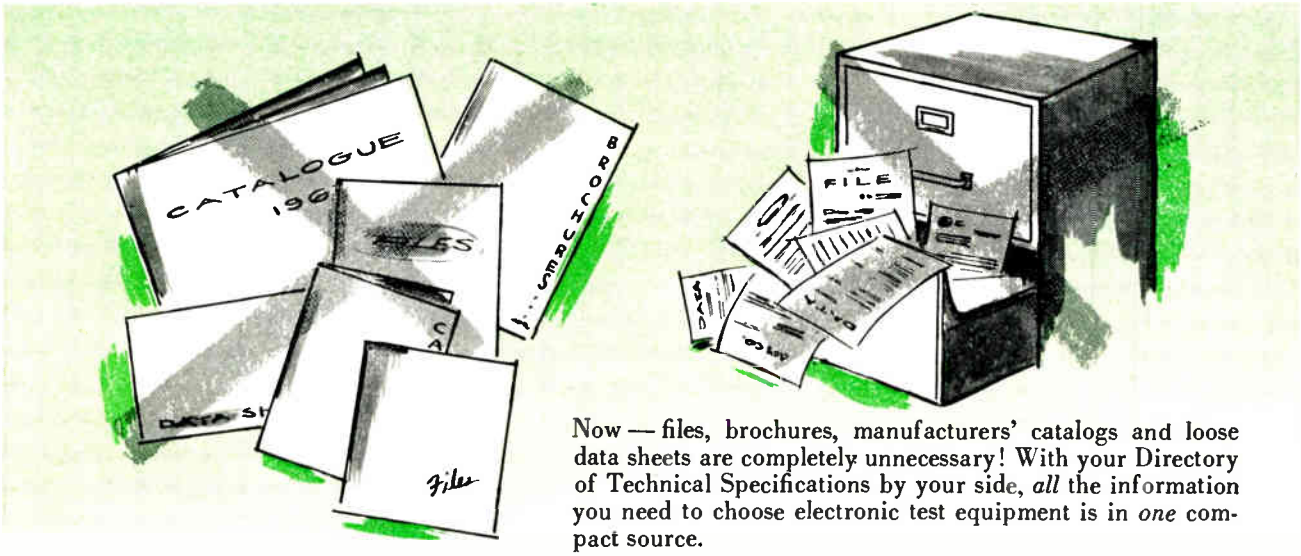
This chart gives key parameter comparisons for Motorola TO-3 package 2N2573-79 type and stud-type 2N681-89 silicon controlled rectifiers.*

	(2N685)	2N2576	
P_{LOSSES} (Av. forward power loss @ max. junction temp. @ I_{avg} above)	(24)	21	Watts
T_C (Max. allow. case temp. @ I_{avg} max. for 180° conduction angle)	(65)	85	°C
I_{surge} (Peak ½-cycle 60 cps surge current @ max. junction temp.)	(150)	260	Amps
I^2t (Max. subcycle surge rating as function of RMS current/time @ max. junct. temp.)	(75)	275	A^2sec

*Data obtained from published specifications

If you would like additional information on Motorola's 2N2573-79 series 25-amp silicon controlled rectifiers, contact your nearest Motorola District Office or Distributor or write Technical Information Center, Motorola Semiconductor Products Inc., Box 955, Phoenix 1, Arizona.

MOTOROLA
Semiconductor Products Inc.
A SUBSIDIARY OF MOTOROLA INC.
5005 EAST McDOWELL ROAD · PHOENIX 8, ARIZONA



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AC Amplifiers • DC Amplifiers • Microwave Amplifiers • High Current DC Power Supplies • Laboratory Type DC Power Supplies (Parts I & II) • DC High Voltage Power Supplies • Special Purpose DC Power Supplies • AC Power Supplies • Signal Generators • Oscillators • Pulse Generators • Sweep Generators • Noise Generators • Square-wave & Function Generators • Fixed Attenuators • Variable Attenuators • Phase Shifters • Variable Filters • Receivers • Time Delay Units • Shorts • Mismatches • Fixed Loads • Variable Loads • Waveguide Directional Couplers • Coaxial Directional Couplers • Isolators • Lab Type Voltmeters • Multimeters • VTVM's • Digital Voltmeters • Ohmmeters • Wattmeters • Phase Meters • Waveguide Frequency Meters • Low Frequency & Coax Frequency Meters • Frequency Counters • Field Strength Meters • SWR Meters • Oscilloscopes • Spectrum Analyzers • Wave Analyzers & Distortion Meters • Slotted Lines

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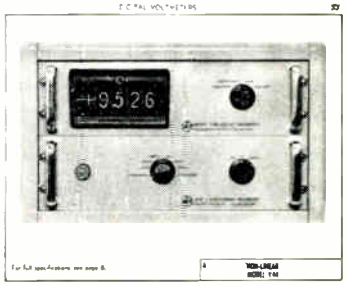

Everything is complete, logical and concise!

Here's how the data appears in the Directory:

DIGITAL VOLTMETERS

Photo See Page	MANUFACTURER	MODEL	No. of Ranges	VOLTAGE Min.	VOLTAGE Max.	Acc. %	Polarity	Read-out Type	Read-ing Modes	Speed Rdgs /sec	Input Imp. Ohms	AC Freq.	OUTPUT Type	OUTPUT Printer	RATIO MEAS. Min.	RATIO MEAS. Max.	Ref. Input
	CUBIC (A)	V-70 J	3 manual	.001	999.9	• .01 ±1 digit	manual	d	manual	•	10M @ balance	converter a • dec	• BCD or dec	•	-	-	-40db @60cps filter
	CIMRON (A)	6100 J V	3 manual	.001	999.9	± .01 ±1 digit	manual	f	auto-matic	•	• 10G @ balance	30cps -10kc •	none	none	.0001	99.99	up to 100v 50kΩ
33	NON-LINEAR SYSTEMS (A)	V44 J	3 manual	.001	999.9	0.01 fs ±1 dig	auto-matic	d	auto manual remote	200 const-ant	10M	30cps -10kc •	BCD & dec-imal	l m n o p	-	-	-

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The Directory of Technical Specifications can end all of this for you. It lists over 40 different categories of instruments, and gives complete specifications of *all* models from *all* manufacturers selling in the United States (over 500). You can make model-to-model comparisons, quickly, since *all* important parameters are shown, in columns. Even prices are included! And to make the Directory especially easy to use, all instruments are arranged according to the parameter most important to you in making your selection!

Different models from the same company are *not* listed consecutively (unless the parameter so dictates) but *are* listed wherever they fit in relation to other manufacturers' equipment.

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DIGITAL VOLTMETERS

MECHANICAL Type	Width Inches	Height Inches	Depth Inches	Wt. Pounds	Price Dollars	NOTES	FOOTNOTES
R	19	5 1/4	14	28	1580.00	4. Absolute, rms sum of systems tolerances. 8. Balance time: 500ms average, 750ms maximum. 10. See AC digital voltmeter sec. 11.12. BCD or 10 line decimal to drive printer special.	l. Flexowriter. m. Electric Typewriter. n. Card Punch. o. Tape. p. Digital Recorder v. Ratiometer also.
C	17	5 1/4	14	26	1330.00	8. Bal rate:30 steps/sec.typical bal time 1sec. 9. On 9.999V, 11MΩ on 99.99 & 999.9V rngs. 10.See AC digital voltmeter sec. Front panel plug-in permits add of AC,preamp & ohms conv.	
R	19	10 1/2	15 1/4	65	6185.00 FOB dest.	10. See AC digital voltmeter sect. Millivolt ranges with model 140 preamp. 11. Outputs provided for parallel decimal & parallel binary coded decimal. 5ms balance time.	

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NEW PRODUCTS

UNIFORM MATERIAL

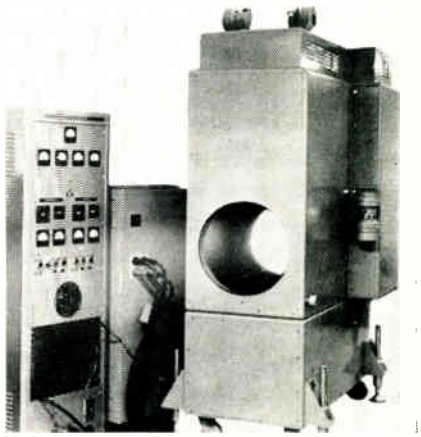
Uniforms for Clean Rooms of a multiplex nylon material called "Nydura."

Nydura is a continuous filament taffeta weave nylon with superior resistance to abrasion, offering remarkable freedom from garment linting. A high "absorbency," very good opacity and drape contribute to outstanding performance and wearer comfort used on coveralls, frocks, headcovers, boots and wiping cloths. Angelica Uniform Co., 1427 Olive St., St. Louis 3, Mo.

Circle 248 on Inquiry Card

SOLAR RADIATION SIMULATOR

Can be used with any space simulator without additional equipment.



"Solar Sim" (Model 147C) is a mobile, xenon and mercury-xenon (with infrared fill-in) solar radiation simulator. Available to irradiate an area of 12 or 18 in. dia., with close spectral match and collimation within 2°. Both earth (130w/sq. ft.) and Venus (275w/sq. ft.) intensities can be obtained. Uniformity is within 10% over the work dia. measured 6 ft. from the exit port of the simulator. Standard "Solar Sim" is 56 x 37 x 71 in. on casters. Tenney Engineering, Inc., 1090 Springfield Rd., Union, N. J.

Circle 249 on Inquiry Card

20 CPS TO 200 KC

ULTRA STABLE "AUDIO"

SWEEPING OSCILLATOR

KAY

Sona-Sweep MODEL M

141-C

- Sweep audio frequencies high-Q filters, tape recorders.
- Ultra-stable narrow frequency sweeps 20 cps to 200 kc.
- 200 cps to 200 kc in single frequency sweep.
- Both linear and logarithmic sweeps plus manual sweep control.
- Built-in audio detector.
- Fixed and variable pulse type markers.

VISIT KAY AT THE IEEE SHOW BOOTH 3512-3518.

New Alignment Technique

The Sona-Sweep Model M adapts the accepted techniques of r-f swept frequency alignment to audio and ultrasonic (e.g., tape recorder) bandpass measurements and adjustments. In addition, the highly stable response curve developed by the Model M and the parallel display provided by its manual control, give easier, more accurate checks of high Q filters and sharp slope devices.

Detecting At Audio

A major disadvantage of previous sweeping oscillator techniques for use at audio frequencies has been the difficulty of obtaining a clean envelope response. Usually, no single audio frequency detector covers the octaves of the full audio range. Often, too, the large bypassing necessary slows down detector response so as to make it inaccurate for changing (swept) conditions. To eliminate this difficulty, a synchronous detector has been provided, giving adequate bypassing down to about 200 cps.

Single Trace With Markers

A clean, detected envelope of audio frequency bandpass characteristics clearly defines amplitude vs frequency. The increase in trace intensity provided by the detected signal (rather than by a diffused a-f pattern) makes it much easier to view the response characteristics and to monitor any adjustments of the circuit under test. The sharp pulse type markers provided by the Model M precisely and clearly define critical points along the trace.

Model M — A Complete System

The Model M provides a complete measurement system, including—logarithmic, linear and manual sweeps, or a calibrated c-w signal; sharp, "crystal," pulse type frequency markers and precision step attenuator.

Variable Center Frequencies

The Model M is a double heterodyne sweep generator employing three crystal controlled oscillators. Either linear or log sweeps are available with center frequencies continuously variable between 20 cps and 200 kc. The swept output is blanked during retrace time, providing a zero-voltage base line. To eliminate phasing adjustments, a sawtooth voltage, synchronized with the swept output, is available to drive the X-axis of the scope.

Varied Sweep Rates

For checking high-Q circuits and low frequency response characteristics, variable rep rates down to 0.2 cps are available. This wide choice of rep rates, continuous to 25 cycles, plus a 30 cycle lock, permits selection of the optimum rep rate which gives an accurate response display of the circuit being tested, plus ease of viewing on the scope screen.

Varied Sweep Widths

Sweep widths are continuously variable from 20 cps to 200 kc. In each of three steps — 2 kc, 20 kc, 200 kc — new modulating circuits are switched in to provide maximum stability in each range.

Logarithmic Sweeps

A nominally logarithmic sweep, most useful for studying audio and video low pass circuits, provides an expanded view of the low frequency end, while showing overall frequency characteristics.

Manual Sweep

A manually controlled swept output provides a means of varying cw signal in synch with the oscilloscope display. The manual control covers the same frequency range to which the Model M is set for electronic sweeping. It can be used to examine response characteristics in detail, or in response to cw and near cw conditions. When the Sona-Sweep is used with an electronic counter and accurate voltmeter, it can perform all the checks where cw is preferred. In addition, it can utilize the counter and its scope synchronization feature to frequency calibrate the oscilloscope display.

High Level Output

The Model M delivers a high level output of 5 volts rms into 600 ohms over the entire frequency range. The built-in, precision step attenuator provides up to 59 db of attenuation in discrete steps. An additional 6 db of variable attenuation is provided. Output is flat within ±0.5 db.

SPECIFICATIONS

Center Frequency Range: 20 cps to 200 kc. Continuously variable.

Sweep Width — Three ranges: 20 cycles to 2 kc., 200 cycles to 20 kc., 200 cycles to 200 kc.

Sweep Output And Repetition Rates: Sawtooth for horizontal deflection of scope trace. Low impedance output, approx. 3 V pp.

a. Fixed at 30 cps in Line-Lock mode.

b. Variable 0.2 to 25 cps for logarithmic sweep.

c. Three continuously variable linear ranges: 0.2 cps to 1 cps, 1 cps to 5 cps, 5 cps to 25 cps.

Output Level: 5 volts rms into 600 ohms.

Flatness: ±0.5 db over widest sweep.

Markers: (Optional): Ten crystal pulse type markers, positioned at customer specified frequencies; e.g., 200 cycles, 500 cycles, 1 kc, 2 kc, 5 kc, 20 kc, 50 kc, 100 kc and 200 kc.

Markers designated for use at wide sweep (200 kc) are not applicable to other sweep widths. Specify whether for wide (200 kc) or narrow (less than 20 kc).

Calibrated CW Output: 20 cps to 200 kc.

Built-In Attenuator: Switchable steps, 3 db, 6 db, 10 db, 20 db, 20 db, plus 6 db variable.

Power Supply: Input approximately 220 watts. 117 volts (±10%), 60 cps B+ electronically regulated.

Dimensions: 19⅜" x 10⅞" x 16⅛".

Price:

$1295.00 f.o.b. factory $1425.00 f.a.s. N.Y.

$17.00 ea. for markers $19.00 ea. for markers

Weight: 57 lbs.

KAY ELECTRIC COMPANY

Dept. EI-3 • MAPLE AVE., PINE BROOK, MORRIS COUNTY, N. J. • CApital 6-4000

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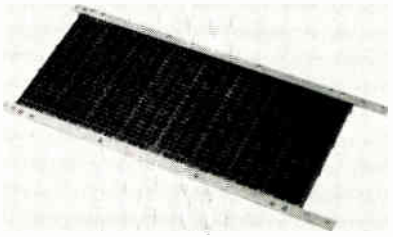
At I.E.E.E. . . .

NEW PRODUCTS

BUSS-LINE WIRING

Introducing a different concept in wiring.



This buss-line wiring technique offers contacts on strips which act as wires, furnished in endless reels, eliminating high cost and unreliability of soldering contacts to wires individually. Buss-lines also speed mass assembly wiring of complex circuitry. Another new product to be shown will be the company's Varipanels and Series 7028-7029 connectors, applicable to buss-line wiring. Elco Corp., Willow Grove, Pa.

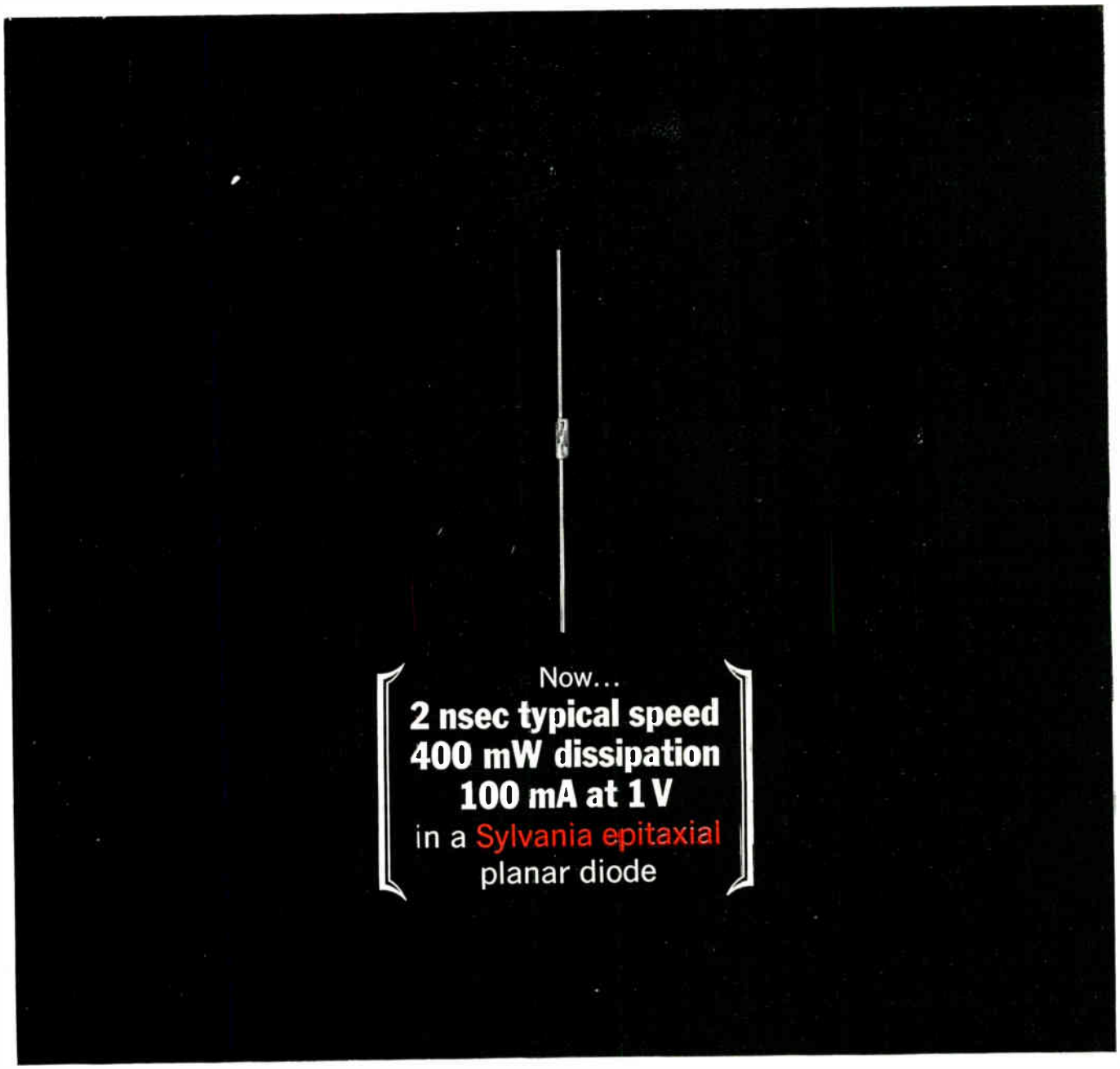
Circle 250 on Inquiry Card

NUMBERING MACHINE

Prints consecutive numbers, trademarks or type numbers.

The Model U-1065 Sequential Numbering Machine also prints value and date code directly on electronic components. Offset printing with metal type allows changing any part of the print, including resetting the automatic numbering unit, in seconds. Markem Super Kemgo Ink makes serial numbering possible as all the ink on the offset pad is transferred to the components. Markem Machine Co., Keene, N. H.

Circle 251 on Inquiry Card



Line 1 of the table shows the best combination of computer diode characteristics available today—all in an epitaxial planar diode with 400 mW power dissipation. ■ Not just the 1N3731, but all of these Sylvania silicon diodes are epitaxial planar, for these very good reasons: Epitaxial techniques—pioneered by Sylvania—provide the high speed, low forward resistance, and an optimum balance of breakdown voltage versus capacitance. The planar process adds other important features: low leakage and high reliability. It puts a protective passivated layer over the entire junction area. Reliability is further enhanced by the double hermetic seal—100% pressure-tested in Zyglo. And by the rugged one-piece construction, which stands up to the severest conditions of vibration and shock. ■ Rely on Sylvania for epitaxial planar diodes, and rely on your Sylvania Sales Engineer or Franchised Semiconductor Distributor to get them for you. For technical information, write directly to: Semiconductor Division, Sylvania Electric Products Inc., Dept. 2011, Woburn, Massachusetts.

	Avg. Fwd. Current mA (min)	Fwd. Current at +1 V mA (min)	Reverse Current μA (max)	Capacitance at C V μμf (max)	Reverse Recovery time nsec (max)	Reverse Peak Voltage V (min)
1N3731	275	100	0.05 at −50 V	2.0	3.0	100
1N3604	75	50	0.05 at −50 V	2.0	2.0	75
1N3064	115	10	0.1 at −50 V	2.0	4.0	75
1N914	75	10	.025 at −20 V	4.0	4.0	100
1N914A	75	20	.025 at −20 V	4.0	4.0	100
1N916	75	10	.025 at −20 V	2.0	4.0	100
1N916A	75	20	.025 at −20 V	2.0	4.0	100

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GENERAL TELEPHONE & ELECTRONICS

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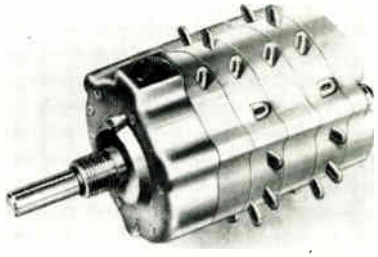
BOOTHS 2322-2332
AND 2415-2425

At I.E.E.E. . . .

NEW PRODUCTS

ROTARY SWITCH

Series 700 Switch available in shorting and non-shorting types.

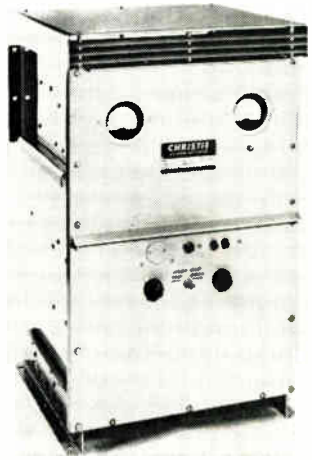


The Series 700 rotary switch also features: fully enclosed 1½ in. diameter; a variable detent action; positive positioning; 12 contacts in either nickel silver or coin silver rated 5a @ 115vac res.; 3a @ 28vdc res., and 2a @ 28vdc ind. It also included 3 solder lugs on common ring wafer instead of the usual 1 lug construction. Vemaline Products Co., Switch Div., Box 1, Franklin Lakes, N. J.

Circle 252 on Inquiry Card

XENON POWER SUPPLIES

Xenon Arc Lamp power supplies for simulators and data display.



Also suited for such applications as flight simulators and star tracking systems. These extremely versatile units may be used equally well with Zenon or Mercury-Xenon lamps, and feature automatic current regulation and extremely low current ripple. Each unit is designed to work with 2 or more lamp sizes. Output characteristic may be adjusted for operation of all lamps. Can be furnished to Mil specs. Christie Electric Corp., Box 43187, 3410 W. 67th St., Los Angeles 43, Calif.

Circle 253 on Inquiry Card

DALE RELIABILITY...

is assured in your circuit with

Deposited Carbon Resistors

Cutaway shows wide choice of protective coatings

DC Resistors – Miniature size, 3-layer lamination of silicone-base varnish protects against moisture and salt spray, high stability at low cost.

DCF – Epoxy coating gives complete insulation and environmental protection.

DCH – Hermetically sealed in non-hygroscopic envelope, can endure severe mechanical shock, can be clip mounted.

MC – Molded housing completely insulates and protects resistance element against environmental and mechanical damage.

Here's How Dale "builds in" reliability...

1. SPECIALLY-SELECTED CERAMIC CORES are heat treated to remove all surface impurities, then abrasive treated to assure maximum carbon adhesion. Untouched by human hands.
2. FIRM, HARD CARBON DEPOSIT is assured through the use of highest purity commercial gases. Adheres tightly to core with no loose particles.
3. ULTRA-PRECISE AUTOMATIC SPIRALLING is continually micro-inspected according to rigid Dale specification which insures accurate resistance values.
4. SILVER TO SILVER contact assures maximum conductivity between resistance element and lead. Silver-plated brass end caps are firmly affixed to silver band on each end of resistor. Tinned copper leads standard. *Weldable leads available.*

Dale Deposited Carbon Resistors are built to specifications which assure maximum reliability. From the start – when selected ceramic cores are processed for maximum carbon adhesion – to the finish – when specially formulated coatings are applied for complete environmental protection, Dale production is geared to give you INHERENT STABILITY and reliability. The rigid quality control procedures and materials procurement standards used in the production of all Dale resistors have reached new levels of achievement as a result of Dale participation in the **MINUTEMAN** High Reliability Component Development Program. EIA Color Banding and Reel Packaging is available for all Dale Deposited Carbon Resistors.

SPECIFICATIONS

• Meet requirements of MIL-R-10509D, Char. B. DC meets Char. X • Seven physical sizes rated at 1/10, 1/8, 1/4, 1/2, 1, 2, 5 watts • Resistance range from 1 ohm to 200 megohms • Standard tolerance 1% • Temperature Coefficient 500 P.P.M. • Operating Temperature Range –55° to 120° C (DC); –55° to 150° C (DCF, DCH, MC)

Write for Dale Resistor Catalog A

DALE ELECTRONICS, INC.

1304 28th Avenue, Columbus, Nebraska

A subsidiary of THE LIONEL CORPORATION

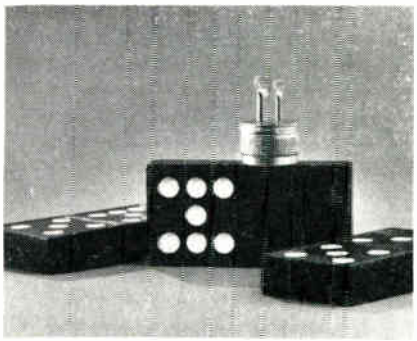
Also Made and Sold by Dale Electronics Canada, Ltd., Toronto, Ontario, Canada

See our specifications in V·S·M·F The Microfilm Catalog File

NEW PRODUCTS

LOW COST SCR

Rated at approximately 4a and up to 100v PRV/PBO.

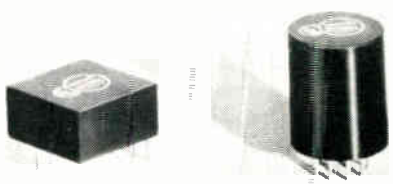


The ZJ265 is for use where the max. device temp. can be kept below 100°C. Applications include: relay replacement; motor speed controls for hand tools; and appliance controls. For automatic assembly in large volume, the silicon controlled rectifier is in the popular cup-type package which can either be pressed, soldered or clipped onto a suitable heatsink. A stud mounted version will also be available (ZJ226). General Electric Co., Rectifier Components Div., W. Genesee St., Auburn, N. Y.

Circle 345 on Inquiry Card

LOGIC MODULES

Nine new silicon-transistor units in U series NOR welded modules.



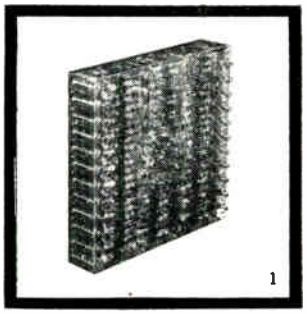
Features include operating temp. range of −55° to +125°C, all-welded construction, restored dc levels out of every gate, and for most types a choice of rectangular or cylindrical packaging. Type includes: U-601, dual 1MC NOR circuit; U-602, dual 1MC driver; U-603, converter; U-604, ac power driver; U-811, dual, 3-input 10MC NOR circuit; U-812, dual, 10MC driver; U-813, 10MC flip-flop; U-814, 10MC multivibrator; and U-815, 10MC mono-stable multivibrator. Engineered Electronics Co., 1441 E. Chestnut Ave., Santa Ana, Calif.

Circle 346 on Inquiry Card

NEW GENERAL ELECTRIC DEVICES FOR TOMORROW'S DESIGNS

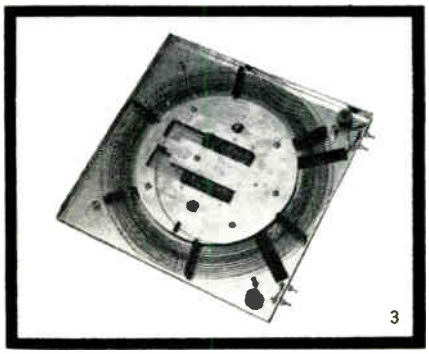
ALL AVAILABLE FROM

SPECIALTY DEVICES OPERATION


1

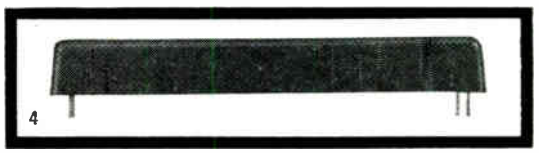

2

1 CUSTOM PACKAGING packs more circuitry in less space and increases reliability. Specialty Devices Operation (SDO) will design complete package, or work from your schematics. SDO-developed materials provide correct epoxy for operation in a wide variety of environments.


3

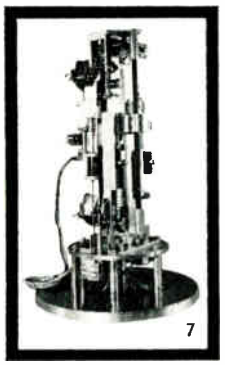
2 MAGNETIC SHIFT REGISTERS, with high reliability achieved through circuit design and worst-case testing, are ideal for missile and satellite applications. The General Electric-pioneered multibit package permits small-size registers that require a minimum of space. Registers are available with highest speed-to-power ratios to meet special applications.

3 WIRE SONIC DELAY LINES provide low insert losses, higher storage rates, and reliable operation—even in severe vibration environments. Sonic delay lines are available in special designs to meet a wide range of requirements. Applications include computer serial memories, buffer data storage, and signal processing. Input/output circuitry is furnished where desired.


4

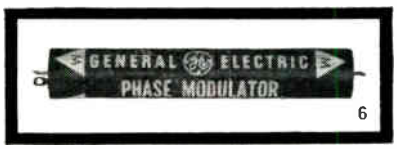
4 ELECTRICALLY VARIABLE DELAY LINES are ideally suited for pulse positioning and phase control applications. These delay lines are used for both carrier and pulse information, providing continuous electrical adjustment.

5


7

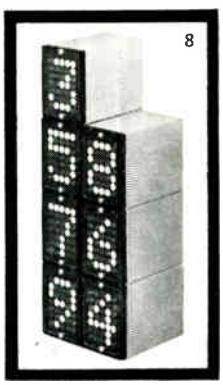
5 FERRITE CORE MEMORY PLANES, encapsulated for protection of highly sensitive cores, are the most durable in industry. Ability to withstand vibration up to 55 cycles per second and to operate reliably in severe environments makes G-E memory planes ideal for military and commercial computer systems.

6 MAGNETIC PHASE MODULATORS replace vacuum tubes as dynamic phase modulation element in FM communications equipment. These devices permit simplified circuitry, increased economy and reliability, low current drain, and improved linearity.



6

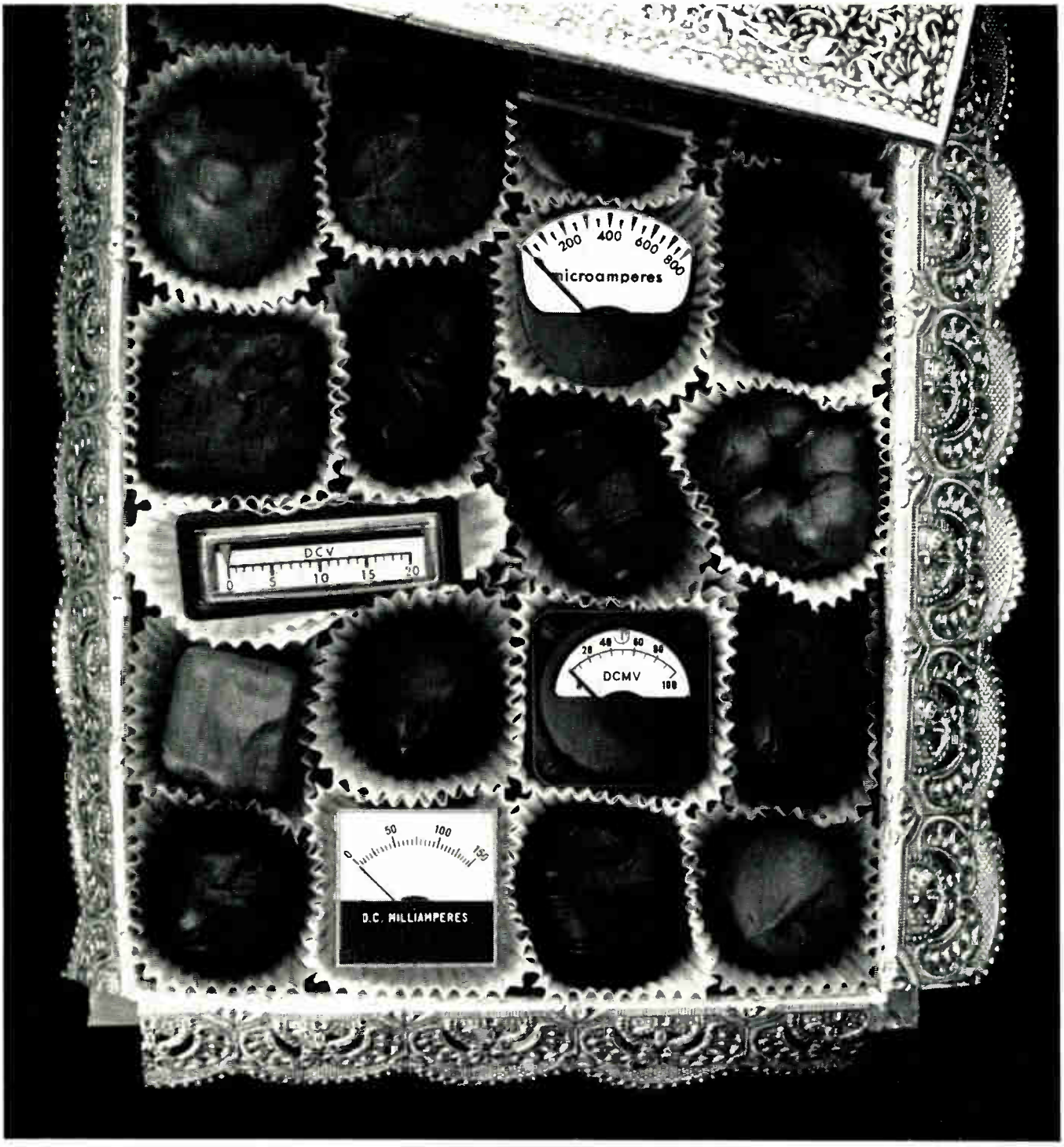
7 PARAMETRIC AMPLIFIER, designed for general satellite communications, has tuning range of 375 to 1200 megacycles, remote tuning capability, and low noise (less than 2.5d).


8

8 DIGITAL READOUT DEVICE, developed for alpha-numeric readout on situation displays and data processing monitors, provides reliability, readability, longer life, wide angle viewing, and flexibility of large character selection.

TOMORROW'S DESIGNS call for most up-to-date electronic techniques. These G-E devices, custom-designed for your specific applications, provide that needed performance. Send requests for information and quotations to Specialty Devices Operation, General Electric Company, 1811 Lemoyne Avenue, Syracuse, N. Y. 171-10

GENERAL ELECTRIC SPECIALTY DEVICES OPERATION ■ DEFENSE ELECTRONICS DIVISION



Sweetest choice in miniatures

Today, you needn't look any further than Honeywell in your move to miniature meters. Honeywell's popular line, broadest in the industry, offers many shapes and models to choose from. Catching on fast is the brand-new, modern-styled MS-1 Square Meter. It has longer scale length, a clean, uncluttered dial and concave cover, stacks flush vertically and horizontally. In addition, there's the HS-1 Ruggedized Meter that shrugs off vibration, is immune to dust and moisture; the MCE-1 Edgewise Meter, for use in cramped areas; and the contemporary-looking MM-1 Medalist®. All Honeywell miniatures are produced in quantity, so you can get immediate delivery. For further information, just write to us at Honeywell, Precision Meter Division, Manchester, New Hampshire. In Canada, Honeywell Controls Ltd., Toronto 17, Ontario. Honeywell International: Sales and service offices in principal cities of the world.

Honeywell

There's a new way to buy NIXIE® tubes

it saves you electrical and mechanical design time

New **NIXIE TUBE ASSEMBLIES**, in their simplest form, consist of any number or arrangement of Nixie tubes mounted in a bezel. These assemblies enhance the appearance of your equipment, provide maximum readability of the display, and eliminate up to 90% of your readout packaging time.

OR . . . you can buy **NIXIE TUBE ASSEMBLIES** as functional circuit packages complete with drivers which operate the readout from a wide variety of input signals. They save you both electrical and mechanical design time. Packaged circuits currently available include:

- **BCD TO DECIMAL DECODERS**
- **DECIMAL COUNTERS**
- **REVERSIBLE COUNTERS**
- **TRIXIE® TRANSISTORIZED DRIVERS**

(Both Integral and Remote Readout Units Are Available)

*Complete packaged drive circuit assemblies with integrally mounted Binary Decoder Units using standard size NIXIE Tubes.

WRITE TODAY for complete information on NIXIE TUBE ASSEMBLIES . . . the new way to buy NIXIE TUBES.

ANOTHER ELECTRONIC CONTRIBUTION BY
Burroughs Corporation
ELECTRONIC COMPONENTS DIVISION
PLAINFIELD NEW JERSEY

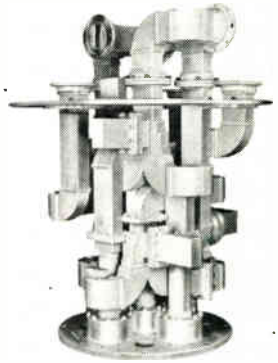
See us at the I.E.E.E. Show Booths #1211-1215

At I.E.E.E. . . .

NEW PRODUCTS

C-BAND SIGNAL COMPARATOR

This C-Band Signal Comparator is for monopulse radar antenna.



The comparator is the feed system which forms an integral component of a high-power monopulse radar system. It provides the proper phases and amplitude characteristics for the transmitted and received signals, obtaining optimum tracking accuracy in both elevation and azimuth planes. Gombos Microwave Inc., Clifton, N. J.

Circle 254 on Inquiry Card

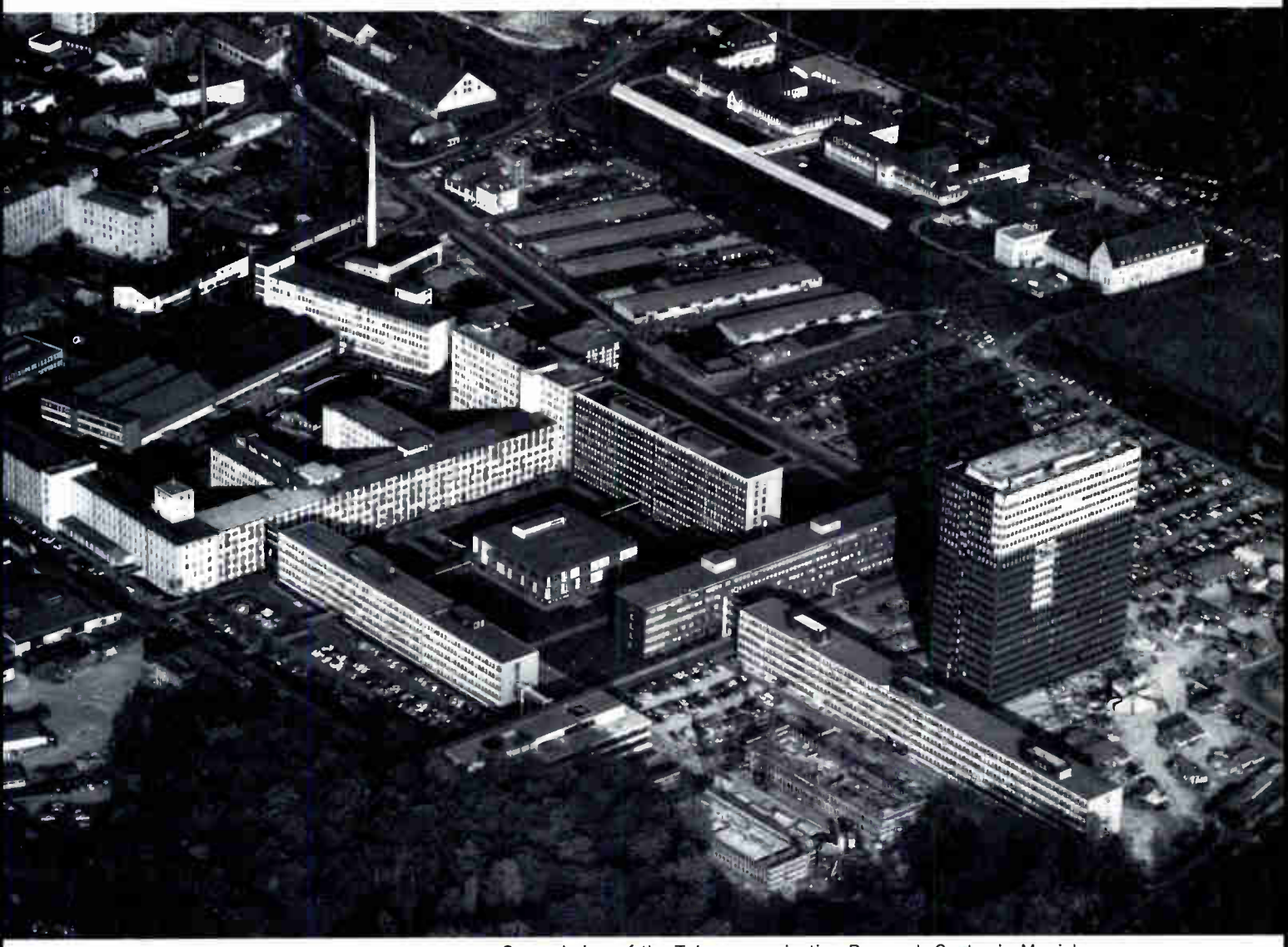
NOISE REJECTING AMPLIFIER

The DY-2411A Guarded Data Amplifier gives DCMs a 10mv range.

It is designed to extend the capability of the DY-2401A Integrating Digital Voltmeter to low-level high-isolation applications. The amplifier/voltmeter combination provides an effective common mode rejection of 134db at all noise freqs. including dc permitting high accuracy micro-volt-level measurements even on signals severely contaminated by noise. The combination provides 6 measuring ranges including a ±10mv full scale 5-digit range, and ±300% overranging on the 5 lower ranges. Dymec, A Div. of Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.

Circle 255 on Inquiry Card

SIEMENS



General view of the Telecommunication Research Center in Munich.

This is Siemens

Siemens (pronounced zee-menz) was founded 115 years ago. It is the largest private employer in Germany and one of the largest business enterprises in the world. It employs 240,000 persons in factories and offices in 79 countries.

Siemens manufactures practically every type of electrical equipment from microminiature components to complete power stations—for reproducing and transmitting sound, sight, data and power.

Siemens products are found in homes, stores, factories, laboratories, trains, planes, ships, theatres...wherever men work, live and play.

For general information on Siemens, circle 90 on Reader Service Card.

SIEMENS & HALSKE AG · GERMANY

Subsidiary in the U.S.A.

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In Canada:

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OVER ▶

Polystyrene ("Styroflex") capacitors

"Mica" properties at "paper" prices

SIEMENS

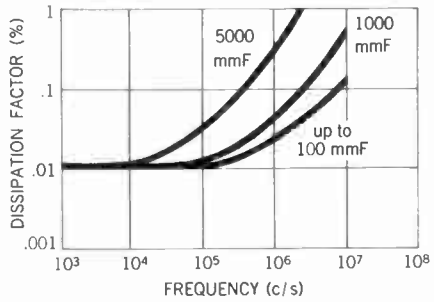
Styroflex capacitors offer reliability against voltage breakdown and stability against change in operating characteristics...at prices unusually low for these properties.

These and other *Styroflex* properties result from the unique properties of polystyrene and the method of manufacture developed by Siemens: The polystyrene film is stretched, and stabilized in the stretched condition, before winding. After winding, special heat treatment shrinks the film, forming a hard, stable body. The heat also fuses the polystyrene layers at the ends to form a solid plastic seal.

Reliability against voltage break-through is assured by the extra thickness of the film as well as the standard Siemens test on each unit at 3.3 times rated voltage. For filter applications, reliability in the microvolt range is assured by positive *welded* contacts between foil and leads.

The reliability of *Styroflex* capacitors is proved by their long, successful use in computers.

Low dissipation factor (usually even lower than for mica capacitors) is provided by *Styroflex* capacitors...making them specially suitable for filter circuits.



Stability against change in capacitance over long periods of time is one result of the solidity and hardness of the capacitors...produced by the shrinkage during manufacture.

Low self-inductance is a result of a special contact design and is particularly important in very high frequency applications. Self-inductance values are as low as for extended-foil construction.

Complete shielding. The outer layer of foil completely encloses and shields the inner foil. (The terminal for the outside foil is indicated by the voltage band.)

Highest insulation resistance (higher than for any other type of dielectric) is a result of the well-known properties of polystyrene.

High resistance to humidity. Polystyrene has the lowest water absorption coefficient of all capacitor dielectric materials. As a result, *Styroflex* capacitors show very low capacitance change due to changes in relative humidity.

Small size. *Styroflex* capacitors in the lower capacitance ranges are even smaller than mica capacitors.

Long life. *Styroflex* capacitors have a record of long and successful use in telecommunication equipment carrying guarantees of 15 years or more. In addition, their extremely long life is proved by hundreds of thousands of capacitors tested under all types of climate and voltage conditions.

Close to a billion *Styroflex* capacitors have been made by Siemens. Hundreds of millions of these are in use in European radio and TV sets as well as in industrial equipment.

SPECIFICATIONS

Operating temperatures: −40° to +85°C.

Stability: Less than 0.2% +0.4 mmF variation in capacitance in 2 years at 40°C and 75% relative humidity. (Capacitance changes due to humidity changes are small and are reversible.)

Insulation resistance: 500,000 megohms at 20°C after 1 minute tested with 100 volts DC.

Temperature coefficient: −150 ±50 ppm/ °C.

Capacitance tolerances: ±20, ±10, ±5 and ±2½% of rated capacitance.

Dimensions *(inches)*

	Nominal Voltage			
	125V(1)		500V	
Capacitance Values (mmF)	*Length*	*Diam. (max.)*	*Length*	*Diam. (max.)*
2-300	0.40"(2)	0.17"	0.60"	0.26"
305-1000	0.40 (2)	0.22	0.80	0.27
1,050-2,000	0.60	0.25	0.80	0.34
2,050-5,000	0.80	0.32	0.80	0.50
5,050-10,000	1.20	0.31	1.20	0.49
10,050-25,000	1.20	0.45	—	—

(1) Smaller capacitors, for 30V and 50V, also available. (2) Capacitances from 2 to 620 mmF are also available in .315" length.

In stock for shipment from White Plains, N.Y.

The following capacitance values in mmF and the same values multiplied by 10, 100 or 1000 (up to 24,000 mmF for 125V and up to 10,000 mmF for 500V) are available in 125V and 500V ratings and with capacitance tolerance of ±2½% for immediate shipment from White Plains, New York:

10(1)	16	27	43	62	100
11(2)	18	30	47	68	110
12	20	33	50	75	120
13	22	36	51	82	etc.
15	24	39	56	91	etc.

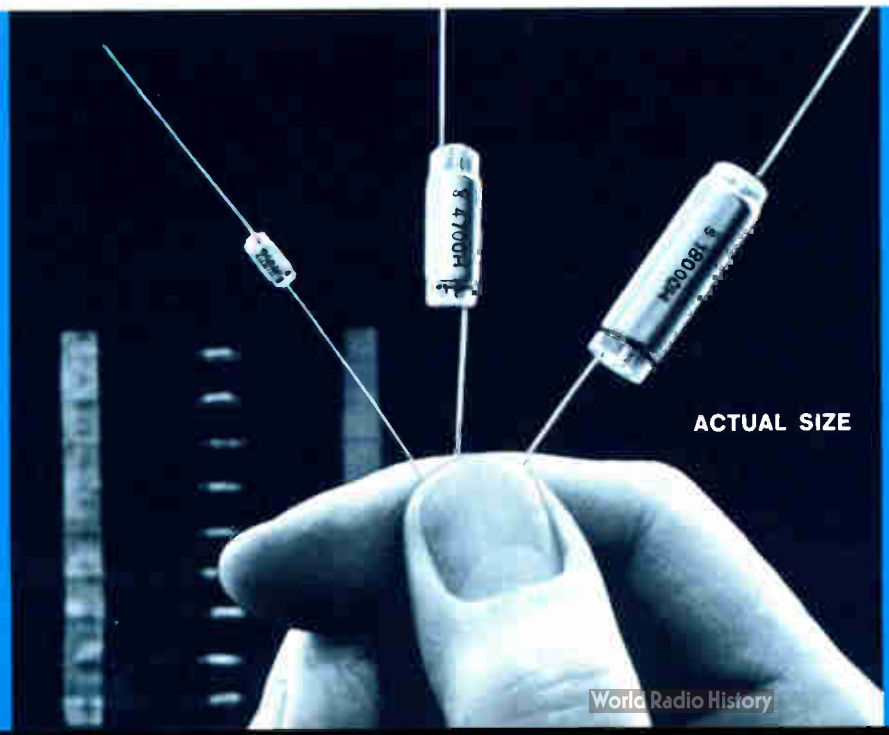
(1) Also 100, 1000, 10,000 mmF. (2) Also 110, 1100, 11,000 mmF, etc.

Other values, voltages and tolerances are available on factory order. Also tape mounting for automatic assembly.

Detailed engineering data and service are available on request.

Styroflex capacitors are distributed by William Brand Electronic Components, Inc., and are available through leading sales representatives throughout the U.S.

CIRCLE 91 ON READER SERVICE CARD



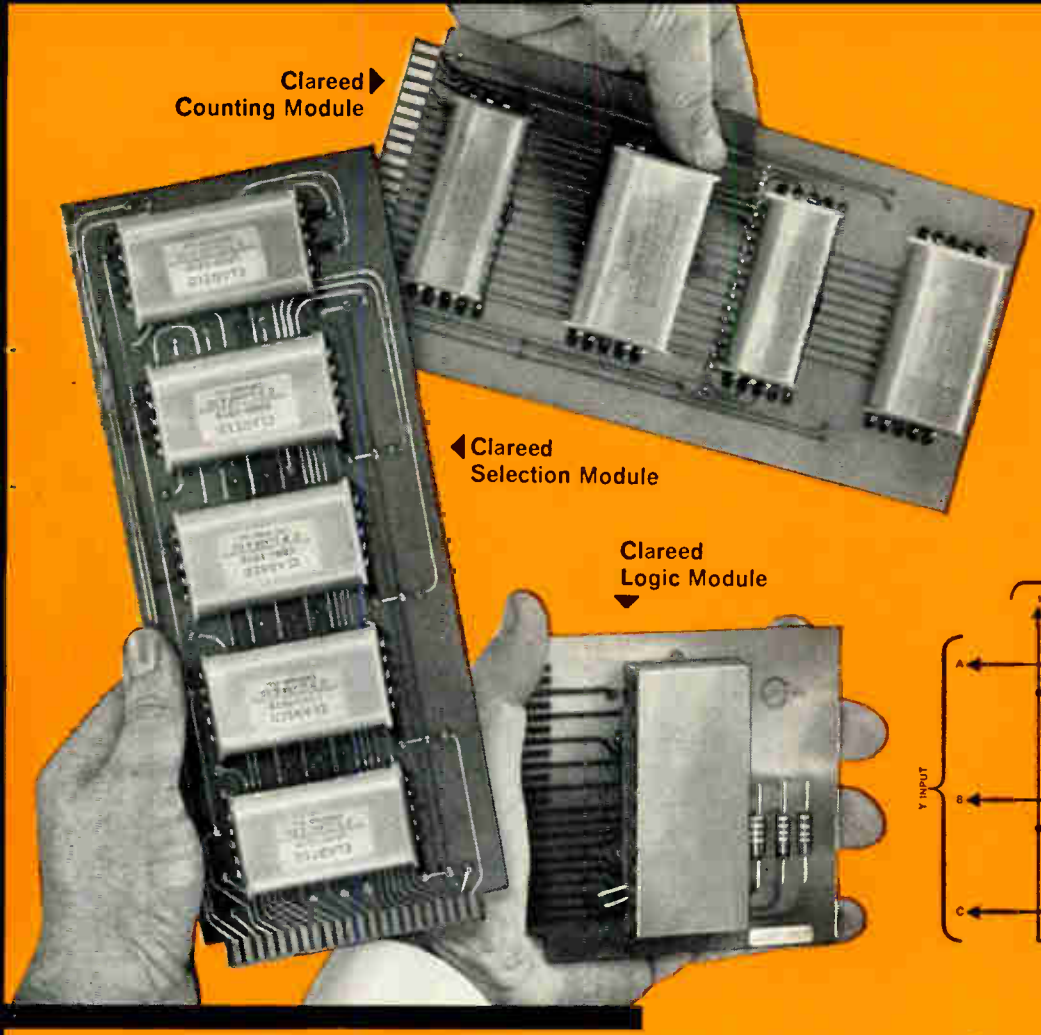
Siemens components available: Ferrite pot cores and transfluxors; capacitors (electrolytic, polystyrene, metalized plastic, metalized paper, tantalum); deposited-film resistors.

Distributor for these electronic components:

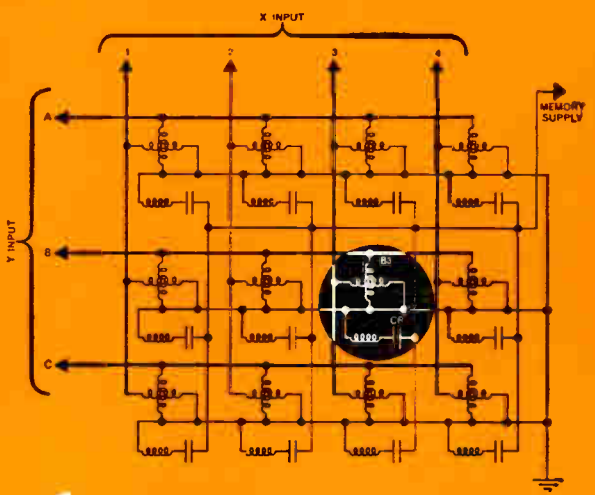
WILLIAM BRAND
Electronic Components, Inc.
220 Ferris Ave., White Plains, N.Y.
Telephone 914 WH 8-3434

In Canada:
SIEMENS HALSKE SIEMENS SCHUCKERT (CANADA) LTD.
407 McGill Street, Montreal 1, P.Q.

◀ OVER



CLARE



NOTE: Each crosspoint of a Clareed Single-Mode Memory Matrix consists of one or several Clareed switches enclosed in each of the multiwound coils shown.

Again we ask... Which one does this?

If you work with control systems which involve counting, selection, or logic functions, take a look at Clareed Control Modules.

You'll see a system approach providing simpler and often more economical solutions than those offered by solid-state or other techniques. You'll find plenty of speed for most applications, and reliability of a very high order.

Clareed Control Modules for counting, selection, and logic use magnetic flux to make decisions. Combinations of flux levels and flux polarities, generated by multiple-wound coils, operate glass-encapsulated Clareed switches. Among the advantages of Clareed Control Modules are:

- Multiple-input and multiple-output capabilities, making possible logic at both input and output.
- Complete isolation between input and output. The output is the contact closure. This contact can handle low level analog signals, other digital signals, and AC or DC power up to 15 va.
- Clareed systems are not affected by transient line noise.

In selection systems which are required to switch analog or digital information, complete isolation between controlling circuits and selected points is essential. Consider the Clareed Single Mode Memory Matrix, shown in diagrammatic form. Energizing input lines B and 3, for example, selects the B-3 crosspoint and closes all Clareeds enclosed in those coils. This action is memorized by one of the Clareeds (CR) which switches winding M to the memory supply. All Clareed switches at B-3 remain closed until memory supply is interrupted; meanwhile, other crosspoints may be selected and memorized at random. (Which Clareed Control Module is used? "Selection.")

Standard Clareed Control Modules offer useful, uncomplicated ways of performing these functions:

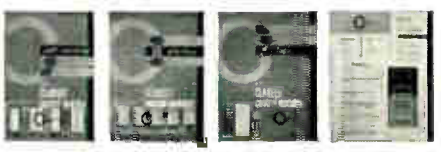
- In selection: A variety of selection systems, using a single-mode matrix, a single-mode memory matrix, or a two-mode matrix (Mode 1: All crosspoints normally open; Mode 2: All crosspoints normally closed).
- In counting: Three basic flip-flops which can be made into ring counters, bi-directional counters and shift registers for binary-coded decimal, decimal and radix$^{(N)}$ counters.
- In logic: AND, INCLUSIVE OR, EXCLUSIVE OR, NAND, NOR, EXCLUSIVE NOR, as well as more complex logic in a single module.

Systems using Clareed Control Modules can be easily serviced with a simple multimeter.

For detailed problem analysis and engineering recommendations, write Group M-1, Application Engineering, C. P. Clare & Co., 3101 Pratt Boulevard, Chicago 45, Illinois. For useful manuals, see offers below.

Take your choice!

Concise: For a terse, time-saving explanation of Clareed Control Modules in counting, selection, and logic, get 8-page Manual 400 by circling number **155** on Reader Service Card.



Complete: For detailed information on Clareed Control Modules in counting, selection, and logic, get Manual 400 plus Application Manuals and data sheets on all Clareed Control Modules. Circle number **156** on Reader Service Card.

NEW PRODUCTS

CHOPPERS AND RELAYS

Syncroverter choppers and relays designed for high reliability.

For example, the Miniature DPDT Chopper operates at 400CPS. Action is "make before—break after." Tracking is very good; the maximum difference in phase lag is 3°. Vibration limit is 3g's, 0-2000CPS. The Bristol Co., Waterbury 20, Conn.

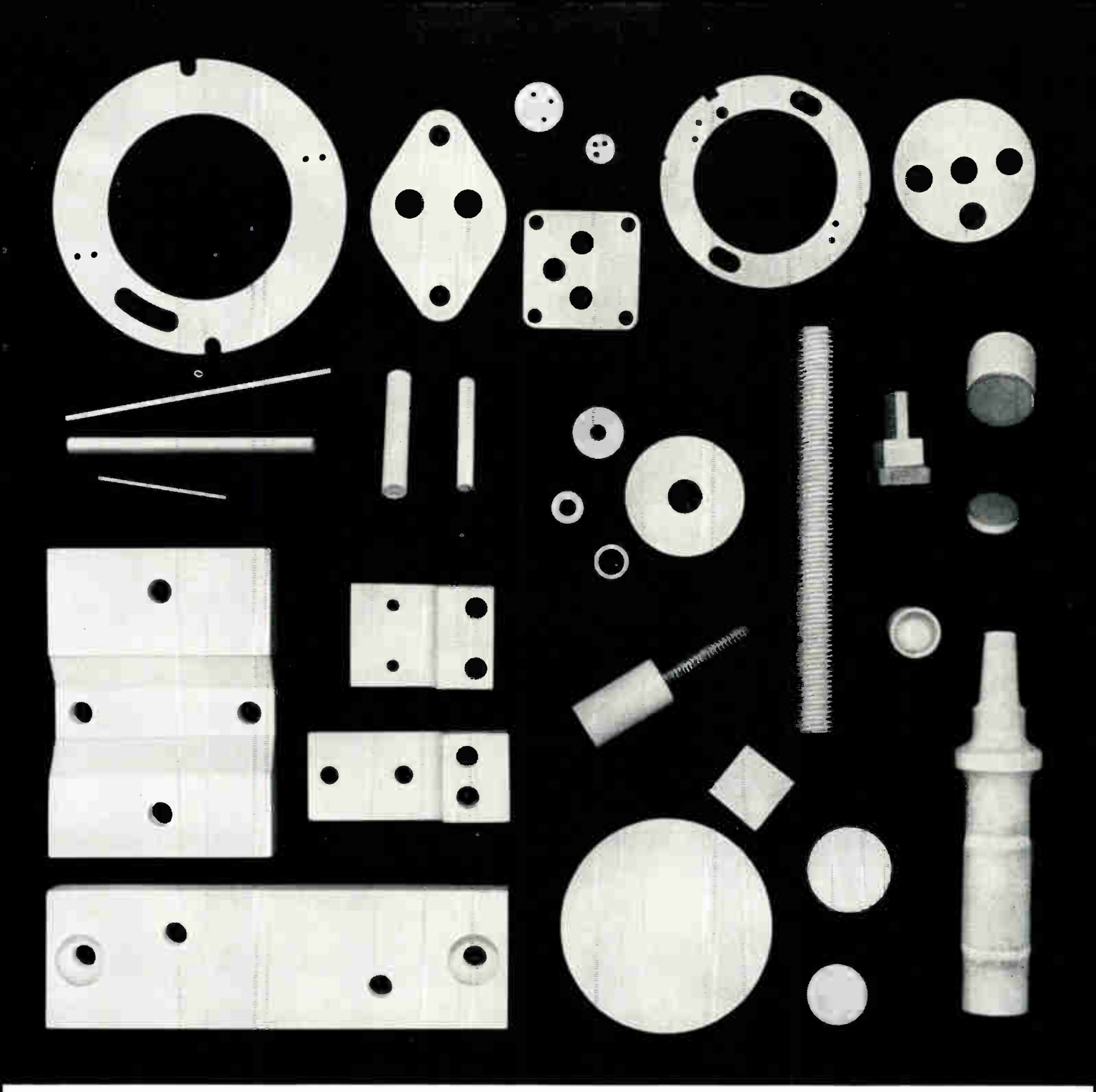
Circle 256 on Inquiry Card

COLOR GENERATOR

This Color, Bar, White Dot Generator is in kit form.

Compact and simple-to-use, the Paco Model G-36 features: high stability; crystal controlled, voltage regulated; only one simple cable connection to the antenna input of receiver under test; no external sync signals needed to lock in test patterns; and 3 front-panel controls. The Model G-36 produces: color bars, white dots, cross hatch, vertical and horizontal bars. R-f output is available on channel 3 or 4. Picture carrier 50mv max. Sound carrier 10% of picture carrier. Output impedance is 300 Ω. Paco Electronics Co., Inc., 70-31 84th St., Glendale 27, N. Y.

Circle 257 on Inquiry Card



31 better ways to stop electric current, but let heat come through

All of these parts have three things in common: (1) they *stop electricity* like a ceramic, but *conduct heat* like a metal; (2) they are used to improve reliability and performance; (3) they are fabricated from Brush beryllium oxide.

If you need a component which will conduct or absorb heat—while it insulates electrically—discover BeO. It combines these properties better than any known material. We can fabricate beryllia in virtually unlimited sizes and configurations and it can be metalized and precision ground.

Many of the parts shown are standard "off-the-shelf" items available on order from Brush. Phone or write us for full details.

To serve you better, Brush offers immediate delivery of improved quality and new standard beryllium oxide semiconductor bases and heat sinks. For full information and specifications, send for our data sheet: "Standard Semiconductor Bases and Heat Sinks." Furnished promptly.

Circle 9 on Inquiry Card

THE BRUSH BERYLLIUM COMPANY

17876 St. Clair Avenue • Cleveland 10, Ohio

Phone: 486-4200 • Area Code: 216 • TWX: 486-5790

NEW PRODUCTS

POWER TRANSISTOR

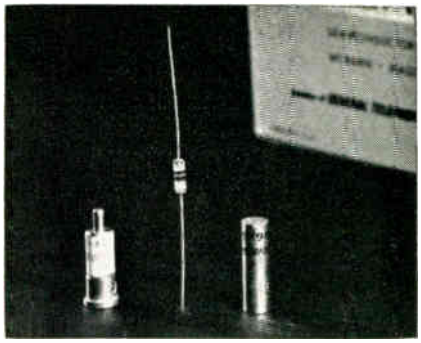
Power dissipation of 60w at freqs. as high as 150MC.

The Shockley Silicon Power Transistor, in 3 types, is available on a standard TO-3 base, with collector voltage ratings up to 100v and collector current to 5a. They will operate at a max. temp. of 200°C. With saturation resistance less than 0.2Ω, and beta relatively independent of collector current, distortion is minimal. Silicon microcircuitry accomplished by a process of inverse epitaxial deposition, and an emitter-base of interdigitated configuration. Clevite Transistor, Palo Alto Plant, 1801 Page Mill Rd., Palo Alto, Calif.

Circle 295 on Inquiry Card

MICROWAVE DIODES

Verified 100% diodes for the freq. range from 1 through 35GC.



Each unit is processed through 14 separate tests. The diodes are individually serialized, tested for applicable electrical parameters and then subjected to operational tests. This testing includes temp. cycling and temp. storage through −65° to +150°C; radiflo leak rate testing to 1×10^{-11} cc/sec; 150°C operational test, and shock at 1500 G for 0.5msec. The diodes are also sample-tested to various destructive design criteria. Sylvania Electric Products, Inc. Semiconductor Div., Woburn, Mass.

Circle 296 on Inquiry Card

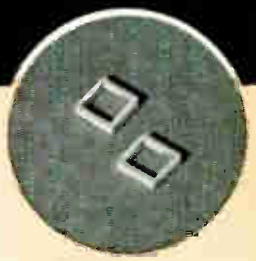
Progress Report on ALSIMAG® Ceramics

CRITICAL TOLERANCES HELD WITHOUT GRINDING

Illustrated approximately actual size.

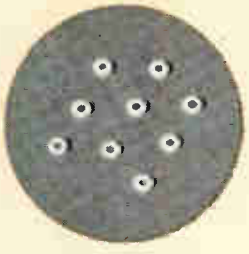
O.D. .152 ± .001
Hole .028 ± .001

Hole .033 ± .002
Slot Width .033 ± .0025

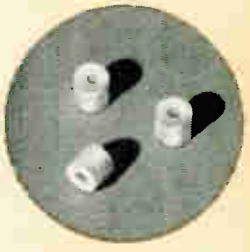


.247 ± .003 Square
Wall Thickness .020

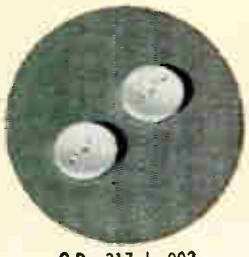
O.D. .247 ± .002
Magnesia



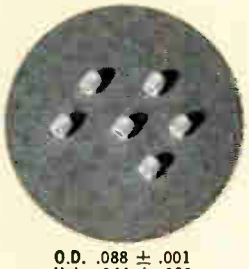
O.D. .091 ± .001
Hole .041 ± .001



O.D. .181 ± .002
Hole .069 ± .002



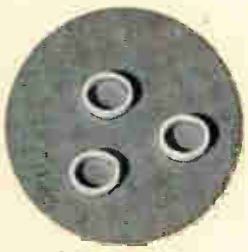
O.D. .317 ± .002
Holes .037 ± .002
and .017 ± .002



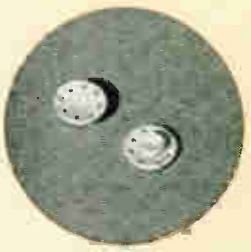
O.D. .088 ± .001
Hole .044 ± .001
Length .080 ± .002

Holes .025 ± .002
Slots .045 ± .002 x
.025 ± .002

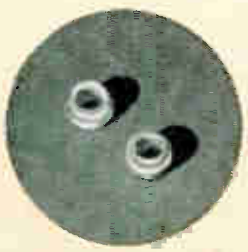
O.D. .221 ± .0015
Thickness .025 ± .001
Hole .044 ± .003



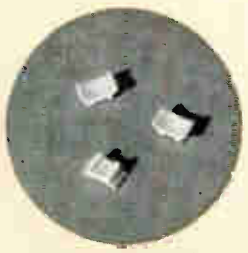
O.D. .245 ± .005
Wall Thickness .0175 ± .0025
Height .047 ± .005



O.D. .260 ± .003
8 Holes .022 ± .001
Height .062 ± .003



Shank O.D. .179 ± .002
Shoulder O.D. .215 ± .005
Hole I.D. .132 ± .002
Steatite



Width .180 ± .003
Height .040 ± .003 and
.100 ± .003
Rib .063 ± .001
Slot Width .068 ± .002

O.D. .260 ± .003
Thickness .015 ± .002
Holes .021 ± .001
Hole Circle .200 ± .002

The ever-increasing demand for greater performance in less space creates a flow of inquiries relating to close tolerances on certain dimensions in miniature and micro-miniature ceramics. Many inquiries specify equally rigid tolerances on metallized areas on these ceramics.

In many instances it is not possible or economically feasible to grind or lap the ceramic to dimension. Recent advances in equipment and in control techniques at American Lava Corporation can be helpful in such designs. A number of efforts have been made to develop a clear statement of tolerances which are practical without grinding. But there are too many variables. The best and clearest statement of these new developments seems to be the accompanying illustrations of present volume production.

METALLIZATION Recent gains have been made in volume production of certain types of close tolerance metallization. While the art is advancing rapidly, there are still definite limitations. Thus, inquiries on close tolerance ceramics or close tolerance metallization should be as detailed as possible. It should also be remembered that the broadest tolerance permitted by the design requirements will result in the lowest cost.

Booth 4401 at IEEE Show

SUBSIDIARY OF 3M COMPANY

AMERICAN LAVA CORPORATION

TELEPHONE 265-3411 • AREA CODE 615 • CHATTANOOGA 5, TENNESSEE

61st YEAR OF CERAMIC LEADERSHIP

For service, contact American Lava representatives in Offices of Minnesota Mining and Manufacturing Co. in these cities (see your local telephone directory): Boston: Needham Heights, Mass. • Chicago: Bedford Park, Illinois • Cleveland, Ohio Farmington, Michigan • Laurens, South Carolina • Los Angeles, California • Minneapolis, Minnesota • Metropolitan New York: Ridgefield, N. J. • Up-State New York: Newark, N. Y. • Philadelphia, Pennsylvania • Richardson, Texas St. Paul, Minnesota • South San Francisco, California • Seattle, Washington

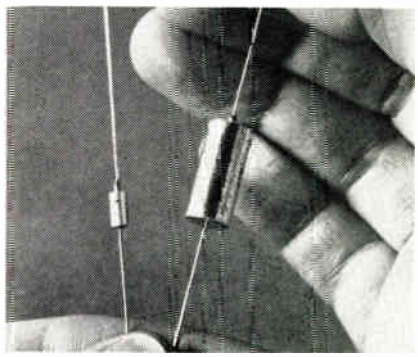
All export except Canada: Minnesota Mining and Manufacturing Co., International Division, 99 Park Ave., New York, N. Y.

Circle 61 on Inquiry Card

NEW PRODUCTS

TANTALUM CAPACITORS

CS12 and CS13 35v capacitors conform to Mil-C-26655A.

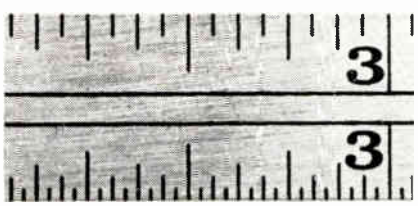


Solid tantalum with ratings from 6 to 35v. They are polar types for use with a dc bias exceeding peak value of the ac component. Rated from 0.033 to 330μf; will withstand operating temps. from −55° to +125°C. Standardized into 4 case sizes ranging from 0.250 to 0.750 in. long and 0.125 to 0.341 in. dia. Standard units hermetically sealed in a plated metal case with a glass-to-metal seal. Rectifier-Capacitor Div., Fansteel Metallurgical Corp., No. Chicago, Ill.

Circle 293 on Inquiry Card

SWITCHING DIODES

Dynamic resistance of less than 0.5Ω with PIV up to 1000v.

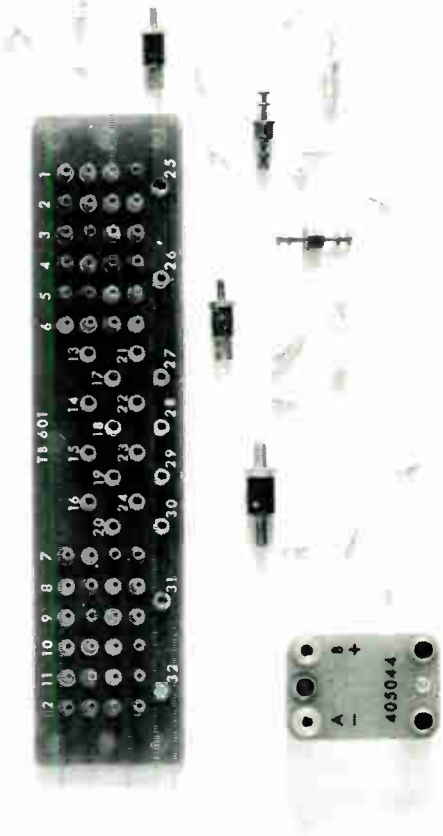


Capacity less than 0.5pf and long lead inductance have enabled these microwave switches to be operated at 5.5gc. Peak power operation in excess of 1kw is possible. Insertion losses of 0.25db and isolation greater than 40db are obtainable. Applications include harmonic generators, modulators, upconverters, parametric amplifiers, limiting and leveling. Physical size: Min. body size 0.40 x 0.90 in. with 0.005 x 0.020 in. flat ribbon leads. Micro-Semiconductor Corp., 11250 Playa Court, Culver City, Calif.

Circle 294 on Inquiry Card

CONNECTIONS IN DEPTH

LERCO ELECTRONIC HARDWARE completes your assembly. This extensive line is available off-the-shelf or in custom designs, including terminals, terminal boards, custom and Mil Spec knobs, eyelets, and handles. Get Lerco Catalog.



Contacts, connectors, cable, Lerco electronic hardware, complete harnesses and assemblies, hermetic sealing—Microdot supplies them all: miniaturized, in depth, mostly off the shelf. Because Microdot is very big on "little." Like:

MICROMINIATURE MULTI-PIN CONNECTORS by Microdot are only ¼ the size of current "miniatures" and yours in 3 shell sizes—for up to 61 power or 19 coax contacts in a 1¼" shell. Parts are interchangeable; inserts available in a variety of straight power, straight coaxial and combination power/coax contacts. Hermaphroditic contact arrangements can be set up with power contacts that interchange without changing inserts. Order completely custom-assembled with Microdot cable or off-the-shelf in unassembled kit form. Check Bulletin MP-0.

MICROMINIATURE COAXIAL CONNECTORS by Microdot come in over 1,000,000 combinations—including the world's smallest 50-ohm job. With straight or angle, screw or slide-on contacts; receptacles including printed circuit and bulkhead feed-thru types. With nothing but highest quality materials throughout: gold-plated coin silver contacts; silver-plated brass housings; Neoprene or silicone bend relief caps and "Teflon" pin protectors. Get Bulletin CX-2A.

MICROMINIATURE COAXIAL CABLES by Microdot give you all these designed-in characteristics: low noise, low capacitance, and high operating temperatures. They meet MIL-C-17C, yield the same matched impedance required for larger systems and come in coax, twinax, and triax constructions. Silver-plated copper-weld or cadmium bronze conductors; "Teflon" or polyethylene dielectrics; "Teflon," "Kel-F," nylon or vinyl jackets. Order off-the-shelf in 50, 75, and 90 ohms impedance ratings or let us custom-manufacture in 30 to 160 ohms ratings. Write for Bulletin CBL-2A.

From crimp contacts to complete harnesses—assembled to your drawings and hermetically sealed into your equipment—Microdot supplies them all, in miniature. Contact your nearby Microdot sales office, rep, or distributor. Or write us direct and tell us what you want.

MICRODOT INC.

220 Pasadena Ave., South Pasadena, Calif.
Overseas: Microdot AG, Zug, Switzerland

Circle 77 on Inquiry Card

NEW PRODUCTS

RESISTANCE-STANDARD SETS

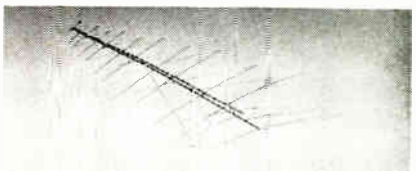
Series DMRL primary standard decade units have 0.0015% accuracy.

Series consists of 5 laboratory-standard individual resistance sets. Each set consists of 12 identical primary standard (Type NB-1) resistors independently susperded in a common oil bath in a hermetically-sealed metal case. The DMRL Series have relative (resistor to resistor) stabilities of better than 0.0005%/yr. DMRL specs. are: resistance (each resistor): DMRL-103—100Ω; DMRL-104 — 1000Ω; DMRL-105 — 10,000Ω: DMRL-106 — 100,000Ω; and DMRL-107—1 megohm. Julie Research Laboratories, Inc., 211 W. 61st St., New York 23, N. Y.

Circle 356 on Inquiry Card

LOG PERIODIC ANTENNA

Type 3701, Rotatable Log Periodic Antenna designed for 6.5-60MC range.



Horizontally polarized directional array features loaded low freq. elements for reduction in size and weight. Average free space gain is 6db over a dipole with side lobes 16db down. Max VSWR is less than 2.25:1 over full freq. range. Antenna has a 50Ω 3⅛ in. EIA flange input or is available with a 75Ω termination. Rotator provides continuous and reversible azimuth coverage. Selsyn transmitter in rotator and remote position indicator are supplied. Andrew Corp., P.O. Box 807, Chicago 42, Ill.

Circle 357 on Inquiry Card

only IEE one-plane readouts give you such versatile displays

NUMERALS AND LETTERS

Up to 12 individual numbers and letters can be displayed, each using one of the 12 available lamps.

DIGITS WITH POLARITY

Up to 10 individual numerals can be combined with a plus or a minus sign, using one lamp for each numeral and one lamp each for the plus and minus signs.

WORDS AND MULTI-DIGITS

Up to 12 individual words or multi-digit numbers can be displayed, each using one lamp.

MODES AND WORDS

Up to 12 mode/word indications can be displayed, each using one lamp; separate mode and word indications can be obtained by using one of the 12 available lamps for each mode and one for each word.

MULTIPLE WORDS

Up to 12 individual words used in combination (each word using one lamp), or up to 12 combination messages using one lamp for each group of words can be displayed.

COLOR EMPHASIS

Color can be added by using one lamp for each color and one lamp for each message, or up to 12 messages combined with color can be displayed, each using one lamp.

SYMBOLS

Any symbol that can be put on film can be displayed, using one of the 12 available lamps for each symbol.

IEE produces the industry's widest line of readout displays with models having maximum character heights from 5/8" to 3 5/8"... front plug-in readouts ... Cue Indicator Switches with pushbutton viewing screens ... Bina-View self decoding readouts with 38 character capabilities for full alpha-numeric display.

IEE rear-projection operation provides bright, distinct displays all on the same plane with unused characters completely invisible.

INDUSTRIAL ELECTRONIC ENGINEERS, INC.

5528 Vineland Avenue • North Hollywood, Calif.

Write for your copy of the
IEE Readout Message Designer's Kit
and new full line catalog.

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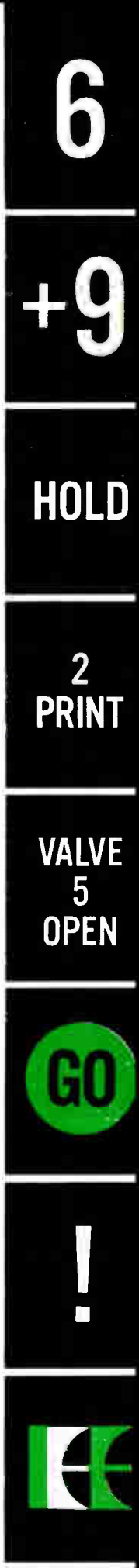
5

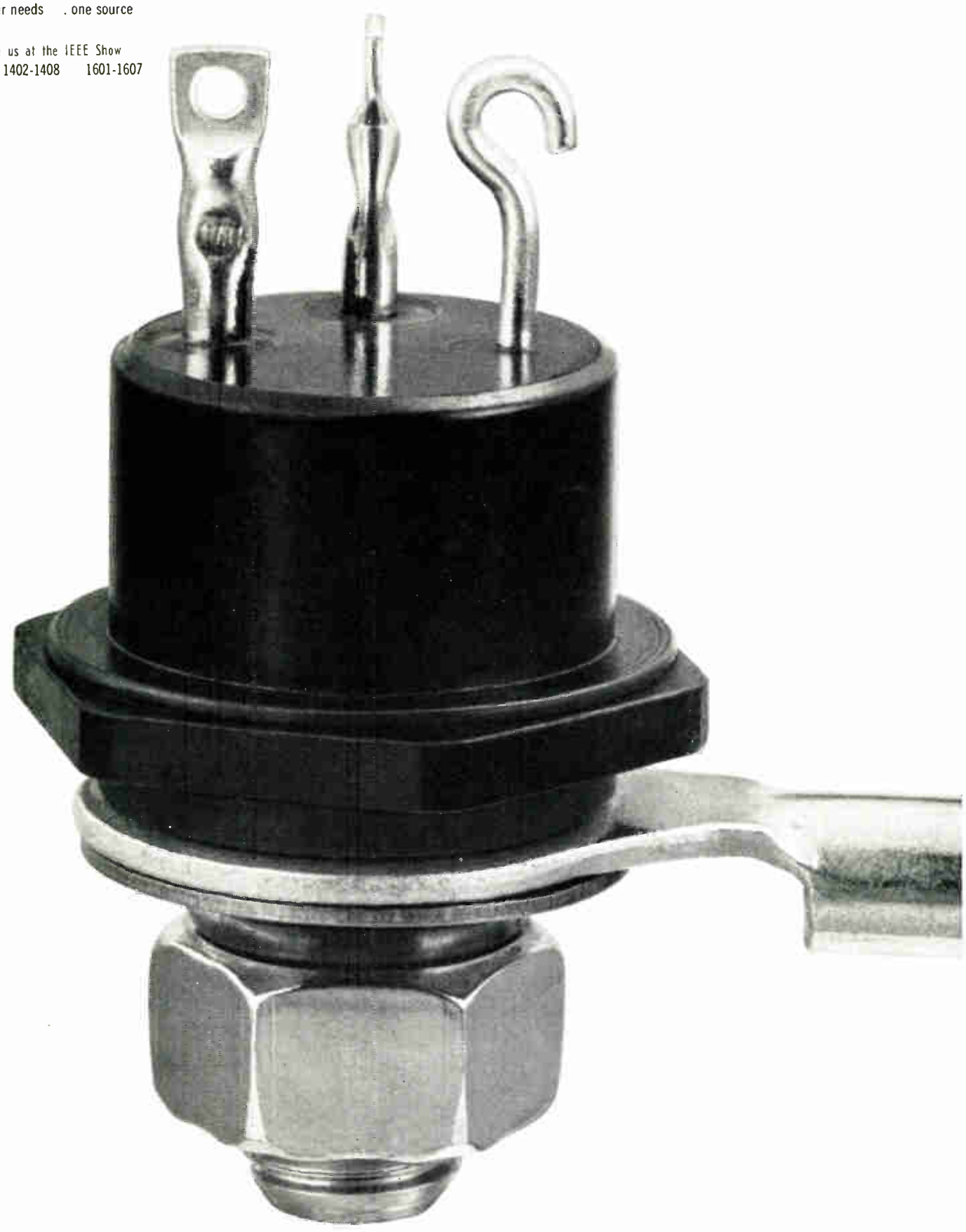


Electronic Components
from Westinghouse

For your needs . one source

See us at the IEEE Show
Booths 1402-1408 1601-1607

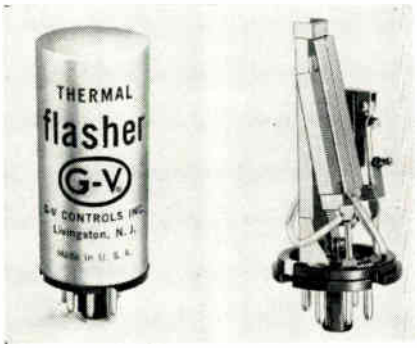
THE NEW CASE FOR RELIABILITY



NEW PRODUCTS

THERMAL FLASHER

Feature accurate flashing cycles and long life.

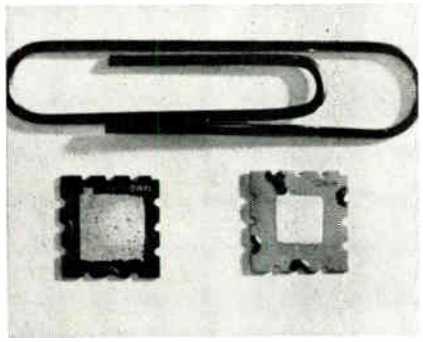


Type DF 9000 Series Flasher combines the principles of differential expansion and snap-action for rapid stabilization. Standard flashing rates of 1 to 60 cycles-per-minute and heater voltages of 6.3, 12, 28, 48, and 115vac or dc available. The on-off flashing ratio can be factory-set for ratios of 50:50 to 80:20. Contact rating is 3a to 250vac, 1a resistive to 32vdc. Life 1,000,000 cycles minimum. Measures 2¾ in. high and 1¼ in. in dia. G-V Controls Inc., 101 Okner Pkwy., Livingston, N. J.

Circle 291 on Inquiry Card

CAPACITOR MICROELEMENTS

Ceramic units for micromodule circuitry rated at 100wvdc.



The single-layer ceramic capacitor microelements are the Temperature Compensating Capacitor, Type MMC, and the General Purpose Capacitor, Type MMG. Each has an element made from a notched ceramic wafer 0.310 in. sq. and 0.010 in. thick with fired silver terminations. The Type MMC is rated at 100wvdc with capacitance range 4.7 to 400pf and tolerances of ±5%, ±10% and ±20%. The Type MMG also is rated at 100wvdc with capacitance range 300 to 5000pf. Max. dissipation factor is 2% and tolerances are ±10%, ±20% and +80% −20%. Cornell-Dubilier Electronics Div., Federal Pacific Electric Co., 50 Paris St., Newark 1, N. J.

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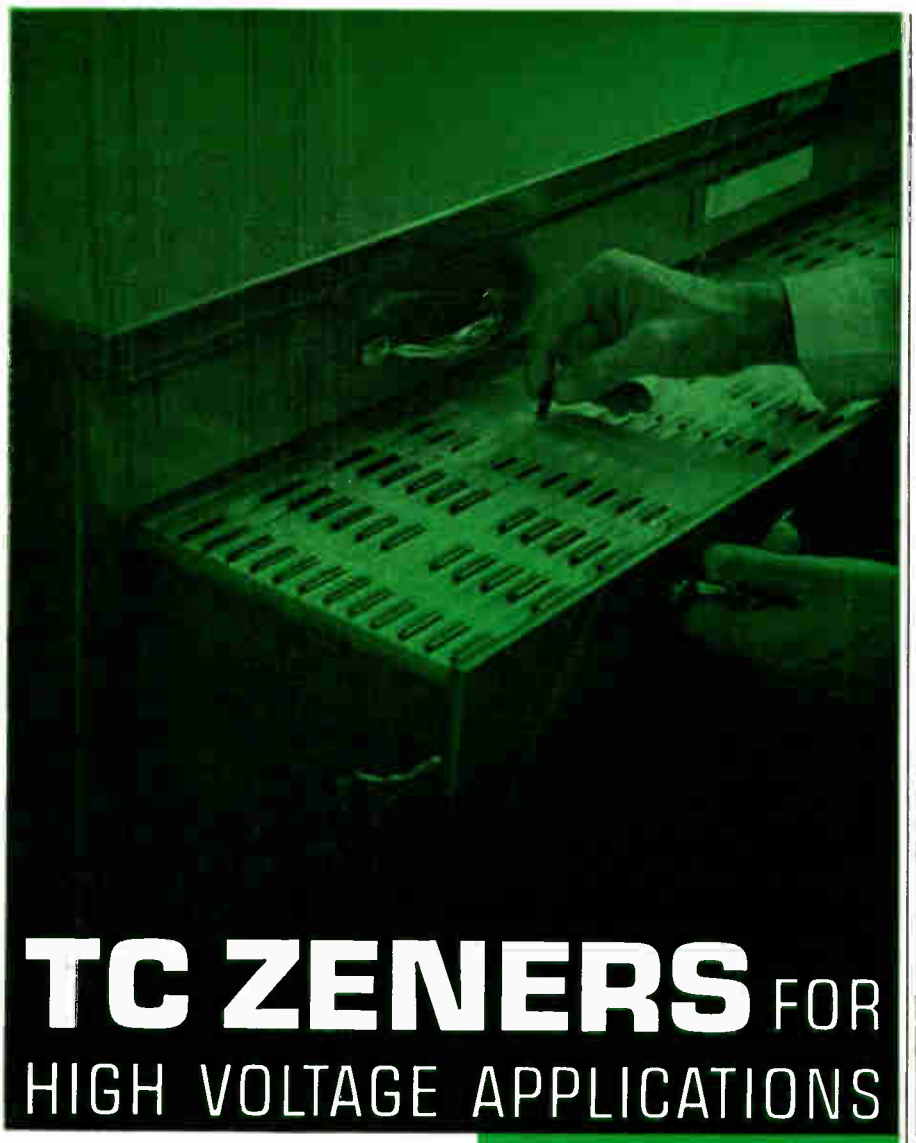
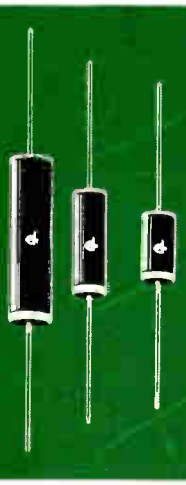


TC ZENERS FOR HIGH VOLTAGE APPLICATIONS

18.5 to 200 volt temperature compensated zeners immediately available from **DICKSON**



This Dickson TC zener series, the broadest ever developed for high voltage circuits, represents an ideal combination of performance, size, stability, and reliability. The rugged DURAPAK* high temperature, vacuum-molded package, exclusive with Dickson, provides a hermetic seal of the highest quality. Units meet or exceed environmental requirements of MIL-S-19500 and have passed 1000 hour storage life tests at temperatures of 150°C.

Economical, too! Lower voltage units cost about 40% less than conventional devices. Higher voltage units offer substantial savings over small devices used "in series".

They are available from your nearby Dickson distributor. Call him, today, for immediate delivery.

FOR COMPLETE TECHNICAL INFORMATION, write: Mr. Frank Malley, Dickson Electronics, P.O. Box 1387, Scottsdale, Arizona.

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348 Wells Fargo Avenue, Scottsdale, Ariz.

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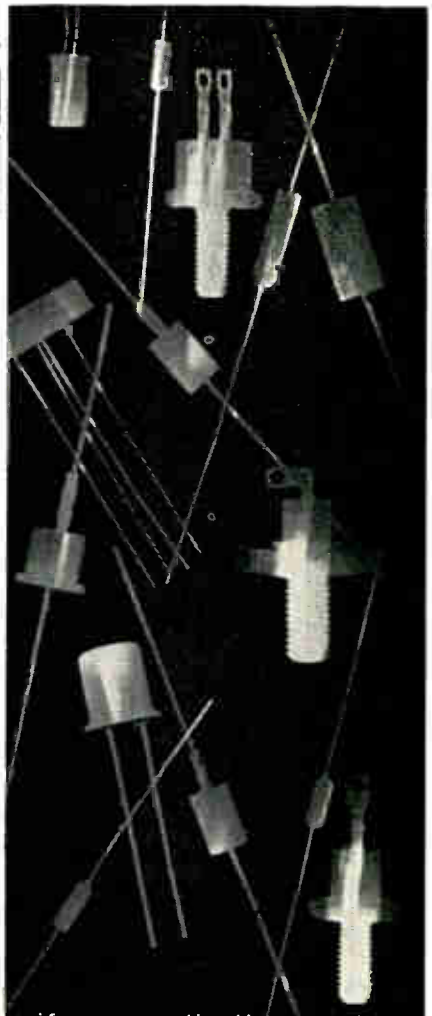

if your application requires
CUSTOM ZENER DIODES
call **DICKSON**

The greatest concentration of proven development, production and application talent in the Zener diode and Reference diode field is ready to create and produce devices to your most exacting specifications.

- special tolerances & characteristics
- unique packaging
- matched pairs
- matched duo in single packages
- "exotic" devices

... are typical of the custom units Dickson is currently supplying for a number of extremely critical applications.

For complete information on this important Dickson service and copies of "Customer Product Specifications" forms ... write, wire, or phone: Mr. Frank Malley, Dickson Electronics, P.O. Box 1387, Scottsdale, Ariz. Phone WHitney 6-5357.

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Circle 89 on Inquiry Card

LETTERS

to the Editor

"R-F Shielding Materials"

Editor, ELECTRONIC INDUSTRIES:

In the article "A Comparison of R-F Shielding Materials" in your December 1962 issue the author presents a table which gives comparative data on the shielding effectiveness of commonly used RFI shielding materials. The table contains data which is not only inconsistent with standard RF shielding design theory but is also in conflict with the results of many measurements which have been performed on standard shielded enclosures.

RF shield design theory indicates that the shielding effectiveness of a metallic barrier is a function of a) the frequency, b) the material of the metal barrier, and c) the thickness of the metal. The table in the article indicates that the attenuation over the frequency range 60 mc-1000 mc of the 4 oz. Electro-Sheet copper is of the order of 10 db less than the 1 oz. copper, which is thinner. In addition, at 5 mc the attenuation of 7 oz. copper is 22 db less than the 1 and 4 oz. copper, both of which are thinner than the 7 oz. material.

The values that are given for the attenuation of the galvanized steel are in complete contradiction with shielding effectiveness measurements that have been performed by Ark Electronics Corporation on an all-welded galvanized steel shielded enclosure and on many laboratory-type shielded enclosures of demountable prefabricated galvanized steel panels, all under carefully controlled conditions. The shielding effectiveness of the welded shielded enclosure had measured values of greater than 100 db over the entire frequency range 150 kc to 10,000 mc. for the electric and plane wave regions. The areas of lowest effectiveness, which are still above 100 db, were at the door frames and penetration areas.

It has been the experience of Ark Electronics that when a comparison test is performed between different shielding materials it is first necessary to measure the shielding effectiveness of the shielded enclosure used for the controlled experiment. The attenuation

(*Continued on page* 158)

LETTERS

to the Editor

(*Continued from page* 157)

of this enclosure must be greater than that of the test panels, or at least equal to the greatest expected attenuation. The results presented in the table indicate a poor shielding effectiveness for the test room, since in view of the other past measurements mentioned above, if the shielded room used for the tests by the author was indeed a "tight" room then the attenuation for the galvanized steel should have indicated values of at least 100 db over the entire frequency range. Another possible source of leakage is in the areas where the test panels were mounted to the shielded room. The photograph of the test set up indicated that the test panel was fastened to the shielded room by ten bolts which, if not properly tightened, could certainly introduce additional areas of leakage by virtue of the incomplete seal around the edges and, if the bolts were not properly tightened or gasketed, through the bolt holes themselves or via distortion of the test panel. These areas must be carefully checked at the time of test for leakage.

If the shielding effectiveness of the test room is low, especially in the frequency range 20 to 10,000 mc (where it is impossible to constrain the irradiation to the relatively small area of the test panel), then it is not possible to compare the attenuation characteristics of different materials as indicated in the article, because of the overshadowing leakage effects of the test room over the attenuation of the test panels. Stated otherwise, the shielding effectiveness of the test chamber and the bonding of the test panel around its periphery to the chamber must be well-nigh perfect, or at least better than that of the test panel itself, or the results are worthless. This could readily be demonstrated, as could also the overall inadequacy of the method used to obtain the results of the article, by the writers of this letter.

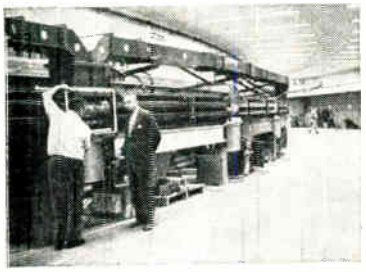
In view of the results, we strongly suspect that the results really represent the shielding effectiveness of the test room proper, whose panels surround the test panel, rather than that of the test panel itself. This would ac-

(*Continued on page* 160)

PDE DESIGN DIGEST

NEWS FOR SYSTEMS COMMUNICATIONS ENGINEERS

WORLD'S MOST POWERFUL ELECTRON ACCELERATOR INCORPORATES A SOPHISTICATED RF SYSTEM



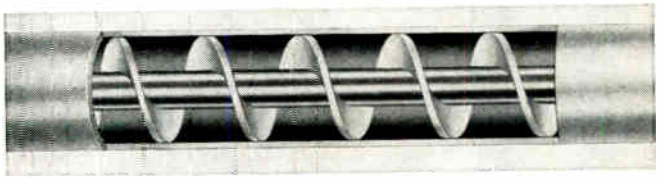
The Cambridge Electron Accelerator is an electron synchrotron of the alternating gradient type designed to deliver approximately 6 x 10^{12} electrons per second at 6 Bev. The electrons acquire this energy while executing 10,000 turns around the circular orbit. When directed into the 100′ x 300′ experimental hall, their mass is about 12,000 times the rest mass, and their speed is 0.999,999,99 times the speed of light in vacuum.

As this mass alters during acceleration, Styroflex® coaxial cable assists in monitoring electron speed by transmitting signals from the sensing units. 300-ton magnets then exercise current control to determine electron movement and direction.

NEED A CABLE THAT DOESN'T EXIST?

Sometimes the performance limitations of existing cable simply cannot meet the engineering challenge of a particular circuit. If you find yourself with this problem, there is a new PDE service that may fill your need. PDE will now design and construct special cables to conform to specific, singular needs involving unusual operating characteristics such as extremely tight electrical tolerances, high temperature, vibration and shock resistance, or submersibility. Connectors, waveguides, delay lines can also be included in the custom package.

NEW HELICAL MEMBRANE COAXIAL CABLE INTRODUCED



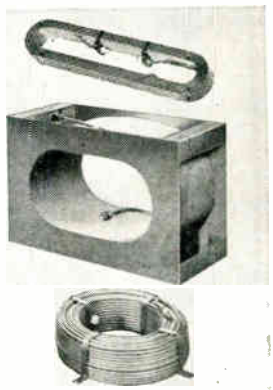
Advanced design features of this latest air dielectric cable offer increased effectiveness in atomic energy instrumentation, missile and missile launching applications. Fast propagation, low signal loss, low attenuation, excellent frequency response, uniform electrical properties over a wide range of temperature variations and unlimited operating life are important factors. Cable construction features a polyethylene helix supporting a copper wire or tube, depending on cable diameter, plus a seamless aluminum outer conductor. Impedances are 50, 75 and 100 ohms; diameters 3/8″, 1/2″, 3/4″, 1″, 1-5/8″ and 2-1/2″. If you have a high frequency transmission application involving ambient temperatures in the range of 100°C to 250°C, a Teflon® helix may be substituted for standard polyethylene.

Fabricated in 1000′ continuous lengths, Helical Membrane cable is available in bulk, cut to specified lengths, with or without connectors, or bent to very small radii.

Like more engineering data? Request a new catalog with power rating, attenuation, other parameters detailed.

PHELPS DODGE ELECTRONIC PRODUCTS
CORPORATION • NORTH HAVEN, CONNECTICUT

COAXIAL CABLE DELAY LINE OFFERS UNUSUAL ACCURACY IN HIGH FREQUENCY APPLICATION

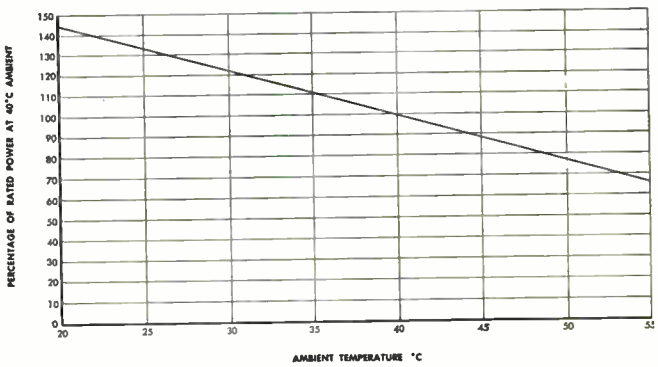


Packed inside the epoxy potted oval is a cable delay line that consistently and uniformly meets delay accuracy standards in the order of ±.02 nanoseconds. The aluminum sheathed coaxial cable is 50 ohm solid dielectric. 500′ of 1/2″ Styroflex, one of five semi-flexible types offered by PDE, is used in the center package for a nuclear application. The round unit on the bottom of the illustration is a Foamflex delay line for use in missile check out equipment.

Shaping coaxial cable without mechanical or electrical distortion to a minimum practical radius of 3 times the sheath diameter to the center line of the bend permits an extremely small, lightweight package. For example, 886 feet of 1/4″ Foamflex cable can occupy less than half a cubic foot and weigh only 35 pounds. If you are looking for freedom of configuration and complete packaging flexibility, coupled with high performance standards, see PDE for cable delay lines with frequencies from 60C to 12 KMC.

POWER RATING VERSUS AMBIENT TEMPERATURE

As ambient temperature drops, so does the percentage of rated power. This curve is indicative of this ratio as applied to all air dielectric, semi-flexible coaxial cables including Styroflex®, Helical Membrane, Spirafil, Foamflex and Corr-O-Foam.



Send me the information requested below: 43

- ☐ Helical Membrane coaxial cable catalog
- ☐ Systems Communications Capability brochure
- ☐ Delay Line catalog
- ☐ Add my name to your mailing list for monthly issues of PDE News.
- ☐ Please have your representative contact me.

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Circle 93 on Inquiry Card

LETTERS

to the Editor

(*Continued from page* 158)

count also for the seemingly anomalous behavior of the measurements with thickness of the test material.

It is therefore recommended that the author reevaluate his results by taking into account the important areas discussed above.

Since the test procedures followed were those of MIL-STD-285 it can be assumed that the receiving equipment was checked for case leakage in making the reference level measurements (i.e. shield not interposed between transmitting and receiving antennas) when using the high power transmitting sources necessary for the performance of these tests. In the event this was not done it should also be checked as a possible source of error in the measurements.

Table 1 indicates that the NM-40A and NM-10A were used in the tests, but no data appears in the frequency range of these instruments (30 cps-15 kc and 14 kc-250 kc, respectively).

Finally, it is recommended that the term "attenuation" not be used synonymously with "shielding effectiveness." The shielding effectiveness of a metal barrier is composed of two effects: *reflection* of the air-metal interfaces, and *attenuation* (or penetration loss) of the residual wave in passing through the thickness of the metal sheet. To equate the part for the whole, even if by indirection, is to add confusion in the mind of the reader.

Albert R. Kall, Technical Director
and Fred Kugler,
Consulting Engineer
Ark Electronics Corporation
Willow Grove, Pennsylvania

"A Simple Square Wave Generator"

Editor, ELECTRONIC INDUSTRIES:

A simple variant of the square wave generator circuit described by Bowers and Gregory in "A Simple Square Wave Generator," Dec. 1962 (their names seem to have been left off their article inadvertently) has been constructed to generate low-frequency square waves (0.1 cps to 10 kc). Since the output of the circuit is taken from

LETTERS

to the Editor

the collector of only one of the transistors, for example, V_{C2} (Figure 3 in the text), only one diode and one resistor, namely, D_b and R_b, are needed in addition to the basic multivibrator circuit. We have noted that occasionally, for certain choices of components, the square wave generator described by Bowers and Gregory is not self-starting. With only one diode, however, the circuit always has started.

E. Baskir
Shell Development Company
Exploration and Production Research Division
3737 Bellaire Boulevard
Houston, Texas

"Guide To Lamp Selection"

Editor, ELECTRONIC INDUSTRIES:

I would appreciate a copy of the January 1963 Electronics Industries "Designer's Guide to: Lamps, Indicator Lights and Illuminated Switches" by Mr. Louis S. Gomolak.

I find this article to be an excellent reference in choosing and applying lamps and indicators and need a copy for our Central Engineering files.

William E. Parker
Components Engineering
Room 2560
General Electric Company
Lynchburg, Virginia

"Guide To Lamp Selection"

Editor, ELECTRONIC INDUSTRIES:

Inasmuch as this laboratory is actively engaged in the development of digital computer control and display consoles, we have found your articles, "Designer's Guide to Lamp Selection" Part 1; "Designer's Guide to Indicator Lights," Part 2; and "Designer's Guide to Illuminated Switches," Part 3, extremely educational and useful.

We would greatly appreciate receiving three reprints of these articles which I can assure you will greatly aid us in our work.

Richard V. Kurczewski
Project Engineer
Advanced Electronics Laboratory
The Bendix Corporation
Eclipse Pioneer Div.
Teterboro, N. J.

WHAT'S NEW

GIANT PULSE LASERS

A NEW FAMILY OF GIANT PULSE LASERS — called "xasers" and producing ultrahigh energy "lasons"— is an outgrowth of an investigation just completed by Dr. Jack De Ment, president, and E. G. Anderson, project engineer, De Ment Laboratories, Portland, Oregon.

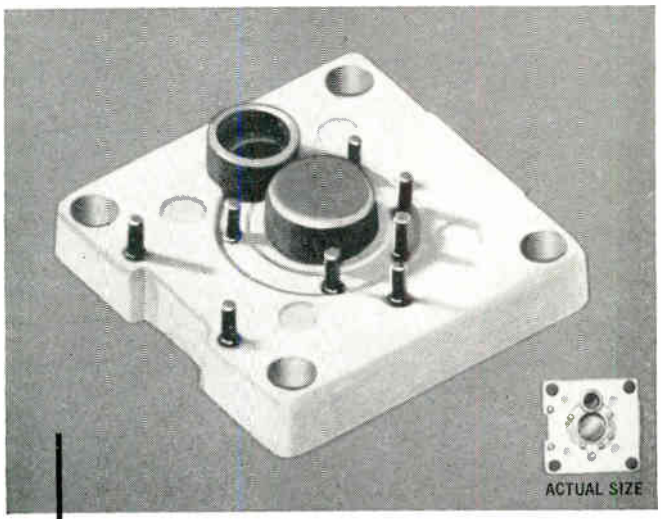
"Xasers," explained Dr. De Ment, "are aimed at the applications of laser light pulses ("lasons") involving power, such as weaponry, cutting and welding, refractory melting, biological studies, photochemical industries, photography, microsurgery, molecular surgery and, generally, non-linear optical effects."

A phased array of electrically explodable conductors, moving at velocities which may be in excess of Mach 1, is a common feature of xasers. The superbrilliant flashes of light successively released by the exploding conductors are optically coupled with one or more laser resonators for extra-high energy pumping.

Laser pumping by a single, non-moving, uncon-

(*Continued on page* 164)

NEW
CERAMIC-TYPE
MOLDING MATERIAL
FOR
Micro Miniaturization
MODULAR PACKAGES



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- insert material molded to exact specifications and inserts sealed – no metallizing required.
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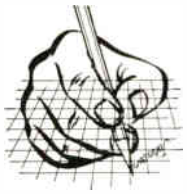

Time after time engineers specify Johnson sockets!

Whatever the choice . . . a miniature 7-pin steatite wafer—or a low-loss Kel-F socket for high power transmitting tubes . . . time and time again design and development engineers specify Johnson tube sockets! All sockets have been categorized under a socket standardization program, reducing the number of variations in each socket type. Standardized specifications and immediately available stock shortens delivery cycles—permits the selection of a Johnson socket for almost any application!

Kel-F Series—Molded of low dielectric loss-factor Kel-F plastic—designed for use with high power transmitting tubes such as the 4X150A, 4X250B, 7032, etc. Available in many designs—with or without low inductance screen grid by-pass capacitors, mounting saddle, or steatite chimney.

Bayonet Types—include Medium and Heavy Duty Medium, Jumbo and Super Jumbo 4-pin types.

Steatite Wafer Types—available in 4, 5, 6, 7, and 8 pin standard sockets, as well as Super Jumbo 4 pin, Giant 5 and 7 pin models and VHF Septar Sockets for tubes with E.I.A. Base No. E7-20 and E7-2.

Miniature Types—all steatite, available in Standard Wafer Type or Shield Base Type for 7 pin miniatures with E.I.A. Base No. E7-1.

Special Purpose Types—include sockets for tubes such as the 204A and 849, the 833 and 833A, 152TL, 304TL, 750TL, 1500T, 2-2000A, 5D21, 705A and other special purpose tubes.

E. F. JOHNSON COMPANY
3020 TENTH AVENUE S.W. • WASECA, MINNESOTA

STANDARD INDUSTRIAL, MILITARY
TUBE SOCKETS

DETAILED COMPONENTS CATALOG AVAILABLE
—Write today on company letterhead!

•CAPACITORS •TUBE SOCKETS •CONNECTORS •PILOT LIGHTS
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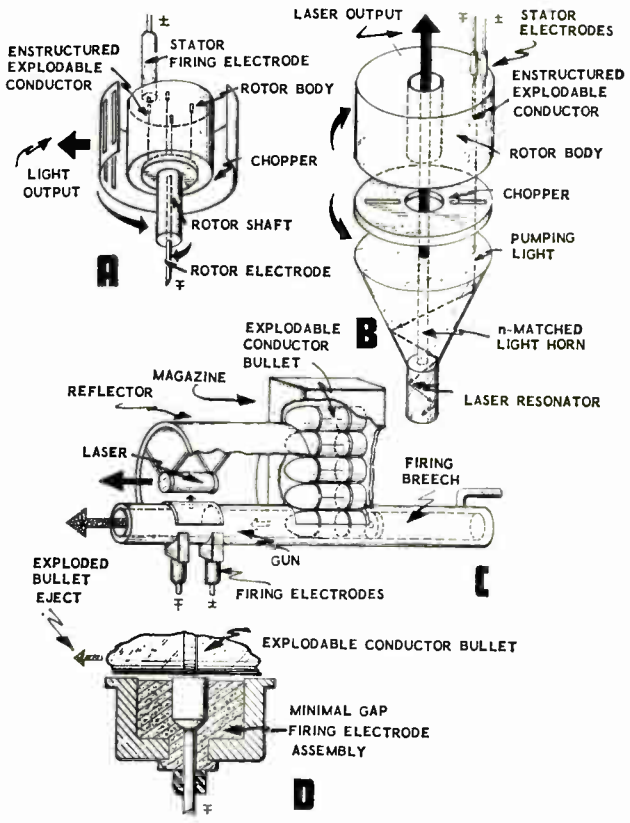
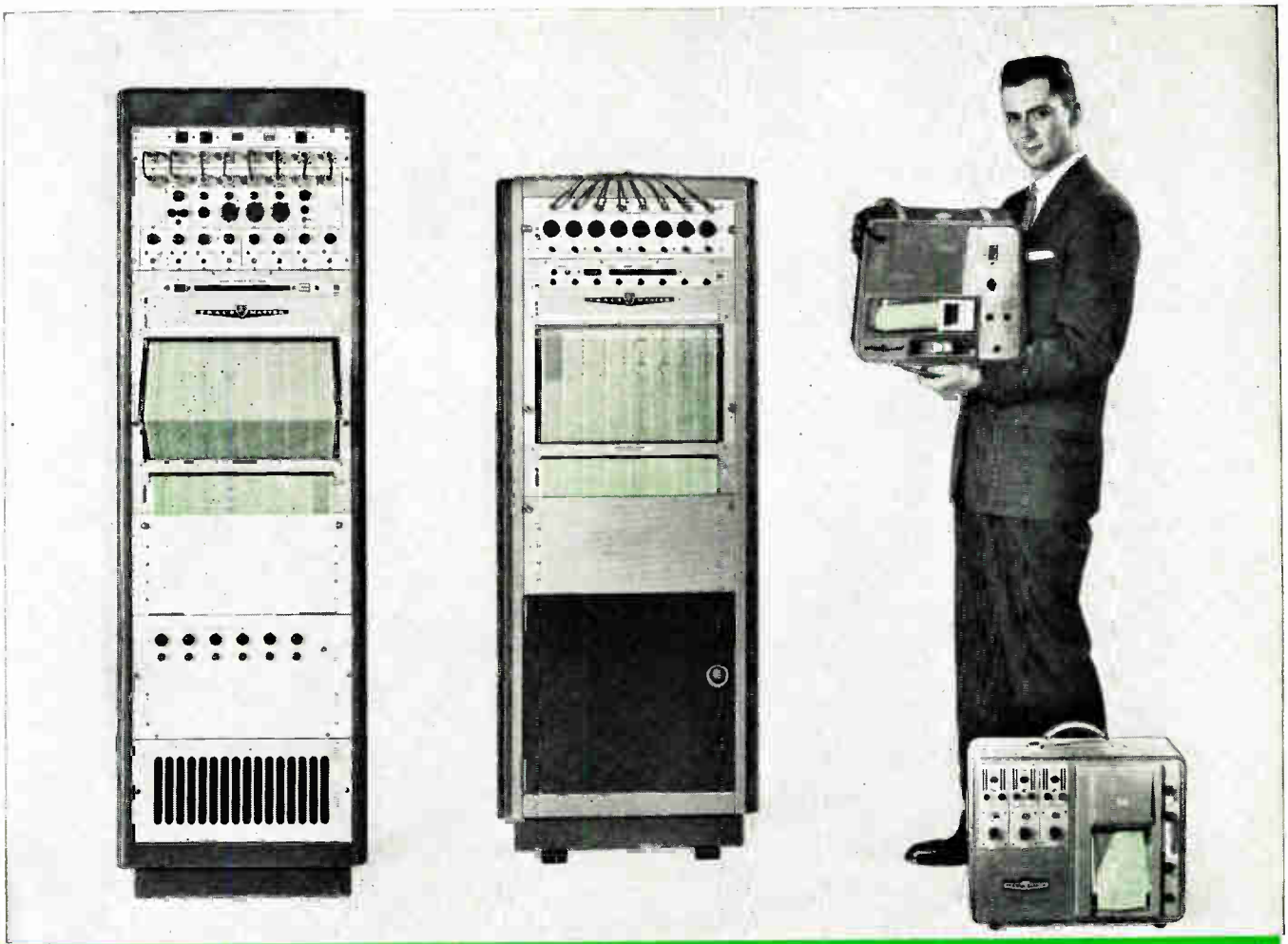
GIANT PULSE LASERS (Continued)



strained exploding wire has been known for a short time, as an outgrowth of studies made by Westing-

(*Continued on page* 166)



	SERIES 250 TRACEMASTER 8-channel, Rack Cabinet on casters	SERIES 260 TRACEMASTER 8-channel, Rack Cabinet on casters	SERIES 290 TRACEMASTER Model 291 Single-channel; Portable	SERIES 290 TRACEMASTER Models 292 & 293 2 and 3 channel; Portable
FREQUENCY RESPONSE	DC to 110 cps. flat at 40 mm. peak to peak. Down 3 db at 140 cps.	DC to 100 cps. flat at 40 mm. peak to peak. Down 3 db at 125 cps.	DC to 90 cps. flat at 30 mm. peak to peak. Down 3 db at 125 cps.	DC to 90 cps. flat at 30 mm. peak to peak. Down 3 db at 125 cps.
TRACE DEFINITION	5.5 lines/mm	5.5 lines/mm	5.5 lines/mm	5.5 lines/mm
SENSITIVITY RANGE	2 Microvolts to 10 v/chart div.	3 mv to 2 v/chart div.	5 mv to 5 v/chart div.	5 mv to 5 v/chart div.
CHART SPEEDS	0.2 to 500 mm/sec.	1 to 250 mm/sec.	1 to 100 mm/sec.	1 to 100 mm/sec.
CHART PAPER/CARBON COST (MIN. ORDER)	4¢ per foot	4¢ per foot	2.36¢ per foot	3.1¢ per foot
CHART CAPACITY	1000 ft. roll	1000 ft. roll	200 ft. roll	200 ft. roll
DIMENSIONS	70" H x 22" W x 22" D	60" H x 23½" W x 23" D	12½" H x 14½" W x 7" D	13½" H x 17½" W x 8" D
WEIGHT	600 lbs., approx.	230 lbs., approx.	20 lbs.	40 lbs.

NOW... a Tracemaster System to meet your recording problem!

AO Tracemaster presents three outstanding direct-writing recorder systems to help you acquire more meaningful low-frequency data.

Series "250" — For test installations requiring a multi-channel record of diverse signal inputs. Full line of pre-amplifiers and signal conditioners available.

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Series "290" — Single, 2-or 3-channel portables for on-the-spot recordings in the lab, field or plant.

All systems provide a far higher frequency response at full stylus deflection than any other direct-writing recorder. This is accomplished by AO's unique pen motor design and fine electronics. Also featured is the exclusive direct-carbon-transfer writing method which offers a far more uniform and finer line trace... two to three times finer than any other direct-writing technique, allowing twice as many lines/mm and twice the definition.

The specifications above give reasons why each Tracemaster system has established new standards of performance for direct-writing recorders in its class and price range. Write for free catalog.

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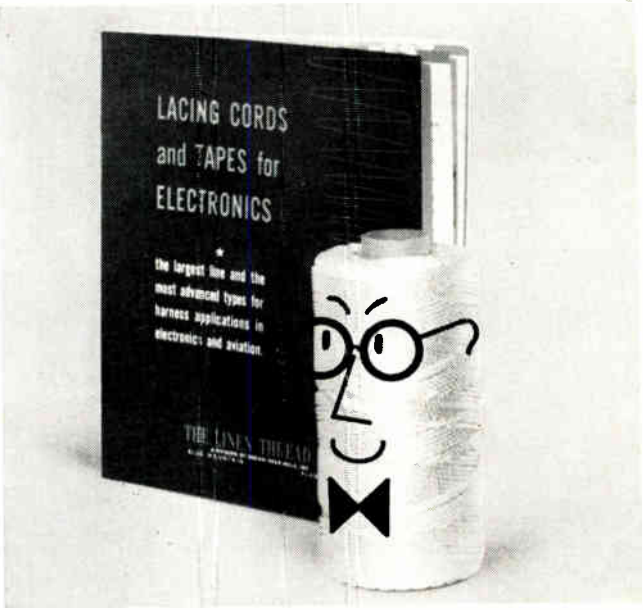
See the complete Tracemaster line at IEEE—AO Booth 3008, 3010

(Continued from page 164)

house scientists and others. But the xaser family is the first of a sophisticated, dynamic exploding conductor system using conductors in phased array. Explodable conductors may be enstructured in a cylindroid or discoid rotor body and electrically fired when spun at high velocities. Or, the conductors may be enstructured in shock constraining, transparent dielectric bullets and shot at high velocities through a special gun that has a minimal spark gap electrode firing assembly.

The new concept of "velocity seiving" is a part of the results of the De Ment-Anderson investigation. This approach involves shock-light parting—taking advantage in several ways of the velocity differential between electromagnetic radiation and shock energy.

The study also came up with explodable conductor adjunctives such as candoluminescent and cathodoluminescent materials (to retrieve and use otherwise wasted heat and electron energies); implodable and explodable-implodable conductors in phased array; isotopic explodants; conductors spectrally matched to laser active species; numerous and variegated explodable conductor phased arrays; internal modulation of pumping light to give built-in modulation for the lasing action; and shock venting enstructured explodable conductor laser pumping systems.



It's the 'Who's Who' in Electronic Threads

The most complete catalog in the industry . . . LTCo's illustrated brochure covering electronic lacing cords and tapes. LTCo's line includes nylon, linen, teflon, cotton and dacron . . . a variety of constructions, put-ups and special finishes.

For catalog, write:

THE LINEN THREAD CO.

Blue Mountain, Alabama

A DIVISION OF INDIAN HEAD MILLS, INC.

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COMBINED ONLY IN HIGH ALUMINA

Diamonite Ceramics

ELECTRICAL — Non-metallic. Non-conductor. Non-magnetic. Extremely high dielectric strength at high frequencies and temperatures.

THERMAL—Beats conditions that often hurt most other materials. Softening temperature: 3,100°F.

MECHANICAL—Strength: tensile to 28,500 psi; compression to 400,000 psi. Hardness: 9+ Mohs scale. Impact resistance: .23/.25 Izod. High resistance to wear.

CHEMICAL — Chemically inert. Non-corrosive. Gas-tight. Water absorption: zero. A-7352A

Diamonite has unmatched values for your components. New bulletin, Technical Ceramics, gives details on properties, shapes, sizes, services, stock list. *Request L-7189A.*

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Division of U.S. Ceramic Tile Co.

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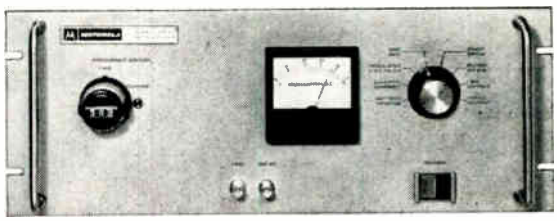
1x10^{-11}
Setability

5x10^{-11}
Aging per Day

5x10^{-11}
Short Term Stability, 1 Second Counts

Less than **2x10^{-10}**
20°C ± 20°C



Motorola 1011 Frequency Standard— the Ultimate in Stability!

■ True proportional control double oven construction. ■ Constant gain oscillator circuitry. ■ Selected 2.5 mc 5th overtone crystals. ■ Solid state silicon design. ■ 15-hour sealed nickel-cadmium batteries included. ■ Power failure alarms. ■ Frequency Adjust setable to 1 part in 10^{11}. ■ Fail-Safe dividers. ■ Optional 5 mc crystal-filtered output for spectral purity. ■ Regulated power supply. ■ Design guaranteed by over 2 decades of Motorola crystal and oscillator experience. ■ Model S1065AR includes 15 hour battery pack $3,950.00. Model S1066AR includes 5 mc spectrally pure output $4,650.00. Model SLN6076A extra 15 hour battery pack to provide 30 hour operation $300.00.

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PRECISION MEASURING INSTRUMENTS

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OCEANOGRAPHY & ASW (Concluded)

3. How best to use the submarine's stealth and concealment, and of its ability to operate at favorable depths.

4. How best to use the continuous observation potential of fixed systems.

5. How best to use mines where they can provide best and most efficient effects.

6. How best to use combinations of our capabilities against the growing numbers of nuclear-propelled submarines.

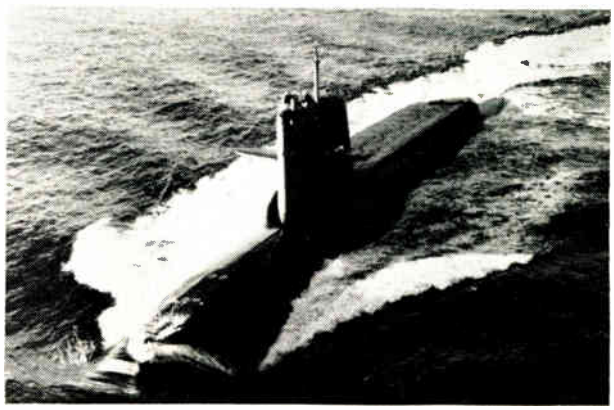
"We are entering an important transition period in developing the tools of anti-submarine-warfare," suggests Admiral Hooper.

The heart of the matter appears to be: how best to detect and classify submarines—in an environment where whales and other animal life often may be mistaken for submarines and where men have spent days in airplanes and ships to locate another ship out in the open *above* the dark, treacherous ocean below. How tough it really must be to fish out an enemy somewhere in the murky depths!

In part, then, the U.S. Navy counts on electronic detection, verification and communication gear to help seek out enemy submarines in their pens, as well as on their way to the open seas. Submarine detection may be made somewhat easier by the uneasy knowledge that the very surface shipping submarines seek to attack also serves as bait to attract enemy submarines to move-in to attack. However, finding long-range, long-capability, deep-going nuclear submarines (bearing nuclear weapons) is a difficult task.

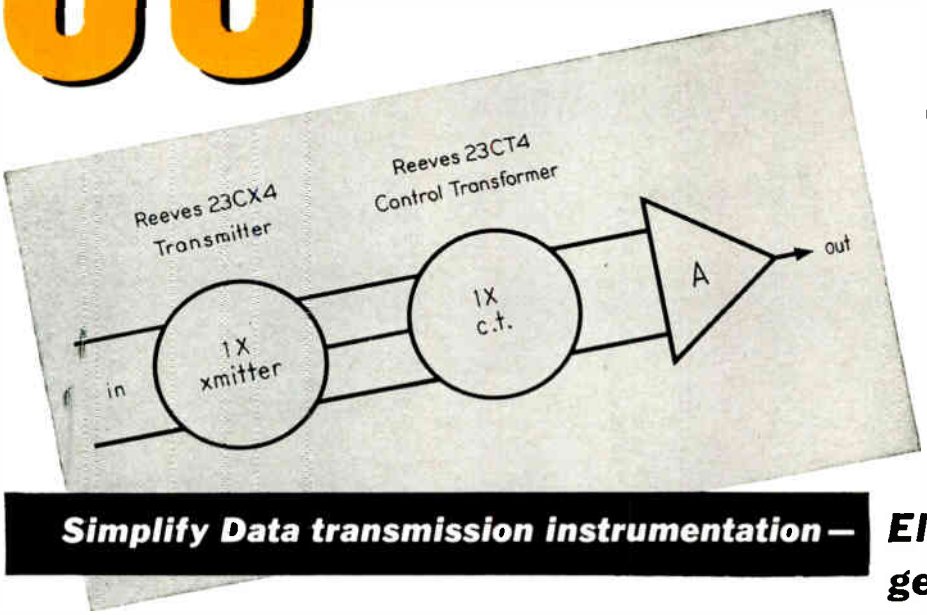
That is why, in large measure, while we and the Russians have cultivated our nuclear submarines and our ASW forces and capabilities, we now seek not so much to cope with each other. We seek, through oceanography, both to befriend the sea and coax it to betray its secrets to us—electronically and through other means.

The USS Theodore Roosevelt, a nuclear powered submarine, typifies the type of underwater craft that now has to be contended with in our anti-submarine warfare program.



30 SECOND synchros & resolvers

in BuOrd size 23 configuration



CONTROL TRANSFORMERS

TRANSMITTERS

3-WIRE SYNCHROS

4-WIRE RESOLVERS

Simplify Data transmission instrumentation—

Eliminate
gear boxes
component duplication
crossover network

DESIGN FEATURES

- 30 second accuracy on production runs
- 20 second accuracy units available on special order
- Stainless steel housings
- High thermal stability
- Compensated and uncompensated resolver models
- Conform to MIL-S20708A requirements

Reeves high precision size 23 synchros and resolvers represent a major design breakthrough. Their extreme accuracy enables the design engineer to develop data transmission systems with a greatly reduced number of components for an equivalent over-all system accuracy.

Compare the circuit diagram shown above with conventional instrumentation for a basic data transmission system. Two synchros, two gear boxes, and the crossover network have been eliminated. Weight and space have been reduced by a factor greater than 2, and the system accuracy will directly reflect the superior synchro accuracies. Reliability is improved immeasurably and field maintenance reduced to a minimum.

The new Reeves Synchros are the only 30-second accuracy instruments currently available in BuOrd size 23. The series includes both transmitters and control transformers, available for either 60 or 400 cycle input. Write for Data File 303.

See our dynamic display at the I.E.E.E. Exhibit — Booths 1305-1307

REEVES INSTRUMENT CORPORATION
A Subsidiary of Dynamics Corporation of America
Roosevelt Field, Garden City, N.Y.

2RV62

NEW TREND IN VARIABLE TRANSFORMERS

AN EXCLUSIVE HEAT SINK RING, a new current collector construction, and a new grain-oriented solid carbon brush result in variable transformers fitting more capacity in the same space. VOLT-PAC, a product of General Electric's Regulator

New design technique features exclusive heat sink ring, a new current collector contruction, and a grain-oriented solid carbon brush for more capacity/unit size.

Products Section, comes in 19 basic single core ratings (11 rated 120v at 2-65a; 8 rated 240v at 3-40a).

The heat sink is a metal ring with high thermal conductivity. It is embedded in the core insulation under the gold-plated, hard wearing brush track. It dissipates heat generated at the hot spot (where the brush contacts the brush track). The new current collector does away with current transfer problems. The load current is transferred directly from the brush to a terminal connection (eliminating hidden sliding contacts).

The exclusive grain-oriented brush features low resistance to load current flow. It simultaneously presents a high resistance to the circulating currents (where the brush contacts the track). This allows low brush temperatures.

Three lines are available. Man-

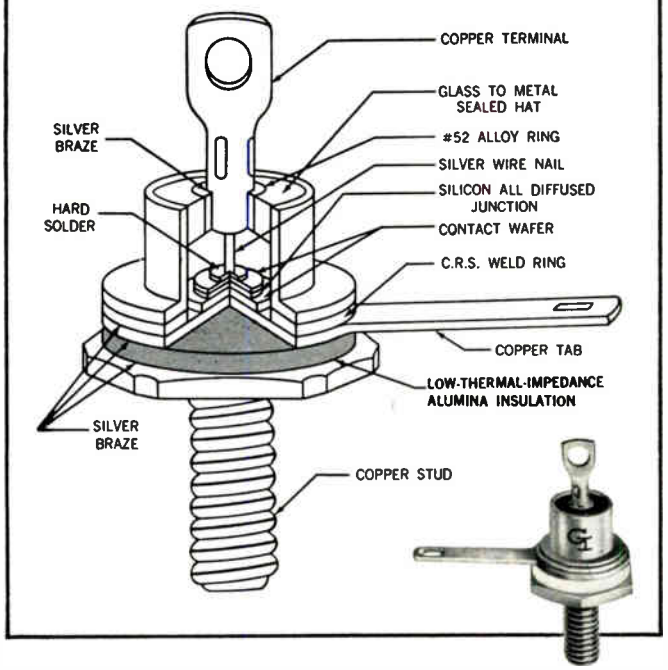
(*Continued on page* 172)

RECTIFIERS

LOWEST THERMAL IMPEDANCE!

GENERAL INSTRUMENT announces new, ALL-WELDED, INSULATED STUD DEVICES — with important mechanical and electrical superiorities never before available

CROSS SECTION OF INSULATED STUD ZENERS AND RECTIFIERS



- **THERMAL IMPEDANCE less than 4½°C/watt**
- **ONLY insulated stud able to withstand 200°C storage temperature**
- **ONLY insulated stud designed to operate safely at 150°C case temperature**
- **ALL-WELDED construction eliminates hazard of cracking, and separation of hat-assembly from stud**
- **ELIMINATES the breakage hazard, and thermal drop of mica insulators and spacers**

THIS NEW design by General Instrument Rectifier Division (patents applied for) can help make your products more reliable, more efficient, more economical to produce...whenever you require a stud rectifier or zener to be *electrically insulated from the mounting.*

MECHANICALLY, this unique package design is vastly superior to conventional studs insulated with fragile, brittle mica hardware. And welding and brazing at all points where mechanical stress is encountered result in far greater terminal rigidity and torque capability...

ELECTRICALLY, because of the use of high-purity alumina, this device maintains a better thermal impedance than conventional *un*insulated studs using mica washers and Teflon spacers.

THERMAL IMPEDANCE COMPARISON CHART

MATERIAL	THERMAL IMPEDANCE junction to heatsink	
	Dry	Lubricated
DO-4 Case Hex Stud Rectifier 12 Amp Type (not insulated)	2.75°C/watt	2.60°C/watt
DO-4 Case Hex Stud Rectifier 12 Amp Type with Mica Insulator	8.5°C/watt	8.0°C/watt
DO-10 Case GI Insulated Stud Rectifier 12 Amp Type	**4.5°C/watt**	**4.3°C/watt**

NOW... The Same Advantages in 10 WATT INSULATED ZENERS!

GI INSULATED STUD TYPE NO.	NOMINAL ZENER VOLTAGE Vz @ Izt Volts	ZENER TEST CURRENT (Izt) ma	MAX. ZENER IMPEDANCE Zzt @ Izt OHMS	MAX. ZENER IMPEDANCE Zzk @ 1 ma (Izk) OHMS	MAX. DC ZENER CURRENT (Izm) @ 55°C Stud Temp. ma	TYPICAL ZENER VOLTAGE Temp. Coeff. %/°C
LB2970-LB2975	6.8-11	370-230	1.2-3	500-250	1,320-780	.040-.060
LB2976-LB2981	12-17	210-145	3-4	250	720-500	.065-.075
LB2982-LB2987	18-25	140-100	4-6	250	460-310	.075-.080
LB2988-LB2993	27-43	95-60	7-12	250-400	300-195	.085-.090
LB2994-LB3000	45-62	55-40	13-17	400-600	185-130	.090
LB3001-LB3007	68-110	37-23	18-55	600-1100	120-72	.090-.095
LB3008-LB3015	120-200	20-12	75-300	1200-2000	67-40	.095-.100

FOR FURTHER information and data showing how these new and unique insulated stud rectifiers and zeners can help you, write: Rectifier Division, General Instrument Corporation, 65 Gouverneur Street, Newark 4, N. J.

see us at **BOOTHS 1311-1323 • IEEE SHOW**

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65 Gouverneur St., Newark 4, New Jersey

GENERAL INSTRUMENT
RECTIFIERS

RECTIFIER DIVISION

Circle 16 on Inquiry Card

VARIABLE TRANSFORMERS

(*Continued from page 170*)

ually-operated; motor-driven; and automatic units. The motor-driven types feature a totally enclosed planetary gear system. It uses a non-recurring pattern of tooth engagement which is maintenance-free. A wide variety of operating speeds are available with these motor-driven Volt-Pacs.

Nylon gear of planetary gear system magnified 20 times. System used in motor-driven type Volt-Pac variable transformers.

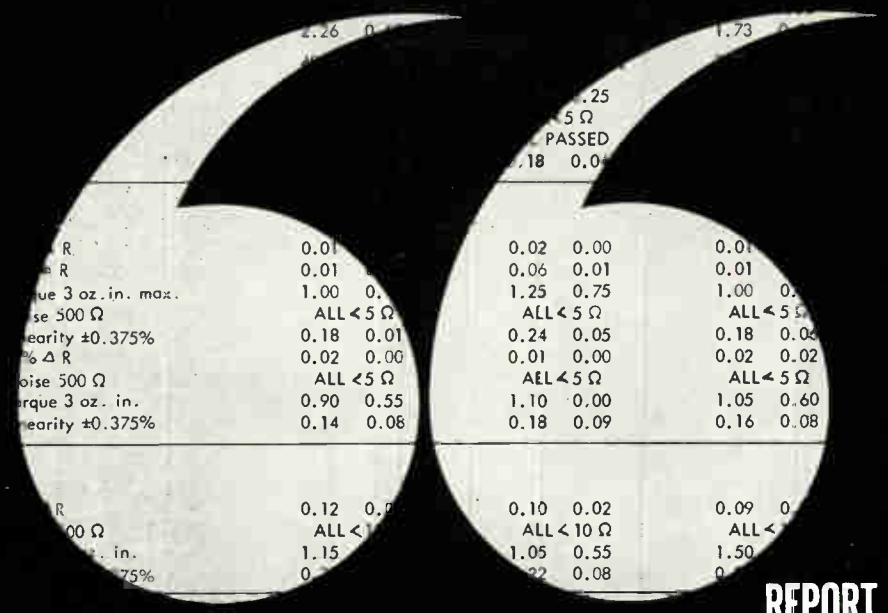
The automatic Volt-Pacs can be used in two ways: for automatic control of line voltage where incoming line fluctuation cannot be tolerated, and for automatic control of variable outputs.

By using a solid state SCR control, with feedback to the basic motor-driven unit, it can be used as a line voltage regulator to accurately and automatically control voltage for a wide variety of applications. The SCR control is used to minimize moving parts for low maintenance.

Multiple stacking and interconnection of a number of single cores make single and 3-phase variable transformers possible, with current ratings up to 400a.

The new design techniques add up to a 14% increase in capacity for the same size unit—with a 22% decrease in price.

* * *



REPORT TO THE INDUSTRY

At introduction a year ago, the industry's reaction was — "It's impossible at that price!" **Now,** the outstanding performance, reliability and value of the Series 62 potentiometer is an historical fact, backed by extensive in-field and laboratory evaluations.

Leading manufacturers are employing this remarkable ten-turn precision potentiometer in industrial equipment of all types. We've doubled and tripled our production capacities — and still the demand increases! Have you taken advantage of this potentiometer in your equipment? A precision ten-turn potentiometer of absolute linearity ± 0.25% for $5.00 (production quantities). Start thinking Series 62 today.

WRITE **for your free copy of a complete engineering test data report for your personal evaluation.**

CLAROSTAT

MFG. CO. INC., DOVER, NEW HAMPSHIRE

CLAROSTAT

NEW TECH DATA

for Engineers.

Micro Connectors

Form MM1162, 6 pages, covers an extensive line of micro-miniature plug and socket connectors, Series MM-22, giving extremely small size and high reliability. Information includes outline drawings, electrical and mechanical specs., illustrations and ordering data. Continental Connector Corp., 34-63 56th St., Woodside 77, N. Y.

Circle 322 on Inquiry Card

Special Electron Tubes

This 12-page brochure describes the resources and facilities of the Electron Tube Dept., CBS Laboratories, a div. of Columbia Broadcasting System. Details include special electron tube, research and development, test and evaluation and production. Electron Tube Dept., CBS Laboratories, High Ridge Rd., Stamford, Conn.

Circle 323 on Inquiry Card

Miniature Connector Catalog

This 49-page catalog, MX-62, describes connectors for standard and miniature coaxial cables. Included are illustrations, mechanical drawings, graphs, tables and charts. Omatron Div., Burndy Corp., Norwalk, Conn.

Circle 324 on Inquiry Card

Vacuum

A pair of brochures, one on Vacuum Systems, the other on Vacuum Components, is available from VACTITE, 1890 Embarcadero Rd., Palo Alto, Calif. These composite, 60-page catalogs give data on deposition evaporators, space simulators, vacuum ovens, and component impregnators. Data is included on the Optical Coating and UHV processing equipment, capable of reaching pressures of 5×10^{-10} torr from cryogenic 1000°C. Vacuum components covered include valves, seals, traps, flanges, bell jars, feed throughs and waveguides.

Circle 325 on Inquiry Card

Subminiature Toroids

This 8-page components catalog describes a variety of subminiature toroids, available in a wide range of standard inductance values. The 2-color catalog includes photographs, comprehensive line drawings and inductance value charts of toroids with Q values ranging from 12 to 190 over a freq. range of from 1kc to 5mc. Standard inductance tolerance is ±5% with tolerances to ±1% available. Units described include epoxy-molded, hermetically-sealed or open-coil types. Johnson Electronics, Inc., Casselberry, Fla. Circle 326 on Inquiry Card

Subminiature Trimmers

Catalog 2500, 2 colors, illustrates, describes and gives ordering information, electrical and mechanical specs. on 3 low priced Series 220 (7/16 x 5/16 x ½ in.) single turn composition trimmer potentiometers. For computers, communications systems, and other printed circuit applications. CTS Corp., Elkhart, Ind. Circle 327 on Inquiry Card

Spur Gear Slide Chart

Spur Gear Data Slide Chart includes recommended tolerances and performance specs. for the various classes of standard fine pitch spur gears, and complete gear tooth data for all standard pitches, from 24 to 200. Formulas are included. PIC Design Corp., 477 Atlantic Ave., E. Rockaway, L. I., N. Y.

Circle 328 on Inquiry Card

RFI Filters

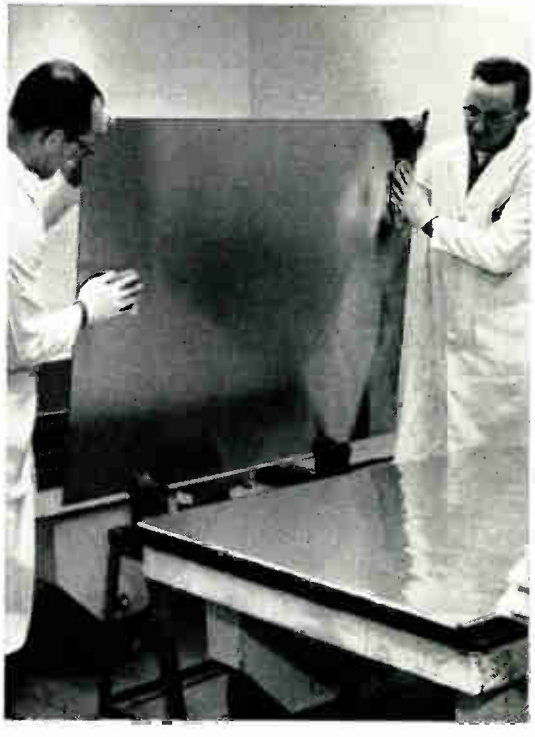
Data-Log No. RFI-2000, 6 pages, describes 11 typical categories of RFI filter design solutions, comprising over 2,000 different designs. These variations include voltage, currents, headers, connectors, terminals, case styles, mountings, etc. Hopkins Engineering Co., P. O. Box 191, San Fernando, Calif.

Circle 329 on Inquiry Card

How Taylor copper-clad quality control

One of the many instruments used by Taylor to check product quality is the Profilometer. Here a quality-control specialist is inspecting surface finish on a composite sheet.

You get clean copper-clad material. The copper-clad laminated plastic, used in making etched printed circuits, is prepared for pressing in Taylor's dustfree "white rooms."



NEW TECH DATA

for Engineers.

Rectilinear Instruments

Rectilinear graphic recording instruments which use no elaborate pulleys and fish-wires to translate curvilinear into rectilinear motion are described in a 4-page, 2-color catalog. A description of the "RECTIgraph" movement is included. Esterline Angus Instrument Co., Inc., P. O. Box 596, Indianapolis 6, Ind.

Circle 330 on Inquiry Card

Phase Shifters

Information describing a series of r-f phase shifters operating at specific user freq. from 5 to 40MC. is available from Nilsen Mfg. Co., P. O. Box 127, Haines City, Fla. The 16-page handbook summing up the most important data developed regarding the theoretical aspects of phase shifting design is included.

Circle 331 on Inquiry Card

Crystal Can Relay

Information is available on a Half-Size Crystal Can Relay, Model SR, designed for close stacking on printed circuit boards and extremely dense switching/unit volume. Dimensional drawings, electrical and mechanical specs., and ordering information are included. Branson Corp., 41 So. Jefferson Rd., Whippany, N. J. Circle 332 on Inquiry Card

Magnet Wire Insulation

"Rea Guide to Magnet Wire Insulation," 24 pages, provides complete information on 14 insulations for copper and aluminum round wire, sizes 8 through 44. Rea Magnet Wire Co., Inc., 741 Alcoa Bldg., Pittsburgh 19, Pa.

Circle 333 on Inquiry Card

Circuit Modules

Use of germanium and silicon circuit modules for low power, with high density efficiencies in digital systems is described in Tech. Data Bulletin series 2300 and 2350. Logical, electrical, mechanical, environmental and reliability specs. for these low cost transistor-diode log building blocks cover flip-flops, read and write amplifiers, strobe generators, logic circuits, inverters, power inverters, level converters and adapter cards. Computer Products Group, LFE Electronics, 1079 Commonwealth Ave., Boston 15, Mass.

Circle 334 on Inquiry Card

Antenna Pedestal

Catalog sheet on Model 12 Servo Position Antenna Pedestal covers accelerations, accuracy, type of drive, and natural freq. of pedestal. TEMEC, Inc., 7833 Haskell Ave., Van Nuys, Calif.

Circle 335 on Inquiry Card

Waterproof Plugs

Catalog WP-1 describes the Cannon W series of waterproof plugs. The W series are designed to provide a watertight solution for any connector moisture problem, whether deep underwater or in a surface application. Cannon Electric Co., 3208 Humboldt St., Los Angeles 31, Calif.

Circle 336 on Inquiry Card

Micro-miniature Relays

Bulletin No. P-62 gives dimensions, electrical and mechanical specs., and prices of 8 styles of ¼ in., single-turn, wire-wound pots., a ⅜ in. pot., and a ¼ in. diameter relay. Specs. and application notes are tabulated in a wall-chart form. MINELCO, 600 South St., Holbrook, Mass. Circle 337 on Inquiry Card

Connector Chart

A chart containing detailed design and performance data on 6 different lines of cylindrical-miniature, electrical connectors is available from The Deutsch Co., Electronic Components Div., Municipal Airport, Banning, Calif. Included is insert configurations available; applicable application tooling; accessories and modification hardware and complete mating/interchangeability data. *Write for chart under company letterhead.*

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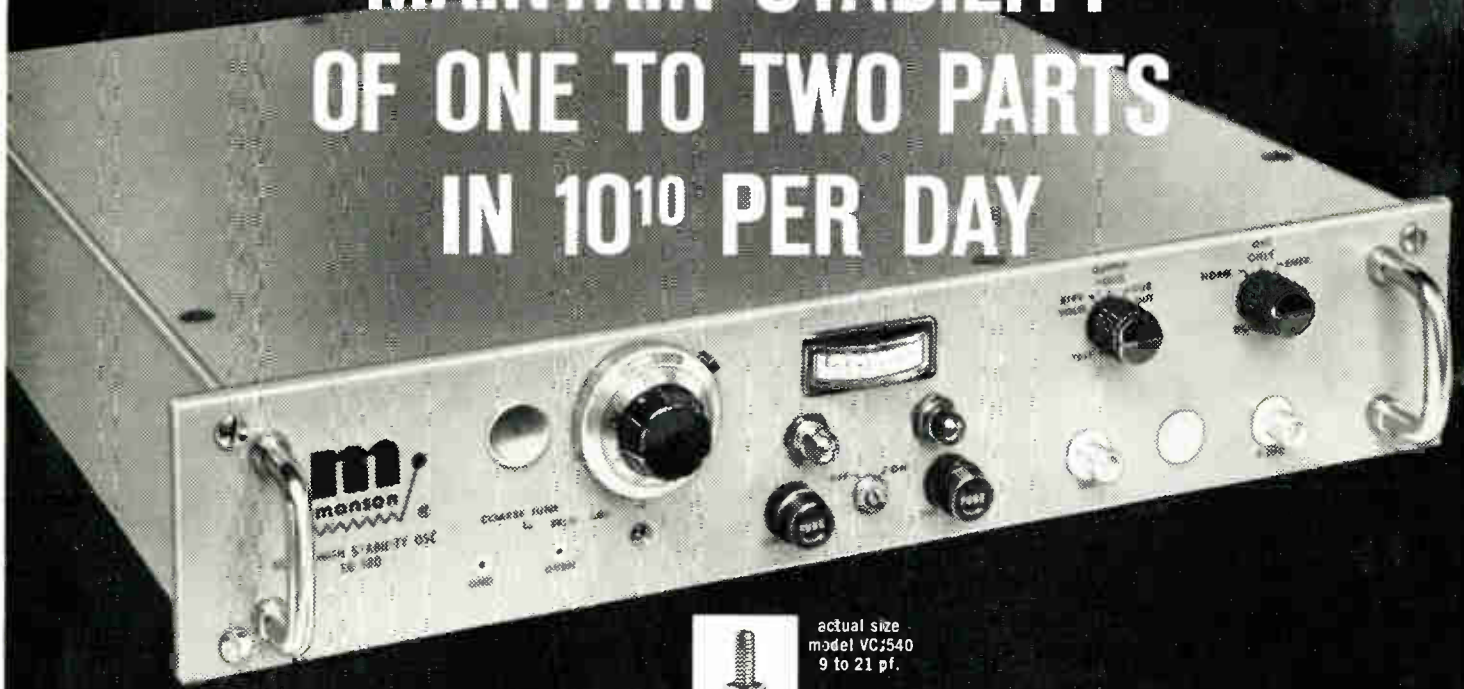

actual size
model VCJ540
9 to 21 pf.

Wherever the generation of an ultra-stable frequency reference is required, you will find the Manson solid-state Frequency Standard model RD-180A at work. ■ Its 5 mc crystal controlled oscillator is enclosed in a dual controlled temperature regulated oven where the JFD VCJ540 piston trimmer capacitor is used to compensate for crystal aging. So precise is the output of the RD-180A that it now serves as the timing reference for the entire Pacific missile range and is also part of the Polaris missile communications network. ■ Only the JFD capacitor VCJ540 with its unique characteristics of ultra-linear tuning, low temperature coefficient, precise tuning resolution, shock and vibration resistance could meet Manson Laboratories' stringent stabilty and reliability standards. ■ The VCJ540 (modified VC12) is a fused quartz unit and has high Q and excellent stability for high voltage applications. It is one of many thousands of special trimmers capacitors possible from JFD's line of over 500 standard units. Complete lines of metalized inductors and LC Tuners are also available from JFD. ■ Call your JFD industrial distributor or your nearest JFD field engineer for further information. Our engineering staff will be glad to consult with you wherever and whenever you say.

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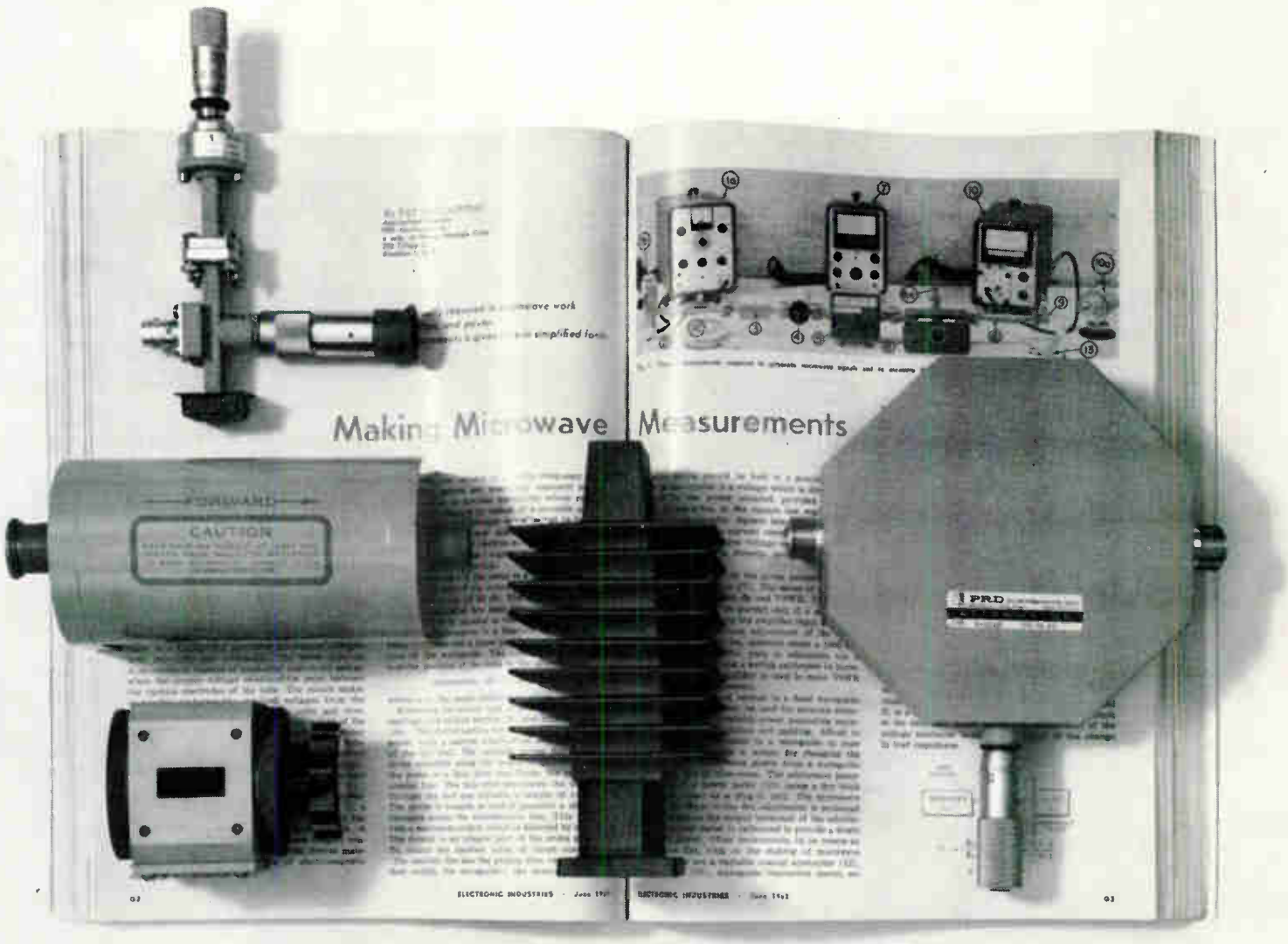

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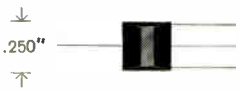

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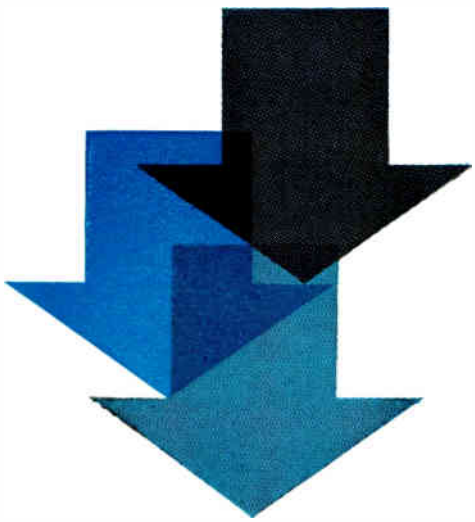

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We've taken the breathing space out of air gaps. Want proof? Take a look at the high-permeability Hallefex Model 335. Its magnetic gap is squeezed to less than 0.001"—up to 15 times smaller than in other Hall generators.

You'll find no trick to this disappearing act. Just a patented manufacturing technique that deposits a microns-thin film of indium antimonide on a ferrite substrate, then covers both with a second ferrite slab which acts as a flux concentrator. But wonders don't cease with the introduction of efficiency to magnetic circuits. The same process also sends input impedance up to a practical range of 100 to 600 ohms and voltage output sensitivity up to an equally impressive 2.0 volts/amp.-Kilogauss, minimum. Other wonders, too—and to learn about them, contact your nearest Helipot rep or Sales Office.

Our Hall Effect Applications Group will provide you with an idea-provoking data file, and stands ready to lend you assistance in every Hallefex application. Write, wire or phone Sales Manager for Special Products, Helipot Division. Telephone: TRojan 1-4848. Teletype: FULLERTON CAL 5210. Model 335 evaluation units are yours by return Air Mail for $35 each.

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NEW TECH DATA

Bearing Analysis

Bearing Inspection, Inc., 3311 E. Gage Ave., Huntington Park, Calif., is offering a brochure entitled, "Ball & Roller Bearing Analysis Through Electronics." Information including photographs and descriptions is included in the BA-20-2E Analyzer, a high speed measuring instrument for evaluating surface defects on raceways, rolling elements and operating characteristics of retainers and shields at an average rate of 2 units/min.

Circle 307 on Inquiry Card

Retaining Rings

This 128-page technical manual contains formulas for calculating static and dynamic thrust loads for rings and grooves, relative rotation, deflection and elastic deformation. Data also covers materials and finishes, including a detailed analysis of their corrosion resistance and suitability for specific design requirements, and selector guides to the company's 21 standard ring series and 30 representative special ring types. Truarc Technical Manual, 12th Edition is available from Waldes Kohinoor, Inc., 47-16 Austel Place, Long Island City 1, N. Y.

Circle 308 on Inquiry Card

Prototype Panels

The Datak Corp., 63 71st St., Guttenberg, N. J., is offering information on their "Instant Lettering." A wide variety of different sizes and types of lettering, in complete alphabets, is available for marking prototype panels and meters. Instant letters are applied by simply pressing them on to the panel or meter to be marked.

Circle 309 on Inquiry Card

Subminiature Switches

Miniature and subminiature snap-action switches are described in a 20-page, 2-color catalog available from Licon Div., Illinois Tool Works Inc., 6615 W. Irving Park Rd., Chicago 34, Ill. A discussion of technical switch terminology and design precedes complete product descriptions, dimensional data, and performance data on 4 types of miniature-subminiature switches, ranging in size from 1¼ x ½ x ½ in. to 25/32 x 7/16 x ¼ in. The dictionary of terms includes illustrations.

Circle 310 on Inquiry Card

Delay Line Bibliography

"Bibliography on Magnetostrictive Delay Lines," a compilation of articles covering this subject which have appeared in tech. publications, is available from Sonic Memory Corp., 494 Oak St., Copiague, L. I., N. Y. Covering a wide area in theory, design and application on delay lines for pulse delay and storage in aircraft navigation, radar, radar target simulation, nuclear instrumentation and digital computers.

Circle 311 on Inquiry Card

NEW TECH DATA

Standards and Specifications

Electronic Industries Association, Room 2260, 11 W. 42nd St., New York 36, N. Y., is offering their latest alphabetically indexed list of recommended standards, specifications, and engineering publications.

Circle 312 on Inquiry Card

Magnetostrictive Filters

This 4-page technical pamphlet includes schematics of array circuit configurations on dual and triplet summation techniques. Although magnetostrictive type filters are cited in the examples, the circuits can be adapted to quartz and lumped constant resonators. Applications for arrays for signal enhancement in sonar, communications and Doppler radar are discussed. Spectran Electronics Corp., 146 Main St., Maynard, Mass.

Circle 313 on Inquiry Card

Encapsulation Discussion

This 8-page tech. paper entitled, "High Production Encapsulation of Electronic Devices" discusses packaging of electronic components and circuits, stressing particularly the methods for high production encapsulation. Direct encapsulation by transfer molding is fully covered, including descriptions of properties of various types of epoxy molding compounds, and other aspects of the process. Hull Corp., Hatboro, Pa.

Circle 314 on Inquiry Card

Relay Hand Book

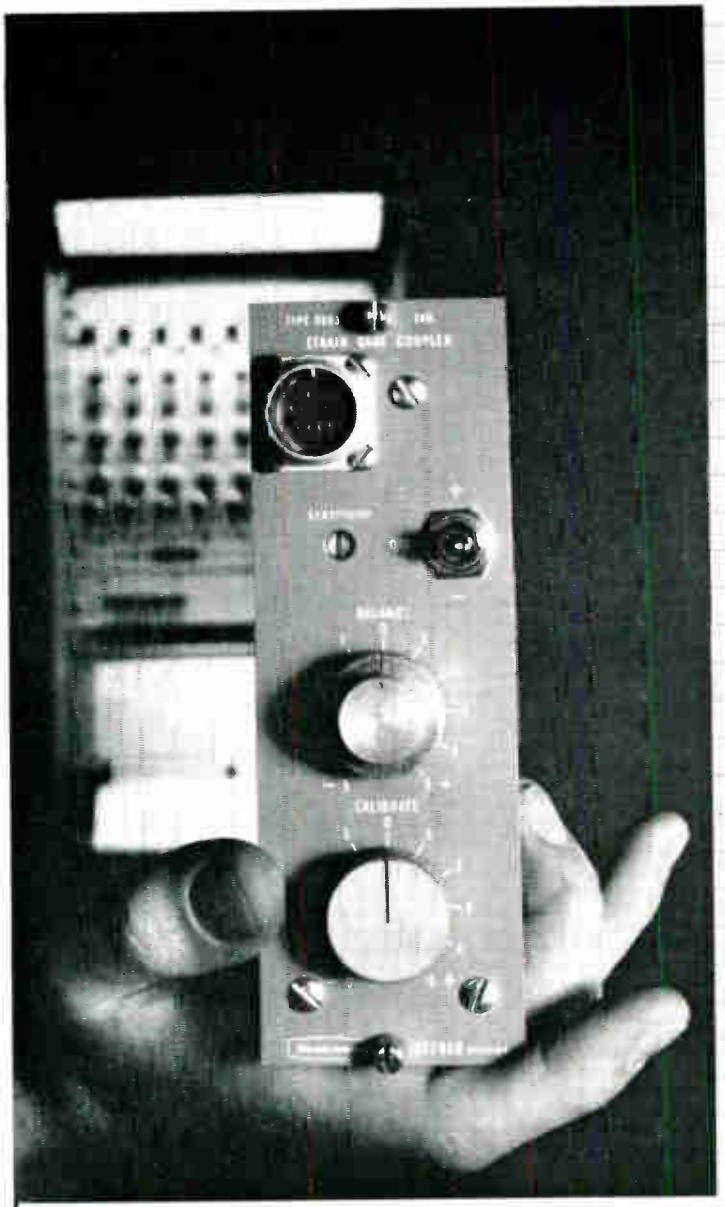
This 36-page, Relay Catalog and Engineering Hand Book, contains illustrations, specs. and dimensional drawings. Relays include telephone type in a wide range of sizes and contact combinations: general purpose; crystal can, and Magnereed dry reed types. Included is a wide selection of high reliability relays available to meet current Mil specs. Information also covers hermetically sealed and dust covered, power, latch-in, snap action and time delay, along with printed circuit relays, and relays with taper tab terminals. One section includes encapsulated, high reliability types. Magnecraft Electric Co., 5577 N. Lynch, Chicago 30, Ill.

Circle 315 on Inquiry Card

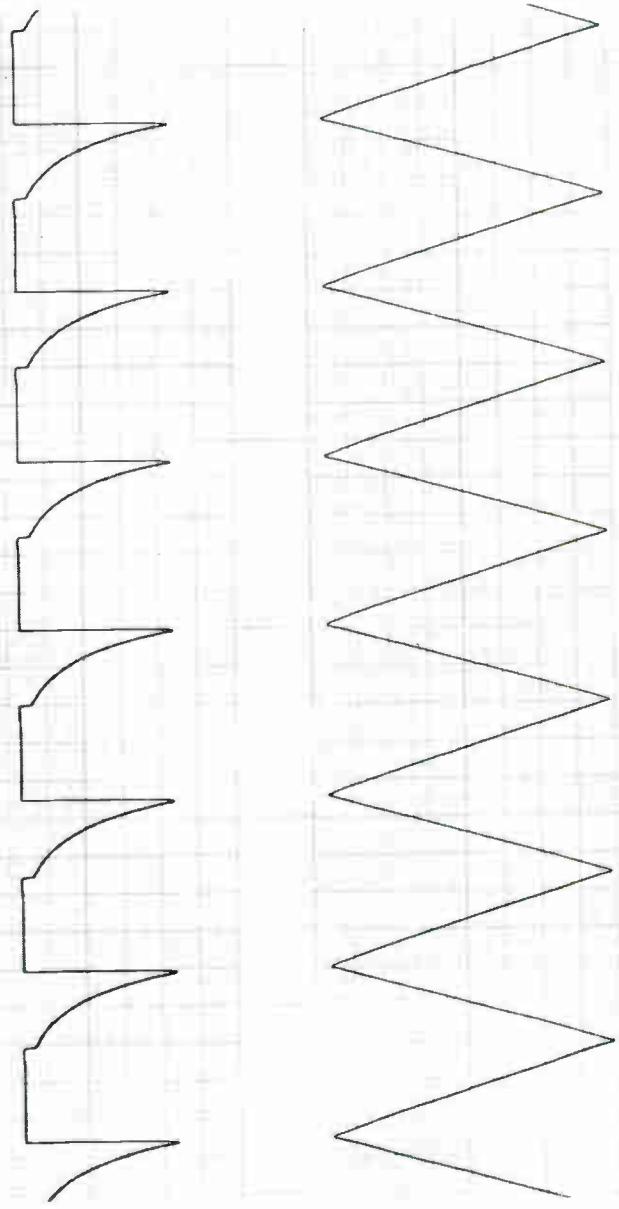
Power Resistors

This 16-page catalog describes precision power resistors offered by California Resistor Corp. (CAL-R), 1631 Colorado Ave., Santa Monica, Calif. The illustrated brochure includes specs. and standard ranges-tolerances-resistances on its silicone coated resistors (including non-inductive), metal clad resistors (inductive and non-inductive) for high power heat sink applications; and its high temp. 350°C silicone coated resistors (including non-inductive) for high temp. power applications.

Circle 316 on Inquiry Card



LOW-COST PLUG-IN INPUT COUPLERS ALLOW THE TYPE S RECORDER TO ACCOMMODATE A WIDE RANGE OF INPUT SIGNALS. 23 STANDARD COUPLERS ARE AVAILABLE.



OFFNER TYPE S DYNOGRAPH® IS SERVO CONTROLLED AT THE PEN POINT TO ASSURE LOCKED-IN ACCURACY.

Offner adaptability in ink rectilinear recordings

Only OFFNER offers the advantages of ink rectilinear recording with the flexibility of fast input coupler exchange. Servo loop at the stylus point forces locked-in accuracy. The OFFNER input couplers change the function of the amplifier system and provide all necessary bridge balancing, calibration and "computing" facilities... thus obviating the need for expensive special-purpose amplifiers.

Specifications:

Number of Channels	1-8 standard, to 24 special
Sensitivity	With preamp 1μv/mm to 5v/mm Without preamp 1mv/mm to 5v/mm
Frequency Response	DC to 150 cps
Phase Error	0-120 cps, 0.05 msec max. delay error
Linearity	0.15% (full scale) for DC; or AC within maximum amplitude envelope
Drift	(shorted input) With preamp 1μv/hr at max. gain Without preamp <0.05mm/hr
Recording Amplitude	Full chart channel width from DC-30 cps with progressive reduction to 5mm at 150 cps
Input Impedance	With preamp 2 megohms without preamp 1 megohm
Warm-up Time	Instantaneous
Nominal Cost/Channel	With preamp $1,250 Without preamp $850

Booths 3822-3824, IEEE Show, New York

Beckman® INSTRUMENTS, INC.

OFFNER DIVISION

Schiller Park, Illinois

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

063-650

Now–a P.A.D.T. transistor

with typical power gain of

15.5 db at 200 Mc...

at the usual P.A.D.T. production-run prices

Amperex 2N2495

The type 2N2495, PNP germanium VHF transistor, newest in the Amperex 'Post Alloy Diffusion Technique' line, is now in full automated production at our Rhode Island Semiconductor plant. This new P.A.D.T. transistor makes possible the production of lower cost, higher gain IIF/VHF amplifiers for front ends of receivers, even at frequencies beyond 200 Mc!

As you know, the unique Amperex P.A.D.T. manufacturing process provides high reliability, optimum performance and uniformity in production-run transistors. Like all P.A.D.T. transistors, the new 2N2495 is available in quantity for immediate delivery at prices reflecting production-run manufacture. Its availability offers the opportunity for improved circuitry in mobile, portable and fixed-station communications, radar equipment, FM and TV receivers, etc.

For complete data on the 2N2495 or applications engineering assistance, write to: Amperex Electronic Corporation, Semiconductor and Receiving Tube Division, Hicksville, Long Island, New York. For geographical listing of authorized industrial distributors who carry Amperex P.A.D.T. transistors, see Amperex ad on facing page.

Typical Characteristics

100 mw max. dissipation	*+25° C*
f_t*=300 Mc*	*12V, 5 Ma*
h_{fe}*=140*	*12V, 1 Ma, 1 Kc*
Power Gain=15.5 db at 200 Mc	*6V, 1 Ma*
C_{ob}*=1.5pf*	*12V, 1 Ma, 35 Mc*
z_{rb}*=10 ohms*	*12V, 1 Ma, 2 Mc*
C_{re}*=0.7pf*	*12V, 1 Ma*
Noise Figure=6 db	*200 Mc, Rs=30*
Envelope	*TO-12*

IN CANADA: PHILIPS ELECTRON DEVICES, LTD., TORONTO 17, ONTARIO.

Ask Amperex

Circle 122 on Inquiry Card

NEW TECH DATA

Microfilm Burn

Information is available on a new non-glare formula developed to prevent microfilm "burn" on drafting details. The Stanpat developed non-glare formula prevents "burn" because the drafting material is free of a reflective surface. Stanpat Co., 150-42 12th Rd., Whitestone 57, N. Y.

Circle 347 on Inquiry Card

Ink Markers

Information is available on a number of different ink markers including, Water Off, Vapor Off, Lightfast, and RETMA markers. Inks which meet the requirements of the Radio, Electronics, Television Manufacturers Assoc. for color and heat resistance are used in the RETMA marker. Organic Products Co., P. O. Box 428, Irving, Tex.

Circle 348 on Inquiry Card

Water Soluble Solder Flux

Complete technical and application details on the Series 1800 Electronic Flux is available in Bulletin 1800 entitled, "Electronic Hydra/Flux Water Soluble Liquid Soldering Flux." Subjects discussed include various flow rates, corrosion factor, methods of application, construction materials, storage, physical and chemical properties. Connecticut Valley Chemical, Inc., Essex, Conn.

Circle 349 on Inquiry Card

Instrument Catalog

A Quick Reference Catalog is available covering freq. selective voltmers; wave analyzers; transistor testers; signal generators; oscilloscopes; line fault analyzers; precision power measuring instruments, power sources; waveguides; coaxial loads; r-f power monitors; directional couplers; detectors; and low pass filters. Sierra Electronic Div., Philco Corp., 3885 Bohannon Dr., Menlo Park, Calif.

Circle 350 on Inquiry Card

Coax Cable Assemblies

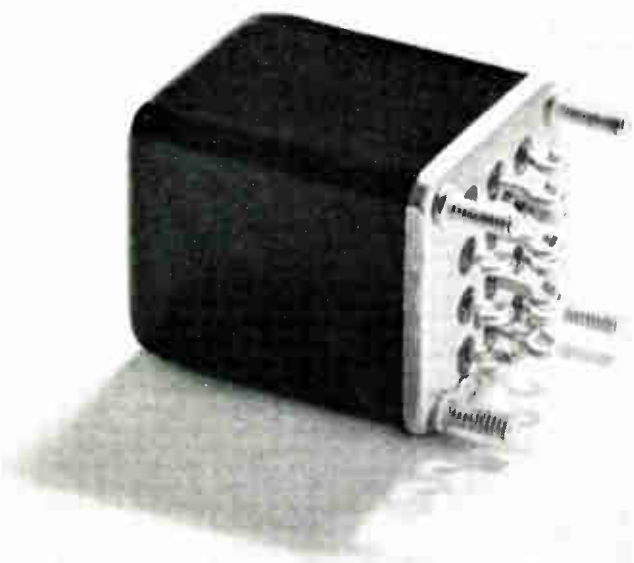
Information is available on a complete line of precision made coaxial cable assemblies. These PAMCO Coaxial Cable Assemblies are available from stock in a wide selection of Series, BNC, C, HN, LC, N and UHF coaxial connectors, and in a corresponding range of Mil spec. types. Paraplegics Mfg. Co., Inc., 304 N. York Rd., Bensenville, Ill.

Circle 351 on Inquiry Card

Rotary Switch

A spec. sheet on Model 10 Rotaswitch contains design and construction information, specs., dimensions and ordering information. The Rotaswitch translates shaft rotation into an electrical output to directly actuate counters, printers, and stepping motors. Specification S010 is available from Disc Instruments, Inc., 3014-B So. Halladay St., Santa Ana, Calif.

Circle 352 on Inquiry Card



Breathing itself to death?

(Not if CEC's 24-120A Leak Detector says it's leak proof)

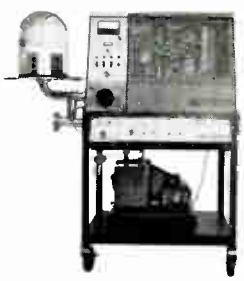
Even if you anticipate a very long wait between completed electronic component and blast off, you can be sure the component will remain absolutely airtight. . . if CEC's 24-120A can't find any leaks.

This instrument will locate leaks as small as 5×10^{-11} atm cc/sec. Fast!

As versatile as it is sensitive, this instrument tests both pressurized and evacuated components. And, equipped with the new 24-038 Test Port and Roughing Station, *automatically* tests small parts on a test port or under a bell jar. In addition, two flanges permit probe testing from either end or via direct hookup to a large test vessel.

Portable too, the 24-120A can be hand carried, rested on a test cart, or installed on a mobile Test Port and Roughing Station. Thus, in lab, field, shop or production line, this instrument will measure up to your most demanding requirements.

For more information, call your CEC office. Or, write for Bulletin CEC 24120-X4.



CEC

Analytical & Control Division

CONSOLIDATED ELECTRODYNAMICS

A Subsidiary of **Bell & Howell** • Pasadena, California

Circle 124 on Inquiry Card

NEW TECH DATA

Altitude vs. Cooling

Tech. report, 10-pages, discussing the effects of max. altitudes and ambient temps. on satisfactory operation of Electronic equipment packages with forced air cooling is available from Rotron Mfg. Co., Woodstock, N. Y. The report, "How Altitude Affects Forced Air Cooling Requirements of Electronic Equipment" shows how ambient density effects the weightflow of air delivered by an air moving device to the package requiring cooling, and how this change in weightflow governs the component temp. rise above the ambient air temp.

Circle 317 on Inquiry Card

Aerospace Guidance

Such new techniques and approaches as the electrostatic gyro and accelerometer, cryogenic gyro, self-adaptive computer, electrostatic memory drum hybrid digital analog pulse-time technique, systems and packages are explained and illustrated in brochure LMEJ-5244 available from the Armament and Control Products Section, Light Military Electronics Dept., General Electric Co., Johnson City, N. Y. This 12-page brochure covers the advancement of missile and space vehicle guidance and control from original Hermes to present technologies.

Circle 318 on Inquiry Card

Silicon Rectifier Guide

"Silicon Rectifier Selector Guide," 8 pages, provides circuit designers with a convenient reference for the selection of medium-current silicon rectifiers. The guide consists of a dual selector chart. One portion shows current vs. temperature derating curves for determining the desired current capability at the required temperature. Once this is known, the second portion of the chart then shows which device to select to meet the peak-inverse-voltage (PIV) requirements. Information includes parameters for 170 EIA silicon rectifier types. Motorola Semiconductor Products Inc., 5005 E. McDowell Rd., Phoenix, Ariz.

Circle 319 on Inquiry Card

Ceramic Capacitors

Tech. data is available on subminiature ceramic capacitors offering up to 1200pf with a case size of 0.250 x 0.095 in. Bulletin 522 describes ERIE Style 390 capacitors, for printed circuit use. Erie Resistor Corp., 644 W. 12th St., Erie, Pa.

Circle 320 on Inquiry Card

Small Signal Transistors

Preliminary Spec Sheets are available on small signal npn silicon planar transistor suited for low-level, low-noise amplifier applications. The sheets are available from Sperry Semiconductor, div. of Sperry Rand Corp., Norwalk, Conn.

Circle 321 on Inquiry Card

NEW TECH DATA

Ultrasonic Reference

This 16-page illustrated brochure entitled, "What You Should Know About Ultrasonic Search Units," is designed as a reference, condensed and simplified, to be used as an aid in selecting proper search units for various ultrasonic testing requirements. Principles of ultrasonic flaw detection are described along with diagrams. Tech. Data 50-798 is available from Sperry Products, Div. of Automation Industries, Inc., Danbury, Conn.

Circle 258 on Inquiry Card

Potentiometer Noise

This 42-page, 2-color illustrated brochure includes sections on precision potentiometer linearity and conformity including detailed testing procedures along with graphs and charts, outline drawings; and a section on resolutions and potentiometer noise with layouts on a conventional noise circuit and alternative noise test circuit. The Gamewell Co., Newton Upper Falls 64, Mass.

Circle 259 on Inquiry Card

Filter Design

This 4-page tech. bulletin entitled "RFI Suppression by Filter Design Techniques (Part II—Physical Realizability)" contains design and realizability data for lumper-element, Butterworth and Tchebycheff, band-pass filters. Tables, charts, graphs, and examples are included. Bulletins are also offered on other filter design and delay line data and on the subject of "The Antenna as a Filter Element." White Electromagnetics, Inc., 4903 Auburn Ave., Bethesda 14, Md.

Circle 260 on Inquiry Card

Electronic Metals

This 32-page, 2-color brochure entitled "Electronic Metals and Compounds" contains sections on germanium; germanium salvage; special electronic compounds including information on germanium in the forms of tetrachloride, tetrabromide, and tetraiodide, silicon, boron tribromide, and boron oxide; cadmium sulfide; gallium salvage; intermetallics high purity elements; and a table of elements including atomic number, elements, symbol, weight, density @ g/cc and °C, melting point and boiling point data. The Eagle-Picher Co., Chemicals and Metals Div., Cincinnati 1, Ohio.

Circle 261 on Inquiry Card

Laser Materials

"Certified Threshold Lasers" is the title of a 16-page tech. bulletin. It gives a concise explanation of how a laser operates, and covers standard sizes of crystal boules and finished laser rods available for various materials such as fluoride, tungstate, molybdate, ruby and doped glass. A chart of refractive indices of laser materials is included, along with a list of operating laser systems with output wavelength and operating temperatures. The section is devoted to points to be considered when ordering lasers and recommended tolerances for finished laser rods. Laser Bulletin #1000 available from Isomet Corp., Palisades Park, N. J.

Circle 262 on Inquiry Card

NEW TECH DATA

Test Procedures

How to increase the reliability and convenience of test procedures through using Esterline Angus Event Recorders and information on one of the most powerful rechargeable batteries available is covered in the "Graphic," Bulletin No. 1162, available from Esterline Angus Instrument Co., Inc., P. O. Box 596, Indianapolis 6, Ind.

Circle 358 on Inquiry Card

CC-TV Vidicon Cameras

Three new brochures describing GE's complete line of compact vidicon cameras for closed-circuit television uses, are available from General Electric Co., Technical Products Operation, 212 W. Division St., Syracuse 3, N. Y. The 8-page 2-color, brochures cover the TE-14 and TE-15 cameras, and the field-proven TE-9 camera. Included are performance features, specs., model and accessory data, and basic guides for system building.

Circle 359 on Inquiry Card

Seals vs. Seals

"Ceramic-to-Metal Seals vs. Glass-to-Metal Seals," points out the outstanding advantages of both types and compares them with drawings and a characteristic chart. Tung-Sol Tips No. 24 available from Tung-Sol Electric Inc., One Summer Ave., Newark 4, N. J.

Circle 360 on Inquiry Card

Variable Phase Shifters

Bulletin TC-120 covers TRI-PLATE® Variable Phase Shifter Modules which are line stretching devices used in variable delay lines, phase measurements, tuners, variable band reject filters and for squinting phased arrays. Sanders Associates, Inc., Microwave Products Dept., 95 Canal St., Nashua, N. H.

Circle 361 on Inquiry Card

Automatic Timer

Bulletin 320 contains photograph and information Time Delay Relay/Interval Timer which is dial adjustable and has an automatic reset feature for switching electrical circuits on or off either after a pre-set time or during the timed period. Automatic Timing & Controls, Inc., King of Prussia, Pa.

Circle 362 on Inquiry Card

Frame Grid Tubes

A detailed description and analysis of how Amperex conceived and conducted reliability and life studies on the high gain frame grid types 6922M and 7737M, a twin triode and pentode, designed for use as broadband amplifiers in military and industrial applications is contained in a brochure entitled "Guaranteed Reliability with Amperex Premium Quality Frame Grid Tubes." This 13-page brochure is available from Amperex Electronic Corp., Special Purpose Tube Dept., 230 Duffy Ave., Hicksville, L. I., N. Y. *Write for brochure under company letterhead.*

Greater range for ECM and space communications systems is what this new Sylvania traveling-wave tube offers. It is the only PPM-focused tube available with 100 watts minimum CW power, and 30 db gain from 7 to 11 Gc. Key to this performance is a new approach to helix structure which results in effective cooling at high power levels.

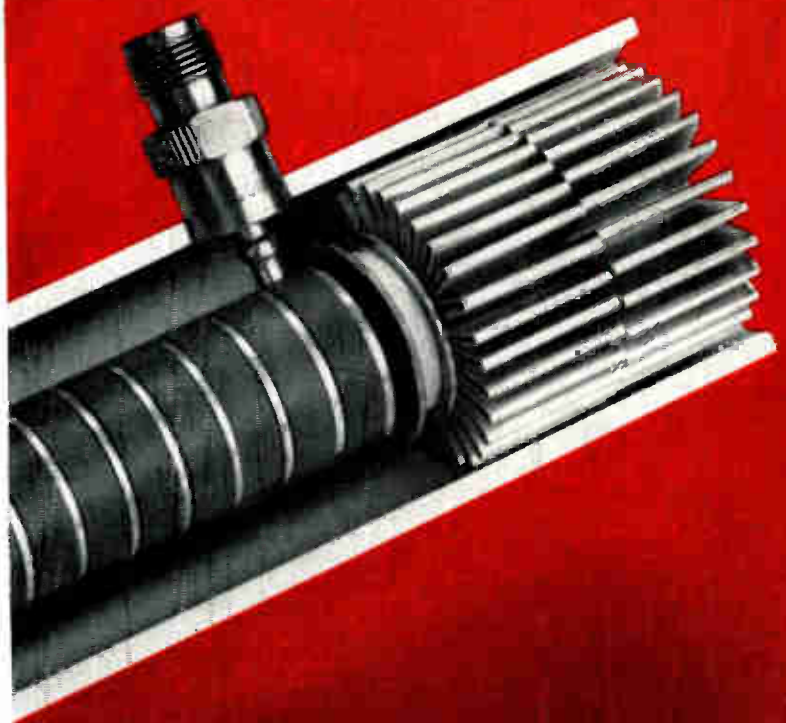
Performance Summary

Type Number	SYT-4369
Frequency, Gc	7 to 11
Minimum CW Power Output, Watts	100
Saturated Gain, db	30
Efficiency, % (with depressed collector)	20-25%
Weight, pounds	2
Cooling	Forced Air

Now—100 watts CW from a Sylvania PPM-

Typical Operating Values	
Cathode Voltage	5.6 KV
Collector Voltage	2.4 KV
Cathode Current	150 mA
Heater Voltage	6.3 V

focused X-Band TWT



Medium-noise TWT— 15 db max. over 1-12.4 Gc

Now you can design wide bandwidth and high sensitivity into ECM equipment. Covering the full frequency range from 1 to 12.4 Gc, Sylvania's new line of PPM-focused medium-noise TWT's provides the full performance of conventional types (5-10 mW output, 25-30 db gain), plus the advantage of a substantially reduced noise figure. All meet MIL-E-5400 Class II requirements and are ideal for ground-based or airborne military systems requiring both wide bandwidth and long range.

Performance Summary

Type No.	Frequency Gc	Min. Gain-db	Min. R-f Power Output-mW	Max. Noise Figure-db	Operating Voltages—Vdc Grid 1	Grid 2	Grid 3	Grid 4	Helix
SYT-4308	1-2	30	10	15	−50 to 5	0 to 50	0 to 100	50 to 200	200 to 300
SYT-4309	2-4	30	10	15	−50 to 5	0 to 100	0 to 200	100 to 300	400 to 600
SYT-4342	4-8	30	10	15	−50 to 0	0 to 100	0 to 200	100 to 400	650 to 900
SYT-4343	8-12.4	25	5	15	−50 to 0	0 to 100	0 to 200	200 to 500	1100 to 1300

Sylvania's Microwave Device Division is geared for "quick reaction"—development of tubes to your specifications in record time. The 100-watt TWT, for example, was completed in only 4 months. For more information on types shown here or others, contact your Sylvania Sales Engineer, or write Microwave Device Division, Sylvania Electric Products Inc., Box 87, Buffalo, New York.

SYLVANIA

SUBSIDIARY OF

GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

NEW CAPABILITIES IN: ELECTRONIC TUBES • SEMICONDUCTORS
MICROWAVE DEVICES • SPECIAL COMPONENTS • DISPLAY DEVICES

SEE US AT IEEE—BOOTHS 2322-2332 AND 2415-2425

Circle 14 on Inquiry Card

NEW TECH DATA

Control Systems

This 29-page, 3-color brochure details Rucker Co.'s experience in electro-hydraulic, simulation, electronic, nuclear reactor and antenna drive systems. Included are photographs, and data information on the electro-hydraulic antenna drive for NASA's Deep Space Information Facilities in Australia, South Africa and California. Rucker Co., 4700 San Pablo Ave., Oakland 8, Calif.

Circle 263 on Inquiry Card

Varactor Brochure

This 28-page brochure describes multiple-stage varactor harmonic generators, all solid state power sources, and the latest development in varactors. "Varactor Harmonic Generation" contains a complete listing of the latest varactors available, including bias, efficiency, temp., noise, power-handing, modulation of signal source and reliability. Microwave Associates, Inc., Solid Circuits Div., South Ave., Burlington, Mass.

Circle 264 on Inquiry Card

Gas Lasers

Describes 3 continuous wave, gas phase laser models operating in the infrared and visible regions of the spectrum. Standard outputs are 6328 Å, with optional wavelengths at 11.523 or 33,912 Å. Perkin-Elmer Corp., Norwalk, Conn.

Circle 265 on Inquiry Card

Indicating Lights

GEA-7366, 4-pages, describes the CR-103C square indicating lights. Included are breakdown photographs, outline drawings, and installation and application, as well as full ordering information. General Electric Co., Schenectady 5, N. Y.

Circle 266 on Inquiry Card

Switching Applications

"Methods of High-Current High-Voltage Switching for Memory Driver Arrays with the Type 2N2100 ECDC Transistor" Semiconductor Application Notes No. 38,014 reviews the various modes of collector breakdown voltage, with particular emphasis on the alpha-multiplication breakdown voltage and considers the resulting circuit problem of "latch up." Included are characteristics, charts, formulas and schematics. Sprague Electric Co., Transistor Div., Concord, N. H.

Circle 267 on Inquiry Card

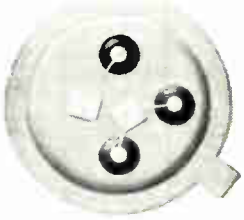
Radar Analyzers

Complete tech. data on a line of transistorized, portable radar performance analyzers is included in a 6-page brochure available from Sperry Microwave Electronics Co., Clearwater, Fla. Data includes characteristics and uses, tabulation of the operating functions provided, and a table listing the shortcomings of alternate test equipment approaches.

Circle 268 on Inquiry Card

NEWEST
MICROELECTRONIC

SEE US AT BOOTHS 2627-2629



high gain

New Darlington Amplifier Transistor In 4 Lead TO-18 Package features very high beta — as high as 2,000 minimum at 100 μA . . . very low leakage — as low as 1nA maximum at 30 volts . . . low noise, typically 2 db. ☐ These microelectronic devices contain two interconnected NPN silicon planar transistors which provide extremely high current gain in a single TO-18 package. ☐ The design economies and characteristics of these devices are particularly well-suited for high impedance amplifier inputs, low noise amplifiers and high gain stages. ☐ Production quantities are presently available for new Sperry types; 2N2723, 2N2724 and 2N2725. ☐ Sales Offices: Chicago, Illinois; Los Angeles, California; Oakland, New Jersey; Medford, Massachusetts; Sykesville, Maryland; Bethpage, L. I., New York. ☐ For complete details, write for technical bulletin. *SPERRY SEMICONDUCTOR, Norwalk, Connecticut.*

SPERRY
DIVISIONS OF
SPERRY RAND
CORPORATION

Circle 130 on Inquiry Card

NEW TECH DATA

Loudness Evaluation

Technical Review 262 is a technical handbook on loudness evaluation for the acoustical engineer. The booklet describes the principal methods of loudness determination in international use today; explains the background upon which they are based; and summarizes principal noise criteria. It provides a correlation of the various ways in which loudness is measured and processed by acoustical instrumentation. Also contains nearly 30 sets of curves, including Fletcher-Munson equal-loudness level curves, Zwicker's calculation diagram for plane sound waves, Zwicker's calculation diagrams for ⅓ octave data at various band pressure levels, Steven's contours of equal loudness, and, among others, Kryter's damage risk criteria for both continuous and brief exposure by individuals of different ages, and an extensive bibliography. B. & K. Instruments, Inc., 3044 W. 106th St., Cleveland 11, Ohio.

Circle 270 on Inquiry Card

American Standards

American Standards Association is offering a 1963 catalog, 84 pages listing more than 2,000 American Standards in addition to recommendations of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). American Standards Association, Dept. P 349, 10 E. 40th St., New York 16, N. Y.

Circle 271 on Inquiry Card

Varistors

This 8-page, 2-color brochure outlines the properties, dimensions, wattage, and electrical specs. on a wide line of voltage of symmetrical non-linear voltage sensitive varistors. Also included is a comprehensive listing of voltage vs. current characteristic curves on a wide range of body sizes. The Carborundum Co., Electronics Div., P. O. Box 337, Niagara Falls, N. Y.

Circle 272 on Inquiry Card

Radiated Capacitors

This 32-page comprehensive radiation study is available from Good-All Electric Mfg. Co., subsidiary of Thompson Ramo Wooldridge Inc., 112 W. 1st St., Okallala, Nebr. The study was made in conjunction with a high reliability program for capacitors in a space satellite application. This summary shows that capacitors which use Mylar dielectric are more resistant to the effects of radiation than many other components.

Circle 273 on Inquiry Card

Regulator Design

This 20-page brochure covers the theory of design and operation of the electronic-magnetic type regulator. The brochure includes charts, graphs and circuit diagrams, describing in detail what the Solatron is, how it functions, its special features, as well as an analysis of the unit's sensing circuitry. Sola Electric Co., Elk Grove Village, Ill.

Circle 274 on Inquiry Card

NEW TECH DATA

Thin Film Memory Planes

This 12-page tech. brochure explains behavior and operation of Thin Film Memory units. Fully illustrated, it contains more than 20 diagrams, photographs and charts showing thin film memory operating characteristics and application data. The thin film brochure is available from Burroughs Corp., Electronic Components Div., Plainfield, N. J.

Circle 275 on Inquiry Card

Strip-Chart Recorders

Three brochures describing the latest changes and additions to Texas Instruments' line of rectilinear strip-chart recorders are available. Each of the 4-page bulletins includes cutaway photographs and full specs. including a list of optional features. Bulletin R-507 is on portable galvanometric recorders, dual and single channel; R-505 describes similar self-balancing recorders; R-508 illustrates flush-mounting self-balancing recorders. Texas Instruments Incorporated, Industrial Products Group, 3609 Buffalo Speedway, Houston 6, Tex.

Circle 276 on Inquiry Card

III-V Materials

Information is available on a single crystal indium arsenide and single crystal indium antimonide. These products are produced by the Czochralski method and are available in doped and undoped types. Monsanto Chemical Co.'s Inorganic Chemicals Div., Electronic Chemicals Dept., 800 N. Lindbergh Blvd., St. Louis 66, Mo.

Circle 277 on Inquiry Card

Computer Glossary

"Glossary of Computer Terminology," 26 pages, defines some 500 computer-language words and phrases from absolute coding to zero-suppression. Information is also included on G.E.'s all-transistorized GE-210 and GE-225 computer systems with peripherals, including Datanet-15 Data Transmission Controller. Brochure CPB-93BP is available from Computer Dept., General Electric Co., Phoenix, Ariz.

Circle 278 on Inquiry Card

Shrinkable Tubing Chart

This chart illustrates the range of wire and cable diameters covered by various types and sizes of the FIT Line of Heat Shrinkable Tubing. To find the proper size of FIT Shrinkable Tubing, the engineer need know only the outside diameter of the wire, cable, connector or component to be insulated. Alpha Wire Corp., 200 Varick St., New York 14, N. Y.

Circle 279 on Inquiry Card

Switching Transistors

Information is available on a series of 10 amp. Diffused Alloy Power DAP Power transistors. JEDEC Types 2N2288 to 2N2290 are germanium PNP DAP transistors designed for efficient high current switching and high frequencies. The series is capable of switching up to 1200w in microseconds over a wide temp. range. The Bendix Corp., Bendix Semiconductor Div., Holmdel, N. J.

Circle 280 on Inquiry Card

NEW TECH DATA

Chopper-Relay

Model 98 Solid State Chopper-Relay is a completely solid state inertialess design using silicon semiconductors and magnetic components for complete isolation between drive and signal. Information is included on advantages of high speed, long life and ruggedness. Dynamic range can be extended from ±75μv to ±20v. Solid State Electronics Co., 15321 Rayen St., Sepulveda, Calif.

Circle 281 on Inquiry Card

Molecular Electronics

Molecular electronics is the subject of this 18-page full color publication covering applications, manufacturing methods, and other aspects. Booklet B-8747 is available from Westinghouse Molecular Electronics Div., P. O. Box 868, Pittsburgh 30, Pa.

Circle 282 on Inquiry Card

Plastics Brochure

This 16-page publication describes Haveg Industries Taunton Div.'s Research & Development Laboratories facilities for compression, transfer, injection and specialty molding; the manufacturing of intricately shaped elastomers and foam products applications for Havelex, a glass bonded mica; and production of sealing caps and tubes. Taunton Div., Haveg Industries, Inc., 336 Weir St., Taunton, Mass.

Circle 283 on Inquiry Card

NEW TECH DATA

SCRs

Silicon controlled rectifiers for power control and switching uses are described in 3 bulletins available from Fansteel Metallurgical Corp., Rectifier Capacitor Div., No. Chicago, Ill. Bulletin 6.371, describes Type 4.7CR (4.7 amps.), Bulletin 6.372 covers Type 10CR (10 amps.), and Bulletin 6.373 discusses Type 16CR (16 amps.). Included are graphs showing average forward current, ambient temp. curves and instantaneous voltage drops.

Circle 338 on Inquiry Card

Miniature Circuit Breakers

Circuit breaker specs. AM513 and AM613 provide detailed characteristics and ratings for specifying desired parameters for electro-magnetic breakers. Included are voltage and current ratings, frequency, time delays, materials, corrosion and fungus resistance, dimensions, calibration, life dielectric stress, moisture and insulation resistance, and inspection and test procedures. Airpax Electronics Inc., Cambridge Div., Cambridge, Md.

Circle 339 on Inquiry Card

10MS Delay Line

Tech. data is available on a 10msec. delay line with tap spacing of 0.5msec., ±1.0. Model 81-31. Model 81-31 has a max. insertion loss of 0.2db/msec. ESO Electronics Corp., 534 Bergen Blvd., Palisades Park, N. J.

Circle 340 on Inquiry Card

Servo Components

A product summary catalog describing a line of advanced servo components gives detailed specs. on 26 instruments, including dc and ac torque motors, stepping motors, rotary and linear signal generators, and potentiometers. This 4-page catalog is available from Giannini Control Corp., 1600 S. Mountain Ave., Duarte, Calif.

Circle 341 on Inquiry Card

Ferrite Circulators

Tech. data is available on 3- and 4-Port Ferrite Circulators for low-loss temperature-compensated parametric amplifier applications. Also included is information on UHF coaxial circulator, isolators and a variable S-band ferrite phase shifter and driver. Motorola Inc., Solid State Systems Div., P. O. Box 5409, Phoenix 10, Ariz.

Circle 342 on Inquiry Card

Temp.-Conversion Chart

A simplified, 2-page, temp.-conversion chart for the ranges from −459.67° to +3290°F and −273.15° to +1810°C, is available from Pacific Transducer Corp., 11836 W. Pico Blvd., Los Angeles 34, Calif.

Circle 343 on Inquiry Card

Molded Mica Capacitors

This 12-page mica capacitor bulletin contains complete engineering information on a line of molded, wire lead type, mica dielectric capacitors. Graphs and charts are included along with complete listings for both commercial and military units. Sangamo Electric Co., Springfield, Ill.

Circle 344 on Inquiry Card

NEW TECH DATA

Semiconductor Arsenic

Information is available on a non-oxidizable amorphous grade of high purity arsenic. Data sheet on gallium is also available. Atomergic Chemetals Co., 1001 Franklin Ave., Garden City, L. I., N. Y.

Circle 284 on Inquiry Card

Circuit Layout Kit

A 3-D sketch set for laying out circuit packages consists of 3 layers. The bottom layer has coordinates with lines on 0.100 in. centers; the other 2 translucent plastic layers are used for the sketching. The sketch set is coordinated with Intercon®, Amphenol Connector's weldable, pre-fabricated printed circuitry. The completed drawings on the plastic layers may be inked in and used as reproduction masters. If drawn in 1:1 scale, the drawings may even serve as direct templates for prototype construction. Amphenol Connector Div., Amphenol-Borg Electronics Corp., 1830 So. 54th Ave., Chicago 50, Ill.

Circle 285 on Inquiry Card

Standardized Modules

Information describes the Hill Standardized module program. Modules currently available include: high-frequency (50MC) oscillators; mid-range oscillators (50KC to 2MC); vlf oscillators (800CPS to 100KC); slow-speed binary, switching to 200KC; high-speed binary, switching to 2MC; Schmitt trigger; sine-wave filter; and proportional-oven control circuit. Hill Electronics, Inc., Mechanicsburg, Pa.

Circle 286 on Inquiry Card

Microwave Testers

This 6-page, 4-color Bulletin 900 describes microwave and electronic test equipment. Featured are a new line of klystron power supplies, power meters, signal sources, noise generators and standing wave amplifiers. Measurement capabilities, data indicating frequency ranges, prices, etc., are included. PRD Electronics, Inc., 202 Tillary St., Brooklyn 1, N. Y.

Circle 287 on Inquiry Card

Digital Telemetry

Bulletin GR-1798, 6 pages, describes TE's low cost digital telemetering system which "time shares" a communication channel with an analog telemeter. Includes information on how the system can solve problems of minimizing inaccuracies and channel costs. General Electric Co., Schenectady 5, N. Y.

Circle 288 on Inquiry Card

Laminates

This 6-page brochure details the complete line of MICAPLY® standard and thin grade glass/epoxy laminates available with and without copper cladding of various weights. The Mica Corp., 4031 Elenda St., Culver City, Calif.

Circle 289 on Inquiry Card

Testing Capacitors

This bulletin describes equipment and methods for testing ac industrial application capacitors. Data includes capacitance measurement, dielectric, mechanical defects, leak test, power factor, insulation resistance, and life tests. Bulletin 102C3 available from Aerovox Corp., New Bedford Div., New Bedford, Mass.

Circle 290 on Inquiry Card

Instant Information for the Man in Command:

STANDARD EQUIPMENT: HUGHES **TONOTRON** STORAGE TUBES

Shipboard naval strategists, using Hughes TONOTRON* storage tubes in the Navy's new Naval Tactical Data System, can now predict enemy moves with uncanny precision. They can watch every move of his aircraft, ships and submarines in a combat area and follow the tactical situation second-by-second as it unfolds.

Key component in the NTDS is the Hughes TONOTRON storage tube. This direct-view tube accurately displays up-to-the-instant information even under difficult ambient light conditions. Its controllable persistence permits high-resolution, halftone displays to be stored for detailed study—or erased instantaneously!

Today's rugged and reliable TONOTRON tubes are the result of more than 10 years' experience in the research, design, development and production of over 50,000 Hughes direct-view storage tubes.

For full information on how Hughes direct-view storage tubes can help solve your display problems, wire, write or telephone today: **HUGHES STORAGE TUBES, VACUUM TUBE PRODUCTS DIVISION,** 2020 Short Street, Oceanside, California. For export information, write: Hughes International, Culver City, California.

*Trade-mark of Hughes Aircraft Company

NTDS displays in Combat Information Center provide instant information for evaluating enemy threats and determining task force countermeasures.

Hughes Model H-1010 TONOTRON direct-view storage tube provides bright, accurate, high-resolution display of information as it is received from sensors.

Creating a new world with Electronics

HUGHES

HUGHES AIRCRAFT COMPANY
VACUUM TUBE PRODUCTS DIVISION

Circle 137 on Inquiry Card

SYSTEMS & CIRCUITS

AUTOMATIC TYPESETTING machine, built around an RCA computer, is now being used by the Los Angeles Times. Copy is processed automatically from the writer's typewriter until it is set in type. The system automatically incorporates editing changes and corrections, divides the copy into lines of column width and even decides where split words are to be hyphenated.

INFRARED MODULATION using an IR diode in a communication's system was successful in recent tests conducted by Avco. A gallium arsenide diode was used as the light source and was voice modulated. The extremely secure communications system was tested at a range of 200 feet. Greater distances will be tried in a few months. Theoretical maximum distances have been placed at 22,000 feet.

MICROCIRCUITS are being incorporated, on a piece-meal basis, in the current production of equipment being built for the Bureau of Naval Weapons. Manufacturers are being encouraged to substitute these circuits for conventional circuits in all new equipment, at no extra charge to the government. This represents the first step in a program called MEETAT—Major Improvement in Electronic Effectiveness Through Application of Advanced Techniques.

CURRENT AIR TRAFFIC CONTROL PROBLEMS will be defined and an improvement program formed by the Radio Technical Commission for Aeronautics, Washington, D.C.

Work will be done by a special committee established by RTCA. The new committee has been designated "SC-104 Air Traffic System."

Because of the importance of the task, and interest already expressed, RTCA anticipates widespread response to invitations being sent to government and industry members to participate in the work of the committee.

SMALL BUSINESSMEN in the Southeast who may need high speed data processing only for short periods of time each day now have available a magnetic tape computer system. A data transmission network announced by The Service Bureau Corp., a subsidiary of IBM, makes this possible. SBC believes it to be the first such network to be set up on a service bureau basis.

SBC offices in Charlotte, Miami, and New Orleans transmit data to the firm's Atlanta data processing center where an IBM 1401 computer recently was installed. Data received during the day is scheduled for overnight processing. It is transmitted back to the sending office the next morning.

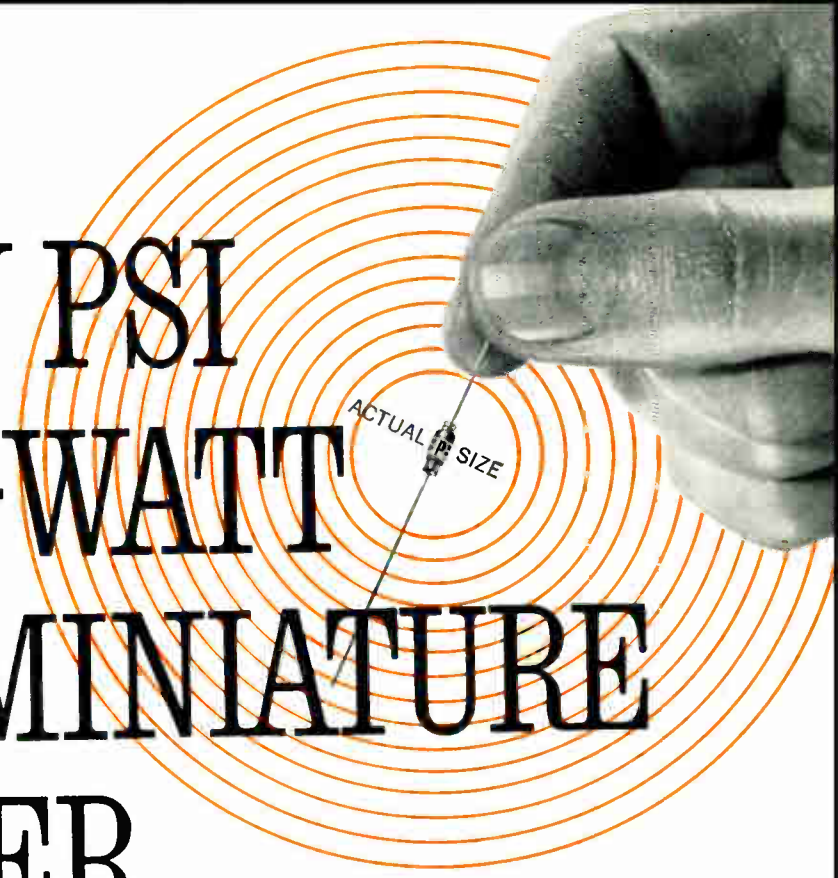
A DIGITAL DATA SYSTEM that will automate the recording of information from a photo electric scanning comparator is being designed by Datex Corp., Monrovia, Calif., for Purdue University's Physics Dept.

The equipment will convert the analog positions of the transverse and cross-feed lead-screws of a spectrum comparator to digital data. It will then record the data in punched cards and in printed page form. Conversion will be done by high-resolution shaft position encoders. Data will be recorded at the rate of 10 characters/sec.

TRW Electronics

PSI

NEW PSI ONE-WATT SUBMINIATURE ZENER



makes Top Hats *old hat!*

Here's the biggest news in zener diodes in nearly a decade...the new PSI One-Watt Zener in a "Trimline" subminiature package!

Look at these outstanding features!

■ ONE-FIFTH THE SIZE—Far smaller than Old Hat types. Directly interchangeable with lower power subminiature types. Greatly simplified handling techniques.

■ PREMIUM ELECTRICAL CHARACTERISTICS—Extremely low reverse leakage current. Optimum voltage regulation affords controlled zener impedance. Excellent stability. The sharpest zener slope in the industry!

■ RELIABILITY—Made to survive extreme thermal stress. Unique "whisker" design provides maximum cushion against thermal expansion. Complete elimination of junction failure. Controlled breakdown, regulation and long term performance assured.

■ LOW COST—These new high performers cost 25% less than the bulky One-Watt Zeners you've had to use until now. (You can forget redundancy expense, too.)

■ AVAILABILITY—Off-the-shelf delivery from PSI authorized distributors coast to coast. Good delivery on large production orders.

It's time to look over your old prints and replace the Old Hats with these remarkable new "Trimline" One-Watt Zeners.

PSI/TRW Electronics sales offices and authorized distributors are in major electronic centers coast to coast. Write for complete list or see your Yellow Pages.

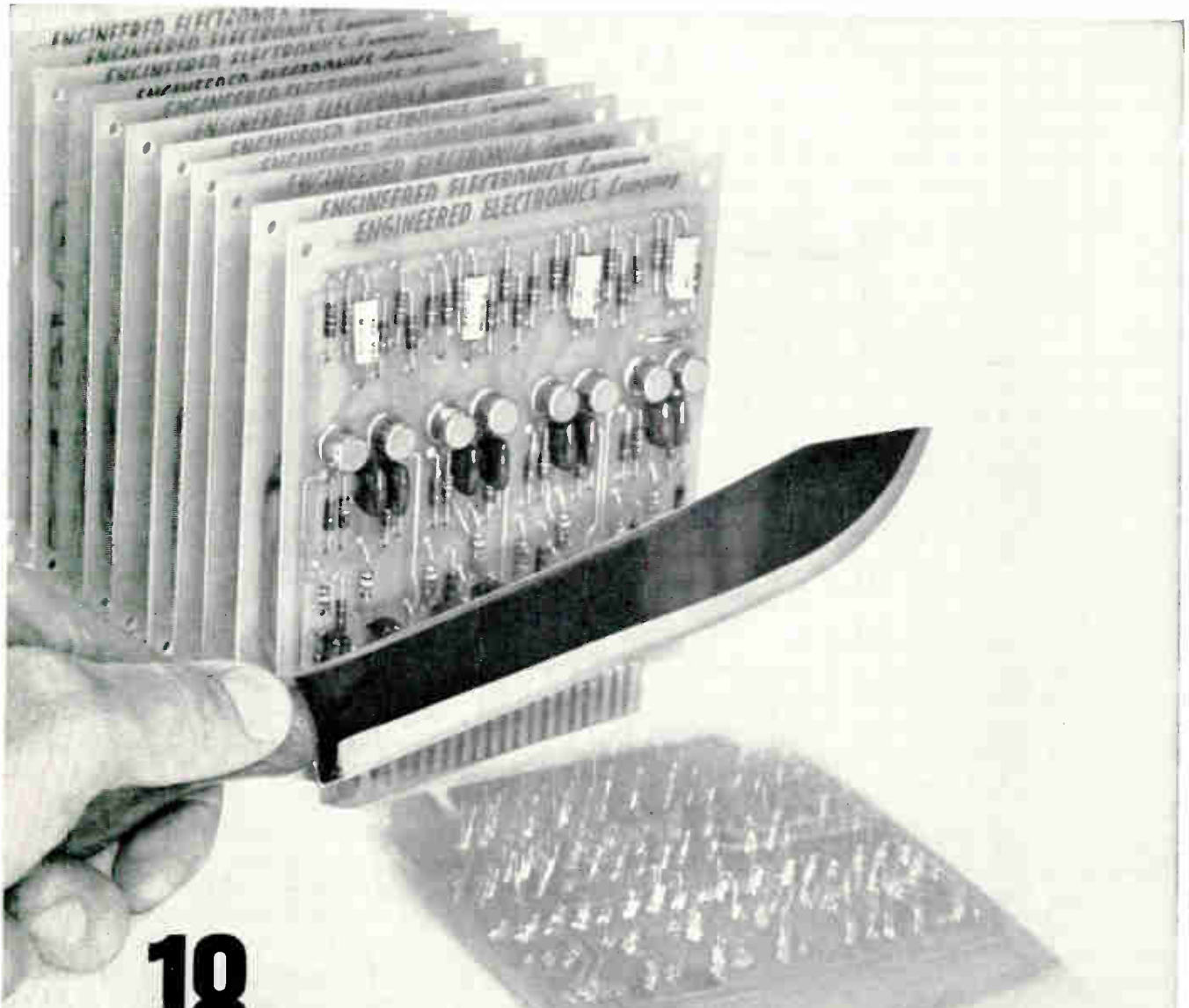
TYPE	BV Breakdown Voltage (nom)	Iz Test Curr	Z Impedance	ΔBV Voltage Regulation	V_R Reverse Voltage	I_R Reverse Current dc	
	volts	mA	ohms	volts	volts	μA @ 25°C	μA @ 150°C
PS 10060	6.8	37	2	.2	4	1	5
PS 10061	7.5	34	2	.2	5	1	5
PS 10062	8.2	31	3	.3	6	.5	5
PS 10063	9.1	28	3	.3	7	.1	5
PS 10064	10	25	4	.3	8	.1	5
PS 10065	11	23	6	.33	8	.1	5
PS 10066	12	21	7	.35	9	.1	5
PS 10067	13	19	8	.40	10	.1	5
PS 10068	15	17	10	.45	12	.1	5
PS 10069	16	15.5	12	.48	13	.1	5
PS 10070	18	14	16	.50	14	.1	5

NOTE: Zener voltage ± 5% tolerance.

Detailed specifications available on request.

Pacific Semiconductors, Inc.
TRW Electronics
THOMPSON RAMO WOOLDRIDGE INC.

14520 AVIATION BLVD., LAWNDALE, CALIF. • OS 9-4561, OR 8-0561 • TWX: 213 647-5113 • Cable Address: PSISOCAL



18 NEW SILICON MODULES FROM EECO

125°C circuits in 1 Mc and 10 Mc versions

1 Mc Series	10 Mc Series	Circuits Available
U-501	U-701	Triple 4-input NOR circuit
U-502	U-702	Eight driver circuits
U-503	U-703	Dual flip-flops
U-504	U-704	Multivibrator and three drivers
U-505	U-705	Three one-shots
U-506	U-706	Two exclusive-OR (NAND) circuits
U-507	U-707	Two exclusive-OR (NOR) circuits
U-508	U-708	Full adder
U-509	U-709	Three 4-input-OR circuits

The ability of all 18 modules in this new silicon family to exceed the searing demands of MIL-E-5400F, Class II, for temperature typifies their excellent performance in general.

Superior materials and special packaging techniques make these circuit cards your logical answer to *any* problem in high temperatures or reliability. Designs are based on derated specifications for the components used, and the resulting specifications are then further derated to give you reliability in reserve. Should any module ever fail to perform according to specs under the terms of the company's warranty, it will be repaired or replaced free.

Standard, conservative loading specifications and the availability of compatible hardware make it easy for you to determine your design requirements. Write, wire or phone today for free technical literature or a call from one of our applications engineers.

Power required: +12VDC, −12VDC.
Logic levels: 0 and +6VDC, nominal.
Card dimensions: 4½″ x 5″ x 1/16″.
Contacts: Two sides rhodium-plated with beveled edges for insertion into standard 22-pin etched circuit board connectors. (Special contacts also available.)
Construction: Glass-epoxy etched circuit card with funnel eyelets.

ENGINEERED ELECTRONICS Company
1441 East Chestnut Avenue, Santa Ana, California
Telephone 547-5651 • Cable Address: ENGELEX

See the EECO Line in Booth 1518 at the I.E.E.E. Show

Circle 140 on Inquiry Card

INTERNATIONAL NEWS

EUROPE

Berlin—Babcock & Wilcox Co., U. S. A., and Deutsche Babcock & Wilcox, Germany, (no organizational connection) will build an atom power plant for a German merchant ship. It will be a smaller version of the U. S. firm's Consolidated Nuclear Steam Generator.

London—Potter Instrument Co., Plainview, N. Y., has a new facility in the suburbs near here. Devoted to marketing peripheral computer equipment, it will be under Vice Pres. E. D. Gray.

London—Marconi has formed a Mechanical Products Div. located at Felling Works, near Gatehead. It will serve external customers, as well as the firm itself.

Bonn — Osnabrucker Kupfer-Und Drahtwerk, Osnabruck, Germany, has been licensed by Nippert Electric Products Co., Columbus, Ohio, to produce the latter's N-4 alloy—a zirconium-copper alloy with high conductivity and strength at very high temperatures.

London—Royal Navy has a new sonar that can be lowered below undersea temperature layers. Sonar is towed and transducer depth controlled by varying tow length. EMI-Cossor Electronics, Ltd., Nova Scotia, Canada, developed it.

Athens—The U. S. Information Agency has awarded Page Communications Engineers, Inc., Washington, D. C., a $1.9 million contract for a transmitting station on the isle of Rhodes.

Paris—Babcock Relays, Costa Mesa, Calif., has received orders for subminiature relays from 4 European electronic firms for NASARR radar of NATO's F-104 supersonic fighter. The firms are licensed by Autonetics Div., North American Aviation, to make the plane.

Copenhagen—Danish Air Force has ordered 9 compact 10 KW air-cooled UHF transmitters from RCA's Surface Communications Div., Camden, N. J. Equipment, in 3 modules, occupies 18 sq. ft. of floor space.

(Continued on page 206)

INTERNATIONAL NEWS

London — New married military quarters, Tidworth, Wiltshire, has community antenna TV system designed into the structures by War Office and EMI Electronics, Ltd.

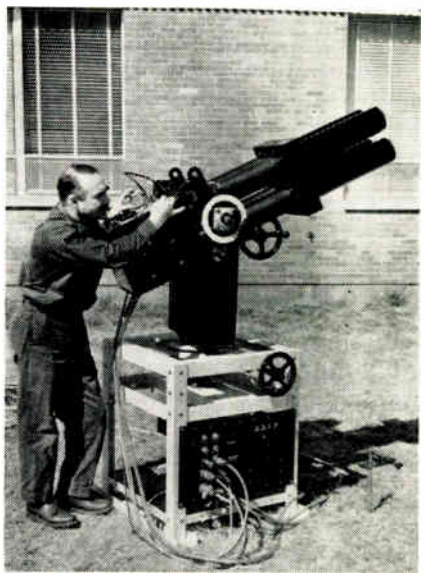
London—An EMIac analog computer has been installed at the BP Oil Research Center, Sunbury-on-Thames, England. From data on oil reservoir structure and behavior in remote parts of the world it will predict optimum operating conditions.

Dublin — Booklet containing a 92-point check list for companies planning to manufacture abroad has been issued by the Irish Industrial Development Authority, an Irish Government agency. Copies may be obtained by writing the Authority, 420 Lexington Ave., New York 17, N. Y.

London — Digital data equipment built by Datex Corp., Monrovia, Calif., has recorded the output of a interferometer in a British study of the far infrared of the planet Venus. The interferometer and Datex units were installed at the Observatoire de Haute Provence, France, and were used, together with the 193-cm reflecting telescope, to observe Venus' infrared spectra.

(Continued on page 208)

DETECTORS



Optical photometer to detect presence of nuclear debris from high-altitude explosions is checked by Dr. E. Manring, of Geophysics Corp. of America, Bedford, Mass., developer of equipment. Rapid-response photometer observes and records fast intensity changes in four spectral regions simultaneously.

INTERNATIONAL NEWS

London—Muirhead & Co., Ltd., Beckenham, England, which makes rotating servo components, will market test equipment made for them by Theta Instrument Corp., Saddle Brook, N. J. Agreement gives Muirhead sole selling rights in Europe, Canada.

London — Newport Instruments, Ltd., Buckinghamshire, England, and Cryotronics, Inc., Clinton, N. J., have concluded a reciprocal sales agreement. The British firm makes electromagnets and instruments, including magnetic field measuring devices. Cryotronics makes cryogenic instruments, components, superconducting magnets and systems and related devices.

London—Rank Cintel, Ltd., has developed a warning system that indicates all kinds of plane failure at one spot on the instrument panel. Condition is written, in varied colors according to seriousness, on a 4 in. CRT. Either a code signal from the faulty equipment or data from a small computer actuates it.

(Continued on page 209)

INTERNATIONAL NEWS

London — The Steel Co. of Wales has placed an order with Elliot-Automation, Ltd., for digital computing equipment. Some 14 different types of modules will be used in a tinning line production quality control system at the Valindre Tinplate Works near Swansea.

Bonn—U. S. Stoneware Co., Akron, Ohio, has licensed Deutsche Steinzug and Kunststoffwarenfabrik, of Nannheim-Friedrichsfeld, W. Germany, to produce its high-alumina ceramic formulations. German firm will make bushings and vacuum-tight ceramic-to-metal seals using U. S. firm's formulations and techniques.

London—The John Lewis Partnership, a department store group, is building a warehouse at Stevenage, equipped with a Robotug driverless truck system supplied by EMI Electronics, Ltd. Three Robotugs will haul trains of trailers and follow an energized wire buried one-half in. underground.

Paris—Genisco, Inc., here has been awarded a contract to provide the French Air Ministry with a large precision centrifuge. These units predict ballistic and satellite trajectories. The USAF has ordered two of these.

London — An English wave-soldering machine is being used by TELautograph Corp., Los Angeles, Calif, to attach heat sensitive semiconductor components to circuit boards, eleminating thermal shock damage. The machine, "Electrovert," was developed by Fry, Ltd.

Paris — Improved transmission and exceptional mechanical strength are claimed for a French communications cable that looks like linked miniature balloons. The U. S. licensees are Superior Cable Corp., Hickory, N. C., and Simplex Wire & Cable Co., Cambridge, Mass.

Athens—Members of the Hellenic Royal Family attended the inauguration of a color TV system in the "P" Surgical Clinic at the Univ. of Thessaloniki. Prof. N. Karazarakis, head of the clinic, inaugurated the system, which was supplied and installed by EMI Electronics, Ltd.

NORTH AMERICA

San Juan — Howard Electronics, Inc., Racine, Wisc., has bought Republic Electronics, Inc., Puerto Rican power tool manufacturer, of Utuado. Wholly owned Howard subsidiary,

(Continued on page 210)

INTERNATIONAL NEWS

(Continued from page 209)

Micro Electric Motors, Inc., will take over operations there.

Ottawa—Ideal Industries, Inc., Sycamore, Ill., has founded IDI Electric (Canada), Ltd., in Ajax, Ont. New firm will distribute Ideal products in Canada. These include wire stripping tools, connectors, live centers, other electrical tools.

New York—RCA is building an electronic Chinese typesetting machine for the U. S. Army. It reportedly marks the first practical departure from hand-set type in the 3,000-year history of the Chinese written language.

Washington—The Dept. of Commerce has issued a booklet called, "What You Should Know About Exporting." It is obtainable for 25 cents from the Supt. of Documents, U. S. Govt. Printing Office, Washington 25, D. C.

Ottawa — Servo Corp. of America, Hicksville, L. I., N. Y., has been granted two Canadian patents on methods of using infrared rays to detect railroad train "hot boxes." The patents are for Servo's Hot Box Detective System, which remotely inspects every journal box on passing trains and determines which bearings may be running dangerously hot.

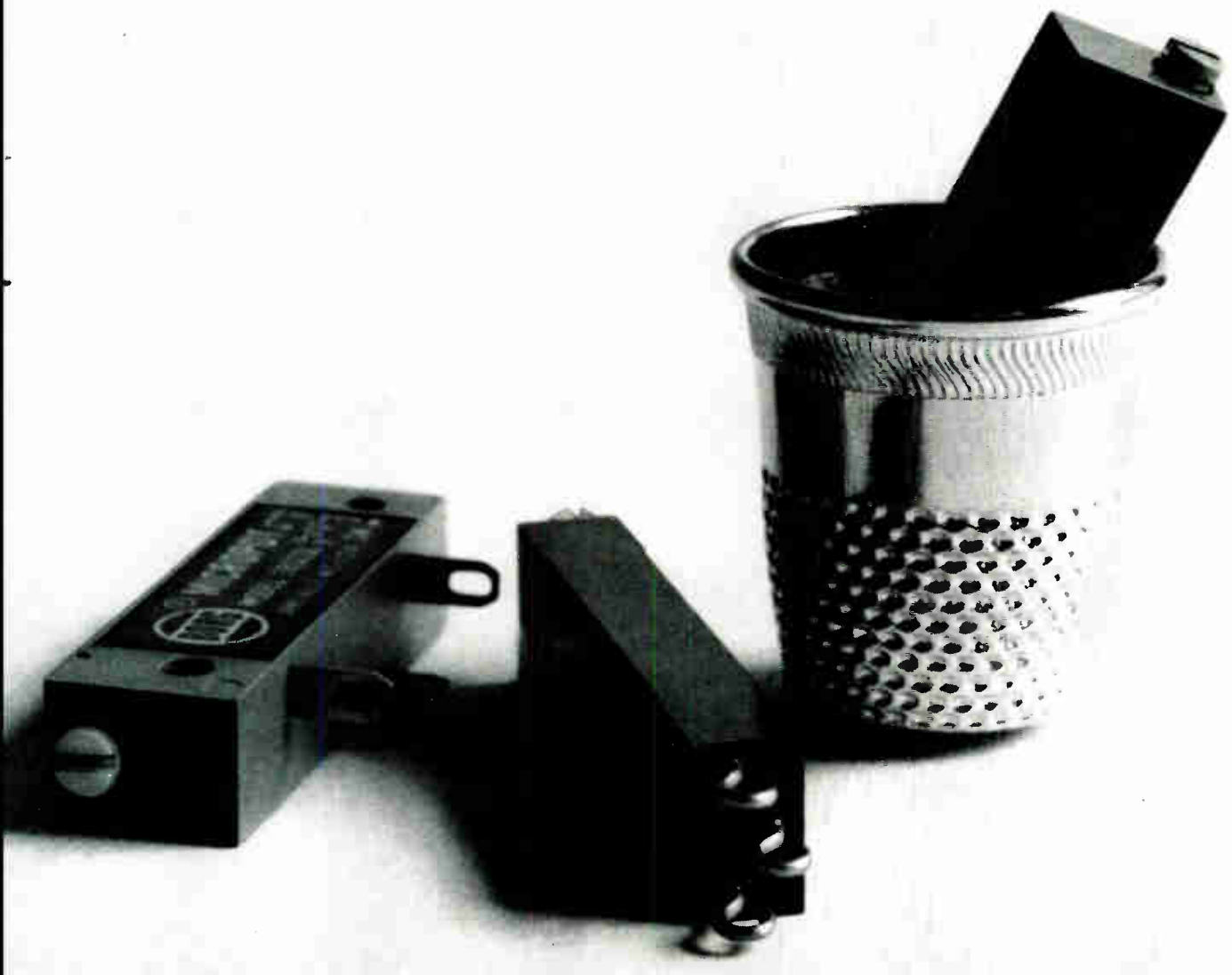
ASIA

New Delhi—NASA and the Indian Dept. of Atomic Energy will conduct 2 joint space research experiments in 1963. Experiments to explore equatorial electrojet and upper atmosphere winds from geomagnetic equator will be launched from Indian site at Thumba, on Southwest coast near Trivandrum.

AFRICA

Lagos — American university professors are aiding African nations with mathematical instruction under State Dept. program. Purdue's Prof. Merrill E. Shanks went to Nigeria in Feb. during winter recess.

Accra—Government of Ghana will build TV service and extend present radio service. Marconi, of England, will build 3 TV transmitting stations, TV studio, radio transmitting station, and a complete microwave link system connecting 3 major cities.



Little... Littler... Littlest...

These three Micropot® potentiometers illustrate how you can pack as much trimmer into just about as small a space as you'll ever require.

The middle trimmer (our 1.25 x .32 x .19" 2750 series) gives you 47% more density than the one on the left (1.25 x .28 x .36" 2800 series); the trimmer on the right (1 x .32 x .19" 2700 series) offers 86% more density than the one on the left.

Environment a problem? No more. We have a trimmer to provide the solution—be it temperature, humidity, or what-have-you. (See chart at right.)

Delivery? Authorized Amphenol-Borg Industrial Distributors located throughout the country can now deliver as many Borg trimmers as you need from their stock at factory prices. There's bound to be one near you.

However you look at trimmers—from component density, environment, reliability, delivery, or price—the Micropot line is a good bet to meet your requirements. And if you need specials, take advantage of our *Quick Reaction Facility*. You can get prototypes built to your own specifications almost as fast as you can ask for them.

Save time, money, and embarrassing trimmer failures by contacting your nearby Borg representative or distributor. Or a note to R. K. Johnson, Sales Manager, will bring you complete information by return mail.

Series	Miniature	High Temperature	Humidity Proof	Wirewound	Carbon
2700	X	X	X	X	
2750		X	X	X	
2800		X	X	X	
990		X		X	
992				X	
993					X
994			X	X	
995			X		X

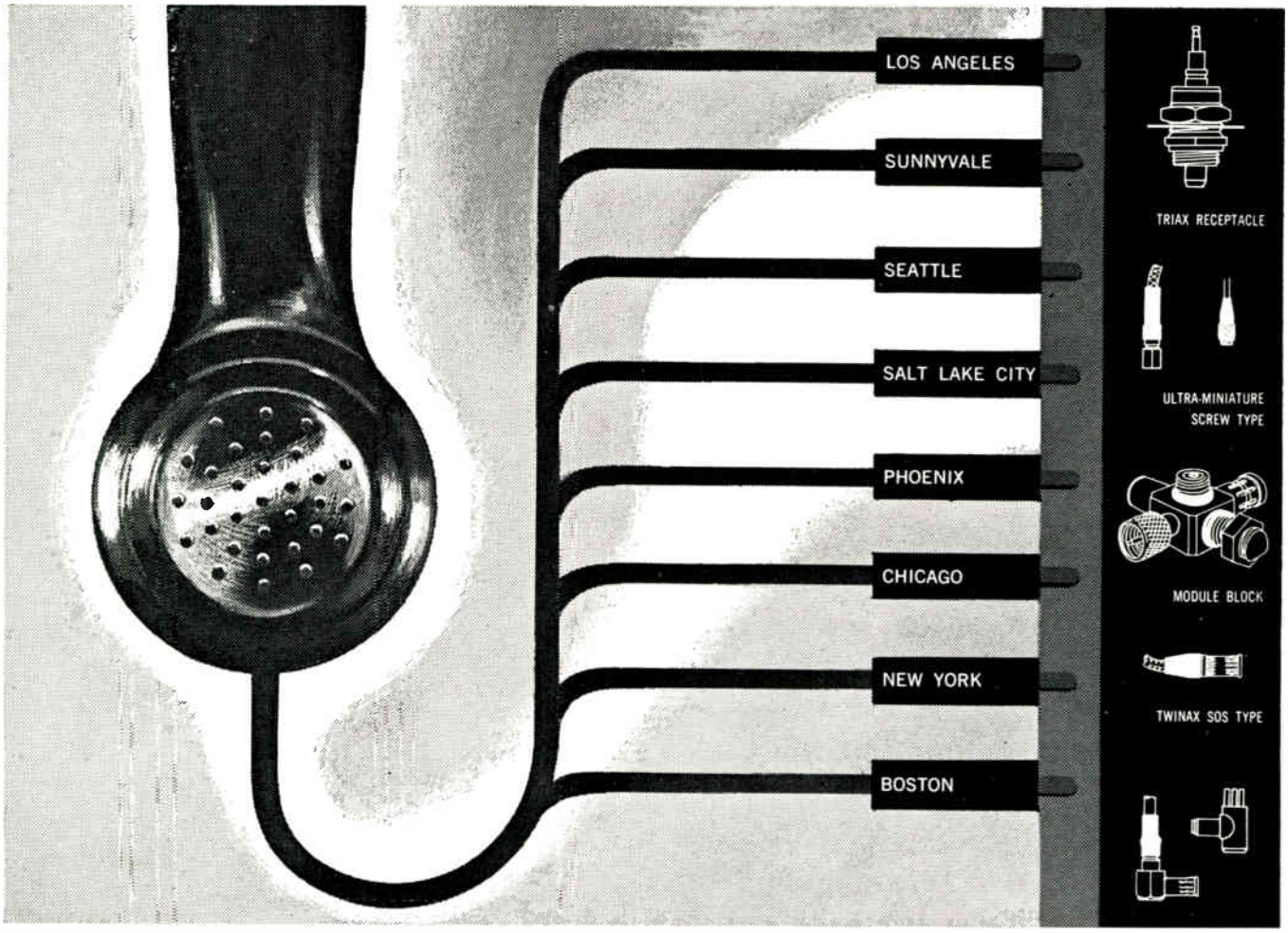
Circle 149 on Inquiry Card

BORG

BORG EQUIPMENT

A Division of Amphenol-Borg Electronics Corporation

Janesville, Wisconsin



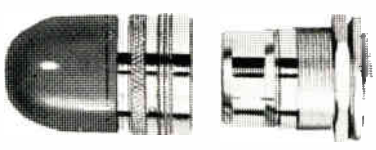
Avnet offers you 8 sources for the complete line of Microdot Connectors –with 1 phone call!

Avnet stocks Microdot's complete line including multipin connectors with up to 61 power or 19 coaxial contacts in a plug with 1⅛" o.d.; microminiature coaxial connectors in 50, 70 and 90 ohm types; coaxial, twinax and triaxial cables (RG types approved to MIL-C-17C).

Discuss your requirements on Microdot Connectors with any of the 8 Avnet Offices listed below. When you phone your local Avnet Stocking Facility, you are — in effect — talking to 8 sources at one time.

AVNET

MICRODOT



AVNET AVNET ELECTRONICS CORP.

THE AVNET SYSTEM

Men / Methods / Materials / Management

LOS ANGELES, CAL., 213 UP 0-6141; SUNNYVALE, CAL., 408 RE 6-0300; SEATTLE, WASH., 206 GL 4-4911; PHOENIX, ARIZ., 602-273-1261; SALT LAKE CITY, UTAH, 801-487-7566; CHICAGO, ILL., 312 GL 5-8160; WESTBURY, L. I., N. Y., 516 ED 3-5800; BURLINGTON, MASS., 617 BR 2-3060.

NEW Subscription Order

I wish a new complimentary Subscription to

ELECTRONIC INDUSTRIES

Company Name _____ Mail Stop or Div./Dept. _____

Name _____ Position/Title _____

Company Address _____

City _____ Zone _____ State _____

IMPORTANT

FOR OUR STATISTICAL RECORDS PLEASE CHECK **THE ONE** APPROPRIATE CATEGORY THAT BEST DESCRIBES YOUR COMPANY OR DEPARTMENT. Failure to do so will delay your subscription.

- ☐ Mfr. of non-military electronic receiving and transmitting equipment.
- ☐ Mfr. of non-military electronic instruments, measuring, control and test equipment.
- ☐ Mfr. of non-military electronic computers, data processing, analysers, business machine.
- ☐ Mfr. of Guided Missiles and Accessories; Aircraft and Accessories, All Type of Military Products and Equipment.
- ☐ Mfr. of electronic components, parts, tubes and like products.
- ☐ Mfg. Co. (non electronic) using any of the above equip. in mfr., research or development work.
- ☐ Broadcasting or telecasting station.
- ☐ Commercial communication user (Tel & Tel, Police, Airports, Recording Studio, Etc.).
- ☐ Independent research, test, design laboratories and independent consultants—not part of a mfg. Co.
- ☐ Gov't Bureaus, Gov't laboratories, Gov't research center, military installation.
- ☐ Wholesaler, mfg. representative, service firm.
- ☐ University (educational) Public Library.
- ☐ Other (Please explain) .....

CHANGE OF ADDRESS

I wish to continue receiving ELECTRONIC INDUSTRIES
Change my address as indicated.

OLD

Paste wrapper imprint here, or . . .
Write in *complete* old address

NEW

Company _____
Mail Stop or Div./Dept. _____

Title/Position _____

Company Address _____

City _____ Zone _____ State _____

Signature _____

IMPORTANT

FOR OUR STATISTICAL RECORDS PLEASE CHECK **THE ONE** APPROPRIATE CATEGORY THAT BEST DESCRIBES YOUR COMPANY OR DEPARTMENT. Failure to do so will delay your address change.

- ☐ Mfr. of non-military electronic receiving and transmitting equipment.
- ☐ Mfr. of non-military electronic instruments, measuring, control and test equipment.
- ☐ Mfr. of non-military electronic computers, data processing, analysers, business machine.
- ☐ Mfr. of Guided Missiles and Accessories; Aircraft and Accessories, All Type of Military Products and Equipment.
- ☐ Mfr. of electronic components, parts, tubes and like products.
- ☐ Mfg. Co. (non electronic) using any of the above equip. in mfr., research or development work.
- ☐ Broadcasting or telecasting station.
- ☐ Commercial communication user (Tel & Tel, Police, Airports, Recording Studio, Etc.).
- ☐ Independent research, test, design laboratories and independent consultants—not part of a mfg. Co.
- ☐ Gov't Bureaus, Gov't laboratories, Gov't research center, military installation.
- ☐ Wholesaler, mfg. representative, service firm.
- ☐ University (educational) Public Library.
- ☐ Other (Please explain) .....

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No Postage Stamp Necessary If Mailed In U. S. A.

POSTAGE WILL BE PAID BY

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Chilton Company
Chestnut & 56th Sts.
Philadelphia 39, Pa.

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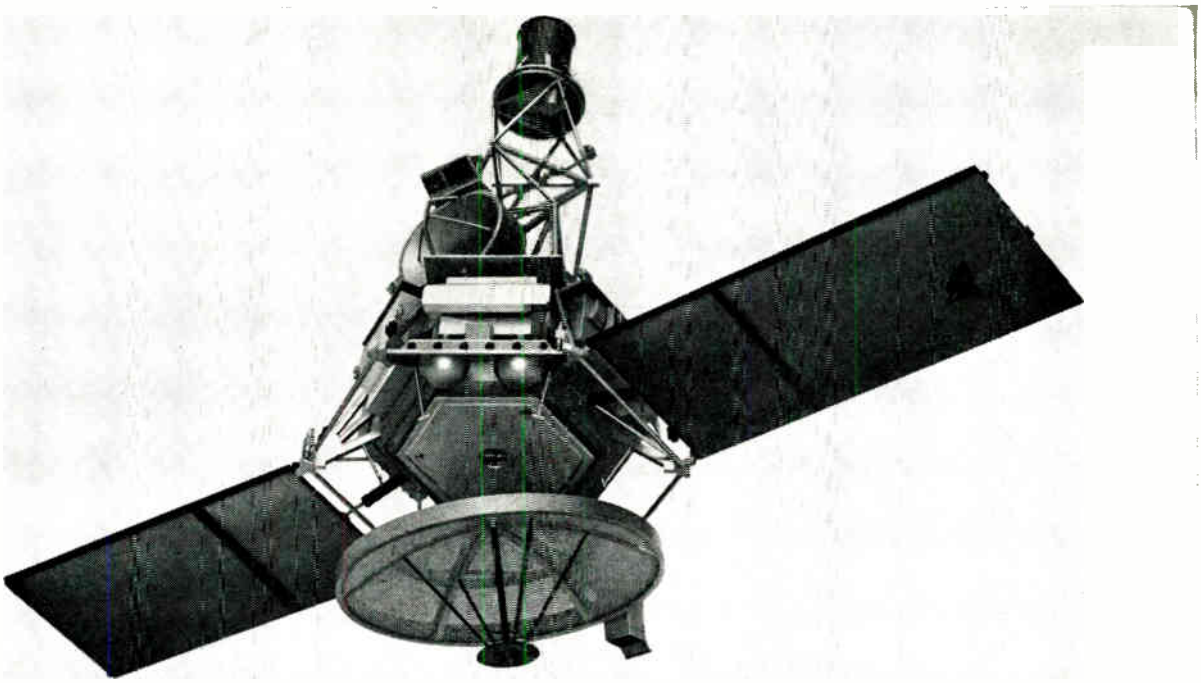
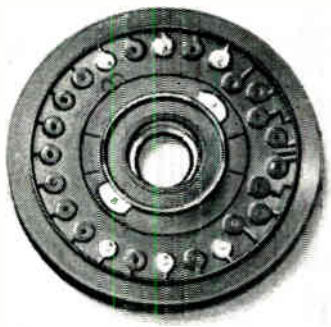


During Mariner II's mid-flight correction... whose pot helped keep it on course?

Mariner photo courtesy of Jet Propulsion Laboratory



Markite's, of course!

As JPL puts it—"Your potentiometers used in the Mariner II control system contributed to the extremely accurate mid-course flight trajectory correction . . . The hostile environment, including high temperature, made the task even more difficult."

Once again, a Markite infinite resolution conductive plastic pot functioned flawlessly on command . . . when and how it had to perform. Once more—a major achievement is added to Markite's record which already includes participation in Gemini, Saturn, Mercury, Pershing, Sparrow, Typhon, F4H, and C-141.

Complex as these systems are, they hardly indicate the upper limit of Markite pot performance. From outer space to the ocean's floor, Markite conductive plastic pots

- meet all system requirements **without reducing any desired parameter at the expense of another**
- prove their ability to perform beyond traditional pot limitations.

Markite pot characteristics include: infinite resolution; exceptionally long useful life; freedom from catastrophic failure; extremely low noise in system use; incomparable accuracy (linearity or conformity); plus the ruggedness and reliability provided only by a 1-piece, molded resistance element—integrating Markite's conductive plastic resistive track with all terminals, taps, series and/or parallel pads.

As originator of conductive plastics, only Markite can offer, as it did for Mariner II, the kind of uninhibited thinking that has solved the most demanding pot problems. This is why we can say, "For performance you may not have thought possible from a potentiometer, talk to Markite." **Write for catalog 633.**

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SIMPLICITY. Fewer parts and high speed installation tools result in lower installation costs. Coax HYFEN® contacts snap-in quickly and are easily removed.

EXPERIENCE. Millions of Coax HYFEN contacts are now in use. Burndy has developed a wide range of contact sizes to meet the many applications for both miniature and standard coaxial cable,and shielded wire. Coax HYFEN contacts are used in many more connectors than the four illustrated above. For further information, write OMATON Division.

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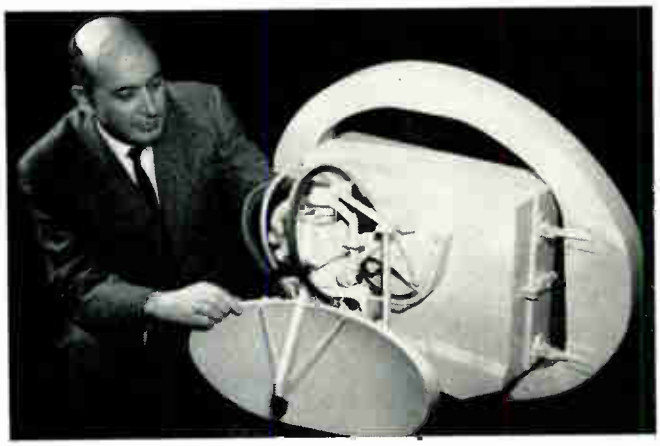
SYSTEMS WISE

COMPACT RADAR FOR TERRAIN/CONTOUR FLYING

In terrain following, this 140-lb. radar lets a pilot or autopilot fly blind at a fixed altitude above the ground, clearing all obstacles ahead. In contour flying the radar not only allows constant altitude flight over objects, but also shows the pilot how to fly around major obstructions. Mapping and navigation capabilities are also included. Built by General Dynamics/Electronics, San Diego, Calif., it can fit the observation type, hedgehopping puddle-jumpers as well as jets.



There are 645 TV stations in the U. S. (42 more than last year). Educational TV accounts for 68 (13 went on air in past year). Commercial TV stations number 577, out of which 486 are VHF, and the rest (91) UHF. Average TV viewing time was 5 hrs and 58 minutes/-day/home. Radio stations total 3,794 AM and 1,062 FM. Average radio listening time was 1 hr., 38 min. a day. TV serves 91% of all homes; radio nearly 94%. (Source—"Broadcasting Yearbook")

Closed-Circuit TV, already in wide use, is in the news with 2 more applications. The first is Tele-Measurements, Inc.'s Tele-Beam, an advanced large screen TV system being used in New York police HQ for line-ups. The other is in use at RCA's Electron Microscope Seminar. The 80 scientists, in effect, can sit at the control panel as the controls are worked, observing close-up the changing images.

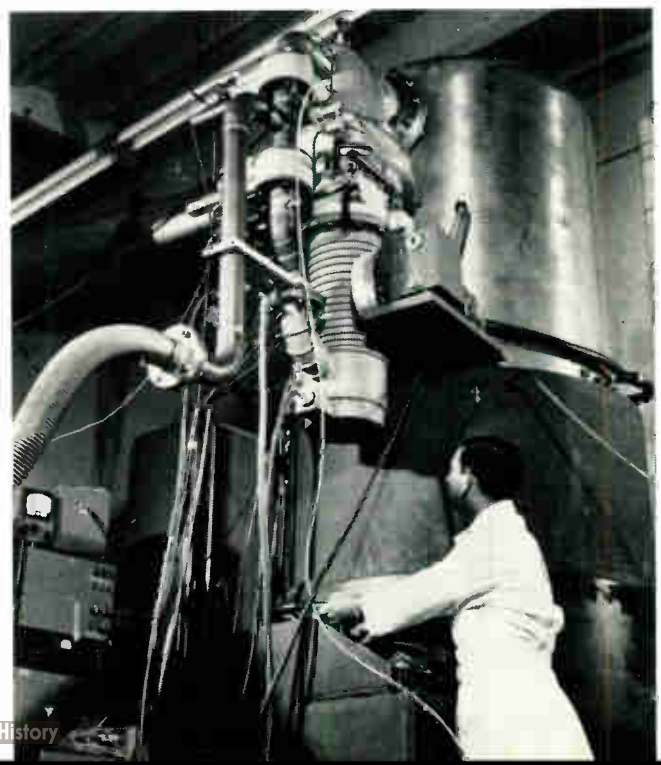
An experimental system for sending direct local cloud cover pictures from meteorological satellites to inexpensive ground stations has passed initial ground-based checkout tests. The Automatic Picture Transmission Subsystem (APT) requires ground equipment costing about $30,000. It will let meteorologists obtain a few immediate local pattern photos when the satellite is within a 1700 mile range of the receiving station. Transmission is similar in principle to sending radio news photos. The pictures will be received and reproduced immediately on specially adapted facsimile machines. Fairchild-Stratos is the contractor for the experimental ground equipment, under NASA.

The Air Force, in its continued push for more manned space flight, has appointed the Instrument Div. of Lear Siegler, Inc., prime contractor, and Rocketdyne Div. of North American Avaiation, Inc., sub-contractor, for a cockpit instrument research and development study. The joint-study will determine what engine operation information must be visually presented to the pilot and the best way of displaying it. A full-scale mock-up of the proposed monitoring panel will be designed and built. This is in anticipation of an upsurge in rocket powered manned vehicles (USAF under the DOD is working with NASA on Gemini), and will end with a full report to the USAF's Aeronautical Systems Division.

The world's largest and most advanced digital communications network is near completion, with the opening of an automatic electronic switching center at Gentile AFS, Ohio. The fourth of five to be built for the USAF by Western Union Telegraph Co., it is another link in the AF DATACOM net (E. I. Systems Wise, Jan. 1963.) The system links some 300 Air Force, Army, Navy, DOD and industry tributaries into a common system for rapid interchange of information.

SPACE SIMULATOR TESTS CENTAUR SYSTEMS

This space simulator can simulate either singly or in combination the extreme cold of the dark side of the moon, the radiation of the sun, the vacuum of outer space, and the shocks and vibration forces of take-off, stage separation, stabilization and re-entry of space craft. Current schedule calls for testing of Centaur sub-systems. The simulator was developed, designed and built by the United Testing Labs. Div. of United ElectroDynamics, Inc., Pasadena, Calif.



amplify signals as low as 5×10^{-14} ampere

new CK587 does it with 1/2 less filament power 40% less volume

Newest addition to Raytheon's line of subminiature electrometer tubes is the CK587. The CK587 is small in size (.230" x .290" x 1"), requires the lowest input power of any electrometer tube available (.00625 watts), and stands up under rugged service with reduced filament resonance effects by virtue of its shorter structure. Compared with the CK5886 under similar gain conditions, the CK587 requires 1/2 less filament power and is over 40% smaller in volume.

Typical Operating Conditions	CK5886 (Pentode)	CK5889 (Pentode)	CK587 (Pentode)
Filament Voltage	1.25 volts	1.25 volts	0.625 volts
Filament Current	10 ma	7.5 ma	10 ma
Plate Voltage	8.5 volts	12 volts	12 volts
Screen Grid Voltage	4.5 volts	4.5 volts	4.5 volts
Control Grid Voltage	−2 volts	−2 volts	−1.6 volts
Nominal Control Grid Current	1×10^{-14} amp.	1×10^{-15} amp.	3×10^{-15} amp.

A maximum control grid current of 1×10^{-13} ampere and input resistance of 10^{15} ohms make the CK587 a logical choice for low-noise amplification of minute outputs from ion chambers, photomultipliers, proportional counters, biological transducer probes and sensors. Complete technical characteristics and application data for Raytheon electrometer tubes, CK-5889, CK5886, and CK587 are available from: Raytheon Company, Industrial Components Division, 55 Chapel Street, Newton 58, Massachusetts.

For small order and prototype requirements see your local franchised Raytheon Distributor.

RAYTHEON

Circle 153 on Inquiry Card

For Computer Systems . . .

A SIMPLE ELECTRONIC ANALOG MULTIPLIER

Using a unique feature of the unijunction transistor, this computation device provides four-quadrant operation over a frequency range from dc to 40 kc, with errors less than 0.75% of full scale. Methods for increasing this accuracy even further are given.

Several decades have passed since man harnessed the electron to do his computational work, first with the electronic analog computer and more recently with digital machines. During this period there has been a constant search to find a device or develop a technique that would perform multiplication in a simple but adequate manner. It is not the purpose of this article to review the many methods developed to perform this operation; this information is available in a number of textbooks. The following comments will be sufficient here.

The digital method, while capable of extreme accuracy, is somewhat cumbersome in many types of data processing. Since it is a numerical device, the problem must be expressed in numerical form. For example, to multiply two time-varying voltages, both have to be converted to a series of discrete numbers, each of the appropriate pairs multiplied to produce a series of numbers representing the results, and this series reconverted to a time varying voltage.

The multiplication process is done either by successive additions or by "looking up" answers in stored tables. The first method is time consuming and generally too slow for real time computation, especially when timely decisions depend on computational results.

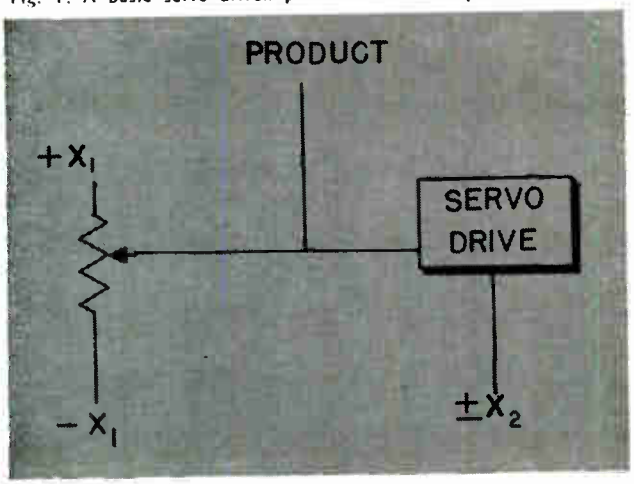
The second method is faster, but consumes a lot of storage. It is economical only for a large amount of numerical multiplication.

To speed up data processing economically, the trend is toward developing hybrid computers that use the best features of both analog and digital methods.

Analog multipliers come in degrees of complexity depending chiefly on the technique used, and the needs for accuracy and speed. A simple analog method (capable of a high degree of accuracy, with errors less than 0.1% of full scale) is the servo driven potentiometer. Its main drawback is the fact that it is electromechanical and therefore limited in its speed to a few cycles per second. Fig. 1 shows the principle of operation. A voltage represented by $+X_1$ and $-X_1$ is applied across the potentiometer. The potentiometer arm is positioned by the other voltage to be multiplied (X_2) through a servomechanism.

The voltage on the arm is then proportional to the product of X_1 and X_2. Applying positive and negative values of X_1 to the potentiometer and positioning the arm through the servo control according to sign and amplitude of X_2 provides four quadrant operation (like signs giving positive, unlike signs giving negative output). (*Continued on page 222*)

Fig. 1: A basic servo driven potentiometer multiplier.



By FREDERICK F. SLACK
Chief, Experimental Measurements Br.
Detection Physics Lab., ERD
Air Force Cambridge Research Labs.
Office of Aerospace Research
Bedford, Mass.

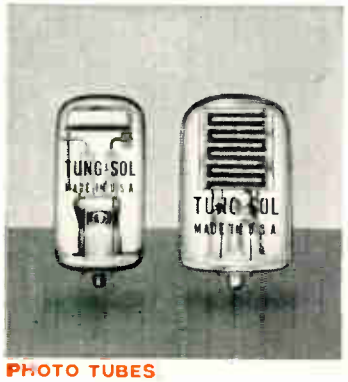
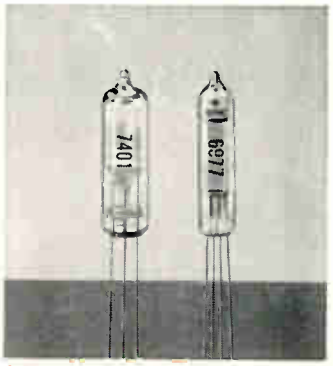
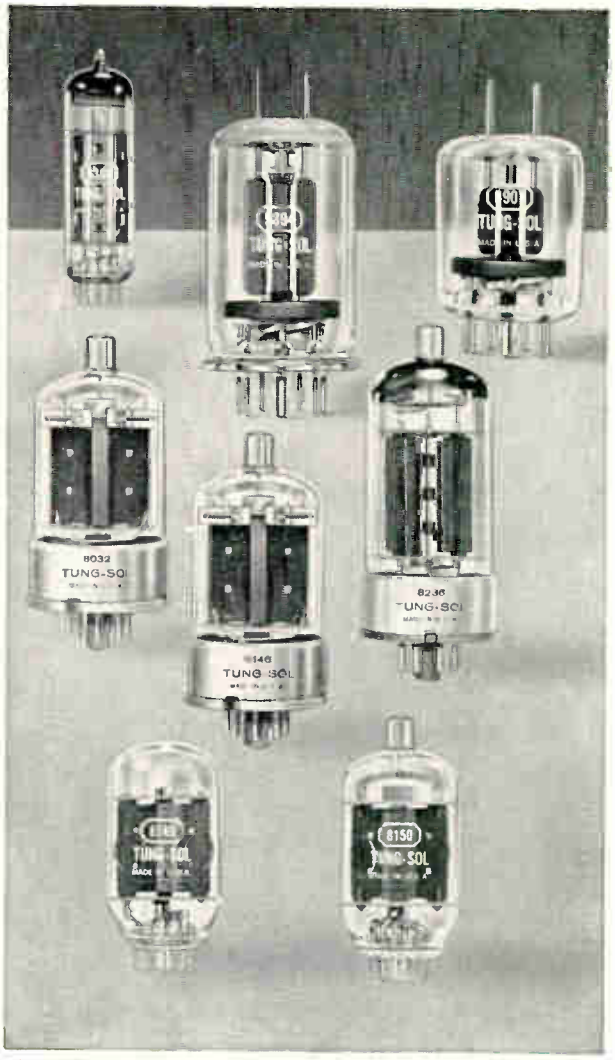


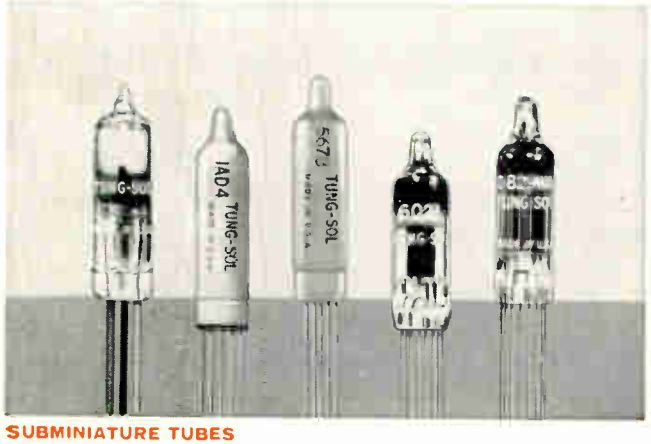
PHOTO TUBES



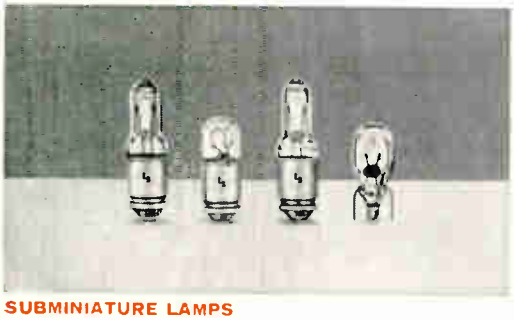
INDICATOR TUBES



TRANSMITTING TUBES, INCLUDING COMPACTRON TYPES



SUBMINIATURE TUBES



SUBMINIATURE LAMPS

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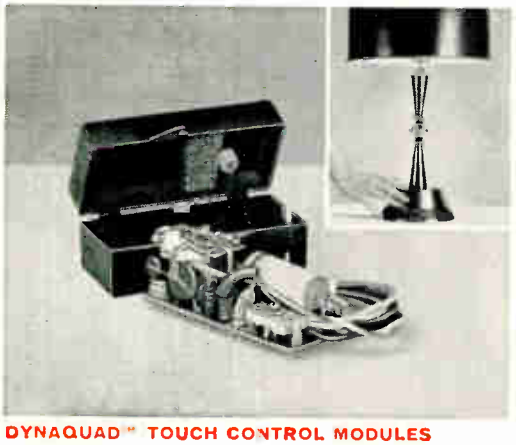

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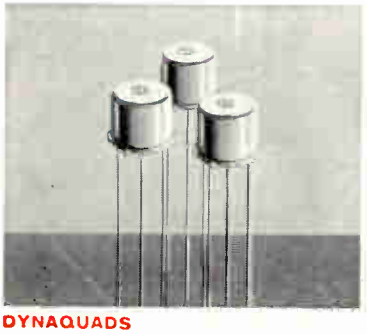
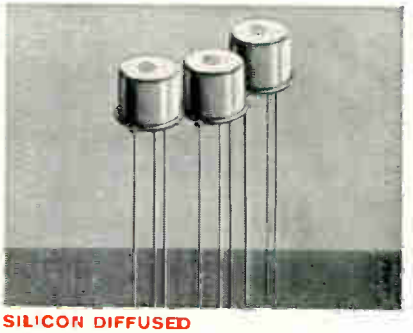


DYNAQUADS



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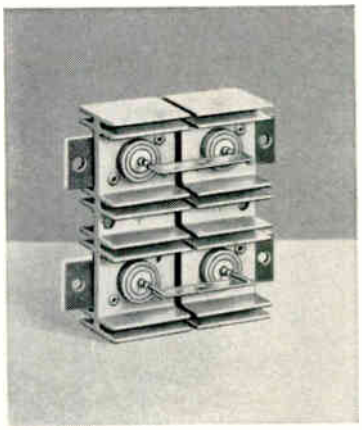
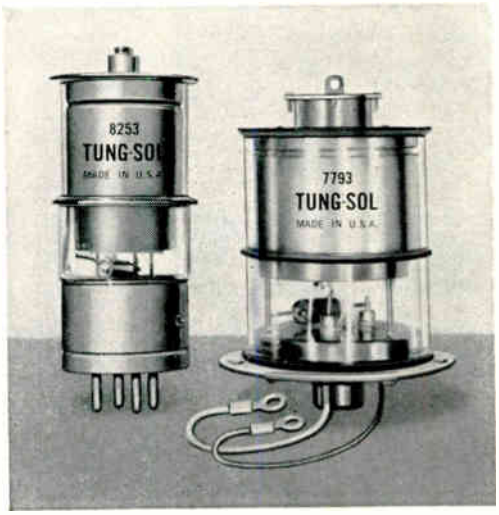
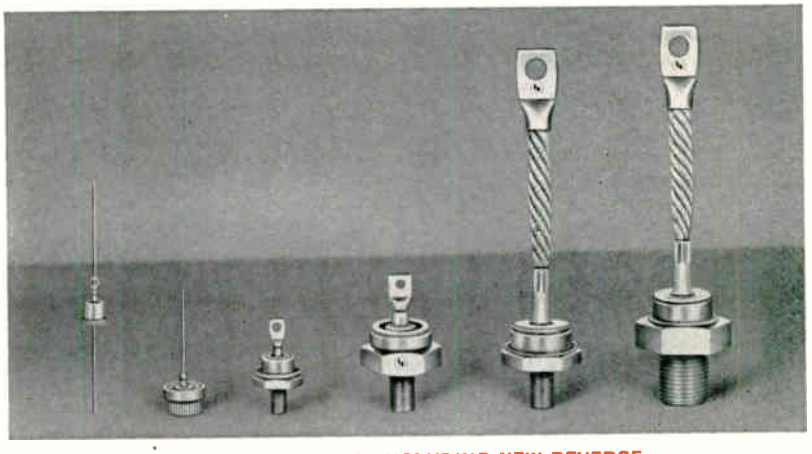
CERAMIC HYDROGEN DIODES AND THYRATRONS



SILICON RECTIFIER STACKS



GLASS HYDROGEN DIODES AND THYRATRONS



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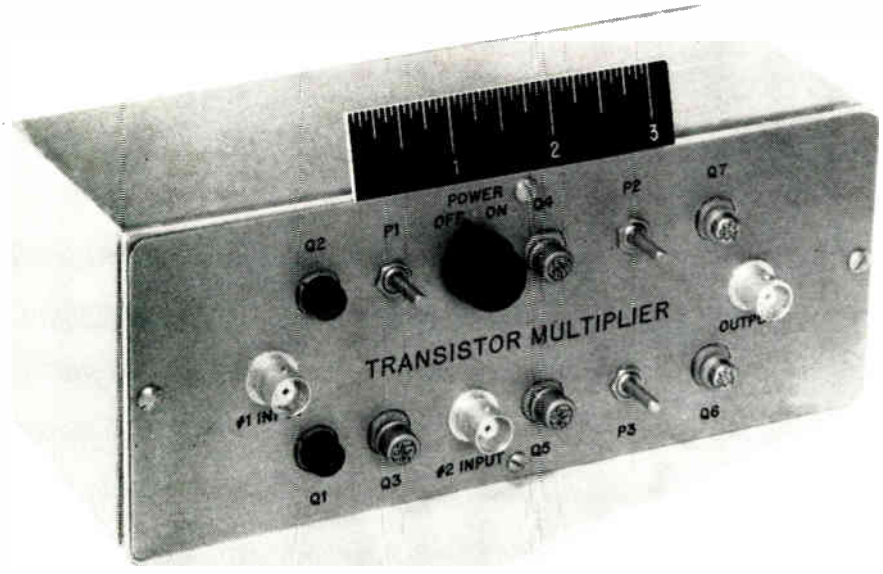


Photograph shows the electronic multiplier. Compact unit has all switches, inputs and transistors mounted on the front.

Transistor Multiplier

An all electronic multiplier, designed and developed in the Astro-surveillance Science Laboratory, is based on the same principle but is not limited by mechanical movement.* It was the result of a search for an electronic device that could replace the potentiometer. In this device the resistance varies as a function of an applied voltage without the need of mechanical motion. The unit was to be used in an auto-correlation, cross-correlation system and could tolerate errors up to 5%.

A number of voltage-sensitive, variable-gain solid-state devices were tried including transistors, crystals and thyrite. The device with the best characteristics was a G.E. unijunction transistor, type 2N491. Fig. 2 shows the resistance between Base 1 and Base 2 as a function of the voltage between the emitter and Base 1. Although this relationship is not linear over its full range, when these transistors were connected in a bridge circuit, multiplication was achieved with errors less than 0.75% of full scale. Cutting the dynamic range of the multiplier in half reduced this error to 0.4%. A means of reducing this error still further is discussed later.

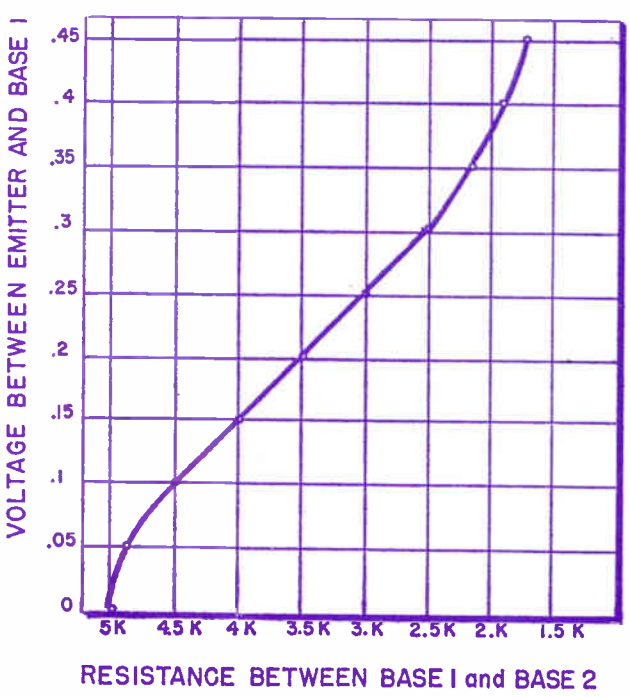
Fig. 3 shows a complete multiplier used in the Astrosurveillance Sciences Lab. This unit has the following:

1. Four quadrant electronic multiplication
2. Frequency range dc to 40 kc
3. Input, 0 to 8V peak to peak
4. Output, 0 to 3V peak to peak
5. Errors less than 0.75% full scale.

*Note—A patent application has been filed.

The heart of the multiplier is the bridge circuit with transistors Q_4 and Q_5. These transistors are connected on opposite sides of the bridge and act as voltage controlled variable resistors. Adjustments are made with P_1, P_2, and P_3 such that with zero volts at input No. 2, the bridge is balanced. That is, the control voltage applied to the emitters is the value needed to make the resistance of the transistors equal to the resistance contained in the other half of the bridge. Under these conditions any signal voltage applied across the bridge will appear as zero at the output. In other words, if either input is zero the

Fig. 2: Voltage vs. resistance plot for 2N491 transistor.



product is zero. If the No. 2 input voltage is made positive, the resistance of the unijunction transistors decreases, thereby unbalancing the bridge in one direction. If the No. 2 input voltage is made negative, the resistance of the bridge is unbalanced in the opposite direction.

The circuit is phased to provide a positive output when both inputs are positive. If both inputs are made negative, the voltage applied across the bridge is reversed, but the bridge is also unbalanced in the opposite direction. Because of this a positive output is still produced. If No. 1 is negative and input No. 2 is positive, the voltage across the bridge can be considered to be negative, and the bridge is unbalanced in the driection that gives a negative output. When input No. 1 is positive and input No. 2 is negative, the voltage across the bridge will be positive, but the bridge is unbalanced in the opposite direction, and the output is again negative. Thus, the unit achieves four quadrant multiplication.

Transistors Q_1 and Q_2 are part of a differential amplifier that converts the single-phase input to push-pull to feed signals that are 180° out of phase on both sides of the bridge output. It also amplifies the out-of-phase product voltage and converts it back to single phase.

Transistor Q_3 is another unijunction transistor. It uses the voltage-controlled resistance feature to multiply the No. 2 input voltage by a portion of itself so that the nonlinearity of the bridge circuit is compensated for.

Increasing the Frequency Range

No attempt was made to increase the frequency range of the specific unit designed above because its response is more than adequate to meet the demands of its designed use. The frequency range of 0-40KC stated earlier was measured at the input to the second differential amplifiers. However, by proper selection of components using high gain negative feed back differential amplifiers, and by paying attention to wiring and layout design, the frequency range can be increased.

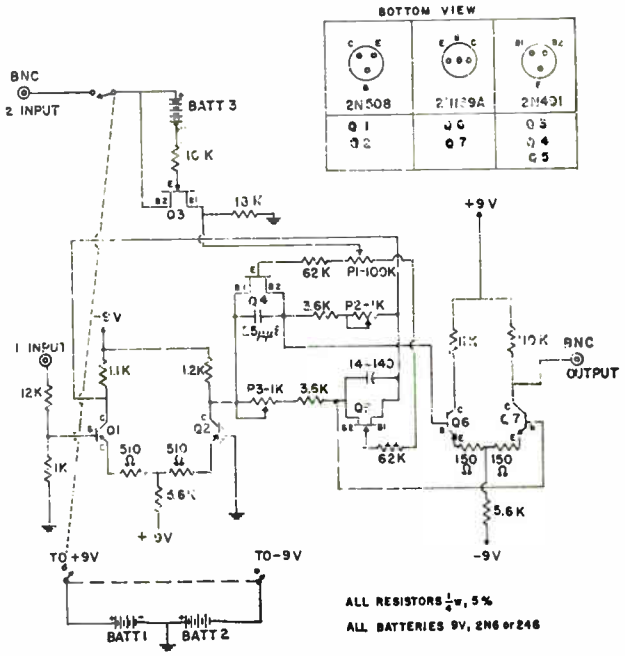


Fig. 3: Schematic diagram of the transistor multiplier. This device offers four quadrant electronic multiplication.

Accuracy Improvement

For applications needing greater accuracy there are several ways of reducing errors. Other solid state devices may be available in the future with more linear voltage-resistance characteristics, or the effects of nonlinearity may be compensated in other ways. For example, a greater order of accuracy may be achieved through negative feedback by using two identical multipliers so that errors in one compensate for similar errors in the other. Fig. 4 shows how this is done. Multiplier M_2 is considered to be a voltage-controlled, variable-gain device with a gain K, although it is not necessarily linear. Then, with Y as the input voltage to be controlled, the output can be written

$$P_2 = KY. \qquad (1)$$

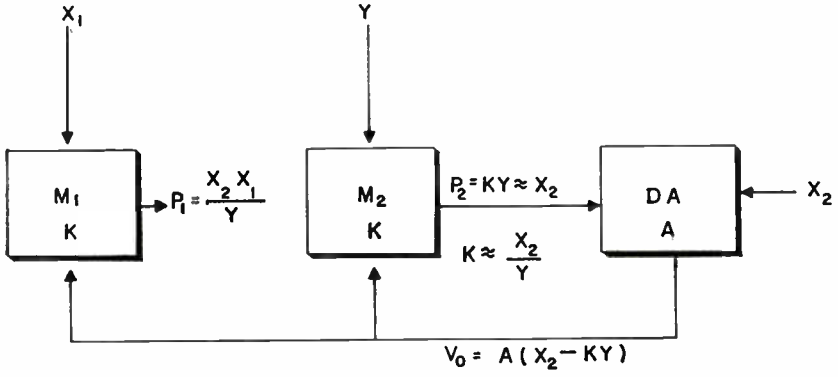


Fig. 4: Diagram illustrates a method of reducing multiplier errors. Two identical multipliers are used so that the errors in one multiplier compensate for similar errors in the other multiplier.

ANALOG MULTIPLIER (Concluded)

With voltage KY applied to one side of a high gain differential amp. and X_2, one of the voltages to be multiplied, fed into the other side, the output becomes

$$E_o = A\,(X_2 - KY). \tag{2}$$

Isolating KY thus becomes

$$KY = X_2 - \frac{E_o}{A}. \tag{3}$$

From this, it is apparent that, if the differential amp. gain A is made sufficiently large, then Eq. 3 reduces to

$$KY = X_2 \text{ and } K = \frac{X_2}{Y}. \tag{4}$$

Now if the differential amp. output E_o is used to control the gain of an identical multiplier M_1, with the variable gain characteristics K the same as it is in M_2, and X_1, the voltage to be multiplied, then output P_1 can be written

$$P_1 = \frac{X_2X_1}{Y}. \tag{5}$$

If Y is a constant, but not zero then for all practical uses

$$P_1 = X_2X_1. \tag{6}$$

If Y is not a constant but represents a signal voltage, this configuration also performs division. Generally speaking, the foregoing technique for increasing accuracy cannot be used for most variable gain devices, because it is essential that the gain be a function of one input only. Unlike most devices, however, the unijunction transistor has the unique feature that the resistance between the two bases is independent of the voltage applied between them over the needed working range. For greatest accuracy, each transistor in one multiplier should be matched to its counterpart in the second multiplier.

BIONICS APPROACH to a systems design is urged by Louis A. DeRosa, Vice President of Engineering, ITT Communications Systems. He urged industry to free itself from "black boxism"—the practice of adding an electronic box for each new communication requirement. The more systems-oriented design inherent in nature, he said, should be copied. In nature, for example, he pointed out, the human uses approximately 10 to 50 times more brain capacity for intelligence collection functions (warning and alert) than for the control of his muscles.

INDUSTRY NEWS

Victor Whittier—elected President of the newly formed Cooperating Users of Burroughs Equipment organization.

Wilson H. Oelkers — elected Vice President., Philco Corp., Philadelphia, Pa.

E. Nevin Kather—named Vice President — OEM Marketing, Raytheon Co., Lexington, Mass.; **Kenneth M. Lord**—named Vice President and General Manager, Raytheon Semiconductor Div.; **Gerald P. O'Neil**—named Acting Director of Manufacturing and Purchasing.

Fred Delnevo—appointed Sales Manager, Advanced Products Div., U. S. Engineering Co., Van Nuys, Calif., a division of Litton Industries.

Charles M. Kirkland—appointed President of the Heath Co., Benton, Mich., subsidiary of Daystrom, Inc.

C. M. Kirkland

H. S. Evander

Herbert S. Evander—appointed Marketing Manager, Semiconductor Div., Hughes Aircraft Co., Newport Beach, Calif.

William R. Olsen—named Marketing and Distribution Manager, Anaconda Wire & Cable Co., Hastings-on-Hudson, N. Y.

A. P. Berlijn—appointed Manager, European Div., The Victoreen Instrument Co., Cleveland, Ohio; **Frank Mannino, Jr.**—appointed Export Sales Manager.

Dale W. Freyberg—named Managing Director, Scherr-Tumico Israel, subsidiary of Scherr-Tumico, Inc., St. James, Minn.

E. Bruce McEvoy — appointed Assistant to the Vice President—Marketing, Electronic Tube Div., Sylvania Electric Products, Inc., Seneca Falls, N. Y.; **William T. Buschmann**—named Distributor Sales Manager, Electronic Tube Div.; also **Ralph J. Summers**—named Southwest District Marketing Manager, Sylvania Electronic Systems Div.

(Continued on page 226)

INDUSTRY NEWS

R. K. Abercrombie—appointed Sales Manager, Ossining, N. Y., Div., Hudson Wire Co.; **Nicholas Lajoie**—named Assistant Sales Manager.

Richard D. Kennedy—appointed Sales Manager, Home Convenience Products, General Electric Co. Receiving Tube Dept., Owensburg, Ky.; **Albert C. Gubitz**—appointed Advertising and Sales Promotion Manager, GE Receiving Tube Dept.

Michael J. James — appointed Sales Manager, Semiconductor Products, Lansdale, Pa., Div., Philco Corp.; **Maj. Gen. Raymond C. Maude**, USAF-Ret. —appointed Manager, Military Requirements Planning, Philco Corp., Philadelphia, Pa.

Arthur P. Clow—elected Vice President for Defense Activities, Western Electric Co., New York, N. Y.

A. P. Clow

D. C. Scott

David C. Scott—appointed Vice President and Group Executive, Fairbanks Whitney Corp., New York, N. Y.

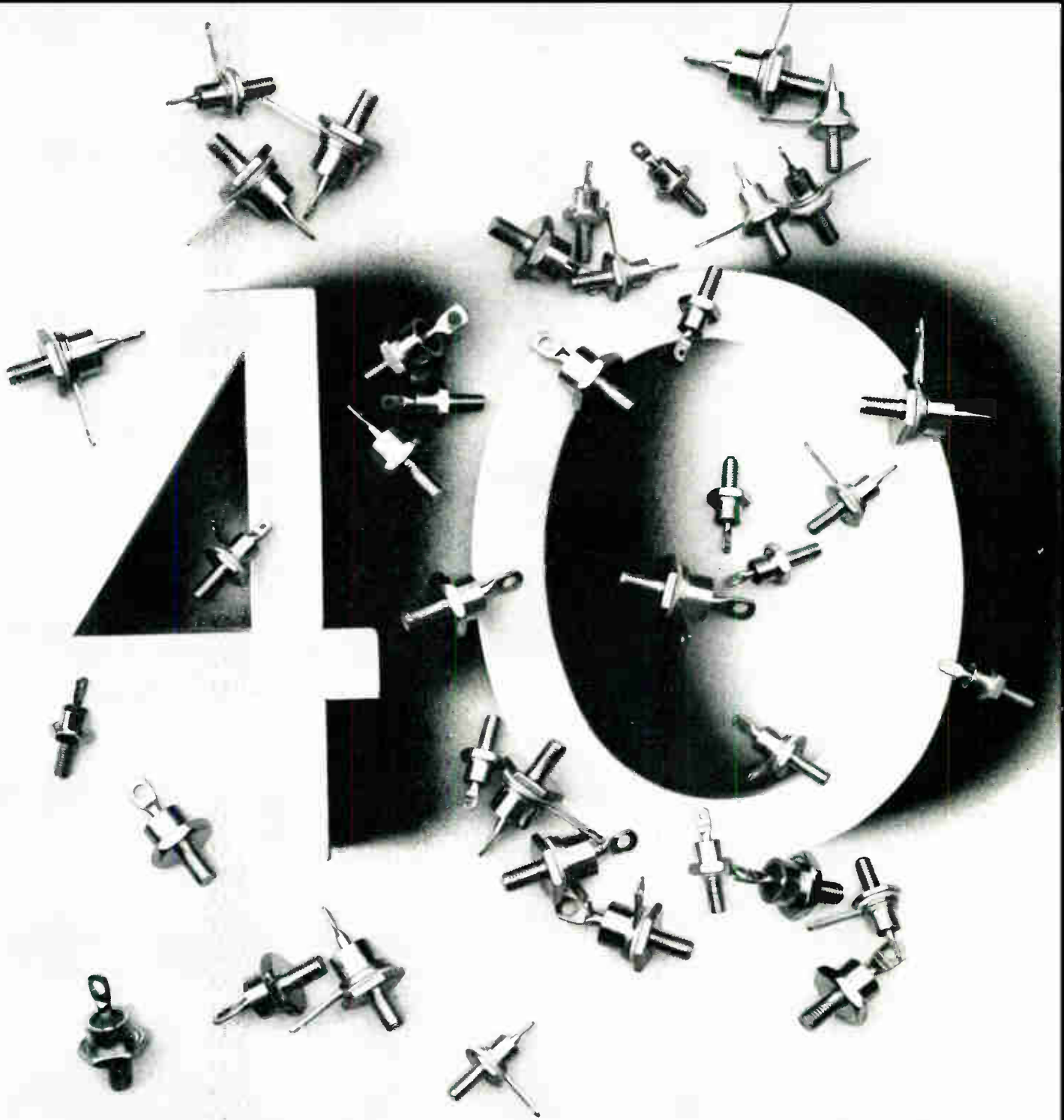
Gen. Frederic H. Smith, Jr., USAF Ret.—appointed Vice President and Executive Assistant to the President for Advance Planning, Republic Aviation Corp., Farmington, L. I., N. Y.

Robert A. Bennet—appointed Western Regional Industry Marketing Manager, International Business Machines Corp., New York, N. Y.

Dr. John J. Bohrer — elected Vice President, International Resistance Co., Philadelphia, Pa.; also **Robert J. Reigel** — appointed IRC Northwest Regional Manager.

John J. Graham—appointed Area General Manager—North America, International Telephone & Telegraph Corp., New York, N. Y.; **John W. Lienhard** —elected an Assistant Vice President of ITT; **John T. Benjamin**—elected a Vice President of ITT Export Corp.; also **John Paivinen** — appointed Vice President, Operations ITT Information Systems Div., Paramus, N. J.

(Continued on page 228)



40 FAST-SWITCH POWER RECTIFIERS EIA-REGISTERED BY HUGHES NOW AVAILABLE FOR IMMEDIATE DELIVERY!

Now double your efficiency with a rectifier line unique in the industry. The unusual efficiency of Hughes HF series "Golden Line" fast-switch, EIA-registered silicon power rectifiers (1-30 amps) allows you to (1) increase the source frequency, which results in a decrease in the size, costs and weight of filter components and power conversion units, and (2) to decrease the source power through the elimination of high voltage drops in the filter circuit and in other filter elements. The result: an increase of up to 50 per cent in circuit efficiency! ■ All Hughes fast-switch rectifiers have recovery times of 200 nanoseconds (max.). Typical recovery time is 120 nanoseconds (but as low as 80 nanoseconds for special applications). ■ Hughes fast-switch rectifiers demonstrate a high degree of immunity to the effects of space radiation. *Remember: Hughes introduced today's fastest-switching diode!*

DO-4 and DO-5 packages with an insulated base (designated DO-10 and DO-11) are available. They provide over 40% more thermal conductivity; eliminate the need for reverse polarity units; and end costly inventory confusion and assembly mistakes, and the tedious, time consuming assembly of insulating washers and connecting lugs.

DIODES • TRANSISTORS • RECTIFIERS • PACKAGED ASSEMBLIES • CRYSTAL FILTERS

DO-4 PACKAGE

EIA No.	I_O	PIV
1N3879	6A	50
*N3880		100
1N3881		200
*N3882		300
*N3883		400
1N3889	12A	50
1N3890		100
1N3891		200
*N3892		300
*N3893		400

DO-5 PACKAGE

EIA No.	I_O	PIV
1N3899	20A	50
1N3900		100
1N3901		200
1N3902		300
1N3903		400
1N3909	30A	50
1N3910		100
1N3911		200
1N3912		300
1N3913		400

DO-10 PACKAGE

EIA No.	I_O	PIV
*N3874	6A	50
*N3875		100
*N3876		200
*N3877		300
*N3878		400
1N3884	12A	50
*N3885		100
1N3886		200
1N3887		300
1N3888		400

DO-11 PACKAGE

EIA No.	I_O	PIV
1N3904	20A	50
1N3905		100
1N3906		200
1N3907		300
1N3908		400
1N3914	30A	50
1N3915		100
*N3916		200
1N3917		300
1N3918		400

For additional details on local delivery or export, contact your Hughes representative; or your Hughes distributor for off-the-shelf stock. Ask for your copy of the "Golden Line" Rectifier Brochure (C-22); or write Hughes Semiconductor Division, Marketing Department.

HUGHES

HUGHES AIRCRAFT COMPANY
SEMICONDUCTOR DIVISION
NEWPORT BEACH CALIF.

*Trademark, Hughes Aircraft Company

Circle 161 on Inquiry Card

INDUSTRY NEWS

Edwin E. van Bronkhorst, Ray L. Wilbur, Jr., and William P. Doolittle—appointed Vice Presidents, Hewlett-Packard Co., Palo Alto, Calif.

Earl L. Clemick—appointed Marketing Manager, Ceramic Products, for Centralab, The Electronics Div., Globe-Union, Inc., Milwaukee, Wisc.

E. L. Clemick

J. G. Edge

J. Gordon Edge—appointed Marketing Manager, Cornell-Dubilier Electronics Div., Federal Pacific Electric Co., Venice, Calif.

Sidney L. Briggs — appointed Vice President — Administration, Information Systems Group, General Precision, Inc., Glendale, Calif.

John W. Steves—appointed Marketing Manager for the new Infrared/Optics/Laser Group, Sperry Rand Corp., Great Neck, N. Y.

Edward C. Belfrey — named Sales Manager, Switch/Relay Components Dept., Electronic Controls, Inc., Stamford, Conn.

E. C. Belfrey

A. A. Hendrix

Algie A. Hendrix — appointed Vice President, Industrial Relations, General Dynamics Corp., New York, N. Y.

Merrill Simon — named Marketing Manager, Lambda Electronics Corp., Huntington, L. I., N. Y.; **Ralph Schlote**—named Sales Manager.

(Continued on page 229)

INDUSTRY NEWS

John M. Pearce — appointed Eastern Manager, Cubic Corp., San Diego, Calif., with headquarters in the company's Washington, D. C., office.

Monson Hayes, Jr. — named Vice President, Telecomputing Corp., Los Angeles, Calif., and General Manager of its Electronic Systems and Data Instruments divisions.

W. A. Johnson—named Product Sales Manager, Westinghouse Semiconductor Div., Youngwood, Pa.

Dr. Lyman R. Fink and Hoyt P. Steele — elected Vice Presidents, General Electric Co., New York, N. Y.

Sol Sparer — elected President and Chief Executive Officer, Pacotronics, Inc., Glendale, L. I., N. Y.

Richard T. Campbell—appointed Director of Marketing, Anadex Instruments, Inc., Van Nuys, Calif.

R. T. Campbell

W. E. Levine

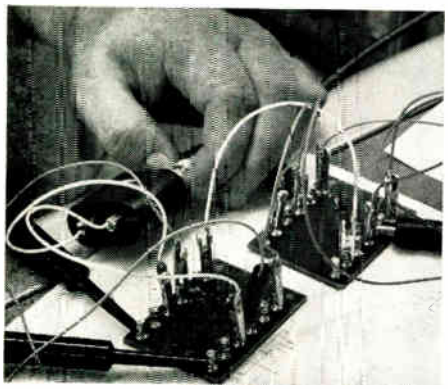
William E. Levine — named Sales Manager, Warnecke Electron Tubes, Des Plaines, Ill.

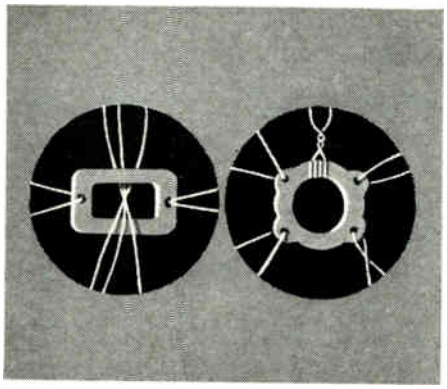
James S. Holtzinger—appointed Solatron Product Marketing Manager, Sola Electric Co., Elk Grove Village, Ill.; Eugene A. Reich—named Product Marketing Manager, Power Supplies.

Arnold K. Weber — appointed Vice President and General Manager, Electronic Data Processing Div., Radio Corporation of America, New York, N. Y.; Edwin S. McCollister—named Division Vice President, Business Planning and Marketing.

Harry A. Jackson—appointed Plant Manager, Spectrol Electronics of Canada, Ltd., subsidiary of Spectrol Electronics Corp., San Gabriel, Calif.

S. N. Smith—named Vice President and Director of Manufacturing, Twin Industries Corp., Buffalo, N. Y.; G. R. Hecht—named Vice President and General Manager, Aerospace Div.; J. L. Hesburgh—named Vice President and General Manager, Special Products Div.





Despite the tremendous speed and ravenous appetite of today's most advanced computers, scientists at Lockheed Missiles & Space Company's Computer Research Laboratories feel that there is room for a great deal of improvement. They have dedicated themselves to the discovery and development of ways to increase the speed and reliability of computers while simplifying their operation.

Though today's computer circuits are capable of operating at speeds measured in tens of nanoseconds, the useful computation rate is far slower. One of the roadblocks hindering speed is the need for the computer to wait for the carryovers from one column of figures to catch up with the main calculation. A possible answer to this problem is modular arithmetic, which avoids carryover. Based on the ancient Chinese Remainder Theorem, this concept is being re-examined at Lockheed for potential computer applications.

Lockheed's Computer Research Laboratories are studying a very broad group of related computer research areas, and the company can boast that an unusual number of its specialists are at the very forefront of their specific fields.

Among the major areas of research being undertaken at this time are basic physical phenomena, such as phonons; quantum mechanics; switching theory; residue arithmetic (number system research); threshold logic and pattern recognition and logic design techniques.

LOOK AT LOCKHEED... AS A CAREER

Consider Lockheed's leadership in space technology. Evaluate its accomplishments —such as the Polaris missile, the Agena vehicle's superb record of space missions. Examine its outstanding advantages —location, advancement policies, creative climate, opportunity for recognition.

Then write for a brochure that gives you a more complete Look at Lockheed. Address: Research & Development Staff, Dept. M-48A, P.O. Box 504, Sunnyvale, California. Lockheed is an equal opportunity employer.

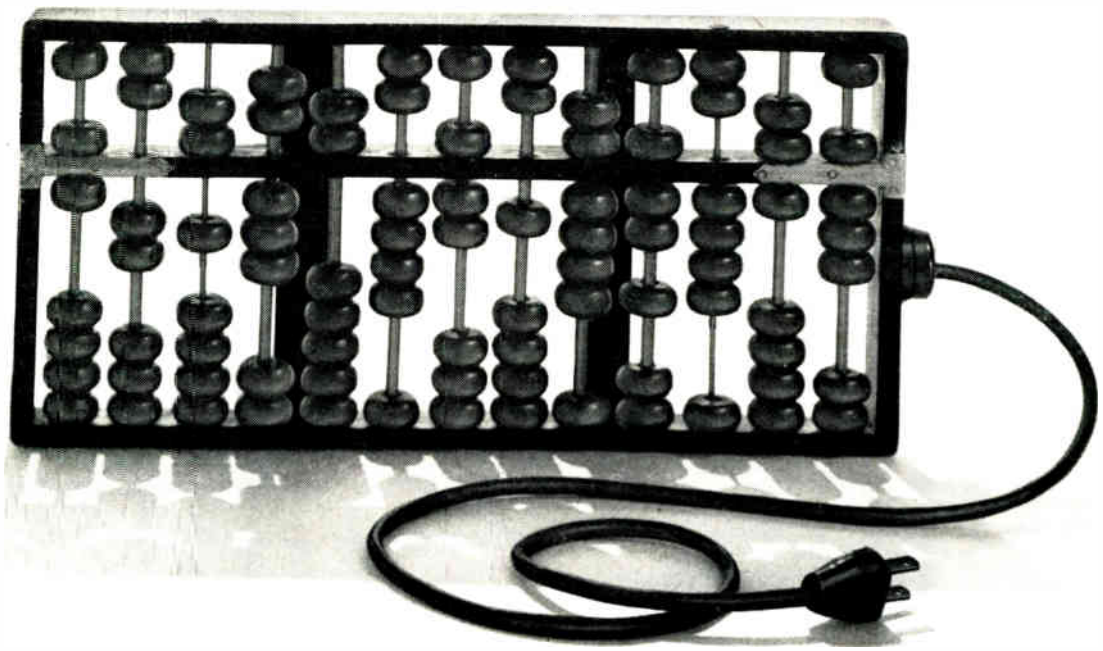
SCIENTISTS & ENGINEERS: In addition to positions relating to computer research, such as logical design specialists and mathematicians, other important openings exist for specialists in: Trajectory analysis • Inertial guidance • Electromagnetics • Orbit thermodynamics • Gas dynamics • Chemical & nuclear propulsion • Systems engineering • Electronic engineering • Communications & optics research

LOCKHEED
MISSILES & SPACE COMPANY
A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION

Sunnyvale, Palo Alto, Van Nuys, Santa Cruz, Santa Maria, California • Cape Canaveral, Florida • Huntsville, Alabama • Hawaii

LOOK AT LOCKHEED IN DIGITAL TECHNIQUES:

Basic research toward simpler, faster, more reliable computers



For a close-up Look at Lockheed, see us at the IEEE Convention Hotel in New York, March 25 through 28.

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

ELECTRONIC ENGINEERS' SALARIES AMONG HIGHEST

Electronic engineering is one of the highest paying professions in the country, latest figures from the 1960 government census show.

The median income of 185,128 employed as electrical or electronic engineers in 1960 was $8,613. Only occupations ranking higher: dentists, doctors, and lawyers, all over $10,000; aeronautical engineers, $9,059, and plant managers, $9,156.

Most electronic engineers (76,649) were employed in the $7,000-$10,000 bracket, figures revealed. Nearly 56,000 were earning over $10,000.

The 185,128 employed as electrical and electronic engineers was a 72.2% increase since 1950.

Other figures of interest: electronic technicians increased by 679.5% in number since 1950. Their median income was $5,921, high in that field.

Unemployment rate for electronic engineers in 1960 was only .7%.

"THE ROLE OF R&D IN FUTURE PROFITS"

The article by the above title appeared in the January 1963 issue of ELECTRONIC INDUSTRIES. It was excerpted from the speech by Texas Instruments Incorporated's Patrick E. Haggerty delivered at the 1962 National Electric Conference in Chicago.

An unfortunate typographical error, in which two lines of type were dropped, radically changed the meaning of the concluding paragraphs.

As the article was published, it read, "Now, I hasten to add that the management in the electronics industry is inferior to that in other industries."

The passage should have read—"Now, I hasten to add that *I am not implying either that our own company management is not competitive with the better management in our industry or that* the management in the electronics industry is inferior to that in other industries."

BOSTON LEADER HONORED

Aaron Solomon (l.), Pres. of Ace Electronics Assoc., Inc., Somerville, Mass., receives award from Greater Boston Assn. for Retarded Children for his leadership in employing the mentally retarded. Presenting award are (ctr.) Diwaker S. Salvi, who directs Assn. Vocational Ctr., and John B. Hogan, GBARC Pres.

MEDIAN SCIENTIFIC SALARY $10,000 A YEAR

The median salary for scientific manpower is now $10,000 a year, according to the National Science Foundation.

NSF says a preliminary report of its 1962 survey shows the median salary up $1,000 since 1960.

Most of the 250,000 scientists covered in the survey are in R & D (about 35%). Highest salaries ($14,000 median) are in managing and administering R & D programs.

More detailed results are in "Scientific Manpower Bulletin No. 19," obtainable from Supt. of Documents, U. S. Govt. Printing Ofc., Washington 25, D. C.

GRADUATE COLLEGES EMPLOY MORE SCIENTISTS, ENGINEERS

More than four-fifths, or 145,000, of scientists and engineers employed by colleges and universities in 1961 were at 306 graduate-level institutions, says the National Science Foundation.

A graduate-level institution is defined as one granting advanced degrees in science or engineering.

The remaining 30,000 were employed by more than 1,700 undergraduate-level institutions.

JOB PROSPECTS GOOD FOR '63 TECHNICAL GRADS

The 1963 engineering graduates will have no trouble finding jobs, according to Dr. Frank S. Endicott, Northwestern Univ. Placement Director.

On the basis of a survey of 218 business and industrial firms, he said, "More companies will hire more engineers and other technical graduates for more jobs and at higher salaries than ever before. This reflects a general feeling that the outlook is especially good in technological fields."

Firms reported they would hire 26.8% more engineers with bachelors degrees than in 1962, and 4.4% more in such non-engineering vocations as accounting, chemistry, marketing and finance. Total reported needs of bachelors degree men in 1963 over 1962 was 13.7%.

Need for masters degree holders in all fields was 29% greater than in 1962. These companies planned to hire 55% more graduates with engineering masters degrees in 1963, as well as 70% more in physics, and 90% more in mathematics-statistics.

For men, average starting salaries for 1963 will be about $588 for engineers and $466 monthly for general business trainees. Corresponding averages reported for 1962 were $455 for general business trainees and $572 for engineers.

Average monthly earnings reported for college men hired five years ago (class of 1957) was $739 in engineering, compared with $906 for those hired ten years ago (class of 1952); $676 in accounting, compared with $871; $703 in sales, compared with $900, and $660 in general business, compared with $856. Salaries are for Nov., 1962.

FOR MORE INFORMATION . . . on opportunities described in this section fill out the convenient resume form, page 234.

AN ENGINEER'S GUIDE TO JOB HUNTING

Are you in the market for a new job?
If so, then now is the time
to do some planning.
This guide is designed to aid you
in this important task.

AS AN ENGINEER IN THE MARKET for a new job you are a seller with a product. Have you planned your sales campaign? Reviewing basic points in job-hunting can improve your odds.

Where Do You Start?

No matter how good you are in your field, or how well educated you may be, you must first get a clear idea of what it is you want to do with your career. The cards are stacked against you if you don't know where you're going.

Not being sure of your future, or even of your present job objectives, doesn't prevent you from looking around. Yet your searches will be more productive if you can say, "I'd like to spend most of my time working with transistor circuits." This way you can make adjustments to best suit you.

Reassessing your present job may call for some calculated thinking on your part. Are you satisfied in your present work? If not, why not? Is it you, or the job's scope, or your employer? Can you learn more in your present job, or have you reached the limit of the field? How are your dealings with supervisors, other engineers, management, customers?

Many engineers find their college's alumni placement bureau an excellent source of job market information.

Do you have trouble keeping up to date with your own field, or the company's goals? Can you adapt to changing management decisions without unusual reluctance or strain?

Then there's your employer or company: what's the outlook for business growth, at least as it might affect you? Does management encourage creative thinking? Do they welcome profitable changes and new ways of doing things? Is your personnel or cost budget enough to support your project work? Be realistic! How about company scheduling: loose, rigid, flexible, impossible?

Answer all these questions, and many more about yourself, your job, your work, your location—and then start your serious job hunting, not before.

Finding the Buyer

There are two ways to approach buyers: the shotgun and the rifle methods. TV is a shotgun; direct mail is a rifle. You can combine features of both methods, but whatever you decide on, you should learn your market first. There are many ways of doing this.

A source of market information for many engineers is their college's *alumni placement* bureau. It can give you information on job openings limited to alumni, and you can often receive aid in your career planning problems and analysis.

Professional Societies usually offer member placement services of one type or another. This is not as personalized as an alumni bureau, but you can often glean valuable leads from the society, or through your contacts with fellow members. Of course conventions are technical in nature (it says so on the program), but don't count on convention recruiting unless you can show up in person.

Next come the *employment agencies* and *recruiting firms*. Your job may be the type that requires the services of an agency. These firms specialize in looking and finding, both for you and for an employer. True, you may have to pay a fee, but a good agency carries a lot of weight with many companies. Many employer-clients pay the agency fee, but should you have to go it alone, remember that fees are regulated by law in many states. You can expect it to run anywhere from a week's to a month's wages.

By JOHN J. TRAYNOR, JR.

Head, Publications Section
Astro-Space Laboratories, Inc.
2104 Memorial Parkway, S. W.
Huntsville, Ala.

SAMPLE RESUME

PHILIP Q. ENGINEER

123 Anystreet Drive MU 2-3546 Available immediately
Filtertown, Iowa Employer notified.
Married; three children; U. S. Citizen; age 28
Height: 6'1" Weight: 185 lbs Sel. Serv. Class: 3A

POSITION DESIRED: Microwave test engineer; mid-West area preferred.

QUALIFICATIONS:

1. Performed supervisory duties on the Eagle missile program ground support equipment and telemetry units, with emphasis on reliability and field checkout procedures. Devised three new short-cut tests which increased program lead time by 30%. Did back-up work on supporting telemetry system in base-to-field and field-to-missile network. Two years.
2. Highly diverse practical troubleshooting and testing of experimental and prototype solid-state microwave components, including wave guide analysis, generator/oscillator design, and s/n improvement studies. Three years.
3. Power unit and filtering experience conducted on production model equipment, via bench-testing, field service, and product redesign based on customer usage. One year.

EMPLOYMENT HISTORY:

Able Airframe Corp., Hiacinth, Iowa; 2-60 to date; Chief, GSE Test & Checkout Section; Salary: $11,200
Baker Beamer Co., Fallstown, Minn.; 4-57 to 2-60; Test Engineer; Salary: $9,400
Charlie Chopper Corp., Highball, Mo.; 1-56 to 4-57; Field Engineer; Salary: $7,900

EDUCATION:

Dakota City General High School, graduated Jan. 1951
Plains University, B.S.E.E., 1955
Jones University, M.S.E.E., 1956

PERSONAL BACKGROUND:

Worked approximately 50% of own college expenses. Left home area after high school. Undergraduate activities moderate. Own home in Greenacres, Filtertown; member Civitan and P.T.A.

REFERENCES: will be forwarded upon request

Be sure to read the contract carefully, even if your new employer picks up the tab.

Who is a good agency? Talk to personnel managers in your field and ask them who they've found to be helpful. Some employers work only through agencies; they can't match the cost or quality of the services themselves!

An off-shoot of the standard agency—and to be distinguished from governmental employment agencies—is the *clearing-house agency*. These companies are supported by employer-paid advertising, with no fee to the job hunting engineer. You are limited, however, by the number of companies willing to recruit in this way. Contacts are fast and partially automated. Filled-out data sheets are transcribed on punch-cards and the print-outs are sent to subscribing employers. Overall value of this

(*Continued on page* 235)

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.

800 801 802 803 804 805 806 807 808 809 **810**

method depends on your qualifications and current market requirements.

Most major *trade journals* and *trade papers* carry "career" advertising and notices, including "situations open and wanted" columns. Again, how closely do your experience and goals correspond with job needs? These ads and notices give you direct contacts, but are often behind by a month or more, so that many "hot" jobs may never be found.

Classified ads are a source of possibilities. They vary from "boxes" to full-page displays. Watch out for "box number" ads; your percentage of replies will be low.

Another sleeper is the "glamour ad": golf courses, winter sports, deep-sea fishing, and the like—perhaps they can't sell the company, so they are selling the city!

Advertisements serve as a good index to the market. Measuring the number of column inches in the Sunday *New York Times* classified and financial sections is a way of telling whether buyers or sellers are in greatest demand. If time allows, you should study large metropolitan papers like, the *Times*, *Boston Globe*, *Philadelphia Inquirer*, or *Chicago Tribune*. They may be available at a newsstand, or at the local library. (In Huntsville, Ala., you can even buy major European newspapers!)

Word of mouth is another way to find the market or let it find you. If you want your employer to know at this time that you'd like to move elsewhere, he may be able to give you some good leads and introductions. Word gets around—better to have the employer on your side if you have good reasons for leaving.

You have to *work* to find work—nobody will do it for you, not even an agency. Even going in cold to a new company can pay off. One employment manager told me: "Nine out of ten walk-ins don't have what I want, but that tenth one may be a gem. Him I want! So I talk to every one of the ten."

Your Specifications Sheet

Since you might approach your job hunting as a sales operation, you need a "product bulletin"—your resume. This is the one or two-page affair that tells your story. Often it's your only "in" or "ice-breaker," so it deserves time and thought. But never forget that it's only a tool.

Resumes are fairly mechanical in nature. They are supposed to whet the reader's appetite for more. Every resume contains certain basic facts about you, your jobs, experience, education, and personal statistics. No personnel man is going to read ten pages of fine print, so don't waste time with that much. Get it down briefly; accentuate the points which support your goal of a certain type of job.

Whether your resume is long or short it should be neat and correct. Professionally written and printed resumes aren't necessary for most engineers, but if you're in the middle and higher levels they might be an inexpensive but profitable investment. Remember that the resume is basically "interview bait": it won't get you a job on the spot.

Once it's ready, get your resume moving. Use it to answer ads, pass out to possible contacts, and to introduce yourself. Unless the situation is unusual let the resume speak for itself, and tailor the cover letter to the specific job inquiry.

Leave "gimmicks" to the other fellow. Most personnel and recruiting staffers are unimpressed, even irritated, although there are exceptions. This is up to you.

Finally, don't think your resume is frozen once you get the facts on paper. You'll have to keep it up to date—sometimes within weeks from the first version. Your hunting may show you where you're hot (or cold), and resume revisions might make future contacts easier for you.

Handling the Prospective Buyer

Be brave! Don't undersell yourself or your ability. If you are qualified for the job, show just where and how. If you don't know the difference between a laser and a maser, don't fake the facts. It's not simply a question of ethics; it's plain common sense. Checking boxes on a card doesn't make up for little experience.

Be bold! Accentuate your strong points and your achievements. Tell what you have done (in some detail), and what you think you're capable of doing. Yet don't try to sell yourself into a job you can't handle.

Be big! As an engineer you'll stand out in the crowd by playing the gentleman at all times. Small courtesies cost little: polite replies to company queries pay off. If you have to inconvenience yourself to oblige a prospective employer, then do so. Nobody owes any of us a job!

Follow up any personal contacts—telephone calls or interviews—with a letter or short note within a

(*Continued on page* 236)

JOB HUNTING (Concluded)

few days. If after an interview you don't hear anything from the company for a couple of weeks, drop them a line to tell them you're still interested (if you are). Letters can still go astray in the mail. They won't mind your inquiry.

Remember that recruiting isn't a completely mechanical operation. Studies have shown that above certain levels (e.g., supervisors and senior engineers) test results on applicants are not weighed as heavily; personal impressions count much more. Hide your previous job problems—they'll come to light to your disadvantage; be enthusiastic and firm about yourself—your odds of success increase.

Happy Hunting!

Whether or not you are now on an employment safari these guidelines still apply. Many engineers have "found themselves" only because they "wanted out" or were laid off. When you have to write that first "situation wanted" ad you come close to understanding what the ancient Greek philosophers meant when they said that "wisdom consists in knowing oneself."

CIGAR SMOKE USED TO DEVELOP OPTIC SYSTEM

Martin Co. engineers used smoke from an oil-smoked cigar to trace intense light beams in developing an optical system to test space vehicles in high temperatures.

Exterior coatings of spacecraft models in a vacuum chamber will be tested on ability to absorb or reflect sun rays. The optical system converts a carbon arc light into parallel beams with the same content and intensity as sunlight.

In developing it, cigar smoke was used in a homemade mechanical smoker. Compressed air forced smoke out of a piece of aluminum tubing containing the lighted cigar. This made arc light patterns stark and clear on photos. Converging and diverging angles were measured. Variations were made on the optics to achieve collimation.

Chemical bombs, used during the first tests, were not used later because their smoke dissipates too readily. Cigar smoke has better staying power.

SATURNS WILL ORBIT METEOROID EXPERIMENTS

Two 4,000 lb. satellites carrying meteoroid experiments will be orbited by two Saturn C-1's (numbers 8 and 9). These will be secondary missions. Primary purpose of the first 10 Saturn launchings is to test the vehicle.

The meteoroid project has been assigned to the NASA-Marshall Space Flight Center, Huntsville, Ala. Twenty-eight firms have been asked to submit prime contract proposals to design and construct the satellite.

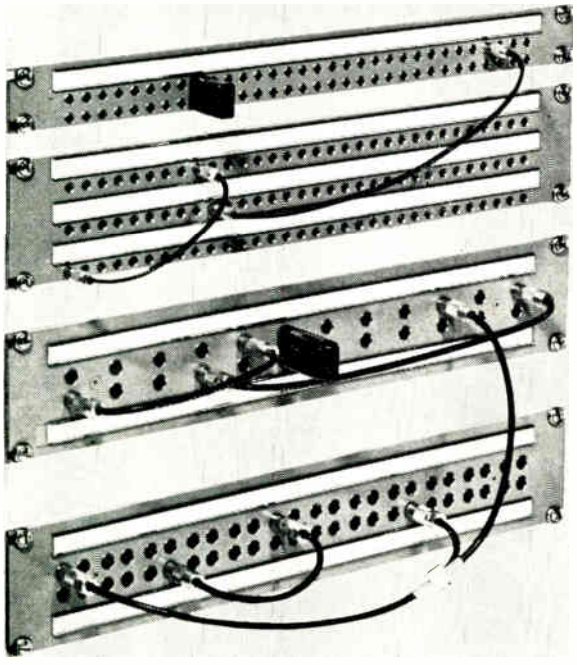
Smaller experiments aimed at detecting the size and density of these particles have been carried on by Explorer and Vanguard satellites. The new satellite, however, will have a 2,000 sq. ft. surface area. This will provide a much greater surface for investigations.

MICROWAVE CONSULTING FIRM OFFERS NEW SERVICES

Microwave Services International, Inc., Denville, N. J., has announced two new services. These are microwave interference coordination and microwave interference protection.

The first is an engineering consultative service designed to expedite FCC license applications. The second is a similar service on potential microwave interference problems.

QUALITY IN INTERCONNECTION



If you have requirements for patching and programming in coaxial cable systems, investigate the full Trompeter line of **standard and miniaturized** patch panels and accessories. These coaxial patching assemblies are available off-the-shelf for data, telemetry, computer, R.F., TV, nucleonics, and communications systems. Finely crafted, the standard 50- and 75-ohm cable systems (using RG-58, 59, 62, 8, 9, and 11), and the miniature RG-122 and Amphenol 21-597 systems, can be combined with compatible Trompeter accessories to make up the most complicated patch bays. Trompeter systems assure top performance and high reliability in interconnection techniques. Special configurations are available to custom order. Catalog sent upon request.

TROMPETER ELECTRONICS / 7238 Eton Avenue • Canoga Park • California • Telephone 346-1550

Circle 111 on Inquiry Card

Makes the Smallest Sound soooo BIG...

LEL SERIES TP Antenna Preamplifiers

TP-5

Whether you're talking to TelStar, directing satellite traffic or trying to set a new distance record for the cross-cosmos signal sprint... LEL's TP Series Preamps provide top-flight performance for amplifying signals at the antenna with 23db minimum gain and noise figures of 2 to 6db. Sun shields for outdoor use in tropical areas are optional. Self contained power supplies operate from 115V, 50-400 cps, 30 watts. Performance is comparable to that of parametric amplifiers in VHF systems.

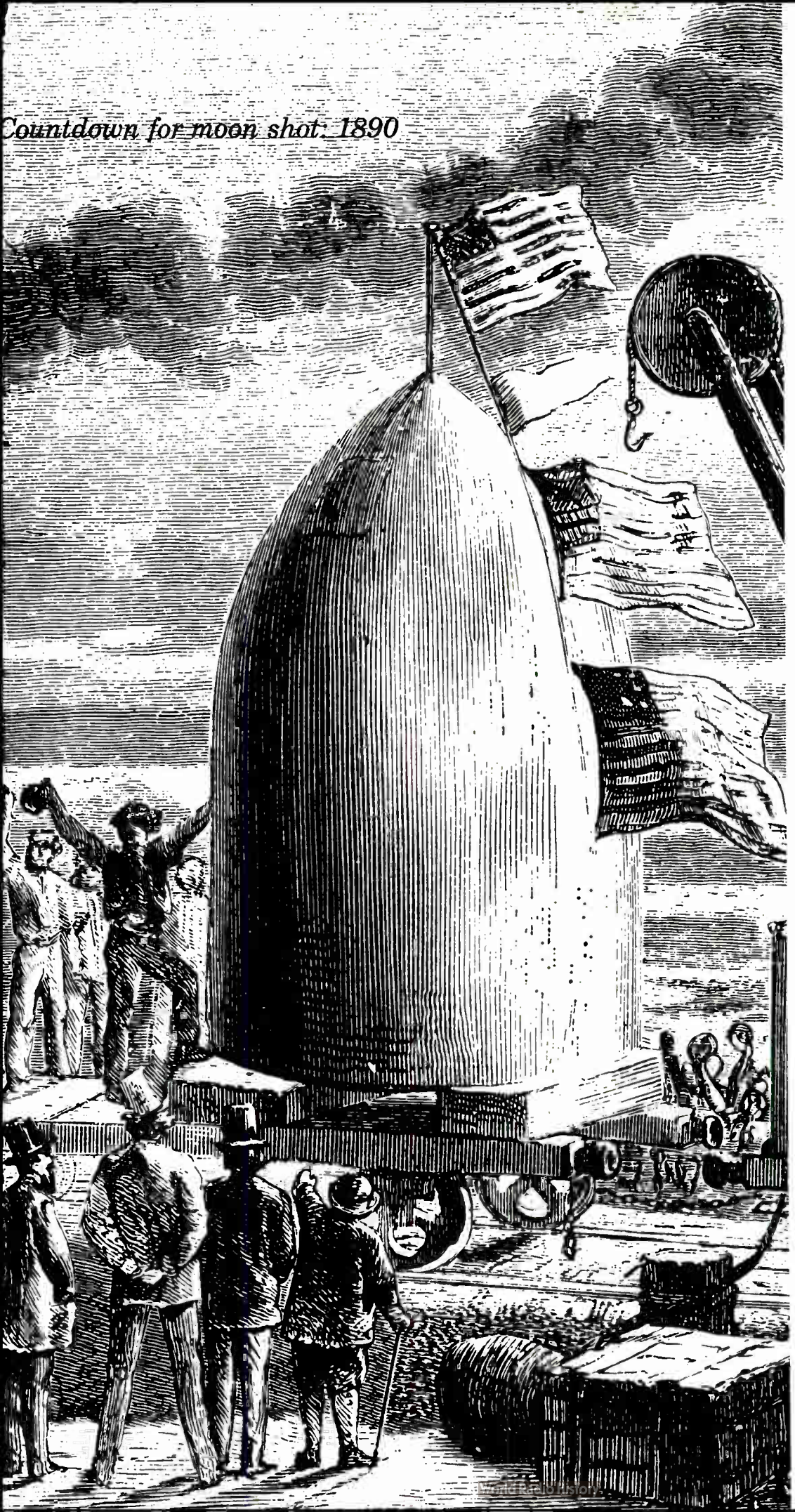
There's a specific model just right for the job of improving reception in Telemetry, Space Vehicle Communications, Range Extension for Air Communications.

Model	Freq. Range (Mc)	Bandpass (Mc)	N.F. (db)
TP-5	215-260 (Fixed)	45	<4
TP-6-136	136 (Fixed)	10	<2
TP-6-400	400 (Fixed)	10	<4
TP-7-108	108-162 (Fixed Tunable)	6	<2
TP-7-160	160-225 (Fixed Tunable)	6	2-3
TP-7-225	225-400 (Fixed Tunable)	6	2.5-4.5
TP-7-400	400-500 (Fixed Tunable)	6	4.5-6.5

Also available are high gain, fixed-tuned, rack mounted models TP-1P, TP-2P and TP-3P.

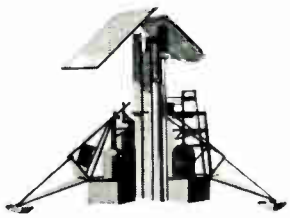
Send now for details ... be sure to inspect the TP Series and other quality LEL equipment at Booths 2106-B, the IEEE Show.

LEL INC. / 75 AKRON STREET, COPIAGUE, L. I., N. Y. (516) MYrtle 4-2200 (516) PYramid 9-8200



Finish the moon shot Jules Verne began 73 years ago!

Science fiction pioneer Jules Verne foresaw problems in hitting the moon. His fictional moonship missed its mark, after nearly colliding with a meteor.* Now, 73 years later, Hughes offers you the opportunity to be part of a real moon project.



Help us soft-land the SURVEYOR on the moon. Or work with us on other advanced projects such as: MMRBM (Mobile Mid-Range Ballistic Missile—Integration, Assembly & Checkout); TFX(N) Electronics; SYNCOM (synchronous-orbit communications satellite); BAMBI; VATE (versatile automatic test equipment)...and many others. Positions are open for senior and junior control engineers, circuit designers, electronic weapon systems analysts, mechanical engineers and infrared specialists, with degrees from an accredited university.

Please airmail your resume today to:

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Creating a new world with electronics

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An equal opportunity employer.

*In Verne's 1890 novel, "From the Earth to the Moon," his spaceship, "Columbiad," was launched from Tampa, Florida—just 120 miles from Cape Canaveral! After missing the moon, the craft returned to earth at 115,200 miles an hour. It plunged into the sea, popped to the surface—and the three men inside were found "playing at dominoes."

Bettman Archive

NORTH AMERICAN WILL DEVELOP SATURN S-2 STAGE

NASA has signed a detailed $319,922,328 contract with North American Aviation's Space & Information Div., Downey, Calif., to develop and produce the S-II stage of the Saturn C-5 rocket.

This is the largest single NASA contract ever awarded.

North American will produce nine live flight units, one inert flight stage and several ground test vehicles under the definitized contract, which carries through 1966. The company has been working on the project for a year under a preliminary contract.

The S-II is the second stage of the C-5 Apollo moon rocket. It will be 33 ft. in diam., 82 ft. long, powered by five J-2 hydrogen oxygen engines. The stage thrust will be 1 million lbs.

ITT UNIT DEVELOPS HEART-READING DEVICE

ITT Federal Labs., Nutley, N. J., has developed a new electrocardiogram device which uses a simplified CRT presentation. It is being tested by Lankenau Hospital Doctors in Philadelphia, Pa.

Electrical leads are attached to the body and 3-dimension (up-and-down, side-to-side, and front-to-back) electrical heart activity is represented on a CRT by a moving trace of light loops. Damaged or malfunctioning heart sections make very apparent changes in the loops.

This method has been used previously. But the physician formerly needed three separate CRT pictures to observe the heart movement. In the ITT device the 3-way movement is displayed at once in loops of different size and brightness.

FLA. ELECTRONIC FIRMS FORM ORGANIZATION

Florida electronic equipment manufacturers have formed an organization to strengthen the industry in the state.

The new electronics committee has decided on five goals: (1) Encouragement and support of technical education. (2) Improvement of the labor and industrial climate by attracting more support industries. (3) A legislative program in which the problems of the industry are coordinated with the problems of industry in general. (4) Establishment of liaison with other groups to make the electronic industry's viewpoint known. (5) Better coordination within the industry.

NEW COMPUTER CENTER

Three computers—a Honeywell 290 digital computer (inset) and 2 231R analog computers built by Electronic Assoc., Inc., will be used to simulate operation and control of complex industrial processes at Minneapolis-Honeywell's Pottstown, Pa., computer center. Honeywell will also rent center to industry and government for industrial control tests.

HONEYWELL COMPUTER SYSTEM HAS SILICON SEMICONDUCTORS

A low-cost control computer system with all-silicon semiconductors has been introduced by Minneapolis-Honeywell. The digital system is designed for industrial applications.

Called H610, the system costs $100,000 for minimum of computer, input multiplexer, analog-digital converter, readout and display equipment. A complete system, including primary sensors, final control elements and special programming, costs more.

The silicon semiconductors used can operate from 32° to 130°F., eliminating the need for system air conditioning. The computer has core memory expandable to 16,384 words, standard magnetic drum memory of 16,384 or 32,768 words expandable in multiples of 32,768 words.

SBA PUBLISHES QUALITY CONTROL GUIDE

Manufacturers that emphasize quality control do not find government requirements too exacting, says a new technical aid leaflet issued by the Small Business Administration.

The leaflet, "Inspection on Defense Contracts in Small Firms," can be obtained at SBA offices. It is intended to aid small manufacturers to meet government inspection norms.

ARMY TESTS RADAR PHOTOMAPPING DEVICE

An instrument which rectifies aerial radar photos so they can be used to make accurate maps is being tested by the Army. The U. S. Army Engineer Geodesy, Intelligence and Mapping Research & Development Agency is testing it at Ft. Belvoir, Va.

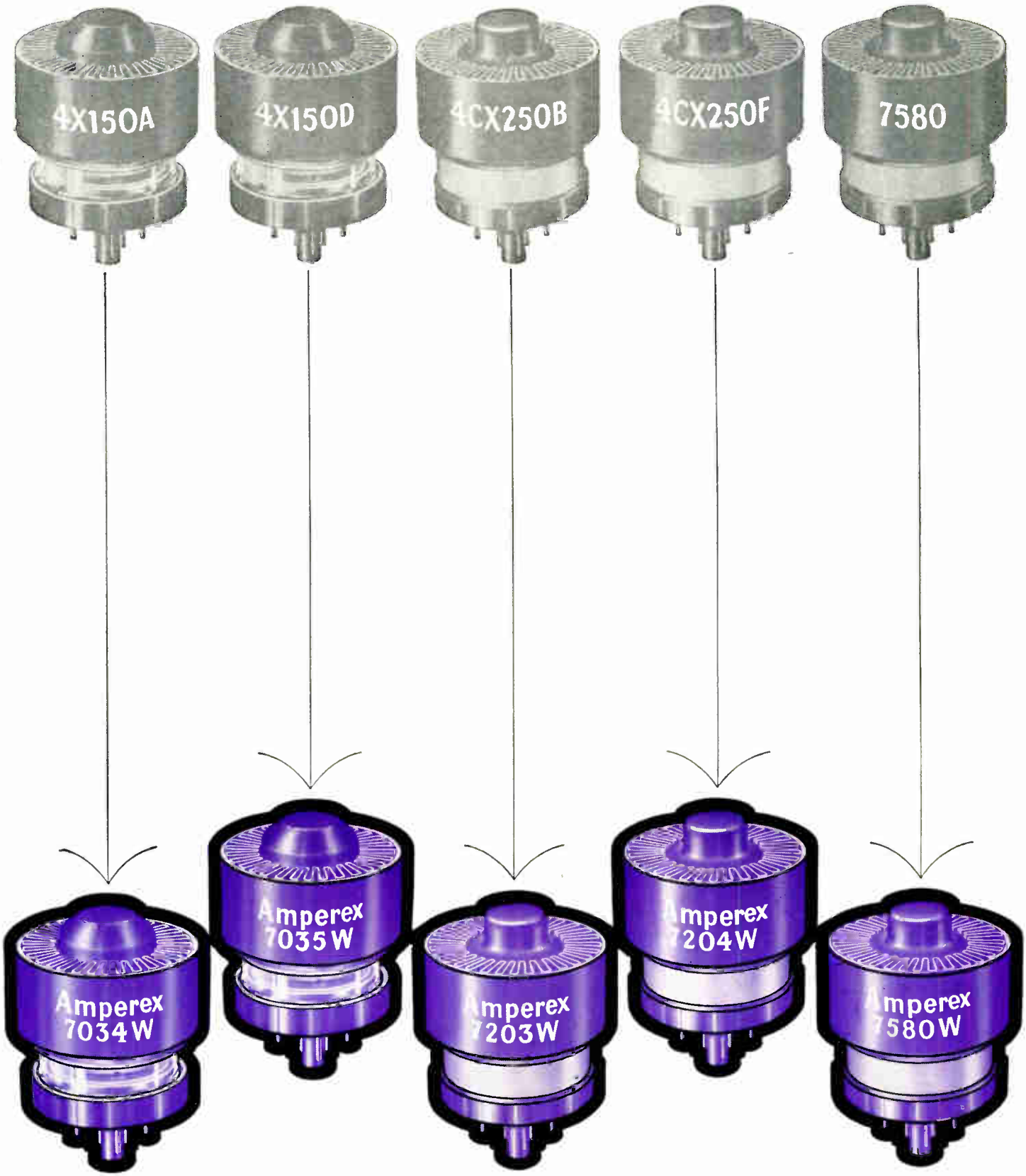
This instrument, called a "Side-Looking Radar Presentation Restitutor," is the principal part of a system including a viewing-measuring instrument and a computer.

Taped correction data from the computer is fed into the restitutor along with the original film. Corrections are to convert radar measurements from slant to ground range, to "adjust the flight path" because of navigational data, and to allow for systems distortions.

A new photo is taken by optical-mechanical means to correct the first photo and produce a geometrically correct PPI presentation. This new photo is suitable for planimetric mapping on a scale of 1:250,000.

The restitutor was built by Bulock Instrument Corp.

Amperex announces
5 new Ruggedized Tetrodes...
direct plug-in replacements for all standard prototypes, ruggedized or non-ruggedized, regardless of brand...and they are available at no premium in price.



7034W and 7035W are Ruggedized Glass/Metal Power Tetrodes, designed for use as a Wide-band RF Amplifier in class B Television Service; class C RF Oscillator/Amplifier; and class $AB_{1\ or\ 2}$ AF Amplifier/Modulator. Fil. Ratings: 7034W (6.0V, 2.6A). 7035W (26.5V, 0.56A). (MIL specifications in preparation.)

7203W and 7204W are Ruggedized Ceramic/Metal Power Tetrodes, for high reliability performance as UHF Frequency Multiplier, RF Pulse Amplifier, class C RF Amplifier/Oscillator or class AB_1 AF Amplifier/Modulator. Fil. Ratings: 7203W (6.0V, 2.6A). 7204W (26.5V. 0.56A). (MIL specifications in preparation.)

7580W is a Ruggedized Ceramic/Metal Power Tetrode, for SSB and other Linear RF Amplifier applications. (Available to specifications MIL-E-1/1385A [Navy].)

These Amperex Ruggedized Tetrodes are rated for full 250 watts plate dissipation in applications up to 500 Mc...and simultaneously meet the additional Amperex Ruggedization Specifications of 90 G Shock Test and 10 G Vibration Test (10-1000-10 cycles)!

Amperex ruggedization has been achieved without alteration of static or dynamic characteristics of the related tube prototypes or of their external physical dimensions. Input and Output capacities and heater ratings remain the same. That is why these Amperex Ruggedized Tetrodes are preferred for BOTH new equipment specifications as well as direct plug-in field replacements . . . and at no premium in price for ruggedization.

These five new ruggedized power tetrodes are now in production at the Amperex, Hicksville, Long Island plant . . . where advanced manufacturing techniques assure high reliability transmitting tubes in production supply. Write for detailed data today.

IN CANADA: PHILIPS ELECTRON DEVICES, LTD., TORONTO 17, ONTARIO.

Ask Amperex

Amperex Electronics Corporation, Tube Division, Hicksville, Long Island, New York

Circle 173 on Inquiry Card

IBM UNVEILS LOW-COST DATA PROCESSING SYSTEM

A new low-cost data processing system, featuring a major achievement in memory technology, was recently announced by I. B. M. Corp.

Called IBM 1440, the system features a disc storage drive unit with interchangeable packs of six magnetic memory discs. This provides virtually unlimited data storage capability. Random as well as sequential access to data on the 14-in. discs is provided. Each disc pack stores nearly 3,000,000 alphabet characters.

The minimum configuration of console with typewriter, central processing unit and card read-punch rents for $1,540 a month. With high-speed printer disc drive unit added, it rents for $2,600 a month, about 40% less than the average IBM 1401 system.

The system has a card read-punch unit which uses the solar cell principle to read information directly into the central computing unit. It can read 80-column IBM cards serially at up to 400 per min., punches them at from 80 to 160 columns per sec.

ELECTRONIC INDUSTRIES Advertisers – March 1963

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NEW FACSIMILE UNITS DEMONSTRATED

New xerographic remote copying or long distance facsimile equipment was recently demonstrated by Xerox Corp., Rochester, N. Y., marking the entry of the company into the field of electronics. The equipment is reported to be up to twenty-four times faster than most commercially available equipment.

The equipment, consisting of a transmitter and remote print-out receiver, is in the advanced stage of development and is being demonstrated to determine current market interest in high speed facsimile. Several additional experimental models will be built and field-tested.

EQUIPMENT, MATERIALS, PARTS & COMPONENTS

A modest proposal

In selecting a microwave signal generator, we urge you to ignore the "specification race". Give or take a split hair, each manufacturer's *performance* specification is conspicuous only by its similarity to the others. We say this despite the fact that many of our signal generators have led the pack in this frantic race for years.

The numbers game is fun to play, particularly when one is so often ahead, but we cannot, in good conscience, urge you to choose a Polarad Generator merely because it has a few megacycles more range, a wider choice of prfs, more linear frequency modulation, or even an intriguing and exclusive operational feature or two.

We propose, instead, that you go *beyond the specification* and ask: "How is this performance achieved? . . . How long will this instrument continue to perform within specification? . . . How much will it cost to maintain in perfect working order? . . . What percentage of the time will it be out of service for repair and recalibration?" Isn't each of these criteria at least as important as the performance specification? Of course it is. *You want and need to buy the instrument that is very well designed and very well built . . . not just very well specified.*

We say this: look beyond the specification, at the instrument itself. Examine the panel critically — but then take off the cover, and look inside. In a Polarad Generator, you will see:

- The highest quality components, generously derated. (You may be surprised at the distinguished labels that flunk this simple test!)
- The meticulous craftsmanship that is uniquely essential to precision and stability in microwave instrumentation (you'll find no "baling-wire" mechanics here!).
- Non-contacting-short cavity tuning, for complete freedom from noise, wear, and frequency skip or drift.
- Clean, modular layout, rugged construction, and an advanced thermo-mechanical design, ensuring rock-solid stability despite hard usage and repeated environmental stress. (Polarad Generators are the "*work-horses*" of the industry.)

It is no accident that Polarad is consistently selected to furnish microwave signal generators for the toughest, most reliability-conscious programs. We design them and build them so that the finished instrument is as impressive as the specification.

Call your Polarad Field Engineer today. Ask him to show you the quality of our instruments.

MODEL MSG-34
4.2 — 11.0 KMC. Accurately calibrated absolute power-level. Adjustable from 0 to −127 dbm from 1 MW.

MODEL	FREQUENCY KMC	CALIBRATED POWER OUTPUT	INTERNAL MODULATION
PMR	0.5 - 1.0	0.5 MW (−3 dbm) to −127 dbm	Ultra-linear FM modulation standard sq-wave, 25-10,000 pps (with optional plug-in pulse, 10-10,000 pps) in pulse modulator
PMX	4.45 - 11.0 (2 plug-ins)	1 MW (0 dbm) to −127 dbm	All instruments in this group: pulse modulation: 10-10,000 pps. *pulse width: 0.2-10 μsec. pulse delay: 2-2,000 μsec. square-wave modulation: 10-10,000 pps. FM deviation: ±2.5 MC min.
MSG-34 (Ultra Broadband)	4.2 - 11.0 digital freq. indicator	1 MW (0 dbm) to −127 dbm	
MSG-1R	0.95 - 2.40	1 MW (0 dbm) to −127 dbm	
MSG-2R	2.0 - 4.60	1 MW (0 dbm) to −127 dbm	*0.3-10 μsec. in MSG-1R and 2R.
KSS (Signal Source)	1.05 - 11.0 (4 plug-ins)	Uncalibrated Power Output: 14-400 MW, depending on freq.	sq-wave, 10-10,000 pps (external pulse, sq-wave FM)

HAVE YOU MADE RESERVATIONS YET?

Polarad's new "Project Mohammed" is now bringing the "Mountain" (our new Mobile Microwave Calibration Laboratory) to "Mohammed" (your microwave instruments). Be sure to take advantage of this opportunity to have your gear checked — at your doorstep. Save weeks of delay and needless expense. Call your Polarad field engineer for details and schedules!

POLARAD

Polarad Electronic Instruments
A Division of Polarad Electronics Corporation
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Circle 180 on Inquiry Card

EXTRA!

NEW "UNIVERSAL" TRANSISTOR RC… CU… UP TO… SILICON TRANSISTORS NOW ON THE MARKET

HERE NOW IN QUANTITY!

HIGH-PERFORMANCE, RELIABILITY-PROVED, TRIPLE DIFFUSED SILICON 2N2102 AND 2N2270 NOW AVAILABLE AT ECONOMY PRICES

RCA now announces new economy prices on the 2N2102, the "universal" triple-diffused planar silicon transistor designed for widest possible application in military and industrial equipment. It can replace up to 40% of all silicon transistors now on the market and will cover a vast majority of your Small-Signal and Medium-Power Applications.

The RCA 2N2102 features high switching speed, high pulsed beta (h_{FE}) at I_C = 1 amp, and controlled beta from I_C = 10μa to 1 ampere. It has high breakdown-voltage ratings, high dissipation ratings, low saturation voltages and low output capacitances.

RCA 2N2270, economy version of the RCA 2N2102, offers many of the features of the 2N2102 at substantial savings.

Call your RCA Representative today or write RCA Semiconductor and Materials Division, Commercial Engineering, Section IJ3, Somerville, N.J.

For Application information on RCA 2N2102, write for Application Note SMA-14, "The Design of Low-Level and RF Circuits Utilizing the RCA 2N2102".

For Reliability data on RCA 2N2102, call your local RCA Semiconductor Field Office. Your RCA Representative will discuss the latest reliability information with you.

AVAILABLE THROUGH YOUR RCA DISTRIBUTOR

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