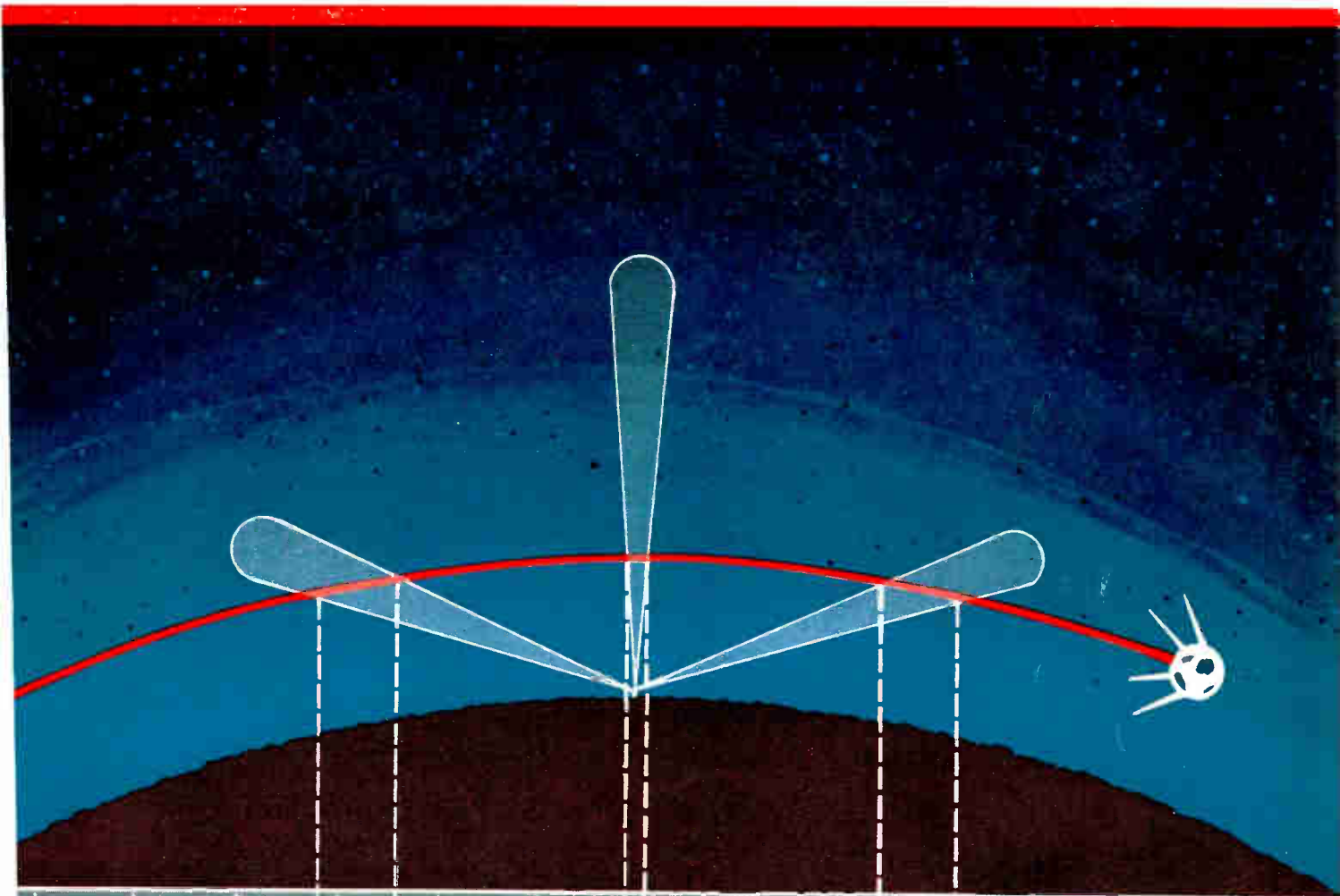
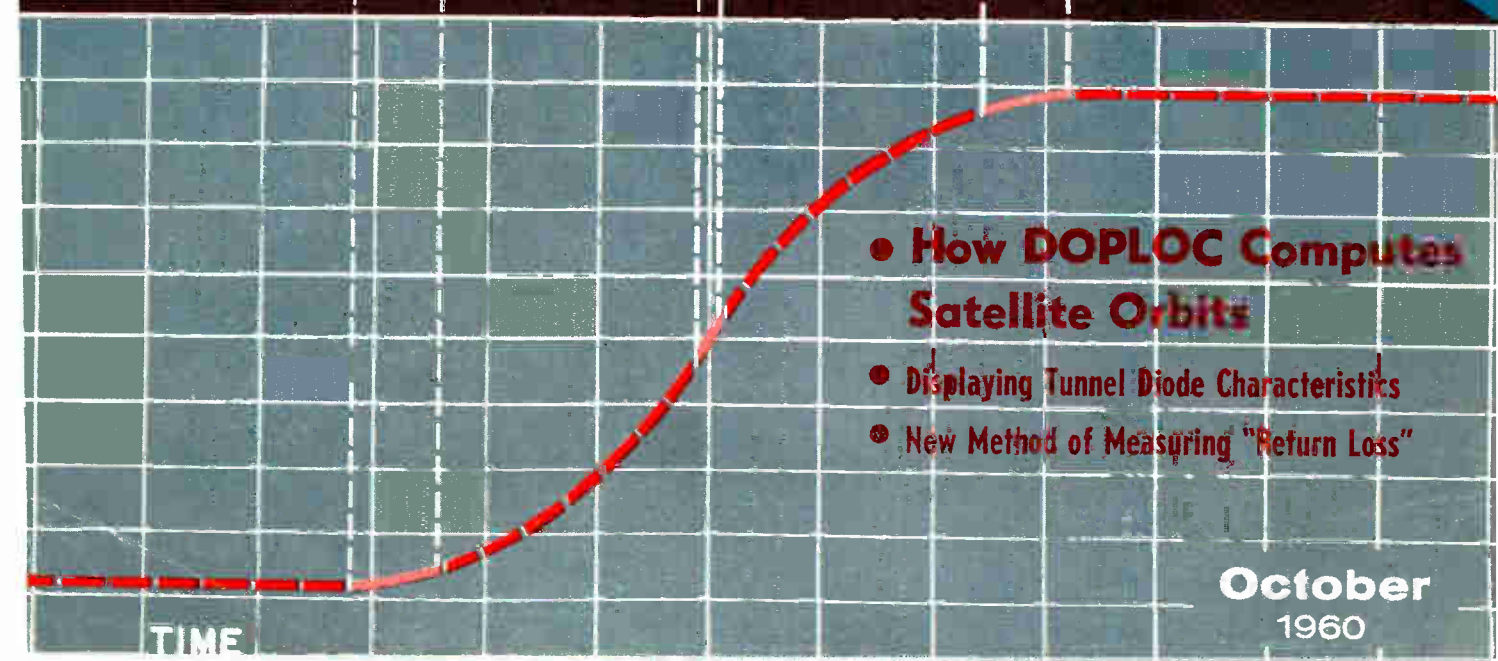
ELECTRONIC INDUSTRIES

A CHILTON PUBLICATION





- How DOPLOC Computes Satellite Orbits
- Displaying Tunnel Diode Characteristics
- New Method of Measuring "Return Loss"

October
1960

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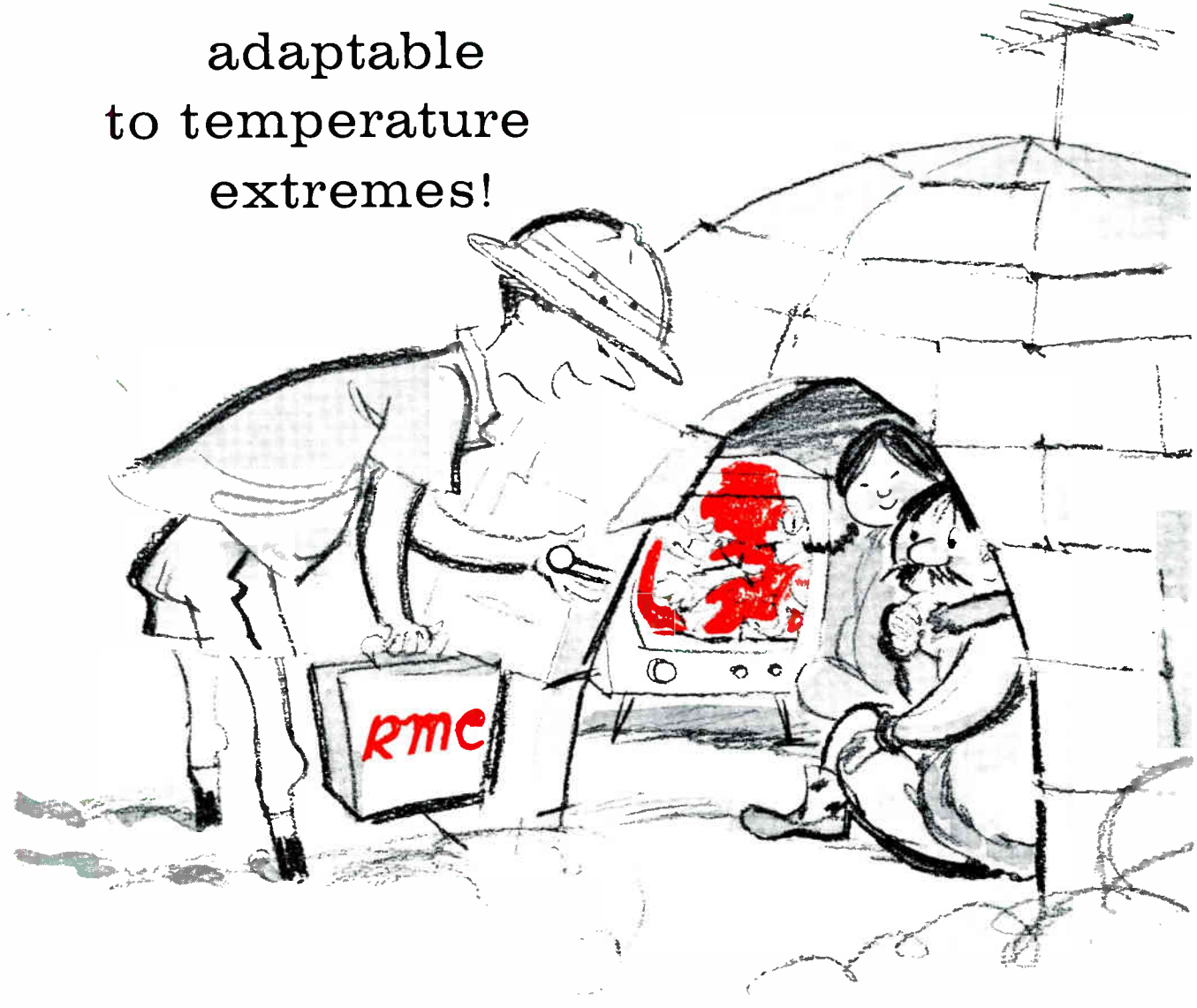
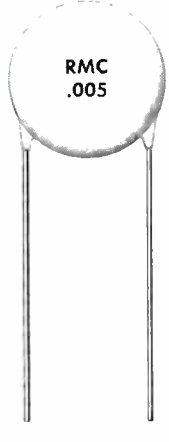
to temperature
extremes!





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ELECTRONIC INDUSTRIES

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

Surplus . . . And New Ideas

SOME heartening news!

Over the years there has been frequent reference to the huge annual surplus of U. S. agricultural commodities. The problem of how to use up these products effectively has defied solution. Now, however, we seem to have taken a hopeful forward step. The National Science Foundation and the U. S. Department of Commerce under the Israel Program for Scientific Translations, Jerusalem, has made its first delivery of Russian scientific and technical publications translated abroad.

The funds for this program accrue under the provisions of the Agricultural Trade Development and Assistance Act of 1954. Here countries purchasing U. S. Farm Surpluses pay in local currency which the U. S. is obligated to spend only in the country of purchase. By a 1958 amendment these currencies may be used to collect, collate, translate, abstract and disseminate scientific and technological information.

Projects are now under way in Israel, Poland, and Yugoslavia to produce translations of some 89,000 pages of foreign technical material. Of this, the Israeli program has contracted for translation and printing of approximately 50,000 pages of Russian material. In Poland a contract with the Central Institute for Scientific and Technical Documentation at Warsaw provides for 19,000 more pages of Polish scientific and technical literature. The contract with Yugoslavia is with the Directorate for Scientific Research of the Yugoslav Federal Council for approximately 20,000 pages.

In carrying out its functions under the program, the National Science Foundation assists participating governmental agencies in the selection of material to be translated. Included are the Departments of Agriculture, Interior, Health Education & Welfare Commerce; the Atomic Energy Commission, and the Smithsonian Institution. Final selection of material is made by Government scientists on the basis of needs of their agencies and the requirements of the scientific community. Translations are sold by the Office of Technical Services, U. S. Department of Commerce at about one cent a page. In cooperation with the Special Libraries Translations Center at John Crerar Library, Chicago, OTS publishes twice monthly "Technical Translations" to announce new translations available and in process (sold on subscription from Supt. of Documents, Government Printing Office, Washington 25, D. C.; $12 yearly domestic, $16 foreign.)

Initially, Serbo-Croatian scientific and technical literature will be translated. At a later date it is planned to include other East European languages.

We think the program should be expanded and permitted to grow even further. Having foreign technical information from all over the world available in the English language will certainly speed up the dissemination of such information in the U. S. It will also enable us to incorporate any new scientific ideas in our own technical design programs much more rapidly.

The world needs and can use our surplus, . . . and we have the know-how to effectively use its new technical ideas

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ELECTRONIC INDUSTRIES

Vol. 19, No. 10 October, 1960

MONTHLY NEWS ROUND-UP

Radarscope: What's Ahead for the Electronic Industries.... 4
As We Go To Press..... 7
Electronic Shorts 8
Coming Events 15
TOTALS: Late Marketing Statistics..... 19
Electronic Industries' News Briefs..... 20
Snapshots . . . of the Electronic Industries..... 22
International News 26
Next Month in Electronic Industries..... 69
Washington News Letter 181

Editorial: Surplus . . . And New Ideas! 1
Measuring Return Loss Accurately.....R. E. Lafferty 70
Displaying Tunnel Diode Curves...R. Crutchfield, Jr. & J. Thompson 74
With Double-Balanced Design, Mixer Circuit Has Clean Output
H. T. McAleer 76
DOPLOC Tracking Determines Orbit.....L. C. DeBey 78
Parametric Amplification by Junction Diodes....Dr. E. L. Steele 81
What's New 84
The FCC Controls Man-Made RFI.....E. W. Allen & H. Garlan 86
Calculate Impedance by Inspection.....L. Kedson 93
Connector Problems . . . Reliability & the Printed Circuit (Part 2).....D. R. Sheriff 94
A New Field-Effect Device . . . The Alcatron..Dr. A. V. J. Martin 98
NEREM—Northeast Research & Engineering Meeting Opens Nov. 15 102
International Electronic Sources..... 183
Electronic Operations 193
Assessing Maintainability...J. M. McKendry, G. Grant & J. F. Corso 194
Build a Transistor Frequency Meter..... F. R. Bretemps & S. Saito 196
Professional Opportunities 215
Improve Your Talk With Demonstrations.....R. C. Wonson 218

NEW PRODUCTS & TECH DATA

New Tech Data for Engineers..... 106
New Products 114

DEPARTMENTS

Tele-Tips 36
Letters 45
Books 52
Systems-Wise 193
Cues for Broadcasters 200
News of Mfrs. Representatives 226
Industry News 228
Personals 231

Highlights of this issue

Measuring Return Loss Accurately page 70

Money and space used to be required for accurate return loss measurements. Now, with an n-f voltmeter and bridge, or directional coupler, they can be made directly in db. The simple technique described permits measuring 55 db of return loss . . . equivalent to a VSWR of 1.004.

How to . . . Display Tunnel Diode Curves page 74

Since a tunnel diode is a negative resistance device, it is easy to operate as a relaxation oscillator. Using the simple circuit described herein, an ordinary oscilloscope can trace the complete characteristic curve—including the negative resistance region.

Mixer Circuit Has Clean Output page 76

A double-balanced mixer circuit is desirable for many communications and measurement systems. The balanced system, when properly designed, will eliminate the input signal and local oscillator from the output.

DOPLOC Tracking Determines Orbit page 78

Data from a single pass of the satellite near a DOPLOC tracking system are sufficient for orbit computation. The entire process takes 30 minutes. Other systems require hours, days or weeks of data collection before a computer can even be fed the information. Further: DOPLOC can do it on the first pass.

Parametric Amplification by Junction Diodes page 81

Though the principle of parametric amplification is not new, it was not feasible until recently to use voltage dependent variable capacitive elements as microwave amplifiers. Diodes with high Q, low loss, and low noise now make application at high frequencies a natural evolution.

The FCC Controls Man-Made RFI page 86

The FCC is the official U. S. agency responsible for controlling RFI that disturbs reception. How this is accomplished, enforcement procedures, and what is actually regulated are given in detail plus some of the problems.

How to . . . Calculate Impedance by Inspection page 93

The impedance of a complicated combination of resistors, inductors, and capacitors may often be calculated by inspection. Certain recurring circuit combinations and a few simple rules make this possible.

A New Field-Effect Device . . . The Alcatron page 98

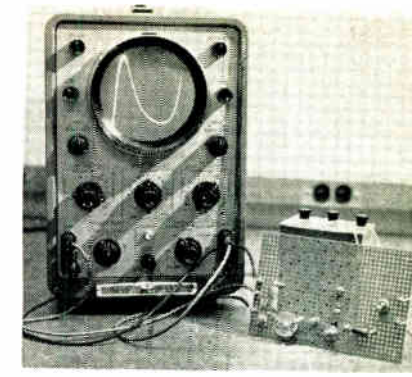
The field-effect in semiconductors originated with Shockley and his unipolar transistor. A commercial application of this principle is the tecnetron. A new device, the alcatron, makes use of the technology gained from these two devices. It holds promise of sizable power at high frequencies.

Assessing Maintainability page 194

The cost of equipment maintenance usually greatly exceeds the initial equipment cost. With the suggestions made here, it is possible to reduce maintenance costs by 50%.

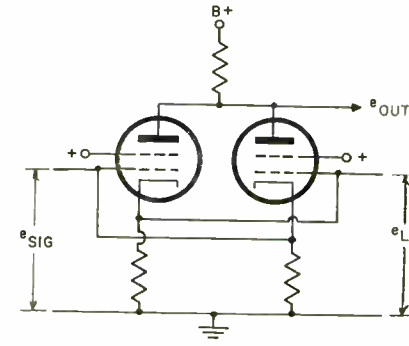
How to build . . . A Transistor Frequency Meter page 196

Providing a usable frequency range from 20 KC to 70 MC, this portable meter is ideal for checking laboratory signal generators.

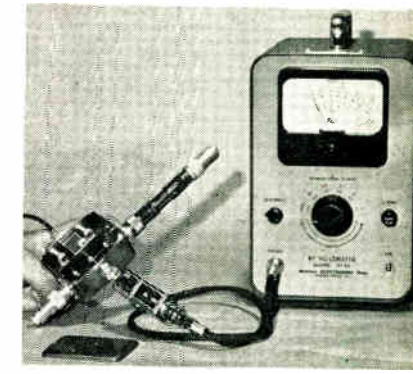


Tunnel Diode Curves

Controlling Man-Made RFI

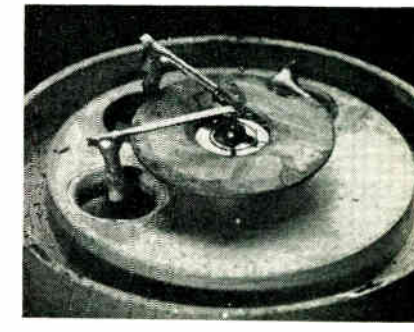


Mixer Circuit



Measuring Return Loss

The Alcatron



RADARSCOPE

NEW LIGHT PANEL

RCA engineer G. Gadbois submerges an RCA electroluminescent panel in a tank of water to test brightness under extreme weather conditions. Flat, glare-free light panels have low power consumption and long life. They are manufactured in five colors.

DEPT. OF DEFENSE is considering a plan to make one of the three services responsible for all purchasing of electronic replacement parts.

JAPANESE OUTPUT of electronic products in the first quarter of this year totalled $282.1-million, up 53% from the same period of 1959. Semiconductors showed the greatest percentage increase—67%.

PROPRIETARY RIGHTS of small business men dealing with the government are getting a lot of attention in Washington. At issue is the government practice of forcing contractors to divulge manufacturing or design secrets. For some manufacturers this know-how is the only protection against competitors; in many cases it is his only means for survival.

UNDERGROUND RADIO was demonstrated last month near Carlsbad, New Mexico, and shows great promise as an emergency communication system in case of nuclear attack. The "Lithocom" transmission was between units located 1,000 ft. down in mine shafts 4½ mi. apart. The medium was a deep-lying sub-strata. Noiselevels were reportedly very low.

INFRARED DETECTORS soon will be able to pick up radiation in the range of 25 microns. Philco's Lansdale Division has developed a technique for sealing germanium windows to IR detectors, greatly extending their abilities in the longer wavelength region. Silicon and sapphire windows limit transmission to 9 and 6 microns.

LOW-POWER 'SCATTER system designed by G.E. uses an antenna screen only 4 ft. wide and 8 ft. high. Called "Thin Route Tropo," it employs relatively narrow bandwidth—500 cps—in transmitting digital information. On a Washington, D. C.—Lynchburg, Va., 152 mi. long test circuit TRT has maintained a 99.9% reliability figure in transmitting teletype signals, using a 175-watt transmitter.

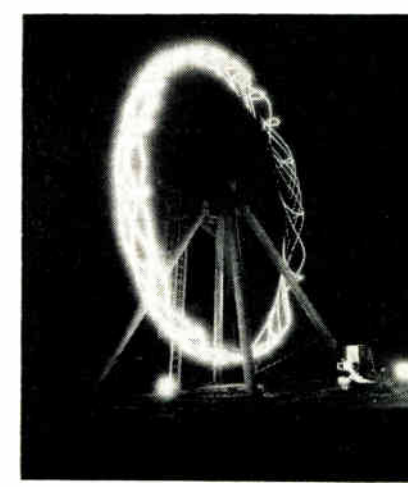
MICROWAVE may be the answer to the oil industry's problem of releasing trapped oil reserves jellied in rock thousands of feet beneath the earth's surface. Raytheon is working on a microwave heater—to generate 5,000 to 10,000 watts of power—that will heat the molasses-like oil around the well bore. Petroleum engineers estimate that in these now inaccessible sources there is seven times the amount of oil that is economically recoverable at this time.

RUSSIAN TECHNICAL ARTICLES are now being translated overseas, financed by overseas sales of surplus U. S. agricultural commodities. The first translations were delivered last month. They were prepared by the Israel Program for Scientific Translations, Jerusalem, under contract to the National Science Foundation.

IMPORTED TRANSISTOR RADIOS will probably go up in price—$1 to $3—before Christmas. There is less "dumping" by overstocked importers since Japan clamped a quota on the number of sets. Most of the radios coming in from now on will be through established importers.

SPACE AGE FERRIS WHEEL

Missile component test boom makes a striking night-time pattern as it revolves on the radar range at the Engineering and Research Center at Ford's Aeroneutronic Div., Newport Beach, Calif.



PARAMETRIC MODE TRANSISTOR developed by Hughes Aircraft Co. has reportedly produced nearly 4 KMC at 10% efficiency. Even higher frequency ranges are predicted by the designer, Hughes' physicist Rainier Zuleeg—eventually up to 10 KMC. The special circuit, designed by Lenkurt's Dr. Vladimir W. Vodicka, extends the performance of transistors so that they develop useful gain considerably beyond their normal cutoff frequency.

GOVERNMENT'S ANSWER to the FFC's request for additional frequencies between 222 and 450 MC for TV use was a firm "No." DOD said that moving military communications to another part of the band would mean an expenditure of $5 billion for U. S. military operations alone. NATO and SEATO communications would also face severe expenses. Military operational readiness considerations" make it impossible to consider the move at this time, said DOD.

R&D FIRMS working on government contracts can now lease the equipment necessary for carrying out the work. Nationwide Leasing Co. will lease environmental test equipment, machine tools, electronic gear, laboratory equipment, etc. for terms of from three to five years. Leases may range from $25,000 to $1 million or more, but the cost of the equipment to be leased cannot be more than one-third of the company's net worth. More details on the plan can be obtained from the R&D Dept., Nationwide Leasing Co., 11 South LaSalle St., Chicago 3, Ill.

SYNTHETIC DIAMONDS for possible use in electronic systems of rockets and other high temperature applications have been made by Army scientists from common graphite. Synthetic diamonds were discovered as part of the development program seeking new electronic materials. Pellets of graphite about 3/16th of an inch in diameter were placed in a bore of a pressable heat resistant metal cylinder and subjected to 1,250,000 psi with temperatures up to 3000°F.

AIR TRAFFIC CONTROL will be extended during the next 10 years into the fringes of space, says Franklin Dermott, Executive Director of the Air Traffic Control Assoc. (ATCA). Among the other advances he visualizes are: improvements in air to ground or pilot/controller communications, automation of many routine communications, reduction in the amount of voice transmission, increasing helicopter traffic, and using parallel runways simultaneously under any weather conditions. He looks for a continued expansion of air traffic at approximately 50% per year during the next decade. The most challenging problem he sees in air traffic control is that of data handling—a job that controllers estimate consumes as high as 50% of their time.

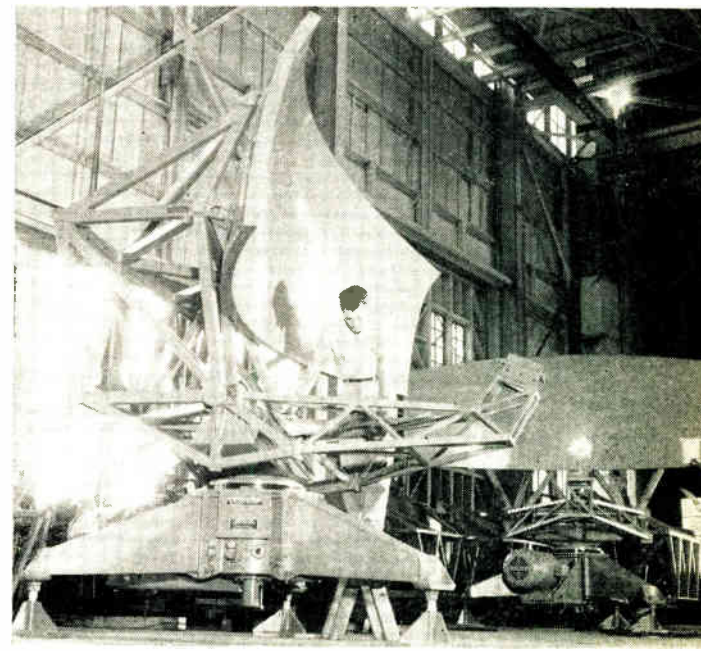
GRADUATE RESEARCH facilities in the country's colleges and universities were awarded more than $2 million last year by the National Science Foundation. Fifty-four colleges and universities shared in the grants.

JAPAN-MADE VIDEO TAPE is now being readied for the Japanese market. TDK Electronics Co. of Tokyo is now launching a mass production of video tapes, as a result of tests made on their product by the Japanese Broadcasting Corp. The test showed that the TDK product was not inferior to those made of foreign equipments—predominately U. S. TDK officials say that the American product now practically monopolizes the Japanese market. As of now some 40 video tape recorders imported from foreign countries are in operation in Japan.

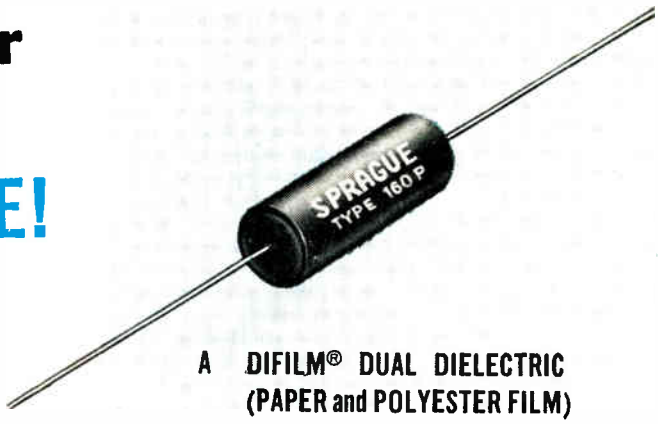
RADIO AND TV RECEPTION will be more completely protected against automotive electrical interference as a result of a new cooperative action by motor vehicle producers. Established practices of shielding have largely solved interference problems in ordinary low frequency radio equipment, but the growth of high frequency broadcasting has created a need for a more thorough suppression. New standards have been established by the Society of Automotive Engineers, and the Automobile Manufacturers Association is urging all auto makers to launch a concerted effort to suppress interference producing radiation in all their vehicles.

AIRPORT SCANNER

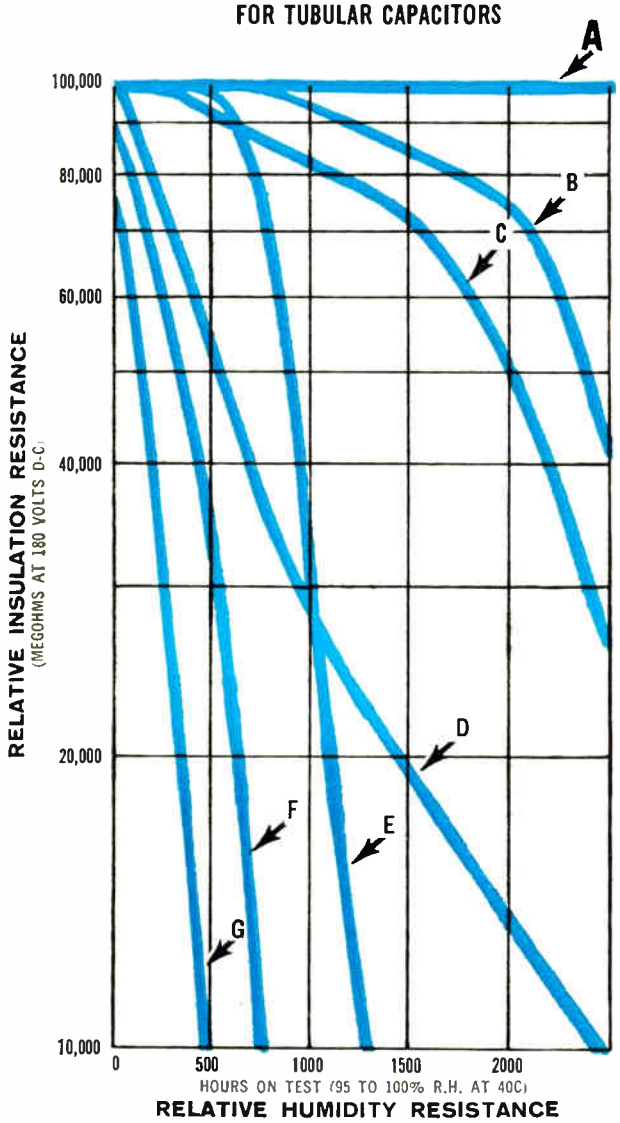
First production antennas for new airport taxi radar system developed by Airborne Instruments Lab., div. of Cutler-Hammer, Inc., are going through final inspection at Goodyear Aircraft, Akron, Ohio.



See What Tubular Capacitor leads all others in MOISTURE RESISTANCE!



MOISTURE RESISTANCE COMPARISON CHART
FOR TUBULAR CAPACITORS



A DIFILM® DUAL DIELECTRIC (PAPER and POLYESTER FILM) with HCX® solid impregnant and molded phenolic case

B PAPER DIELECTRIC with HCX solid impregnant and molded phenolic case

C DIFILM DUAL DIELECTRIC (PAPER and POLYESTER FILM) with HCX solid impregnant and dipped epoxy resin coating

D PAPER DIELECTRIC with wax or oil impregnant and molded phenolic case

E POLYESTER FILM DIELECTRIC with molded case

F PAPER DIELECTRIC with HCX solid impregnant and waxed cardboard jacket

G PAPER DIELECTRIC with wax or oil impregnant and waxed cardboard jacket

The graph tells the story simply and to the point!

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As We Go To Press...

EIA Told, "Japs Threat To All U.S. Electronics"

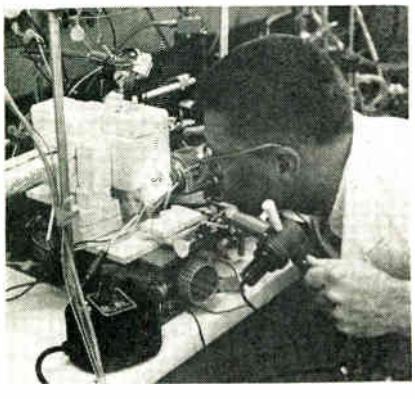
Last year's flood of Japanese transistorized radio imports is but the "initial onslaught" of domestic markets which will be felt by every segment of the U. S. electronics industry, Mark Shepherd, Jr., a vice president of Texas Instruments Inc., told a session of the Electronic Industries Association.

Mr. Shepherd, a member of the EIA Electronic Imports Committee, warned against taking an optimistic view because the Japanese have slackened their efforts in the U. S. market. The Japanese still retain a large portion of the U. S. transistor radio business following their capture of more than 50% of the American market in 1959, Mr. Shepherd declared, and added, "As I see it, the present period is nothing more or less than a short and shallow breathing spell for the U. S. industry."

The Japanese drive for new export markets, Mr. Shepherd said, is being stimulated by near-saturation of the home market for radios and difficulties of pricing television receivers within the reach of Japanese wage earners.

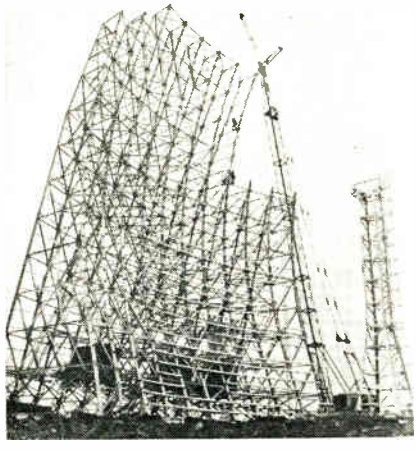
Export of television receivers to this country, already underway, offers the Japanese "their most immediate hope of escape" from domestic marketing problems, he stated. Color and portable television sets particularly, he predicted, will be merchandised in the U. S. "in the most aggressive manner."

"GROWING" COMPONENTS



Semiconductor crystal position inside furnace during vapor growth process is checked by IBM research scientist, H. S. Ingham. Iodide vapors pick up semiconductor material at high temp., then move into cooler part of tube where semiconductor "grows" from vapor onto a single crystal seed.

RADAR DEFENSE SYSTEM



Prototype structure near Harmarville, Pa., is 120-ft. diam. tropospheric scatter parabolic communication antenna, being checked before shipment to U. S. DEW line System. Blaw-Knox Co., Pittsburgh, Pa., has building sub-contract with Western Electric Co., Inc., Prime Contractor for new Eastern extension of DEW line, and rearward communications system of USAF's BMEWS.

New IR Sniperscope Developed For Army

A new lightweight T-1 Infrared Sniperscope designed to fit virtually any individual weapon used by front-line troops, has been developed for the Army Engineer Research & Development Lab., Ft. Belvoir, Va. by the Raytheon Co., Waltham, Mass.

Weighing but 13 lbs, it hooks onto a rifleman's cartridge belt. Its gunsight shows a target image twice as large as the World War II version, allowing more positive identification of the enemy and easier detection of enemy camouflage attempts.

A central infrared searchlight sprays the target image with infrared energy. Reflected heat waves are then projected on the detector's screen by an infrared-sensitized image tube.

"Aerospace" Replacing Aeronautical in IAS

Council of the Institute of the Aeronautical Sciences, on a resolution proposed by the combined IAS Regional Advisory Committees, voted unanimously to submit to its members for approval the word "Aerospace" as a substitute for "Aeronautical" which has been in its official title since 1932.

Military Electronics Growth To Slow Down

Manufacturers of military electronic equipment no longer can expect the phenomenal yearly market expansions which have prevailed since the Korean war.

This is the conclusion of EIA's Military Marketing Data Committee, based on a survey of opinion among the more than 50 military marketing experts comprising the committee's membership.

Since the end of the Korean war, military electronic equipment demand has risen from 15 to 25% yearly. The rate of increase has begun to level off, the committee said, and for the next 5 to 10 years can be expected to run between 8 and 10% annually.

The slow-down could be attributed to reductions in expenditures for military aircraft, the fact that the nation's principal air defense systems are nearing completion, and abandonment by the military of the practice of introducing many new weapons to concentrate on a relatively few major systems. Forty-six major missile systems, the committee pointed out, have been canceled in the last 10 years.

The period of "stability" in the military electronics market, the committee said, will give the industry an opportunity to apply its military equipment experience to the development of new products for civilian markets.

SMALLER THAN EYELASH

New Micro-miniature resistors, rated at 1/16 watt with resistance values at 100K at 15% tolerance, measure only 0.125 in. length and 0.020 in. diameter. Manufacturer is Wilrite Products, Inc., Cleveland.

MORE NEWS
on Page 8

Electronic SHORTS

▸ Lockheed Aircraft Corp. (Sunnyvale, Calif.) engineers see the cost of solar cells dropping to about $300 per watt, and the "practical" efficiency of these cells at about 15%. But papers presented at the recent AIEE Pacific General Meeting indicate that new fabricating and processing techniques make the theoretical efficiency of 19.6% possible.

▸ ARPA (Advanced Research Projects Agency) has awarded an additional $1,000,000 for LASER development to TRG, Inc., Somerville, Massachusetts and Syosset, N. Y. LASERS (Light Amplification by Stimulated Emission of Radiation) operate in the optical frequency range on principles similar to microwave MASERS. (See "LASER—Coherent Light Source," Electronic Industries, Vol. 19, No. 8, pp. 88, August 1960.)

▸ The Ultrasonic Manufacturers Assoc. expects to have acceptable standards on ultrasonic cleaning and ultrasonic transducers by the end of the year. The cleaning committee is working on standards for measuring the intensity of cavitational energy and the committee on transducers on standards for the use of transducers for both power and instruments.

▸ The Federal Aviation Agency is installing advanced radars in over 34 airports. The new ASR-9, Airport Surveillance radars have a range of 60 mi., reach to 25,000 ft., and will increase FAA capability in handling air traffic, particularly high speed jets. Texas Instruments Incorporated is building and installing the equipment.

▸ California Computer Products, Inc., Downey, Calif., has built a complete digital data-processing system without using a soldering iron. They did this by using Junction Cells, gold-plated brass eyelets with flexible rubber cores. Each cell can grip up to 6 leads—connections have essentially zero resistance. Plastic Assoc., Laguna Beach, Calif., supplies the cells.

▸ Federal Radiation Council's do-it-yourself provision allowing each Federal Agency in Atomic work to set its own radiation standards without FRC review and approval, will be re-examined by President Eisenhower. The Council was originally supposed to set the radiation standards for all agencies.

▸ NASA has asked for Industry's help in designing a maneuverable three-man spaceship to fly around the moon and back. A "bidders" conference was held recently at Langley Field, Va., to discuss design study contracts. Up to three $300,000 contracts are planned. Construction is planned for 1962-65. It will operate in space for several weeks at a time under complete control of its crew.

▸ TelAutograph Corp. and Comptometer Corp. have each introduced systems that provide instantaneous transmission of oral and handwritten messages over a single dial telephone circuit. Transmission uses AT&T's Dataphone, which permits switching from talking to writing over the same dial phone circuit.

▸ RCA's Dr. V. K. Zworykin proposes a network of electronic data storage centers for storing individual health records. These would provide patients and doctors with a high-speed source of diagnostic aid. The population would regularly fill out questionnaires which would be checked against their previous records. Individuals would be notified when they need a doctor's help. One storage center, with today's capability, could maintain files on 20 million people.

▸ An automatic factory control system records instantaneously and simultaneously units produced and production time of as many as thirty different machines. It also records breakdowns and pinpoints their causes. It pre-programs possible causes of breakdowns electronically. The complete system, twenty machines, uses punched cards, tape, computers, and telephone hook-ups. Farrington Mfg. Co., has the American rights to the German system called Productograph.

▸ The antennae on Discoverer XIII used a combination of teflon and ceramic fibers which could ablate (wear away) uniformly under the tremendous speeds, pressures and temperature changes encountered during orbit and when the satellite enters and leaves the earth's atmosphere. Rogers Corp., Rogers, Conn., supplied the material.

As We Go To Press . . .

Philco Produces Automated Transistor

Philco Corp's Lansdale Div. has introduced a new switching transistor — the 2N769 MADT (Micro-alloy diffused base) featuring an 800 MC gain bandwidth, low hole storage factor and low emitter and collector diode capacities.

The new PNP germanium units are intended for saturated switching circuits at switching rates up to 300 MC. Housed in TO-18 cases, the new 2N769 transistors are being produced on Philco's Fast Automatic Transfer Lines with an active semiconductor emitter area scaled down to 2.8 mils and a wire dia. of 1 mil, compared to 5½ mils and 2 mils of earlier devices

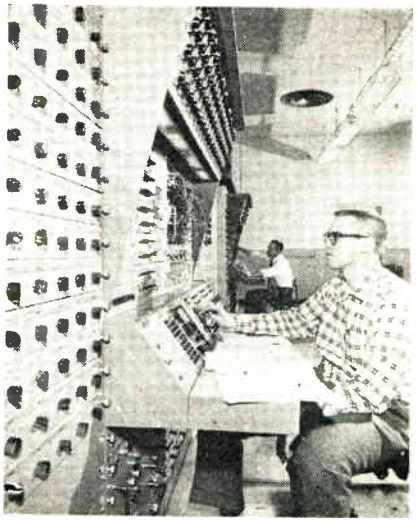
NAB Policy Group EngineeringCommittees

The Engineering Advisory Committee and the Broadcast Engineering Conference Committee have been appointed by the Policy Committee of the National Association of Broadcasters for 1960-61

The former appointed committee provides advice and assistance to NAB's Board of Directors and the NAB staff of broadcast engineering matters concerning the industry.

The latter appointed committee makes plans for the annual engineering conference, which is held as part of the Annual NAB Conference.

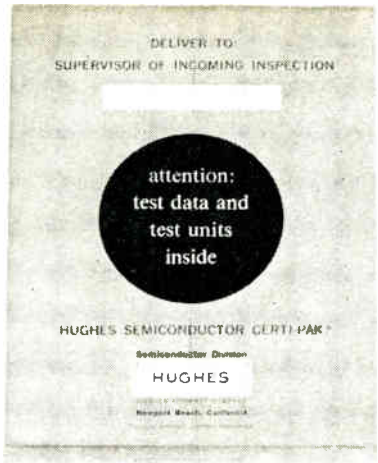
PROBLEM-SOLVING "PACE"



At Boeing's Wichita, Kan., Div. four Precision Analog Computing Eqpt. (PACE) 231-R's solve engineering problems in Time History and Parameter Variation for application to the B-52 missile bombers.

Exclusive Certified Test Data Correlation Program from Hughes Semiconductors

New Certi-Pak* gives you simple, easy device evaluation



Hughes' unique Certified Test Data Correlation Program gives you quick, easy assurance that the devices you specify from Hughes meet or exceed the parameters you require. This new service is provided absolutely free with quantity orders of Hughes Semiconductors.

Here's the way it works: when your order is readied for shipment, several units are selected *at random*—and carefully checked by the Hughes Quality Assurance Department for your specific requirements. The random sample is then tagged and the test results are entered on the Certified Test Data Correlation Form: actual *proof* that your units were thoroughly tested immediately before they were shipped to you.

When you receive your shipment, you'll find the Hughes CERTI-PAK containing the correlated test samples and the test data inside, appropriately marked. In the CERTI-PAK you'll also get a blank reporting form marked "Customer Results." After you complete your own tests, enter your data findings and correlate them with the Hughes original report.

The facilities of the Hughes field sales force and the plant at Newport Beach are readily available to you.

Hughes, of course, scrupulously tests every unit before it is approved for sale. But the unique Hughes Certified Test Data Correlation Program gives you benefits far beyond this. It saves time and money in lengthy tests and costly reshipments. It tells you at a glance that Hughes has tested your device to your specific requirements. And most of all, it gives you proven assurance that Hughes is making every effort to provide you with a product of quality.

For more information about this new service to you, contact Hughes Semiconductor Division, Marketing Department, 500 Superior Avenue, Newport Beach, California.

*HUGHES TRADEMARK

Creating a new world with ELECTRONICS

HUGHES

SEMICONDUCTOR DIVISION
HUGHES AIRCRAFT COMPANY

Circle 3 on Inquiry Card

Now for the first time—a single source of supply for CONTOUR* cable, connectors and custom engineered inter-connection and harness systems

Hughes offers a complete line of continuous and etched CONTOUR cable and connector components—off-the-shelf and custom engineered. They are designed to meet the most rigid performance requirements. Their use offers marked advantages over conventional methods in fabricating all types of wiring harnesses, interconnecting cables, moving joint connectors, and relay rack drawer connections. For technical assistance in the application of these components to your interconnecting and wiring problems; for literature, price or delivery information, write, teletype (TWX INGL 4117) or call collect: **HUGHES Industrial Systems Division,** P.O. Box 90904, International Airport Station, Los Angeles 45, California. For export information, write: HUGHES International Culver City, California

*Trademark of Hughes Aircraft Company

CREATING A NEW WORLD WITH ELECTRONICS

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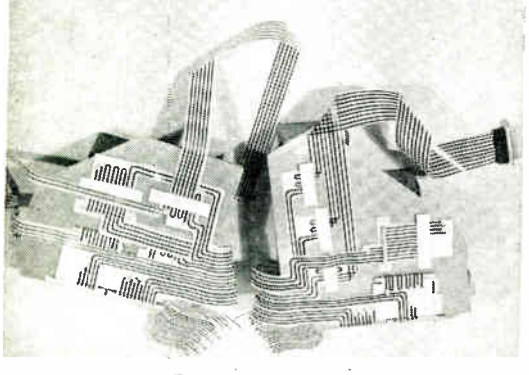
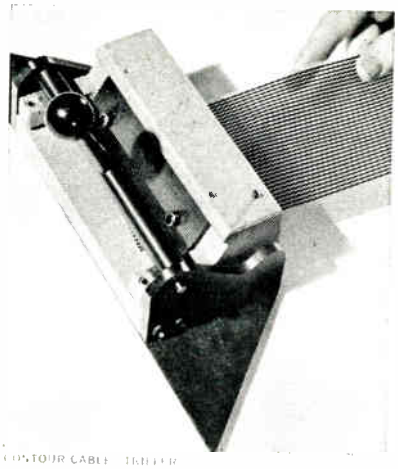
HUGHES AIRCRAFT COMPANY



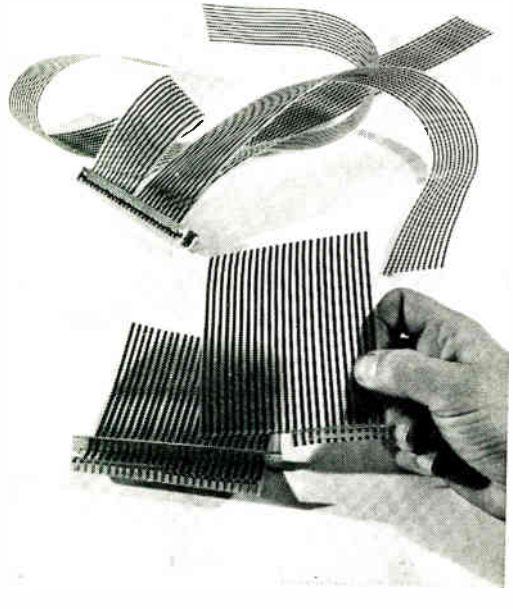
DOUBLE CONTACT ETCHED CIRCUIT
CONTOUR CABLE CONNECTION

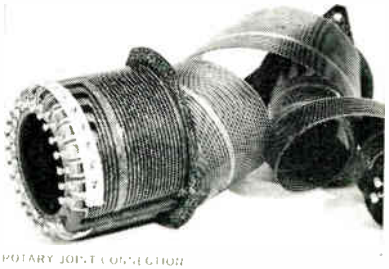
CONTOUR CABLE WIRING HARNESS



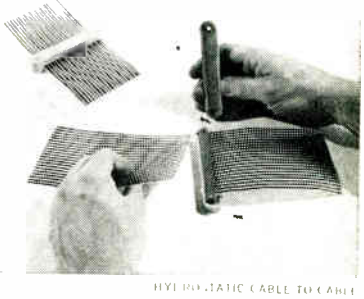
CONTOUR CABLE TESTER

CONTOUR CABLE



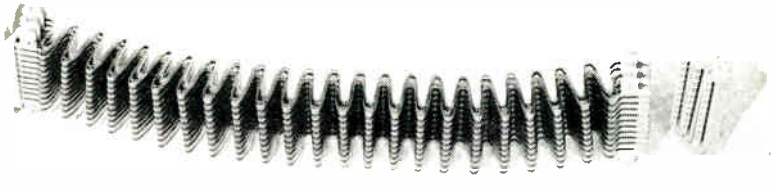


ROTARY JOINT CONNECTION



HYDROSTATIC CABLE TO CABLE ENVIRONMENTAL CONNECTOR

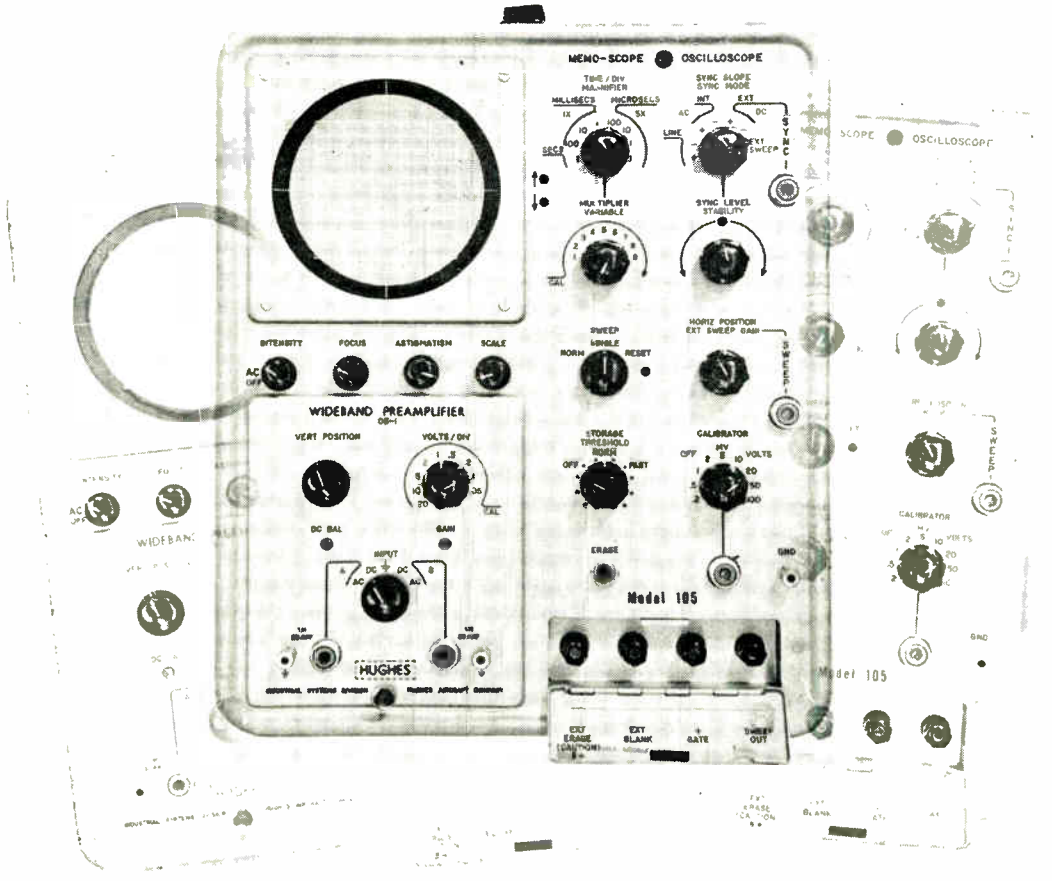
SELF RETRACTING CONTOUR CABLE



Circle 4 on Inquiry Card

All New Hughes 10 mc MEMO-SCOPE® Oscilloscope

2 PRECISION INSTRUMENTS IN 1



CONVENTIONAL MODE

- DC to 10 mc Band Pass
- Sweep Range: 0.1 μ secs/division;
  5 X Magnifier for speeds to .02 μ secs/division;
  Multiplier for sweeps long as 10 secs/division
- Rise Time: 35 nanoseconds
- Built-in Delay Line (0.25 μ secs)
- Numerous Trigger Selections
- Electron Beam Position Indicators
- Plug-in Preamplifiers

STORAGE MODE

(All features of Conventional Mode, PLUS:)

- 1,000,000"/sec Writing Speed
- Unlimited Storage Time
- Fast Erase (Less than 150 millisecs)
- X-Y Plotting
- Single Shot Trigger
- Photograph or Trace Directly Off Scope Face

This unique, high frequency instrument combines the benefits of a precision laboratory oscilloscope and a Hughes storage oscilloscope. The new Model 105 MEMO-SCOPE oscilloscope provides high frequency response (10 mc) and fast writing speed (1,000,000 inches/sec). And, in addition, it can store non-recurring transients on the scope for any desired period, keeping them visible until intentionally erased.

For complete details or an interesting demonstration of the MEMO-SCOPE oscilloscope and its many accessories, write, teletype (TWX INGL 4117) or call collect: *HUGHES Industrial Systems Division, P.O. Box 90904, International Airport Station, Los Angeles 45, California.*
For export information, please write *Hughes International, Culver City, California.*

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HUGHES AIRCRAFT COMPANY

Circle 5 on Inquiry Card

ECHO, Moon Bounce Techniques Prove Out

NASA's "PROJECT ECHO," the recent orbiting of a 100-ft.-diameter inflatable "Satelloon" made of ½-mil Mylar with a metallized mirror surface, is proving the feasibility of a world-wide Satellite Communications System.

Prior efforts began in 1946. A radar echo bounced off the moon was received at Ft. Monmouth, N. J. In 1954, the Naval Research Labs achieved the first reflected voice signal. Last year, Massachusetts Institute of Technology scientists successfully transmitted a voice signal across the Atlantic, one-way, via the moon, to the Jodrell Bank station in Great Britain. During January and February, 1960, voice signals were reflected off two 100-ft.-diameter aluminum spheres at an altitude of 250 miles. They were launched by NASA from Wallops Island, Va. The signals were received by MIT at Round Hill, Mass. Bell Labs and Jet Prop. Labs later reflected unmodulated radio waves off the TIROS weather satellite, as it circled the earth.

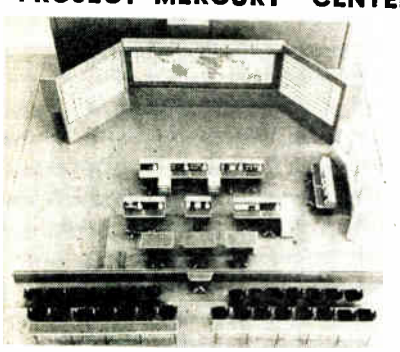
All these preliminary experiments led to the most recent events. In June and July, 1960, the first two-way conversations took place between Bell Labs, New Jersey, and the Jet Propulsion Labs in California and the Jodrell Bank in Great Britain. On August 4, 1960, William C. Jakes of Bell Labs, Crawford Hill, Holmdel, N. J., and Walter K. Victor of the Calif. Instit. of Tech's Jet Propulsion Labs, Goldstone, Calif., conversed with each other, their voices translated into radio beams traveling to the moon and return to earth—a distance of 480,000 miles—a time lag of six seconds between question and answer.

At Holmdel, a 60-foot dish-shaped antenna transmitted at a frequency of 960 MC, while at Goldstone an 85-foot antenna transmitted at a frequency of 2390 MC.

An 85-foot antenna received signals at Goldstone, but at Holmdel a 50-foot horn reflector antenna, with special receiver circuitry and a highly sensitive ruby maser amplifier, cooled by liquid helium to −456°F., accomplished the transmission. In the receiver circuitry, a special "frequency modulation feedback circuit" is used. It improves the signal-to-noise ratio one hundred fold, giving a high quality audio output for a weak ratio signal.

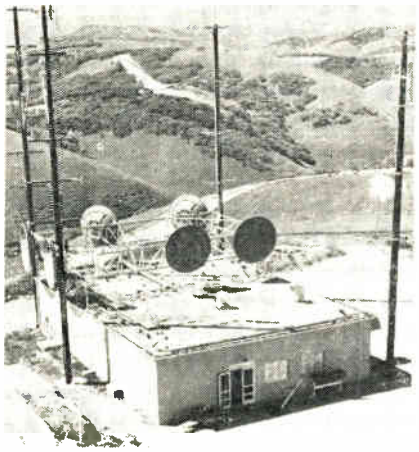
Envisioned for the future by the Bell System is a fleet of 50 radio relay spheres — gyroscopic active transmitting satellites serving as microwave towers orbiting at 3,000 miles altitude. Television programs and telephone calls will be relayed by way of microwave radio frequencies, which travel in straight lines and hence are blocked by the earth's curvature. James B. Fisk, President of Bell Telephone Labs, and Charles M. Mapes, Assistant Chief Engineer of AT&T, presented this plan to the FCC recently. Estimated cost for such a satellite system, linking 26 stations throughout the world, including TV capability, would be $170,000,000.

"PROJECT MERCURY" CENTER



Wall map, trend charts and display consoles now being built by Stromberg-Carlson, San Diego, are shown in scale model of Project Mercury Control Center, Cape Canaveral, Fla. Consoles will provide vital information about flight, astranaut and orbiting capsule.

MICROWAVE RADIO SITE



Collins Radio is installing 33 microwave transmitters and receivers at the Santa Cruz Island Junction Repeater Station. It will serve the Pacific Missile Range, headquartered at Point Mugu, Calif.

ARDC Redesignates 3 of Its Research Divisions

ARDC has renamed three of its Research Div's Directorates. The Geophysics and Research Directorates, Hanscom Field, Bedford, Mass., last May named Detachment No. 2 of ARDC's Air Force Research Div. (AFRD), will now be identified as the Air Force Cambridge Research Laboratories (AFCRL).

The third name change redesignated AFDR's Detachment No. 3, at Thule, Greenland, as Detachment No. 1 of AFCRL.

"Higher Tube Industry Pay Would Cost Jobs"

Raising minimum pay scales in the electron tube and semi-conductor industry would cause American workers to lose jobs to foreign competitors, would cause higher unemployment in surplus labor areas, and would harm small businesses, the Chamber of Commerce of the U. S. has warned the U. S. Department of Labor.

Under the Walsh-Healey Act, the Labor Department tentatively has set minimum electron tube pay at $1.42 an hour and solid semi-conductor pay at $1.35. Employers must pay these rates on government contracts.

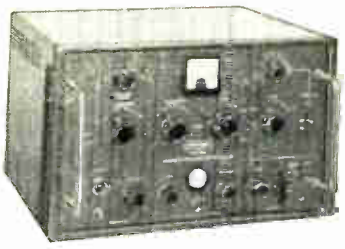
The National Chamber pointed out that in 1956, 560,000 semi-conductors were imported. In 1958, 26,737,000 were imported. American workers lost jobs to foreign, substandard manufacturers, the National Chamber said, and a Walsh-Healey increase would aggravate the trend.

The Chamber quoted the Small Business Administration that Walsh-Healey tends "to raise wages throughout the country to the levels paid by large firms in the industrial areas without due regard to local economic conditions and to the financial problems of small business."

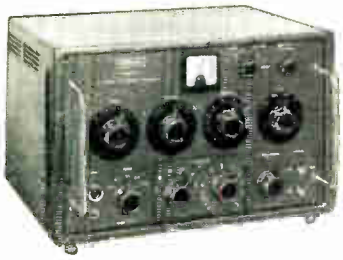
The tentative Walsh-Healey rate for semi-conductors is 15 cents above minimum rates paid in New England, the Chamber said. Such a high rate would irreparably impair the ability of small business in surplus labor areas to obtain government business.

MORE NEWS on Page 20

D-890-A (with crystal check)
Frequency: 1 c/s to 111.1 kc/s
Accuracy (max.): 0.05%; 0.005% at spot frequencies
Output (max.): 126 v into 8 k ohms or 24 v into 600 ohms

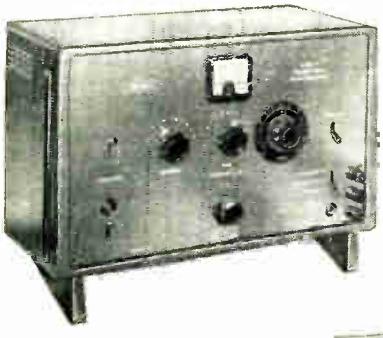


MUIRHEAD

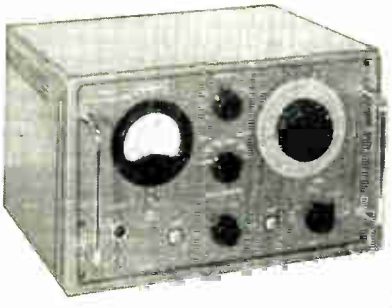


Four of the most ACCURATE and STABLE variable-frequency OSCILLATORS

D-880-A (2-phase)
Frequency: 0.01 c/s to 11.2 kc/s
Accuracy: 0.2% above 5 c/s; 2% at 0.01 c/s
Outputs: 10 v into 10 k ohms and 600 ohms



D-695-A
Frequency: 10 c/s to 31.2 kc/s
Accuracy: 0.2% above 100 c/s; 0.3 c/s at 10 c/s
Output: 10 v into 10 k ohms; 2.4 v into 600 ohms



D-888-A (Analyser/Oscillator)
Frequency: 200 c/s to 650 kc/s
Accuracy: 2%
Output (OSC): 2.5 v into 600 ohms

"TECHNIQUE"

A technical journal edited and published quarterly by Muirhead & Co. Limited. Free on request. In addition to articles by our own engineers, giving news about the latest designs, developments and applications of Muirhead products, there are also many articles by engineers outside the company, describing specialized projects in which Muirhead equipment plays its part.

Models cover a frequency range from 0.01 c/s to 650 kc/s

WRITE TODAY FOR PUBLICATIONS 130, 136, 137 & 138

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462/3

NEW EECO MAGNETIC CORE CIRCUITS

now you can choose

In designing digital systems and equipment employing EECO T-Series Transistor Circuits, you now have an extra choice—EECO Magnetic Core Circuits that are both physically and electrically compatible with the EECO T-Series. This new family of compatible magnetic core circuits for the frequency range 0 to 250 kcs includes a large selection of shift registers (in single or dual units), pulse gates, and core drivers.

ADVANTAGES

The ability of magnetic cores to maintain one of two discrete states makes them ideal for shift registers, or counters. A pulse sent through one set of windings will set the core to the "High-Level" state. A pulse sent through another set of windings will reset the core to the "Low-Level" state. Thus you get flip-flop action with a single core. In transistor circuits, on the other hand, it is normally necessary to use two transistors for each flip-flop.

Core circuits are used to good advantage in our line of shift registers. They offer versatility and space saving at a price lower than that of an equivalent transistor circuit.

COMPATIBILITY WITH T-SERIES

EECO Magnetic Core Circuits are electrically and physically compatible with EECO T-Series Transistor Circuits. They are packaged in T-Series containers, measuring ⅞" diameter x 2¹⁄₁₆" seated height, and they plug into the same miniature tube sockets as the T-Series.

ENGINEERED ELECTRONICS Company

Write, wire, or 'phone today for detailed information on EECO Magnetic Core Circuits.

ENGINEERED ELECTRONICS COMPANY

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Kimberly 7-5651

Coming Events in the electronic industry

Oct. 9-13: Meeting, The Electrochemical Society, Inc.; Shamrock Hotel, Houston, Tex.

Oct. 9-14: Fall General Meeting, AIEE; Morrison Hotel, Chicago, Ill.

Oct. 10-11: Fuels Conf., ASME, AIEE; Daniel Boone Hotel, Charleston, W. Va.

Oct. 10-12: 16th Annual Nat'l Electronics Conf., AIEE, Ill. Inst. of Technology, IRE, Northwestern & Illinois Univ.; Sherman Hotel, Chicago, Ill.

Oct. 10-12: Meeting, Fibre Box Assoc.; Waldorf-Astoria Hotel, New York, N. Y.

Oct. 10-12: Nat'l Office Management Assoc. Fall Conf. & Exposition, NOMA; Atlanta Biltmore Hotel, Atlanta, Ga.

Oct. 10-13: 4th Annual Industrial Film & A-V Exhib., Industrial Exhibitions, Inc.; New York, N. Y.

Oct. 10-15: Reliability Training Conf., IRE, ASQC; Kansas City, Mo.

Oct. 11-14: 12th Annual Conv., Audio Eng'g Soc. AES; Hotel New Yorker, New York, N. Y.

Oct. 11-14: Inelastic Scattering of Neutrons in Solids and Liquids Symp.; Vienna.

Oct. 12-14: 3rd Annual Astronautics Symp., AFOSR, Soc. of Automotive Engineers; Ambassador Hotel, Los Angeles, Calif.

Oct. 12-14: 4th Conf. on Analytical Chemistry in Nuclear Reactor Technology and 1st Conf. on Nuclear Reactor Chemistry, Oak Ridge Nat'l Laboratory; Gatlinburg, Tenn.

Oct. 13-14: Nat'l Symp. on Engineering Writing and Speech, IRE(PGEWS); Bismarck Hotel, Chicago, Ill.

Oct. 13-14: Meeting, Effective Drafting Management (Process Industries); Engineering Institute, Univ. of Wisconsin, 4020 Stadium, Madison, Wis.

Oct. 13-14: 16th Annual SPI New Eng. Sec. Conf., The Soc. of the Plastics Industry, Inc.; Wentworth-by-the-Sea, Portsmouth, N. H.

Oct. 13-14: Fall Conf., Nat'l Assoc. of Broadcasters; Biltmore Hotel, Atlanta, Ga.

Oct. 14: Meeting, The Institute of Printed Circuits, Inc., Sheraton Towers, Chicago, Ill.

Oct. 14: Meeting Amer. Soc. For Testing Materials, Sheraton-Palace Hotel, San Francisco, Calif.

Oct. 14-15: Rapid Processing Symp., Soc. of Photographic Scientists & Engineers, SPSE; Shoreham Hotel, Washington, D. C.

Oct. 16-22: 5th Int'l Congress on High-Speed Photography & Int'l Equipment Exhib. (included 88th Tech. Conf. of the SMPTE), SPSE, SPIE, ISA; Sheraton Park Hotel, Washington, D.C.

Oct. 17-18. CAI/IAS Joint Meeting. IAS/CAI; Queen Elizabeth Hotel, Montreal, Que., Canada.

Oct. 17-18: Fall Conf., Nat'l Assoc. of Broadcasters; Sheraton-Dallas Hotel, Dallas, Tex.

Oct. 17-19: Symp. on Basic Science in France and the U.S., N. Y. Univ., Maison Francaise & Office of Research Services; NYU's Loeb Student Center, Washington Sq. So., New York, N. Y.

Oct. 17-19: Symp. on Adaptive Control Systems, IRE, Long Island Section; Garden City Hotel, Garden City, L. I., N. Y.

Oct. 17-19: Lubrication Conf., ASME, ASLE; Statler-Hilton Hotel, Boston, Mass.

Oct. 17-21: Fall Meeting Metallurgical Soc. of AIME, Institute of Metals Div., Hotel Sheraton, Phila., Pa.

"CALL FOR PAPERS"
is listed on page 234

Oct. 17-21: Neutron Pile Research Symp.; Vienna

Oct. 17-21: 1960 Phila. Metal Show (42nd Nat'l Metal Congress & Exposition), American Soc. for Metals; Convention Hall, Phila., Pa.

Oct. 17-21: 48th Annual Safety Congress, Nat'l Safety Council; Conrad Hilton, Pick-Congress, Sheraton Towers, Morrison and La Salle Hotels, Chicago

Oct. 18-19: Meeting, Steam Plant Operation; Engineering Institute, Univ. of Wisconsin, Madison, Wis.

Oct. 18-19: Fall Conf., Nat'l Assoc. of Broadcasters; Sheraton-Dallas Hotel, Dallas, Tex.

Oct. 19: Nat'l Management Assoc. 37th Annual Conv.; Dinkler-Plaza Hotel, Atlanta, Ga.

Oct. 19-21: Plastics-Basic Chemistry & Technology Meeting; Engineering Institute, Univ. of Wisconsin, Madison, Wis.

Oct. 19-22: American Records Management Assoc. Annual Conv. and Seminar; Plankinton House, Milwaukee, Wis.

Oct. 19-26: 1960 Interkama, the 2nd Int'l Congress & Exhib. for Instrumentation and Automation; Ehrenhof Exhibition Grounds, Dusseldorf, Germany.

Oct. 20-21: Fall Conf., Nat'l Assoc. of Broadcasters; Mark Hopkins Hotel, San Francisco, Calif.

Oct. 20-21: Nat'l Symp. on Hypervelocity Techniques, IAS; Shirley-Savoy Hotel, Denver, Colo.

Oct. 20-22: 7th Annual Int'l Meeting, Institute of Management Sciences; Hotel Roosevelt, New York, N. Y.

Oct. 20-22: Fall Meeting, Nat'l Soc. of Professional Engineers; Hilton Hotel, Denver, Colo.

Oct. 23-25: Fluorcarbons Div. Meeting, The Soc. of the Plastics Industry, Inc.; Homestead, Hot Springs, Va.

Oct. 24-25: Fall Conf., Nat'l Assoc. of Broadcasters; Denver-Hilton Hotel, Denver, Colo.

Oct. 24-26: 7th East Coast Aero & Nav. Elec. Conf., IRE, PGANE; Lord Baltimore Hotel, Baltimore, Md.

Oct. 24-27: Chemical Effects of Nuclear Transformation Symp.; Prague.

Oct. 24-28: American Management Assoc. Advertising Course.; AMA Academy, Saranac Lake, N. Y.

Oct. 25-26: Industrial Adhesives Applications Meeting, Eng'g Institute, Univ. of Wisconsin, Madison, Wis.

Oct. 25-27: 11th Nat'l Conf. on Standards, American Standards Assoc.; Sheraton-McAlpin Hotel, New York, N. Y.

Oct. 26-27: Computer Applications Symp., Armour Research Foundation; Morrison Hotel, Chicago, Ill.

Oct. 26-28: 5th Annual Conf. on Non-Linear Magnetics & Magnetic Amplifiers, AIEE, IRE, PGEC, PGIE; Bellevue-Stratford Hotel, Phila., Pa.

Oct. 27-28: Engineering Applications of Magnetodynamics Meeting, Engineering Institutes, Univ. of Wisconsin, 3030 Stadium, Madison, Wis.

Oct. 27-28: 6th Annual Electron Devices Meeting, IRE(PGED); Shoreham Hotel, Washington, D. C.

Oct. 27-28: Fall Conference, Nat'l Assoc. of Broadcasters, Fontenelle Hotel, Omaha, Nebr.

Oct. 27-28: "Teaching with TV," Institute for Advancement of Medical Communication; Univ. of Florida College of Medicine, Gainsville, Fla.

(Continued on page 16)

Coming Events

(*Continued from page* 15)

Oct. 27-29: 18th Annual Display of Electrical & Electronic Equipment for Aircraft and Missiles, Aircraft Electrical Soc., Pan Pacific Auditorium, Los Angeles, Calif.

Oct. 31: One Week Course in Packaging Management, American Management Assoc.; Hotel Astor, New York, N. Y.

Oct. 31: Assoc. of American Medical Colleges Meeting; Gainesville, Jacksonville and Hollywood, Fla.

Oct. 31-Nov. 2: 13th Annual Conf. on Electrical Techniques in Medicine and Biology, IRE, AIEE, ISA, PGME; Sheraton Park Hotel, Washington, D. C.

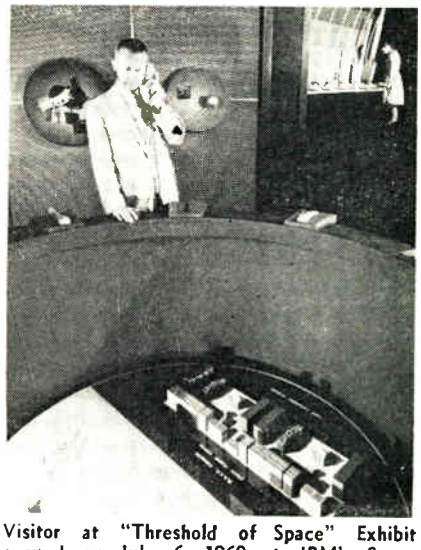
Oct. 31-Nov. 2: Radio Fall Meeting, IRE, EIA; Hotel Syracuse, Syracuse, N. Y.

Oct. 31-Nov. 12: 25th General Meeting, Int'l Electrotechnical Commission, U.S. Tech. Comm. of IEC, Amer. Stand. Assoc.; New Delhi, India.

Abbreviations

AES: Audio Engineering Society
AFOSR: Air Force Office of Scientific Research
AIEE: American Institute of Electrical Engineers
AIME: American Institute of Metallurgical Engineers
AMA: American Management Association
ASLE: American Society of Lubrication Engineers
ASME: American Society for Mechanical Engineers
ASQC: American Society for Quality Control
EIA: Electronic Industries Association
IAS: Institute of Aeronautical Sciences
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
SMPTE: Society of Motion Picture & TV Engineers
SPI: Society of the Plastics Industries, Inc.
SPIE: Society of Photographic Instrumentation Engineers
SPSE: Society of Photographic Scientists & Engineers

"THRESHOLD OF SPACE"



Visitor at "Threshold of Space" Exhibit opened on July 6, 1960 at IBM's Space Computing Center, 615 Pennsylvania Ave., N.W., Wash., D. C., examines revolving model of world-wide tracking system for Project Mercury. Models in foreground are IBM-7090 computers to be installed in NASA's Goddard Space Flight Center, Greenbelt, Md.

The Man who runs the Mincom plant has just told us we can't use advertising's favorite cliché—the competitive comparative. You know: "richer, fuller, milder, more popular" and like that. Richer than *what*, he says. Okay. No use crying over spilt milk, just makes it salty for the cat.

This heartless ukase does cramp our style today, though, because we want to give you the story of Extended Frequency Response at Lower Tape Speeds, or, why You Too should own the one-rack-wonderful Mincom Model CM-100 Instrumentation Recorder Reproducer.

We were going to say that the CM-100 gives you twice the performance (which it does) and then the Man said twice *what* performance and that was that.

You Be The Judge

Anybody who knows the difference between passband and bandwidth ought to realize this: When you have a system like the Mincom CM-100 that records and/or reproduces 1 mc at 120 ips for 12 minutes, it's giving you twice *something*. Even if it's only twice 500 kc at 120 ips for 12 minutes. But if you want to play *that* way, the irrepressible CM-100 gives you 24 minutes with 500 kc at 60 ips, and that's the way it goes for all of its six fashionable speeds. Here's a handy, businesslike (and dull) tabulation that tells the story:

Frequency	Speed	Recording Time
62.5 kc	7½ ips	3 hours and 12 minutes
100 kc	12 ips	Two fun-filled hours
125 kc	15 ips	96 minutes (1.60 hrs.)
250 kc	30 ips	48 minutes (lunch)
500 kc	60 ips	24 minutes (call your wife)
1 mc	120 ips	12 minutes (coffee break)

Greater bandwidths at slower speeds equal longer recording time. Q.E.D.

All This And The DC Top Plate, Too

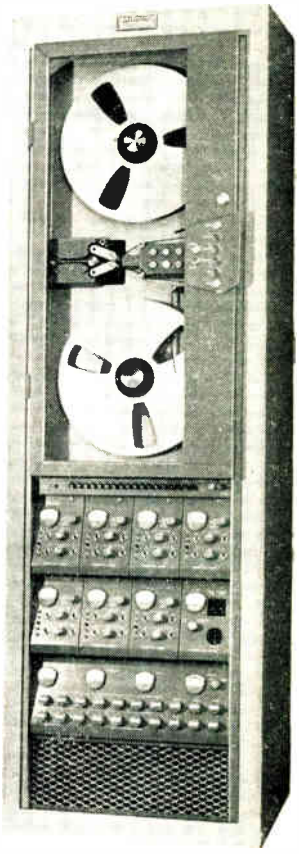
The Model CM-100 is graced in its upper story by the Mincom DC Top Plate. (So is our C-100, but that's for another day.) Both functionally and artistically, this top plate, the darling of the instrumentation business, is the living end. We made the glass in the dust door a lot bigger recently, just so you could see the trouble that isn't there any more. Only 12 moving parts and four easy adjustments, and the whole DC assembly is so cross-referenced, phase-referenced and interlocked that you have lots more control in the lab than you ever will at home with your loving family.

The ancient and honorable chore of belt-changing is passé. Now, with the DC top plate, you simply figure out what speed you want, take dead aim and push the button. Instantly you get your choice of the six favorite speeds listed in the table in column at left.

Dynamic braking, performed swimmingly by smooth little DC torque fields, makes life sweeter by far than it was when those troublesome and extinct mechanical brakes were in vogue. Three similar shunt-type motors do the job on takeup, capstan and rewind. This means that if you have six motors and two CM-100's you are (all else being equal) in business.

The Commercial

With the higher bandwidths at lower speeds, plus the DC top plate, you ought to be pretty interested in the Mincom Model CM-100 by now. We have a Most Informative Brochure with dandy four-color pictures all through it. Why don't you send for it today? (Please.)



3M COMPANY

...WHERE RESEARCH IS THE KEY TO TOMORROW

MINCOM DIVISION **M**INNESOTA **M**INING AND **M**ANUFACTURING COMPANY

2049 SOUTH BARRINGTON AVENUE, LOS ANGELES 25, CALIFORNIA • 425 13th STREET N.W., WASHINGTON 4, D.C.

News Briefs

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

EAST

ITT COMMUNICATIONS DIV.'s KELLOGG SWITCHBOARD SUPPLY CO. has shortened its name to ITT KELLOGG.

JERROLD ELECTRONICS CORP., Phila., Pa., has sold, subject to approval of its stockholders, nine antenna systems and two microwave companies for $5 million. Purchaser was H & B American Corp., Los Angeles, through its newly formed and wholly owned subsidiary, TransContinent Communications Systems, Inc.

EMERSON RADIO & PHONOGRAPH CORP., N. Y., will buy $3 million worth of radios annually from Granco Products, Inc., Kew Gardens, N. Y., with sales and marketing of same being handled by Emerson's subsidiary, DuMont Emerson Corp.

PRD ELECTRONICS, INC., Brooklyn, N. Y., subsidiary of Harris-Intertype Corp., will stock for the first time its precision microwave and electronic test equipment at its West Coast Facility in Inglewood, Calif.

McLEAN Engineering Labs., Princeton, N. J., manufacturer of electronic cabinet cooling equipment, and **SYNTORQUE, INC.**, Bearsville, N. Y., manufacturer of precision military specification motors, have formed a new company—McLean Syntorque Corp of West Hurley, N. Y.

CORNING GLASS WORKS, Corning, N. Y., has constructed new lab facilities for ultrasonic delay line development. They became operational in the Corning Electronic Components plant on Oct. 1.

AMERICAN SUPER-TEMPERATURE WIRES, INC. of Winooski, Vt., subsidiary of Haveg Industries, Inc., has doubled the area of its Research and Development Dept. and has installed a new corona tester and high voltage dielectric tester to enable all necessary qualification tests and ultimate development of a larger product line.

SPERRY RAND CORP., "broke ground" at Sudbury, Mass., for construction of a 67,000 sq. ft. Advanced Research Center, which will house 200 scientists, technicians and administrators by next Spring.

SPERRY RAND DIV.'s Sperry Gyroscope Co., Ford Instrument Co., and Remington Rand as well as the Navy's Office of Naval Research and Gibbs and Cox, Inc., naval architects, are coordinating efforts in project SURIC (Surface Ship Integrated Control). It's a study to reduce costs and personnel in the operation of Naval surface ships by having control functions relegated to automated machinery.

MELPAR, INC., a subsidiary of Westinghouse Air Brake Co., has opened a West Coast office at 468 N. Bedford St., Beverly Hills, Calif.

SYLVANIA ELECTRIC PRODUCTS, INC., N. Y., N. Y., has made a general factory price increase ranging from 2 to 5% on all 23-inch models in their 1961 TV line, as well as increasing the manufacturer's suggested list prices by $10 on these models.

TAYLOR FIBRE CO., Norristown, Pa., manufacturers of laminated plastics and vulcanized fibre, is acquiring Dytronics Inc., Rochester, Michigan, manufacturers of die-stamped circuits for electrical and electronic applications.

WESTINGHOUSE ELECTRIC'S MICARTA DIV., Trafford, Pa., has established a new marketing program to provide advice and assistance in the development and use of insulating materials.

VITRAMON, INC., Trumbull, Conn., manufacturers of electronic components, have merged with Vitramon Inc. of Delaware, a subsidiary, allowing the transfer of all assets and business of the Connecticut company to the Delaware firm.

ALPHA METALS, INC., Jersey City, N. J., is now able to produce preforms of Gold 99.99+% pure alloyed with antimony, silicon, germanium, gallium or tin into spheres, foil, washers, discs, rectangles and squares for semiconductor devices.

RCA is constructing a $4 million Electronic Data Processing Equipment Manufacturing plant on a 100-acre plot in Palm Beach Gardens, a new city being created five miles from Palm Beach, Fla.

STANDARD GRAVURE CORP.'s Louisville, Ky., plant is installing a new electronic d-c printing press, powered and controlled by an advanced G.E. drive system, which can print 60,000 sixty-four page magazine sections per hour.

LITTON SYSTEMS, INC., has established a new Research and Development Lab in Waltham, Mass. It is part of the Company's Advanced Development Lab with headquarters at the corporate offices in Beverly Hills, Calif.

MIDWEST

MINNESOTA MINING AND MANUFACTURING CO., St. Paul, Minn., and **WARNER-LAMBERT PHARMACEUTICAL CO.**, Morris Plains, N. J., are negotiating a merger subject to approval of each other's Board of Directors and Stockholders.

REMINGTON RAND UNIVAC, St. Paul, Minn., has formed a new Product Programming Dept., which will be responsible for all standard programming efforts concerning new Univac Computer Systems.

CANNON ELECTRIC CO., Los Angeles, Calif., has opened a new Central Service Store at 107 Gateway Rd., Bensenville (Chicago area), Ill., which will assure 48 hour shipments to industrial customers and distributors in 14 Midwestern states.

AMPHENOL-BORG ELECTRONICS CORP., Broadview, Ill., has reorganized management of its electronics divisions to enable each to be self-contained in controlling its own engineering, manufacturing and sales operations, for better market coverage and customer service.

DALE ELECTRONICS, INC., formerly Dale Products, Inc., of Columbus, Nebraska, has merged with Hathaway Instruments, Inc., of Denver, Colo.

RCA 501 ELECTRONIC DATA PROCESSING CENTER is being installed in the Morton Salt Bldg., Chicago, Ill., as part of a network. Other Centers are in New York; Wash., D. C.; and Cherry Hill, N. J. They will be linked by DaSpan, a new RCA Communications System to enable companies with various offices to channel data processing between each with ease and speed.

THE BARBER-COLMAN CO., Rockford, Ill., has contracted with Philco Corp. for the lease of a 2000 Electronic Data Processing System to be delivered by Dec., 1961.

DELCO-REMY DIV., GENERAL MOTORS, will build a modern, completely equipped Engineering and Research Center comprising 225,000 sq. ft. of floor space on a 40-acre tract southeast of Anderson, Ind., in close proximity to the division's general offices and ten manufacturing plants.

WEST

GE's POWER TUBE DEPT. has formed two new product sales planning operations for microwave tubes and devices; one based at its Microwave Lab in Palo Alto, Calif.; the other at Dept. Hdqs. in Schenectady, N. Y.

THE A. W. HAYDON CO., a newly formed organization, located at 4060 Ince Blvd., Culver City, Calif., will market, sell and distribute electronic timing devices and test equipment, for use in aircraft, missiles and related equipment, in the U. S. A., Canada, and other foreign countries.

CUBIC CORP., San Diego, Calif., designer and builder of AGAVE (Automatic Gimballed Antenna Vectoring Equipment), has supplied RCA with this highly efficient tracking system for down-range, ship-board instrumentation on the Atlantic Missle Range.

EITEL-McCULLOUGH, INC., is constructing an ultra-high-voltage power supply to be located in the super-power tube facility now under construction near Eimac's corporate headquarters at San Carlos, Calif.

COLLINS RADIO CO., Western Div., Burbank, Calif., is supplying the U. S. Army Corps of Engineers with more than $1 million worth of Kineplex Data Communications Equipment as part of a nation-wide high-speed Data Communication Network.

ALLIED CHEMICAL CORP. has completed production and packaging facilities of electronic chemicals at the El Segundo, Calif., works of its General Chemical Div.

SYSTEM DEVELOPMENT CORP. (SDC), Santa Monica, Calif., has completed negotiations for the acquisition of more than 7 acres of industrial property directly across from SDC's main corporate offices.

LANGEVIN, manufacturer of professional audio equipment, was purchased from the W. L. Maxon Corp., N. Y., by Sonotec, Inc., Santa Ana, Calif.

ELECTRO-PULSE, INC., Los Angeles subsidiary of Servo Corp. of America, has organized a Military Systems Div. because of the Military's interest in "E-P modular plug-in design."

ITT has acquired from the L. C. Miller Co., Los Angeles, Calif., its complete interest, including manufacturing rights, tooling, equipment, inventory and key personnel, in electromagnetic vibration equipment. ITT's Industrial Products Div. will produce and market electromagnetic shaker and calibration systems for testing of electronic equipment and components.

THE GARRETT CORP.'s AiRESEARCH MFG. DIV., Phoenix, Ariz., has received orders from three governments: U. S. A., Canada, and Indonesia for small gas turbine engines, air turbine starters and valves for use in Lockheed C-130 Hercules Turboprop Transports.

THOMPSON RAMO WOOLDRIDGE INC., Canoga Park, Calif., has formed an Educational Electronics Div. through consolidation of the educational sales groups of TRW's subsidiary, Magnetic Recording Industries and the company's Dage Television Div.

WESTERN GEOPHYSICAL CO. OF AMERICA, subsidiary of Litton Industries, engaged in world-wide seismic exploration, with division and survey offices throughout the free world, has moved into newly completed four-story headquarters at 933 North La Brea Ave., Los Angeles, Calif.

How to use a 4-megacycle instrumentation tape recorder

Ampex's new AR-300 and FR-700 answer a whole new range of needs

For video-bandwidth phenomena

Radar, for instance, can now be tape recorded off receiver and played back repeatedly to scopes, analytical devices or radar guided equipment. Radar testing, reconnaissance and tracking are enormously aided by tape's live-playback capabilities. And for simulation and training, elusive transient phenomena now become repeatable at will.

For predetection recording and communications monitoring

The recorder's bandwidth catches everything at once – any 4-megacycle band of radio frequencies or the IF stage off a telemetering receiver. This simplifies on-site equipment. One kind of recording serves for all usual types of communications and telemetered data. Later you can play back through detector, discriminator and other equipment as many times as necessary to separate and process the desired channels of information.

For 5,000,000 binary bits per second

Super-efficient acquisition and reduction systems can be developed around serial pulse-coded data put directly on tape. One reel lasts 60 minutes – holds over seven billion binary bits. Compare this with previous PCM techniques on tape limited to less than 1,000,000 bits per second even at much higher tape speeds and proportionately shorter recording time.

The essential data

The Models: AR-300 Mobile or airborne record only; FR-700 single-rack laboratory record/playback. Response: 10 cps to 4 mc (±3 db). Tape speeds: 12½ and 25 ips. Playing time: 60 minutes. Tape: 1.0-mil Mylar, 2-inch width, 10½-inch reels. Data tracks: two wideband plus two auxiliary. Electronics: all solid state. Environmental (AR-300): 10g vibration; 50,000 ft. alt.; −54°C to +55°C. Tape interchangeability: yes, among all AR-300/FR-700 recorders.

Write for full information

AMPEX DATA PRODUCTS COMPANY

Box 5000 · Redwood City, California · EMerson 9-7111

AMPEX

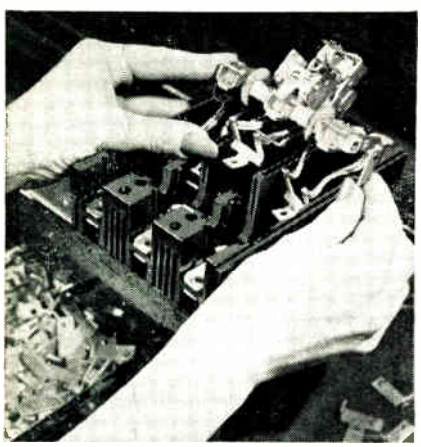
Circle 10 on Inquiry Card

Important facts to know about Laminated Plastics

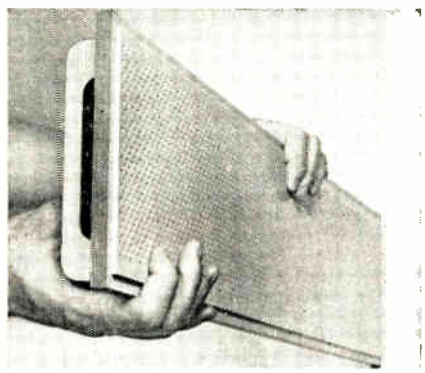
LAMINATED PLASTICS *What they are, where they can be used*

Taylor laminated plastics, also known as reinforced plastics, are thermosetting-type materials formed by impregnating paper, cotton cloth, asbestos, glass cloth, nylon or other base materials with synthetic resins and fusing them into sheets, rods, tubes and special shapes under heat and pressure. These materials exhibit a valuable combination of characteristics, including high electrical insulation resistance, structural strength, strength-to-weight ratio, and resistance to chemical reaction; also adaptability to fabricating operations.

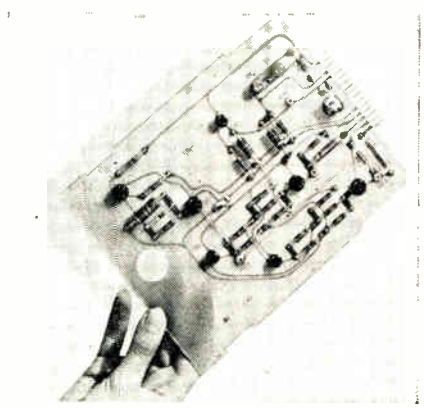
Types of laminated plastics made by Taylor
There are four basic types of Taylor laminated plastics commonly specified and used throughout industry today. They are as follows:



Phenolic Laminates. Paper, cotton fabric or mat, asbestos, glass cloth or nylon bases impregnated with phenol formaldehyde resins. These provide strength and rigidity, dimensional stability, resistance to heat, chemical resistance, and good dielectric characteristics. Some Taylor grades are excellent basic materials for gears, cams, pinions, bearings and other mechanical applications. Others are widely used in terminal boards, switchgear, circuit breakers, switches, electrical appliances and motors. Also in radios, television equipment and other electronic devices; and in missiles as nose cones, exhaust nozzles, and combustion chamber liners.

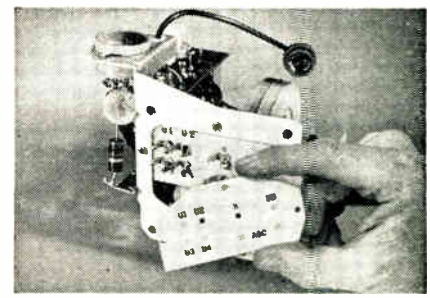


Melamine Laminates. Glass cloth or cotton fabric impregnated with melamine formaldehyde resin. Taylor melamine laminates have superior mechanical strength and are especially desirable for their arc-resistant qualities. Good flame and heat resistance, good resistance to the corrosive effects of alkalis and most other common solvents, besides other favorable characteristics. Typical applications include arc barriers, switchboard panels, and circuit-breaker parts in electrical installations.



Silicone Laminates. Continuous-filament woven glass fabric impregnated with a silicone resin. These laminates combine high heat resistance (up to 500°F. continuous) with excellent electrical and mechanical properties. They are primarily used in high-temperature electrical applications and high-frequency radio equipment.

Epoxy Laminates. Continuous-filament woven glass fabric or paper impregnated with epoxy resin. Glass-fabric grades are designed for use in applications requiring high humidity-resistance, good chemical resistance,



and strength retention at elevated temperatures. Paper grades are used under high-humidity conditions where resistance to acids and alkalis is required. Both grades are characterized by good dielectric strength, low dielectric losses, and high insulation resistance even following severe humidity conditions.

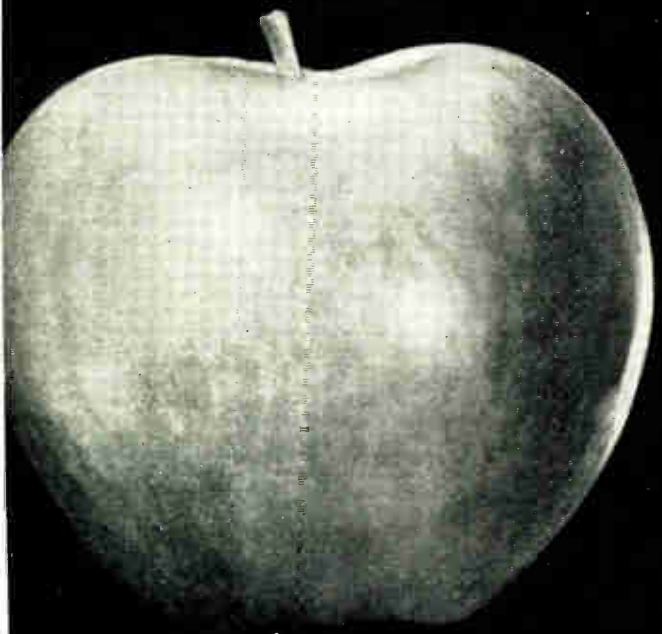
• • •

Recent technical advances in the bonding of various metallic and nonmetallic materials to laminated plastics have opened up new design opportunities. It is now possible to bond virtually any compatible material with a laminated plastic to form a composite which combines the advantages of both. One of the first composite materials was a copper-clad laminate used for printed circuits. More recent composite laminates, usually manufactured to customer specification, include the following: Taylorite® vulcanized fibre-clad, rubber-clad, asbestos-clad, aluminum-clad, beryllium-copper-clad, stainless-steel-clad, magnesium-clad, and silver- and gold-clad. Any one of these materials can be sandwiched between sheets of laminates, too, and can be molded to fit specific requirements.

Send for complete information about any or all of these Taylor laminates. And remember Taylor's new selection guide will simplify your problems in choosing the right laminate for your specific application. Taylor Fibre Co., Norristown 53, Pa.

Taylor
LAMINATED PLASTICS VULCANIZED FIBRE

Surest Way To Count Anything



From Apples To Oranges

Raytheon's versatile decade counter tubes provide long reliable service in equipment and systems designed for counting, sampling, or coding anything from apples to oranges.

The Raytheon CK6909, CK6910, CK-6802, and CK6476 are cold cathode bi-directional ring stepping types providing visual neon glow and electrical readout. They feature negligible power dissipation, short resolution time, no moving parts, extremely long life, and the use of simple, low cost circuitry.

Complete Raytheon engineering facilities are available to aid you in the application of these tubes to any operation you may be planning—timing, frequency dividing, matrixing, telemetering, controlling, counting, sampling, or coding. For additional information and technical data on these or any of Raytheon's expanding line of industrial and military gas-filled tubes, please write to: Raytheon Industrial Components Division, 55 Chapel St., Newton 58, Massachusetts.

CHARACTERISTICS AND TYPICAL OPERATION

TYPES	CK6909 CK6910*	CK6476* CK6802
DC Supply	450 volts	425 volts
Anode Resistor	0.27 meg ohms	0.82 meg ohms
Nominal Tube Drop	235 volts	195 volts
Cathode Resistor	24 K ohms	100 K ohms
Output (Across Cathode Resistor)	15 volts	30 volts
Speed	to 100 kc	to 4 kc

*All ten cathodes brought out independently for electrical readout.

For Small Order or Prototype Requirements See your Local Franchised Raytheon Distributor

RAYTHEON COMPANY

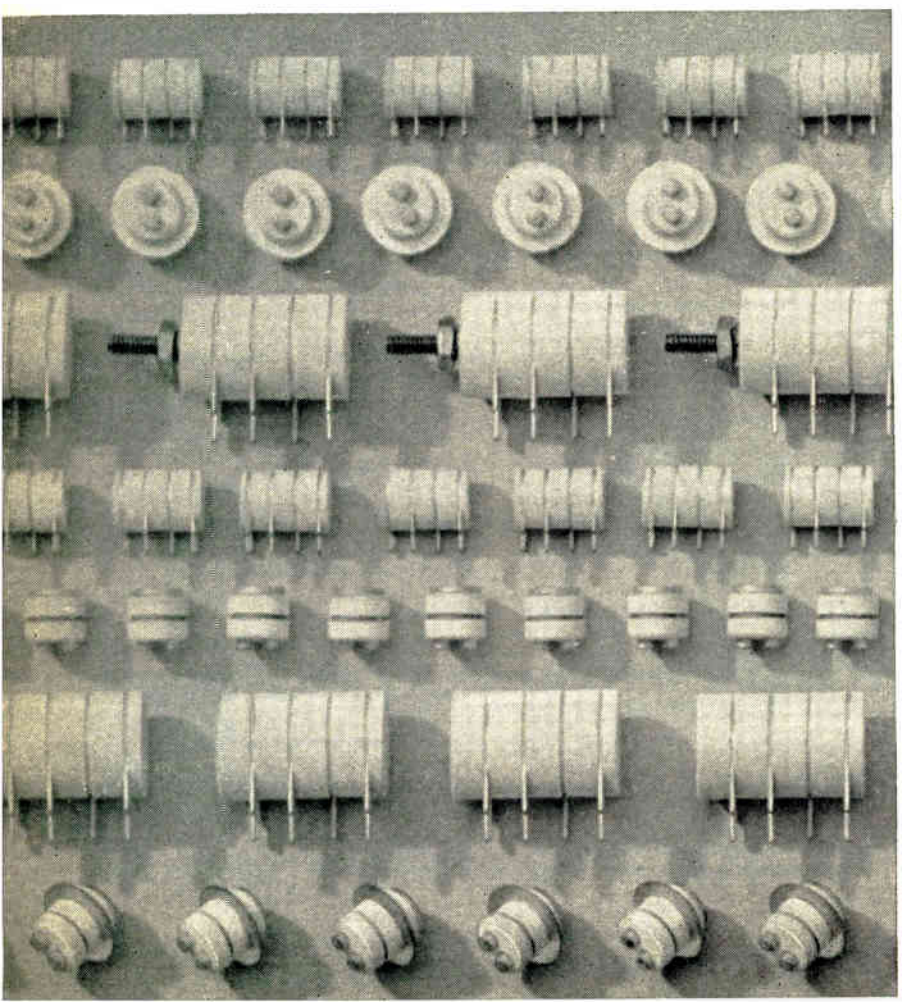
INDUSTRIAL COMPONENTS DIVISION

RAYTHEON

Circle 12 on Inquiry Card

RELAX! Just select the power output, bandwidth, everything else you need: and radiation tolerance...

Telephone today! New York, WI 7-4065....Boston, DE 2-7122....Washington, EX 3-3600....Chicago, SP 7-1600....Dallas, RI 7-4296..



(ACTUAL SIZE)

7462
RF-amplifier triode

7486
RF oscillator-mixer triode

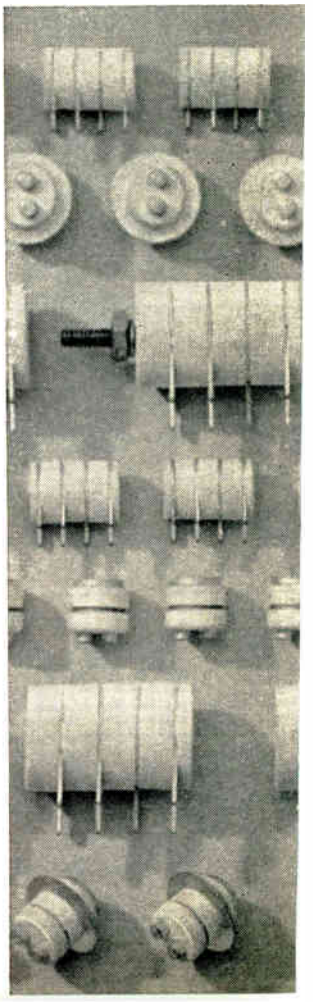
7296
VHF-UHF low-power triode, shown with mounting bolt

7625
High voltage-gain triode

7266
VHF-UHF detector diode

Developmental, broadband, 40,000-G_m triode

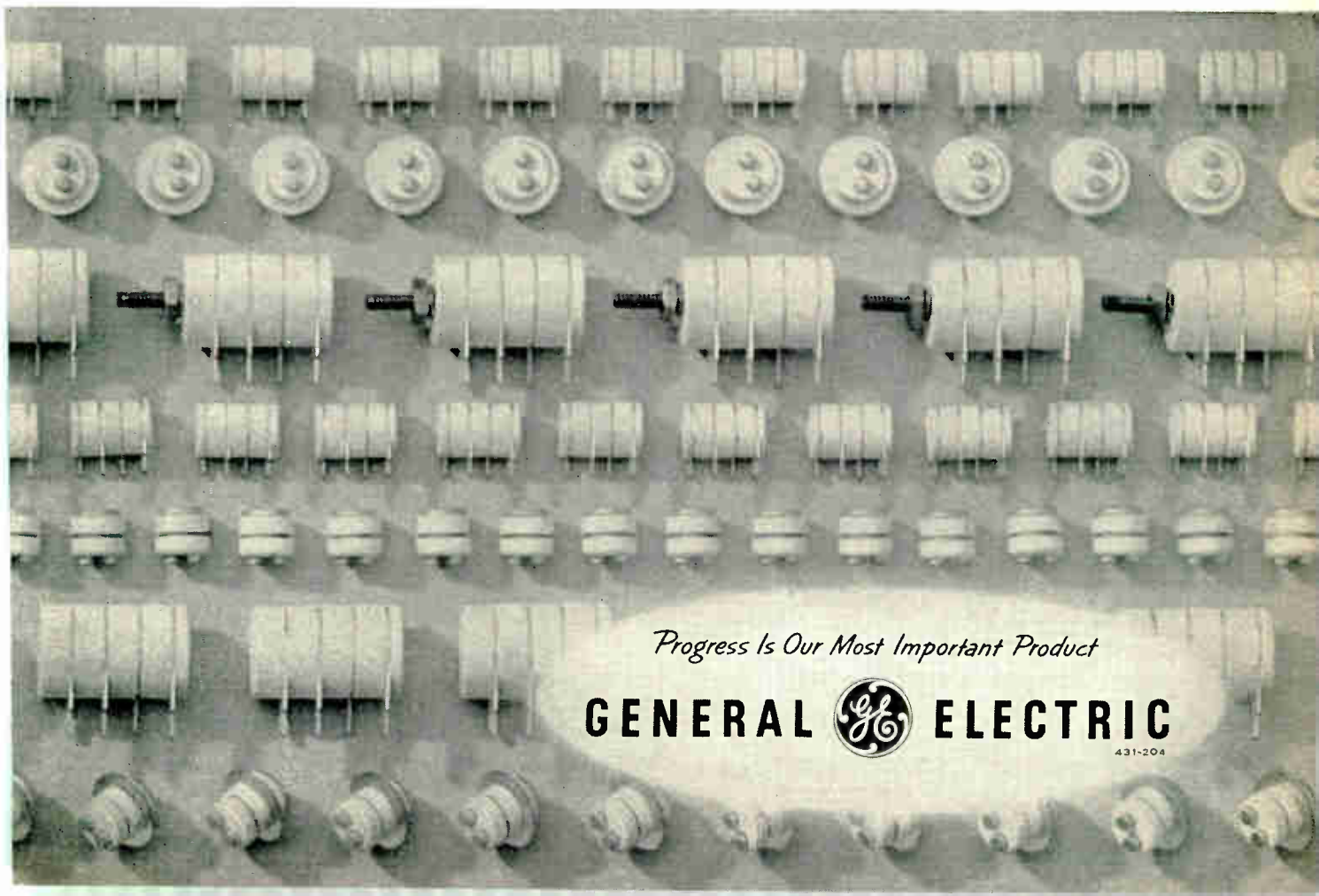
7077
RF-amplifier triode

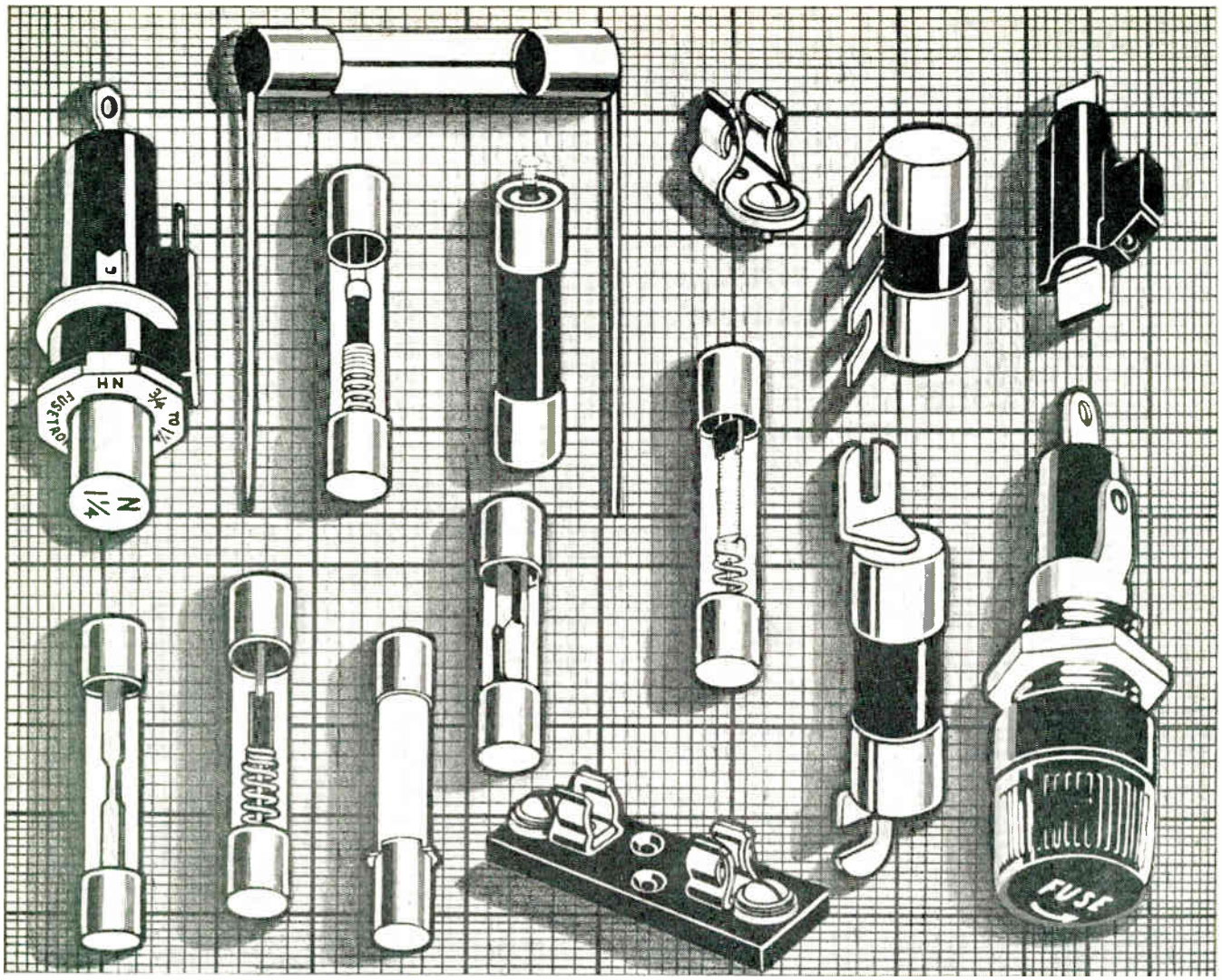


right frequency, function, G-E Ceramic Tubes have ruggedness...temperature high gain...low noise.

Circle 9 on Inquiry Card

.os Angeles, GR 9-7765, BR 2-8566 . . . . San Francisco, DI 2-7201 . . . . Or call your General Electric Industrial Tube distributor.





BUSS fuses can help protect

your product and it's reputation for quality

You get double protection when you specify BUSS fuses.

First, BUSS fuses are designed and manufactured to give maximum electrical protection.

But it doesn't stop there.

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

This is your assurance that BUSS fuses will operate as intended.

Second, BUSS fuses help protect your reputation as a quality manufacturer. A fuse that opens prematurely causes a needless shutdown. Likewise, one that doesn't function properly may cause other components to burn out or be damaged. In either case, it's an annoying headache for the customer who buys your equipment. More often than not, he will blame your product for his trouble.

With dependable BUSS fuses, you need have no worries that faulty fuses will give your product a bad name. That's why it makes good sense to specify BUSS fuses.

For more information on BUSS and FUSETRON small dimension fuses and fuseholders . . . Write for bulletin SFB.

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

1060

BUSS FUSES ARE MADE TO PROTECT - NOT TO BLOW NEEDLESSLY

FUSETRON BUSS McGRAW EDISON

BUSS MAKES A COMPLETE LINE OF FUSES FOR HOME, FARM, COMMERCIAL, ELECTRONIC, ELECTRICAL, AUTOMOTIVE AND INDUSTRIAL USE.

LOG FOR LESS

...$575 to $1100 less with the new NLS 484 digital voltmeter

Here is the only 4-digit voltmeter to provide printer connection and automatic print control for only $2150 . . . the only digital voltmeter at this price to provide heavy duty *plug-in stepping switches*, snap-out readout, and simple single-package design. With plug-in NLS accessories it forms a host of automatic data logging systems. Performance? The 484 retains the basic design and quality construction of the NLS 481, the world's most popular 4-digit voltmeter. Contact NLS for complete information on the 484 if you require ±0.01% accuracy and printout at low cost.

BRIEF SPECIFICATIONS: Accuracy ±0.01% of full scale on each range . . . ranges: ±9.999/99.99/999.9 volts DC, ±99.99/999.9 millivolts DC using NLS 140 Preamplifier, 9.999/99.99/999.9 volts AC using NLS 125B AC/DC Converter . . . input impedance: 10 megohms at balance, 1000 megohms on lowest range by modification . . . automatic range and polarity selection . . . balancing time: 1 sec., average . . . internal standard cell for verification of calibration . . . simple conversion to ratiometer.

Originator of the Digital Voltmeter

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

International News

(*Continued from Page 26*)

Profit Experience of U. S. Companies in Puerto Rico

Puerto Rico's Office of Economic Research, Economic Development Administration reports that 600 U. S. business concerns are operating plants on the island.

Of the 69 industrial groups reported, 57 showed profits. Twenty-two showed profits upward of 15.5%. Some of these were: chemical and allied products, 49.5%; electrical industrial apparatus, 28.0%; storage batteries, other electrical supplies, 28.0%; and plastic products, 12.6%.

Also included in the report are statistics relating profits to average equity and sales; figures concerning employment, capital, and other operating information; comparisons with U. S. mainland experiences; and a consolidated balance sheet dealing with each industrial category.

During 1959, 91 plants commenced operations in Puerto Rico.

The report (Annual Statistical Report of EDA Manufacturing Plants) may be obtained by writing to Dept. PRQ, Economic Development Administration of Puerto Rico, 666 Fifth Ave., N. Y. 19, N. Y.

Stretch Computer for British Atomic Energy Authority

IBM World Trade Corporation announces that the United Kingdom Atomic Energy Authority, through IBM United Kingdom Ltd. has signed a contract for a STRETCH class computer. The system will be installed towards the end of 1961. It will be 75 to 100 times more powerful than the large-scale IBM 709 which is at present in use by the U. K. A. E. A. Though it takes up only the same space as the IBM 709, the STRETCH class system can perform well over 1,000,000 logical operations/second. It will also have random access disc storage units capable of transferring one word every eight microseconds, six magnetic core storage units with retrieval time of 2.18 millionths of a second, and a vast magnetic tape backing store.

Polarad Imports Talent For Advanced Scientific Work

The Polarad Electronics Corp., New York, manufacturers of microwave test equipment and related instruments and components, unsuccessful in filling positions locally, advertised in prominent London newspapers for electronic technicians and engineers.

Of nearly a dozen selectees, six have arrived and are working in conjunction with American supervisors and fellow engineers on unclassified, non-military projects in Polarad's test department and advanced development laboratories.

New Allen-Bradley
LINE OF
Discoidal Capacitors
PROVIDES
SUPERIOR PERFORMANCE, PHYSICAL UNIFORMITY

ACTUAL SIZE
of the seven standard
A-B filter capacitors

Type SB3A
Screw mounting with
¼-32 UNEF-2A thread

Type SS5A
Solder mounting with
0.195″ max diam eyelet

Type FU6D
Solder mounting with
0.195″ max diam eyelet

Type FA5C
Solder mounting with
0.195″ max diam eyelet

Type SB4A
Screw mounting with
6-40 UNF-2A thread

Type FB3B
Screw mounting with
¼-32 UNEF-2A thread

Type FB2B
Screw mounting with
12-32 UNEF-2A thread

NO PARALLEL RESONANCE EFFECTS AT 1000 MCPS OR LESS

The exclusive dielectric construction of Allen-Bradley Discoidal Feed-thru Capacitors eliminates all parallel effects normally associated with tubular feed-thru designs. This complete freedom from self-resonance permits the use of much higher capacitance values, providing far greater attenuation of undesired radiation.

Allen-Bradley Discoidal Stand-off Capacitors provide maximum capacity for by-pass purposes in a minimum of size.

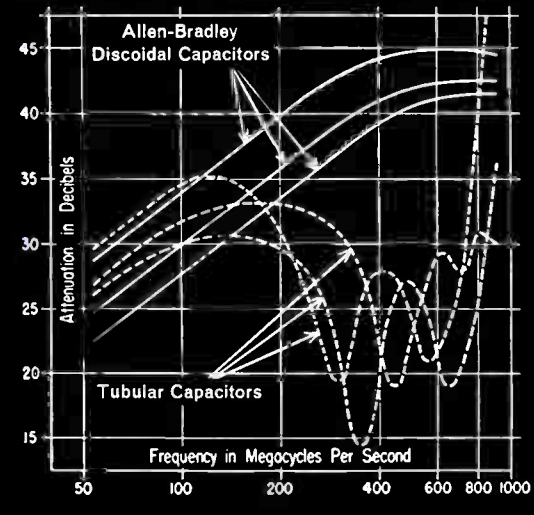
These extremely compact Allen-Bradley capacitors have an unusually rugged structural design, which provides complete and permanent mechanical protection as well as ease of assembly. The gold-plated terminals assure excellent solderability.

Insist on Allen-Bradley *quality* discoidal capacitors—they have no equal on the market. Write today for Technical Bulletin 5409.

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

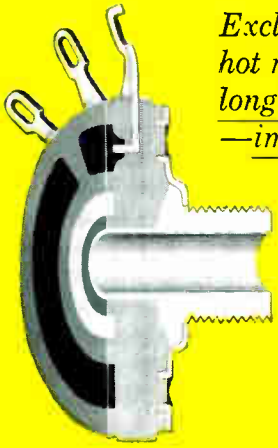
ALLEN-BRADLEY

Discoidal vs tubular feed-thru ceramic capacitors



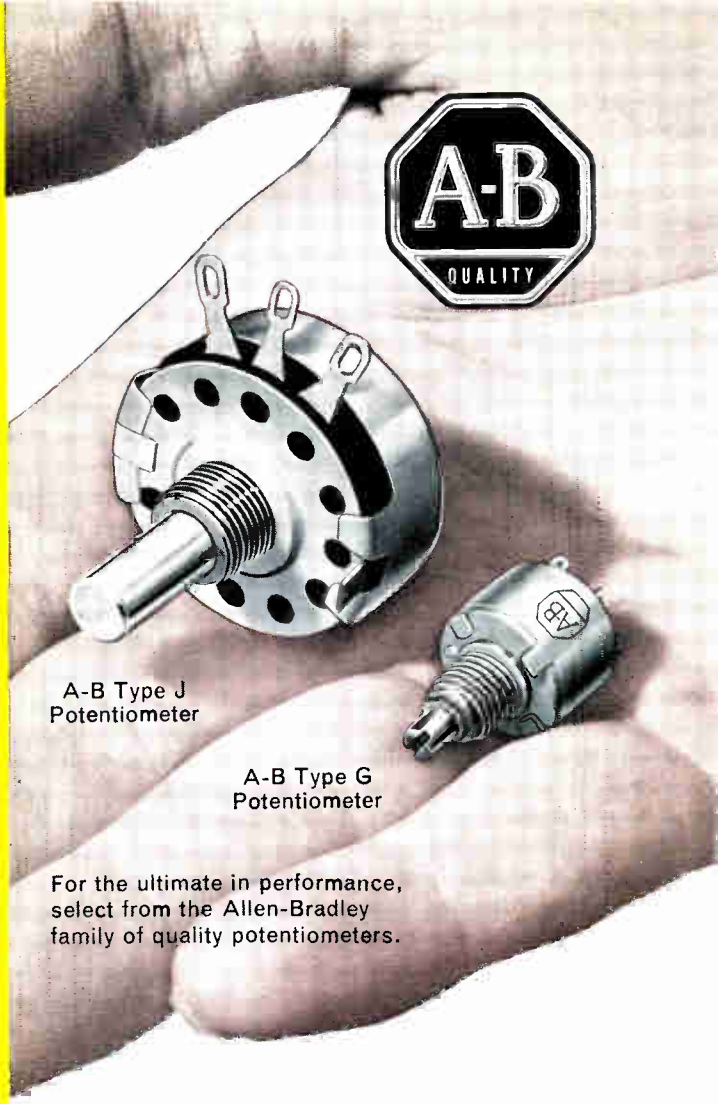
QUALITY ELECTRONIC COMPONENTS

Choose ALLEN-BRADLEY QUALITY POTENTIOMETERS for your critical circuits



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

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

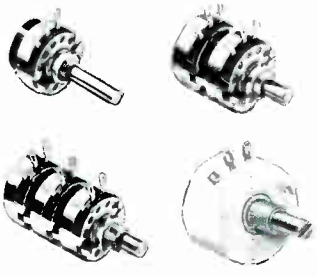


A-B Type J Potentiometer

A-B Type G Potentiometer

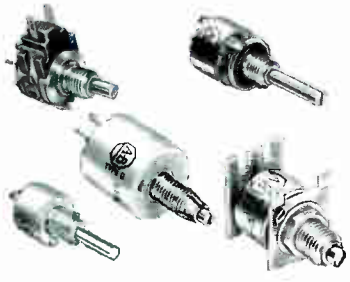
For the ultimate in performance, select from the Allen-Bradley family of quality potentiometers.

THE ALLEN-BRADLEY FAMILY OF POTENTIOMETERS



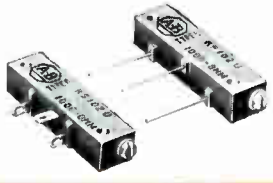
TYPE J—rated 2 watts at 70°C. Total resistances to 5 megohms. Single, dual, and triple units. *Many RV-4 types in stock for overnight shipment of prototype quantities. Send for list.*

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



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

TYPE L—similar to Type G, but rated at ½ watt at 100°C. Can be used to 150°C under "no load."



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

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

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

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

7-60-E

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

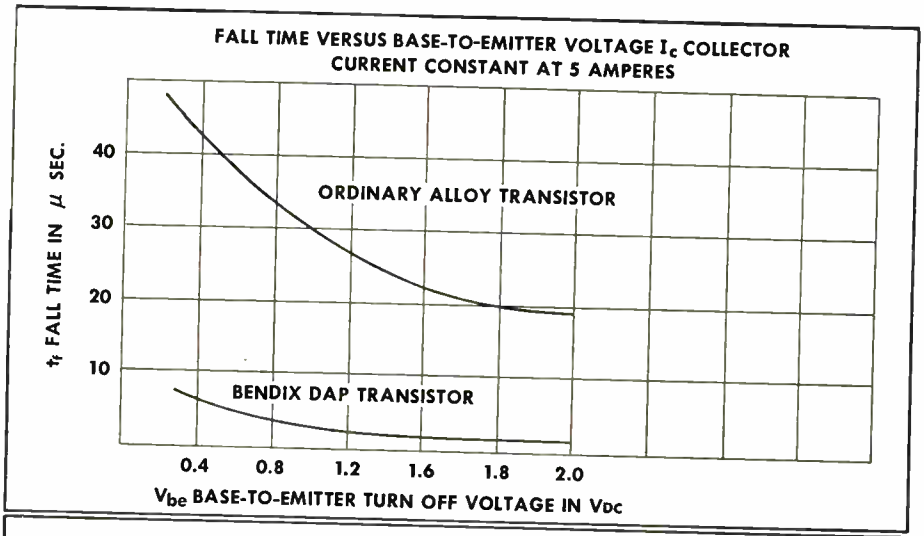
ALLEN-BRADLEY | *Quality Electronic Components*

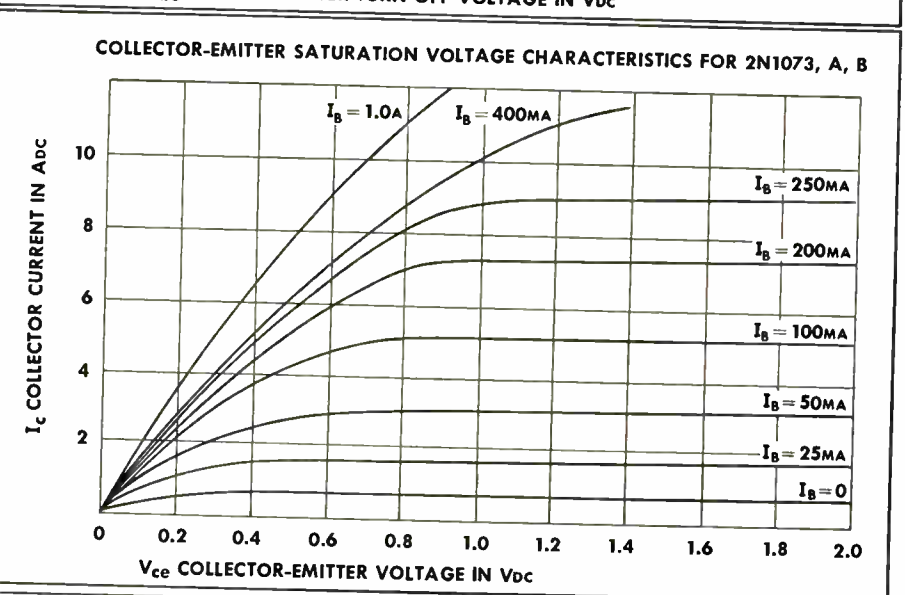
EXTRA QUALITY AT NO EXTRA COST WITH BENDIX TRANSISTORS

Bendix Bulletin

Up-to-the-minute news about transistors

NEW DAP TRANSISTORS SWITCH 5 TIMES FASTER





ABSOLUTE MAXIMUM RATINGS

TYPE NUMBERS	Vce Vdc	Vcb Vdc	Veb Vdc	Ic Adc	Pc W	T Storage °C	Tj °C
2N1073	— 40	— 40	10	10	35	−60 to +100	100
2N1073A	— 80	— 80					
2N1073B	−120	−120					

Ideal for such applications as: **ULTRASONICS • HORIZONTAL OUTPUT AMPLIFIERS FOR TV OR CATHODE RAY TUBES • POWER CONVERTERS • HIGH CURRENT AC SWITCHING • CORE DRIVERS • HI-FI**

Higher breakdown than ordinary transistors also a DAP feature.

Now design engineers are freed from many of the limitations imposed by ordinary germanium alloy transistors. Bendix* germanium PNP Diffused-Alloy-Power DAP* transistors can switch up to 10 amperes with typical speeds of a microsecond.

While maintaining high collector-to-emitter breakdown voltage—up to 120 volts—the new transistors provide lower input resistance, controlled current gain, and higher cut-off frequency. Particularly suited to high current, high frequency switching, the DAP transistor's exclusive features will suggest to the design engineer many new applications which, until now, have not been feasible.

NEW BENDIX SEMICONDUCTOR CATALOG on our complete line of power transistors, power rectifiers and driver transistors available on request.

Bendix offers many challenging opportunities in semiconductor engineering and sales. Write Personnel Manager for full details.

*TRADEMARK

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Tele-Tips

ROCKET MAN Dr. Robert H. Goddard got posthumous recognition of his pioneering role last month. The military departments paid his widow $1,000,000 for the rights to use over 200 of his patents.

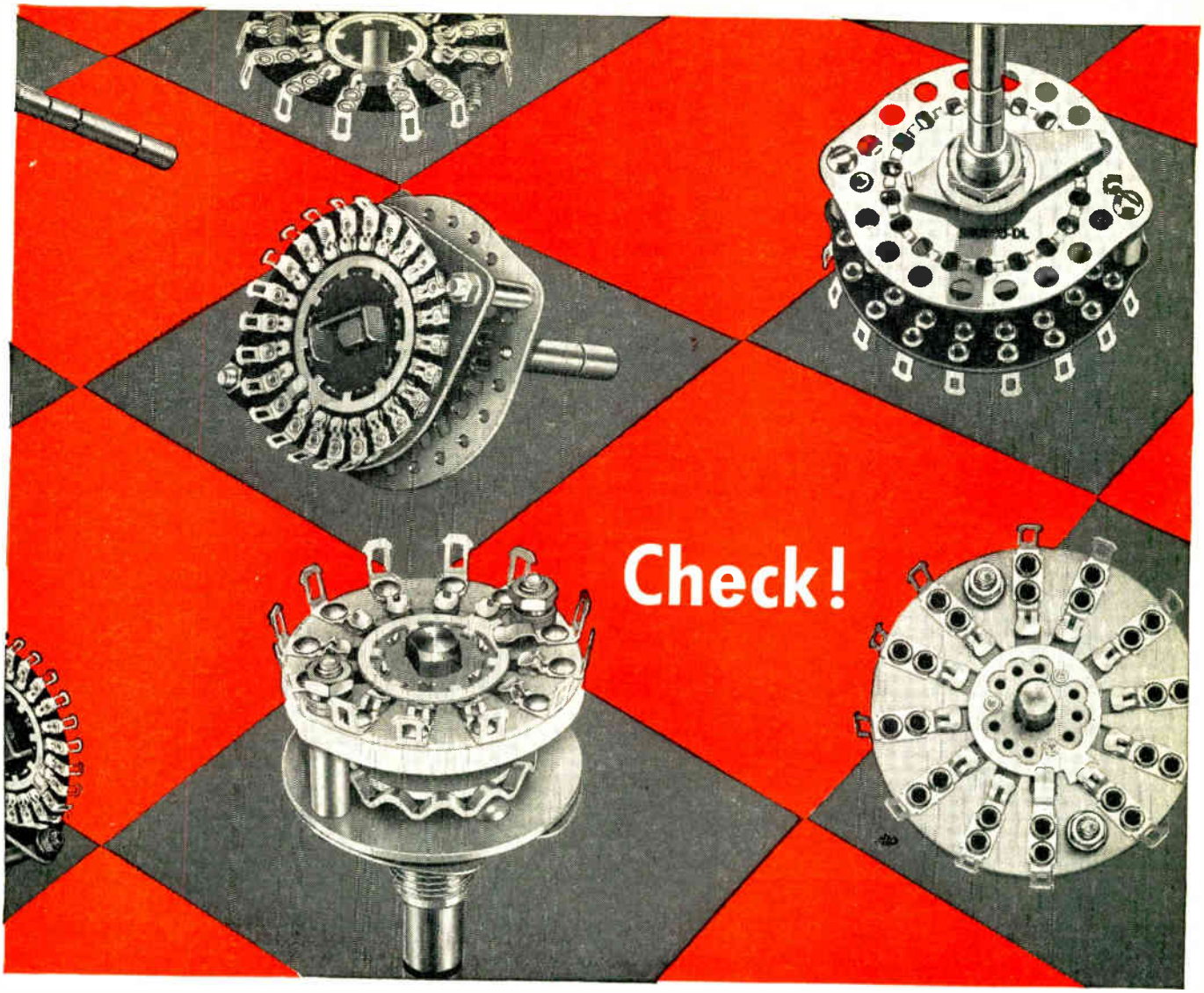
RADIO ASTRONOMERS at Green Bank, W. Va., are using their 85-ft. radio telescope to listen for radio messages from outer space. Code name of the operation is Project Ozma.

ROCKET-POWERED arrows were used by the Chinese against Mongol invaders as early as 1232 A. D. The weapons were called Chen-Tien-Lai—weapons having a great noise and bright glare.

SMALL TRANSMITTER, transistorized, that can be attached to a patient's head is simplifying the task of picking up brainwaves for electroencephalographs. The patient can move freely about within a radius of 40 ft. of the recorder. Films of the patient's behavior are synchronized with his brainwave record to correlate the two.

RELIABILITY being much in the news reminds us of this story going around—about the TV serviceman called in to fix audio trouble in a receiver. The trouble was rather obvious—a dead audio amplifier tube. He replaced the tube and confidently turned up the volume. The sound came through perfectly—for just a few seconds, then everything went, sound and picture. Mentally cursing the tube manufacturer, he whipped out another new tube, replaced the first. Stepping back he listened approvingly as the sound came through. As a final test, he turned up the volume just a little louder. Bang, the set went dead again. He shook his head disgustedly — these new tubes! — and reached for another. Then from the basement he heard a bellow, "If you children don't leave the TV alone and get to your homework I'll take the fuse out again and throw it away!"

(*Continued on page* 38)



The move to Oak Stock Switches wins Design Time

One of our 124 different stock switches may be just what you need to put your prototype on the production line. The model you choose is available for 48-hour delivery, in quantities up to 249. What's more . . . most types and sizes are available from OAK only—fully assembled or as sub-assemblies.

And remember—if you can't find an OAK Stock Switch to suit your needs, OAK's creative engineering staff will quickly modify an existing unit or develop a new one to meet your exact specifications.

Learn how OAK Stock Switches will save you time. Contact your nearest OAK representative or send for Catalog 399 showing complete stock line and prices.

Creative engineering • Quality components

OAK MANUFACTURING CO.

1260 CLYBOURN AVENUE, CHICAGO 10, ILLINOIS
phone MOhawk 4-2222

Switches • Rotary solenoids • Choppers • Vibrators • Tuners • Subassemblies

Tele-Tips

(*Continued from page* 36)

OLDER UNIVERSE? Astronomers have believed for some time that the uinverse is about 12 billion years old. Last month Dr. Fritz Zwicky of Mt. Wilson and Palomar Observatories told a meeting of the American Astronomical Soc. in Mexico City that he believes the universe to be at least a million billion years old. At least that much time is needed for matter to become bunched into stars and then into centers of galaxies, he says.

PAY-AS-YOU-LEARN plans are finding increased acceptance as a way to meet the skyrocketing costs of a college education. Costs of a 4-year course range from $8,000 to $12,000. Tuition Plan, Inc., of New York City last year financed education costs for more than 100,000 students. The repayment plans range from more than two years to ten years.

HIGH-SPEED GOGGLES developed for the Air Force have tiny shutters that flick closed in less than 500 μsecs when hit by high intensity flashes. Closing 20 times faster than the eye can blink, the goggles are operated by a light-sensitive photodetector.

EFFICIENCY RATINGS seem to bring out the best in latent humorists. Wonder how many engineers could be aptly described by these wry descriptions from Army records:

"His leadership is outstanding, except for his lack of ability to get along with subordinates."

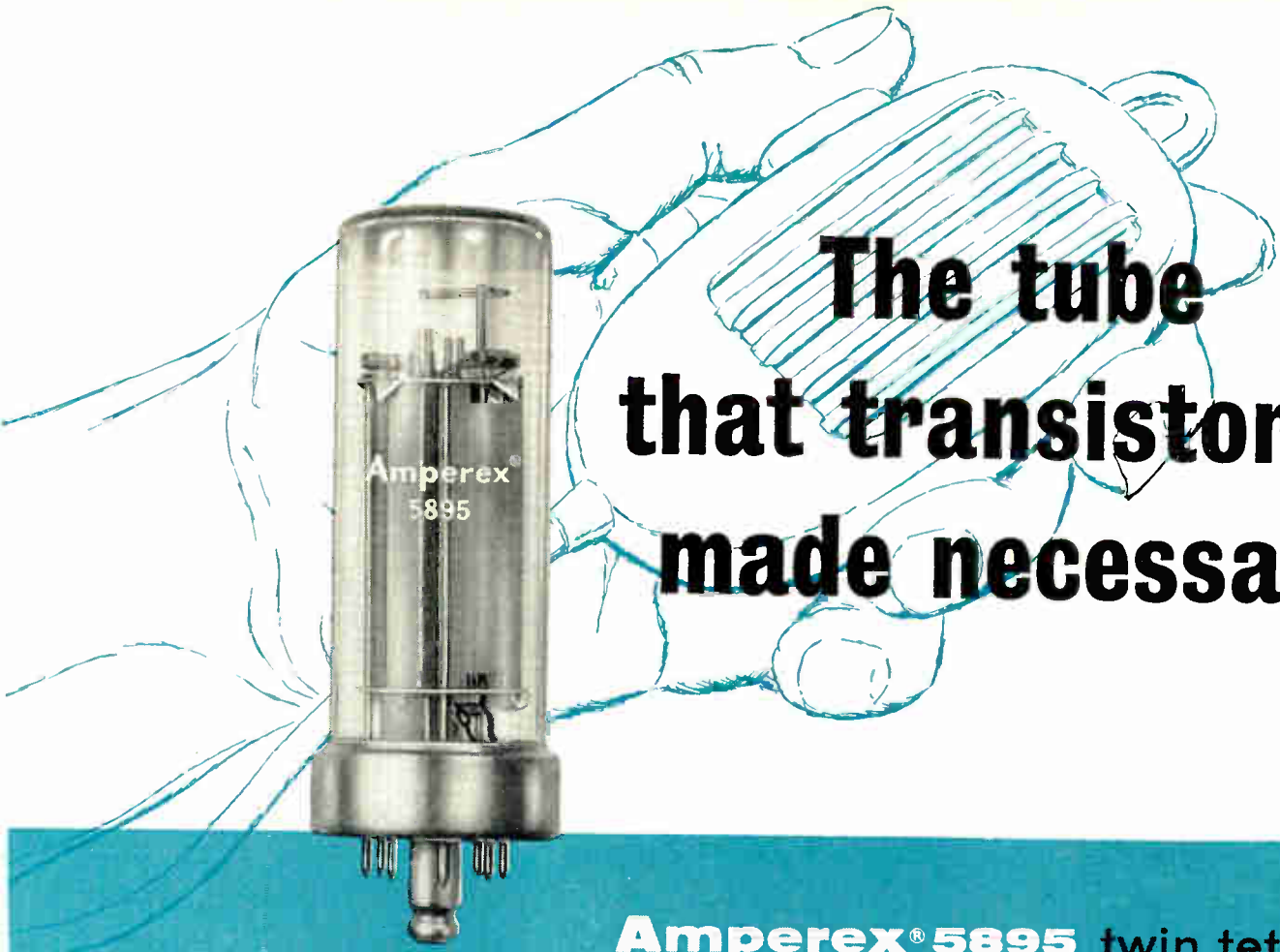
"In any change of policy or procedure, he can be relied upon to produce the improbable, hypothetical situation in which the new policy cannot work."

"Needs careful watching, since he borders on the brilliant."

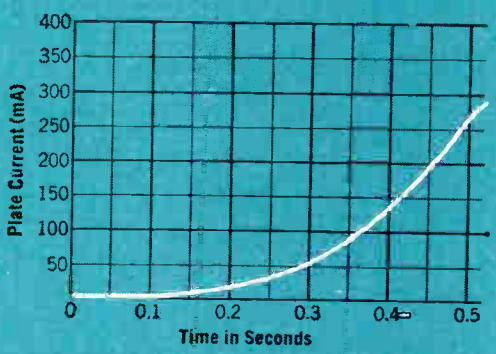
"Keenly analytical and his highly developed mentality could best be utilized in the R&D field. He lacks common sense."

"Open to suggestions, but never follows same."

"Never makes the same mistake twice, but it seems that he has made them all at least once."



The tube that transistors made necessary!



Amperex® 5895 twin tetrode reaches 85% of full emission in ½ second — minimizes transistor drift.

The Amperex 5895 allows "push-to-talk" operation in compact, transistorized mobile equipment – reaches a practical operating level of 85% of full emission in ½ second (see curve). Minimizes transistor drift and reduces battery drain

The 5895 RF power amplifier facilitates the design and manufacture of compact, mobile FM VHF/UHF transistorized transmitters.

RF Power Amplifier – Class C Telegraphy

Frequency (mobile)	ICAS 25-50	ICAS 148-174 mc.	
DC plate voltage	600	600	volts
DC screen grid voltage	200	200	volts
DC plate current	2x40	2x40	mA
DC screen grid current	5.5	4.5	mA
DC control grid current	2x1.2	2x1.3	mA
Plate input	2x24	2x24	watts
Plate dissipation	2x6.5	2x7.2	watts
Power output	35	33.6	watts

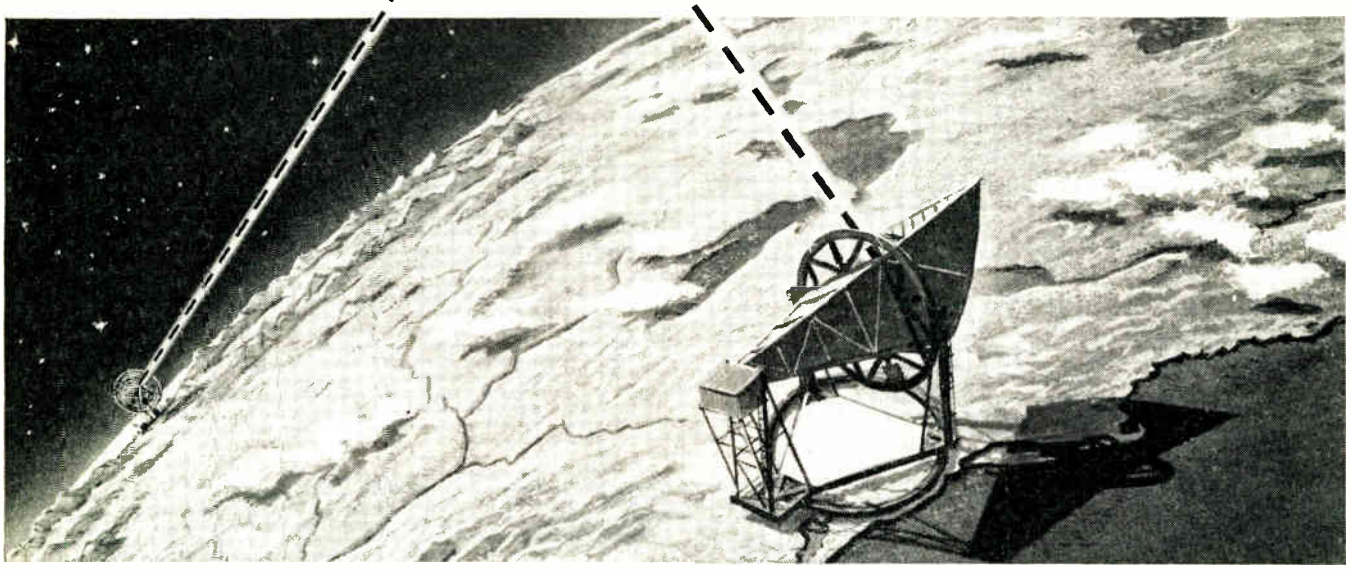
ask Amperex
for your copy of the latest condensed tube catalog containing data on tubes for mobile operation.

Circle 25 on Inquiry Card

AMPEREX ELECTRONIC CORP. 230 Duffy Avenue, Hicksville, L. I., N. Y.
In Canada: Rogers Electronic Tubes & Components, 116 Vanderhoof Ave., Toronto 17, Ont.

FIRST PHONE CALL VIA MAN-MADE SATELLITE!

"Project Echo" satellite went into a near-perfect circular orbit 1000 miles high, circling the earth once every two hours. Its orbital path covered all parts of the U. S.



BELL TELEPHONE LABORATORIES BOUNCES VOICE OFF SPHERE PLACED IN ORBIT A THOUSAND MILES ABOVE THE EARTH

Think of watching a royal wedding in Europe by live TV, or telephoning to Singapore or Calcutta—*by way of outer-space satellites!* A mere dream a few years ago, this idea is now a giant step closer to reality.

Bell Telephone Laboratories recently took the step by successfully bouncing a phone call between its Holmdel, N. J., test site and the Jet Propulsion Laboratory of the National Aeronautics and Space Administration (NASA) in Goldstone, California. The reflector was a 100-foot sphere of aluminized plastic orbiting the earth 1000 miles up.

Dramatic application of telephone science

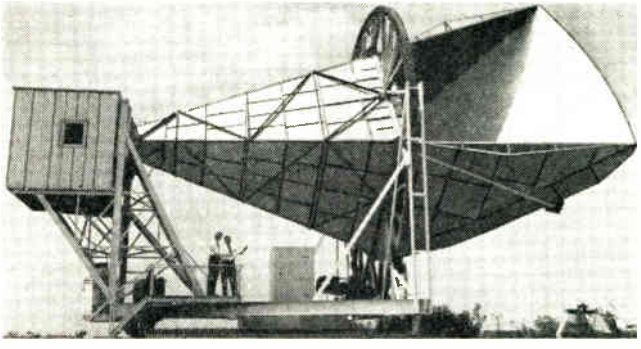
Sponsored by NASA, this dramatic experiment—known as "Project Echo"—relied heavily on telephone science for its fulfillment . . .

- The Delta rocket which carried the satellite into space was steered into a precise orbit by the Bell Laboratories Command Guidance System. This is the same system which recently guided the remarkable Tiros I weather satellite into its near-perfect circular orbit.

- To pick up the signals, a special horn-reflector antenna was used. Previously perfected by Bell Laboratories for microwave radio relay, it is virtually immune to common radio "noise" interference. The amplifier—also a Laboratories development—was a traveling wave "maser" with very low noise susceptibility. The signals were still further protected from noise by a special FM receiving technique invented at Bell Laboratories.

"Project Echo" foreshadows the day when numerous man-made satellites might be in orbit all around the earth, acting as 24-hour-a-day relay stations for TV programs and phone calls between all nations.

This experiment shows how Bell Laboratories, as part of the Bell System, is working to advance space communication. Just as we pioneered in world-wide telephone service by radio and cable, so we are pioneering now in using outer space to improve communications on earth. It's part of our job, and we are a long way toward the goal.

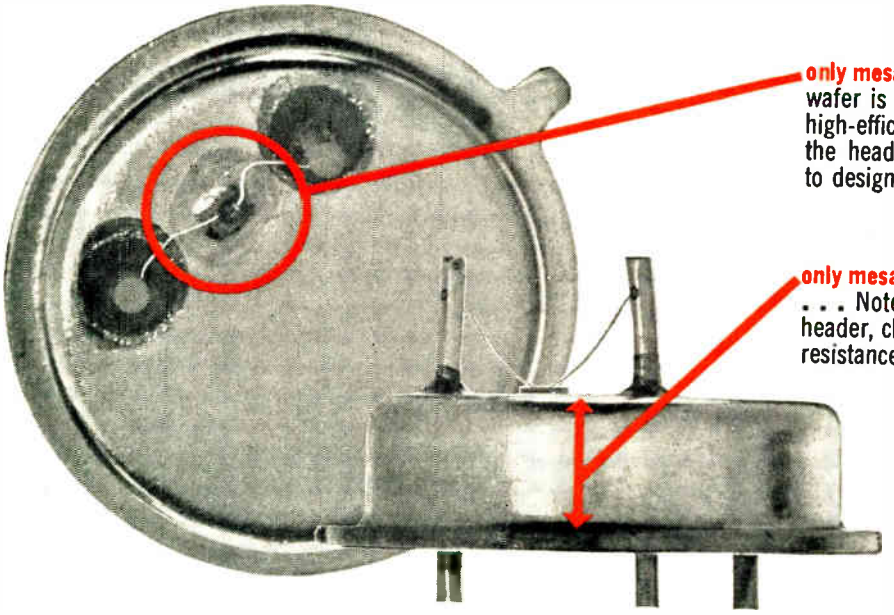


Giant ultra-sensitive horn-reflector antenna which received signals bounced off the satellite. It is located at Bell Telephone Laboratories, Holmdel, New Jersey.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

NEW TI GENERAL-PURPOSE SILICON MESA TRANSISTORS



only mesas give you maximum dissipation . . . Note how wafer is bonded directly to header, forming a direct, high-efficiency metal-to-metal thermal path through the header. High dissipation capabilities permit you to design conservatively for maximum reliability!

only mesas give you maximum mechanical ruggedness . . . Note how active element is bonded directly to header, close to unit's center of gravity—for maximum resistance to vibration and shock.

TI 2N1564 series GUARANTEES -55°C beta, 600-mw dissipation and gain at 30mc

Design now with industry's first small-signal silicon mesa transistors . . . the new TI 2N1564-series! Take advantage of guaranteed –55°C betas of 12, 20 and 40 . . . guaranteed 600-mw free-air dissipation . . . guaranteed current gain at 30 mc. Apply the design flexibility of 1 to 50 ma collector current operating range; 20-50, 40-100 and 80-200 beta spreads at 25°C and 60-v collector-emitter breakdown voltage to your audio, medium-power and higher frequency amplifier and switching designs . . . Specify the new TI 2N1564-series.

absolute maximum ratings at 25°C ambient (unless otherwise noted)

Collector-Emitter Voltage (see note 1)	60 v
Emitter-Base Voltage	5 v
Total Device Dissipation at 25°C Case Temperature (see note 2)	1.2 w
Total Device Dissipation at 25°C Ambient Temperature (see note 3)	0.6 w
Collector Junction Temperature	175°C
Storage Temperature Range	−65°C to +200°C

Note 1: The voltage at which h_{FB} approaches one when the emitter-base diode is open circuited. This value can be exceeded in applications where the dc circuit resistance (R_{BE}) between base and emitter is a finite value.

Note 2: Derate linearly to 175°C case temperature at the rate of 8.0 mw/°C.

Note 3: Derate linearly to 175°C ambient temperature at the rate of 4.0 mw/°C.

Available TODAY in production quantities through all TI Sales Offices and Authorized TI Distributors.

	Parameter	Test Conditions	2N1564 Min.	2N1564 Typ.	2N1564 Max.	2N1565 Min.	2N1565 Typ.	2N1565 Max.	2N1566 Min.	2N1566 Typ.	2N1566 Max.	Unit
I_{CBO}	Collector Reverse Current	V_{CB} = 40 v, I_E = 0			1			1			1	μa
BV_{CBO}	Collector-Base Breakdown Voltage	I_C = 10 μa, I_E = 0	80			80			80			volt
BV_{CEO}	Collector-Emitter Breakdown Voltage	I_C = 10 ma, I_E = 0	60			60			60			volt
h_{fe}	A-C Common-Emitter Forward Current Transfer Ratio	V_{CE} = 5 v, f = 1 kc, I_E = −5 ma	20		50	40		100	80		200	
		V_{CE} = 5 v, T_A = −55°C, I_E = −5 ma, f = 1 kc	12			20			40			
		V_{CE} = 5 v, f = 30 mc, I_E = −5 ma	1	4		2	4.5		2	5.0		

the FIRST silicon transistor manufacturer

TEXAS INSTRUMENTS INCORPORATED

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

Circle 26 on Inquiry Card

MOTOROLA POWER TRANSISTORS

OFFER YOU THE WIDEST SELECTION OF STANDARD TYPES AVAILABLE anywhere!

NEW
"LOW SILHOUETTE"
TO-36 CASE
ADDED TO
MOTOROLA
POWER FAMILY

3 AMP POWER TRANSISTORS—TO-3 CASE

Type Number	MAXIMUM RATINGS BV_{CBO} volts	BV_{CES} volts	T_J °C	I_C amps	Electrical Characteristics h_{FE} @ I_C amps min	max	
2N1359	50	40	100	3.0	35	90	3
2N1360	50	40	100	3.0	60	140	3
2N375	80	60	100	3.0	35	90	3
2N618	80	60	100	3.0	60	140	3
2N1362	100	75	100	3.0	35	90	3
2N1363	100	75	100	3.0	60	140	3
2N1364	120	100	100	3.0	35	90	3
2N1365	120	100	100	3.0	60	140	3
2N297A	80	50	100	3.0	40	100	2
2N297A (SIG. C)	80	50	100	3.0	40	100	2
2N1011	80	80	100	3.0	30	75	3
2N1011 (SIG. C)	80	80	100	3.0	30	75	3

5 AMP POWER TRANSISTORS—TO-3 CASE

Type Number	MAXIMUM RATINGS BV_{CBO} volts	BV_{CES} volts	T_J °C	I_C amps	Electrical Characteristics h_{FE} @ I_C amps min	max	
2N1529*	40	30	100	5	20	40	3
2N1530*	60	45	100	5	20	40	3
2N1531*	80	60	100	5	20	40	3
2N1532*	100	75	100	5	20	40	3
2N1533	120	90	100	5	20	40	3
2N1534*	40	30	100	5	35	70	3
2N1535*	60	45	100	5	35	70	3
2N1536*	80	60	100	5	35	70	3
2N1537*	100	75	100	5	35	70	3
2N1538	120	90	100	5	35	70	3
2N1539*	40	30	100	5	50	100	3
2N1540*	60	45	100	5	50	100	3
2N1541*	80	60	100	5	50	100	3
2N1542*	100	75	100	5	50	100	3
2N1543	120	90	100	5	50	100	3
2N1544*	40	30	100	5	75	150	3
2N1545*	60	45	100	5	75	150	3
2N1546*	80	60	100	5	75	150	3
2N1547*	100	75	100	5	75	150	3
2N1548	120	90	100	5	75	150	3

10 AMP POWER TRANSISTORS—TO-3 CASE

Type Number	MAXIMUM RATINGS BV_{CBO} volts	BV_{CES} volts	T_J °C	I_C amps	Electrical Characteristics h_{FE} @ I_C amps min	max	
2N627	40	30	100	10.0	10	30	10
2N628	60	45	100	10.0	10	30	10
2N629	80	60	100	10.0	10	30	10
2N630	100	75	100	10.0	10	30	10
2N1120	80	70	100	10.0	10	50	10
2N1120 (SIG. C)	80	70	100	10.0	10	50	10

15 AMP POWER TRANSISTORS—TO-3 CASE

Type Number	MAXIMUM RATINGS BV_{CBO} volts	BV_{CES} volts	T_J °C	I_C amps	Electrical Characteristics h_{FE} @ I_C amps min	max	
2N1548*	40	30	100	15	10	30	10
2N1550*	60	45	100	15	10	30	10
2N1551*	80	60	100	15	10	30	10
2N1552*	100	75	100	15	10	30	10
2N1553*	40	30	100	15	30	60	10
2N1554*	60	45	100	15	30	60	10
2N1555*	80	60	100	15	30	60	10
2N1556*	100	75	100	15	30	60	10
2N1557*	40	30	100	15	50	100	10
2N1558*	60	45	100	15	50	100	10
2N1559*	80	60	100	15	50	100	10
2N1560*	100	75	100	15	50	100	10

25 AMP POWER TRANSISTORS—TO-3 CASE

Type Number	MAXIMUM RATINGS BV_{CBO} volts	BV_{CES} volts	T_J °C	I_C amps	Electrical Characteristics h_{FE} @ I_C amps min	max	
2N1182*	50	35	100	25	15	65	25
2N1183*	50	35	100	25	15	65	25
2N1184*	80	60	100	25	15	65	25
2N1185*	80	60	100	25	15	65	25
2N1186	100	75	100	25	15	65	25
2N1187*	100	75	100	25	15	65	25

NEW 15 AMP POWER TRANSISTORS IN "low silhouette" TO-36 CASE

Type Number	MAXIMUM RATINGS BV_{CBO} volts	BV_{CES} volts	T_J °C	I_C amps	Electrical Characteristics h_{FE} @ I_C amps min	max	
2N441	40	40	100	15	20	40	5
2N442	50	45	100	15	20	40	5
2N443	60	50	100	15	20	40	5
2N174	80	70	100	15	25	50	5
2N1358	80	70	100	15	25	50	5
2N1100	100	80	100	15	25	50	5
2N1412	100	80	100	15	25	50	5
2N277	40	40	100	15	35	70	5
2N278	50	45	100	15	35	70	5
2N173	60	50	100	15	35	70	5
2N1099	80	70	100	15	35	70	5

* "A" series of these devices is offered under "Meg-A-Life" program... providing military quality units for industrial applications.

MEG-A-LIFE CERTIFIED RELIABILITY

MOTOROLA now has a *standard* power transistor to match nearly any design requirement. With the addition of the new "low silhouette" TO-36 package, Motorola is now your *most complete... most dependable* source for industrial and military power transistors.

11 TYPES OFFERED IN NEW "LOW SILHOUETTE" TO-36 CASE

- 15 amps — 150 watts
- 40 to 100 volts
- Requires 30% less headroom than other TO-36 packages.
- 43% less thermal resistance (0.5°C/W max.) than comparable types.
- h_{FE} ranges from 20-70
- 100°C junction temperature
- Improved internal construction

118 TYPES OFFERED IN INDUSTRY STANDARD TO-3 CASE

- 3, 5, 10, 15 and 25 amps
- 90 watts power dissipation
- Up to 120 volts
- 0.8°C/W maximum dissipation
- Special "Meg-A-Life" units provide military-quality for industrial applications.
- 100°C junction temperature

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This sub-miniature DM-10 Mica Capacitor retains the same superior electrical characteristics of silvered mica capacitors as found in much larger sizes. It assures a high order of performance in extreme miniaturization applications — missiles, printed circuits and all compact electronic equipment. Parallel leads provide greater versatility. Tough phenolic casings protect against physical damage and penetration of moisture.

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Working Voltage	Capacity Range
100 WVDC	1 MMF thru 360 MMF
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500 WVDC	1 MMF thru 250 MMF

Operating Temperature: *up to 150° C.*
Characteristics: *C, D, E and F, depending on capacitance value*
Leads: *#26 AWG (.0159") Copperweld wire*

EL-MENCO'S DM-10 MEETS ALL THE ELECTRICAL REQUIREMENTS OF MILITARY SPEC. #MIL-C-5B AND EIA SPECIFICATION RS-153

Other sizes also ideal for miniaturization applications —
DM-15 ... up to 820 mmf at 300 VDCW, up to 400 mmf at 500 VDCW.
DM-19 ... up to 5400 mmf at 300 VDCW, up to 4000 mmf at 500 VDCW.

WRITE FOR SAMPLES OF EL-MENCO DM-10 CAPACITORS and brochures describing El-Menco's complete line of capacitors.

EL-MENCO'S SUB-MIDGET DM-10 . . . THE NEW SMALLER MINIATURE MICA CAPACITOR

El-Menco Capacitors

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Letters to the Editor

"New Electronic Markets"

Editor, ELECTRONIC INDUSTRIES:

I would greatly appreciate your sending me 6 reprints of Mr. Hickey's splendid article in your July, 1960, issue on "New Electronic Markets."

Crescent itself is pursuing a vigorous program of developing new uses for electronic devices. Mr. Hickey's article strikes a very responsive chord.

R. C. Chapman,
Executive Vice President
Crescent Engineering & Research Co.
5440 North Peck Road, El Monte, Cal.

Editor, ELECTRONIC INDUSTRIES:

Your magazine is a constant source of reading and reference for our Engineering Department, and they were particularly interested in the series entitled "Searching for New Electronic Markets," in your July, 1960 issue.

Since our company has been engaged in the manufacture of automatic control attachments for construction equipment for several years, we were particularly interested in the top of the right hand paragraph on Page 108, which refers to a development in this field by the Minneapolis-Honeywell Company. Automatic slope control mechanism for motor graders, such as you describe in your article, has been manufactured by us, and been on the market since 1956, and is fully described in the attached literature.

In view of your discussions on the subject of markets for electronic equipment, we felt that the data on the Preco Automatic Blade Control would be of interest to you.

R. P. Nichols
Product Sales Director
Construction Equipment Division

Preco, Inc.
6300 East Slauson Avenue
Los Angeles 22, California

Editor, ELECTRONIC INDUSTRIES:

I certainly enjoyed reading your article on "New Electronic Markets," as I have been convinced for several years that there should be more emphasis on commercial electronics. After thinking about the situation, however, one finds that there are also needs for more emphasis on better highways, better schools, and just lots of other things we have gotten behind on. Why? Simply because of the stupendous burden of military defense and military deterrent forces, both of which nearly everyone agrees are necessary. The answer to the situation appears to be that non-military

(*Continued on page* 46)

Letters to the Editor

(*Continued from page* 45)

things must continue to be de-emphasized—we must continue to stay behind in development of so many important non-military things so long as we are obliged to carry the military burden as we are now.

On the other hand, I feel that we are just passing through a phase in world affairs that will eventually straighten out satisfactorily. For example, it might happen that eventually the only military burden we will carry will consist of the maintenance of a world police force, with no other organized military forces in existance. This would require less than one tenth as much arms as we are presently supporting. The points raised in your article would certainly be pertinent in this case. What industrial and consumer markets can electronics find? I am especially interested in electronics for auto safety and traffic control, since I am a senior radar design engineer, and it appears that radar will eventually be used extensively in these applications.

Would you please send me the names and addresss of companies that are conducting research on the use of radar in connection with motor vehicles?

Richard J. Symonds
435 Beirut Ave.
Pacific Palisades, Calif.

"Electronic Hardware—"

Editor, ELECTRONIC INDUSTRIES:

Would you please send me a reprint of the very useful article entitled "Electronic Hardware" by L. H. Henschel that appeared in the following issues of ELECTRONIC INDUSTRIES: Part I, Vol. 18, No. 6; Part II, Vol. 18, No. 9; and Part III, Vol. 18, No. 12—1959.

W. R. Marklein,
Materials & Processes,
Laboratory,
Building 273, Room 1055
General Electric Company,
273 North Ave., Schenectady 5, N. Y.

"Electronics In Agriculture"

Editor, ELECTRONIC INDUSTRIES:

We have received one copy of your article, "Electronics and the Future of Agriculture." I wish to compliment you on the scope of your article and the method in which you handled the material.

Truman E. Hienton, Chief,
Farm Electrification
Research Branch
U. S. Dept. of Agriculture, Agricultural Research Service, Agricultural Engineering Div., Beltsville, Md.

(*Continued on page* 57)

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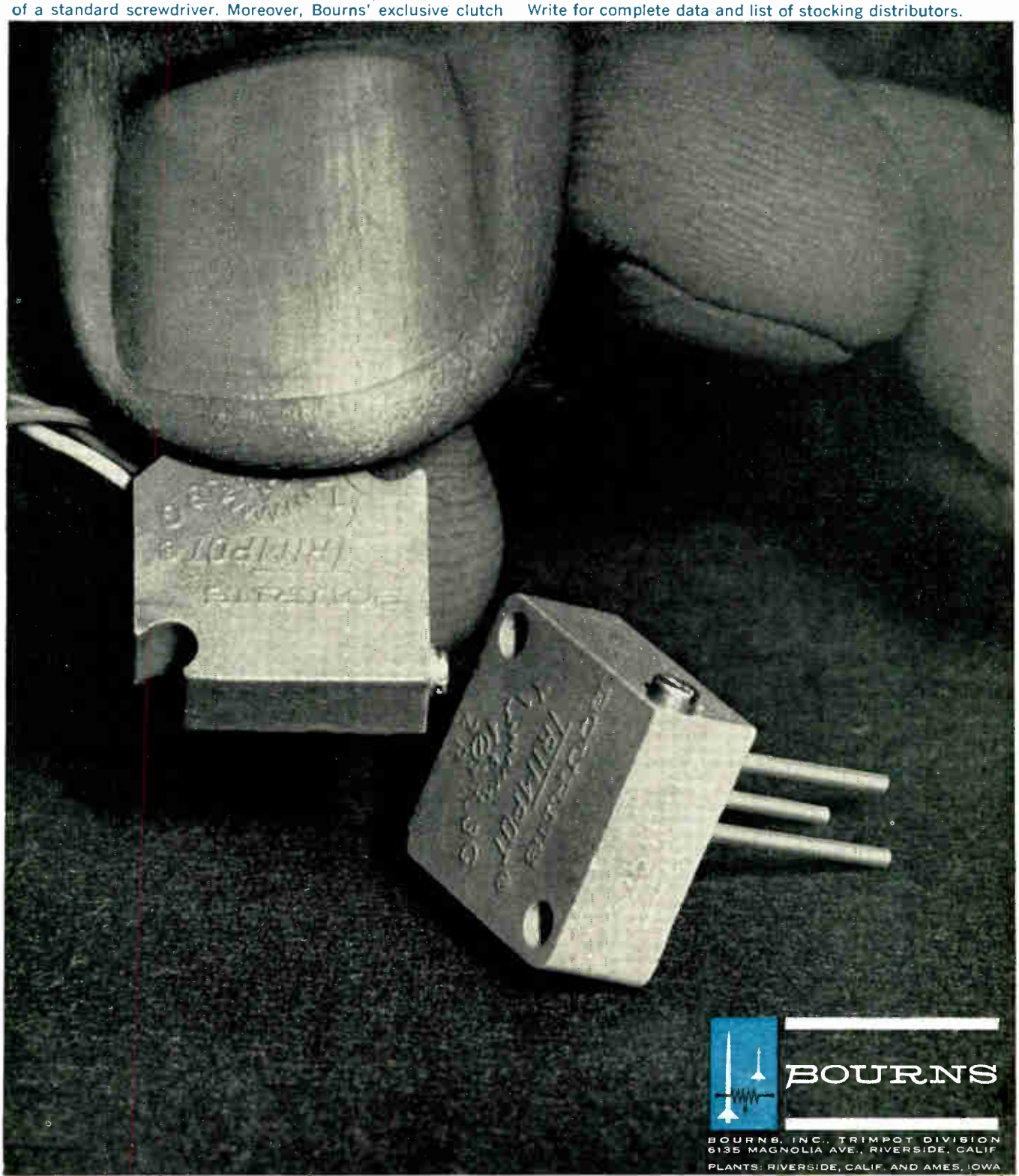

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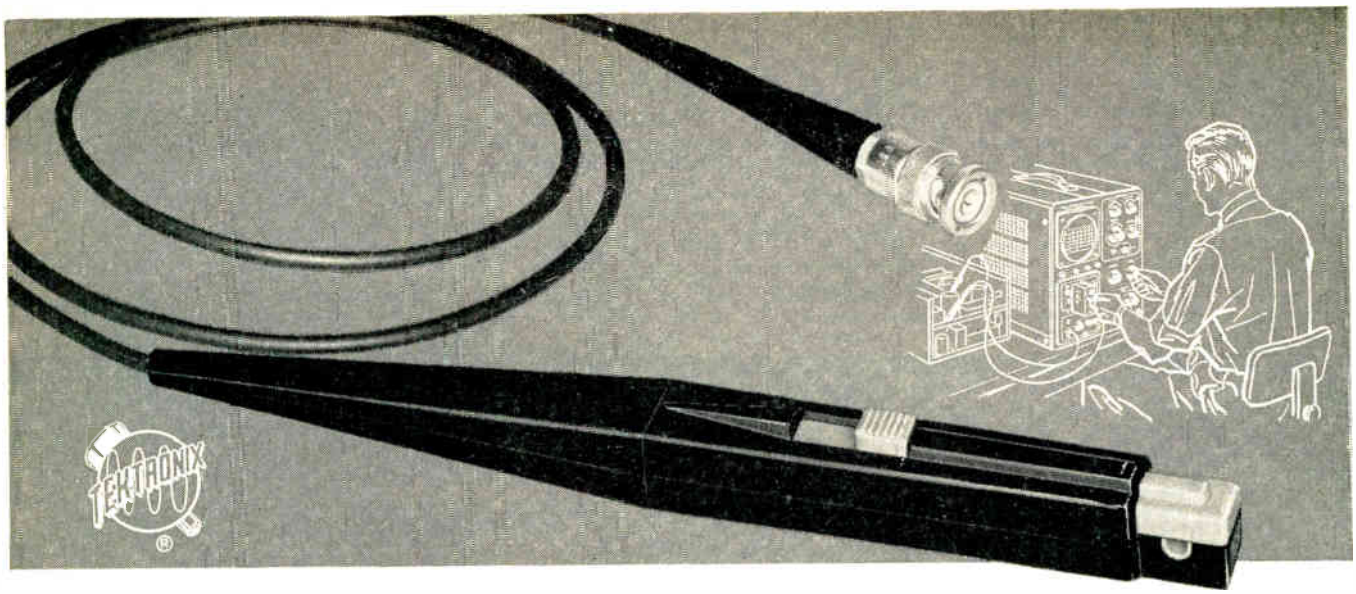

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A second system comprises the P6016 AC Current Probe with a Passive Termination. Although less versatile, this system provides for observation and measurement of current waveforms at frequencies to approximately 20 mc with a 30-mc oscilloscope.

Long narrow shape and convenient thumb control make the P6016 easy to use. Just place probe slot over conductor and close slide with thumb—no direct electrical connection is required. Wiping action keeps core surfaces clean. Loading introduced is so light that it can almost always be disregarded.

CAREER OPPORTUNITIES now exist at Tektronix in the following fields: Instrument design, Circuit design and engineering, Cathode ray tubes, Electron physics, Solid state and semi-conductor devices. For information write to Irving Smith, Professional Placement.

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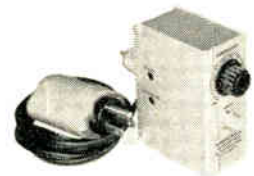
SPECIFICATIONS

P6016 and TYPE 131 SYSTEM



Sensitivity with 50 mv/div Oscilloscope Input:
1 ma/div basic sensitivity. Ten-position switch provides calibrated steps of 1, 2, 5, 10, 20, and 50 ma/div . . . 0.1, 0.2, 0.5, and 1 amp/div, accurate within 3%. Continuous uncalibrated adjustment is possible by using variable control on the oscilloscope.

Noise:
Equivalent to a 100-microampere peak-to-peak input signal.

Risetime (with Type K or L Plug-In Unit in a Type 540-Series Oscilloscope):
20 nanoseconds (approximately 17 mc at 3 db down).

Low-frequency Response:
50 cps at 3 db down.

Maximum Current Rating:
10 amperes peak-to-peak.

Power Requirements:
105-125 volts ac, approximately ½ watt at 117 v.

P6016 and PASSIVE TERMINATION SYSTEM

Sensitivity:
Either 2 or 10 milliamps per millivolt of oscilloscope sensitivity, accurate within 3%.

Risetime (with Type K or L Plug-In Unit in a Type 540-Series Oscilloscope):
16 nanoseconds (approximately 20 mc at 3 db down).

Low-Frequency Response:
At 2 ma/mv—about 850 cps at 3 db down (5% tilt of 14 microsecond square pulse).

At 10 ma/mv—about 230 cps at 3 db down (5% tilt of 55 microsecond square pulse).

Maximum Current Rating:
15 amperes peak-to-peak.

COMMON TO BOTH SYSTEMS

Direct Current Saturation Threshold:
½ ampere.

Maximum Breakdown Voltage Rating:
600 volts, with thumb slide closed.

Insertion Impedance:
About 0.005 ohms or less in series with conductor under test, and typically about 1.5 picofarads between the conductor and probe case.

Price, TYPE P6016 and TYPE 131 SYSTEM	$235
TYPE P6016 and PASSIVE TERMINATION SYSTEM	$ 90
Type P6016, purchased separately	$ 75
Type 131, purchased separately	$160
Passive Termination, purchased separately	$ 15

f.o.b. factory

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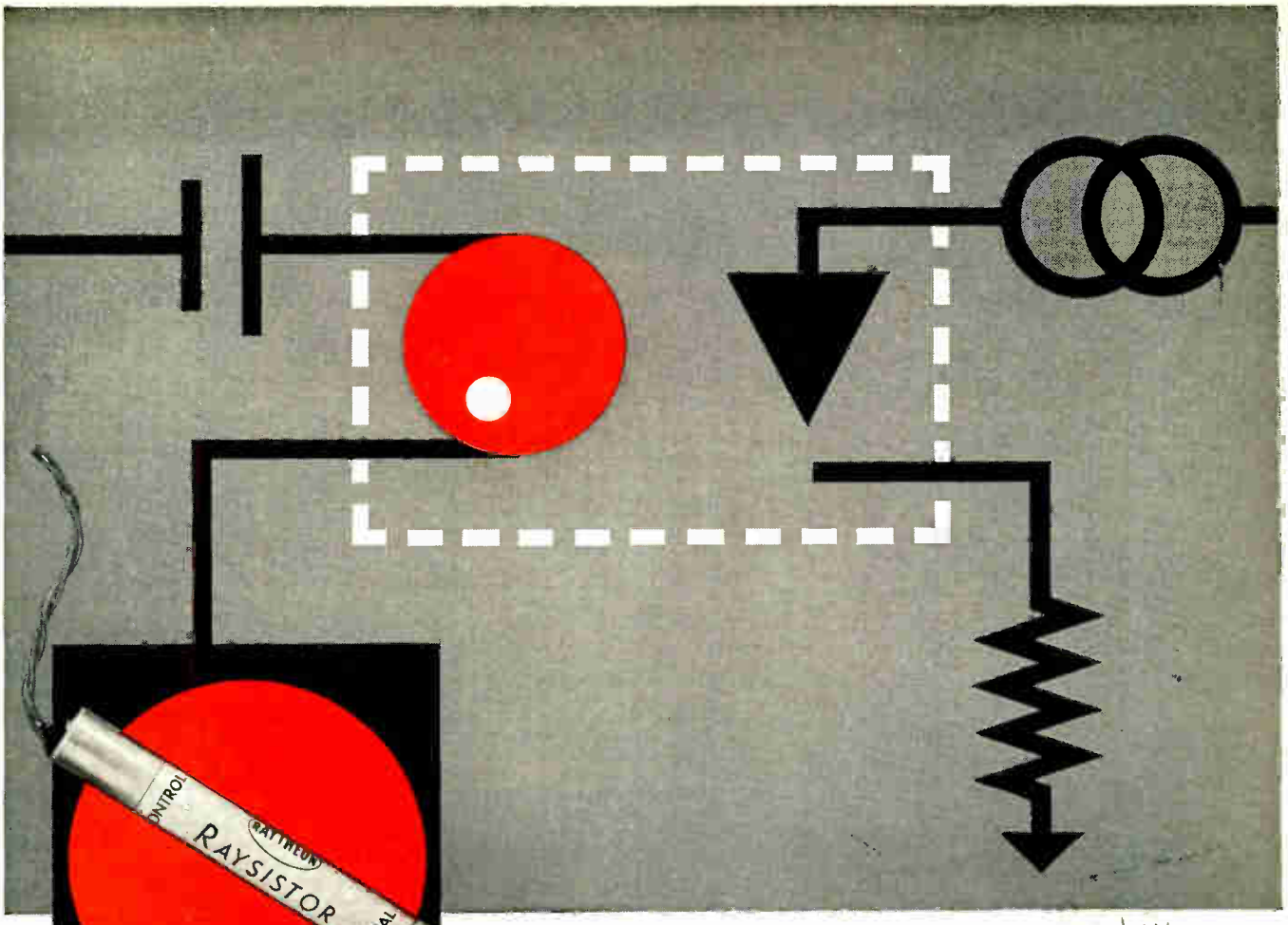

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FM/FM TELEMETERING TRANSMITTER 4 Watts
MODEL 1483

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3.37" x 3.25" x 2"
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Letters to the Editor

"Human Factors—"

Editor, ELECTRONIC INDUSTRIES:

I am very interested in the article "Human Factors—Newest Engineering Discipline" by Christopher Celent which appeared in your February 1960 issue of ELECTRONIC INDUSTRIES, and would appreciate your forwarding me a reprint of the article.

I look forward to receiving ELECTRONIC INDUSTRIES each month and would like to take this opportunity to commend the staff for a very interesting and useful magazine.

Allan M. Stave,
Human Factors Section,
Technical Specialties Br.,
Offensive Engineering Div.
Wright Air Development Div., Air Research and Development Command.

"Electronic Sources"

Editor, ELECTRONIC INDUSTRIES:

In No. 4 April 1960 of ELECTRONIC INDUSTRIES Vol. 19, we found abstracts of our article on pages 189, 191 and 194 with some mistakes, as following:

Page 189

There is: (i) Resistance Voltage Dividers for Impulse Tests. K. Auleytner. R. Wlodarski. "Prace ITR," Vol. 5, No. 3. (ii) A Certain Problem in Solving Linear Circuits with Inductive Couplings Between Branches. T. Kaczorek. "Prace ITR," Vol. 5, No. 3.

It should be: (i) Resistance Voltage Dividers for Impulse Tests. K. Auleytner, R. Wlodarski. "*Rozprawy Elektrotechniczne PAN*," Vol. 5, No. 3. (ii) A Certain Problem in Solving Linear Circuits with Inductive Couplings Between Branches. T. Kaczorek. "*Rozprawy Elektrotechniczne PAN*," Vol. 5, No. 3.

Page 191

There is: Transmitter for 1— V.F. Dialling System. F. Keminski. "Prace ITR," Vol. 3, No. 3 (9).

It should be: Transmitter for 1— V. F. Dialling System. F. Kamiński, "Prace ITR," Vol. 3, No. 3 (9).

Page 194

There is: Frequency Synthesizers. A. Nowak. "Prace ITR," Vol. 5, No. 3.

It should be: Frequency Synthesizers. R. Nowak. "*Rozprawy Elektrotechniczne PAN*," Vol. 5, No. 3.

Dr. Ing. A. Wojnar
Instytut Tele-i-Radiotechniczny, Ul, Ratuszowa ii, Warsaw 4, Poland.

Ed.: We are happy to print Dr. Wojnar's corrections, but we cannot help but wonder how he got the copy of EI. We have no registered—or known—circulation in the Iron Curtain countries.

Books

Electronic Processes in Solids

By T. R. Aigrain, R. J. Coelho and G. Ascarelli. Published 1960 by The Technology Press, MIT, and John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 67 pages. Price $4.00.

This book is intended for those with a background in calculus and wave mechanics.

Band theory and transport theory in covalent semiconductors are presented on a level intermediate between that of the detailed original work and that of elementary treatment. The major assumptions are discussed in some detail but the mathematical developments have only been indicated.

The rather new thermodiamic approach to transport theory and a unique treatment of the "hot electron" problems will interests physicists, as well as those who are mostly concerned with practical applications.

Analogue and Digital Computers

Edited by M. G. Say, A.C.D. Haley, and W. E. Scott. Published 1960 by Philosophical Library, Inc., 15 E. 40th St., New York 16. 308 pages. Price $15.00.

This book, written by a panel of specialists, aims at presenting the basic material on the design and application of both analog and digital computing systems. It is intended primarily as a first source of information for newcomers to the computing field, but also provides a useful background for those experts in other subjects whose duties bring them into contact with computing systems.

Avionics Research; Satellites and Problems of Long Range Detection and Tracking

Edited by E. V. D. Glazier, E. Rechtin and J. Voge. Published 1960 by Pergamon Press Inc., 122 E. 55th St., New York 22. 257 pages. PPrice $10.00.

This work contains the proceedings of the symposium held in Copenhagen by the Advisory Groups for Aeronautical Research and Development (AGARD), NATO.

A principal purpose of the Avionics Panel of AGARD is to highlight profitable areas of avionics R&D which may be carried out in the various countries of NATO.

The papers in this volume show how the study of the physical environment is important for all operations in the high atmosphere and space; they indicate areas for basic physical research to be carried out cooperatively among the NATO countries; and they demonstrate how closely technology today follows on the heels of "pure" research.

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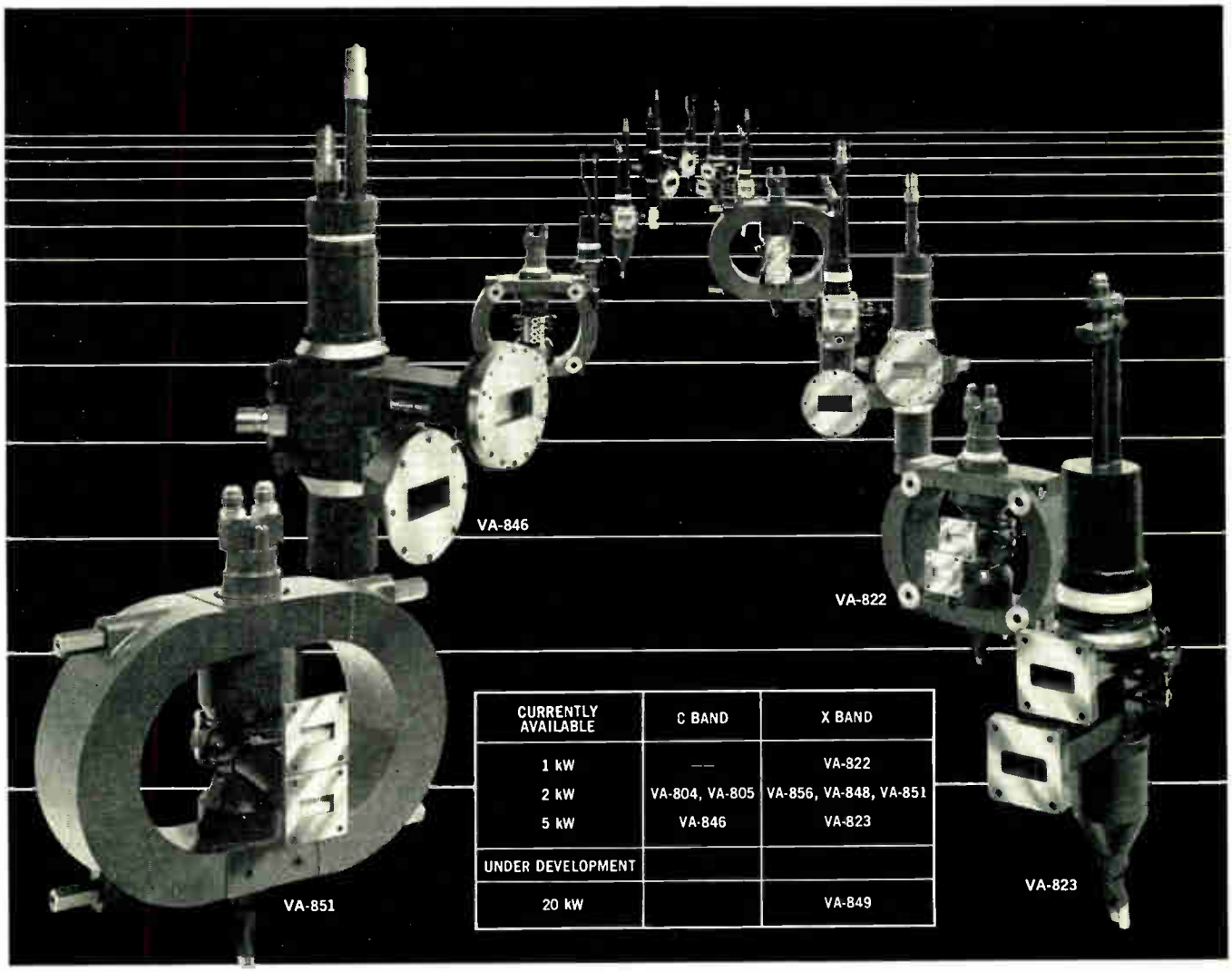
Because of their extremely low noise close to the carrier, these types will enable you to design radar and illuminator systems of great sensitivity and precision. They also afford new design opportunities in radio astronomy and communications systems.

May we send full specifications or discuss development of special types for your requirements?



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1 kW	—	VA-822
2 kW	VA-804, VA-805	VA-856, VA-848, VA-851
5 kW	VA-846	VA-823
UNDER DEVELOPMENT		
20 kW		VA-849

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Books

Organizing the Technical Conference

By Herbert S. Kindler. Published 1960 by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 139 pages. Price $5.50.

This is more than a book about holding technical conferences; it is a working manual that clearly charts the duties and activities of the organizing committee. It answers completely the questions of when to initiate, and how to plan, organize and conduct effective technical conferences, whether large or small. All facets of programming, promoting, documenting, administering and evaluating professional meetings of all kinds (symposia, workshops, seminars, lectures, clinics and exhibits) are explained. The book also analyzes and interprets key factors that contribute to a successful conference.

Thermoelectricity

Edited by Paul H. Egli. Published 1960 by John Wiley & Sons, Inc., 440 Park Ave. So., New York 16. 407 pages.

This book is divided into four sections. Section 1 presents an introduction and broad survey of the fundamental concepts of thermoelectricity. The second section examines the physics of the properties which determine thermoelectric performance. The last section emphasizes high temperature problems and explores the relative merits of static and transient methods of measuring thermoconductivity. In conclusion, written by Dr. Eglie, synthesizes the ideas presented in the main body of the book and offers valuable guides for the selection of materials at this early stage of development.

The Dynamic Behavior of Thermoelectric Devices

By Paul E. Gray. Published 1960 by The Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 136 pages.

This book is the first published report that investigates the small-signal dynamic behavior of thermoelectric devices.

Exact analysis of thermoelectric heat pumps and generators is difficult because these devices are described by differential equations that contain product-type nonlinearities. But since the dynamic behavior of these devices is of interest principally as a consequence of the requirement for control of the device, much useful information can be obtained by small-signal analysis.

Automatic Translation

By D. Yu. Panov. Published 1960 by Pergamon Press, Inc., 122 E. 55th St., New York 22, N. Y. 73 pages. Price $3.50.

This work is an informative ac-

(*Continued on page* 58)

Which cable has the
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Both shielded cables have the same number of twisted pairs with identical AWG. But . . . the cable with exclusive Belden BELDFOIL is smaller in diameter.

What does this mean to you? It means that when you specify BELDFOIL, you are really buying extra space—extra conduit space, extra raceway space, extra console and rack space.

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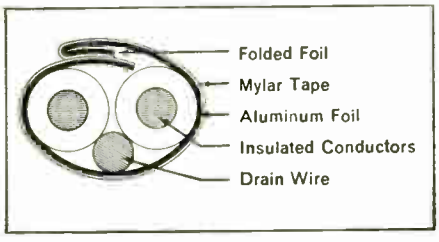

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*Belden Trademark Reg. U. S. Pat. Off.
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SINCE 1902
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power supply cords • cord sets and portable cordage • electrical household cords • magnet wire • lead wire • automotive wire and cable • aircraft wires • welding cable

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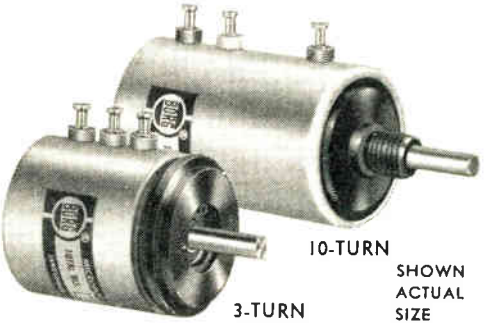
NOW FROM BORG, MAKER OF FAMOUS MICROPOTS, COMES AN IMPORTA BREAKTHROUGH IN THE FIELD OF MINIATURIZED PRECISION POTENTIOMETERS

NEW BORG 2100 SERIES MINIATURE MICROPOTS



A new concept in the field of miniature precision potentiometers . . . Borg 2100 Series Micropots! Only 7/8″ diameter, these new Micropots are wirewound, multiturn and linear. Housings are aluminum for maximum heat dissipation and are completely sealed against sand, dust and moisture. Permanent concentricity is assured. Terminals are gold plated for perfect solderability and are color coded to identify function! Available in ten and three-turn models, the 2100 Series can be ganged up to three units. Standard resistance ranges of from 25 to 120,000 ohms for ten-turn models, and from 10 to 40,000 ohms for three-turn models are available. Other resistances on special order. Let us send you complete information on new Borg 2100 Series Micropots today!

BORG EQUIPMENT DIVISION
Amphenol-Borg Electronics Corporation
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Write for complete engineering data . . .
ask for Catalog Sheets BED-A160 and BED-A161

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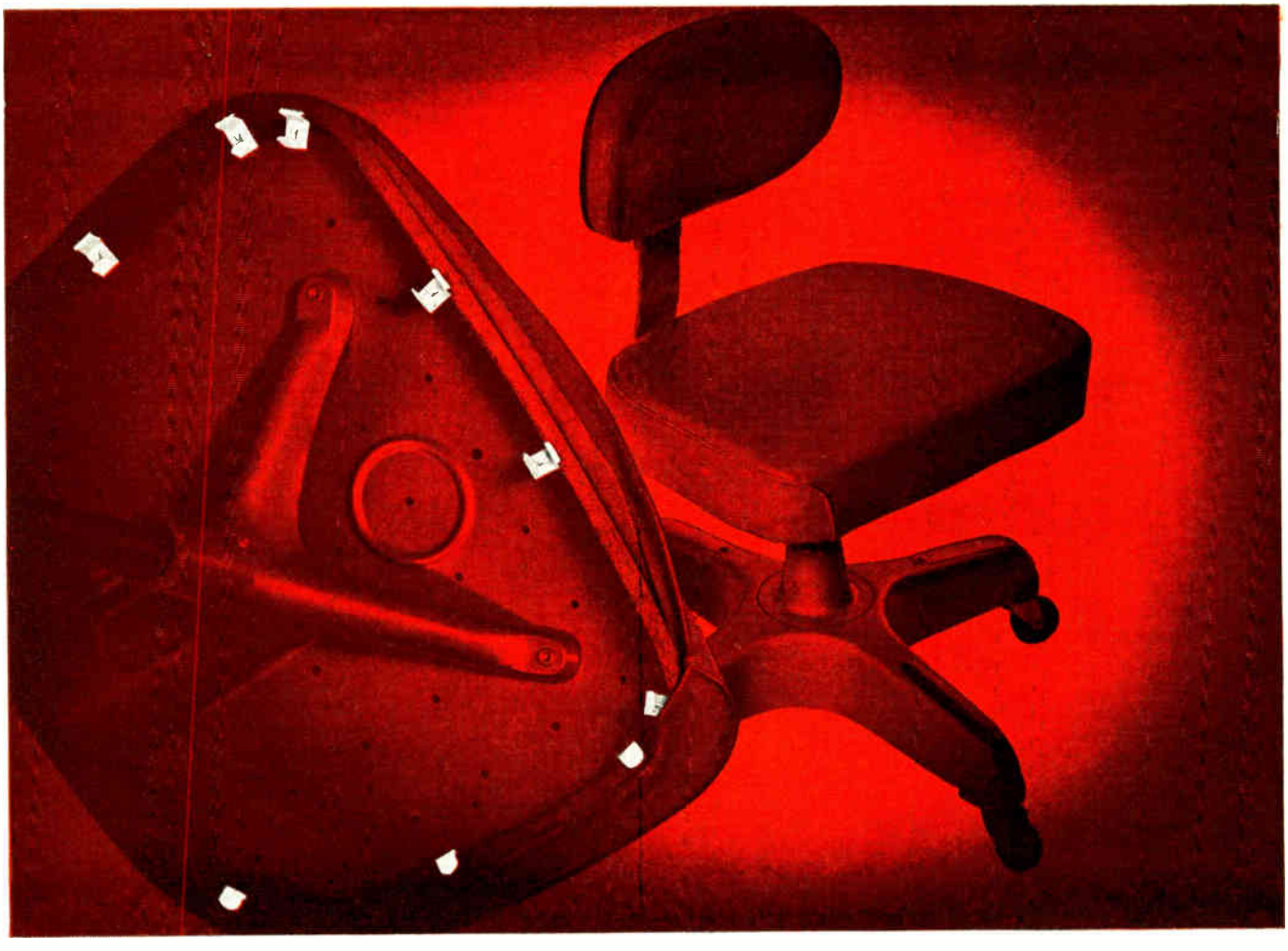
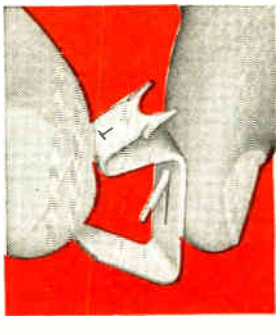
Mechanical Rotation	ten-turn: 3600° +5° −0°*; three-turn: 1080° +5° −0°*
Electrical Rotation	ten-turn: 3600° +5° −0°*; three-turn: 1080° +5° −0°*
Total Resistance Range	ten-turn: 25 to 120,000 ohms**; three-turn: 10 to 40,000 ohms**
Standard Linearity	±0.5%
Temperature Range	−55°C to 125°C

*These tolerances are identical.
**Tolerances: ten-turn — 25 to 50 ohms ±10%; 100 to 120,000 ohms ±3%; 120,000 ohms ±5%.
three-turn — 10 to 30 ohms ±10%; 100 to 40,000 ohms ±3%.



Another SPEED NUT Savings Story . . .

62% cost reduction made with **SPEED CLIPS**® on Cramer Posture Chairs



A dozen SPEED CLIPS now do the job of fastening upholstery to the steel seat of Cramer Posture Chairs. Before the switch to Tinnerman SPEED CLIPS, an expensive formed-steel rim was spot-welded to the seat to do this job.

SPEED CLIPS save Cramer at least 46 cents—or 62% of fastening cost—on each chair . . . they eliminate the rim-forming and spot-welding operations . . . permit faster, easier assembly . . . simplify disassembly if the chair ever needs re-upholstering. Working jointly with Cramer's engineering staff, Tinnerman fastening specialists were able to provide all these advantages without sacrificing product quality.

Assembly costs on your product are likely to benefit greatly, too, if you'll enlist the aid of this Tinnerman team. You can arrange for a free FASTENING ANALYSIS of your product simply by calling in your nearby Tinnerman representative. You'll find him listed in the "Yellow Pages" and in Sweet's PD File under "Fasteners." Or write direct to:

TINNERMAN PRODUCTS, INC.
Dept. 12 • P. O. Box 6688 • Cleveland 1, Ohio

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Speed Nuts®

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CANADA: Dominion Fasteners Ltd., Hamilton, Ontario. GREAT BRITAIN: Simmonds Aerocessories Ltd., Treforest, Wales. FRANCE: Simmonds S. A., 3 rue Salomon de Rothschild, Suresnes (Seine). GERMANY: Mecano-Bundy GmbH, Neidelberg.

Books

(*Continued from page* 54)

count of the problem of automatic translation from one language to another, written by one of the leading Russian scientific experts in this field.

The book gives not only full details of the early experiments using the BESM electronic computer of the USSR Academy of Scientists for translation of scientific material from English into Russian, but also covers recent progress and future prospects. Actual examples of translated texts and results are included, and the possibilities of automating literary translation and of dealing with more complex problems such as translating Oriental languages are discussed.

Books Received

Official Registry of Business and Miscellaneous Radio Systems

Published 1960 by Communication Engineering Book Co., Monterey, Mass. Edited by Ethel V. Sleeper. 103 pages, paper bound. Price $5.00.

Histological Techniques for Electron Microscopy

By Daniel C. Pease. Published 1960 by Academic Press, 111 Fifth Ave., New York 3, N. Y. 275 pages. Price $7.50.

Proceedings of the First User's Conference on Dynamic Digital Logic

Published 1960 by Computer Control Co., Inc., 983 Concord St., Framingham, Mass. 72 pages, paper bound.

Air Transport Indicator Cases and Mounting, ARINC Spec. No. 408

Published 1960 by Aeronautical Radio, Inc., 1700 K St., N.W., Washington 6, D. C. 44 pages, paper bound. Price $1.00.

GOVERNMENT ELECTRONIC CONTRACT AWARDS

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

Adapters, connector	27,711
Altimeter, radar	80,000
Amplifiers	176,901
Amplifiers, i-f	46,451
Amplifiers, spectrum	291,740
Antennas	1,293,561
Armature assemblies	35,274
Batteries, storage	1,346,498
Bolometers	26,372
Blower assemblies	316,000
Boxes, junction	74,988
Bridges, wheatstone	75,240
Cable assemblies	253,998
Cable, r-f	97,012
Cable, telephone	36,933
Calibrators, range	207,252
Calibrators, transducer	62,720
Capacitors	32,262
Capacitors, variable	27,266
Changers, frequency	229,230
Computers, digital	427,898

(*Continued on page* 66)

Centralab Ceramic-to-Metal Seals withstand 14,000 psi at 350°C*

The art of high temperature ceramic metalizing has been developed to new heights by CENTRALAB engineers. The most exacting tolerances can be readily achieved, as can the most permanent bond. Whether metalizing for the attachment of metal hardware or in preparation for hermetic sealing, CENTRALAB'S techniques will satisfy the most critical requirements.

* Temperature limits and tensile strength are functions of the geometry of the part and/or the melting point of the brazing alloy. Bond strengths are routinely achieved as high as 14,000 psi. This high temperature metalizing is a suitable base for silver solders, B-T brazing alloys, copper and many other metals. All seals are 100% tested on a mass spectrometer, with no leaks detectable to 2×10^{-10} cc/sec.

For additional technical data, write for CENTRALAB Bulletin EP-994.

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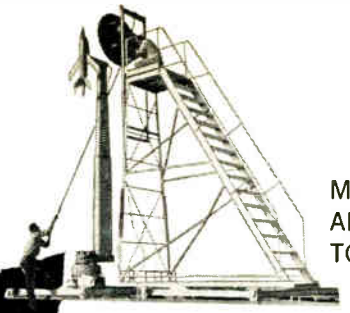
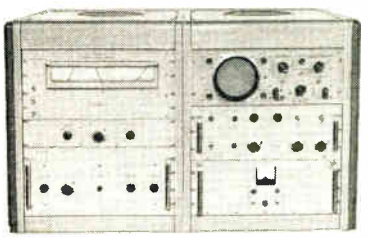


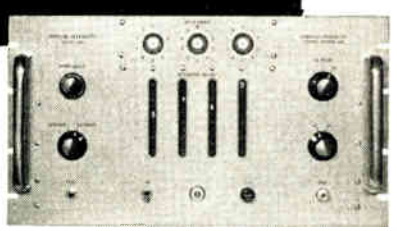
MODEL RANGE AND TRANSMITTING TOWERS

STANDARD GAIN HORNS AND TRANSMITTING ANTENNAS

CENTRALIZED OPERATING CONSOLES



FOURIER INTEGRAL COMPUTERS



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2

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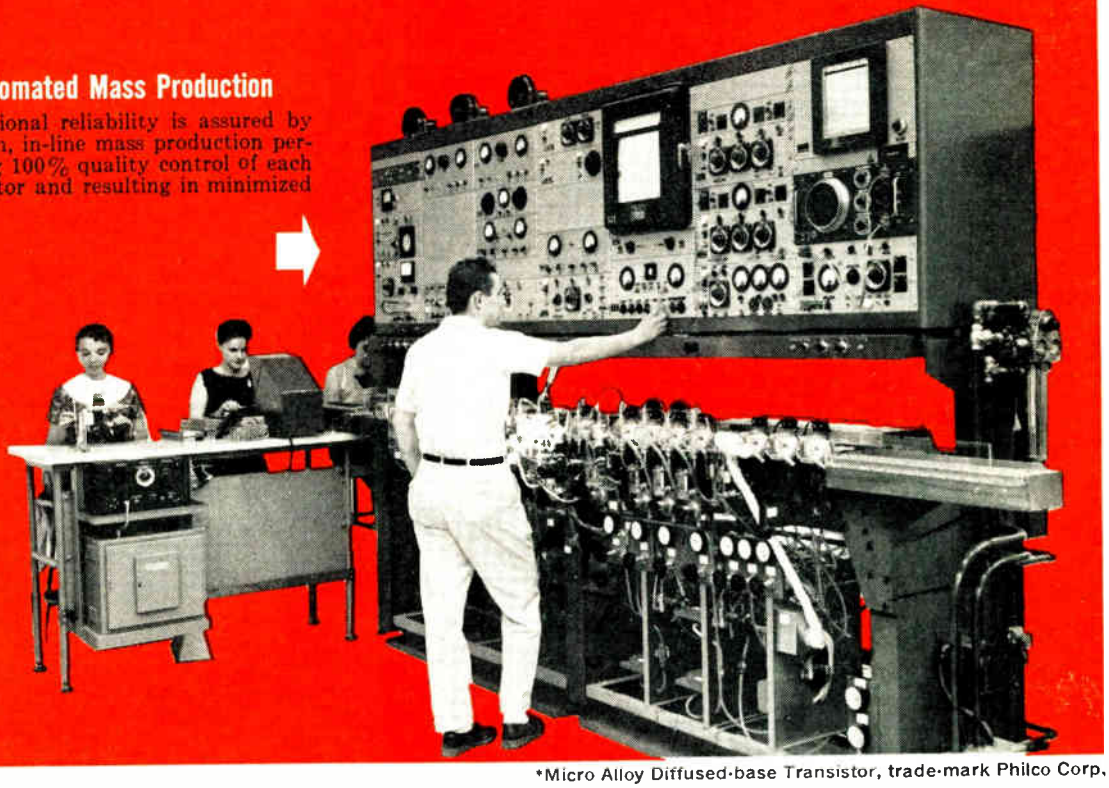

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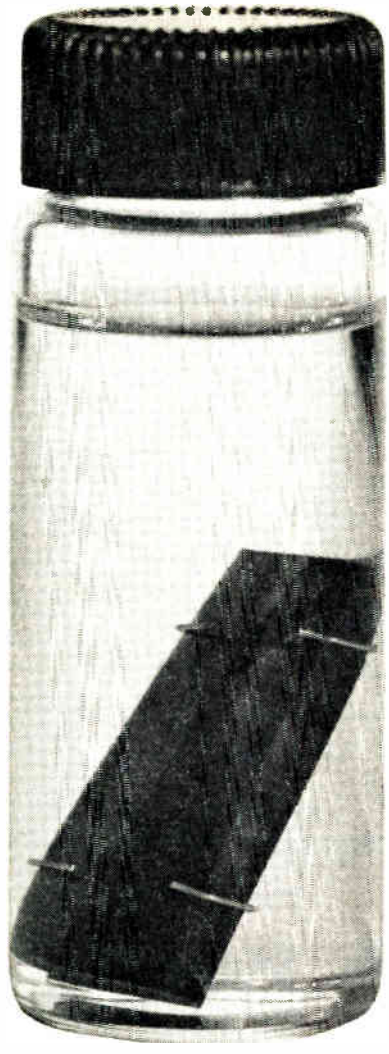
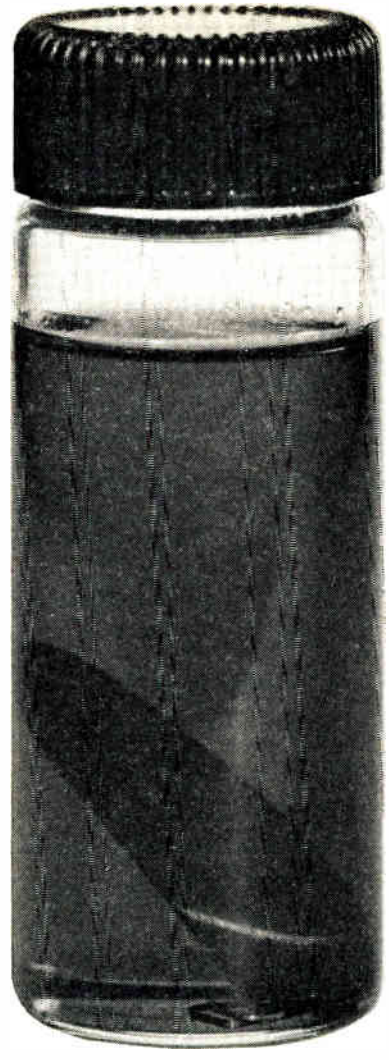


"FREON" SOLVENT left this acrylic resin and metal unharmed after prolonged exposure.



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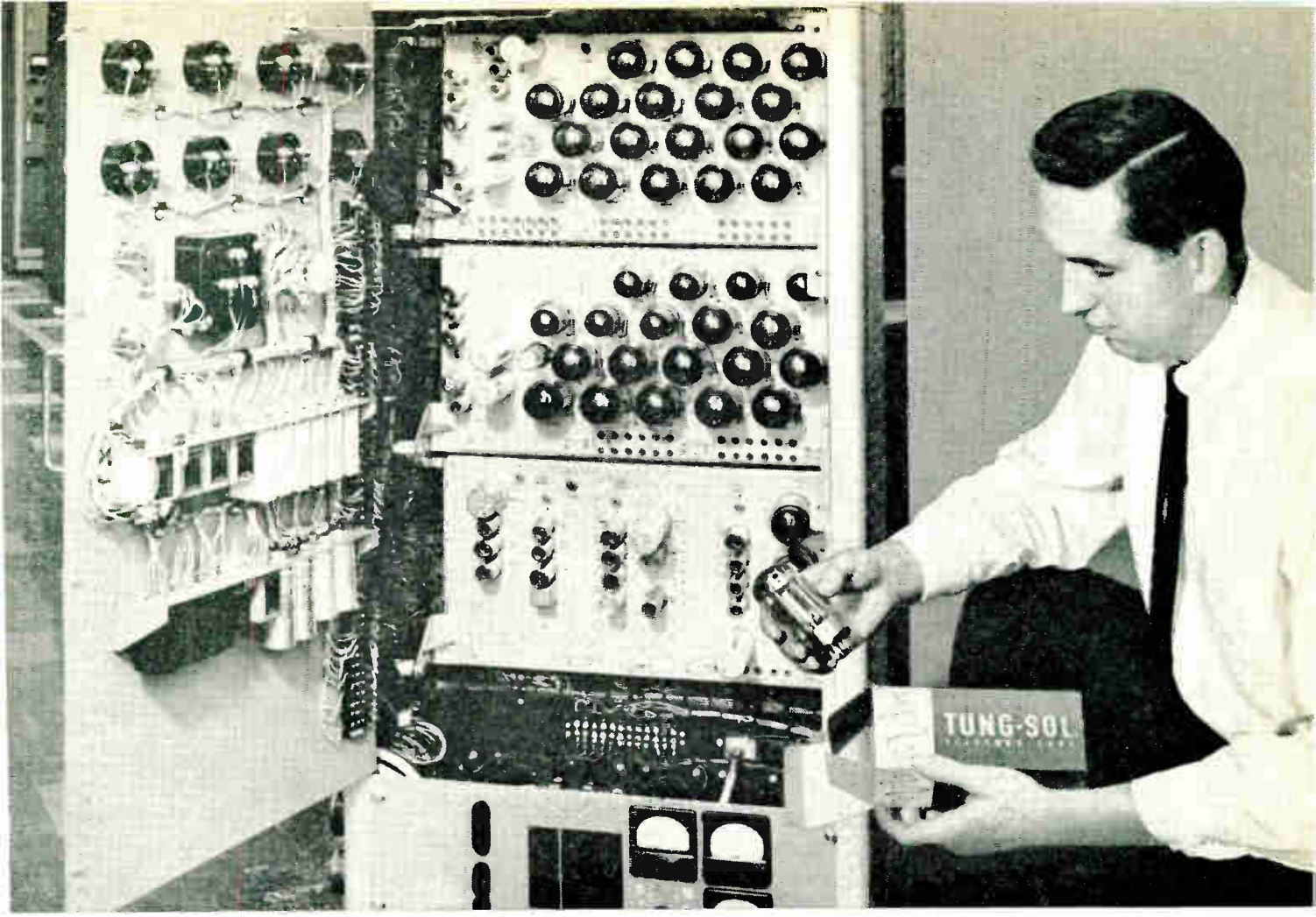


Tung-Sol/Chatham 6336A lets HUGHES shave size of vital power supply

This is Hughes' 9-in-1 powerhouse. It's doing a mighty turn in the national defense effort at Hughes' El Segundo plant. There the Integrated Power Supply is serving as a comprehensive power source for testing fire control systems. It supplies 9 DC voltages and delivers up to 2 kilowatts with the kind of accuracy that makes these systems perform with split-second precision.

Hughes selected the Tung-Sol 6336A's to handle the all-important voltage regulation function. A 34-tube bank is used. Hughes' reasons for selecting the 6336A were twofold. High efficiency to keep wasted power heat low was half the story. The other half — superior power handling ability in a small "bottle". These attributes, combined with mounting flexibility, helped Hughes come up with a small package size and a minimum cooling system. Hughes also enjoys the reduced downtime and maintenance requirements resulting from the 6336A's long life and high electrical stability.

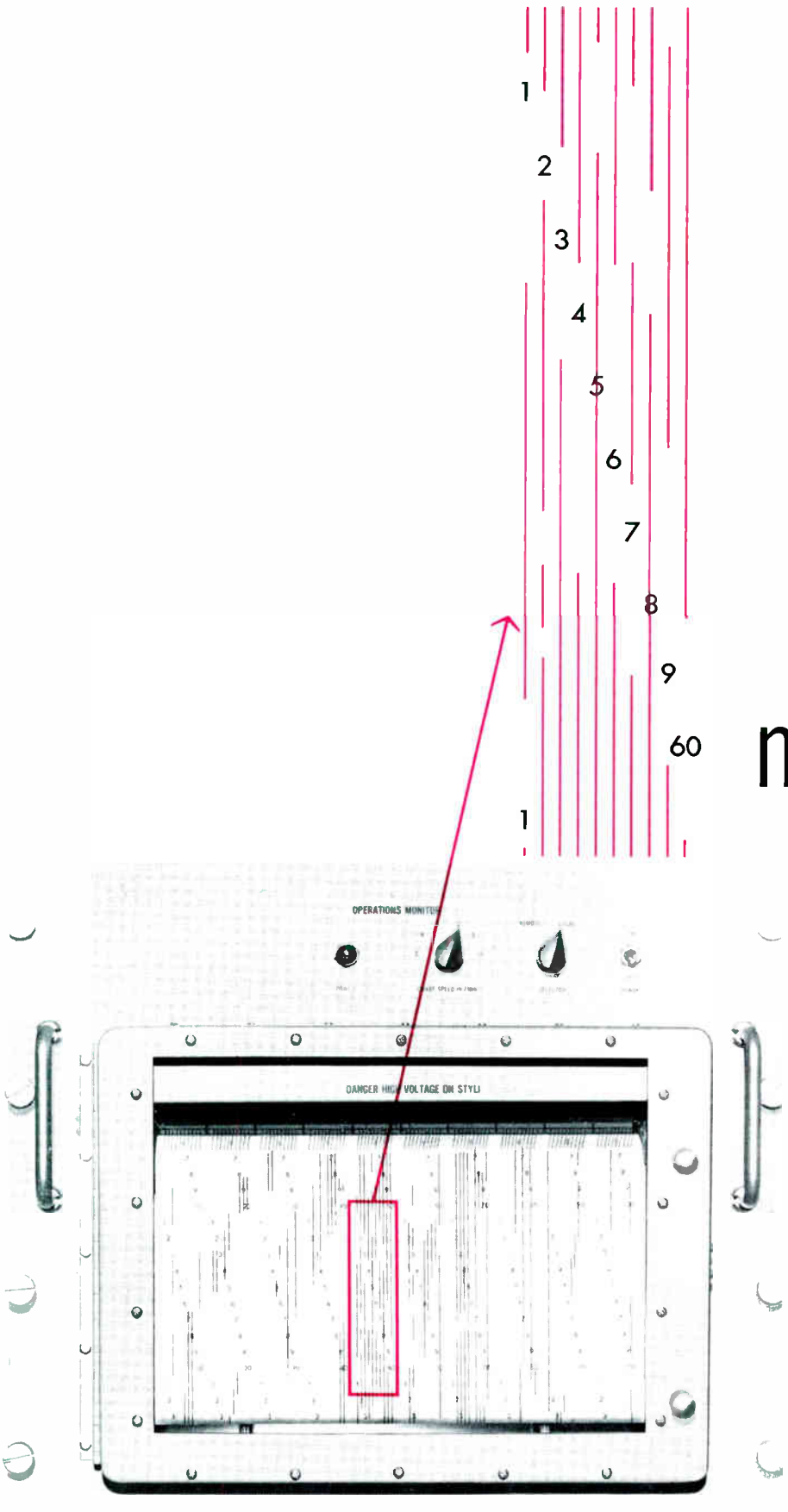
Why don't you get the benefit of Tung-Sol's components know-how, too? Whether it's tubes or semiconductors — and there's a premium Tung-Sol unit for virtually every military and industrial need — you'll be designing only the best components into your circuit. Like Hughes you'll be getting quality units that have made the name of Tung-Sol synonymous with the finest componentry. Tung-Sol Electric Inc., Newark 4, New Jersey. TWX:NK193

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

TUNG-SOL®

(*Continued from page* 58)

Consoles	207,268
Controls	39,500
Controls, intercom	66,035
Converters, telephone signal	74,369
Converters, wind data	72,901
Couplers, antenna	224,478
Couplers, TACAN	319,019
Data handling equipment	80,330
Discriminators	58,791
Duplexers	27,840
Echo sounders	297,650
Filters, band-pass	42,800
Fuel cells	88,010
Fuses	159,014
Generators, pulse	188,148
Generators, special purpose	84,449
Heads, record playback	58,397
Indicators, special purpose	414,840
Logging system, digital data	27,840
Loran	458,000
Meters, frequency	1,048,293
Meters, ohm	38,905
Meters, volt	453,772
Microphones	79,654
Modulators	126,155
Multimeters	482,661
Navigation systems, radar	488,083
Netting, radar	4,681,765
Oscillators	755,953
Oscillators, r-f	46,000
Oscillographs	45,058
Oscilloscopes	984,987
Paper, recording	25,187
Plug, telephone	27,178
Potentiometers	91,137
Power supplies	130,946
Pre-amplifiers	88,328
Radar	9,322,454
Radiometers	33,740
Radio sets	1,131,299
Radiosondes	215,285
Radomes	184,140
Receivers, intercept	29,800
Receivers, radio	241,126
Recorders, data	43,703
Recorders/reproducers	206,892
Relays	89,979
Relays, armature	272,711
Relays, solenoid	83,344
Resistors	26,850
Resistors, decade	51,072
Resistors, variable	305,214
Resolvers	56,428
Semiconductor devices	183,640
Signal generators	1,381,150
Solenoids	57,773
Spectrometers	30,425
Spectrometers, mass	43,363
Standards, capacitance	44,895
Switchboard equipment	61,389
Switches	399,825
Synchros	134,738
Systems, inertial navigation	145,000
Tape, electronic	84,975
Terminal equipment	164,812
Terminal boards	10,320
Terminals, telephone	1,204,644
Test sets, computer	28,448
Test sets, oscillator	102,050
Test sets, radar	1,069,062
Test sets, telephone	34,685
Test sets, telegraph transmitter	34,364
Test sets, transceiver	80,900
Test sets, transistor	113,997
Test sets, tube	235,494
Towers	36,500
Transformers	140,610
Transformers, pulse	41,450
Transmitters	736,757
Transmitters, height-converter	42,147
Transmitter/receivers	50,000
Transmitters, synchro	200,953
Tubes, electron	3,662,062
Tubes, klystron	8,393,176
Tubes, magnetron	1,654,782
Tubes, thyratron	161,200
Tubes, traveling wave	45,000
Vibrators	77,841
Waveguide components	110,208



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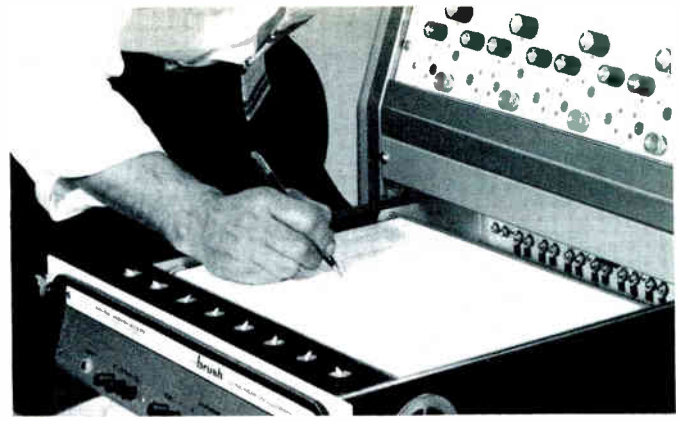

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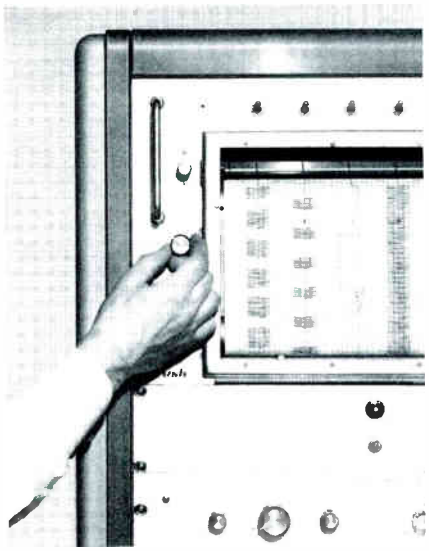
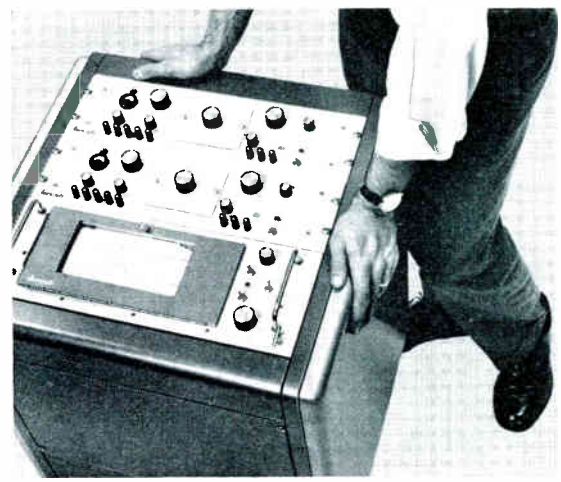
systems





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- **8th ANNUAL MICROWAVE ISSUE**

  With more and more industry attention being focused on this field, this year's issue promises to be packed with more technical data than ever before. Feature articles, new product announcements and new literature announcements will all be microwave-oriented.

- **1960-61 SURVEY OF MICROWAVE POWER SOURCES**

  Up-to-the-minute technical specifications for microwave oscillators, amplifiers, traveling wave tubes, backward wave tubes, klystrons, magnetrons, etc.

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  During the past 20 years the basic principles of microwave beam tube development have been greatly extended and refined. For this reason current manufacture is on a highly competitive basis. What's ahead for the coming decade? The number and variety of tubes manufactured will be greatly increased.

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  An accurate, low cost method of constructing parabolic reflectors.

- **MEASURING MICROWAVE DIELECTRIC CONSTANTS AND DISSIPATION FACTORS**

  A method of measuring the complex permittivity of low and medium loss dielectrics with standard lab equipment is with a shorted line. This shorted line method is discussed with emphasis on both equipment and calculation methods for dissipation factors below 0.1.

Plus all our other regular departments

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

COMING SOON

- **1961 CALENDAR OF COMING ELECTRONIC EVENTS**

  Year-round reference guide to all electronic symposia, conventions and shows.

Watch for these coming issues:

***JANUARY**
Industry Review

***MARCH**
Annual IRE Issue

***JUNE**
Annual All-Reference & Directory Issue

Money and space used to be required for accurate return loss measurements. Now, using an rf voltmeter and bridge, or directional coupler, they can be made directly in db. The simple technique described permits measuring 55 db of return loss . . . equivalent to a VSWR of 1.004.

Determine mismatch by . . .

Measuring Return Loss Accurately

By RAYMOND E. LAFFERTY
Chief Engineer
Boonton Electronics Corp.
738 Speedwell Avenue
Morris Plains, N. J.

MISMATCH in an rf transmission system can be expressed in terms of either the standing wave ratio (VSWR), or the return loss of the system. Both are related to the reflection coefficient. A curve of return loss *vs* VSWR is given in Fig. 1.

R. E. Lafferty

A standing wave ratio greater than unity signifies a mismatch in the system; the degree of mismatch being proportional to the ratio. Slotted line techniques are generally used to measure standing wave ratios, but the ratio becomes increasingly difficult to accurately measure as it approaches unity.

Similarly, any measure of return loss also indicates a system mismatch; the higher the return loss, the better the match. Return loss, however, is a more meaningful figure than the VSWR for it not only informs us as to the degree of mismatch, but it is also a measure of the energy reflected from the discontinuity, or mismatch, relative to the energy directed toward the load.

Although there is little argument as to the usefulness of return loss measurements, heretofore accurate measurements have required a considerable expenditure of both money and space. Return loss measuring facilities presently in use at several laboratories permit measurements from zero to approximately 40 db. These equipments are built around directional couplers and require high gain wide-band amplifiers and precision high frequency attenuators. The cost of such a facility is understandably high.

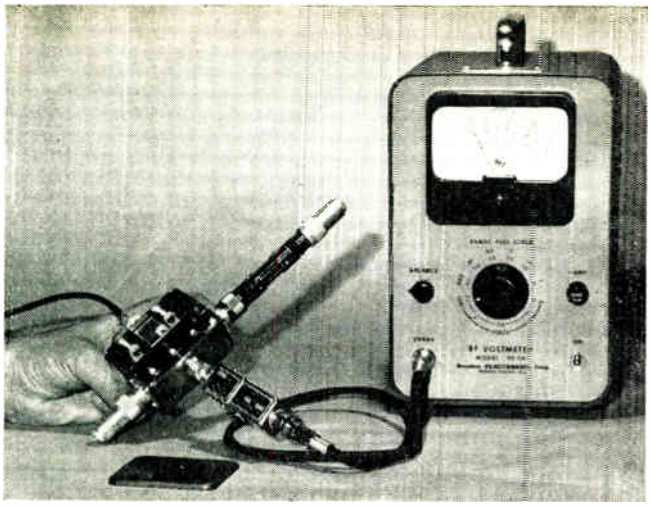
Several years ago an rf voltmeter with a range of 300 microvolts to 3 volts was developed (Boonton Electronics, Model 91CA) which permits return loss measurements to be made with either a directional coupler or a bridge. The measurable range is from zero to over 50 db, from low radio frequencies to several hundred megacycles.

The bridge measurement has the advantage that the impedances of the source and detector (rf voltmeter) are of minor importance, provided they are low and high, respectively. It has the disadvantage that a carefully designed unbalanced-to-balanced transformer is required.

The directional coupler, on the other hand, is unbalanced throughout, but requires careful matching at all four terminals which include the source and the voltmeter.

Return Loss

Before proceeding with the techniques of measuring return loss, it may be well to briefly discuss the relation of return loss, reflection coefficient, standing



Wide-band return loss bridge, showing rf attenuator under test.

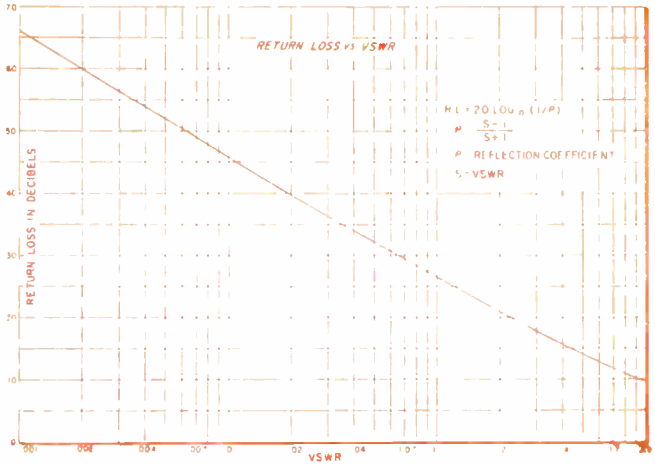


Fig. 1: Curve illustrates the relationship which exists among the return loss, voltage standing wave ratio, and reflection coefficient.

wave ratio and impedance.[1] By definition, the reflection coefficient, ρ, is the ratio of reflected voltage to incident voltage, or,

$$\rho = e_r/e_i$$

The return loss, in db, is simply:

$$\text{Return loss} = 20 \text{ Log}_{10} (1/\rho) \qquad (1)$$

We can also say that the impedance, Z_x, which terminates the line is the ratio of the total voltage across the termination to the total current through the termination. The total voltage and current are the sums of the incident and reflected components. That is,

$$Z_x = \frac{e_i + e_r}{i_i - i_r} = \frac{e_i + e_r}{(e_i/Z_o) - (e_r/Z_o)} .$$

Solving for e_r/e_i,

$$\rho = e_r/e_i = \frac{Z_x - Z_o}{Z_x + Z_o} \qquad (2)$$

It can also be shown that the standing wave ratio bears a direct relation to the reflection coefficient. Evidently, maximum voltage along the line occurs when the reflected voltage adds directly to the incident voltage. Similarly, minimum voltage is the result of the reflected voltage subtracting directly from the incident voltage. In equation form,

$$\text{Standing Wave Ratio} = S = \frac{e_{max}}{e_{min}} = \frac{e_i + e_r}{e_i - e_r}$$

Rewriting,

$$S = \frac{1 + \left[\frac{e_r}{e_i}\right]}{1 - \left[\frac{e_r}{e_i}\right]} \qquad (3)$$

But, e_r/e_i equal ρ, the reflection coefficient. Therefore,

$$S = \frac{1 + \rho}{1 - \rho}$$

Bridge Measurement

The schematic of Fig. 2 is for analysis only. Two practical bridge circuits and consideration for their successful operation will be discussed later.

Referring to Fig. 2, circuit conditions for proper performance of the bridge are as follows:

1. Z_1 and Z_2 must be equal and carefully matched. Two resistors are recommended with a value approximately that of Z_o. Residual parameters may be present, but should exist to an equal degree in each resistor.
2. The input impedance of the rf voltmeter, which measures E_o, should be sensibly an open circuit with respect to Z_o.

From simple circuit theory, we can write,

$$E_a = E_g/2$$

and

$$E_b = E_g \frac{Z_o}{Z_x + Z_o}$$

The voltage, E_o, is the difference of E_a and E_b,

$$E_o = E_a - E_b$$

or,

$$E_o = \frac{E_g}{2}\left[\frac{Z_x - Z_o}{Z_x + Z_o}\right]$$

From Eq. (2),

$$E_o = \frac{E_g}{2}\rho \qquad (4)$$

When Z_x is either shorted or open, return loss is zero and the output voltage, E_o, is simply $E_g/2$. This level is used as a reference. With the unknown load impedance connected to the bridge, the output voltage

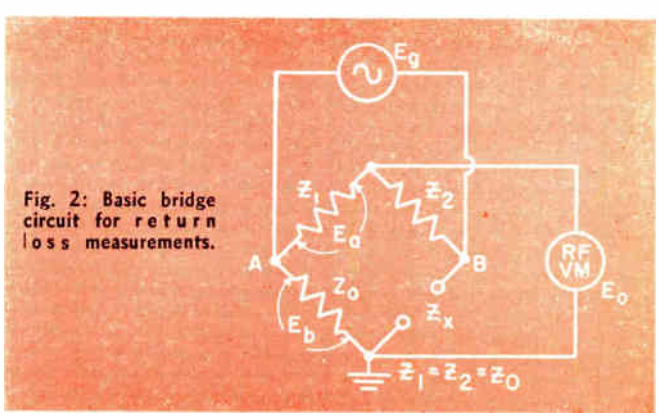


Fig. 2: Basic bridge circuit for return loss measurements.

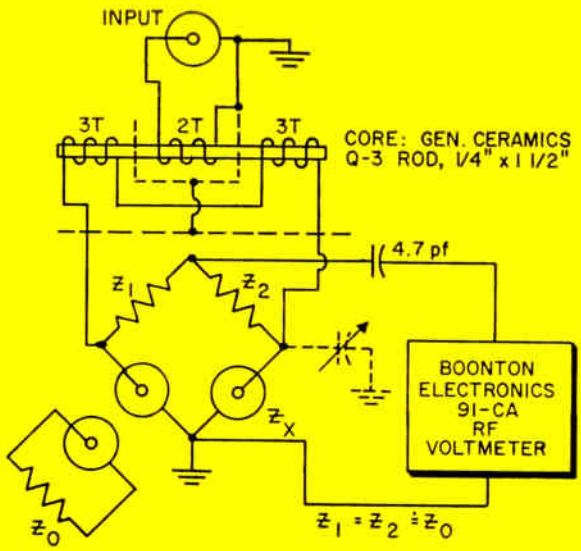


Fig. 3: Five to 200 MC bridge for measuring return loss up to 40 db.

Loss Measurements *(Continued)*

of Eq. (4) is the product of this reference voltage and the reflection coefficient of the load.

Because the voltmeter already mentioned provides a decibel scale, it is only required that the generator output be adjusted for a given meter deflection (preferably, full scale/zero db) with the unknown terminals open or shorted. Subsequently, with the load connected, the meter will read return loss directly in db.

Bridge Construction

Two bridge circuits which have been successfully used are shown in Figs. 3 and 4. The bridge of Fig. 3 will function over a relatively wide frequency range, but is incapable of making as high a return loss measurement as the bridge of Fig. 4. The latter bridge must be tuned to the measuring frequency, hence operates over a narrow frequency band.

The principal reason for the difference in sensitivity of these bridges lies in the degree of balance of the two input transformers. The transformer in Fig. 4 has a tuned secondary and does not require tight coupling for an efficient transfer of voltage. Such an arrangement allows the placement of a good electrostatic shield between primary and secondary windings. It is absolutely essential that capacitive coupling between windings be sensibly zero. Perfect balance, aside from arm impedance considerations, demands the voltage at points A and B of Fig. 2 be 180° out of phase. Capacitive coupling will produce in-phase voltage at these points, and consequently spoil the balance.

The two windings for the transformer of Fig. 3 are wound on a common core of ferrite (General Ceramics, Q-3). A simple electrostatic shield is placed over the primary winding, but because of the proximity some capacitive coupling remains.

An adjustment for balance can be made on either transformer by moving one winding with respect to the other while noting the bridge output voltage as read on the rf voltmeter. This measurement and adjustment should be made without Z_o or Z_x connected to the bridge. By so doing, a check will obtain on the reactive balance of the bridge. The balanced output voltage with respect to the unbalanced output voltage, should be at least 6 to 8 db lower than the highest return loss measurement desired. If the balance is insufficient, a small amount of capacitance may be added to one side of the bridge. A simple test will determine which side requires this capacitance. The capacitor may take the form of a 3/8-inch disc soldered to the end of a grounded screw. Such an arrangement is quite effective and simple to adjust from outside the shield. All adjustments, incidentally, should be made with the bridge shielded as well as possible, consistent with making the adjustments.

Standard Mismatch

Thus far, we have referred to complete unbalance as either short or open circuit conditions at the Z_x connector. If it were possible to tightly couple the generator to the bridge, the same output voltage would obtain for either case. Practically, the coupling must be loose to allow proper electrostatic shielding, hence, the attendant poor regulation will cause the open and short circuit readings to differ. A simple remedy is to provide a standard mismatch in the form of a capacitor mounted in a connector plug. The plug is inserted into the Z_x connector during the initial set-up for the reference voltage. The capacitor should be selected to make the impedance presented to the transformer by the bridge approximately to Z_o. Assuming

$Z_1 = Z_2 \doteq Z_o$, —

$$C = \frac{1}{8 f Z_o}$$

Signal Generators

Where return loss measurements of only 20 to 30 db are needed, the output of a standard signal generator

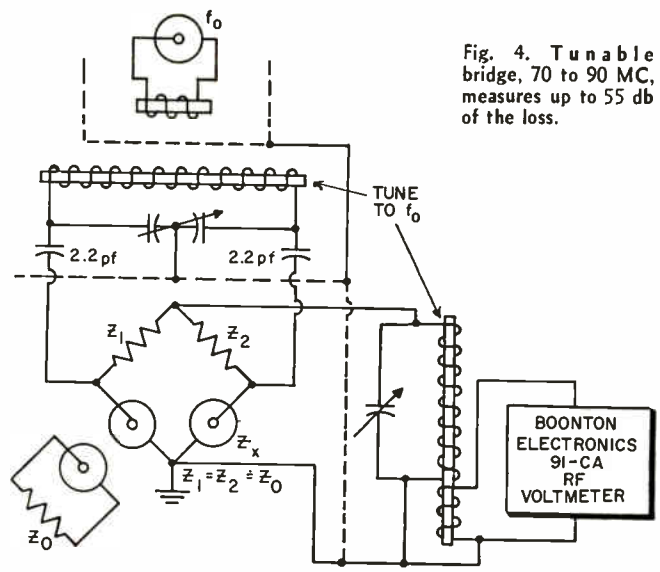


Fig. 4. Tunable bridge, 70 to 90 MC, measures up to 55 db of the loss.

will usually be sufficient. For higher return loss measurements, it will generally be necessary to employ a generator with an output of several volts. If the generator cable length must be electrically long, it will be desirable to add a terminating resistor across the primary winding of the transformer to maintain a low VSWR on the cable.

Coupler Measurements

Fig. 5 shows schematically a typical co-axial directional coupler. This type of network may take several forms, but all are predicated upon a generator-load circuit with both inductive and capacitive coupling to a second circuit consisting of a pair of terminating resistors. When the ratio of mutual inductance to coupling capacitance bears a specific relation to the characteristic impedance, Z_o, the voltage across one terminating resistor will be proportional to the output of the generator, regardless of the impedance of the load. The voltage across the other terminating resistor is directly proportional to the reflection coefficient of the load.

The polarities of the secondary voltages shown in Fig. 5 are for the assumed direction of generator current and the subscripts associated with these polarities indicate whether the voltage is the result of inductive or capacitive coupling. The relation of coupler parameters is given in Fig. 5.

If we examine either terminating resistor for voltage, owing first to capacitive coupling, then to inductive coupling, we acquire an equivalent circuit for each condition. See Figs. 6 and 7.

Let the voltage across either terminating resistor, Z_o, owing to capacitive coupling equal e_1. From the equivalent circuit of Fig. 6,

$$e_1 = E_g \left(\frac{Z_x}{Z_x + Z_o}\right)\left(\frac{Z_o/2}{-j/\omega C}\right)$$

or,

$$e_1 = +j\,E_g \frac{Z_x\,Z_o\,\omega\,C}{2\,(Z_x + Z_o)}$$

Let the voltage across either terminating resistor owing to inductive coupling equal e_2. From Fig. 7,

$$e_2 = e'_2/2 = -j\,\frac{i\,\omega\,M}{2}$$

or,

$$e_2 = \frac{E_g}{2}\left(\frac{\omega\,M}{Z_x + Z_o}\right)$$

The two coupled voltages at connector "D" in Fig. 5 are in phase. E'_o, therefore, equals,

$$E'_o = e_1 + e_2$$

Since M was previously adjusted to equal $C\,Z_o^2$,

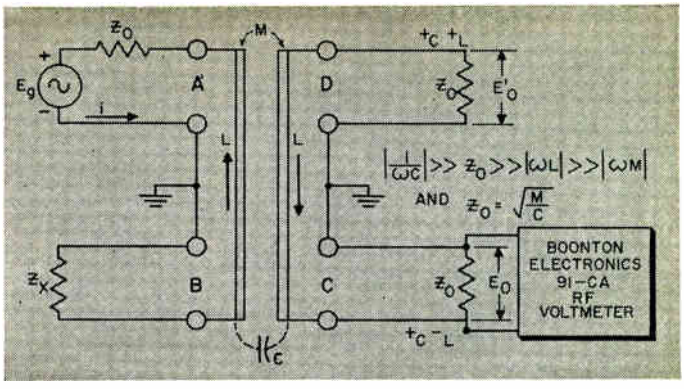


Fig. 5: A form of directional coupler for return loss measurements.

$$E'_o = \frac{E_g}{2}\left[\frac{Z_x\,Z_o\,\omega\,C}{Z_x + Z_o} + \frac{\omega\,C\,Z_o^2}{Z_x + Z_o}\right]$$

and

$$E'_o = \frac{E_g\,\omega\,C\,Z_o}{2}\left[\frac{Z_x + Z_o}{Z_x + Z_o}\right]$$

or,

$$E'_o = \frac{E_g\,\omega\,C\,Z_o}{2} \qquad (5)$$

It is evident that E'_o is independent of Z_x.

At connector "C," Fig. 5, the two coupled voltages are out of phase. We can, therefore, write,

$$E_o = e_1 - e_2$$

Remembering that the directional coupler is adjusted so that,

$$M = C\,Z_o^2$$

$$E_o = \frac{E_g}{2}\left[\frac{Z_x\,Z_o\,\omega\,C}{Z_x + Z_o} - \frac{\omega\,C\,Z_o^2}{Z_x + Z_o}\right]$$

Rearranging,

$$E_o = \frac{E_g\,\omega\,C\,Z_o}{2}\left[\frac{Z_x - Z_o}{Z_x + Z_o}\right]$$

Substituting from Eqs. (2) and (5), we can write,

$$E_o = E'_o\,\rho$$

With E'_o as our reference voltage, E_o, as measured on the rf voltmeter, is the product of this reference voltage and the reflection coefficient of the load.

There is no need, however, to re-connect the voltmeter at "D" to adjust the generator output for a convenient reference value. It can easily be shown that when Z_x is either open or shorted, the rf voltmeter at "C" will receive a voltage equal to E'_o.

Coupler Construction

The directional coupler usually consists of two short conductors juxtaposed in a suitable cavity with means

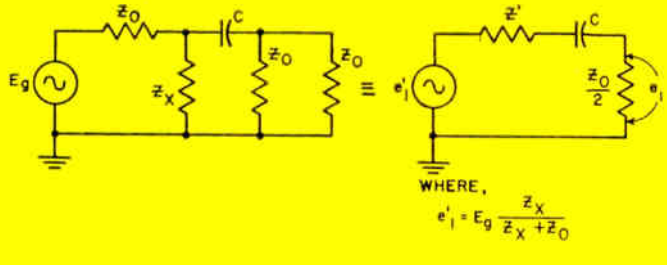
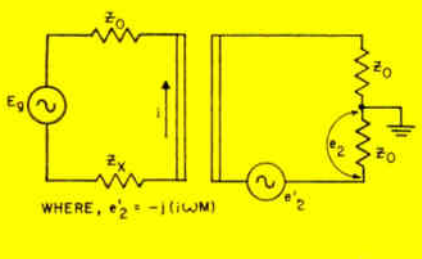


Fig. 6: Equivalent circuits for capacitive coupling, only.

Fig. 7: Equivalent circuit for inductive coupling condition.



Loss Measurements *(Concluded)*

provided for adjusting the spacing between the conductors. Because the capacitance will increase inversely with the spacing while the mutual inductance is a function of the logarithm of the spacing, the ratio of M to C will vary with conductor proximity. Constructional details for several forms of directional couplers have appeared in technical publications[2, 3, 4, 5] during the past few years.

Because of the difficulty in designing an rf generator with an output impedance sufficiently close to Z_o, which is required for useful return loss measurements, it will generally be necessary to use a masking pad to obtain a proper source impedance. When planning the construction of a directional coupler, it is, therefore, wise to include the design of a relatively high output level signal generator to overcome the loss in such a pad. This is especially important since the parameter conditions specified in Fig. 5 result in a minimum loss of 20 db between primary and secondary.

Although the minimum measureable signal with our rf voltmeter is as low as 300 microvolts, a return loss measurement of 40 db using a directional coupler will require an input level of 5 volts, or more.

In this respect the bridge circuit of Fig. 4 is superior in that a return loss of more than 50 db can be measured with this voltmeter and a generator having an output of 3 or 4 volts.

Conclusions

Both bridges of Figs. 3 and 4 have been successfully used for return loss measurements on rf attenuators, filters, and special terminations. The bridge of Fig. 4 balanced to 60 db from 70 to 90 MC, assuring accurate measurements of return loss to about 55 db. The circuit of Fig. 3 was balanced to 46 db over a frequency range of 5 to 200 MC.

Only a few exploratory measurements were made using the directional coupler to confirm the theory of operation.

The writer is indebted to A. J. Robinson, Section Head in charge of RF Attenuators at the Daven Company and his assistant, F. Dobroski, for the design and construction of these bridges and the many measurements they made to substantiate the accuracy of the method.

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How to . . . Display

IN working with non-linear devices such as tunnel diodes, it is often desired to visually display their electrical characteristics. Transistor curve tracers have generally been used for examining tunnel diodes, although they do not show the shape of the entire negative resistance region. And, since the tunnel diode is a negative-resistance device, it is important to be able to observe the negative resistance region in a voltage-current characteristic.

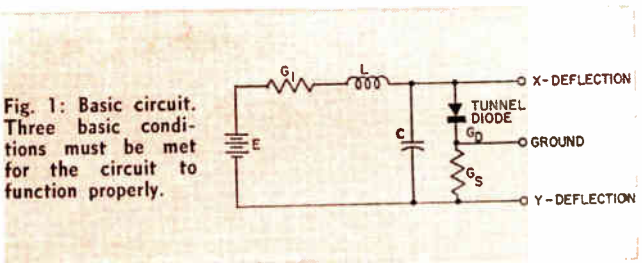
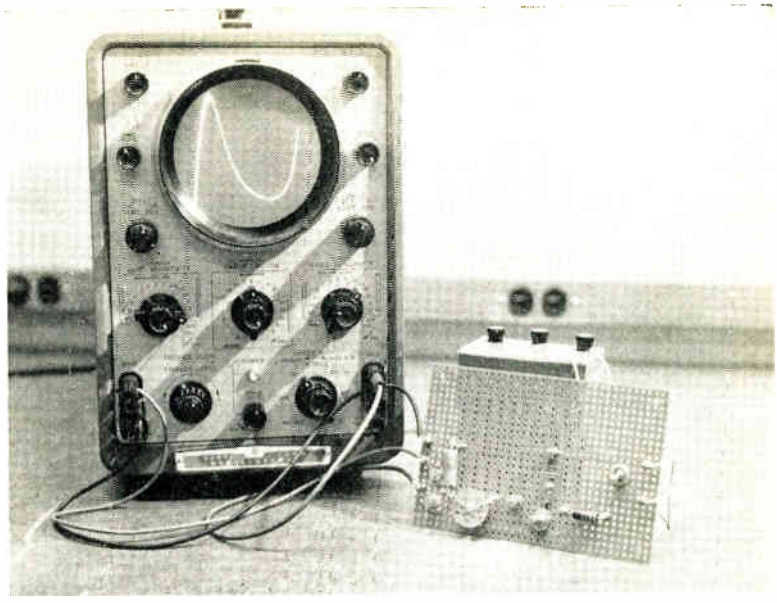


Fig. 1: Basic circuit. Three basic conditions must be met for the circuit to function properly.

Present methods of displaying the V-I characteristics usually employ a sweep circuit of some type. However, in using this method it is necessary that the impedance of the sweep circuit be less than the negative resistance being observed. This criteria is very often hard to satisfy in practice with the tunnel diode.



Displaying tunnel diode characteristics. Horizontal deflection shows voltage and vertical deflection shows current.

Tunnel Diode Curves

Since a tunnel diode is a negative resistance device, it is easy to operate as a relaxation oscillator. Using the simple circuit described herein, an ordinary oscilloscope can trace the complete characteristic curve—including the negative resistance region.

Circuit Description

The basic circuit is shown in Fig. 1. The only conditions which must be met in order that the circuit function properly are:

(a) The conductance of G_1 in series with G_s must be greater than the absolute value of the negative conductance of the diode;

$$\frac{G_1 G_s}{G_1 + G_s} > \left| G_D \right|$$

(b) the absolute value of the product of these two conductances must be greater than the quotient of C divided by L;

$$\left| \left(\frac{G_1 G_s}{G_1 + G_s} \right) G_D \right| > \frac{C}{L}$$

(c) the supply voltage E must be adjusted so that the load line intersects the tunnel diode characteristic in the negative resistance region.

If the above conditions are met, the circuit will oscillate. Now if an oscilloscope is connected as indicated so that the horizontal deflection will show the voltage across the diode and the vertical deflection will show the current through the diode, the oscilloscope will display the desired characteristic curve.

Theoretically, no additional capacitance need be added to the circuit to produce the desired oscillations as the capacitance of the diode itself is sufficient. However, to slow down the switching speed and eliminate undesirable phase shift effects due to various stray capacitances, an additional capacitance is desired.

Fig. 2 shows a practical circuit embodying the principles of Fig. 1. This circuit was built and tested and found to operate satisfactorily for all tunnel diodes tested.

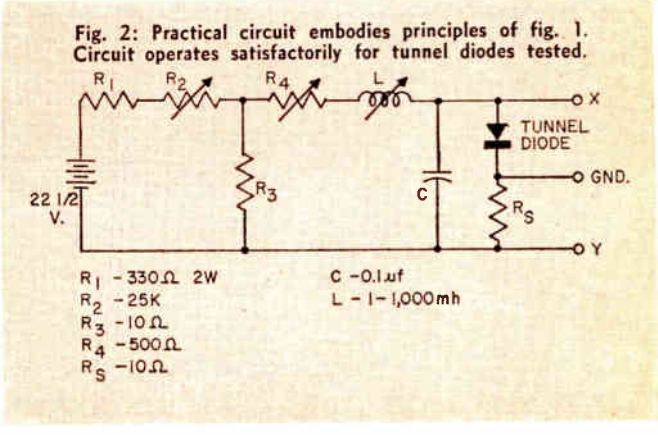


Fig. 2: Practical circuit embodies principles of fig. 1. Circuit operates satisfactorily for tunnel diodes tested.

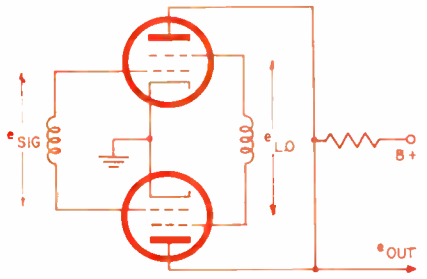


Fig. 1: Common double-balanced mixer circuit. Input signal and local oscillator signal are cancelled in combined plate current.

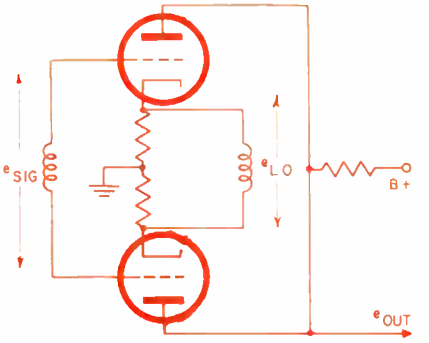


Fig. 2: A variation. The local oscillator signal is applied to a pair of cathodes rather than to a pair of grids.

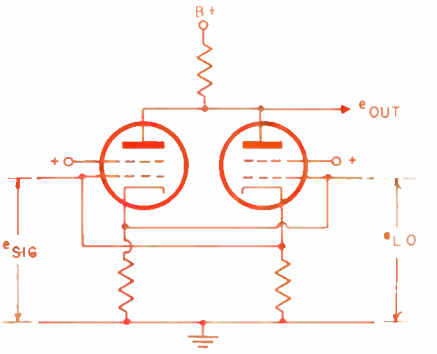


Fig. 3: Circuit has none of the disadvantages of figs. 1 and 2. Output contains only the beat signal and even-order harmonics of input.

With Double-Balanced Design the

Mixer Circuit Has Clean Output

A double-balanced mixer circuit is desirable for many communication and measurement systems. The balanced system, when properly designed, will eliminate the appearance of the input signal and local oscillator from the output.

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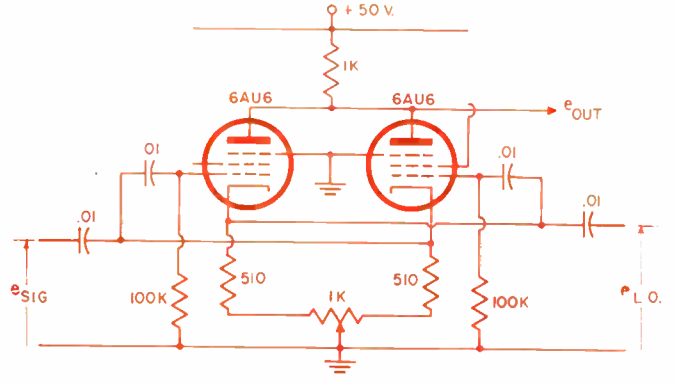
IN many communication and measurement systems, the use of balanced mixer circuits is highly desirable. A balanced mixer circuit is one which is so designed that either the input signal frequency or the local oscillator frequency does not appear in the mixer output.

Fig. 4: Potentiometer in the cathode circuit provides dc g_m balance. Circuit is inherently broadband.



In one form of single sideband generation, for example,[1] a balanced mixer circuit is used which eliminates the local oscillator (or carrier) frequency from the output, leaving the input signal and the two sidebands. One sideband is then extracted from the mixer output by filtering.

Occasionally, a mixer circuit is required in which both the local oscillator and the input signal frequencies are cancelled in the output, leaving only the beat signals or sidebands. Such a circuit is called a double-balanced mixer.

As an example of the use of a double-balanced mixer, consider the problem of measuring the frequency of a signal of approximately 11 MC with a 10 MC frequency counter. One method involves mixing the 11 MC signal with a 10 MC local oscillator signal and applying the 1 MC difference frequency to the counter. However, since the counter may be sensitive to both the 11 MC signal and the 10 MC reference, as well as the 1 MC beat, a mixer is required which does not pass the signal or local oscillator frequencies, i. e., a double-balanced mixer.

A common double-balanced mixer circuit is shown in Fig. 1.[2] In this circuit two tubes are used, each having two control grids. The local oscillator signal is applied as a balanced push-pull signal to one pair of grids and the input signal is similarly applied to the other pair of grids. The two plates are connected in parallel. Since both the input signal and local oscillator signal are applied in opposite phase to each tube, their effect is cancelled in the combined plate current, leaving only the beat signal and harmonics of the inputs.

A variation of this circuit employing a double triode is shown in Fig. 2. In this circuit the local oscillator signal is applied to a pair of cathodes rather than a pair of grids.

Both of the above-mentioned circuits require well balanced push-pull drive for proper operation. Since many input signals occur as single-ended signals, some form of single-ended to push-pull converter is usually required. Such a converter circuit is often difficult to design and expensive to produce. In addition, the above circuits often require two balancing adjustments, a dc adjustment to equalize the g_m's of the two tubes and a drive amplitude or phasing adjustment.

A circuit without these disadvantages is shown in Fig. 3. In this circuit a single-ended input signal is applied to both the grid of one tube and the cathode of the other, and a single-ended local oscillator signal is applied to the other grid-cathode pair. The two plates are connected in parallel. The circuit may be thought of as a pair of grounded-cathode amplifier stages driven in parallel with a pair of grounded-grid amplifier stages and with a common plate load. Since the gain of the grounded-grid stages is equal and opposite to that of the grounded-cathode stages, the net gain is zero at the input frequencies. In the appendix we show that the output contains only the beat signal and even-order harmonics of the inputs. This analysis also applies to the circuits of Figs. 1 and 2. The only balancing adjustment necessary is a dc g_m balance. This is accomplished in the circuit of Fig. 4 by the potentiometer in the cathode circuit. Because of the low input impedance of the grounded-grid stages, the circuit is inherently broadband and will operate over a wide range of frequencies without tuning. The circuit shown in Fig. 4 exhibits a conversion transconductance of about 1500 μmhos with a local oscillator drive of 0.5 volt.

Several variations of the basic circuit are shown in Fig. 5. The triode circuit of Fig. 5A does not balance as well as the pentode circuit because of direct feed-through from input to output through the plate-to-grid capacities. For operation over a very narrow band, however, the grid-plate capacities can be neutralized by shunt inductors. The transistor circuit of Fig. 5B is a direct counterpart of the triode circuit of Fig. 5A.

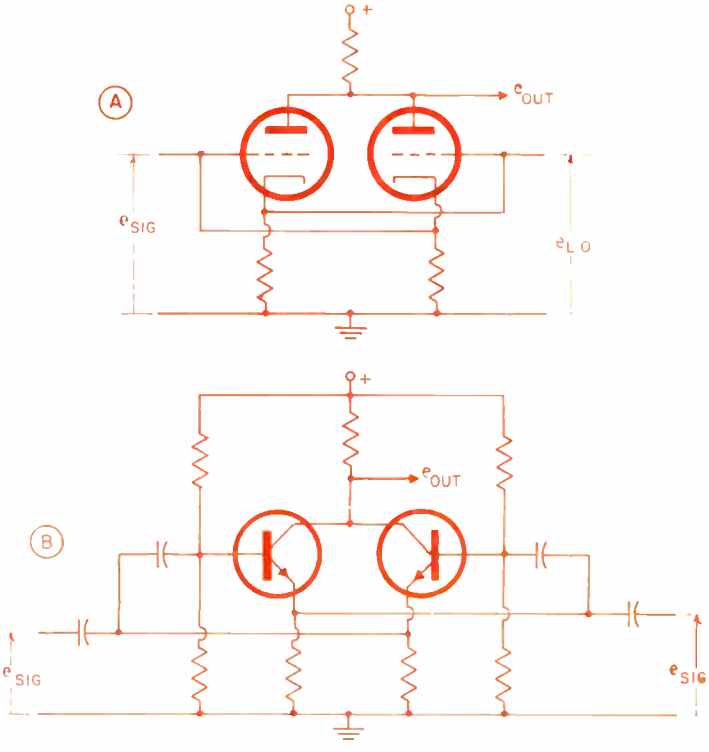


Fig. 5: Variations of the basic circuit. 5A does not balance as well as the pentode circuit because of direct feed-through from input to output through the plate-to-grid capacities.

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Appendix

In Fig. 3 let:

e_1 = the input signal applied to one grid-cathode pair
e_2 = the local oscillator signal applied to the other grid-cathode pair
i_1, i_2 = the variational plate current of each tube
$e_{g1} = e_1 - e_2$ = the grid-to-cathode voltage of one tube
$e_{g2} = e_2 - e_1$ = the grid-to-cathode voltage of the other tube

The transfer characteristic of each tube can be represented by a power series as follows:

$$i = a_1 e_g + a_2 e_g^2 + a_3 e_g^3 + \cdots$$

The total variational load current is:

$$i_L = i_1 + i_2 = a_1 e_{g1} + a_2 e_{g1}^2 + a_3 e_{g1}^3 + \cdots + a_1 e_{g2} + a_2 e_{g2}^2 + a_3 e_{g2}^3 + \cdots$$

$$i_L = a_1 (e_1 - e_2) + a_2 (e_1^2 - 2e_1 e_2 + e_2^2) + a_3 (e_1^3 - 3e_1^2 e_2 + 3e_1 e_2^2 - e_2^3) + \cdots + a_1 (e_2 - e_1) + a_2 (e_2^2 - 2e_2 e_1 + e_1^2) + a_3 (e_2^3 - 3e_2^2 e_1 + 3e_2 e_1^2 - e_1^3) + \cdots$$

$$i_L = 2a_2 (e_1^2 - 2e_1 e_2 + e_2^2) + \cdots$$

It can be seen that i_L contains only even-order terms indicating that the mixer output contains only sidebands and even-order harmonics of the input signals.

The above analysis was carried out with the assumption of zero source impedance for both the input signal and local oscillator signal. The results are true, however, for any source impedance, the only assumption being that $1 + \mu \approx \mu$. The degree to which this assumption is in error determines the residual unbalance of the circuit.

DOPLOC Tracking Determines

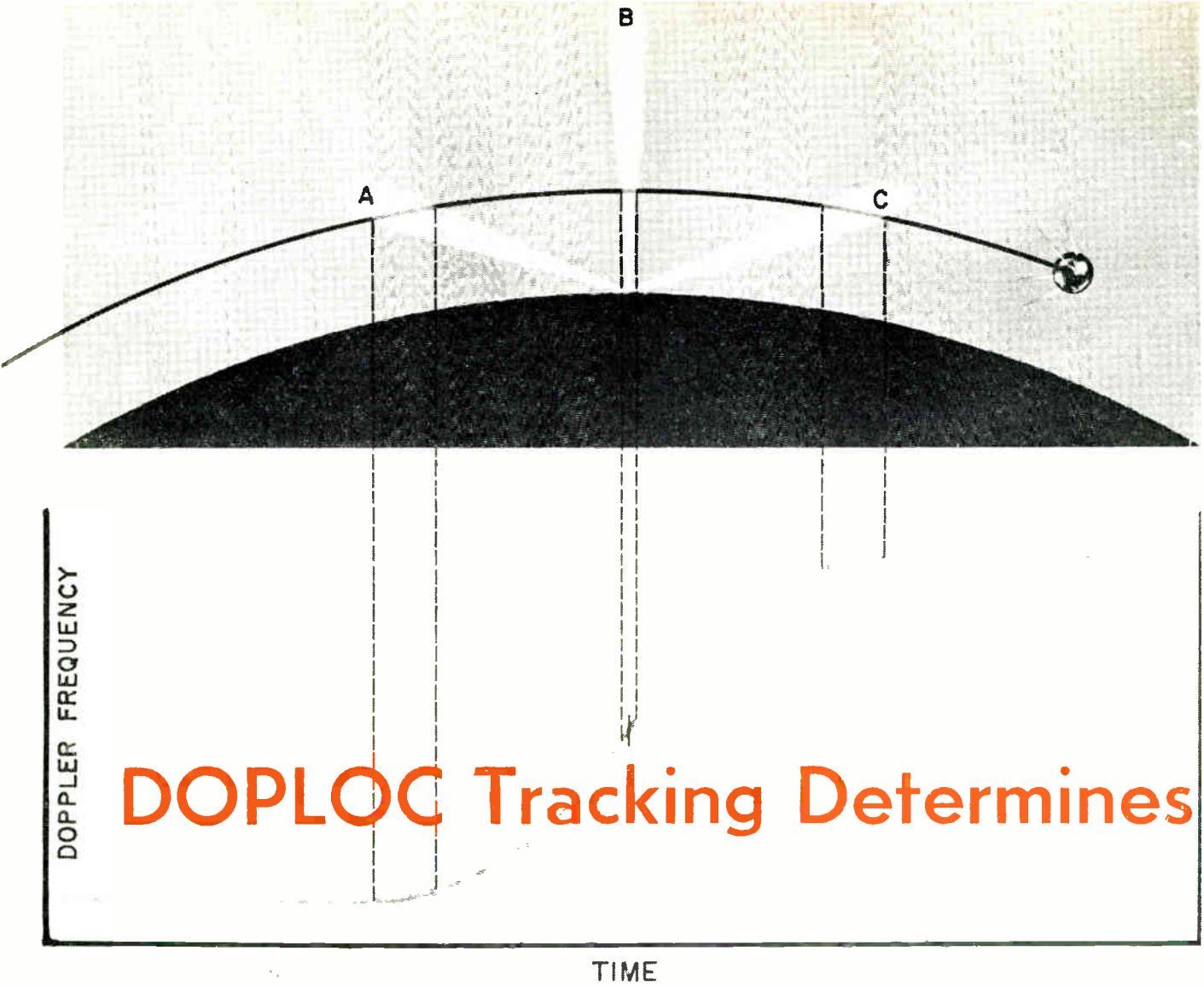

Fig. 1: Three separate antenna systems form fan beams. Passes thru fans permit determination of segments of the "S" curve.

WE are computing orbits from tracking measurements made on single passes of a satellite near our tracking station. Even though the measurements are made in only a few minutes, the orbits tally closely with those determined by the National Space Surveillance Control Center (NSSCC). At that center all available data are coordinated over a period of time to compute the orbit.

Data Collection

The tracking data, obtained by a CW radio Doppler system called DOPLOC (*Dop*pler Phase *Lock*), may be obtained from either active (transmitting) or passive (dark or radio silent) satellites. Dark satellites are illuminated by a transmitting station located at Fort Sill, Oklahoma, while the signal reflected by the satellite is picked up by a receiver located at Forrest City, Arkansas.

The Doppler shift in the received frequency is determined by mixing the carrier signal with the output of a precision frequency standard and noting the difference, or Doppler frequency, which is converted to digital form. Product detection of this form is required throughout the system to realize maximum benefit from the narrow band characteristics of the tracking filter.

The digital Doppler data are transmitted via teletype to the Ballistic Research Laboratories where the received data, recorded on punched paper tape, are fed into the ORDVAC computer. In 10 to 20 minutes, the computer furnishes the parameters which describe the shape and size of the orbit—and, the position of the satellite along the orbital path. A new computer being installed at the Laboratory, the BRLESC, is expected to reduce computation time by a factor of ten.

Data are obtained by the use of three separate antenna systems which form fan beams, Fig. 1. The passage of an object through either fan A or fan C is automatically noted by lock-on elements in a narrow band tracking filter, and the Doppler frequency as a function of time is recorded. Successive passes through either fans B and C or B and A permit determination of three segments of the Doppler "S" curve as shown.

This system not only tracks the original satellite, but it can be used to detect the separation of capsules and determination of their orbits. Recently, capsules ejected in USAF experiments have been detected and possible orbits calculated. Similar determinations have also been made on the most recent Soviet satellite.

Equipment

The DOPLOC receiver system

By L. G. DeBEY
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Data from only a single pass of the satellite near a DOPLOC tracking system are sufficient for orbit computation. The whole process can be accomplished in 30 minutes. Other systems require hours, days or weeks of data collection before a computer can even be fed the information. Further, DOPLOC can do it on the first pass; the others cannot.

Orbits of Satellites

block diagram is shown in Fig. 2. Most of the components of the system are quite conventional. The system's very high sensitivity to very low level signals is due to the frequency-tracking filter following the receiver. These narrow band filters allow the use of low gain, broad beam antennas for tracking most active satellites. Only modest gain and directivity are being used with the DOPLOC system for dark satellite tracking.

While the block diagram shows particular types of preamplifiers and receivers, a number of other types are available to permit tuning the system to any frequency up to about 1000 MC for active tracking missions. Passive tracking is accomplished at 108 MC only.

Tracking data are recorded in both analog and digital form at each of the receiving stations in addition to being transmitted to the computer. The noisy signal from the receiver and the cleaned-up signal from the tracking filter are recorded on magnetic tape. Should a failure occur in the tracking filter-digitizing system during a satellite pass, the magnetic tape record can be played back into the filter after the pass and the data can be recovered. Digital data are printed on strip paper during the pass to provide the operators with an accurate check on system performance. Time data, synchronized within one millisecond with WWV time, are recorded on all records.

The effective bandwidth of the tracking filters, and hence of the receiving system, is variable over the range of 1 to 50 CPS and is normally operated around 5 CPS. These filters, equipped with auxilliary signal search and lock-on equipment, automatically find weak satellite signals as much as 30 db below receiver output noise level. The filter output signal-to-noise ratio is always greater than +4 db. The Doppler frequency, which is recorded on magnetic tape in analog and digital form at frequent intervals, can be measured with errors of less than a fraction of a cycle per second.

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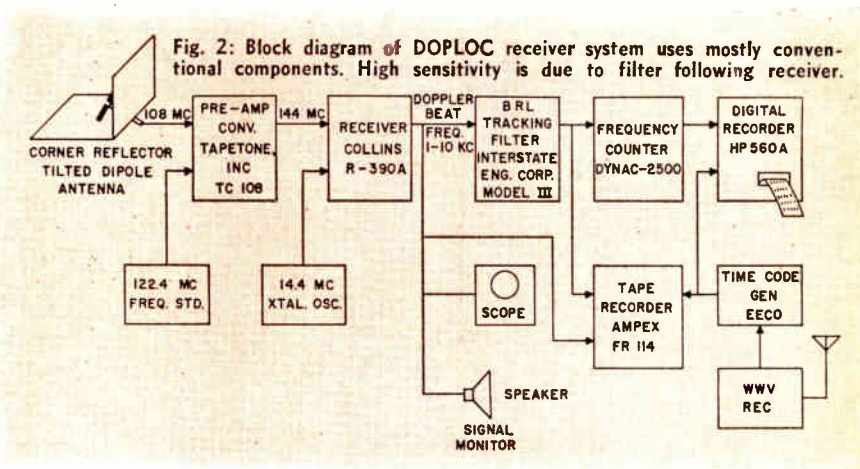


Fig. 2: Block diagram of DOPLOC receiver system uses mostly conventional components. High sensitivity is due to filter following receiver.

DOPLOC Tracking *(Continued)*

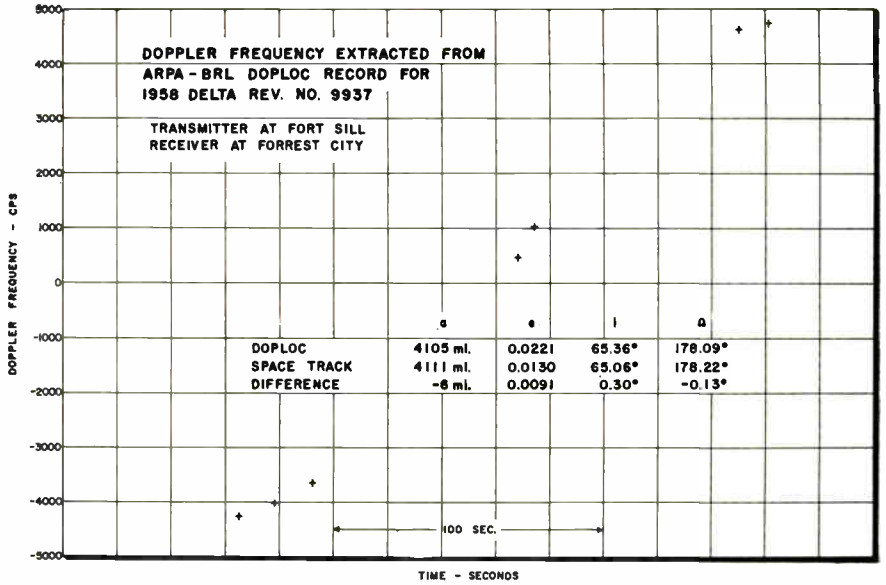


Fig. 3: Analog Doppler data are used to determine initial position and velocity components.

Computation

The orbit is determined by mathematically finding an orbit which would yield Doppler data matching as closely as possible those data obtained by the tracking system. Referring to Fig. 3, the analog Doppler data are used to determine initial position and velocity components from which are computed orbital parameters (α, ϵ, σ, ι, Ω, and ω), position and velocity components *vs* time (x, y, z, $\dot{x}$, $\dot{y}$, $\dot{z}$), and Doppler frequency (f_c) *vs* time. The latter data are compared to the observed Doppler data (f_{obs}) in a mathematical comparison routine. Differential corrections are derived and used to correct the initial point estimates. This iterative process is repeated until the corrections fall below predetermined lower limits after which the process is stopped and the final orbital parameters are printed out by the computer.

Fig. 4 illustrates how a small amount of Doppler data will permit accurate determination of orbit parameters. Seven discrete frequency measurements along the Doppler "S" curve were used in lieu of complete data. A minimum of six points is required by theory to achieve a solution. Only the parameters semi-major axis (α), eccentricity (ϵ), inclination (ι) and right ascension of ascending node (Ω) are tabulated. It will be noted that DOPLOC data are in good agreement with data from NSSCC.

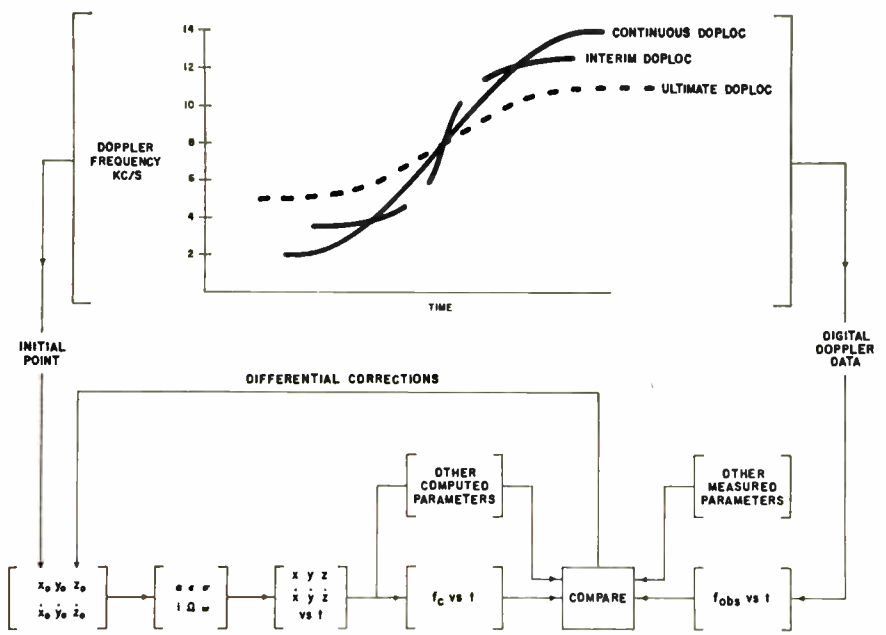
This is characteristic of the single pass solution when the eccentricity is small and the computational input is limited to Doppler frequency. Since the orbit is very close to being circular, both the argument of perigee (ω) and the mean anomaly at epoch (σ) are difficult for either DOPLOC or NSSCC to determine accurately.

Advantages

It should be pointed out again that DOPLOC data from only a single pass of the satellite near the system was used to compute the orbit. This is a prime advantage of the DOPLOC system over some systems which are required to collect data over periods of hours, days, or weeks before an orbit can be computed.

There does not now exist a network of tracking stations capable of detecting, tracking, and computing orbits in the first pass of new satellites, whether launched by this Country or others. The characteristics of DOPLOC required to fulfill this role have been demonstrated by the Ballistic Research Laboratories.

Fig. 4: A small amount of Doppler data permits accurate determination of orbit parameters.



Though the principle of parametric amplification is not new, it was not feasible until recently to use voltage dependent variable capacitive elements as microwave amplifiers. Diodes with high Q, low loss, and low noise now make the application of this principle at high frequencies a natural evolution.

Parametric Amplification By Junction Diodes

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THE p-n junction has physical properties which make rapid capacitance variation at high frequencies possible.

Consider what happens to the dipole region between the n- and p-type semiconductor material when an external voltage is applied. Assume a battery voltage is applied so as to make the n-type region positive and the p-type region negative. This will tend to draw electrons away from the junction region on the n-side thereby increasing the number of uncovered ionized donors near the junction. Simultaneously, this potential will pull holes away from the junction region on the p-side and increase the dipole strength by uncovering acceptors in the p-type material near the junction. These ionized donors and acceptors are unable to move under the influence of the field since they are rigidly bound in the crystal lattice; a dipole is thereby formed. As the voltage is increased, the total number of uncovered or ionized impurities will also increase. This is shown schematically in Fig. 1.

This action is similar to that which occurs when a capacitor is charged. The p-n junction or barrier will exhibit a voltage dependent capacitance. This is commonly called a "transition" capacitance since it occurs in the semiconductor region between the p- and n-type material.

For a step junction, i.e., one in which the transition from n- to p-type is abrupt, the capacitance C per unit area as a function of applied voltage V will be of the form:

$$C = K/\sqrt{V + \phi} \tag{1}$$

where the constant K depends on doping level and other physical constants and the "built in" barrier potential ϕ is an inherent material property varying from one semiconductor to another.

If a small signal approximation is made, the voltage can be expressed with a dc bias component V_o and a time variation component $V_1 \sin \omega t$:

$$V = V_o + V_1 \sin \omega t \tag{2}$$

Then the capacitance can be written as follows:

$$C = K\,(V_o + \phi + V_1 \sin \omega t)^{-1/2} \tag{3}$$

and for the small signal case ($V_1 \ll V_0$)

$$\frac{1}{C} \cong (1/K)\,(V_o + \phi)^{1/2}\left[1 + \frac{1}{2}\left(\frac{V_1}{V_o + \phi}\right)\sin \omega t\right] \tag{4}$$

or collecting terms into simpler constants

$$\frac{1}{C} = \frac{1}{C_o} + \frac{1}{C_s}\sin \omega t \tag{5}$$

Descriptive Model

For a physical description of the parametric principle, consider first the simple resonant circuit, Fig. 2a, which has the resonant frequency ω_1. Furthermore, assume that the capacitor C is fully charged

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ELECTRONIC INDUSTRIES, Chestnut & 56th Sts., Phila. 39, Pa.

Parametric Amplification

(Concluded)

to a potential V as indicated and an electric charge q is on the plate. Energy will be stored in this resonant circuit.

If, at this moment, the capacitor plates are separated, by an amount Δx, the capacitance will be decreased and for small separations $\Delta x/x \ll 1$, it will be noted that the change in capacitance ΔC is given by the following expression:

$$\Delta C \cong C\,(\Delta x/x) \qquad (6)$$

The total energy in the system, then, is changed and therefore energy is "pumped" into the system provided the plates are separated at the time when the voltage is a maximum on the capacitor.

The capacitor will subsequently discharge and the energy which was stored in the electric field between the capacitor plates will be converted to energy in the magnetic field surrounding the inductance L. Subsequently, when the capacitor is fully discharged and there is no voltage on the plates, the plates can then be restored to their original separation with no energy transfer required. Thus, the circuit configuration will be restored to its original state, but a net transfer of energy to the resonant system will have occurred at the expense of energy supplied by the "pump" source.

It can be seen from this description that an energy build-up can be accomplished in this resonant system by varying the reactive element with time. Amplification can be achieved at the resonant frequency if input and output terminals are coupled to the inductance as shown schemetically in Fig. 2b. This could function as a narrow band regenerative amplifier near the resonant frequency ω_1 of the tank circuit.

The Idler Circuit

If a slightly more complex circuit configuration is considered, the critical phase relationship between the resonant circuit current and the pumped variation of the capacitor does not have to be fixed externally.

With the addition of an "idler circuit," it turns out that the phase condition for current build-up occurs automatically. To show this, assume a circuit configuration, Fig. 3, in which the element coupling the two resonant circuits is the variable capacitance element C_3. This will be pumped at an angular frequency ω_3. The signal circuit is resonant at the angular frequency ω_1 and the idler circuit is resonant at angular frequency ω_2. This latter circuit is termed "idler" because there is no energy supplied directly to it from an external source; oscillations are started and maintained in it by interacting with the signal circuit and the pump, but it is not driven separately by a voltage source at the idler frequency.

Let all the constant capacitance elements be lumped into the series circuit capacitance C_1 and the idler circuit capacitance C_2; the coupling element C_3 then can be assumed to vary periodically with time at the pump frequency ω_3:

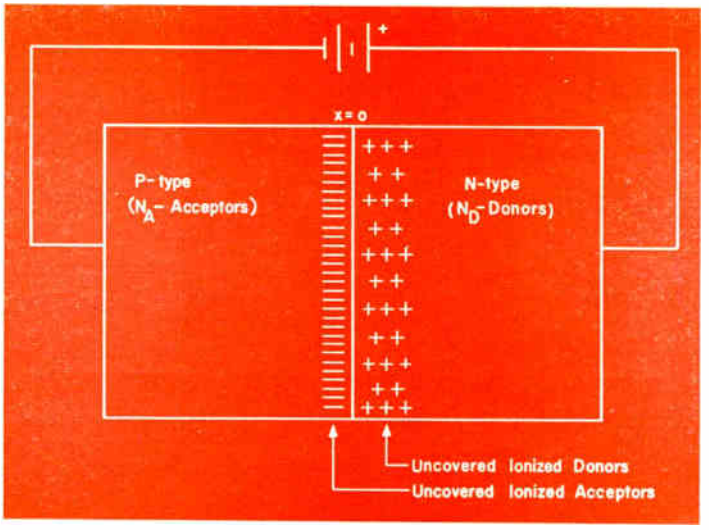


Fig. 1: Diagram of dipole layer between n- and p-type semiconductor material due to uncovered donors and acceptors in transition region.

$$\frac{1}{C_3} = \frac{1}{C_s} \sin \omega_3 t$$

Now, assume the current in the signal circuit i_1 with a phase ϕ_1 relative to the variable capacity:

$$i_1 = i_o \sin (\omega_1 t + \phi_1) \qquad (7)$$

The voltage V_3 across the variable capacitor C_3 due to the the signal circuit current i_1 can then be obtaied.

$$V_3 = (1/C_3) \int i_1 dt = -\left[i_o/2\omega_1 C_s\right]$$

$$\left[\sin (\omega_3 t - \omega_1 t + \phi_1) + \sin (\omega_3 t + \omega_1 t + \phi_1)\right] \qquad (8)$$

If it is now assumed that the signal resonant frequency ω_1, the idler frequency ω_2, and the pump frequency ω_3 are related as follows, an appreciable current will be induced in the idler circuit due to this voltage $\omega_3 = \omega_1 + \omega_2$.

$$V_3 = -(i_o/2\omega_1 C_s)$$

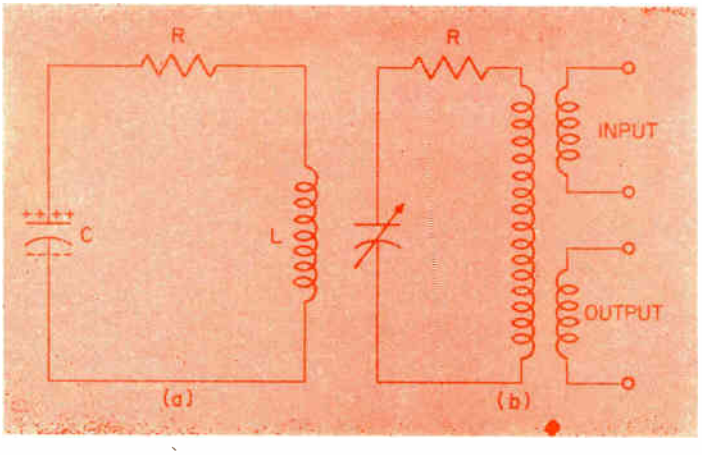
$$\left[\sin (\omega_2 t - \phi_1) + \sin (2\omega_3 t + \omega_1 t + \phi_1)\right] \qquad (9)$$

The resulting current in the idler circuit i_2 will then be given by

$$i_2 = V_3/R_2 = -(i_o/2\omega_1 R_2 C_s) \sin (\omega_2 t - \phi_1) \qquad (10)$$

since the current at the non-resonant frequency can

Fig. 2: (a) Resonant circuit with energy stored in capacitor, maximum voltage on capacitor; (b) simple resonant parametric amplifier.



be neglected due to the resulting relative impedance levels in this resonant circuit.

This current now flowing in the idler circuit will react back on the variable capacitance and induce on it an additional voltage V_3'.

$$V_3' = (1/C_3) \int i_2 dt$$
$$= \left(\frac{i_s}{4\omega_1 \omega_2 R_2 C_s^2}\right) \left[\sin(\omega_1 t + \phi_1) + \sin(\omega_2 t + \omega_2 t - \phi_1)\right]$$

$$\Delta i_1 = V_3'/R_1 = \frac{i_s \sin(\omega_1 t + \phi_1)}{4\omega_1 \omega_2 R_1 R_2 C_s^2} \qquad (11)$$

This indicates that the effect of the idler circuit is to cause mixing with the pump frequency and generate additional current in the signal circuit provided the proper frequency relation is established between the signal, idler, and pump circuits. In addition, the phase is automatically adjusted by the idler circuit so as to give additional in-phase current in the resonant signal circuit.

If this circuit is now compared to a simple feedback circuit, Fig. 4, a further comparison can be made. With an input current i_1, assume that the gain of the amplifier μ results in an output current μi_1. If a feedback fraction β is now returned to the input, an increased current Δi_1 will flow into the input. This will be given as follows:

$$\Delta i_1 = \beta \mu i_1$$

Circuit Parameter Evaluation

The combination feedback-gain factors for this particular parametric configuration can then be evaluated in terms of circuit parameters.

$$\mu\beta = \frac{1}{4\omega_1 \omega_2 R_1 R_2 C_s^2}$$

or in terms of circuit conductance G_1 of the signal circuit and G_2 of the idler circuit, this can be written:

$$\mu\beta = \frac{G_1 G_2}{4\omega_1 \omega_2 C_s^2} \qquad (12)$$

It should be noted that the feedback factor $\mu\beta$ is very sensitive to the loss elements in both resonant circuits G_1, G_2 as well as the operating frequencies ω_1, ω_2. Since the feedback in this type of amplifier is positive, it is necessary to keep the feedback factor relatively low and one way to accomplish this would be to set the idler frequency higher than the signal frequency.

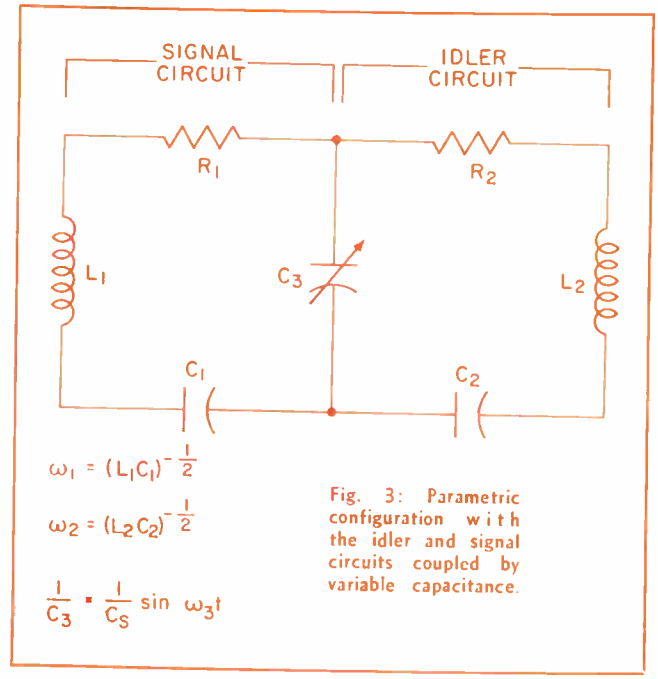
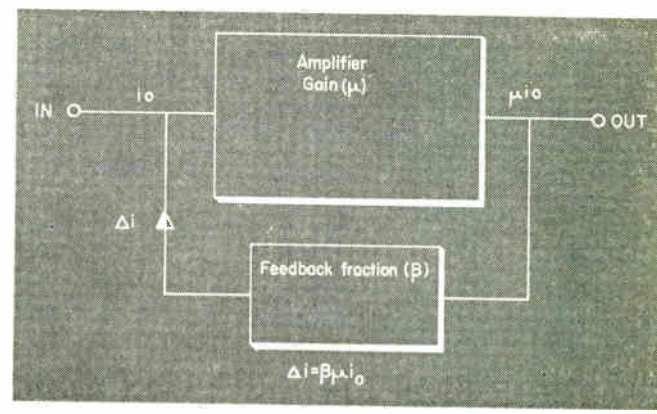


Fig. 3: Parametric configuration with the idler and signal circuits coupled by variable capacitance.

Fig. 4: Feedback amplifier for evalutation of the feedback factor.



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New Design in Relays

A new printed contact permanent magnet relay, which makes possible substantial savings in space, weight and assembly costs, was developed by the Components Division of Executone, Inc. The relay, represents a new approach to relay design and manufacture.

The Printact® relay is designed to mount directly on a printed circuit board as shown. Intermediate connections to fixed contacts are eliminated by doing away with the contacts themselves. The moving contacts on the relay armature assembly mate directly with conductors on the printed circuit board. The conductor pattern is designed by the user to meet his specific application problem.

The armature assembly carrying the moving contacts is held in position against the edge of one of the U-shaped fixed magnetic members by a small ceramic permanent magnet. Application of an electromagnetic field opposing the field of the permanent magnet causes the armature to rotate. The only moving part is the balanced armature assembly on which the contacts are mounted. The absence of mechani-

(*Continued on page* 190)

What's New . . .

Orbital Scatter

A NEW and unique method of reliable global communications by millions of minute orbiting particles for teletype, voice, and television according to W. E. Morrow, Jr., of M. I. T. Lincoln Laboratory in Lexington, Mass.

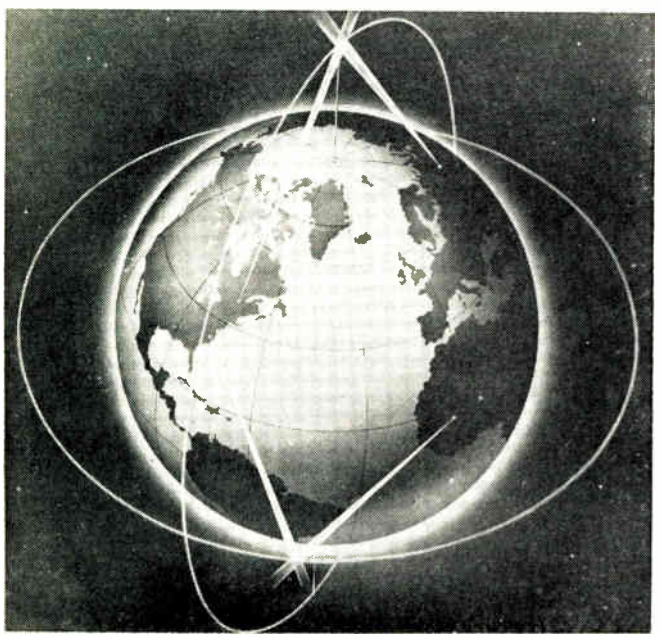
Speaking at a meeting of the International Scientific Radio Union in London, he said the new technique, known as orbital scatter, uses the reflective properties of a belt of tiny metallic fibers, or dipoles, about ½ inch long and ⅓ the diameter of a human hair, placed in orbit several thousands of miles above the earth. Radio waves transmitted to the belt will be scattered back to earth where they can be picked up by radio receiving equipment. Transmitting and receiving antennas will be trained on the same spot in the belt. The reflective principle will be similar to that employed in ionospheric and tropospheric radio communications.

The basic concept of orbital scatter was developed by Mr. Morrow in collaboration with Harold Meyer of the Thompson-Ramo-Wooldridge Corp., in 1958. Full-scale technical development is being carried on at Lincoln Laboratory where experiments are being prepared to test the feasibility of the technique and to confirm the results of theoretical studies. Orbital scatter can potentially serve both civilian and military purposes.

The ever-growing demand for long distance communications has increased the desirability of using higher radio frequencies where bandwidth is still available.

The number of circuits between any two locations will be determined by the capacity of the ground radio equipment and the size of the belt. With two such belts, one east-west over the equator and one north-south over the poles, communications can be established between any two points on the earth. This technique offers promise of very high system reliability, since all of the active radio equipment is on the ground, easily accessible for maintenance.

Two "orbital scatter" belts (one over the equator and one over the poles) will relay radio messages.



Metallic "dipole" fibers will be placed in orbit to relay messages. Fibers in orbit will be hundreds of feet apart.

A rocket will be used to place in the desired orbit a cylindrical container into which the small dipoles have been packaged. When the orbit has been attained the container will be ejected from the rocket. A dispensing mechanism will then release the fibers gradually from the container, over a period of one day.

It is estimated that within one to two months the dipoles will spread to form a continuous belt around the earth. In a completed belt, using the example described in the technical paper, it is calculated that the small fibers will be separated on the average by about 1000 ft.

Orbital scatter appears to offer a number of advantages in long-distance radio communications. With two orbits, only two rockets will be required to provide practically world-wide coverage. The electronic and physical characteristics of the dipole belt will afford a very large number of communications circuits. Since the dipole belt will be relatively stationary in space, transmitting and receiving antennas on the ground can be trained continuously on the same spot in the belt with a movement of only a few degrees per day. This slow motion eliminates the need for high-speed tracking equipment. The lifetime of the belt can be varied from a matter of months to years, depending on the altitude and inclination of the orbit together with the dipole design. As the belt nears the end of its useful life, the dipoles will be dissipated harmlessly in the atmosphere. Belts with a relatively short lifetime are proposed for an initial experiment.

Theoretical studies have indicated that known phenomena such as solar radiation pressure, atmospheric friction, sun and moon gravitation, micrometeorites, magnetic field effects, and the influence of high energy particles will not produce excessive undesirable changes in the belt.

Pressure Sensing With Solid-State

COMBINING the best overall characteristics of both strain gauge and potentiometer-type transducers but having the inadequacies of neither, a new pressure transducer developed by Fairchild Controls Corp. is the first of a completely new line of solid-state strain gauge transducers. It has been designated the 3S-G, a name derived from the first letters of the words that describe it.

The transducer uses a semiconductor strain gauge sensor, possesses extraordinary accuracy and environmental capabilities, and produces a high-level d-c output signal that eliminates the need for impedance-matching or signal amplification.

New transducer uses a semiconductor strain gauge sensor. It is responsive to both static and high-frequency dynamic pressures.

It is responsive to both static and high-frequency dynamic pressures; it is fully compatible with existing military ground, telemetry and industrial systems, and is interchangeable with devices now in use. Because it obviates the need for an amplifier—required by conventional strain gauge transducers to increase output signal strengths by a factor of 125 or more, from an average 20-40 mv to approximately 5 vdc—and because of its markedly superior linearity, hysteresis and environmental characteristics—the 3S-G is conservatively regarded as representing a ten-fold increase in the state of the transducer art.

The 3S-G transducer consists essentially of three modules, all contained in a rugged anodized aluminum case 1⅛ in. in diameter and 3 in. long. These modules perform the functions of energy conversion, signal conditioning and calibration.

Energy Conversion

Energy conversion is accomplished by a sensitive element made up of several microminiature piezoresistive semiconductor elements coupled to a resilient high-alloy steel, low mass diaphragm. These elements form the conducting paths (or resistive arms) of a four-arm Wheatstone Bridge.

Applied pressures deflect the diaphragm, creating an unbalance in the bridge and producing a d-c signal proportional to the deflection. The diaphragm is suitably proportioned to fit the selected pressure range—from 0.100 psig to 0-10,000 psig full scale. Pressure ranges below 100 psig are to be made available shortly.

Input excitation to the transducer is from 10-25 volts d-c nominal, and it can take up to 30 volts d-c without damage. Input impedance is approximately 700 ohms. Output impedance is less than 4500 ohms. Input pressures up to 150% of rated have a negligible effect on instrument calibration. Pressures in excess of 200% of rated cause no damage.

Signal Conditioning

A completely transistorized amplifier receives the differential signal generated in the sensing element and produces the output signal. The transducer transfer function is 25%. Thus, a full-range change in pressure at 20 volts d-c (rated excitation) results in a 5-volt d-c output signal.

Calibration

The calibrator is essentially an internally-contained shunt resistor. When it is keyed across one leg of the Wheatstone Bridge — accomplished by shorting two connector pins—the Fairchild 3S-G produces an output signal equivalent to one-half full scale rating.

1. Strain gauge type. Strain gauge sensing elements (bonded or unbonded) are more accurate than pot-type devices and have infinite resolution, high-frequency response characteristics and long life. But their output signal is of such low level—in the order of 20-40 millivolts—that they must be amplified to be usable. Since most amplifiers cannot withstand transducer environments, they are usually located far from the strain gauge transducer. The complete system of strain gauge transducer, remotely-located amplifier and connecting cable is prone to noise pick-up, signal distortion and maintenance problems. In addition, amplifiers are usually bulky, heavy and high-priced.

2. Pot-type. Bourdon tube or diaphragm sensing elements with potentiometric outputs. Although these devices have a high-level d-c output signal, they are relatively inaccurate, suffer serious friction and resolution problems, have frequency response and short life limitations, and offer no means for a calibration check.

There are also several varieties of piezoelectric crystal-type trans-

(*Continued on page 225*)

Bernard Osbahr, Editor, ELECTRONIC INDUSTRIES, inspects Fairchild Control Corp.'s new 3S-G, Solid - State Strain Gage Pressure Transducer. Looking on (L to R): F. Carlson, Chief of Fairchilds R&D (West Coast); J. Ames, Project Engineer; and R. Stanaway, Mngr., West Coast Plant. Circuit on table demonstrates unit's high output signal.

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

The FCC is the official U. S. agency responsible for controlling RFI that disturbs the reception of desired transmissions. How this is accomplished, their enforcement procedures, and what they actually regulate are given in detail along with some of their problems.

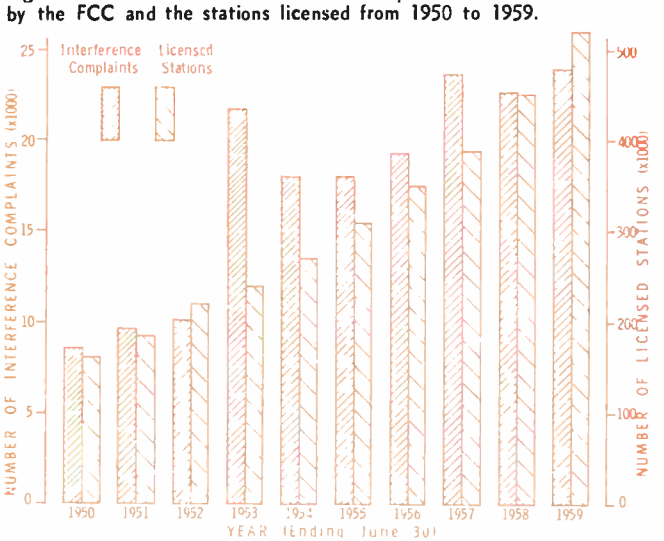
The FCC Controls

THE development that has produced broadcasting and long range communications has also given us medical diathermy equipment and radio frequency industrial heating. Radar, without which we might not have won the last war and which is today providing all weather guidance to aircraft, has also given us microwave cooking of food. The proximity fuse has its counterpart in the electronic intruder or burglar alarm.

Television has undoubtedly produced a greater change in our way of life than any other recent invention. But insofar as producing interference is concerned, the television receiver is perhaps the greatest enemy of its own service and of its companion service—AM broadcasting.

Each advance in the radio electronic art has produced new components and new techniques. These have been eagerly pounced upon and applied to industrial processes and to home gadgetry—in many cases regrettably, with little thought to the interfering potential of the new equipment.

Fig. 1: Chart shows the interference complaints received by the FCC and the stations licensed from 1950 to 1959.



But what is this thing RFI, or as it is more correctly called, radio-frequency interference. RFI is more than the unwanted transmissions from another radio station. RFI is any radio frequency energy that produces an unwanted response in the output of a receiver—whether it be audio noise in the loudspeaker, or snow in the TV picture, or a false indication in an aircraft radio navigation instrument.

Some of this RFI comes from natural sources—lightning discharges, dust static, snow static, rain static, cosmic and solar noise. Here we are not concerned with natural sources of RFI. We are concerned with RFI from man-made devices—from electronic and electrical equipment in common use.

Man-made RFI can be divided into two areas. The first and the best known area encompasses unwanted radiation from transmitters and undesired responses in receivers. The second area includes emanations from the multiplicity of other electrical or electronic non-communications equipment that man uses. This area includes not only industrial equipment, which is a well recognized source of RFI, but also the host of electrical/electronic equipment that is present in the home. Many of these household devices contribute significantly to our radio interference problem.

The RFI Problem

The present emphasis on the control of RFI arises largely from the more intensive use of the radio spectrum. There are more stations in operation using a larger number of frequencies than ever before.

Fig. 1 shows that the number of stations licensed by the Commission has more than tripled in the last ten years. But this is not the whole story since, under our present licensing practices, each station may be operating a multiplicity of transmitters. The

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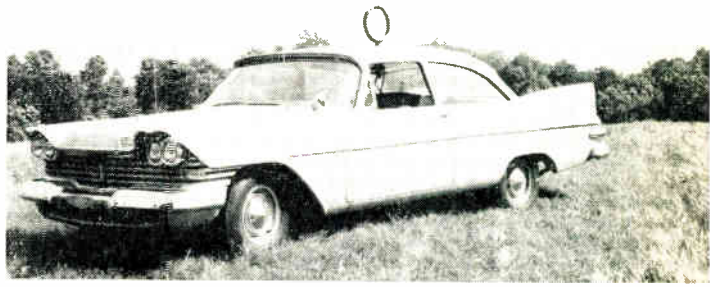


Fig. 2: Mobile investigative unit of FCC.

Man-Made RFI

Commission estimates that in the Safety and Special Radio Services alone, it has authorized about 1.7 million transmitters. To these figures must be added the amount of radio equipment operated by the Federal Government. While no numbers are available, the increase is at least equal to that for civilian equipment with the end not in sight. It should be needless to add that a similar rate of increase has occured in the amount of equipment in use in other countries.

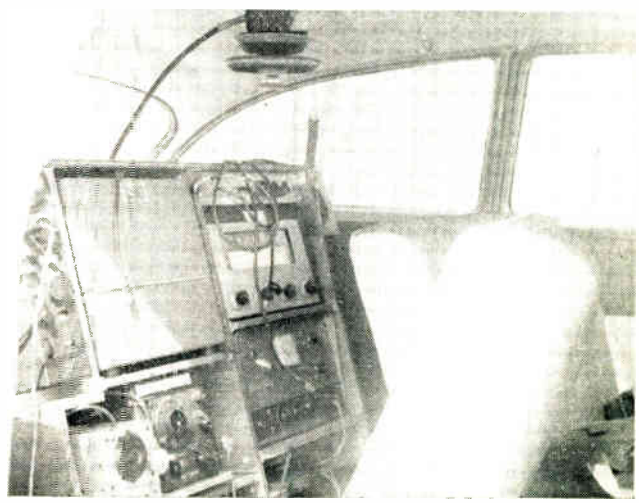
To compound the RFI problem, receivers are more sensitive than ever before, and therefore respond to weaker interfering signals. Trained operators who could hear the desired message in the presence of interference are being superseded by persons of lesser skill or by completely automatic stations. Many of these automatic systems use pulse transmission. But the receiver cannot distinguish a noise pulse from the transmitted pulse without fantastically complex auxiliary circuitry. Many of our systems require broad transmission bands—multiplex, data transmission systems, television. Receivers accepting energy over a broader band have simultaneously increased the probability of receiving interference.

At the same time, there has also been an increase in the number of devices producing interference. Transmitters are radiating more power, which means that harmonic radiation is more difficult to suppress. We are using frequencies higher in the spectrum and can no longer ignore the higher order harmonics, as we did in the past. Radio frequency heating has taken so firm a grip in our manufacturing processes that a place in the spectrum must be found for it. Ultrasonic cleaning of parts and more recently ultrasonic drilling, cutting and soldering are other r-f applications in industry that must be accommodated.

Countless electronic devices are in use around the home and more are on their way. Unless properly shielded, these devices emit energy capable of disrupting radio communications. In San Diego a few years ago, a 30° segment of the Navy's GCA (Ground Control Approach) installation was rendered useless because a builder equipped the houses in his subdivision with radio-controlled garage door openers.

As the use of radio for communications and broadcasting has expanded and use of r-f generators for industrial and household purposes has grown, the number of interference complaints has shown a comparable increase. This increase is also shown in Fig. 1. This chart does not include the complaints handled directly by the TVI Committees without reference to the Commission as described later in this article. The data show a rather sharp increase in the number of interference complaints over the ten year period, with some leveling off during the last three years. It is too soon to tell whether this is a temporary condition or forecasts a definite trend.

Fig. 3: Interior of mobile investigative unit shows some of the electronic equipment that is used by the FCC engineers.



the radio spectrum around-the-clock, every day. A major task is to detect, identify and locate sources of RFI. Such sources may include two or more radio stations interfering with each other because of close frequency assignments. Or the interference may be a spurious emission from a faulty transmitter.

Another common cause of RFI is radiation from Industrial, Scientific and Medical (ISM) equipment. If the interfering signal cannot be identified directly, the monitoring stations obtain DF bearings which are relayed to and plotted at Monitoring Control to produce a "fix." If the "fix" is not sufficiently decisive to identify and locate the source of the interfering signal, one or more mobile investigative units is directed into the area determined by the "fix." These units locate the offending equipment by close-in loop DF bearings and by signal strength indications.

Some of the FCC monitoring stations near the coast have loop-type direction finders which are employed to obtain single bearings on interfering signals below 2 MC down to 250 KC. Coordination between such a DF and one or more of the mobile units can produce a "fix" to help track-down RFI in this frequency range.

On frequencies above 30 MC only limited help can

Fig. 7: A modern Adcock antenna used for long range direction finding from 2 to 30 mc.

be given by the monitoring stations. On these frequencies the mobile investigative units are the Commission's mainstay for investigating interference complaints. The source is located by DF bearings using the loop in the car and by field strength indications.

When it is necessary to pinpoint the interference source, as when investigating interference in a building, the FCC field engineer has available miniaturized portable receivers and direction finders and miniature field strength indicators.

The FCC Laboratory

The Commission maintains a small laboratory at Laurel, Md. The laboratory makes engineering studies of systems and equipment, both as to service that may be rendered and the interference that may result. Besides studies of communications equipment, the laboratory also investigates other electronic and electrical equipment for RFI. The laboratory also has the responsibility for calibrating and adjusting the various measuring equipments used by the Field Engineering and Monitoring Bureau, including those used in RFI investigations. The laboratory has also developed special monitoring equipment—much of this also for the FCC's RFI program.

Certain classes of electronic apparatus are required to be tested at the FCC laboratory for type approval before being marketed for wide spread use. These include shipboard telegraph transmitters, lifeboat transmitters, and automatic alarm receivers which are important for the protection of life and property at sea. They are tested from the standpoint of assuring a maximum reliability of operation under adverse conditions.

Also tested in the Commission's laboratory are new models of monitoring equipment used by aural and TV broadcast stations to see that maximum transmission quality is obtained with minimum interference to other stations.

Another class of devices given laboratory test comprises those which perform various functions at some risk of causing interference to licensed radio and TV services, and where the operator or user may not be qualified to detect their possible interference. These embrace medical diathermy and ultrasonic equipment, epilators (hair removers), electronic neon signs, marine radars, personalized radio transmitters, electronic cooking ovens, and other items.

Figure 10 shows a view of the diathermy test range. The equipment—a diathermy machine—is mounted on a wooden turntable so that measurements can conveniently be made at all azimuths.

The laboratory participates in the work of a number of engineering groups working toward the wider and better use of radio and the reduction of RFI. It cooperated closely with the IRE during the development of a standard procedure to measure radiation from TV and FM receivers. Fig. 11 shows the laboratory receiver test site. This site complies with the standard 51 IRE 17S1. At present the laboratory is making comparison tests between the IRE method of measuring receiver radiation and the method adopted by CISPR—an international committee concerned with RFI. The work of this committee is discussed in detail later in this article.

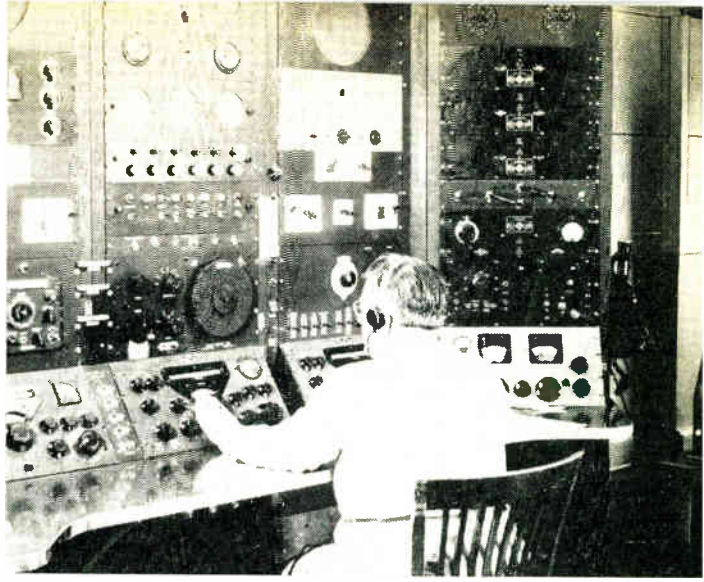
FCC Enforcement Procedures

When a communications user is troubled with interference from another transmitter, he should obtain as much information as possible about the interfering signal and its probable source. If the source is known, he should notify the owner and seek his cooperation in eliminating the interference. In the event the person responsible for the offending transmitter fails or refuses to make corrections, a report containing all the available information should be forwarded to the nearest field office of the FCC. The procedure is the same if the interference comes from a non-communication source, such as diathermy, industrial radio frequency heater, incidental or restricted radiation device.

If warning letters and visits by its field engineers are not successful in correcting the interference, the FCC can institute legal action to compel compliance. It is empowered to issue cease and desist orders, and appeal to the courts to compel compliance. In extreme situations the Commission can institute injunction proceedings. This was done in the New York City area when improperly operated plastic sealers were causing harmful interference to several aeronautical VOR stations, thereby endangering the safety of aircraft and the passengers. At the request of the Commission, the U. S. District Courts issued orders requiring the offending plants to cease operations until the interference situation was corrected and the plant was complying with the Commission's rules.

But notwithstanding the facilities at their disposal, there just aren't enough FCC engineers to investigate all interference complaints. The FCC's Field Engineering and Monitoring Bureau therefore sponsors and encourages voluntary groups among those interested or working in the communications field to carry on a program of self-help in tracing and correcting RFI. In the industrial communications field 35 Cooperative Interference Committees (CIC) have been formed with membership drawn from the radio users, equipment manufacturers, service organizations and engineers concerned with radio communications systems. To investigate interference to television (TVI) allegedly caused by amateur stations, the Commission has sponsored the formation of TVI committees (TVIC) composed of amateurs, radio and television servicemen, and others interested in broadcasting who volunteer their time to investigate complaints of TVI and suggest a remedy. There are about 540 TVIC's in existence.

Complaints can reach the TVIC in various ways. Some broadcast stations are acquainted with the work of the local committees and often forward the complaint to the appropriate TVIC. In a similar manner radio dealers and servicemen refer complaints to the committee in their community. A member of one TVIC who is an employee of a telephone answering service has arranged with the answering service to accept complaints at any time during the day or night for referral to the local TVIC. The TVIC concept has become so well accepted throughout the country that these committees successfully handle thousands of complaints of TV interference which never come to the attention of the Commission.



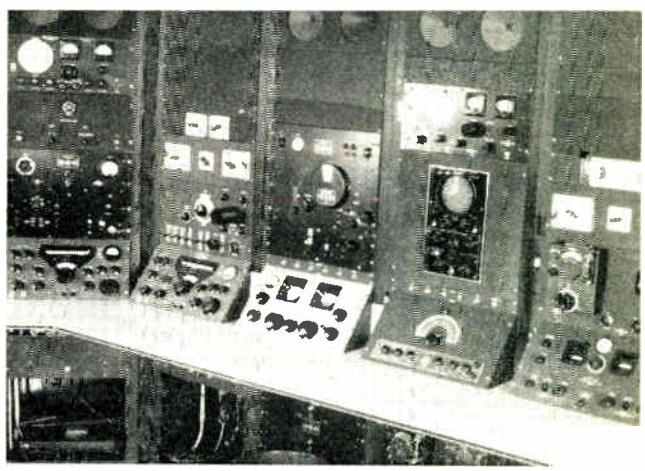


Fig. 8 (above) & Fig. 9 (below): Views of the inside of a fixed monitoring station showing the operating positions and equipment.

The CIC's normally are not concerned with interference situations affecting individual listeners. The CIC's concern themselves with RFI to industrial communications. The members of these committees are usually personally aware of the interference problems in their area and have banded together to make their cooperative attack on RFI more effective.

In addition to the CIC's and TVIC's, many trade associations and professional engineering societies have formed groups to study and combat RFI in their own industry. The Institute of Radio Engineers has many technical committees working on various RFI problems. Its Professional Group on Radio Frequency Interference (PGRFI) was organized in 1957 for the purpose of providing a common meeting ground for engineers concerned with RFI.

The American Institute of Electrical Engineers has a group working on problems, including RFI, of industrial radio frequency heating. The Society of Automotive Engineers is working on reducing RFI from automotive ignition systems. The Joint Industry Committee on High Frequency Welding works with the Commission on RFI from radio frequency stabilized welders. The Society of Plastics Industry has recently set up a committee to assist the FCC in reducing RFI from heaters used in the

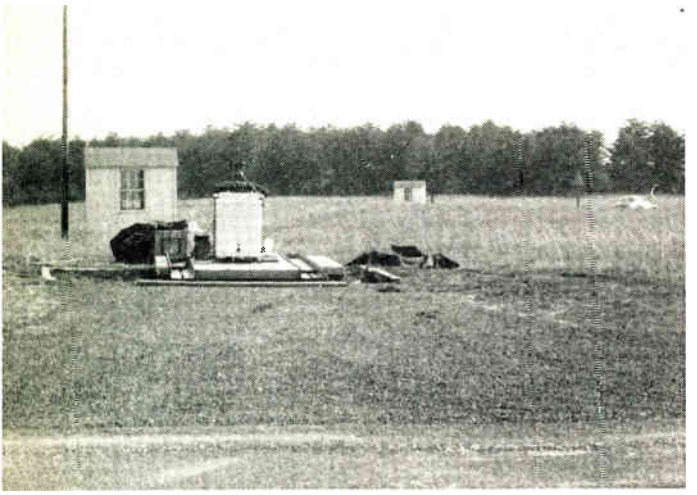


Fig. 10: View of diathermy test range at FCC Lab. shows equipment under test. Diathermy is mounted on a wooden turntable and measuring equipment is in wood shack. Lamps are dummy load.

FCC and RFI *(Concluded)*

plastics industry. The Radio Electronic and Television Mfrs. Association, predecessor of the Electronics Industry Association, cooperated with the FCC in developing a set of regulations to control RFI from receivers.

International Cooperation

Radio knows no national boundries and RFI is no exception. The need for an international table of frequency allocations was recognized as early as 1906 when the first International Radiotelegraph Convention was adopted. Many conferences have been held since then, the most recent being the Geneva Conference, August to December 1959. The regulations agreed to at these conferences covered allocation of frequencies, transmitter standards and operating practices—all designed to accommodate the largest number of radio stations with a minimum of interference.

Fig. 11: TV receiver test range at FCC Lab. Measuring equipment is in foreground. Antenna height can be varied on pole.

In 1934, it was recognized that there were other RFI problems in addition to those between radio stations. These are the problems previously mentioned in this paper as falling within area two of man-made RFI. To solve these the International Electrotechnical Commission—a voluntary organization to promote uniform international standards in the electrical industry, in cooperation with the CCIR —the radio technical consultative group to the International Telecommunications Union, created CISPR[2]—a special international committee on radio interference. CISPR's primary function is to promote international cooperation in protecting sound broadcasting and TV services from the interference of electrical appliances, ignition systems, other non-communication equipment and the radiations of sound broadcasting and television receivers. To establish a common basis for comparison of results, CISPR is (1) developing standards for equipment and techniques for the measurement of RFI, and (2) seeking to establish a set of radiation limits that are practically attainable for the protection of sound broadcasting and television services.

Although CISPR has government support from a number of the participating countries, it is basically a voluntary organization. However, many countries, particularly in Europe, have given CISPR recommendations the weight of law by requiring noise measurements to be made in accordance with CISPR procedures using a meter meeting CISPR standards.

In the U. S. we are just beginning to recognize the importance of the RFI work being carried on by CISPR. At the last CISPR conference at the Hague, 1958, the FCC was represented for the first time and we are looking forward to even greater participation at the next conference which is scheduled to be held in Philadelphia during October, 1961. However, much wider participation by U. S. engineers and manufacturers is required. A special plea for participation is made to those concerned with the export of electrical appliances and equipment, if for no other reason than to safeguard their own interests. It will be too late to object after other countries require imported electrical equipment to meet CISPR standards. By participating now, you can have a voice in what these standards will be.

Acknowledgment

The authors wish to express their appreciation for the many contributions from the Field Engineering and Monitoring Bureau.

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2. Comite Internationale Special de Perturbations Radioelectriques.

Progressing in a few short decades
from an auxiliary design objective, reliability
has achieved importance equalling performance itself.
Thousands of reports on components are being compiled.
Among these components is the lowly "electrical connector."
Its story is told here.

and Printed Circuit Connectors

and operate in a constant atmosphere. Many excellent connectors at sea level are totally useless in the environment of a missile or operational aircraft.

High Insulation Properties

Insulating materials when used with high voltages must not only have a high resistance to leakage current, but must also be able to resist dielectric puncture, i.e., in addition to being a good insulator, the material must be a good dielectric. Insulation resistance decreases very rapidly with increase in temperature. Absorbed moisture reduces the insulation resistance, and moisture and humidity have a large effect on surface leakage. Among the things that must be considered in selecting a proper insulator are surface resistivity, volume resistivity, dielectric strength, dielectric constant, dielectric endurance strength, moisture absorption, dissipation factor, decomposition rate, tracking resistance and flame resistance. Aging, fungi, nuclear radiation, chemical resistance, and corona all contribute to the decomposition rate.

Degradation Caused by Moisture and Dirt

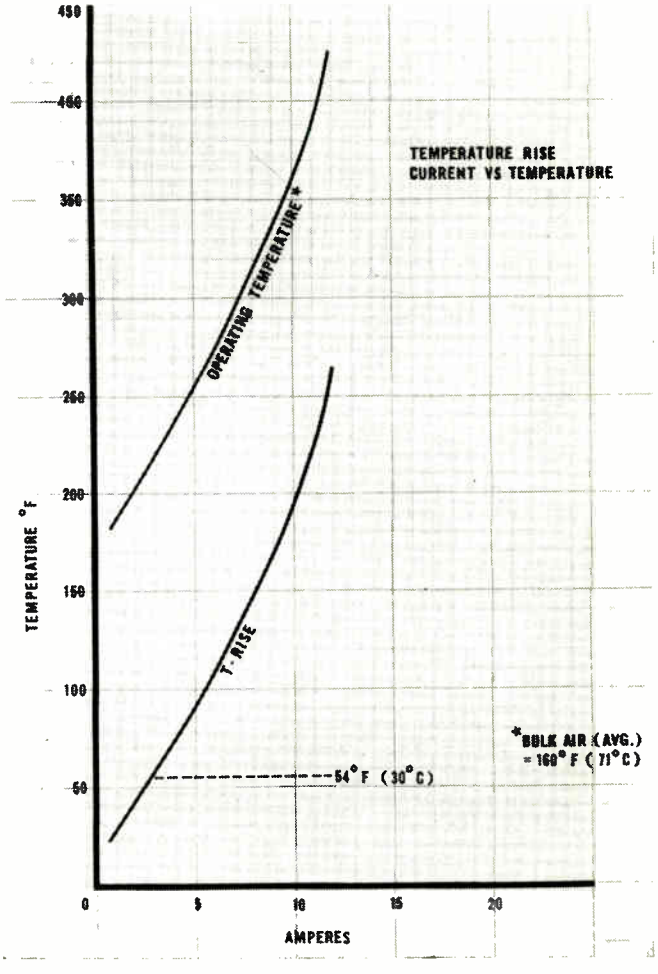
Of equal importance to a gas-tight seal is a seal which will prevent the entry of moisture and dirt. It should be emphasized that a seal which performs this purpose will not, of necessity, exclude air. Moisture can cause undesirable chemical reactions which will affect conductivity and insulation resistance; dirt can prevent good contact and cause permanent damage to the conductive coatings. Lowered insulation resistance can cause severe leakage problems in high impedance and low-level circuits.

One additional contaminant should be excluded—the test prod. The damage done by over-enthusiastic technicians forcing them into pins and sockets and against sliding contacts has often exceeded any deterioration caused by poor design. A good connector will, by its configuration, retard the entry of these human (destructive) elements.

Optimum Durability and Safety Factors

Obviously, the connector must withstand the environment—and this includes the body of the connector as well as the contact material. Many designers have taken an approach which leads to a virtually

Fig. 4: Quantitative measure of temperature rise for a connector.



Connector Reliability
(Continued)

armor-plated device capable of withstanding everything but a thermonuclear attack. The ideal connector is one which has optimum qualities of durability and safety. Often these objectives can be achieved by the shape, material used, and basic configuration, rather than by bulk alone. In fact, the overdesigned connector often requires insertion forces which preclude its use. The proposed MIL-SPECIFICATION limits this force to 35 pounds (regardless of the number of contacts contained).

Plug Gage to Eliminate Overstressing

Printed circuit boards are manufactured items, and as such, are subject to manufacturing variations. The variation which is of most concern is the thickness and warp of the board. When boards vary in thickness, the designer often attempts to accommodate this variation by a large "stop" in the connector admittance dimensions. Unfortunately, any attempt to accommodate various thicknesses can cause two undesirable results. The contact pressure may be low and will affect parameter of contact resistance because the force will vary from board to board; and, the contacts on the board can become permanently distorted or overstressed. Some form of plug-gage should be a part of the connector to act as a "go, no-go" device to prevent these undesirable results. One solution is to select this gaging dimension below the minimum nominal board plug dimension and has chosen to machine this plug end to very tight tolerances.

Low Insertion Force

This parameter is of equal importance to contact resistance, and is interrelated with this and continuous conductivity. It is desirable, if not essential, that the printed circuit board plug be inserted in the connector with a low insertion force, and that the clamping force between the contacts on the connector and the printed circuit board be as great as possible. As is shown in Fig. 5, contact resistance varies linearly and inversely with force. A maximum contact operating force is desirable. But it would be difficult, if not impossible, to insert the printed circuit board under such conditions without causing permanent damage to the board plug foil tab contacts or without using additional assist mechanisms. The ideal connector can combine both of these objectives through the use of a simple device which holds the connector's jaws open for insertion and lets them clamp shut after insertion.

Now referring specifically to the details of an ideal connector, Table 2, a resin foam base of the non-interconnected cellular type, or similar material, should provide for the support of two parallel contact strips.

Table 2

An Ideal Connector

The ideal connector should include the following features:

1. **Minimize wear of circuit foil (contact stability, dual pressure).**
2. **High volume and weight efficiency.**
3. **Loading and operating pressure independently optimized. (For stable low resistance.)**
4. **High contact pressure (during operation only).**
5. **Low insertion and withdrawal force (dual pressure—high operating and low loading).**
6. **Contact electrical design independent of contact pressure spring.**
7. **High contact stability (area and pressure).**
8. **Larger contact area (low resistance and wear).**
9. **Automatic compensation for circuit board dimensions and flatness.**
10. **High pressure moisture and dust seal. (To minimize contamination.)**
11. **Air voids and moisture traps practically eliminated (elastomer envelopes contact and mating surface).**
12. **Eliminate overstress of contact (adjusted to board with independent load spring in addition to gaging).**
13. **Minimum susceptibility to abuse (recessed contacts and no pins).**
14. **Use circuit itself as part of connector (reducing total number of connections).**
15. **Wipes contacts clean just prior to contact engagement.**
16. **Larger damping with inherently non-resonant materials.**
17. **Contact of solid non-corrosive metal alloy (solderability and minimum film resistance).**

This base thus provides for a resilient moisture proof seal around the contacts and nominal positioning of the embedded contact strips.

These contact strips, with appropriate spring pressure, can therefore form to possible board irregularities and maintain high contact pressure and, in addition, maintain a high pressure protective seal around these contacts.

Dimensional differences of the printed circuit, including initial and dynamic variation, are continuously compensated for. The action of the parallel contact strips can be considered analogous to a larger binder clip with the exception that these are maintained parallel and are always flat to the printed circuit due to the action of the resilient base.

To complete the seal around the contacts, multiple resilient barriers provide a three stage squeegee action around the top and two sides. These independent resilient ribs around the otherwise open contacts prevent harmful contaminants from entering the contact area. Since the bottom where the contacts terminate is also sealed, the contact area is completely sealed. The resilient ribs also act to wipe clean mating contact surfaces just prior to actual engagement. This minimizes the interference or increased contact wear that sand, dust and such like particles can cause.

Contact pressure is maintained and optimized for the functions of insertion and operation by the use of an independent spring mechanism. This mechanism eliminates the compromise often associated with contact design. The contact materials and geometry have only an electrical function. The spring has only a mechanical function. The spring mechanism, therefore, can have independent control for insertion and operation. This dual pressure feature permits very high operating pressures that would otherwise be intolerable. High contact pressure is a most important feature providing low resistance, stable resistance, and minimum wear since relative motion be-

tween contact surfaces is essentially non-existent. In addition, protection from corrosion is possible, particularly with the additional seals that the design provides.

The deleterious effects of contaminants producing chemical and absorbed films are reduced and, therefore, bulk contaminants are further reduced. To achieve low modulation of intelligence effects and wear, large and stable, effective or actual contact area is needed. With the flat type contacts, protuberancy population is increased beyond the conventional line or point area of intimacy. The many conducting paths, therefore, reduce contact resistance which keeps the source of such disturbances to a minimum. The high pressure also should virtually eliminate the relative motion between these surfaces, providing a relatively constant number of conducting spots, thus providing minimum signal modulation or noise and minimizing wear. The motion is also reduced by eliminating the need for the floating contact approach.

The contact design is not a compromise between the divergent factors interrelating the electrical and mechanical requirements but is independently designed for its specific function. The spring is also independent and designed solely for producing high contact mating force and a high pressure seal to exclude contaminants.

Insulation is essentially continuous and envelops each contact to reduce corona starting voltage at low operating pressures with air dielectric. The wide contacts (0.050) relax dimensional tolerance often required. The selection of dimensionally stable essentially non-hydroscopic materials also effectively control this problem.

Load-operate actuator configuration can accommodate itself to the ultimate end use. For instance, when used as a receptacle, the spring linkage may be offset or remote. In addition, the mechanism for closing the connector can be linked with ejection or locking hardware. Versatility is inherent with this concept. When used as a plug, the binder clip type handles can be used. As the drawings show, spring force is evenly distributed along the connector to assure conformity of plug and receptacle.

The ability to be non-critical to the pluggable board dimensions is attacked two ways. First, the independent spring design permits work loads and deflections to be the controlling factor of its geometric configuration and material selection. Typical space restrictions are circumvented by its exterior position. Secondly, the pillow that supports the contact strips can absorb lesser variations without adverse effects. The basic principle here may be considered somewhat analogous to the operation of hydropress forming die.

With the independent spring contact loading actuators, the contacts can be constructed of precious metal alloy ribbon. The flat ribbon design gives larger contact area for low resistance and minimum wear. Solid metal eliminates the well-known problems associated with plating, consistently providing sufficient adhesion, hardness, ductility, density, and thickness.

Long life expectancy is based on the dual pressure concept. Low loading pressure can reduce wear and provide ease of operation without compromising operating performance. It also makes feasible successful use of the printed wiring circuit conducting foil as the mating connector contact material which is convenient, weight and space saving, and eliminates the added connection created by an adapter. High operating pressure, as previously mentioned, reduces wear that can be especially acute with high vibration frequencies.

Ability to take abuse is based on the relative weakness of the often used 0.040 inch diameter pins and a split tulip or napkin ring type socket. The female contacts of this connector are recessed and the larger independent spring with deflection limits will make overstress impossible. The flat male contacts fully supported by the circuit board precludes any bent pin problems and are reasonably immune to tampering.

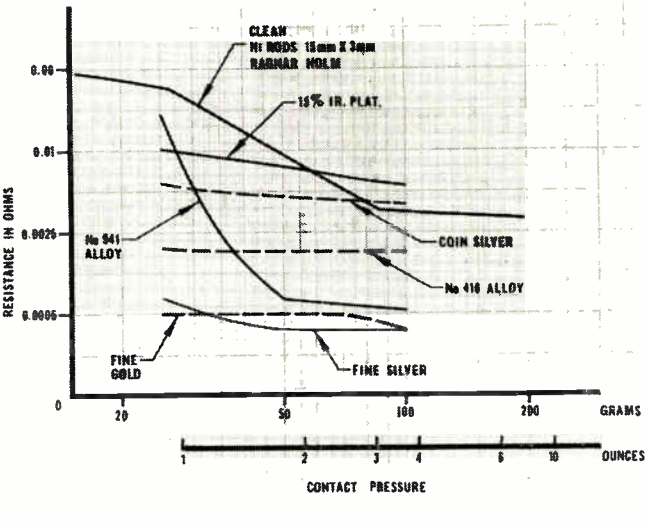
Since wear is practically non-existent, the ribbon can be thin. The thinness attributes to the intercontact seal which permits high altitude or low atmospheric pressure performance by the fact that essentially all air voids are filled by the resilient pillow that supports the contacts. Also, cost is reduced making feasible the use of solid precious metal contacts.

Weight and volume efficiency was optimized by the combined function of the spring with structural rigidity, the low volume of metallic contact material needed, combined with high contact density per linear inch and light-weight materials.

Every effort was made to select materials and processes with proven performance and predictable results.

We all recognize that the printed circuit board is a temporary expedient. As manufacturing techniques improve, micro-modules and such will become more prevalent. But, some form of connecting device will be used even with these packages. The science of connector design for printed circuit boards is finally beginning to take shape. The design objectives that have been enumerated will enable the equipment designer to specify connectors on a rational basis. The connector I have described meets these requirements for an ideal connector. If used intelligently where it fits, it can solve many vexing problems involving connector use. And if it has merely stimulated a few more engineers to attack this problem, only good can result.

Fig. 5: Contact resistance varies linearly and inversely with force.



The field-effect in semiconductors originated with Shockley and his unipolar transistor.
A commercial application of this principle is the tecnetron.
A new device, the alcatron, makes use of the technology gained from these two devices.
It holds promise of sizable power at high frequencies.

A New Field-Effect Device . . .

The Alcatron

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FIELD-EFFECT can be used with semiconductor devices. The idea originated with Shockley and his unipolar transistor.[1] The only commercial application to date was the tecnetron,[2] manufactured in France by C.F.T.H. A new field-effect device, the alcatron, has recently been presented in France by C.S.F. It seems to hold promises of sizable power at high frequencies.[3]

Unipolar Transistor

When a metal-semiconductor junction is reverse-biased, a depletion or space charge layer develops in the semiconductor underlying the junction. In this depletion zone, no free charge carrier is available, and the semiconductor behaves as an insulator.

Shockley's unipolar transistor is represented Fig. 1. It consists of a slab of semi-conductor carrying two ohmic contacts, the source and the drain, at its ends, and two rectifying junctions, the gate, on two opposite sides. When the gate is reverse-biased, depletion zones appear as indicated, and the conducting cross-section of the semi-conductor is reduced. This conducting part is called the channel.

Varying the gate bias results in variable channel cross-section, so that resistance modulation of a current flowing between source and drain is obtained.

This simplified explanation shows that the unipolar transistor can be useful as an amplifier. It has several interesting features. It is a high impedance device, can be made in very small sizes and has high frequency limits. Transistor exhibits drain current saturation and needs only small input signals to control the channel cross-section down to zero, this point being called the pinch-off. It works in convenient ranges of voltage and current.

Fig. 1: Shockley's unipolar transistor.

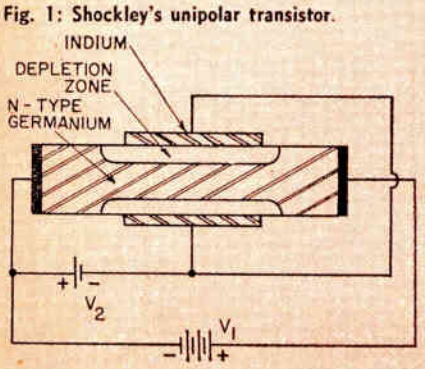


Fig. 2: A tecnetron amplifier circuit.

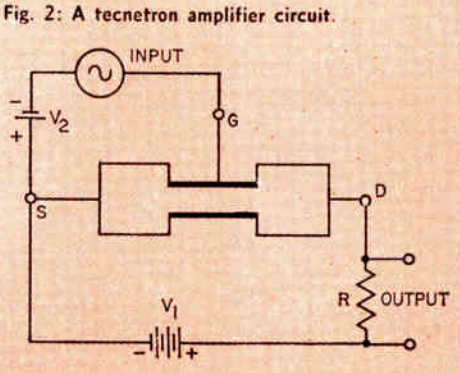
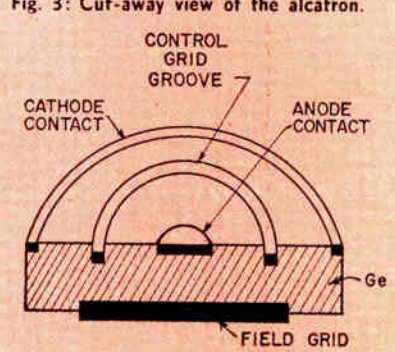


Fig. 3: Cut-away view of the alcatron.



Tecnetron

The tecnetron differs from the original unipolar transistor in that it has symmetry of revolution around the longitudinal source-drain axis (Fig. 2). This cylindrical symmetry modifies somewhat the characteristics and performances. An undesirable result is that pinch-off is punctual, or in other words that at pinch-off the channel cross-section reduces to a point. This is, of course, unfavorable as far as power handling ability is concerned. It should be pointed out here that the most advantageous working point is at or near pinch-off, as far as slope or frequency performance is of importance. And speaking of slope, the tecnetron has a very small transconductance, of the order of 0.1 ma/v. Because it has very low parasitic capacitances, say 2 pf, the intrinsic coefficient of merit of the device is nevertheless not too bad. When in a circuit, however, things are different, because any circuit parasitic capacitance will drastically reduce the coefficient of merit.

Finally, the germanium filament constituting the active part of the tecnetron is about 100 microns long and 100 microns in diameter, and in no way can be considered a paramount of ruggedness.

Alcatron

The alcatron may also be considered as derived from the original unipolar transistor by rotation. This time, however, rotation takes place about an axis passing through the drain.

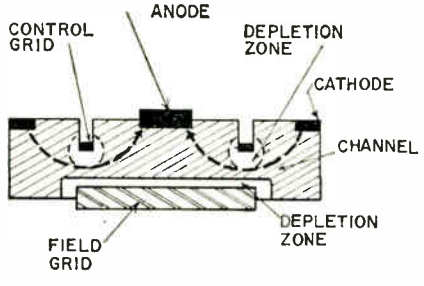
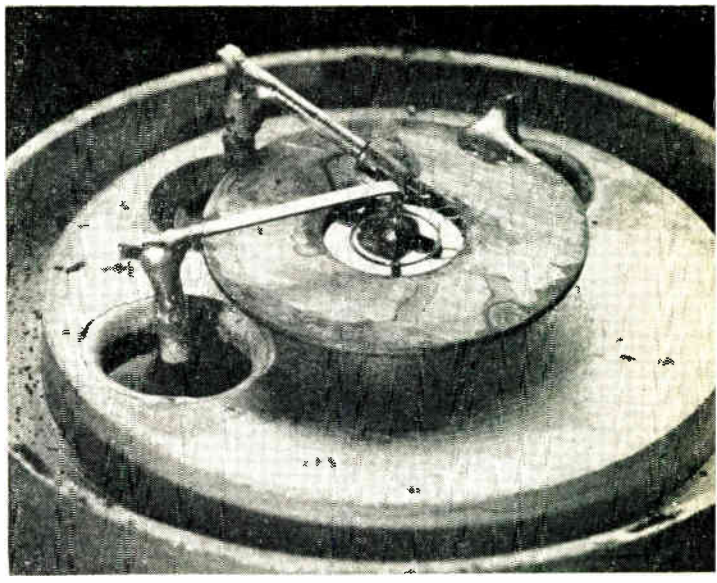


Fig. 4: Cross-section of the alcatron along a diameter.

The actual device, when cut in half, looks somewhat like Fig. 3. For the laboratory samples available, the semiconductor is N-type germanium, which was used for developmental work simply because its technology is well established. It should be pointed out right now that production of germanium alcatrons is not planned. However, the use of N-type semiconductor results in the free carriers being electrons, so that the familiar electrode names have been retained, as shown in Fig. 3.

The alcatron is actually a four-electrode or tetrode device. The lower electrode is a pre-striction or field grid. Its role is to produce a fixed striction of the channel. The upper grid is the signal or control grid, which modulates the channel section. The center electrode is the anode, and the circular electrode on the periphery of the germanium disc is the cathode. This disposition is preferred to the alternate arrangement (cathode at center, anode on outside) because experience has shown it leads to better performance. Fig. 4 represents the cross-section of the alcatron along a diameter.



Enlarged photograph shows the construction of the alcatron.

Physical Characteristics

N-type germanium of 25 ohms resistivity has been used, in the form of a disc of 3 mm diameter, and 200 microns thickness. Cathode connection is made by ohmic soldering of the semiconductor pellet on a kovar disc. Anode connection is obtained by an N + ohmic contact at center.

The field grid is a circular ohmic junction, 2.5 mm in diameter, made of indium. In some early models, this electrode was annular and made of a ring of indium. This is apparent in Fig. 6. The control grid junction also uses indium, and is made at the bottom of a circular groove cut in the semiconductor. Electrolytic jet etching produces a groove 2 mm in diameter, 50 microns wide and 50 microns deep. Reversing the polarity results in indium plating at the bottom of the groove, thus ensuring a rectifying control grid contact. During these operations, the semi-conductor pellet revolves on a small lathe and is held in place by suction. Control grid connection is made by a gold wire. The distance between control grid and field grid is 40 microns. It is in this zone that striction takes place.

Voltages are applied as shown in Fig. 5.

Performances

A laboratory sample exhibited the following characteristics:

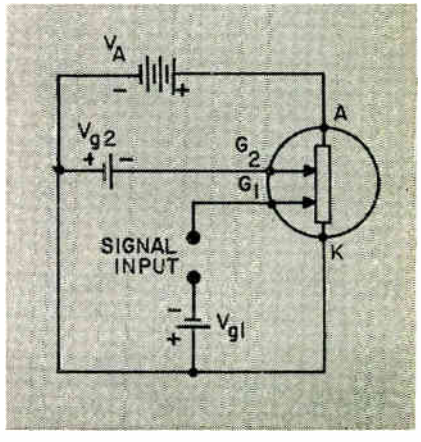


Fig. 5: Diagram shows the electrical hook-up for the alcatron.

Alcatron *(Concluded)*

Anode voltage	50 v
Anode current	100 ma
Field grid bias	−15 v
Control grid bias	−6 v
Transconductance	6 ma v
Admissible power	6 w min.

This sample worked correctly at 120 MC/s.

It is evident, by the geometry of the device and by its characteristics, that the alcatron is akin to power transistors. Obvious advantages are ruggedness, high transconductance and high power. Besides, the alcatron is a high impedance device, and exhibits pentode characteristics.

Frequency performance is limited by the time-constant determined by the input capacitance and its associated resistance. It is worth pointing out that in the alcatron the effective resistance is not the equivalent channel resistance, through which the input capacitance is charged. There is another charge path, by capacitance to the field grid, which reduces

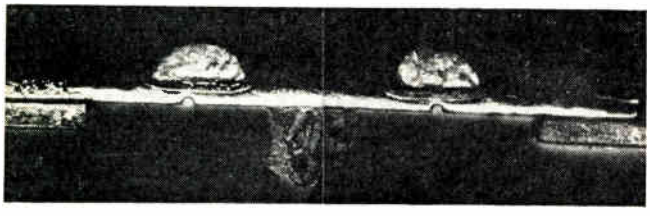


Fig. 6: A cut through alcatron, showing ohmic contacts and junctions. Notice that the field grid is annular.

the effective time constant and improves performances.

A theoretical study of the alcatron leads to the following expressions for the important parameters:

$$g_o = \tau \frac{a}{l} 2\pi R$$

$$W_o = \frac{2\pi\tau a^2}{\epsilon_o \mu K}$$

$$F_{max} = \frac{1}{2\pi R C}$$

$$I_{max} = \frac{2 g_o W_o}{3}$$

with

τ = semiconductor conductance
$2a$ = distance between grids
l = channel length
R = control grid radius
ϵ_o = vacuum dielectric constant
K = germanium dielectric constant
μ = carrier mobility
C = grid capacitance
W_o = pinch-off voltage

Future Possibilities

The peculiar geometry of the alcatron lends itself to several variants. An interesting point is the large area field electrode, which carries no r-f signal and can be directly soldered on the base of the transistor case. Since the indium reaches the immediate vicinity of the channel, very good thermal conductivity is ensured to the case, with resulting improvement in power capability.

Another worthwhile comment relates to the input capacitance. If the dimensions of the device are linearly increased, to obtain better power performance, the control grid capacitance evidently increases. However, the equivalent channel resistance, through which the capacitance charges, decreases simultaneously. The somewhat paradoxical result is that the frequency performance does not degrade much. Since the first alcatron samples delivered several watts above 100 MC, it seems fairly safe to predict large powers at much higher frequencies for the future.

An immediate way to obtain improvements would be to replace germanium by a better semiconductor, such as gallium arsenide. As a first approximation, this would result in a four-fold improvement in frequency limit. At the same time, temperature performance would be better and the device could work at higher power dissipation.

On recent alcatrons, large improvement has resulted from the diffusion of arsenic down to 25 microns inside the upper face. This creates a superficial layer of N + semiconductor, which in effect brings cathode and anode electrodes right to the rim of the grid groove. The anode-cathode channel resistance is then decreased from 200 to 15 ohms, and surface state becomes much less important. Such a technique also opens the way for simpler manufacture and construction.

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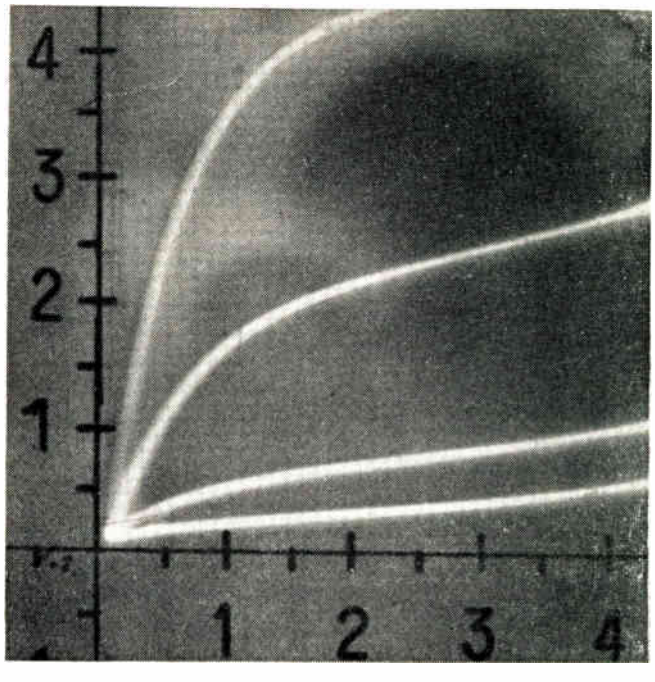
3. A. V. J. Martin, *Electronique et Automatisme*, May 1960, p. 107.

Fig. 7: Family of anode characteristics of the alcatron.



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Here is shown the size of the Chassis hole for the sockets, either solder or mechanically fastened.

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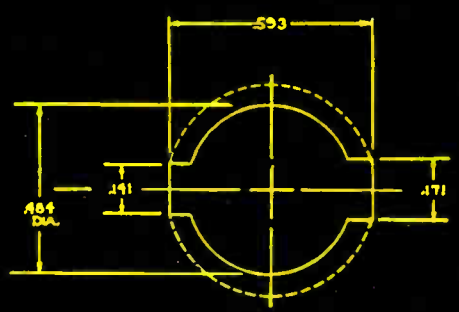

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Northeast Engineering Meeting

MORE than 15,000 engineers and scientists are expected to attend the 1960 Northeast Electronics Research and Engineering Meeting (NEREM) which will be held on November 15, 16, 17, 1960 in the Commonwealth Armory and the Sheraton-Plaza, Hotel, Boston, Mass.

NEREM now ranks as the third largest electronic show and convention in the country, behind the IRE Show and WESCON.

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The outstanding technical papers program will feature the presentation of 250 oral presentation papers. There will be forty sessions; thirty-three day sessions and seven night sessions.

This year's meeting will see a marked departure in technical program, format, scope and size, as well as type and number of exhibits. The program will feature many invited state-of-the-art tutorial sessions, with related evening informal discussion periods.

All registrants will receive—at the conference—free of additional charge, a copy of the NEREM record. This is a printed 200-page conference report with 600-1,000 word digests (supported by drawings and photographs) of every paper presented at the meeting and illustrations. Illustrated profiles of every NEREM speaker will also be included in the Record.

The Professional Group on Production Techniques (PGPT) will be holding its 4th Annual Conference on November 15-16, in conjunction with NEREM. Papers for the two sessions, are being grouped under two general headings: "Design Techniques That Insure a Better Product," and "Materials and the Product Today."

Among the highlights of the technical sessions will be a series on "Space Electronics," moderated by Dr. Edward I. Hawthorne of AVCO Corporation. Papers will touch on the problems encountered in a number of the latest satellite programs, including ECHO and SAURUS, and ABLE STAR.

Included in the technical session on semiconductors will be papers by three distinguished British engineers, "Automatic Transistor

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Avnet Electronics Corp.	33, 34
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The Bendix Corporation, Eclipse-Pioneer Div.	828, 829
The Bendix Corporation, Red Bank Division	830
The Bendix Corporation, Scintillo Division	831, 832
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Bogart Manufacturing Corp.	54
Bomac Laboratories	1012, 1013
Book Clearing House	42
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The Bristol Company	627, 628
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Broger Instrument Sales Co., Inc.	222, 223
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Burlingame Associates Boston, Inc.	1025, 1026
Burroughs Corporation, Electronic Tube Div.	529
Bussman Manufacturing Div., McGraw-Edison Co.	227
Bussmann Manufacturing Div., McGraw-Edison Co.	227
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Consolidated Electrodynamics Corp.	428
Consolidated Vacuum Corp.	47
Control Equipment Corp.	1047
Cornell-Dubilier Electric Corp.	521
Corning Glass Works	402
Cowperthwait & Brodhead	20, 21
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Cramer Electronics, Inc.	13, 14
Cubic Corporation	230
The Darbury Corporation	B07, B08
Data Instruments	924
The Daven Company	1167
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DeVeer Sales Engineering Co., Inc.	803
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Dynamic Gear Co., Inc.	72B
Dynamics Research Corp.	429
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Thomos A. Edison Industries	928

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(NEREM)

Opens Nov. 15

Testing," by H. S. L. Cameron and P. M. Tipple of Associated Transistors Ltd. and "The Transistor: Today and Tomorrow," by E. Wolfendale, Mullard Southampton Works.

A panel discussion on Wednesday evening, Nov. 16, will deal with one of the most important problems of today's electronic industry—the very large percentage of engineering talent involved in simply analyzing proposals, rather than designing hardware.

Many industry people feel that our manpower utilization is often only 50% effective, sometimes even less. At a time when we are engaged in open competition with Russia in the space race this situation deserves a good deal of attention.

This problem will be discussed in "Improving the Utilization of Technical Manpower in R&D Proposals —A Proposal to Limit Proposals." The moderator of the discussion will be L. Mautner, Manager Special Systems Laboratory, Hughes Aircraft Co.

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Eitel-McCullough, Inc. 1106
Electrolab Printed Electronics Corp. 17
Electralab Products 17
Electrical Apparatus Co., Inc.
Electricol Supply Corp. 35, 36
Electro Devices, Inc. 1021
Electro Instruments, Inc. 1130, 1131
Electronic Components & Services 1032, 1033
Electronic Measurements Co., Inc. 229
Elgin National Watch Co., Electronics Division 1107
Eltron Engineering Sales, Inc. 823, 824
Emcor-Ingersoll Products Div., Borg-Warner Corp. 923
Emerson & Cuming, Inc. 401
Engineered Electronics Co. 1145
Epsco, Inc. 311, 312
Equipment Sales Co., Inc. 330, 332

Falstrom Company 1108
Federal Stamp Company 801
John Fluke Mfg. Co., Inc. 926
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Garde Manufacturing Co. 910
General Electric Company 323-326, 403-406
General Electric Company, Instrument Department 403, 404
General Electric Company, Specialty Control Dept. 405
General Electric Company, Power Transformer Dept., V.R. Section 406
General Electric Company, Receiving Tube Dept. 324
General Electric Company, Capacitor Department 325, 326
General Electric Company, Power Tube Dept. 327
General Products Carporation 710
General Radio Company 9, 10
Berber Sales Company, Inc. 407, 427
Globe Industries, Inc. 526
Gordos Corporation 1010
W. L. Gore & Associates, Inc. 1122
Garman Machine Corp. 226
George Gostenhofer & Assoc., Inc. 723, 724
Green Instrument Co., Inc. 932
The Dan Greene Organization, Inc. 26, 27
George Gregory Associates 307, 308
Gudebrod Bros. Silk Co., Inc. 1022

W. M. Hague Company 126
Harawe-Precision, Inc. 129
The Hart Manufacturing Co. 204

The Hartwell Corporotion 1020
Harvey-Wells Electronics, Inc. 31, 32
Robert B. Hotch Co. 1048
Glenn M. Hathaway Electronics, Inc 929, 930
Heli-Coil Corporation 1165
Helipot Division, Berkman Instruments 821
Hewlett Packard Co. 1005, 1006
Hi-G Incorporoted 209, 210
Samuel C. Hooker, Inc. 306
Hughes Semiconductor Div. 1028
V. J. Huntoon Associates, Inc. 1123
Hyperion, Inc. 1042

Industrial Products Co. 501
Industrial Test Equipment Co. 225
Industro Transistor Corporation 1124
L. K. Ingber Company 911
Instrument Associates, Inc. 623, 624
Instrument Development Labs., Inc. 905
Instrument Dynamics, Inc. 527
Instrument Specialties Co., Inc. 912
Instruments of New England 50
International Rectifier Corp. 927

Jones & Lamson Machine Co. 727

Koy Electric Co. 522
Kearfott Division, General Precision, Inc. 11, 12
Keithley Instruments, Inc. 827
Ken-Tron Corporation 1162
Kepco, Inc. 121, 122
Kinney Vacuum Division, The New York Air Broke Co. 1129
Kin Tel Division, Cohu Electronics, Inc. 811, 812
Fran Kosowicz 18E
Krohn-Hite Corporation 19

Laboratory for Electronics, Inc. 625, 626
Lafoyette Radio Corp. of Mass. 507, 508
Henry Lavin Associates, Inc. 1023, 1024
Erik A. Lindgren & Assoc., Inc. 331
Lumatron Electronics, Inc. 721

Macdonald-Wadman Co., Inc. 523, 524
Richard F. MacDowell Co., Inc. 424, 425
Magnecraft Electric Co. 124
R. P. Mahan Company 45, 46
P. R. Mallory & Co., Inc. 629, 630
A. W. Mayer Company 39
McMillan Electronic Industries 530
Measurement Equipment Co., Inc. 1146, 1147
Mepco, Inc. 127

Microdot, Inc. 712
Microwove Development Labs., Inc. 225
Microwove Electronic Tube Co., Inc. 228
James Miller Monufacturing Co. 327
Millivoc Instrument Division, Cohu Electronics, Inc. 221
Minneapolis-Honeywell Regulator Co. 51, 52
Monohan and Company 1127
Motorola Semiconductor Products Inc. 1109

H. D. Q. & H. V. Neff 1110, 1111
New Englond Retinning, Inc. 40
New England Transformer Co., Inc. 37
North American Electronics, Inc. 1017
North Atlontic Industries, Inc. 56
North Electric Company 505, 506

Oak Manufacturing Company 504

Pacific Semiconductors, Inc. 49
Woyne B. Pallioca, Inc. 1101 1102
Panoramic Radio Products, Inc. 132
Perkin Engineering Corp. 131
Perkin Engineering Corp. 134
Ray Perran & Company, Inc. 123
George A. Philbrick Researches, Inc. 610
Philco Corporotion, Lansdale Tube Division 730
Photocircuits Corporation 18C
Pic Design Corp. 205
Stan Pierce, Inc. 1166
P. J. Engineering Sales Co., Inc. 704, 705
Polaroid Corporation 1126
W. B. Pray Sales 110
PRD Electronics, Inc. 725
Richard Purinton, Inc. 60(6)
Pyrofilm Resistor Co., Inc. 706

Radio Corporation of America, Electron Tube Division 601, 602
Radio Corporation of America, Semiconductor & Materials Div. 601, 602
RCA Northeastern Region 601, 602
Radio Shack Corporation 1029, 1030
Rawson Electrical Instrument Co. 125
Raytheon Company 3-6
Raytheon Company, Commercial Apparatus & Systems Div. 3, 4
Raytheon Company, Industrial Components Division 5
Raytheon Company, Microwave & Power Tube Div. 6
Rescon Electronics Corparation 48
Rohde & Schwarz Sales Co (U.S.A.) Inc. 531
Rotron Manufacturing Co., Inc. 1044

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The Howard J. Schuft Co., Inc. 605, 606
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Charles Segel Company 1036, 1037
Henry P. Segel Co., Inc. 908, 909
Sensitive Research Inst. Corp. 1008, 1009
The Sibley Company 1128
Sigma Instruments, Inc. 701, 702
Skydyne, Inc. 207, 208
Sola Electric Co. Div., Basic Products Corp. 1169
Solid State Products, Inc. 1043
Sorensen & Company 1001, 1002
Spaulding Fibre Company Inc. 231, 232
Sperry Microwave Electronics Co. 925
Sprague Electric Company 201, 202
Sprague Products Division, Sprague Electric Company 203
Sterling Precision Corporation 43, 44
Stevens Manufacturing Co., Inc. 1125
Stockwell Technical Sales 526
R. H. Sturdy Co., Inc. 41
The Superior Electric Co. 15, 16
Systron Corporation 1027

Taber Instrument Corporation 631, 632
Sarkes Tarzian, Inc. 408

Taurus Corporation 18D
Technical Instruments, Inc. 29, 30
Technology Instrument Corp. 101, 102
Tektronix, Inc. 7, 8
Texas Instruments, Inc., Geosciances & Instrumentation Div. 511
Texas Instruments, Inc., Metals & Controls Div. 512
Texas Instruments, Inc., Semiconductor & Components Div. 509, 510
The Thomas & Betts Co., Inc. 410
Todino Engineering Sales, Inc. 1105
Trans-Sil Corp. 804
Transistor Applicotions, Inc. 423
Transitron Electronic Corporation 303, 304
Tru Connector Corp. 810

United States Dielectric Products, Inc. 53
Universal Instruments Corporation 1015, 1016

Valney Crystal Corporation 621
Varian Associates 1010, 1011
Veeco Vacuum Corp.
Vitramon, Inc. 128

Waltham Precision Instrument Co. 1040
Waterman Products Co., Inc. 1031
Waters Manufacturing, Inc. 707, 708
Weldmatic Division, Unitek Corporation 922
Westinghouse Electric Corp. 901-906
Westinghouse Electric Corp., Industrial Electronics Dept. 901
Westinghouse Electric Corp., Standard Control Division 902
Westinghouse Electric Corp., Electronic Tube Division 903
Westinghouse Electric Corp., Specialty Transformer Dept. 904
Westinghouse Electric Corp., Instrument Department 905
Westinghouse Electric Corp., Semiconductor Department 906
Westline Products Division, Daystrom, Litho Co. 731
Weston Instruments Division, Daystrom, Inc. 305
White Sales Company, Inc. 1143, 1144
Wood Electric Co., Inc. 931

Jewell Associates, Inc. 107, 1007

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Tuesday Morning, November 15, 1960 — **Sheroton-Plaza Hotel**

STATE OF THE ART OF MICROMINIATURIZATION

Chairman: E. Keonjian, American Bosch Arma Corp., Garden City, N. Y.
"A Realistic Look at Microminaturization," E. Keonjian, American Bosch Arma Corp.
"Micro-Module Program-Status and Progress," S. G. Bassler, U. S. Army Signol Corps Laboratory, Fort Monmouth, N. J.
"Swiss Cheese Concepts of Circuit Packaging," Robert G. Bender, Hughes Products, Newport Beach, Cal.
"Tantalum Film Circuitry," Lawrence J. Varnerin, Bell Telephone Labs, Murray Hill, N. J.
"Silicon Layer Junction—A New Concept in Microcircuitry," J. Allegretti and D. J. Shombert, Merck, Sharpe & Dome Co.

Tuesday Morning, November 15, 1960 — **Sheraton-Plaza Hotel**

NEW ART COMPUTER ELECTRONICS

Chairman: Frank H. Tendick, Bell Telephone Laboratories, Murray Hill, N. J.
"A Random Access Cryosar Memory," R. C. Johnston, MIT, Lincoln Laboratory.
"The Microwave PLO os a Building Block for Ultra Fast Computing Systems," G. B. Herzog and H. S. Miller, RCA Laboratories and E. L. Willette, IBM, Poughkeepsie, N. Y.
"Esaki Diode Inverter Logic Techniques," Hannon S. Yourke, IBM, Advanced System Development Div., Poughkeepsie, N. Y.
"Millimicrosecond Computer Circuits" W. J. Poppelbaum, Univ. of Illinois.

Tuesday Afternoon, November 15, 1960 — **Sheraton-Plaza Hotel**

COMMAND AND CONTROL SYSTEMS—PANEL DISCUSSION

Chairman: Arthur P. Hill, The MITRE Corporation, Lexington, Mass.
Panel Participants: Maj.-Gen. Kenneth P. Beraquist, Air Research and Development Command; Maj.-Gen. Clyde H. Mitchell, Air Materiel Commond; C. W. Halligan, THE MITRE Corp.; William J. Sen, Command and Control Division, ARDC; Charles A. Zraket, THE MITRE Corp.

Tuesday Afternoon, November 15, 1960 — **Sheraton-Plaza Hotel**

INFORMATION THEORY AND SIGNAL PROCESSING

Chairman: David VanMeter, Litton Systems, Waltham, Mass.
"Diversity Combining for Signols of Different Mediums," J. Granlund and W. Sichak, ITT Labs.
"Intrapulse Coding to Solve Radar Ambiguous Range Problems," R. C. Heimiller, Hughes Aircraft Co.

Tuesday Afternoon, November 15, 1960 — **Commonwealth Armory**

PRODUCTION TECHNIQUES

"Design Techniques that Insure Better Products."

Tuesday Afternoon, November 15, 1960 — **Commonwealth Armory**

NEW ENERGY SOURCES

Chairman: Joseph Kaye, MIT, Cambridge, Mass.
"Modes of Operation of Direct Conversion Cesium Devices," T. C. Robinson and E. N. Carobateas, Thermo Electron Engineering Corp.
"Recent Developments in Fuel Cells," D. Sama, Lowell Technological Institute, Lowell, Moss.
"The Static Performance of Thermoelectric Heat Pumps," P. E. Gray, MIT, Cambridge, Mass.

Tuesday Afternoon, November 15, 1960 — **Commonwealth Armory**

OCEANOGRAPHICAL INSTRUMENTATION

Chairman: A. Gross, Gross Instrument Co., Quincy, Moss.
"Background of Oceanographic Instrumentation," W. S. Richardson, Woods Hole Oceanographic Institution.
"Position Finding," W. S. von Arx, Woods Hole Oceanographic Institution.
"Buoy Systems," D. H. Frontz, Jr., Woods Hole Oceonographic Institution.
"Dota Acquisition by Unattended Buoys," R. G. Wolden, Woods Hole Oceanographic Institution.

Tuesday Evening, November 15, 1960 — **Sheraton-Plaza Hotel**

THE FUTURE OF MICROMINIATURIZATION (Informal Discussion Sessions)

Chairman: E. Keonjian, American Bosch Arma Corp., Garden City, N. Y.
Panel Members: S. G. Bassler, U. S. Army Signal Corps Laboratory, Fort Monmouth, N. J.; R. G. Bender, Hughes Products, Newport Beach, Cal.; L. J. Varnorin, Bell Telephone Labs, Murroy Hill, N. J.; J. Allegretti and D. J. Snombert, Merck, Sharpe and Dome Co., Rahway, N. J.; J. P. Wollmark, RCA Laboratories, Princeton, N. J.; S. Schneider, Burroughs Research Center, Paoli, Po.

Tuesday Evening, November 15, 1960 — **Sheroton-Plaza Hotel**

COMPUTER TRENDS—HERE AND ABROAD

Chairman: S. G. Campbell, IBM, Poughkeepsie, N. Y.
"European Computer Developments," I. L. Auerbach, Auerbach Electronics Corp., Narberth, Pa.
Panel Discussion: "Development Potential of New Art Techniques," R. C. Johnston, MIT, Lincoln Laboratory, Cambridge, Mass.; W. J. Poppelbaum, University of Illinois, Urbana, Ill.; E. L. Willette, IBM, Poughkeepsie, N. Y.; Hannon S. Yourke, IBM, Advanced System Development Div., Poughkeepsie, N. Y.; I. L. Auerbach, Auerbach Electronics Corp., Norberth, Pa.; William B. Hugle, Westinghouse; J. I. Raffel, MIT Lincoln Labs, Cambridge, Mass.; A. E. Slade, A. D. Little Co., Cambridge, Mass.
"Small Lot and Specialty Production Problems" —Workshop Clinic (Sponsored by PGPT).

Tuesday Evening, November 15, 1960 — **Commonwealth Armory**

REGION 1-STUDENT PRIZE PAPERS

"Information Retrieval, A Mechanical Scheme for Searching Technical Literature," Raymond A. Shoppy, Rhode Island Univ.
"Broadband Transformer Desian," Allen F. Podell, Cornell Univ.

Wednesday Morning, November 16, 1960 — **Sheraton-Plaza Hotel**

SPACE ELECTRONICS—I

Chairman: E. I. Hawthorne, Avco Corporation, Wilmington, Mass.
"Quantitative Performance Evaluation of a Position and Velocity Range Measurement System, AZUSA Mark II," D. C. Prim and L. N. Lowhead, Convair Astronautics.
"The TRANSIT Dopple Tracking Station Digital System," M. B. Greenlee, Johns Hopkins Univ.
"SAURUS, Search and Rescue Using Satellites," Frank W. Lehan, Space Electronics Corp.
"The Role of the Jet Propulsion Laboratory in Project Echo," W. K. Victor, Jet Propulsion Laboratory.

Wednesday Morning, November 16, 1960 — **Sheraton-Plaza Hotel**

ACTIVE NETWORKS

Chairman: F. H. Blecher, Bell Telephone Laboratories, Murroy Hill, N. J.
"Theoretical Limitations on the Esaki Diode os a Network Element," B. K. Kinariwalo, Bell Telephone Laboratories, Murroy Hill, N. J.
"Synthesis of Multi-Parameter Active RC Networks," J. M. Sipress, Bell Telephone Laboratories, Murroy Hill, N. J.
Active Synthesis by RC-RL Partitioning," Donald A. Calahan, Univ. of Illinois.
"Challenges and Promises of Active Network Theory" N. DeClaris, Cornell University, Ithaca, N. Y.

Wednesday Morning, November 16, 1960 — **Sheraton-Plaza Hotel**

SUPER-HIGH MICROWAVE POWER

Chairman: H. J. Carlin, Microwave Research Institute, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.
Aerospace Applications of Beomed Microwave Power," H. Letaw, Jr., Raytheon Co.
"Problems in the Generation of Microwave High Power," G. L. Guernsey, Lincoln Laboratory, MIT.
"Some Technical Aspects of Microwove Radiation Hazards," W. Mumford, Bell Telephone Laboratories, Whippany, N. J.
"High Power Microwave Systems; Past, Present and Future," R. Bietz, Cornell Aeronautical Laboratory, Buffalo, N. Y.

Wednesday Morning, November 16, 1960 — **Commonwealth Armory**

CIRCUITS I

Chairman: M. Kerman, ACF Electronics Division, Paramus, N. J.
"Retiming of Digital Signals With a Local Clock," C. J. Byrne, M. Karnaugh and J. V. Scattaglia, Bell Telephone Laboratories, Murray Hill, N. J.
"Group-Redundant Techniques for Feedback Control Systems," S. Adelman and S. Shinners, Sperry Gyroscope Co.
"The Phase-Controlled Loop With a Saw-Tooth Comparator," A. J. Goldstein and C. J. Byrne, Bell Telephone Laboratories, Murray Hill, N. J.
"An Analysis of Cross-Talk in Unbalanced Cabled Circuits," N. W. Feldman and G. P. Tripp, U. S. Army Signal R and D Lab, Ft. Monmouth, N. J.

Wednesday Morning, November 16, 1960 — **Commonwealth Armory**

PRODUCTION TECHNIQUES—MATERIALS AND THE PRODUCTS TODAY

Wednesday Morning, November 16, 1960 — **Commonwealth Armory**

COMPONENT RELIABILITY

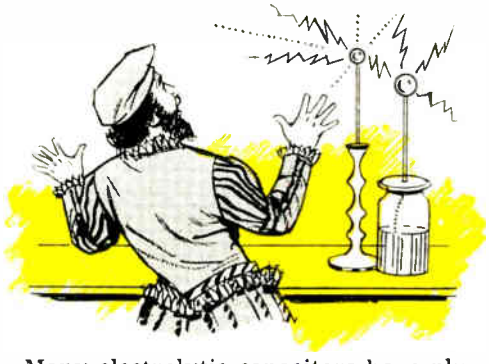
Chairman: R. G. Fitzgibbons, Raytheon Co.

(Continued on page 209)

after routing, clip and save

a continuing series on technical topics of specific interest to engineers

Folio 12 REFERENCE DATA FILE SANGAMO



Polarity Of Aluminum Electrolytic Capacitors

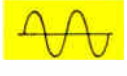
Many electrolytic capacitors have plus and minus terminals, like flashlight batteries, which makes them quite different from other types of capacitors. Polarity becomes necessary because of special construction that provides maximum capacitance for a given volume, weight, and cost.

Aluminum electrolytic capacitors are built around one of the best overall dielectric materials available. Aluminum oxide formed on a high-purity aluminum foil has a dielectric constant of from 7 to 10 and an extremely high dielectric strength of 2.5 million volts per 0.1 inch of thickness.

These unique dielectric characteristics of aluminum oxide can be utilized fully by controlling thickness of the oxide dielectric from a film only a few molecules thick to any depth required for conventional voltage ratings of electrolytic capacitors. Furthermore, aluminum foil can be etched to increase its surface area as much as ten times, increasing capacitance proportionally.

This extremely thin dielectric film offers very high resistance to passage of electrical current as long as the anode is positive with respect to the cathode. If the capacitor is connected with polarity reversed, the oxide film offers very little resistance to current flow and the resulting high currents will cause the capacitor to overheat.

This is the reason why polar electrolytic capacitors must be properly connected in a d-c circuit. Most electrolytic capacitors for filter, by-pass, and energy storage applications are polar capacitors. That is, they are constructed with the anode covered with dielectric oxide to a thickness capable of withstanding both rated and surge voltage of the capacitors. The negative plate normally has no dielectric oxide other than a thin film formed when aluminum is exposed to air.



It is possible to adapt the electrolytic principle for a non-polar capacitor to a-c applications. Two anodes are used, each plate having an aluminum-oxide dielectric formed on its surface to a thickness capable of withstanding normal and surge-voltage rating in either direction. When connected to an a-c source, one foil acts as an anode for one-half the cycle while the other functions as an anode on the other half of the cycle. Thus, there is no need to observe polarity with a non-polar capacitor. Because a non-polar capacitor is really two capacitors in series, it will have approximately one-half the capacitance of a polar capacitor of the same voltage rating when read on a bridge. Or, to put it another way, it will have twice the volume of a polar capacitor for the same capacity and voltage rating.

Non-polar electrolytic capacitors can operate on a-c provided service is intermittent or if reactive currents are low enough to prevent overheating. They cannot operate continuously at a-c potentials higher than 40 volts rms because of their high power factor and small surface area for dissipation of heat.

Type DCM, Polar Energy Storage | Type MJ, Non-Polar Motor Starting | Type TR, Polar High Reliability | Type MT, Polar General Purpose

Motor-starter capacitors are non-polar. They are also used where voltage may reverse on occasion or where a-c current must be passed continuously during the starting period.

There is another large family of electrolytic capacitors which, for lack of a better name, are called semi-non-polar. As the name implies, oxide is purposely formed on the negative plate, but of a thickness less than that formed on the anode. Most semi-non-polar capacitors are especially designed for particular applications.

Where a-c ripple voltage across semi-non-polar capacitors is high in filter applications, it is desirable to have oxide formed on the cathode capable of withstanding peak-to-peak voltage of the ripple wave — otherwise, oxide will accumulate on the cathode which will reduce capacitance and increase impedance.

Since non-polar and semi-non-polar electrolytic capacitors have more foil area to absorb heat, more parallel paths for current, and larger case sizes with greater area to dissipate heat, they are used where high a-c ripple currents and/or low impedance requirements make polar capacitors impractical.

Sangamo has a complete line of polar and non-polar capacitors for filtering, energy storage, motor starting, by-pass, coupling, and non-critical timing circuit applications. Where semi-non-polar capacitors are required, Sangamo engineers are well qualified to supply the most economical design that will give good service and long life.

SC60-6

SANGAMO ELECTRIC COMPANY, Springfield, Illinois

— designing toward the promise of tomorrow

New Tech Data for Engineers

Circuitry Guide

Plastic Cabling and Circuitry Guide, Bulletin S-9, includes design features, specs and applications for multiconductor flat wire cable, multilayer circuitry and flexible etched cable, circuits and laminates. Plastic Products Div., International Resistance Co., 401 N. Broad St., Phila. 8, Pa.

Circle 258 on Inquiry Card

Technical Proposals

New 16-page booklet "Guidelines for Writing Technical Proposals," discusses the engineer's role in writing proposals for commercial and military business. Sections cover planning, scheduling, program planning and technical discussion. Duralith Service Co., 1025 Race St., Phila. 7, Pa.

Circle 259 on Inquiry Card

Connectors

A new, 8-page condensed catalog on precision electronic connectors highlights the important features and specs of Continental's complete line of printed circuit, micro-miniature, subminiature, miniature and power connectors for missile, aircraft, computer and communication applications. Special designs, and a detailed description of new crimp type removable contact connectors are also included. (Form No. CC-860). DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.

Circle 260 on Inquiry Card

Power Supplies

Short Form catalogue (4 pages, 2-color) from Harrison Laboratories, Inc., 45 Industrial Rd., Berkeley Heights, N. J., describes their line of regulated power supplies. The power supplies feature all transistorized design, full overload protection, low impedence at all frequencies, 50-100 μsec recovery time, all supplies floating, glass-epoxy printed circuit boards, 3-wire power cord on all units.

Circle 261 on Inquiry Card

Shift Registers

A 4-page engineering bulletin on Wide-Width Magnetic Shift Registers includes a very informative technical discussion of Wide-Width theory, as well as circuit diagrams explaining the functioning of the Company's Ultra-Flex data-control circuit, which reduces equipment requirements at one core per bit. Typical characteristics of standard shift registers employing these principles are also given. Magnetics Research Co., 255 Grove St., White Plains, N. Y.

Circle 262 on Inquiry Card

Semiconductor Efficiency

New 4-page qualification test reports of tests conducted in accordance with MIL-STD-202A specs, show that heat radiators increase semiconductor efficiency as much as 25 to 27% while preventing thermal runaway. Test results are graphically shown in the report by 2 charts which plot the temp. rise on a time curve of a transistor with and without benefit of the radiators. Tests were conducted in both ambient and forced air. Analysis of the temp.-time curves in the tests shows the increase of semiconductor efficiency attained with the radiator-transistor combination. The Birtcher Corp., Industrial Div., 4371 Valley Blvd., Los Angeles 32, Calif.

Circle 263 on Inquiry Card

Circuit Design

"How to Design Power Supplies for Voltage-Tunable Magnetrons," Bulletin PT-39, 12 pages, provides information on designing power supplies for voltage-tunable magnetrons. Frequency and amplitude of the power output of VTM's is changed electronically by controlling voltages applied to the tube, and thus proper use of VTM's is dependent on the circuit designer's understanding of the effects of all voltages. Bulletin also contains a listing of available VTM's with their specs. General Electric Co., Schenectady 5, N. Y.

Circle 264 on Inquiry Card

Solar Cell Design

SPAN, the bi-monthly publication of Hoffman Electronics Corp., Semiconductor Div., 1001 Arden Dr., El Monte, Calif., presents a detailed report on the design considerations affecting the vital role of solar cells in space exploration. Also, applications stories describing 2 of the most recent of the rapidly growing commercial and industrial uses being made of their silicon solar cells.

Circle 265 on Inquiry Card

Winches and Hoists

Catalog file covers line of winches and hoists. All pertinent data and drawings are shown. Breeze Corps., Inc., 700 Liberty Ave., Union, N. J.

Circle 266 on Inquiry Card

Test Jacks

"Push Fit" test jack for electronic circuits needs no external hardware for mounting the component into a panel board or chassis. Contacts are beryllium copper, electro-tin plated. Insulators are molded Nylon and are available in blue, red, black and other colors. (Data Sheet No. 3-60.) Augat Bros., Inc., 33 Perry Ave., Attleboro, Mass.

Circle 267 on Inquiry Card

Stepping Switches

New 40-page, 2-color catalog on a complete line of stepping switches contains data on construction features, circuitry, and performance characteristics of spring-driven, cam-operated, and direct-drive stepping switches. Mounting accessories, sealed and dust-cover enclosures are pictured and described. Helpful information for proper switch selection is included. C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Ill.

Circle 268 on Inquiry Card

Research Procedures

"Procedures of Contact Research for Industry," a booklet from Battelle Memorial Institute, 505 King Ave., Columbus 1, Ohio, describes in a step-by-step manner the relationship existing between the client and the research institute, beginning with the initial meeting of the parties and progressing beyond the successful completion of a specific project. Included are preliminary conferences; conferences among institute specialists, the contractual agreement, actual conduct of the research, reports to the client, and presentation of final results.

Circle 269 on Inquiry Card

Electrical Connectors

Bulletin PR259-1, 12 pages, covers technical information, ratings and outline dimensions on new single-conductor plugs and receptacles called Supercon Electrical Connectors. New line features a functional "fishtail" plug design, simplified assembly, a range of 6 colors, gold-plated brass parts and nylon plastic parts. The 4-color bulletin describes all 25, 50, 100 and 250 amp. types offered. The Superior Electric Co., Dept. SPR, 88 Laurel St., Bristol, Conn.

Circle 270 on Inquiry Card

Power in Space

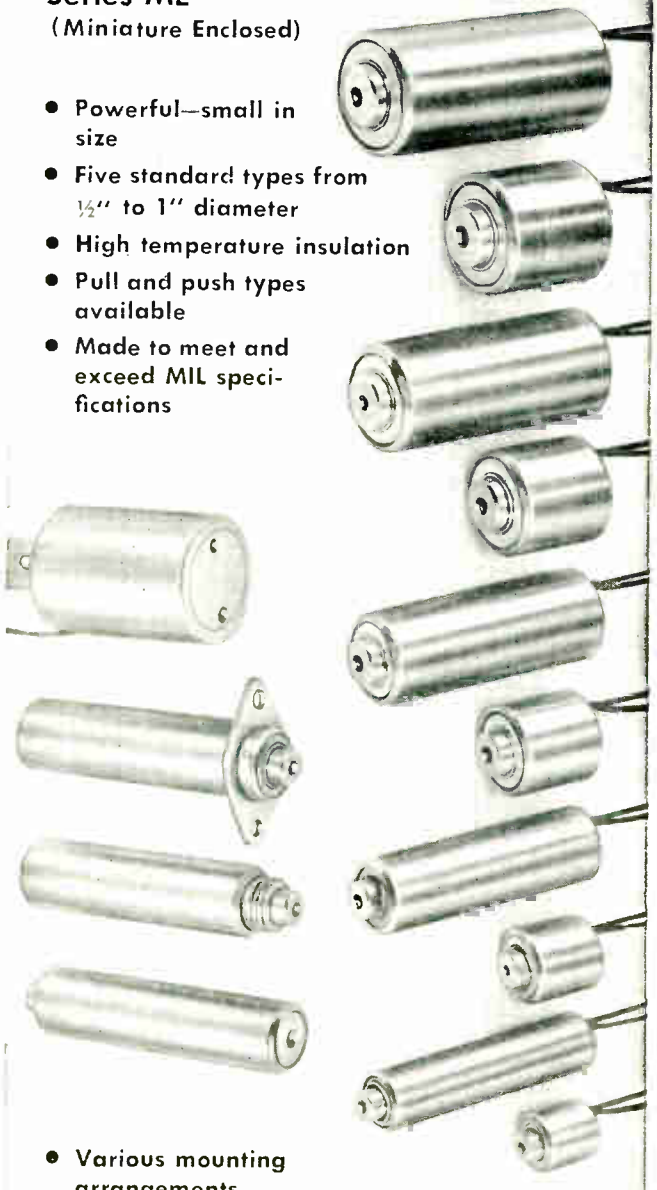
"Progress in Power for Space," an 8-page bulletin, PIB-A-9, describes electrical power systems for missiles, satellites and space vehicles being flight tested and researched by the General Electric Co. It includes analysis, applications, and power potentialities of solar thermionic, photovoltaic cell, fuel cell, storage battery, nuclear reactor, thermoelectric and magnetohydrodynamic power requirements for various space missions, along with the feasible types of power systems for these missions. Missile and Space Vehicle Dept., General Electric Co., 3198 Chestnut St., Phila. 1, Pa.

Circle 271 on Inquiry Card

MINIATURE SOLENOIDS

Series ME
(Miniature Enclosed)

- Powerful—small in size
- Five standard types from ½" to 1" diameter
- High temperature insulation
- Pull and push types available
- Made to meet and exceed MIL specifications



- Various mounting arrangements

Designed for DC application only, these units are available with ratings up to 125 volts, unique construction meets exacting specifications, provides long life.

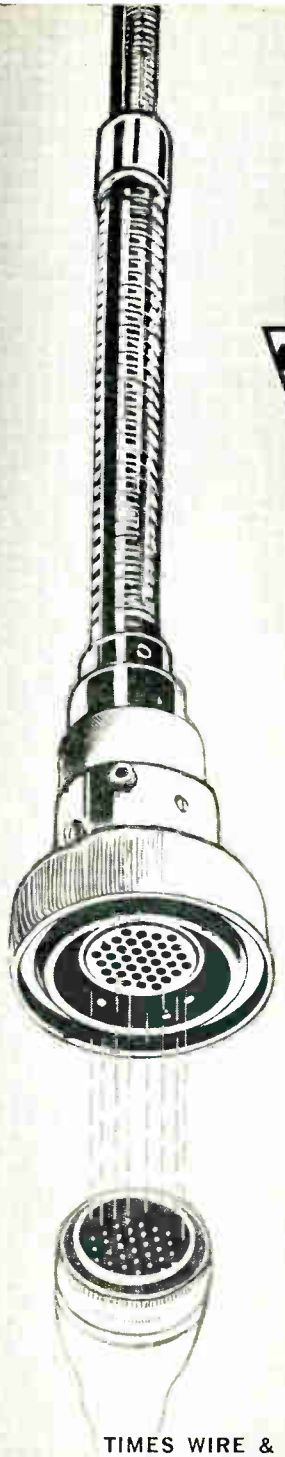
Write for complete information.

SOLENOIDS • COILS • ELECTRICAL COMPONENTS

anderson controls, inc.

General Offices:
9959 Pacific Avenue • Franklin Park, Illinois
Phone: GLadstone 1-1210

Circle 53 on Inquiry Card



TIMES

CUSTOM CABLE ASSEMBLIES

TIMES wide experience in developing RF cables, as well as standard DC and low frequency AC control cables will benefit you. Our custom engineering service has designed cable assemblies — for the most critical applications — using many combinations of wire constructions. Let us quote on cable assemblies to meet your specific requirements.

TIMES WIRE & CABLE DIVISION
THE INTERNATIONAL SILVER COMPANY
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Clip This Coupon To Your Calling Card or Letterhead

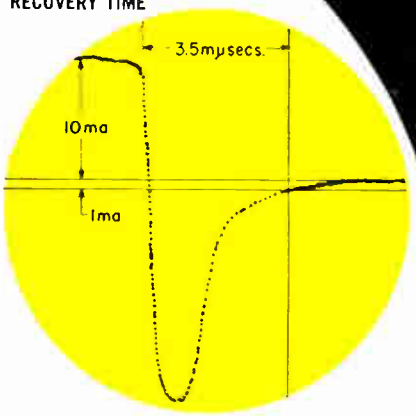
Please rush FREE literature on:

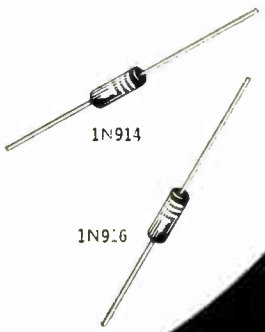
- ☐ Coaxial Cables
- ☐ Data Transmission Cables
- ☐ Multi-Conductors & Hook-up Wire
- ☐ For Info. Only ☐ Have Rep. Call

Circle 54 on Inquiry Card

FROM INDUSTRY'S BROADEST LINE OF SEMICONDUCTORS

1N914 and 1N916
DIFFUSED MESA
DIODE
RECOVERY TIME

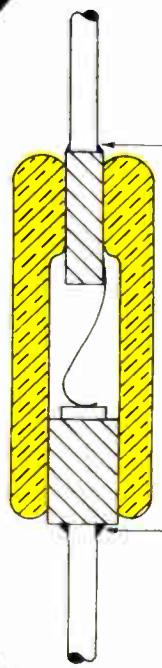




DIFFUSED SILICON MESA DIODES

IN NEW RUGGEDIZED PACKAGE

with .004 μsec recovery, low capacitance



BUTT WELD FOR RUGGEDIZED PACKAGE, POWER DISSIPATION AND IMPROVED HERMETIC SEAL

Transitron's new 1N914 and 1N916 diffused silicon mesa diodes have fast recovery times and low capacitance ideal for computer circuits. And their "Hour-Glass" construction provides rugged, shock-resistant characteristics meeting environmental requirements of MIL-S-19500B.

NEW METAL PLUG PACKAGE . . . engineered for strain relief at *both* ends — prevents cracking of glass-to-metal seals for 4 times greater strength in pull test, greatly increased bend resistance . . . gives added power handling ability.

Write for Bulletin No. TE-1350G

SPECIFICATIONS

Conditions	1N914	1N916
Max. Reverse Recovery Time (from 10mA I_F to 6 volts V_R)	.004	.004 μsec
Max. Capacity (at 0 volts bias)	4	2 μμf
Min. Forward Current (at 1 V)	10	10 mAdc
Min. Saturation Voltage (at 100μA)	100	100 volts
Max. Reverse Current (at −20V)	.025	.025 μAdc

MAXIMUM RATINGS

Conditions	1N914 and 1N916
Reverse Voltage (−65° to +150°C)	75 Volts
Average Rectified Current (25°C)	75 mA
Operating Temperature Range	−65° to +150°C
Storage Temperature Range	−65° to +200°C

Transitron electronic corporation

wakefield, melrose, boston, mass.

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

New Tech Data for Engineers

Servo Components

Kearfott Div., General Precision, Inc., 1150 McBride Ave., Little Falls, N. J., offers 2 tech. texts on the construction, performance, application, and testing of high precision components. One, (56-pages) "Technical Information for the Engineer—Servo Motors, Motor Generators, Synchros," describes important technical aspects associated with servo components and their use in systems. It has diagrams, charts, outlines, tables, schematics, definitions, and formulas. The second (44-pages) is "Technical Information for the Engineer — Gyros," contains theoretical considerations of gyroscopic instruments, also details the performance, application, construction, and testing of rate gyros, rate intergrating gyros, rate switches, free gyros, vertical gyros, directional gyros, stable platforms, and accelerometers.

Circle 272 on Inquiry Card

Free Space Rooms

A 12-page "Handbook of Free Space Room Design" from McMillan Industrial Corp., Brownville Ave., Ipswich, Mass., is a discussion of the many elements of FSR design. It includes charts for estimating room dimensions and absorber needed according to frequency and antenna size, design problems and solutions, discussion of specification pitfalls and a tearout FSR questionnaire.

Circle 273 on Inquiry Card

Triode Oscillator

Technical data sheet describes "C" Band Triode Oscillator, Model 101C. It is continuously tunable in 500 MC min. steps from 4200 to 6000 MC; weighs 9 oz; offers stability at 20 G's and simplifies power problems since only a plate voltage of 175 v. and 6.3 v. for filaments are required. Applications include: local oscillators; CW signal sources; and drivers for crystal harmonic generators. John Gombos Co., Inc., Webro Rd., Clifton, N. J.

Circle 274 on Inquiry Card

Radiolocation

LORAC is a general family of phase-comparison, radiolocation systems, designed for position fixing and for hydrographic and geodetic surveying. Problems and solutions to these problems which have been solved by Seiscor Div., Seismograph Service Corp., Box 1590 Tulsa, Oklahoma, are outlined in a 20-page brochure, "Electronic Positioning Systems and Services for the Space Age." Examples are from missile launching; missile tracking and recovery; submarine cable laying; oceanography; geophysical exploration (marine and airborne), etc.

Circle 275 on Inquiry Card

Ferrite Materials

A survey of ferrite materials is the feature article of Vol. 8, No. 1, Applied Magnetics (a quarterly tech. publication). Four main groups of ferrite materials are discussed and illustrated, including "soft" ferrites, "hard" ferrites (permanent magnets) and ferrites used in memory products. A Ferrite Application Chart summarizes the information by usage and magnetic characteristics. Indiana General Corp., Dept. AM, Valparaiso, Ind.

Circle 276 on Inquiry Card

AC-DC Conversion

A new method of ac to dc conversion, developed by Adage, Inc., 292 Main St., Cambridge 42, Mass., is described in a technical data sheet, "Applications Notes on ac to dc Conversion." It describes, in detail, the essential mode of operation and the significant waveforms, both illustrated with diagrams. A functional block diagram, corresponding to the physical hardware used to perform ac-dc conversion, is also included.

Circle 277 on Inquiry Card

Angular Accelerometers

Features, applications and specs of angular servo accelerometers are included in a new 6-page brochure. Units described are for control and measurement of missile and aircraft flight dynamics; structural analysis of induced angular acceleration; monitor and control of servo systems, and closing the loop in inertial guidance systems. Donner Scientific Co., Concord, Calif.

Circle 278 on Inquiry Card

Motor-Generators

Four-page, 2-color brochure from Leach Corp., Inlet Div., 18435 Susana Rd., Compton, Calif., describe their brushless synchronous motor-generators. Featured are no slip rings, brushes or commutators, separate excitation, inherent low radio noise, conservative ratings, and simple, compact design. The voltage regulation system is free of long-term drift, insensitive to frequency or wide range of temp. change, contain no tubes or moving parts, and have extremely fast response.

Circle 279 on Inquiry Card

Miniature Transformers

New 1961 catalog lists miniature transformer information, diagrams and detailed specs. Transformers designed to meet MIL-T-27A are included. Microtran Co., Inc., 145 E. Mineola Ave., Valley Stream, L. I., N. Y.

Circle 280 on Inquiry Card

Radar Noise Figures

An 11-page application note, No. 43, describes latest techniques for the "Continuous Monitoring of Radar Noise Figures." It reviews the theory of automatic noise figure measurements and outlines radar system requirements for integral noise figure meters. It also describes a new noise figure meter (Model 344A) and its various applications in operating radar sets. Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, Calif.

Circle 281 on Inquiry Card

Fractional HP Motors

New 4-page issue of the "Bodine Motorgram" (Vol. 40, No. 4), published by the Bodine Electric Co., 2500 W. Bradley Place, Chicago 18, Ill., features an article which discusses the operation of a new bar chart recording instrument designed for monitoring productive time of machines. Also: definitions of terms commonly associated with fractional horsepower motors.

Circle 282 on Inquiry Card

GaAs Developments

Ohio Semiconductors, Inc., 1205 Chesapeake Ave., Columbus 12, Ohio, offers information on several new grades of gallium arsenide. Four of the five grades are dense, with crystallites usually in the order of 1 vm^2 in crossectional area and cm or more long. The fifth is a dense fine-grained material whose crossectional area is in the order of 1 mm^2. This material is suitable for laboratory devices as well as starting materials for doping and crystal growth.

Circle 283 on Inquiry Card

Custom Transformers

Facilities for engineering and production of custom transformers described in a booklet by the AmerTran Div., Reeves Instrument Corp., Lakewood Rd., Farmingdale, N. J. Types of transformers, reactors, and power supplies which can be made to order are listed. Ratings range from 10 v-a to 250 kva and 10 cycles to 150 KC, at potentials up to 100 kv, and for 1, 2, 3, 6 or 12 phase systems.

Circle 284 on Inquiry Card

Flip-Flop Circuits

Application Note from Texas Instruments Incorporated, Semiconductor Components Div., P. O. Box 312, 13500 N. Central Expressway, Dallas, Texas, describes 8 silicon transistor flip-flop circuits. Design considerations, schematics, test conditions and results, etc., are given for each circuit. (8-pages).

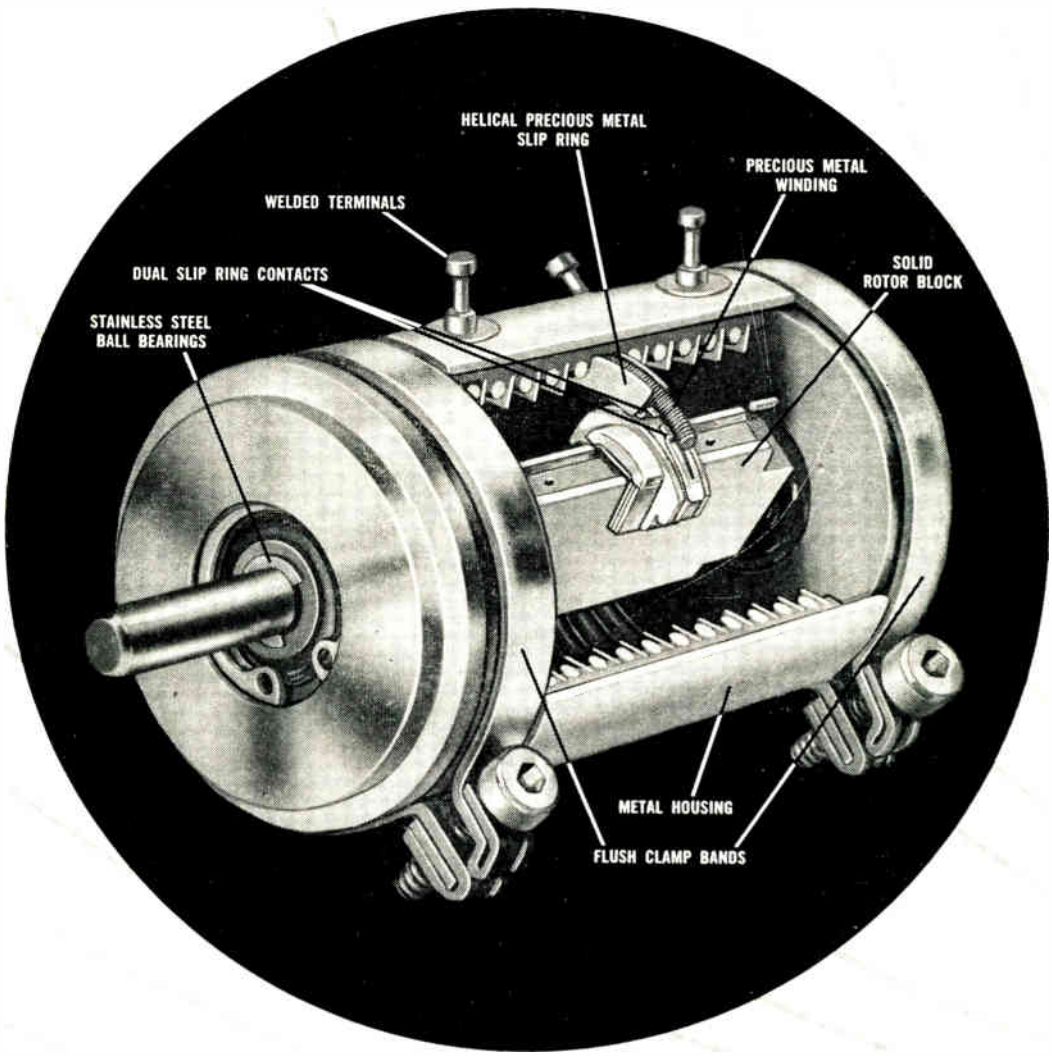
Circle 285 on Inquiry Card

← Circle 55 on Inquiry Card

THOR REDSTONE PERSHING JUPITER POLARIS ATLAS

Proven in flight... FAIRCHILD PRECISION

SNARK SERGEANT REGULUS NIKE-ZEUS TITAN BOMARC FALCON



This cutaway of the Fairchild 10-turn ⅞"-diam. precision potentiometer represents the complete line of multi-turns now being produced at our West Coast facility. Here are some reasons why this design offers the utmost in stability and Reliability in Performance:

- One-piece precious metal wiper-collector ring pick-off eliminates all welds and soldered joints and pressure contacts between slip ring pick-off and wiper.
- Parallel slip ring-winding design reduces friction and torque.
- Specially-designed flush clamp bands — new cross-section combined with new material selection — assure higher anti-rotational and axial holding power.
- With this design, many cups can be ganged on a common shaft.
- The number of taps possible per cup is limited only by mechanical considerations.

POTENTIOMETERS

In our country's defense program, failure cannot be tolerated. The "Reliability Factor" of all elements of this defense is becoming more and more important as the arsenals of both East and West become more and more sophisticated.

In the future, less business will go to the unproven though low priced producer. Management has learned that the lowest initial cost does not always result in the lowest end cost.

Fairchild precision potentiometers are *proven performers*. They are flying with *predicted excellence* in many important missile, special weapon and space vehicle applications. They have earned a reputation over the years for sustained high accuracy over a wide temperature range, lowest noise level and long life — quality features that can be achieved only with experienced, precision workmanship and painstaking attention to the smallest detail.

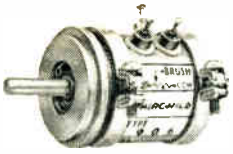
As a result, "Fairchild Reliability" is fast becoming an industry standard.

Fairchild produces complete lines of precision multi-turn, single-turn, rectilinear and rotary trimmer pots, deposited metal FilmPot® single-turns and trimmers, and linear displacement transducers. Variations on most standard model specifications can be obtained to suit your particular needs.

Why not consult Fairchild? The complete services of our experienced Engineering Dept. are available to help you.

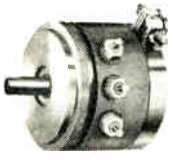
For more information, write or call direct, or contact any one of the many leading engineering and sales organizations that represent Fairchild nationally and in Canada.

Multi-Turn — 3, 5, 10, 20



The complete line of multi-turns consists of two diameters—⅞" and 1⅞"—with four models in each diameter —3- 5- 10- and 20-turns. All have a linearity of ±0.25 to ±.05% over a temperature range of —55°C to +105°C, standard. Hi-temp. units available on special order. Power rating: 2.5 watts at 40°C. This design lends itself to multi-tapping and multi-ganging.

Single-Turn — Linear Non-Linear Sine-Cosine



There are over 28 standard models available in sizes that range in diameter from ¾" to 5". They feature high functional accuracy, high resolution, low noise, wide electrical angle, wide temp. range, one-piece wiper, simplified precious metal slip-ring construction, welded taps and terminals, and precious metal contacts and resistance wires. Bushing or servo mounts, sleeve or ball bearings. Gangable, with no increase in diameter.

Linear Displacement Transducers

Linear displacement transducers — with or without spring-loaded return stroke — are available in all sizes, from ½" to 6" strokes. Smallest in the line is only 1²¹⁄₆₄" x 1³⁄₃₂" x 1¹⁄₃₂".

Trim-Tite® Microminiature Trimmers

Trim-Tite® microminiature trimmers — Type 926 and 927 — can fit under a postage stamp. They meet and exceed MIL-STD-202A shock requirements (100-G's), vibration (25-G's at 2000 cps), temp. cycling and load life; and MIL-E-5272B for environmental conditions. Available in a wide range of resistance values.

Rotary & Rectilinear Trimmer FilmPots®

Fairchild FilmPots® use a continuous film of evaporated alloys of precious metals as the resistance element. This exclusive Nobl-Ohm® resistance element provides infinite resolution and is electrically stable over a wide temp. range of from —55°C to +225°C.

Rotary FilmPots® (left) are available in ⅞" to 2" diameters. They can be supplied in ganged assemblies and can also be ganged with similar size Fairchild wirewound pots.

Rectilinear FilmPot® trimmers (right) come in two sizes. Precise adjustments are made by a 28½ turn screw. Resistance ranges: 50 to 25KΩ; up to 50KΩ on special order.

Fairchild components . . . built and tested beyond the specs for Reliability in Performance.

FAIRCHILD CONTROLS CORPORATION
COMPONENTS DIVISION
225 Park Avenue, Hicksville, L. I., N. Y. • 6111 E. Washington Blvd., Los Angeles, Calif.
A Subsidiary of Fairchild Camera and Instrument Corporation

GYROS
PRESSURE TRANSDUCERS
POTENTIOMETERS
ACCELEROMETERS

Circle 56 on Inquiry Card

New Tech Data for Engineers

Test Equipment

Four-page, 2-color, Bulletin 400 from PRD Electronics, 202 Tillary St., Brooklyn 1, N. Y., categorizes the Company's products by frequency range, waveguide size, and price. Featured are attenuators, isolators, slotted sections, mounts, frequency meters, adapters, klystron power supplies, and coaxial equipment.

Circle 300 on Inquiry Card

Testing Insulation

Manual on methods and equipment for testing insulating materials compiled by Associated Research, Inc., 3777 W. Belmont Ave., Chicago 18, Ill. Some subjects covered: High voltage breakdown testing of insulating materials in accord with ASTM specs.; Automatic rate of rise control for high voltage breakdown testing of insulating materials; Determining resistance to arcing of insulating materials; Testing insulating oils for high voltage breakdown; Detection of corona leakage in high voltage equipment; and high voltage breakdown testing of power cables and bushings.

Circle 301 on Inquiry Card

Wire and Cable

Catalog from Tensolite Insulated Wire Co., Inc., West Main Street, Tarrytown, N. Y., includes sections on Teflon TFE and FEP; general information on high temperature wire and cable; hook-up wire, cables and cable assemblies, coaxial cable, airframe wire; and wire specialties. Section B features an article "What Every Engineer Should Know About High Temperature Wire and Cable." Also included are tables on Government Wire Specifications; American Wire Gage, a Wire Stranding Chart, Useful Wire Formulas, and Wire Conversion Tables.

Circle 302 on Inquiry Card

Transistor Transformers

Single-page data sheet from Arco Electronics, Inc., Transformer Div., 64 White St., New York 13, N. Y. describes the Company's miniaturized transistor transformers. Featured is the new type TT aTTom[R] series. Sheet includes tech data in tabular form.

Circle 303 on Inquiry Card

Microwave Signal Sources

Tech data sheets from Wave Particle Div., Ramage & Miller, Inc., 3221 Florida Ave., Richmond, Calif., describe their Microwave Signal Sources. Units are virtually free from frequency drift and residual FM. Output r-f can be adjusted for CW or Swept Frequency with or without simultaneous Square Wave Modulation.

Circle 304 on Inquiry Card

Fine Pitch Spur Gears

Fifth in a series of tech. booklets outlines specs established on low inertia, custom made, certified military type, fine pitch spur gears. Also detailed: a newly developed standard stock specification numbering system covering all basic variables, such as type of gear, number of teeth, pressure angle, material, precision class, dimetral pitch, face width, bore diameter and finish. PIC Design Corp., 477 Atlantic Ave., E. Rockaway, N. Y.

Circle 305 on Inquiry Card

Tape Programmer

Single-page tech sheet from Electronic Engineering Co., 1601 East Chestnut Ave., Santa Ana, Calif., describes the Model TP-813, 13-channel Punched Tape Programmer for airborne applications. It features high tape capacity, light-weight construction, compatible design, and heavy-duty contacts. A description and tech specs are given.

Circle 306 on Inquiry Card

Electrical Connector

Details of a 26-contact electrical connector are presented in Bulletin 4004-5 from CEC's Electro Mechanical Instrument Div. Photos, drawings, and charts describe the various configurations of plugs and receptacles available. Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif.

Circle 307 on Inquiry Card

Instruments

Four-page, condensed catalog, A-26, from Electro Scientific Industries, 7524 W. W. Macadam Ave., Portland 19, Oregon, describes their line of impedance bridges, resistance bridges, capacitance bridges, decade voltage dividers, resistors, and capacitors. Includes photographs and prices.

Circle 308 on Inquiry Card

High-Vacuum Pumps

Short Form catalog, from Ultek Corp., 920 Commercial St., Palo Alto, Calif., describes the Company's electronic high-vacuum pumps and high-vacuum fittings. Four-page brochure includes description and tech data.

Circle 309 on Inquiry Card

Bimetal Thermostats

Revised version of its full-line catalog covers all main types of bimetal thermostats in the line of Stevens Manufacturing Co., Inc., P. O. Box 1007, Mansfield, Ohio. The 4-page publication, Bulletin 8400, gives tech specs and performance data for both semi-enclosed and hermetically sealed styles. A Centigrade Fahrenheit conversion chart is included.

Circle 310 on Inquiry Card

Plug-in Rectifiers

Bulletin XSR-216 from International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif., describes ruggedized, 500 ma rated silicon plug-in rectifiers which utilize completely new diffusion techniques resulting in very low reverse current (200 μa) at rated PRV, a much higher than average surge current rating (50 a peak, 1 cycle) an exceptionally low forward voltage drop (0.92 v.) and may be rapidly snapped into radio-TV, motor control audio-amplifier, industrial power supply and other circuits utilizing clip-type rectifier holders.

Circle 311 on Inquiry Card

Coaxial Plugs

Catalog supplement describes BNC series of r-f coaxial plugs. The 16-page booklet describes the BNC series for small coaxial cables. The plugs are lightweight, weatherproof, and meet MIL-C-3608. It includes nomenclature, a mating functional diagram, BNC assembly instructions, KWIK-assembly BNC instructions, and photos, drawings and specs for jacks, plugs, receptacles, adapters and other accessories. Cannon Electric Co., 3208 Humboldt St., Los Angeles 31, Calif.

Circle 312 on Inquiry Card

Damped Servo Motor

John Oster Mfg. Co., Avionic Div., Racine, Wis., has released tech. data sheet illustrating and giving complete electrical, mechanical and physical characteristics, outline drawing, schematic and torque curve of new Type 5752-03 size 11 precision hi temp inertially damped motor designed for military and other high speed and/or high gain servo systems.

Circle 313 on Inquiry Card

Indicator Lights

New 4-page bulletin (Form 47-7-1-60) illustrates and describes the "Tec-Lite" MCL series of miniature cartridge lights for control panel indicator systems and individual signals. Diagrams show mounting arrangements and dimensions for 6 different models. Specs and ordering information are listed for the several variations available in lamp types, lenses, lens colors and legends, terminals. Transistor Electronics Corp., 3357 Republic Ave., Minneapolis 26, Minn.

Circle 314 on Inquiry Card

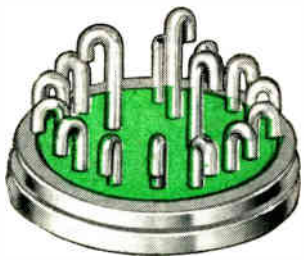
Tower Erection

Details on a new tower erection service for companies and organizations that need the erection of complete towers and tower systems for communication and industrial purposes from Rohn Systems, Inc., 6718 W. Plank Rd., Peoria, Ill.

Circle 315 on Inquiry Card

The Fusite Quality Control Director said,

"1 x 10^{-10} STD CC/SEC"



The Advertising Man said,

"SPEAK AMERICAN, BOY!"

The Fusite quality control director was explaining a testing procedure for Fusite solid glass hermetic terminals.

It seems that every batch of this type (and practically all Fusite Terminals) is given a heat shock treatment to simulate the condition encountered when the customer solders or welds them in his production.

Fusite Terminals have this unique V-24 glass that actually fuses with the metal parts. When the terminal is heated to 500° F in 20 seconds this is supposed to be sheer murder. If the glass is ever going to leak, now is the time.

Well sir, now they put the test terminal on a Veeco Mass Spectrometer which tries to pass helium through the terminal and into the innards of the machine. This thing is so sensitive that it can detect one part of helium in 10 million parts of air and according to this long hair, that's the same as $1x10^{-10}$ std. cc/sec.

If Mr. Veeco gets even a sniff of helium, no terminal from that run ever sees the shipping department.

You can decide for yourself whether or not this is as big a deal as the lab boys make out, by the simple expedient of asking for samples of Fusite Terminals to test in your own way.

They are yours for the asking. Write Fusite Dept. G-5.

INSULATE ELECTRICALLY · GLASS TO METAL · SEAL HERMETICALLY

FUSITE TERMINALS

PROTECT PRODUCT PERFORMANCE

THE FUSITE CORPORATION

6000 FERNVIEW AVE., CINCINNATI 13, OHIO

Woodford Mfg. Co., Versailles, Kentucky.

In Europe: FUSITE N. V. Königsweg 16, Almelo, Holland

New Products . . . for the Electronic Industries

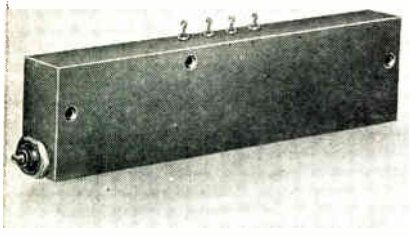
NOISE FIGURE METER

New noise figure meter directly and continuously monitors the noise figure of operating radar sets. Model 344AR operates automatically and includes a simple front panel calibration. It operates on either a 25 or 30 MC i-f frequency, and is for direct application to pulse radars with repetition rates of 90 to 500 pps or up to 3000 pps with special sampling circuitry. System noise figure is measured on a time-shared basis with the radar scan. High sensitivity minimizes signal and transmitter losses; noise source may be decoupled 20 db from the main transmitter line. Two alarm functions give visible and electrical indication when an allowable noise figure is exceeded, or a noise source malfunctions. Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, Calif.

Circle 189 on Inquiry Card

VARIABLE DELAY NETWORKS

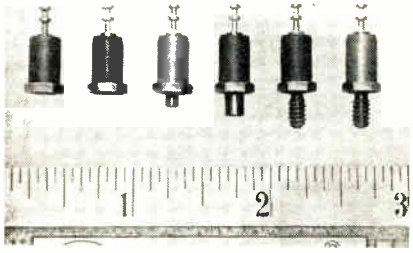
Series 700 Miniature Variable Delay Networks meet the demand for smaller units of high accuracy for printed circuit mounting. Specs (in this order—Model No.—Time Delay —Impedance—Pulse Rise Time Max.): (701), 0.125 μsec., 1500 ohms, 0.03 μsec.; (702), 0.25 μsec., 1800 ohms, 0.06 μsec.; (703), 0.50 μsec., 1000 ohms, 0.10 μsec.; (704), 0.75 μsec., 680 ohms, 0.15 μsec.; (705), 1.0 μsec., 560 ohms, 0.20 μsec.; (706), 1.25 μsec., 470 ohms, 0.25 μsec.; (707), 1.50 μsec., 390 ohms, 0.30 μsec.; (708), 0.65 μsec., 93 ohms, 0.10 μsec.; Pulse Attenuation is 1.0 db (max.) all units, and dc working Volts is 500 v (max.). ESC Electronics Corp., 534 Bergen Blvd., Palisades Park, N. J.



Circle 190 on Inquiry Card

TERMINALS

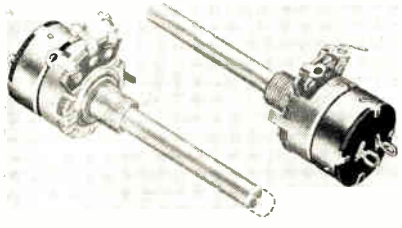
Addition of double-turreted standoff terminals to line of insulated terminals have Diallyl Phythalate insulators (4800 Series) or Melanine (4900 Series). Diallyl Phythalate provides especially suitable characteristics for more demanding circuit requirements — Dielectric properties surpass Melamine by 5/1. Dissipation factor, approx. 7000/1, permits insulation of much higher frequencies. Other advantages include much greater resistance to the effects of sunlight, acids, alkalies and fungus. Three types of mounting studs are: (1) external threaded, (2) internal threaded and (3) rivet type. Terminals are brass and finished in 0.0003 in. electro-tin lead plate or 0.0003 in. silver plate. Cambridge Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass.



Circle 191 on Inquiry Card

PUSH-PULL SWITCH

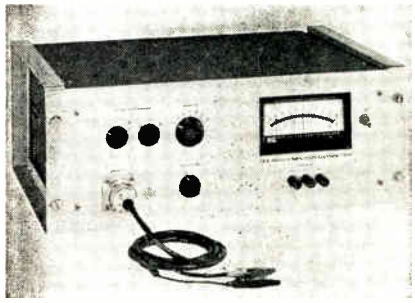
Used with variable resistors, Type G-16, Pull-on, Push-off switch allows greater operating convenience for radio and TV receivers, hi-fi equipment, instruments and other electronic assemblies. It can be furnished on many single and dual-section variable resistors. The switch operates from the same shaft used to control the resistor. It carries an Underwriters' Laboratories, Inc., inspected rating of 5 a at 125 vac. Its single-pole, single-throw contacts are well isolated from solder flux entry and the entire mechanism is free from lubricants that might cause premature failure from excessive carbon build-up. Stackpole Carbon Co., Electronic Components Div., St. Mary's, Pa.



Circle 192 on Inquiry Card

MILLI-MICROVOLTMETER

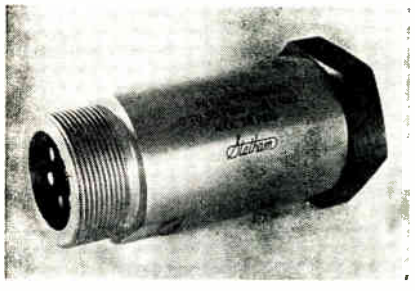
Model 149 Milli-microvoltmeter will measure potentials of a few millimicrovolts. It is recommended where source resistance is low (thermocouples). Ranges: 0.1 μv to 100 μv full scale in 1x and 3x steps. Amplifier gain varies from 10^8 on most sensitive range to 100 on least sensitive range. Stability, at relatively constant amb. temp. and after a 1-hr. warm-up, is within 0.01 μv/hr, 0.03 μv/8 hrs, and within 1 μv over the life of the instrument. Speed of response to 90% of full scale is less than 0.5 sec. on most ranges. Other features: Zero suppression up to 100 times full scale with a max. of 10 mv; floating or grounded operation; a 10 v., 5 ma output for a full scale deflection on any range. Keithley Instruments, 12415 Euclid Ave., Cleveland 6, Ohio.



Circle 193 on Inquiry Card

PRESSURE TRANSDUCER

Pressure transducer, Model P713, uses the Statham zero-length unbonded, strain-gage principle. Industrial transducer is for absolute, gage, and both bi-directional and uni-directional differential pressure transducers. The absolute, gage, and unidirectional differential models have pressure ranges from 0-5 to 0-5000 psi. The bi-directional differential model has ranges from ±2.5 psid to ±50 psid and is operational with line pressures to 500 psig. With 5 vdc or ac excitation, they provide a nom. 25 mv output for full-range excursion. Dia. is approx. 1.7 in., length approx. 4 in., and weight approx. 1½ lbs. Statham Instruments, Inc., 12401 W. Olympic Blvd., Los Angeles 64, Calif.



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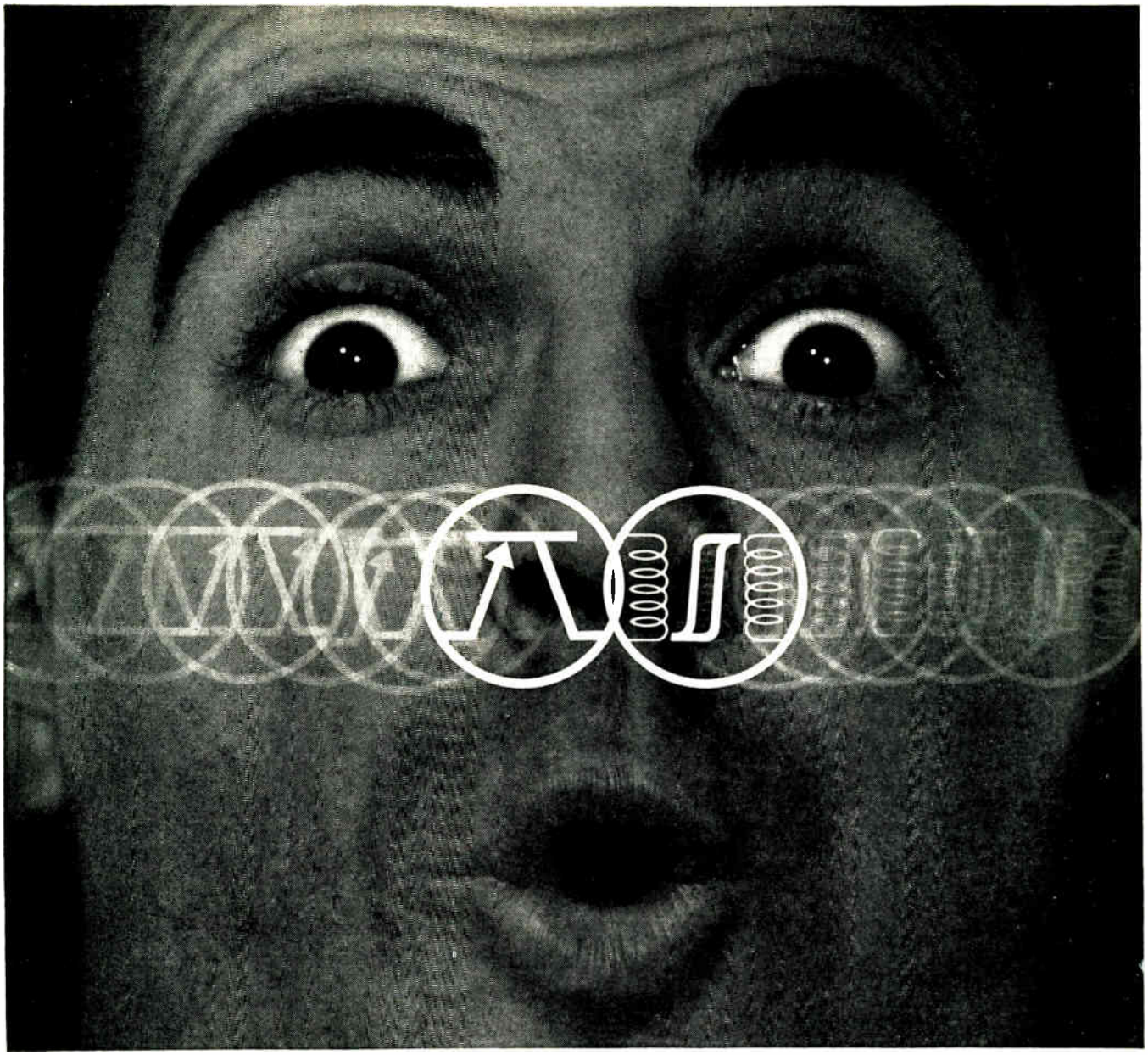


Open your eyes to new amplifier designs!

See how to combine tape wound cores and transistors for more versatile, lower-cost, smaller amplifiers

Tie tape wound cores and transistors into a magnetic-transistor amplifier, and open your eyes to new design opportunities.

To start with, these are static control elements—no moving parts, nothing to wear or burn out. Next thing you find is that you reduce components' size—your amplifier is smaller and costs less. That's because between them the core and the transistor perform just about every circuit function . . . and then some.

For instance? The core has multiple isolated windings. Thus you can feed many inputs to control the amplifier. The core also has a square hysteresis loop, and thus acts as a low loss transformer. That means you save power. In addition, the core can store and remember signals—so time delay becomes simple.

There's no need for temperature stabilization, either. The transistor acts only as a low loss, fast, static switch—and in this function it has no peer.

How do you want to use this superb combination? As a switching amplifier—or a linear one? In an oscillator? A power converter (d-c to d-c or d-c to a-c)? You'll have ideas of your own—and if they involve tape wound cores, why not write us? Ours are Performance-Guaranteed. *Magnetics Inc., Dept. EI-81, Butler, Pennsylvania.*

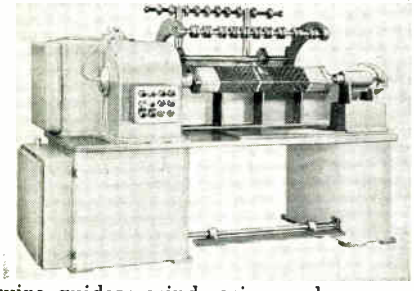
MAGNETICS inc.
®

Circle 58 on Inquiry Card

New Products . . . for the Electronic Industries

TRANSFORMER WINDER

Compact heavy duty multiple transformer winder features; rectangular and square coils finish wound without pounding; winds round, square or rectangular wire without changing

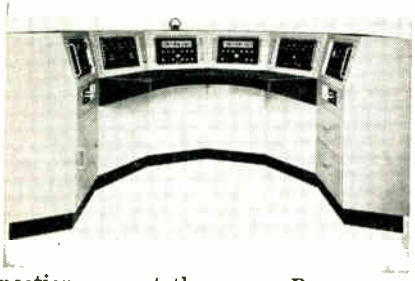


wire guides; winds wire as heavy as #2 AWG and up to #24 AWG; 2 ft. coil dia. clearance for winding; 4 winding speeds: 25, 50, 85 and 165 RPM; controlled acceleration; selector switch permits winding 3 different wire sizes on any one coil without removing form or changing gears. Loading distance for multiple winding is 3 ft. 4 in. Winding width instantly adjustable. Winding range is 2.5 to 50 turns/in. If desired, turns/-in. ratio can be different on each of the 3 transmissions. Machine is furnished with 5 hp motor. Geo. Stevens Mfg. Co., Inc., Pulaski Rd. at Peterson, Chicago 46, Ill.

Circle 183 on Inquiry Card

BRIDGE CONSOLE

A compact High Precision Bridge Console, Type BC-101, for comprehenve a-f measurements. It forms a omplete measuring station and features recent developments for measuring impedance from 20 micro-ohms to thousands of megohms. Accuracy is 0.01%. Comparisons of impedances can be made to 0.001% accuracy. A separate meter for insertion at any working station provides a convenient means of determining bridge balance. Protection bars are on the front panels, and serve for removing any instrument from its individual dust-cover. Power inputs and inter-con-

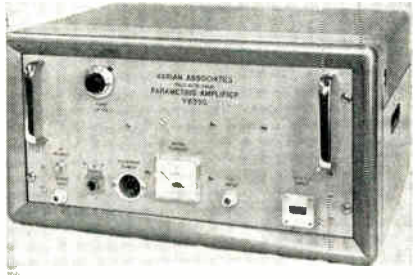


nections are at the rear. Power supply sockets are provided for soldering guns or other auxiliary items. Dimensions are 40 x 87 x 57 in. Wayne Kerr Corp., 1633 Race St., Phila., Pa.

Circle 184 on Inquiry Card

PARAMETRIC AMPLIFIER

The V-8350 parametric amplifier provides instantaneous bandwidth of 35 to 40 MC, overall noise figure of 2.0 db and stable gain of 20 db is available at center frequencies in the

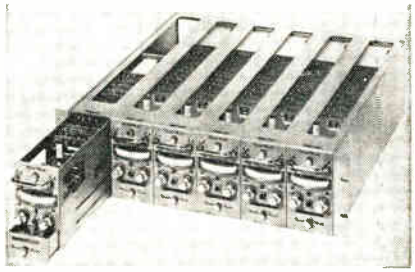


500 to 1,000 MC range. It uses 2 wideband variable reactance up-converters for simultaneous amplification and frequency conversion of a signal and its associated source of local oscillator power. I-f frequency stability is maintained even with variations in pump frequency or phase. It provides a large channel capacity of 40 MC when used with a wide-band i-f amplifier. With narrow-band i-f, low noise operation over the entire instantaneous bandwidth is achieved by tuning only the receiver local oscillator. Radiation Div., Varian Assoc., 611 Hansen Way, Palo Alto, Calif.

Circle 185 on Inquiry Card

SUBCARRIER DISCRIMINATOR

New telemetering subcarrier discriminator, Model TDA-300, uses the phase lock concept of coherent detection. Front panel monitor points permit signal observation and evaluation with panel controls kept at a min. for operational simplicity. Specs: Operating freq., IRIG standard up to 300 KC; freq. deviation, IRIG standard and ±40%; intelligence freq., IRIG standard; input range, 60 db 10 mv to 10 v. (no input potentiometer); input impedance, greater than 500 K and less than 30 mmf; linearity, ±0.05% of best straight line; output stability, ±0.25% after 10 min. warm-

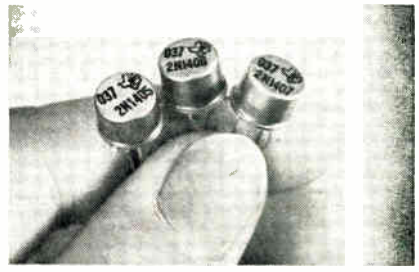


up; output, ±10 v. adjustable at ±100 ma; power consumption, 30 w at 115 vac. The Bendix Corp., Bendix-Pacific Div., 11600 Sherman Way, N. Hollywood, Calif.

Circle 186 on Inquiry Card

MESA TRANSISTOR SERIES

A new diffused-base germanium mesa transistor series for communications applications, the 2N1405 series, features low noise figures with f (max) in excess of 1000 MC. The

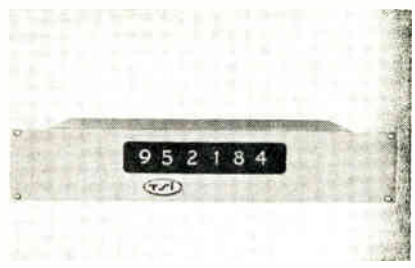


2N1405, 2N1406 and 2N1407, which operates in the VHF/UHF range, are tested to assure max. noise figures of 6 db, 8 db and 10 db respectively at 200 MC. The 2N1405 series emitter-base diode characteristics make them useful as mixers, well into the UHF range. Noise figures, in mixer application, are essentially equal to amplifier noise figures for each device. Conversion gain approx. amplifier gain in the 200 to 500 MC range. The 2N1405 and 2N1406 have typical bandwidth products of 300 MC (excellent characteristics for video amplifier circuits). Texas Instruments Incorporated, P.O. Box 312, Dallas 21, Tex.

Circle 187 on Inquiry Card

REMOTE-READOUT

Three Remote-Readout Modules for numerical data display. Each provides 6-digit in-line Nixie readout in a rack-mounted assembly 3½ in. high on a 19 in. wide panel. Model 342 is for service as a "slave" to the TSI line of Apti® Meters, reproducing the output reading of these solid-state countertimers at remote locations. It is equipped with integral amplifiers and power supply for 10-line-per-digit input. A low-level signal on one of the 10 lines per Nixie lights the corresponding numeric character. It is equipped with integral amplifiers, power supply and a binary-decimal



decoding network, to permit driving the Nixies from 1, 2, 2, 4 or 1, 2, 4, 2 binary-coded-decimal devices. Transistor Specialties, Inc., Terminal Dr., Plainview, L. I., N. Y.

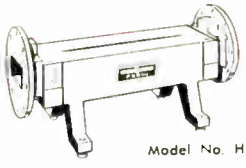
Circle 188 on Inquiry Card

Interchangeable SLOTTED SECTIONS

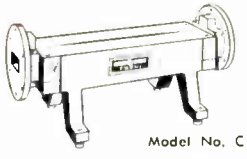
convenient and positive

- conveniently interchangeable waveguide sections
- no slope adjustment required
- vernier position scale readable to 0.1 mm.
- dial gauge holder and movable stop
- tapered slots to minimize residual VSWR

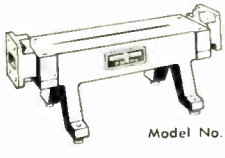
INTERCHANGEABLE WAVEGUIDE SECTIONS



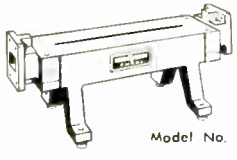
Model No. H115A



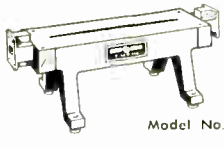
Model No. C115A



Model No. W115A

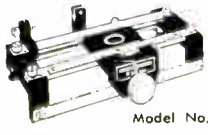


Model No. X115A



Model No. Y115A

UNIVERSAL CARRIAGE



Model No. Z116A

Like the finest camera with a precisely fitted set of lenses, the FXR Universal Carriage and family of five Interchangeable Slotted Sections are matched to perfection. "Togetherness" with this unrivalled modular waveguide system gains new meaning . . . more rapid interchange of each section without tools or need for alignment, and more dependable performance over the entire frequency range from 3.95 kmc to 18.00 kmc. Another fine FXR "package" with quality and reliability built into it—from the first mark on the drawing board.

SERIES 115 PRECISION SLOTTED SECTIONS

MODEL NO.	FREQUENCY RANGE (KMC)	WAVEGUIDE DIMENSIONS (Inches)	INSERTION LENGTH	WAVEGUIDE TYPE	FLANGE TYPE
H115A	3.95- 5.85	2 x 1	10⅜ in.	RG-49/U	UG-149A/U
C115A	5.85- 8.20	1½ x ¾	10⅜ in.	RG-50/U	UG-344/U
W115A	7.05-10.00	1¼ x ⅝	10⅜ in.	RG-51/U	UG-51/U
X115A	8.20-12.40	1 x ½	10⅜ in.	RG-52/U	UG-39/U
Y115A	12.40-18.00	0.622 x 0.311 ID	10⅜ in.	RG-91/U	UG-419/U

ACCESSORY: FXR Model No. B200A Tunable Probe.
All units when mounted in Z116A Carriage:
Slope—1.01 max. Irregularity—1.005 max.

Write for Bulletin No. SS115 or contact your local FXR representative.

FXR, Inc.

Design • Development • Manufacture

25-26 50th STREET • RA. 1-9000
WOODSIDE 77, N. Y. • TWX: NY 43745

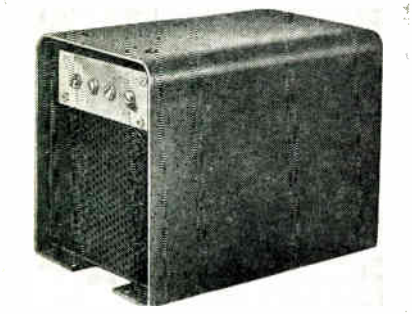
PRECISION MICROWAVE EQUIPMENT • HIGH-POWER PULSE MODULATORS • HIGH-VOLTAGE POWER SUPPLIES • ELECTRONIC TEST EQUIPMENT

Circle 59 on Inquiry Card

New Products

DC TO DC INVERTER

The DC to DC Inverter operates from a battery or similar 22 vdc source. It has 9 outputs widely varying in va ratings. For example: 2 low-voltage, high current outputs—30

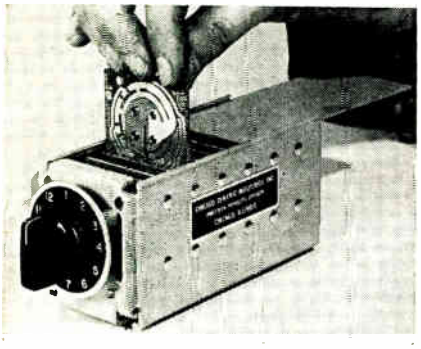


v. at 1¼ a, 18 v. at 2 a—2 high-voltage, low current outputs—1800 v. at 2 ma, 650 v. at 20 mils. Ripple content of all outputs is less than ½ of 1%. Outputs will vary directly with input voltage variations. This variance can be corrected by the use of new Freed transistorized regulators. These units maintain voltage to the inverter constant over an input voltage range variation of 25%. Unit shown regulates over a range of 24 to 28 v. input at 20 a max. output current. Freed Transformer Co., Inc., 1718 Weirfield St., Brooklyn 27, N. Y.

Circle 195 on Inquiry Card

PRINTED CIRCUIT SWITCHES

Removable PC wafers for quick, crror-proof servicing of rotary selector switch. Wafers lift out for instant replacement. Corrosion-resistant wafers are etched from a copper clad laminated plastic grade — Formica XXXP-36 — which is translucent, easily cold-punched and offers high insulation resistance. A glass epoxy laminate—Formica FF-91—is used for more adverse moisture conditions.

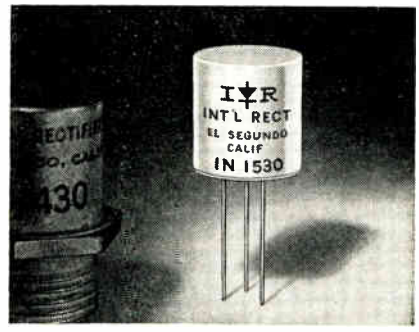


Wafers plug into individual receptacles. Switches are available for manual, solenoid or motor-driver operation. Chicago Dynamic Industries, Inc., Precision Products Div., 1725 Diversey Blvd., Chicago 14, Ill.

Circle 196 on Inquiry Card

ZENER VOLTAGE REFERENCE

For rapid insertion into printed circuit boards, the 1N1530 and 1N1530A silicon zener voltage reference elements are miniaturized versions of the highly stable 1N430 ref-



erence elements. The 1N1530 will provide a reference voltage of 8.4 v. (ave) at 10 ma bias current and a dynamic resistance of 11 ohms (ave). They will provide a stability of ±16 mv or better from −55°C to +100°C, with temp. coefficients of ±0.002%/°C. The 1530A element is manufactured to a tighter tolerance on temp. coefficient than the 1N1530, providing a stability of ±8 mv or better from −55°C to +100°C. Units measure 0.590 x 0.560 in. (dia.) excluding leads. International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.

Circle 197 on Inquiry Card

BATTERY SUBSTITUTES

Battery replacement units for strip chart recorders, laboratory measuring potentiometers, and other applications. Units can replace the 1½ v. dry cell or the dry cell, standard cell and standardizing mechanism in strip chart recorders of all types. The battery substitute operates from 117 vac ± 20% and delivers a constant voltage to the measuring circuit bridge. Temp. coefficients of less than

± 0.004%/°F or ± 0.0006%/°F available. Output voltage stability is better than ± 0.04% for a ± 20% input variation. Size is 2½ x 2½ x 3¼ in. Dynage, Inc., 75 Laurel St., Hartford, Conn.

Circle 198 on Inquiry Card

1. THE FASTEST 2N697 AVAILABLE!

Nearly half the collector saturation voltage . . . half the leakage current . . . half the collector capacitance . . . 40% greater power dissipation!

COMPARE THESE OUTSTANDING FEATURES OF THE PSI 2N697!

Nine out of ten PSI type 2N697 transistors meet these premium specifications. Guaranteed 100% shipment to the higher specifications will be made when the buyer specifies PSI type PT 822 premium grade.

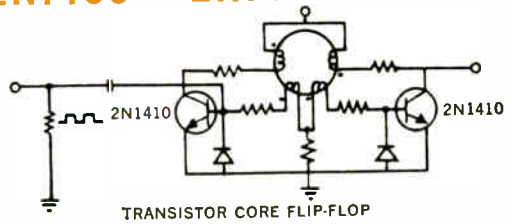
Many of these "plus characteristics" are also featured in the PSI 2N696 . . . ideally suited for the designer not requiring the high gain performance of the PT822.

MAXIMUM RATINGS

PARAMETER	REGISTERED SPECIFICATION	PSI PREMIUM SPECIFICATION	UNIT	TEST CONDITION	% IMPROVEMENT
V_{CER}	40	50	Volts	$R_{BE} = 10\Omega$	25% Higher
V_{CBO}	60	80	Volts	$I_{CBO} = 100\ \mu A$	33% Higher
V_{EBO}	5	8	Volts	$I_{EBO} = 100\ \mu A$	60% Higher
Power Dissipation	2	2.8	Watts	25°C Case Temp	40% Higher
Power Dissipation	0.6	0.8	Watts	25°C Ambient Temp	33% Higher
I_{CBO}	1.0 100	0.5 50	μA μA	$V_{CB} = 30V, T = 25°C$ $V_{CB} = 30V, T = 150°C$	50% Decrease
$V_{BE(SAT)}$	1.3	1.3	Volts	$I_C = 150mA, I_B = 15mA$	———
$V_{CE(SAT)}$	1.5	0.8	Volts	$I_C = 150mA, I_B = 15mA$	47% Decrease
h_{FE}	40-120	40-120	———	$V_{CE} = 10V, I_C = 150mA$	———
h_{fe}	2.5 min	7.0 min	———	$V_{CE} = 10V, I_C = 50\ mA$ $f = 20mc$	280% Increase
C_{ob}	35	18	$\mu\mu f$	$V_{CB} = 10V, I_E = 0$ $f = 140\ kc$	48% Decrease

2. HIGH SPEED SWITCH TYPES – 2N1409 – 2N1410

Typical switching speed of 52 nanosec turn-on time and 130 nanosec turn-off . . . saturation resistance of only 5 ohms and power ratings of 2.8 watts (25°C case temp.) For use in low current logic or high current core-driver circuitry.

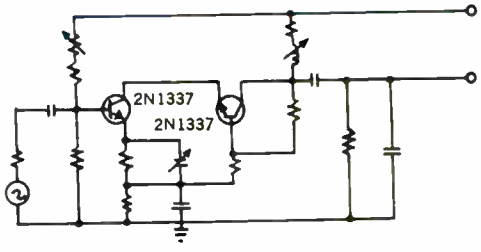


TRANSISTOR CORE FLIP-FLOP

3. HIGH VERSATILITY TYPES – 2N1335 thru 2N1341

The higher power dissipation, faster rise time and lower collector capacitance of the 2N1337, for example, makes this transistor an unusually fine performer in advanced video amplifier circuits.

These 2.8 watt, 120 volt VHF transistors are well suited to IF and DC amplifiers, RF power amplifiers and oscillators and to high voltage switching applications.



TEN MC BANDWIDTH, HIGH VOLTAGE VIDEO AMPLIFIER

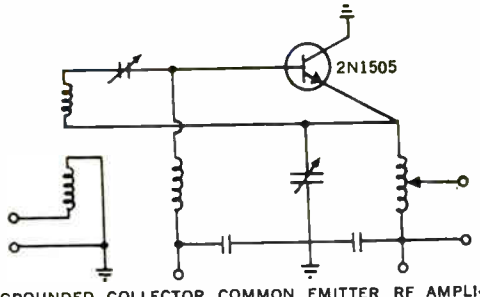
4. COMMUNICATION TYPES – 2N1505 – 2N1506

This series of silicon mesa transistors provides high power output at Very High Frequencies. Typical power outputs are one-half watt at 200 mc with 3 db gain or one watt at 70 mc with 12 db power gain operating from 28V source.

A power output of 2.5 watts at 250 mc. may be obtained by using these transistors with a High-Q Varicap[R] frequency multiplier.

"VARICAP" IS THE REGISTERED TRADEMARK OF SILICON VOLTAGE-VARIABLE CAPACITORS MANUFACTURED BY PACIFIC SEMICONDUCTORS, INC.

CALL ANY PSI SALES OFFICE FOR FULL DETAILS AND FAST DELIVERY SCHEDULES!



GROUNDED COLLECTOR COMMON EMITTER RF AMPLIFIER PROVIDES UNIQUE COMBINATION OF HIGH GAIN AND HIGH POWER.

PSI

Pacific Semiconductors, Inc.

A SUBSIDIARY OF THOMPSON RAMO WOOLDRIDGE INC.

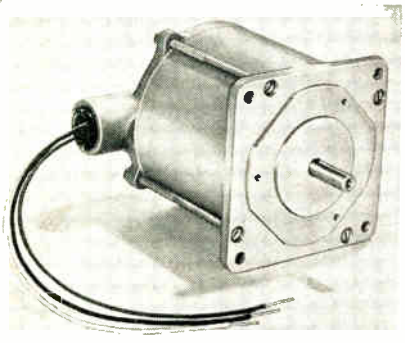
12955 CHADRON AVENUE • HAWTHORNE, CALIFORNIA

Circle 60 on Inquiry Card

New Products . . . for the Electronic Industries

SYNCHRONOUS MOTOR

Explosion-proof Slo-Syn Synchronous Motor, type X250, provides safe operation in hazardous areas. Case will withstand internal gas and vapor explosions and prevent the ignition of surrounding external gas and vapor

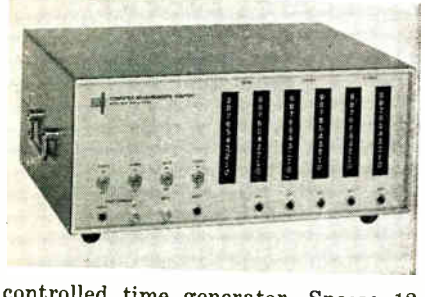


by internal spark, flash or explosion. Underwriters' Laboratories approved for Class 1, Group D service. Can be started, stopped or reversed instantly with a single-pole, 3-position switch. If desired, one revolution of the motor shaft can be converted into 200 precise steps by applying dc voltage to field windings. Ratings are: input 120 v. 40/70 CPS, 1 phase, 0.6 a max. current (at 60 cycles); 72 RPM output speed at 60 CPS; 250 oz-in. torque. The Superior Electric Co., Dept. SS, Bristol, Conn.

Circle 199 on Inquiry Card

DIGITAL CLOCK

New digital clock, Model 224A, provides digital time display, digital time in 1-2-2-4 coded output form, and elapsed time measurement with digital time display and coded output. Real time or time measurement is displayed in hrs., min., and sec. The internal 1-cycle clock pulses are generated by synchronization with the 60-cycle power line (0.1% mom. accuracy) or by external sources, such as a crystal



controlled time generator. Specs: 12 or 24 hrs., 59 min. and 59 sec. visual display; external or manual gate for start-stop; reset to "O." Computer Measurements Co., 12970 Bradley Ave., Sylmar, Calif.

Circle 200 on Inquiry Card

DIRECT WRITING RECORDER

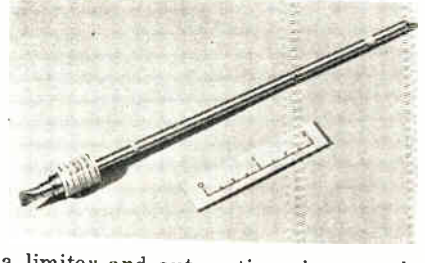
New electric writing feature of the Brush Mark II, Model 2522, direct writing recorder permits unattended recording of analog and event data over prolonged periods even where extremes of environmental are encoun-

tered. Two channels of analog data and 2 channels of coded, event or time data can be recorded instantly on a common time base. Recorder has 4 chart speeds selected instantly and positively from pushbutton controls. Chart speeds are 0.4, 2, 10 and 50 mm/sec. At the slowest speed of 0.4 mm/sec, up to 31½ hrs of continuous, unattended recording can be made on a standard 150-ft. roll of Brush chart paper. Brush Instruments, Div. of Clevite Corp., 37th & Perkins, Cleveland 14, Ohio.

Circle 201 on Inquiry Card

TRAVELING-WAVE TUBE

Low-noise traveling-wave tube for operation in the C-band, the metal-ceramic tube, type Z-3028, covers 4,000-to-8,000 MC. Max. noise figure is 10 db with an ave. integrated noise figure of about 8 db. Min. small signal gain is 25 db. Power output is 5 mw. Designed as a pre-amplifier for radar receivers, it can also be used in microwave relay systems, radiometry, countermeasures, radio astronomy; as

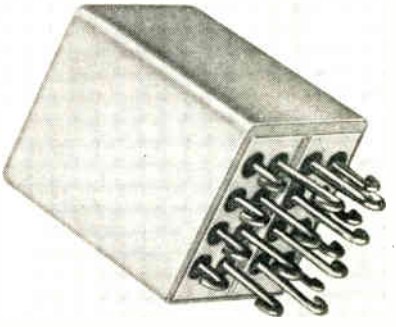


a limiter and automatic gain control, and as a microwave mixer and frequency divider. Withstands shock to 50 g's; vibration to 15. It will operate at 100,000 ft. General Electric Co., Schenectary 5, N. Y.

Circle 202 on Inquiry Card

RELAY

New 4-pole, double throw, 10 a relay series, BR-14 in two contact configurations, BR-14X with heavy-duty AgMgNi contacts rated to 10 a (resistive @ 28 vdc or 110 vac) and BR-14Y with lighter weight AgMgNi 5 a

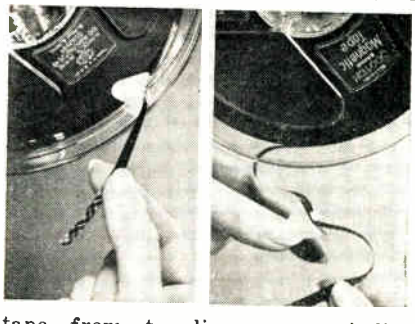


contacts. BR-14 series has a life span of better than 300,000 operations at rated load at amb. temp. 100,000 operations or more at +125°C to Mil-R-5757C. The relays are designed for operation between −65°C and +125°C, are rated to 25 a min. overload, with max. coil dissipation of 6 w. Operate and release time of the design is 7 msec (max.), with drop-out adjustable between 10% and 40% of pull-in. Meet Mil-R-5757C and Mil-R-25018. Babcock Relays, Inc., 1640 Babcock Ave., Costa Mesa, Calif.

Circle 203 on Inquiry Card

TAPE CLIP

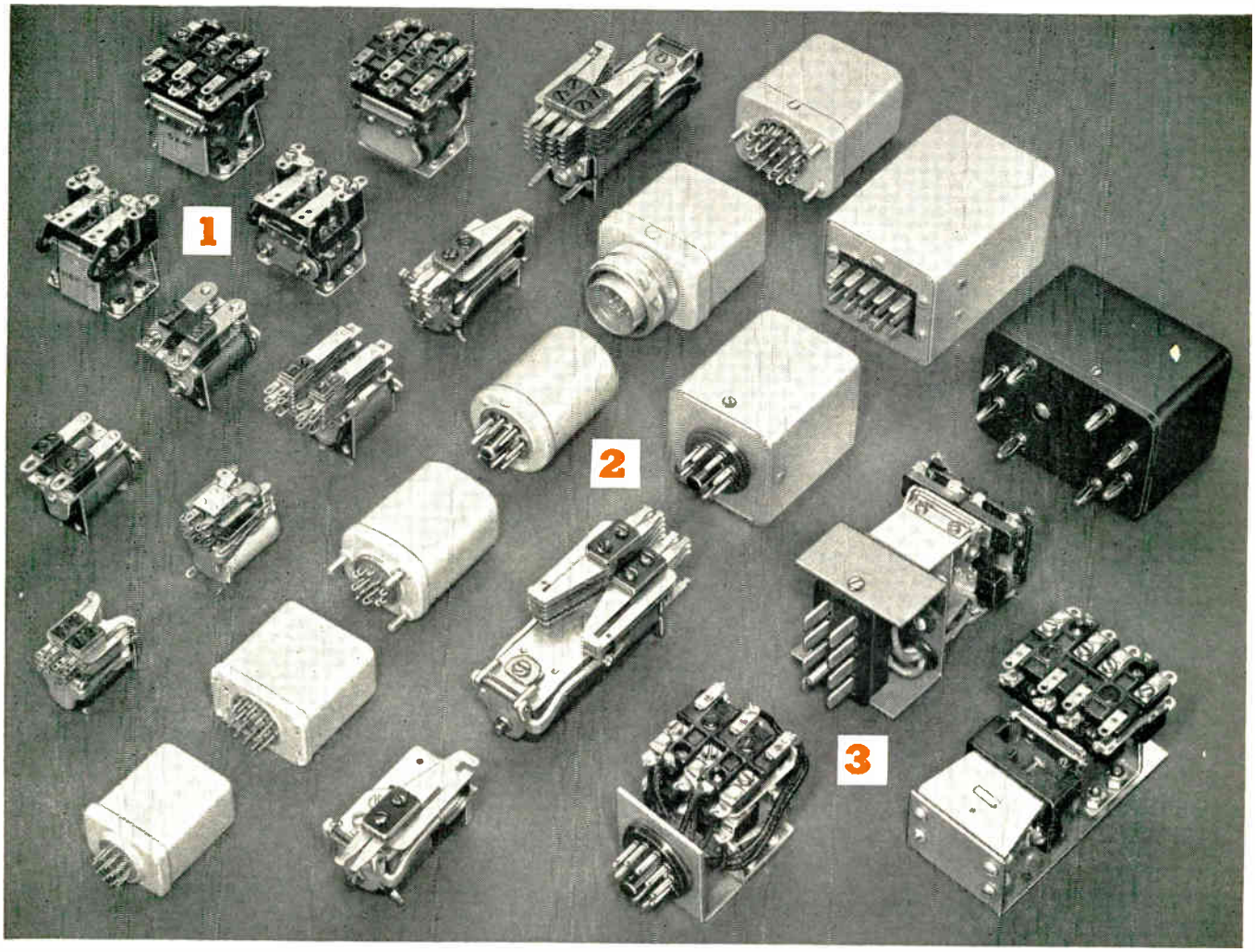
Plastic clip slips smoothly between the flanges of reels to hold loose ends of magnetic tape securely in place. Molded of polystyrene plastic, the triangular-shaped accessory is sturdy yet flexible and easily clips onto tape on reels. All edges are tapered and smooth to prevent any possibility of scratching the tape. The clip is a simple and quick means of keeping



tape from tangling or unwinding during storage and shipment. Clip fits standard quarter-inch recording tape on any size reels. Minnesota Mining and Manufacturing Co., 900 Bush Ave., St. Paul 6, Minn.

Circle 204 on Inquiry Card

specify OHMITE Relays for Reliability



1. Eleven Standard Models 2. Typical Relay Enclosures 3. Relays with Special Construction

EXCLUSIVE! Contact Combinations on New Ohmite Relays Are MOLDED*

Permanence and ease of adjustment of the individual contact springs are the result of a revolutionary, new innovation found in two new Ohmite Relays—Models TT and TS. This innovation is the unique "Molded Module"* contact spring construction. The "module" is a standard, single-pole, double-throw spring combination molded into a single compact assembly. As many as six modules can be incorporated into a relay. *(*Pat. Applied For*)

QUALITY CONSTRUCTION—All Ohmite relays embody the same meticulous engineering, strict quality control, and generous use of high quality materials which have made Ohmite components the standard of the industry. Parts are plated where necessary for corrosion resistance. Springs are of nickel-silver or phosphor-bronze. Contacts are fine silver. Special contact materials, such as silver, tungsten, palladium, or gold alloy, can be supplied. Protection against humidity and moisture is paramount and is accomplished in layer-wound coils, through complete sealing with cellulose-acetate. Relays are available in a wide range of coil operating voltages and contact combinations in both AC and DC types.

65 TYPES IN FOUR STOCK MODELS—For fast service, four models in the Ohmite relay line are carried in stock in 65 types at the factory, and by Ohmite Distributors from coast to coast.

HERMETICALLY SEALED AND DUST-TIGHT RELAYS—You can specify many of the basic Ohmite relays in nonremovable, hermetically sealed enclosures for applications requiring complete relay protection. These high-quality relays are sealed in seamless steel enclosures which are exhausted and filled with dry, inert gas under control of Ohmite engineers. Ohmite hermetically sealed relays are available with either plug-in or solder terminals. Relays are also made with nonremovable dust-tight covers and removable dust covers.

RELAYS WITH SPECIAL CONSTRUCTION—Ohmite relays are available with special terminals or special construction, such as relays with push-on or screw terminals, relays with binding-post terminals. Where quantities warrant, Ohmite will manufacture relays made to your specifications. Ohmite can furnish not only special terminals, special contact combinations, contact materials, and coils but also special enclosures, connectors, impregnation, or frames. Ohmite relays can be engineered to meet your special pull-in, drop-out, or time-delay requirements.

For your special or unusual relay applications, let Ohmite's experienced engineers help you work out the best solution.

Write on company letterhead for Catalog and Engineering Manual 58.

OHMITE

OHMITE MANUFACTURING COMPANY
3662 Howard Street,
Skokie, Illinois

RESISTORS RELAYS TAP SWITCHES
RHEOSTATS TANTALUM CAPACITORS
R.F. CHOKES VARIABLE TRANSFORMERS
DIODES

New Products . . . for the Electronic Industries

UHF BEAM POWER TUBE

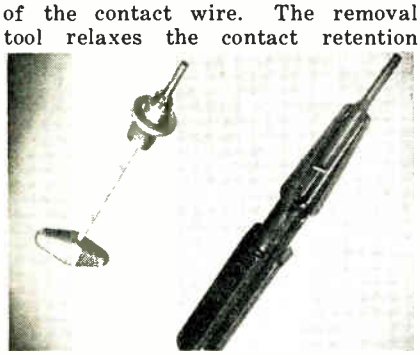
Forced-air-cooled, ultra-high frequency beam power "Cermolox" tube, RCA 7649, is for pulse applications under severe shock and vibration. It is for use in grid-and-screen-pulsed and plate-and-screen pulsed r-f oscil-

lator and amplifier service at frequencies up through 2000 MC in compact airborne, mobile and fixed equipment. It can be used to drive the RCA-7651. When used under continuous commercial service conditions as a plate-and-screen-pulsed r-f amplifier in a cathode-drive circuit at 1215 MC with a 10-μsec pulse duration and 0.01 duty factor, it can deliver about 4500 w of useful power at peak of pulse with a driver power output of about 450 w at peak of pulse. Radio Corp. of America, Dept. of Information, RCA Bldg., 30 Rockefeller Plaza, New York 20, N. Y.

Circle 205 on Inquiry Card

"SNAP-IN" CONTACT TOOLS

New, simplified insertion and removal tools for the Deutsch "snap-in" contact connector line. Featured is the replaceable tip which when damaged or worn, can be removed and replaced at a fraction of the original tool cost. The insertion tool inserts and locks the "snap-in" contact in a positive alignment position — then slips back out of the insert hole free of the contact wire. The removal tool relaxes the contact retention

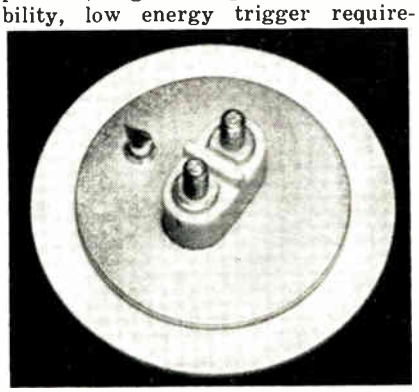


spring and pushes the contact toward the rear of the connector for easy removal. Tools are precision made. The Deutsch Co., Electronic Components Div., Municipal Airport, Banning, Calif.

Circle 206 on Inquiry Card

TRIGGERED SPARK GAP

The triggered spark gap is a 3 or more electrode device which can be used as a switch for the transfer of high energy. It has high unfired impedance, high voltage holdoff capability, low energy trigger require-

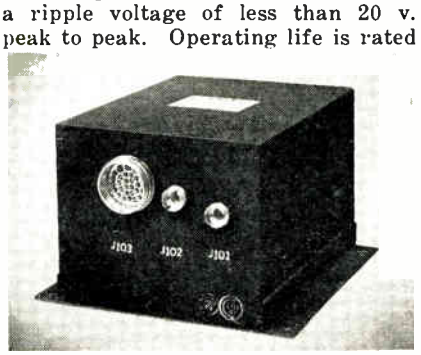


ments, extremely low fired impedance and fast follow through after application of the trigger pulse. Ceramic-metal triggered gap (TG-88) has a static breakdown between main electrodes of approx. 5300 vdc. It can be used as a switch by applying any voltage from 1000 to 5000 vdc from the energy storage network to the main electrodes and then applying a trigger pulse of approx. 5 to 2 kv respectively from a pulse transformer between the trigger and the adjacent electrode. The Bendix Corp., Red Bank Div., Route 35, Eatontown, N. J.

Circle 207 on Inquiry Card

POWER SUPPLY

New 10,000 vdc power supply weighs 5¾ lbs. and provides the gun potential to a high persistency display tube. It may be used in other applications where space and weight are prime considerations. Hermetically sealed unit is of the unregulated transformer-rectifier type and operates from a 115 v., 400 CPS input. The fixed output of 10,000 vdc at 2 ma has a ripple voltage of less than 20 v. peak to peak. Operating life is rated

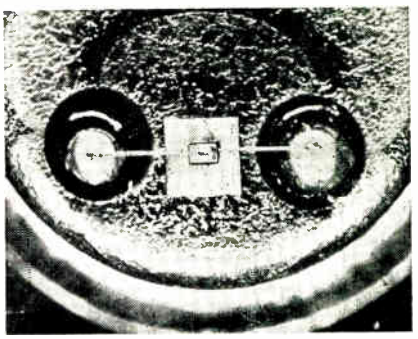


at a min. of 2000 hrs within a temp. range of −54° to +71°C. Designated ITT Model P755A, it measures 4½ x 5 2/5 x 6¾ in. Industrial Products Div., ITT, 15191 Bledsoe St., San Fernando, Calif.

Circle 208 on Inquiry Card

SWITCHING TRANSISTOR

Improved internal mesa structure assures lower saturation resistance and lower intrinsic base resistance of the new 2N706B silicon switching mesa transistor. The max. collector saturation voltage, $V_{CE\,sat}$, and base

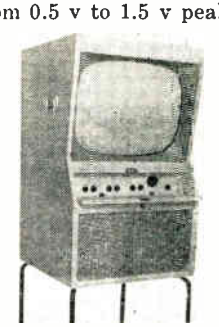


resistance, r'_b, of the Motorola 2N706B are specified at 0.4 v. and 50 ohms. Storage time is 18 n sec. (typical). Unit is conservatively rated for operation at temp. up to +175°C and receives an in-process high-temp. storage test at a min. of 300°C. Max. ratings are: Collector-base voltage, 25 v.; collector-emitter voltage, 20 v.; emitter-base voltage, 5 v., and 0.3 w dissipation in a 25°C amb. Housing is standard TO-18 package. Motorola Semiconductor Products Inc., Technical Information Center, 5005 E. McDowell Rd., Phoenix, Ariz.

Circle 209 on Inquiry Card

MONITOR/RECEIVER

Industrial quality monitor/receiver for the educational and industrial fields features lockable control cover, removable speaker enclosure, tape output jack for recording, on-off pilot light, safety glass and picture tube sloped 11° to prevent glare, and 15 foot three wire cord. Audio output is 10 w, 30 to 12,000 CPS not more than +3 db or −6 db with tone control set flat. Signal inputs: composite video from 0.5 v to 1.5 v peak to peak



with sync negative. 300 ohm balanced r-f input. Bandwidth is: video response beyond 8 MC; resolution better than 600 lines where video line driven. Miratel, Inc., 1080 Dionne St., St. Paul, Minn.

Circle 210 on Inquiry Card

ROAST IT!

INHERENT STABILITY
Assured in a DALOHM RH Resistor

Even searing heat from a glowing bed of coals causes no deviation from the inherent stability that is standard in Dalohm resistors.

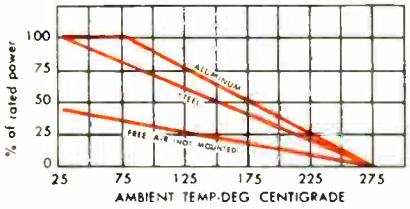
Stored on the shelf for months . . . or placed under continuous load . . . operating in severe environmental, shock, vibration and humidity conditions . . . Dalohm precision resistors retain their stability because it has been "firmly infixed" by Dalohm design and methods of manufacture.

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

HIGH POWER • WIRE WOUND • MINIATURE
DALOHM TYPE RH RESISTORS

Designed for specific application of high power requirements, coupled with precision tolerance. Mount on chassis for maximum heat dissipation.

TYPICAL DERATING CURVE



- **Rated at** 5, 10, 25, 50, 100 and 250 watts
- **Resistance range** from 0.1 ohm to 175K ohms, depending on type
- **Tolerances** ± 0.05%, ± 0.1%, ± 0.25%, ± 0.5%, ± 1%, ± 3%
- **Temperature coefficient** 20 P.P.M.
- **Operating temperature range** from −55° C. to +275° C.
- **Welded construction** from terminal to terminal.
- **Ruggedly housed;** sealed in silicone and inserted in radiator finned aluminum housing.
- **Smallest in size,** ranging from ⅝" x ⅝" to 3" x 4½"
- Surpass applicable paragraphs of MIL-R-18546B (Ships).

Write for Bulletin R-21, with handy cross-reference file card.

SPECIAL PROBLEMS?

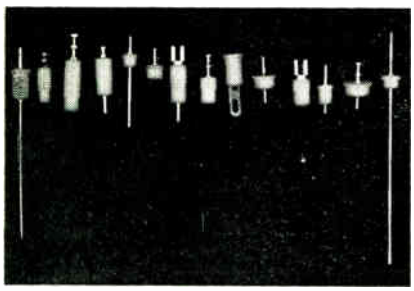
You can depend on Dalohm, too, for help in solving any special problem in the realm of development, engineering, design and production. Chances are you can find the answer in our standard line of precision resistors (wire wound, metal film and deposited carbon); trimmer potentiometers; resistor networks;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

DALE ELECTRONICS, Inc.
FORMERLY DALE PRODUCTS Inc
1304 28th Ave., Columbus, Nebr.
A DIVISION OF
Hathaway
INSTRUMENTS, INC.

New Products

TEST JACKS

Subminiature test point jacks, Teflon - insulated "KWIK - TERM" line, offers a variety of subminiature stand-off and feed-thru terminals. Test jacks are manufactured in both lug and turret styles. Each is of-

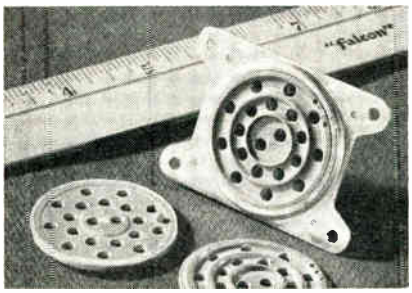


fered with reverse mountings. Available in colors for color coding. Standard contact and terminal material is gold flash over silver plated beryllium copper. Probe diameter range from 0.041 to 0.090 inch. Available lengths range from 0.120 to 2.500 inch, pin diameter from 0.40 to 0.078 inch. Standard pin material is silver-plated brass. Terminals are pressed into holes. Cannon Electric Co., 3208 Humboldt St., Los Angeles 31, Calif.

Circle 211 on Inquiry Card

ALKYD BASES—SOCKETS

Component bases and sockets molded from glass-fiber-reinforced alkyd have strength, high arc and insulation resistance, in addition to unusual dimensional stability. The alkyd (Plaskon 540) molded parts

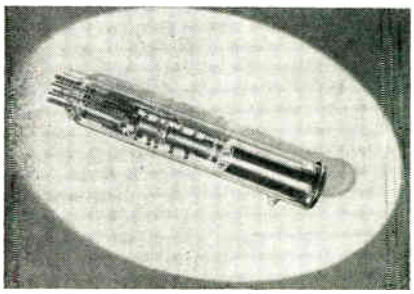


hold their tolerances during rapid production cycles. The complete series of components is specifically designed for plug-in construction. Tough, non-interchangeable bases and sockets have no molded center bosses to break, are available in 20 and 11-pin design as well as 7 and 9-pin bases and sockets for miniature and subminiature circuits. Alden Products Co., 117 N. Main St., Brockton 64E, Mass.

Circle 212 on Inquiry Card

VIDICON TUBE

A new vidicon tube sensitive in the near ultra-violet region, the ML-S522B, has a peak response about 0.4 μa per μw of radiant energy at a wavelength of 4050 angstrom. Designed primarily for special industrial and scientific applications, the new tube is expected to be especially useful to operators of closed-circuit monitoring systems for observation of



phenomena in the far-blue region of the visible light spectrum. The photoconductive layer and construction permits televising of underwater scenes with high efficiency. Resolution capability is 600 lines. It is 6¼ in. long x 1.125 in. in dia. and is interchangeable with standard tubes. Both focusing and deflection are accomplished magnetically. The Machlett Laboratories, Inc., 1063 Hope St., Springdale, Conn.

Circle 213 on Inquiry Card

Creative Microwave Technology

Published by MICROWAVE AND POWER TUBE DIVISION, RAYTHEON COMPANY, WALTHAM 54, MASS., Vol. 2, No. 4

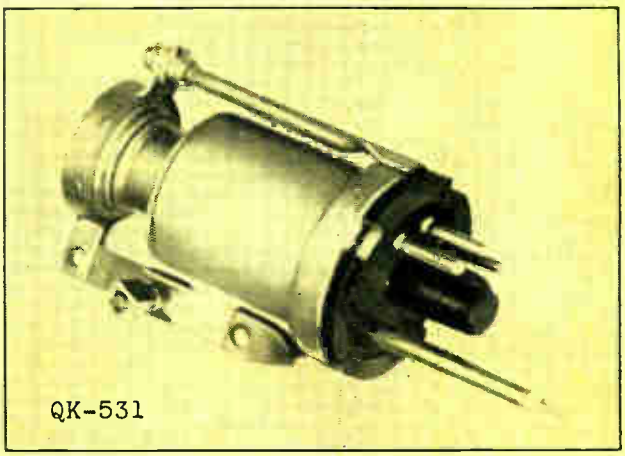
RAYTHEON KLYSTRON CLOCKS 62,000 HOURS OF SERVICE

--tube retired after seven years of continuous operation

We don't send out 62,000-hour warranties; however, you can expect unusual performance from Raytheon klystrons. Take the tube cited above -- the QK-531 -- a 6,575-6,875 mc reflex klystron which we conservatively warrant for 7,500 hours. As the local oscillator in the Houstonia, Missouri, link of the Panhandle Eastern Pipeline Company's 400-mile microwave system, the tube performed a major function in relaying up to ten channels of information between the Odessa and Boonville stations.

How is this kind of performance built into a tube? Advanced manufacturing techniques and rigorous quality control is the answer.

If you need low-power coverage of government, studio link and common carrier frequency bands, look into the characteristics of Raytheon's complete line of klystrons.



QK-531

The QK-531 is particularly suited for local oscillator service in microwave receivers. It is useful, also, as a local oscillator in microwave spectrum analyzers, as a pulse generator for testing circuit response and as a frequency modulated source in microwave relay links.

Homer Marrs of Motorola presents gold-plated klystron trophy to F. J. McElhatton, Panhandle Eastern Pipeline Co. J. A. Fowler, Supervisor of Communications for Panhandle, is at the left. Prized klystron, the Raytheon QK-531, performed for 62,000 hours.

Close control of product quality and costs at every state of production is responsible, in part, for Raytheon's success in meeting industry and government specifications. Every step of assembly is spot checked by inspectors, each with 10 years or more experience in microwave tube production.

Excellence in Electronics

RAYTHEON

You can obtain detailed application information and special development services by contacting: Microwave and Power Tube Division, Raytheon Company, Waltham 54, Massachusetts. In Canada: E. Waterloo, Ontario.

A LEADER IN CREATIVE MICROWAVE TECHNOLOGY

*Of acute mental vision or discernment, keen.

DU MONT offers the most complete—yet individually specialized—family of cathode-ray tubes available for work in the high to ultrahigh *(kilomegacycle)* frequency range. Du Mont has contributed special developments on electrode adjustments, plate mounts, timing marker plates, integral mu-metal shields, r-f coaxial connectors, and many other designs specifically oriented to the high-frequency field. Only Du Mont can provide such completeness in selection and design.

SPECIALTY FEATURES

5BHP—High sensitivity; astigmatism and pattern adjustment electrodes for distortionless displays.

5XP—High vertical sensitivity; low capacitance.

K1409—Type C r-f coaxial connectors and special deflection plate mounting for UHF applications. Integral mu-metal shield.

K1524—50 ohm distributed deflection system using Type C r-f coaxial connectors. Integral mu-metal shield.

K1546—High voltage, high writing speed.

K2082—Traveling wave vertical deflection plates, high sensitivity.

K1570—50 ohm distributed vertical deflection; Type C r-f coaxial connectors. Extra horiz. and vert. deflection plates for introduction of timing marks. Interplate shield reduces crosstalk between adjacent deflection plates. Integral mu-metal shield.

Shaded areas indicate traveling wave types

TYPE	A_1 (KV.)	A_2 (KV.)	SENSIBILITY (V/TRACE WIDTH)		USEFUL SCAN (IN.)		USEFUL SCAN (TRACE WIDTHS)		FREQ. 3 db DOWN (Mc.) (VERT.)	WRITING SPEED† (TW/US.)
			HOR.	VERT.	HOR.	VERT.	HOR.	VERT.		
5BHP	10	1 65	1 54	0 33	3 9	1 6	195	80	220	9000
5XP	12	2	2.90	0.94	4.25	1.6	220	80	460	9000
K1409	30	7.5	2.5	1.75	4.2	2.8	420	280	1650	120,000
K1524	35	10	2.2	0.65	3.5	0.75	435	90	2800	205,000
K1546	24	4	4.2	1.0	4.0	1.6	160	105	325	33,600
K2082	12	1.4	1.65	0.43	3.94	1.97	120	60	4100	9000
			$D_1 D_2$ / $D_5 D_6$	$D_3 D_4$ / D_7	$D_1 D_2$ / $D_5 D_6$	$D_3 D_4$ / D_7	$D_1 D_2$ / $D_5 D_6$	$D_3 D_4$ / D_7		
K1570	35	10	1.4 / 1.6	1.0 / 0.55	4.5 / 3.5	1.25 / 1.75	650 / 575	200 / 280	1400	205,000

† Writing speed determined at 25 ua beam current. Tests made on 35 mm Tri-X film, 4 7 to 1 reduction ratio, f/1.5 lens.

DU MONT®

precision electronics is our business

Write for complete details
ELECTRONIC TUBE DIVISION

ALLEN B. DU MONT LABORATORIES, CLIFTON, N. J.,
DIVISIONS OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION
Du Mont International Division, 515 Madison Avenue, New York 22, New York

Circle 66 on Inquiry Card

Experience is the optimum test for Energy Storage Capacitors...

time-proven Sangamo Type DCM Electrolytic Capacitors exceed operating requirements of practically every application

Sangamo Type DCM Electrolytic Capacitors are housed in seamless, drawn-aluminum containers with a molded thermosetting plastic top that is sealed with a gasket to prevent electrolyte leakage and contamination. Terminal construction insures minimum contact resistance in current-carrying members. Cover design provides an adequate safety vent in case of heavy overload.

Sangamo was the first capacitor manufacturer to produce and establish standards in the manufacture of electrolytic energy storage capacitors. Since 1949, design and manufacturing techniques have been developed to such a scientific degree that Sangamo is still regarded as the leader in the field with the Type DCM. The time-proven characteristics of the DCM more than meet normal requirements of operating temperature, equivalent series resistance and life expectancy. Those techniques mean, too, that maximum capacity can be put in the smallest case size consistent with good engineering practice and performance reliability.

Occasionally applications call for energy-storage capacitors to meet special requirements — including higher temperature, and higher ripple current. Sangamo is uniquely qualified and equipped to engineer and produce to the most exacting specifications. We would appreciate the opportunity of supplying your future needs.

Complete data on capacitance and voltage combinations on Type DCM Capacitors is detailed in Sangamo's Engineering Catalog 2231. Contact your Sangamo Representative, or write us for your copy.

Maximum Capacity in Mfds VS Case Size in Inches

Rated Voltage	Surge Voltage	D=1-7/16 L=4-1/2	D=1-13/16 L=4-1/2	D=2-1/16 L=4-1/2	D=2-1/16 L=6	D=2-9/16 L=4-1/2	D=3-1/16 L=4-1/2	D=3-1/16 L=6
5	8	14,750	25,500	33,000	48,750	55,500	85,000	125,000
10	15	10,500	18,500	23,500	35,000	40,000	60,000	90,000
15	20	8,000	14,000	18,000	26,500	33,300	46,000	68,500
20	30	6,650	11,700	14,750	22,000	27,000	38,000	56,500
30	40	5,100	9,000	11,400	16,900	19,000	29,000	43,000
35	50	4,000	7,000	9,100	13,500	15,400	23,500	34,800
40	50	4,000	7,000	9,100	13,500	15,400	23,500	34,800
50	75	2,650	4,765	5,900	8,800	10,000	15,300	22,500
75	100	1,350	2,400	3,000	4,500	5,400	7,750	11,450
100	135	1,000	1,790	2,250	3,350	4,000	5,750	8,500
150	185	720	1,250	1,600	2,400	2,800	4,000	6,000
200	250	500	900	1,100	1,650	2,000	2,750	—
250	300	390	690	880	1,300	1,550	2,200	—
300	350	275	490	620	900	1,000	1,500	—
350	400	190	350	440	650	775	1,100	—
400	475	170	300	380	570	680	975	—
450	525	150	260	340	500	600	850	—

NOTE: Case dimensions include insulating sleeve. Subtract 1/16" from diameter and 3/8" from length for overall dimensions of uninsulated case.

SC-60-4

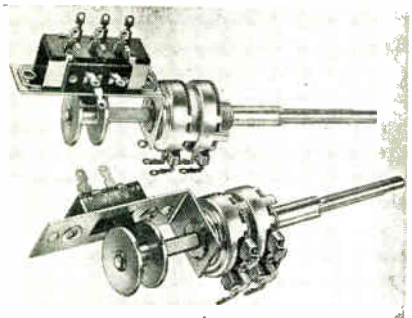
SANGAMO ELECTRIC COMPANY, Springfield, Illinois

—designing toward the promise of tomorrow

New Products

VARIABLE RESISTORS

Ingenious switching arrangements are possible with a new series of slide switch variable resistors, with ratings up to 6 a, 125 vac. Units are based on the Model 2 composition variable resistor. This is a ½ w unit, 15/16 in. in diameter with resistances from 200 ohms to 10 megohms, any taper. Switches are available in positive or spring return styles, SPST to 4 pole, double throw.

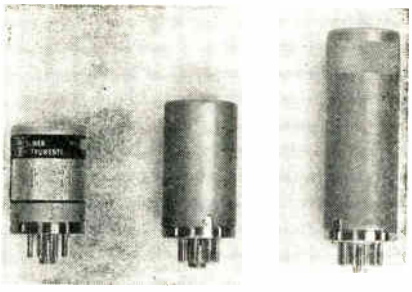


In addition to 6 a ratings, ½, 1, and 3 a ratings can be supplied. For hi-fi, stereo, radio, TV and phonograph applications. Centralab, The Electronics Div. of Globe-Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.

Circle 214 on Inquiry Card

COMPONENT-CRYSTAL OVENS

For computers, test equipment, and missile/space service, Models E 1091, E 931, and E 109 provide octal or eleven-pin base mounting, metal-to-glass headers and spring-loaded, bayonet-slotted covers. Covers can also be hermetically sealed. Internal component space available on the three ovens is 1 in. dia. x 1 in., 1 1/16 in. x 1⅝ in., and 1 1/16 in. x 2⅜ in. respectively. Stability is ±1°C in a



range of −20°C to 10°C below setting temp. Maximum power consumption is 10 w for the larger oven and 6 w for the 2 smaller ovens. Palmer Instruments, 1017 Mission St., So. Pasadena, Calif.

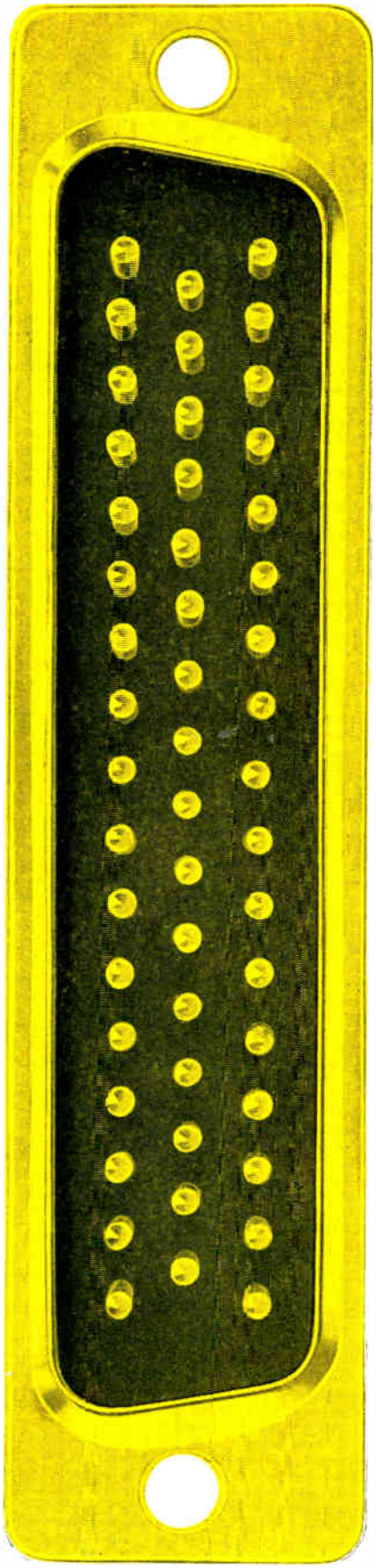
Circle 215 on Inquiry Card

POWER SUPPLY

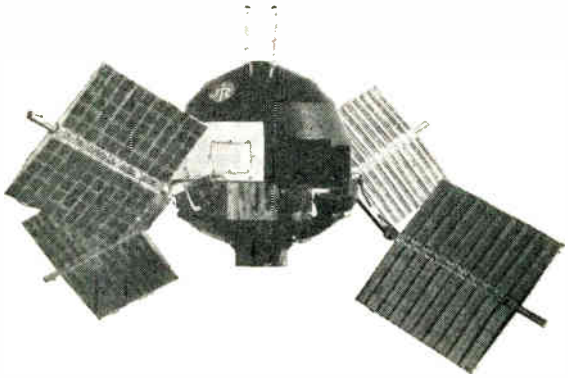
High voltage ac power supply for test applications features over-load protection and zero start lock-out relay as well as input and output amperes, output voltage metering. Oil immersed high voltage transformer is supplied by a motor-driven powerstat. Specs are: rating 35 kva;

input 220 v., 60 CPS, 1 ø; Ac output 0-35,000 v. @ 1.0 a; width 43 in.; depth 34 in.; height 61 in. Other sizes available up to 50 kva and 100 kv. Light Electric Corp., 212 Lackawanna Ave., Newark 4, N. J.

Circle 216 on Inquiry Card



THREE AND ONE-HALF TIMES ACTUAL SIZE.



CANNON GOLDEN-D SUBMINIATURE PLUGS

DESIGNED ESPECIALLY FOR MISSILE CIRCUITRY AND MAXIMUM RELIABILITY APPLICATIONS

The "Golden-D" Cannon Plugs are engineered to deliver superior performance in a subminiature size! Supplementing our famous standard D-Subminiature line, the "Golden-D" has these new design features: • MONOBLOC INSULATORS • PROBE-PROOF CLOSED-ENTRY SOCKET CONTACTS • LOW ENGAGEMENT/SEPARATION FORCES • GOLDEN CADMIUM SHELL FINISH • MATES WITH ANY CANNON "D" OF SAME SIZE AND LAYOUT. Wherever maximum reliability is needed in a subminiature multi-contact plug—for both military and industrial applications—ask for the new "Golden-D"...another reason why you should contact the world's most experienced plug manufacturer for *all* your plug requirements. The "Golden-D" is available in four types with a large variety of contact layouts. For further information write to:

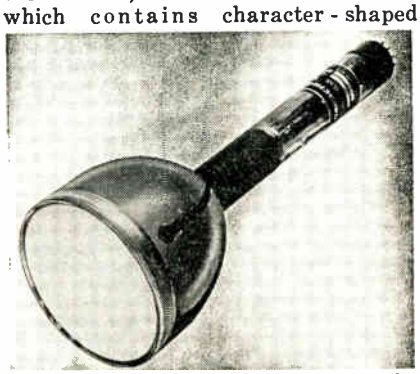
CANNON PLUGS

CANNON ELECTRIC COMPANY, 3208 Humboldt St., Los Angeles 31, Calif.

New Products

SHAPED BEAM TUBE

New compact version of the CHARACTRON shaped beam tube utilizes the aperture selection principle. It is smaller and lighter in weight than previous tube designs. Type C5G is essentially a highly-refined cathode-ray tube. An electron beam emitted inside the tube floods the matrix, a small metal stencil, which contains character-shaped

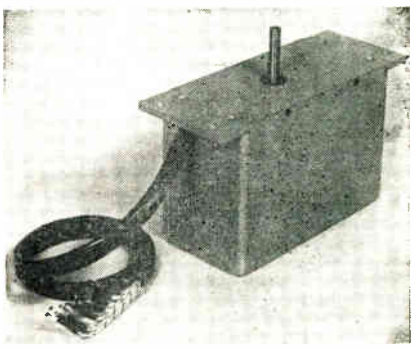


openings. By electronic control, the tube can select and display individual characters. These, in turn, can be displayed as words at speeds up to 10,000/min. Stromberg-Carlson Div., General Dynamics Corp., Box 2449, San Diego 3, Calif.

Circle 217 on Inquiry Card

SYNCHRO TRANSMITTER UNITS

New series of synchro transmitter units feature a wide selection of input ratios, high accuracy, and a small size. Series PX-1 units supply linear or angular position information to a remote location from electromechanical devices such as industrial control systems, automatic machinery, antenna pedestals, and missile or satellite tracking systems. The standard 2-speed unit has one synchro geared 1:1 and the other geared 36:1 in relation to the shaft motion to be



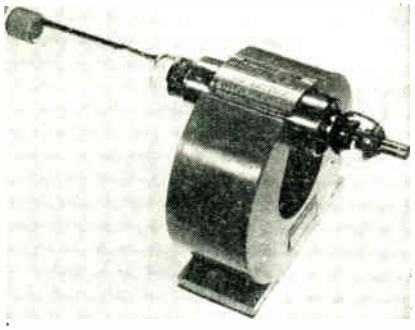
monitored. The 1:1 synchro provides the non-ambiguous signal while the 36:1 synchro provides the high accuracy signal. System accuracies range from 0.05% to 0.01%. Scientific-Atlanta, Inc., 2162 Piedmont Rd., N.E., Atlanta 9, Ga.

Circle 218 on Inquiry Card

New Products

HIGH VACUUM ION PUMP

A new line of ultra high vacuum ionization pumps contain no moving parts, refrigerants, traps, oils nor heating elements, can provide cleaner, drier and more trouble-free vacuum pumping for up to 50,000 hrs. One model in the new line is a compact, lightweight 6-liter pump that is only ¼ the size of conventional units with the same capacity. It pumps at the

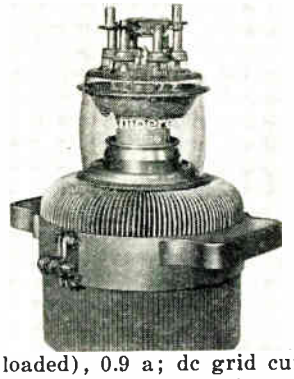


rate of 6 liters a sec., can achieve pressures of less than 10^{-9} mm Hg in either metal or glass vacuum systems, and can be used concurrently as a vacuum gauge. Hughes Vacuum Tube Products Div., Marketing Dept., 2020 Short St., Oceanside, Calif.

Circle 219 on Inquiry Card

CONSTANT POWER TUBES

Types 7806 and 7807 are constant power tubes. The 7806, plate dissipation rating—20,000 w, is a forced air cooled, high vacuum power triode (external plate type). Type 7807 is the water cooled version. Characteristics are identical. Power output remains constant with impedance variations found in dielectric and induction heating operation. Specs (CCS operation as an r-f (30 MC) Class C oscillator): dc plate voltage, 12,000 v.; dc plate current (loaded), 4.5 a; dc plate current (unloaded), 0.65 a; dc grid cur-



rent (loaded), 0.9 a; dc grid current (unloaded), 1.22 a; power input, 54,000 w; plate dissipation, 15,000 w; plate power output, 29,000 w; efficiency, 72.5% and useful power in load, 30,000 w. Amperex Electronic Corp., Power Tube Div., 230 Duffy Ave., Hicksville, L. I., N. Y.

Circle 220 on Inquiry Card

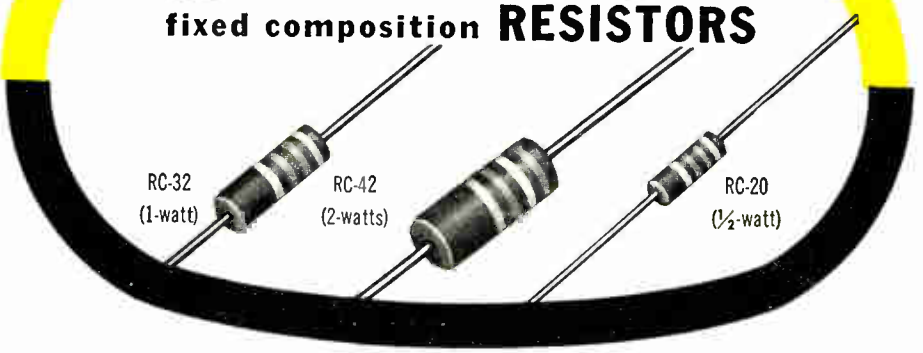
Unmatched for
MIL-R-11 APPLICATIONS

Today's best looking resistors are every bit as good as they look. Going beyond MIL-R-11 requirements, Coldite 70+ Resistors give important dividends in terms of load life, moisture resistance and other important characteristics.

Unmatched for
EASY SOLDERING

Thanks to an exclusive extra solder coating applied after the usual tin dipping, Coldite 70+ Resistors solder readily by any method —dip or iron. Leads stay tarnish-free and solderable even after months in storage.

Coldite 70+®
fixed composition RESISTORS



GET THEM IN 24 HOURS OR LESS
. . . from These Leading Distributors

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Kann-Ellert Electronics, Inc.

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Electronic Supply Corp.

BINGHAMTON, N. Y.
Morris Distributing Co., Inc.

BIRMINGHAM, ALA.
MG Electrical Supply Co.

BOSTON, MASS.
Cramer Electronics, Inc.
Sager Electrical Supply

BROOKLYN, N. Y.
Electrical Equipment Corp.

CLEVELAND, OHIO
Pioneer Electronic Supply Co.

DALLAS, TEXAS
Tekko

DAYTON, OHIO
Srepco, Inc.

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ST. LOUIS, MO.
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Morris Electronics of Syracuse, Inc.

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Electronic Industrial Sales, Inc.

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Bond Radio Supply Co. Inc.

WEST PALM BEACH, FLA.
Goddard Distributors, Inc.

WICHITA, KANS.
Interstate Electronic Supply Corp.

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Industrial Components Corp.

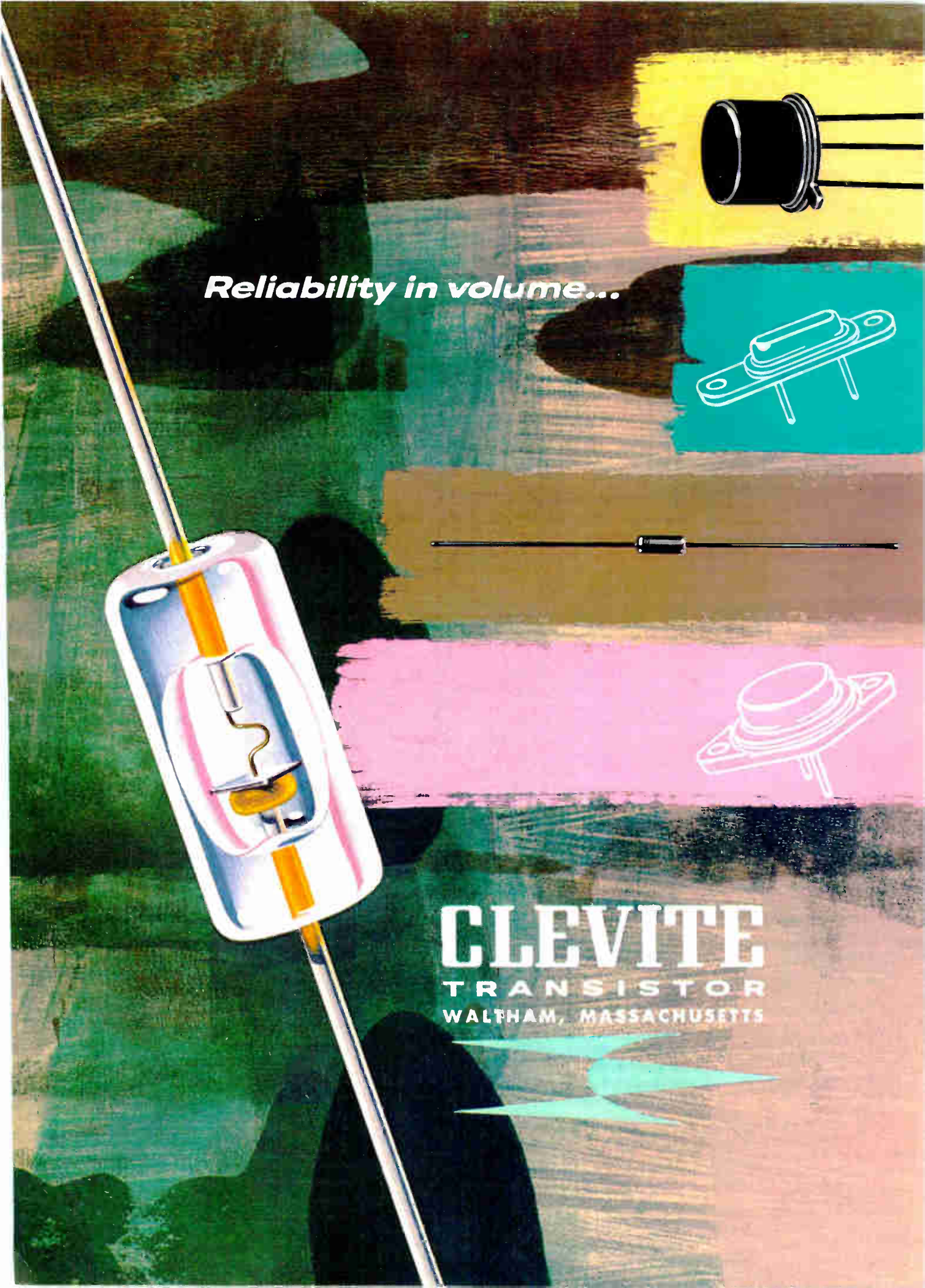
WINSTON-SALEM, N. C.
Dalton-Hege Radio Supply

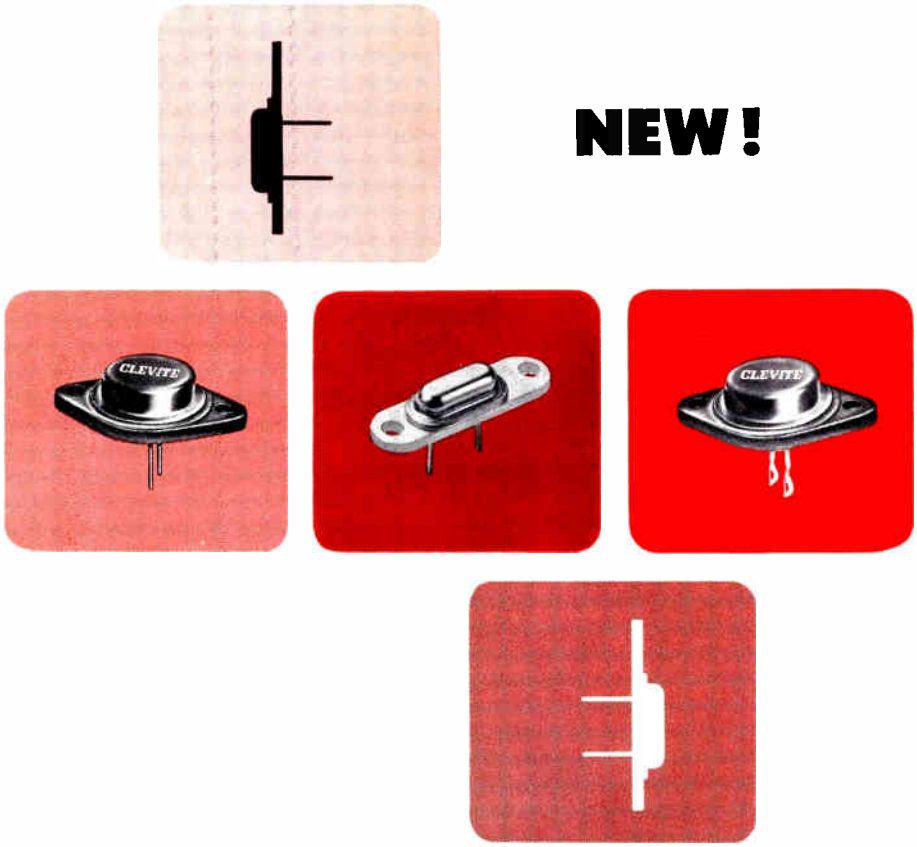
. . . and G-C / STACKPOLE, TOO!—Attractively packaged by G-C Electronics for service replacement uses, Coldite 70+ Resistors are also available through over 800 G-C distributors.

STACKPOLE

Circle 74 on Inquiry Card

Circle 75 on Inquiry Card →


Reliability in volume...
CLEVITE
TRANSISTOR
WALTHAM, MASSACHUSETTS



NEW!

ADVANCED DESIGN POWER TRANSISTORS FROM CLEVITE

Three new lines of germanium power transistors by Clevite feature new advances in controlled gain spread, fully specified collector-to-emitter voltage characteristics and low current leakage — even at maximum voltages and high temperatures.

The new 8 ampere switching series can be used to replace the older, more costly ring-emitter types in 3 to 8 ampere service.

The new 25 ampere switching type offers exceptionally low saturation voltage and is available with either pin terminals or solder lugs.

The new Spacesaver design not only affords important savings in space and weight, but its significantly improved frequency response means higher audio fidelity, faster switching and better performance in regulated power supply applications. Its low base resistance gives lower input impedance for equal power gain and lower saturation resistance, resulting in lower "switched-on" voltage drop. Lower cut off current results in better temperature stability in direct coupled circuits and a higher "switched-off" impedance.

CLEVITE NOW OFFERS THESE COMPLETE LINES

Switching Types	Amplifier Types
5 ampere	2 watt
8 ampere	4 watt
15 ampere	2 watt Spacesaver
25 ampere	
3 ampere Spacesaver	

All Clevite germanium power transistors are designed for low thermal resistance, low base input voltage, low saturation voltage and superior current gain.

For latest data and prices or application assistance, write for Bulletin 60 . . .

A DIVISION OF CLEVITE CORPORATION

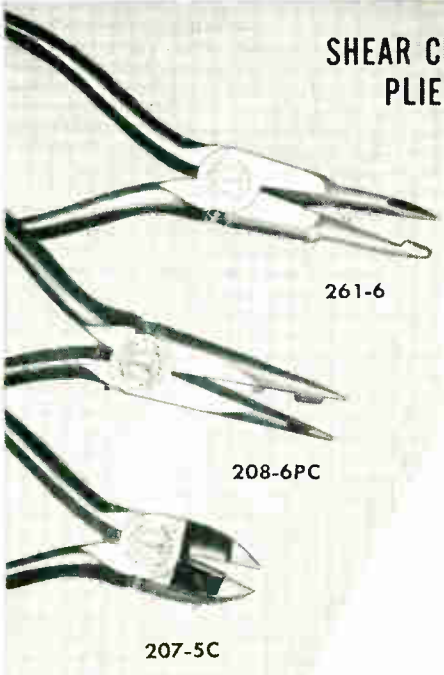
Reliability in volume . . .

CLEVITE TRANSISTOR

254 Crescent Street Waltham 54, Mass. Tel: TWinbrook 4-9330

SPEEDING UP ASSEMBLY LINE WITH KLEIN ELECTRONIC PLIERS

SHEAR CUTTING PLIERS

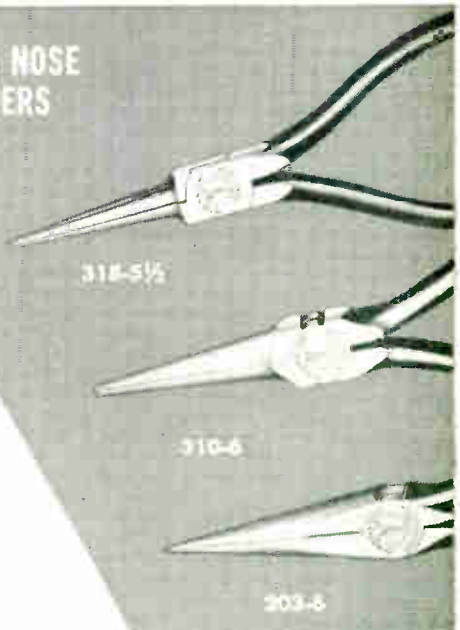


261-6

208-6PC

207-5C

LONG NOSE PLIERS



318-5½

310-6

203-6

In the rapidly growing field of electronics, there is an increasing need for highly specialized pliers. While you're using a plier designed to do a particular job, not only is assembly speeded up but better performance is assured.

Our own engineers, working with electronic manufacturers, have developed many pliers that serve the specialized needs of this field.

On this page are shown a few of the many pliers available in the complete Klein line.

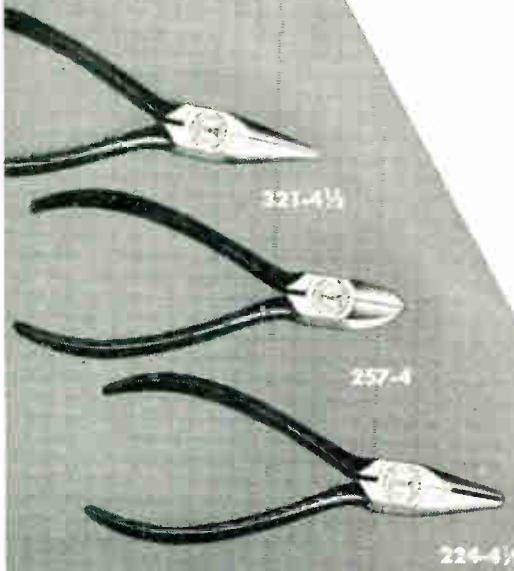
WRITE FOR CATALOG

If you do not have a copy of the new Klein Catalog 103A illustrating and describing Klein Pliers, write for a copy It will be sent without obligation.

ASK YOUR SUPPLIER

Foreign Distributor:
International Standard
Electric Corp., New York

MIDGET PLIERS

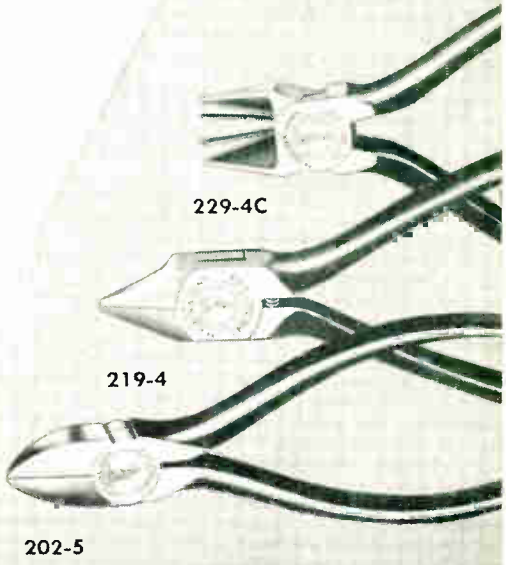


321-4½

257-4

224-4½

OBLIQUE CUTTERS



229-4C

219-4

202-5

Mathias KLEIN & Sons
Established 1857 — Chicago, Ill., U.S.A.
7200 McCORMICK ROAD • CHICAGO 45, ILLINOIS

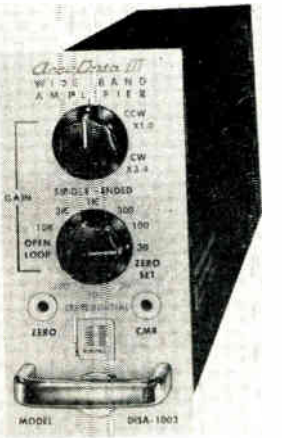
← Circle 75 on Inquiry Card

Circle 76 on Inquiry Card

New Products

DC AMPLIFIER

New chopper-stabilized, dc amplifier. The AccuData III, all-transistorized, can step up low-level signals from a variety of transducers to 10 v. with high accuracy. It has both single-ended and differential input connections. Max. gain is 34,000; input impedance is 20 megohms single-ended, or 2 megohms differential; output current is 65 ma at 5 v., or 25 ma at 10 v. Output impedance is less than 0.1 ohms. It is useful in high-frequency data handling systems because it minimizes the pick-up problems associated with long cable runs, and ground loops. The 10-v. output allows direct connection from transducer to a number of output devices, such as analog digital converters, high-speed oscillographs, etc. Minneapolis-Honeywell, Boston Div., 40 Life St., Boston 35, Mass.



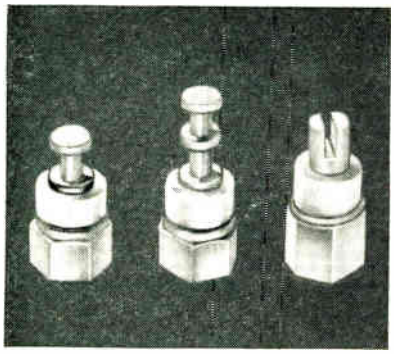
Circle 221 on Inquiry Card

RELAXATION OSCILLATOR LAMP

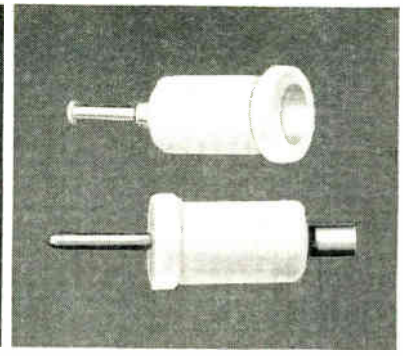
Model PL-11 is to be used primarily as a pilot light for battery powered equipment, but could also serve as a warning light or signal driven indicator. Voltage ranges cover 3 to 30 volts and flash rate from 0.1 to 5 seconds per flash. Associated duty cycle from 5:1 to 250:1. Operable from −25° to +50°C. Average battery consumption can be as low as ½ milliwatt. Polytronix, P.O. Box 53, Manhattan Beach, Calif.

Circle 222 on Inquiry Card

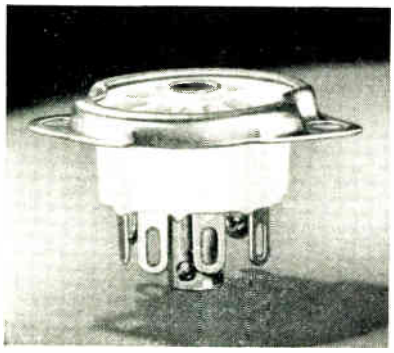
ENGINEERED COMPONENTS
for the Electronics Industry



Chemelec Insulators



Chemelec Connectors



Chemelec Sockets

Plastic Shapes and Parts

RELIABILITY AT ITS ULTIMATE

Garlock electronic components are your assurance of reliable performance in missile guidance, fire control, radar, television . . . electronic systems that operate *only* as well as the smallest component within them. Garlock offers one of the most complete lines of engineered electronic components and materials available from a single source:

Chemelec* Standoff & Feed-Thru Insulators are made of Teflon† because of its exceptional dielectric properties, chemical inertness, resistance to extreme temperatures (−110°F to +500°F). The insulators resist severe shock and are designed for quick and easy installation. They are available in all sizes, designs and colors.

Chemelec Connectors are Teflon-insulated for outstanding high frequency service with plug-in crystal diodes, plug-in coils and forms, test probes. Once installed, they require no further adjustment or hardware. Male and female in .040, .050, .064 pin size, female also in .080 size.

Chemelec Miniature Tube Sockets are specifically designed for use where high or low ambient temperatures or frequency stability are problems. Body insulating material of Teflon and Kel-F**; all metal parts are precision made and plated to JAN specifications. Available in all sizes, types.

Plastic Stock Shapes and Intricate Parts, inserts, thin sections, threaded parts and precision tolerances are available. Excellent facilities and experience in compression and injection molding, extruding, machining of Nylon, Teflon, Delrin†, Kel-F.

Garlock facilities and personnel are also at your disposal for design and development of new electronic products.

GARLOCK

A complete engineering staff keeps abreast of new developments in electronics, reviewing latest techniques and materials thoroughly before introducing them into component products.

Find out more about what Garlock offers. Contact the Garlock Electronic Products representative near you. Call him, or write for Catalog AD-169, Garlock Electronic Products, Garlock Inc., Camden 1, New Jersey.

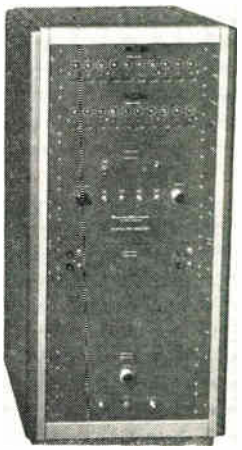
*Registered Trademark
**Trademark, Minnesota Mining & Manufacturing
†DuPont Trademark

Circle 78 on Inquiry Card

New Products

TIME ANALYZER

Twenty-channel time analyzer, System 1500, with optional pulse height analysis features 10 μsec resolution for each channel. As a time analyzer, it can be used with any pulsed neutron source for making decay studies. It will make a time analysis of events

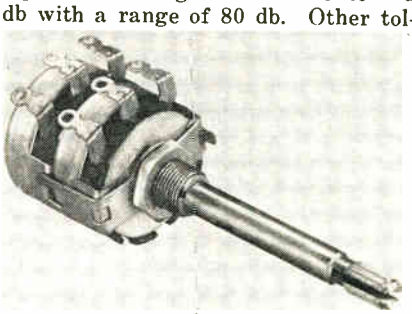


during total interval of 200 μsec to 2 sec. Events counted in 1 of 20 channels which are opened sequentially for equal time intervals. As a pulse height analyzer, obtains spectrums up to 100 points. Window amplifier selects a 20 v. portion of applied input for analysis on 20 one-v. channels. A 100-channel analysis is made in 5 steps by successively increasing the window amplifier threshold level. Threshold control permits selection of specific portion of spectrum for more detailed analysis. Eldorado Electronics, 2821 10th St., Berkeley, Calif.

Circle 223 on Inquiry Card

STEREO CONTROLS

Matched element controls provide tracking characteristics for controlling gain of dual-channel sound systems. Matched-element controls are dual assemblies made up on the basic Series 37 or Series 47 Clarostat designs. Tracking is available to ±2 db with a range of 80 db. Other tol-

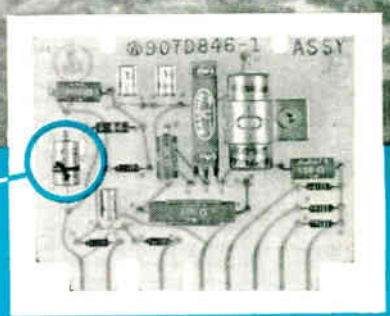


erances include ±4 and 6 db tracking in 40, 60 and 80 db ranges. The use of matched element controls simplifies operation of stereo equipment through 1-knob control of both channels. Clarostat Mfg. Co., Inc., Dover, N. H.

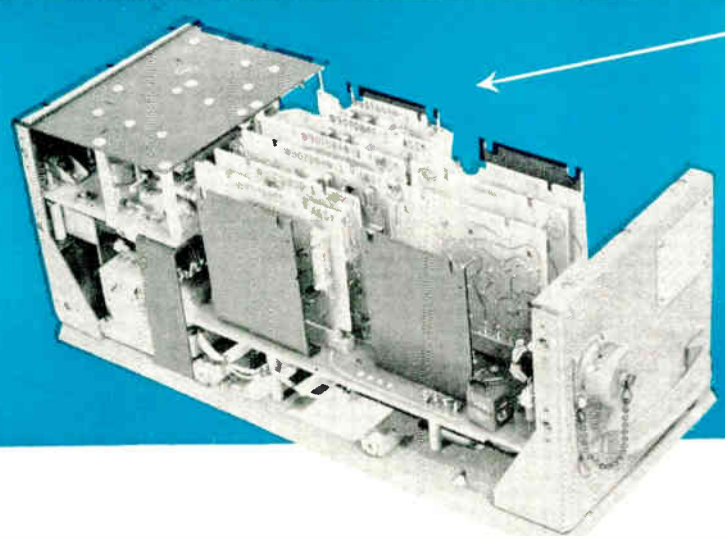
Circle 224 on Inquiry Card

"KEMET" CAPACITORS HELP CONTRIBUTE TO THE PERFORMANCE AND RELIABILITY OF THE BOEING 707 ELECTRICAL CONTROL SYSTEM

Boeing 707 commercial jet transport.



A transistorized panel showing position of a "Kemet" solid tantalum capacitor.



Uncovered control panel with transistorized panels in position.

Westinghouse Electric Corporation engineers are using "Kemet" capacitors in the control for the electric power system used on the Boeing 707. This most modern a-c electrical power system — each system comprised of a generator, control panel, voltage regulator and current transformer—provides optimum performance . . . simplified control . . . and automatic protection so essential in jet transport operation.

Transistorized control panels utilize static components in place of conventional relay circuits to provide reliability equal to that of the equipment being protected. "Kemet" solid tantalum capacitors were specified to help achieve this purpose. These extremely rugged capacitors insure the reliability required to minimize maintenance and alterations . . . the small physical size needed to reduce power plant bulk . . . and the stability of operation demanded by the power supply to insure maximum efficiency and dependability from the associated equipment. These "Kemet" capacitors, along with the other components of this electrical system, help provide precise instrumentation data to the crew and offer increased safety and comfort to the passengers.

You can apply the proved reliability and performance of "Kemet" capacitors to your equipment. For details, write Kemet Company, Division of Union Carbide Corporation, 11901 Madison Avenue, Cleveland 1, Ohio.

"Kemet" and "Union Carbide" are registered trade-marks for products of

KEMET COMPANY

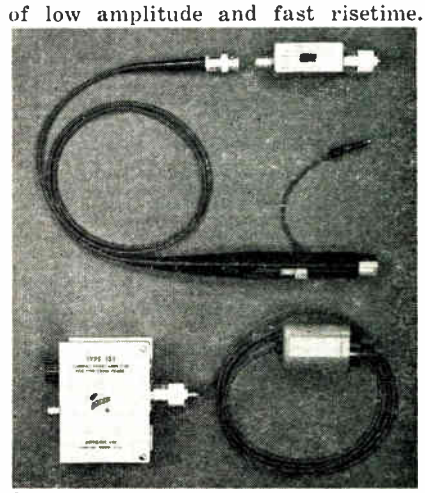
UNION CARBIDE

Circle 80 on Inquiry Card

New Products

CURRENT PROBE

The P6016 AC Current Probe and Type 131 Amplifier are a current-detecting system for use with a wide-band oscilloscope. It provides accurate displays for observation and measurement of current waveforms of low amplitude and fast risetime.

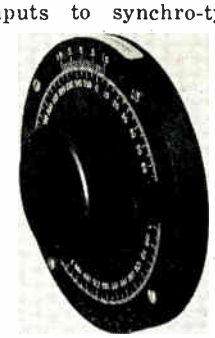


Current range is 1 ma to 10 amps. Passband, with a 30 MC oscilloscope, is 50 CPS to 17 MC. Probe slot is placed over conductor and slide closed with thumb—no direct electrical connection required. Loading introduced can almost always be disregarded. A second system is the P6016 with passive termination. Less versatile, it provides for observation and measurement of current waveforms at frequencies to 20 MC (with 30 MC oscilloscope) and sensitivity of either 2 or 10 ma/mv (of oscilloscope sensitivity). Tektronix, Inc., P.O. Box 500, Beaverton, Ore.

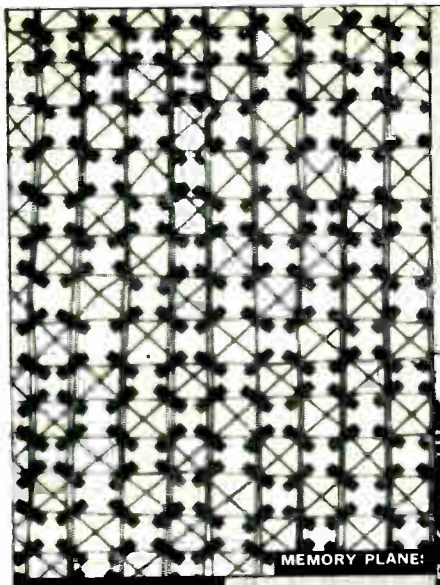
Circle 225 on Inquiry Card

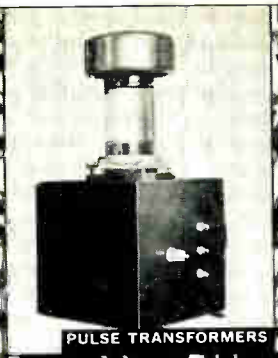
DIAL ASSEMBLY

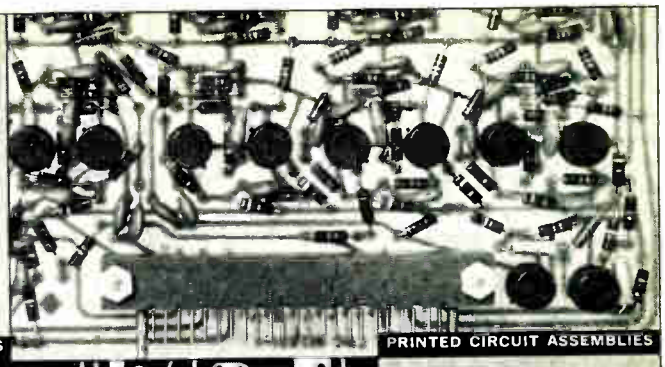
For use in testing aircraft indicators, new 360° Dial Assembly for synchros and resolvers mounts on any test panel and accepts the synchro without further fixturing. It provides inputs to synchro-type indicators and measures the output position from transmitter-type indications. Specifications: O.D., 5 in.; accuracy, 5 min.; readability, 6 min. Theta Instrument Corp., 520 Victor Street, Saddle Brook, New Jersey.

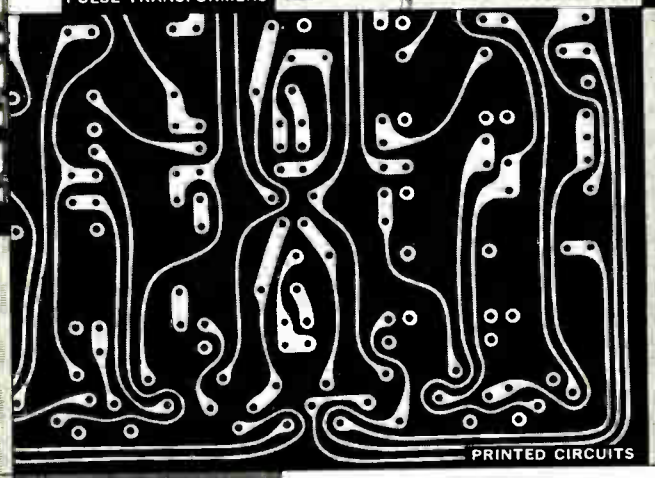


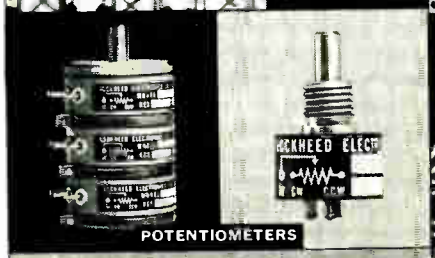
Circle 225 on Inquiry Card

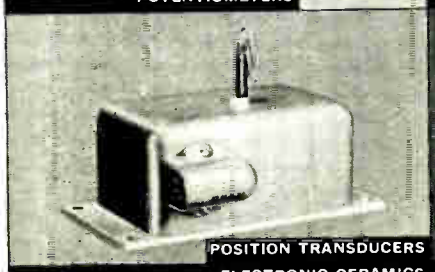


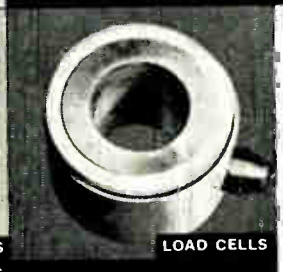


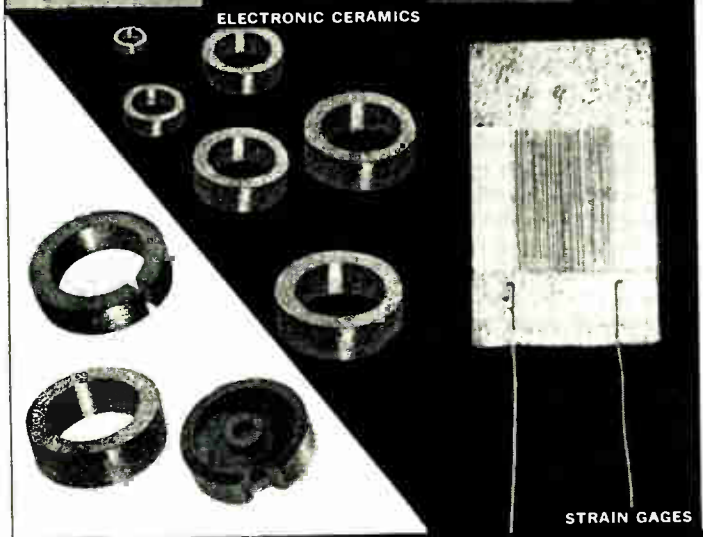












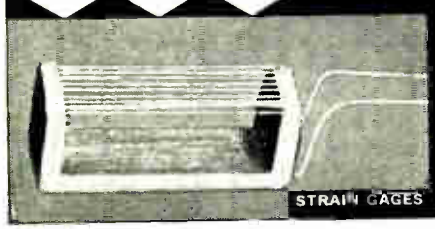
Quality components mass produced

Advanced engineering and manufacturing techniques are your assurance of the highest reliability in these mass-produced Lockheed Electronics components.

Lockheed offers its customers years of experience as both a major buyer and supplier of components as well as the compiete resources of the Lockheed complex. This experience is coupled with the most up-to-date facilities for the manufacture of a variety of quality electronic components. Our design engineering staff is available to assist you with special component problems.

LEC LOCKHEED ELECTRONICS COMPANY

AVIONICS AND INDUSTRIAL PRODUCTS DIVISION



For information on Lockheed Electronics, write:
Marketing Branch – Lockheed Electronics Co.
Avionics & Industrial Products Division,
6201 East Randolph Street,
Los Angeles 22, California
Or phone: OV 5-7070

Circle 82 on Inquiry Card

New Products

CHART DRIVE

New Insco Multi-Speed Chart Drive now available as accessory for use with Leeds & Northrup Speedomax G strip chart recorder. Easily field mounted in place of standard change gears, unit provides dial selection of 8 different chart speeds while the

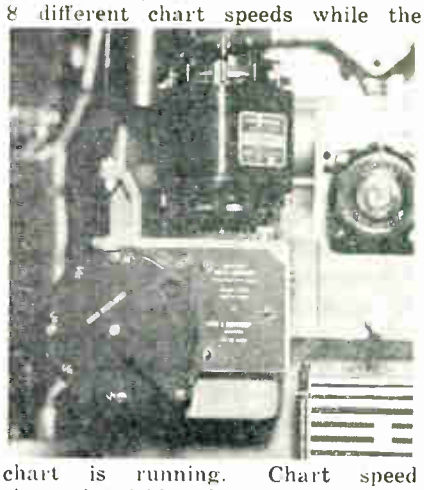
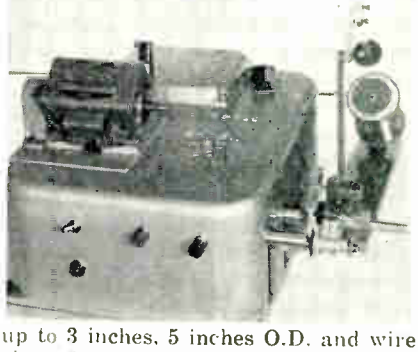


chart is running. Chart speed changed quickly, change gears eliminated. Unit provides greater number of available chart speeds and wider overall ratio than is provided by change gears. Allows quick selection of proper chart speed to match requirements of test speed. Savings may be realized by dialing a slow speed for "monitoring," then switching to faster speed during important tests or when the greater resolution of faster chart speed is required. Insco Co., Div. of Barry Controls Inc., Hollis St., Groton, Mass.

Circle 229 on Inquiry Card

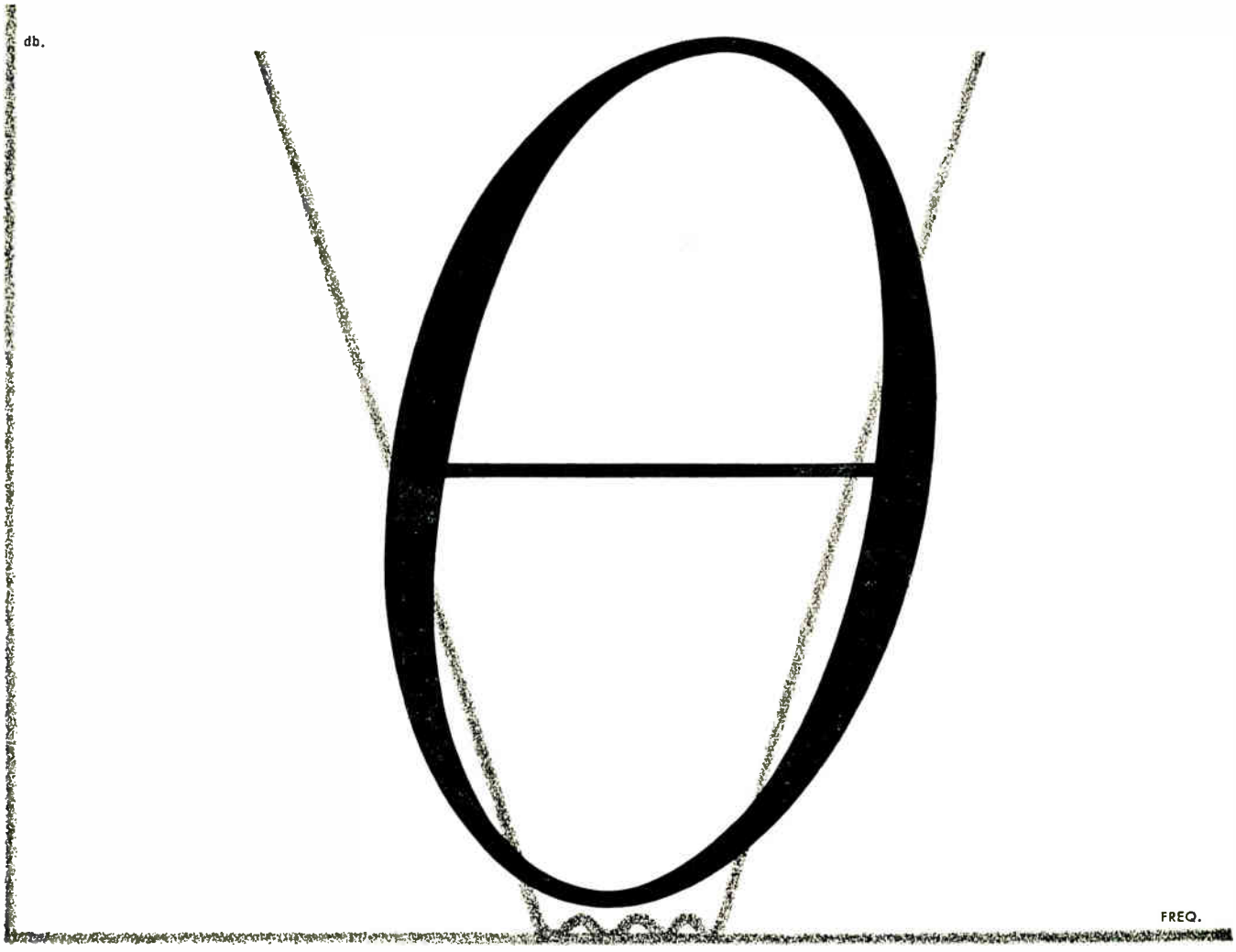
COIL WINDER

A new Model 505 high speed automatic bobbin-resistor coil winder designed for winding relay coils, solenoids, repeater coils, transformer coils and resistors. Coil winder speeds are variable up to 12,000 RPM, and no cams are needed. It winds coil widths

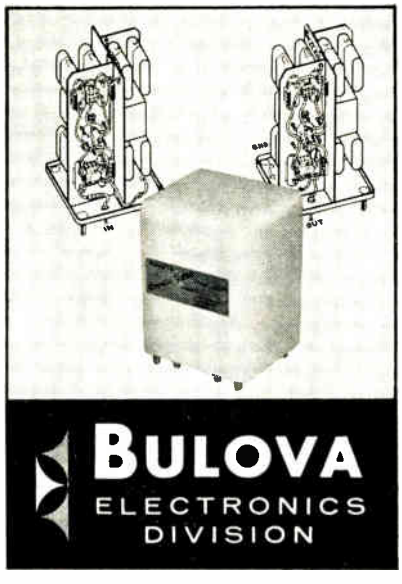


up to 3 inches, 5 inches O.D. and wire sizes from 17 to 50 AWG. It can be made for multiple winding with or without tail stocks. Elden Manufacturing Corp., 2712 N. Elston Ave., Chicago 47, Ill.

Circle 230 on Inquiry Card



BULOVA PRECISION CRYSTAL FILTERS



Whatever the frequency you wish to "isolate", Bulova experience with prototype and production quantities of precision filters assures maximum sensitivity and stability. The following examples show Bulova's mastery of the most difficult problems in high-performance filter engineering.

BAND PASS FILTERS—In a band of 30 filters, insertion loss variation between filters, and over the temperature range 25° C to 75° C, held to .3db between highest and lowest. *Part #69-A-RP-13-2N* (1 thru 30)

SINGLE SIDE BAND FILTERS—Band ripple held to ± ½db, both 1 and 3db points defined, over the temperature range 0° C to 85° C, and 300 to 2000cps vibration at 30G level. *Part #117B-FC-22-4WU*

DISCRIMINATOR—Center frequency held to within 10cps, frequencies equally spaced from center, held to 5.4v peak ± 5%. *Part #186C-TN-22A-WD*

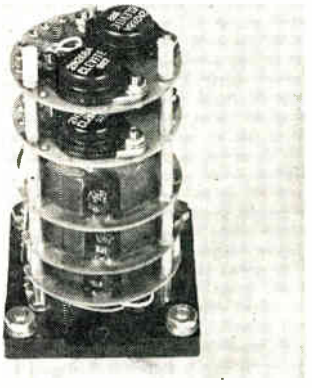
BAND SUPPRESSION FILTERS—2kc wide band attenuated 60db, right next to it a pass band held flat to ± ¼db for 150kc. *Part #158-TF15-6R*

If you're faced with tough filtering problems, need additional information or practical application assistance, contact Bulova for engineering specialists to assist in selection of filters best suited to your needs. Write Department 1820, Bulova Electronics, Woodside 77, N. Y.

New Products

SEMICONDUCTOR RELAY

SCR-60 model is packaged as a direct replacement for the WE-255A. The relay operates as a single-pole, single-throw unit with input coil and output circuit isolation. Output transistors are operated in series or



parallel to key circuit loads of up to 300 vdc. Independent isolation of transistor inputs provides a variety of series or parallel connections. Input current, 10 to 80 ma max., 20 to 60 nom.; Input resistance, 135 ohms; Max. open skt. voltage per dual "contact" unit, 150 v.; max. safe "contact" current, 200 ma; Closed circuit voltage drop per "Contact," less than 1 v.; Input coil safe working voltage to ground, 300 v.; Output contact safe working voltage to ground, 300 v. Rixon Electronics, Inc., 2414 Reedie Dr., Silver Springs, Md.

Circle 231 on Inquiry Card

FLEXIBLE COAXIAL SECTION

This 3⅛ in. flexible coaxial section is capable of three megawatts peak pulse power. Section encompasses vibration in three planes from 5 to 500 cycles per second and meets vibration

of MIL-E-5422. Units have a very low SWR. Coaxial sections use special flanges to reduce r-f leakage. Telerad Mfg. Corp., 1440 Broadway, New York 18, N. Y.

Circle 232 on Inquiry Card

WHERE
SMALLNESS
IS
IMPORTANT

Designed for use where space is a critical factor, this tiny DC 1/10 resistor measures only ¼"* in length, and yet its solid ceramic core foundation makes it thermally stable, while the use of diamond spiralled carbon film assures higher reliability. Sturdy No. 22 leads 1½" long (plus or minus ⅛") with silver plated compression caps provide the resistor with positive termination. Coated with Electra's "R" Coating to resist moisture, impact and high temperatures, it has a resistance range of 10 ohms to 300 K, a wattage rating of 1/10 watt @ 125° C., and a maximum rated voltage of 250 volts. *Actual size: .250"± .010" length; diameter .093".

Availability:

Deposited carbon:
Electra DC 1/10... "R" coated epoxy
Electra DCM 1/10... Molded Jacket

Availability:

Metal Film:
Electra MFS 1/10... "R" coated epoxy
Electra MF 1/10... Molded jacket

ELECTRA

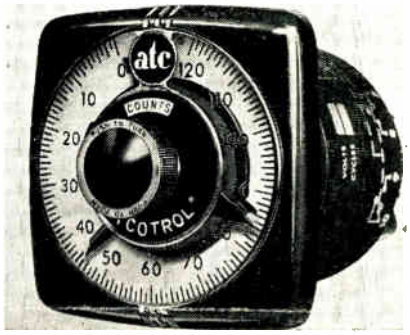
ELECTRA MANUFACTURING COMPANY—ELECTRONICS DIVISION—4051 BROADWAY, KANSAS CITY, MISSOURI

Circle 88 on Inquiry Card

New Products

IMPULSE COUNTER

Miniaturized count control with automatic reset is provided by impulse counter, Type 310, which proves a range of 1-120 impulse counts at a rate of 500/min. Min. pulse duration is 50 msec, and reset time for full scale count range is 1/10 sec., with

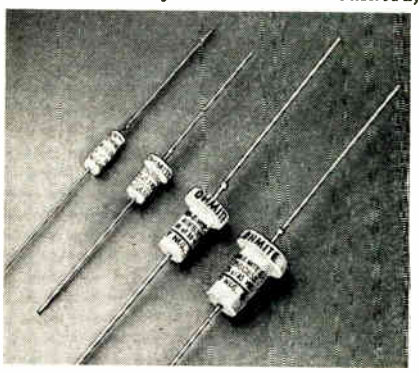


min. pointer rebound. It performs with 100% counting accuracy. Available for 115 v., 50 or 60 CPS, it has 2 sets of single pole, double throw contacts which are rated at 10 a. To assure max. setting accuracy, setting is by a detented knob and dial. Features include: an impulse switch which must close and release in order to advance 1 count, and the impulse motor which includes a hardened steel pawl and operates with a clock escapement principle. Automatic Timing & Controls, Inc., King of Prussia, Pa.

Circle 233 on Inquiry Card

CAPACITORS

Expanded line of TAN-O-MITE® tantalum slug wet electrolytic capacitors include all 3 case sizes (T1, T2, T3) specified by MIL-C-3965B, for styles CL44 uninsulated, CL45 insulated. These are "hat-shaped" capacitors. Also a tubular or straight-cylindrical shape equivalent to case size T1 in Styles CL64 uninsulated,



CL65 insulated. All standard MIL capacitance and voltages values for these case sizes and styles available from stock for a total of 79 different values in slug capacitors. Ohmite Manufacturing Company, 3638 Howard Street, Skokie, Illinois.

Circle 234 on Inquiry Card

TAPCO ELECTRICAL POWER COMPONENTS

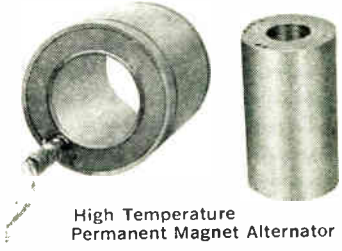
TAPCO Group primary and auxiliary electrical power systems for space, missile, aircraft and ground power applications are tried and proven. Systems performed under environmental conditions including nuclear radiation, high-temperature, liquid metal vapor, zero-G and vacuum.

Below are typical TAPCO components now available for integration into systems for such applications. Other available TAPCO electrical power components include tachometer generators, speed sensors, high temperature electromagnets and solenoids, nuclear reactor rod drive controls, static inverters, voltage regulators and electronic power conversion devices.

ALTERNATORS

Among the special purpose rotating machines designed by TAPCO is a series of high temperature alternators. These range in capacity from a few watts to 15 kw at temperatures up to 1000°F.

PERFORMANCE DATA: TYPICAL ALTERNATOR—**Power Rating:** 3 kw, 0.8 pf lagging. **Ambient Temp.:** 700°F. max. **Operating Speed:** 40,000 rpm. **Output:** 115v, 2000 cps. **Inherent Voltage Regulation:** ±5%. **Harmonic Content:** 5% total. **Efficiency:** 85%. **Weight:** 9 lbs w/o shaft and bearings. **Size:** 3⅝" OD, 5⅛" long. **Special Conditions:** Operates in mercury vapor.

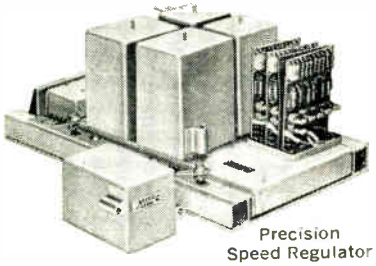


High Temperature
Permanent Magnet Alternator

VOLTAGE REGULATION AND SPEED CONTROLS

Associated with the TAPCO alternator and drive systems are system speed and voltage controls for extremely accurate frequency and voltage regulation. The unit shown is adaptable to many drive systems.

PERFORMANCE DATA: TYPICAL SPEED REGULATOR: **Frequency Stability:** 1 part in 100,000 integrated over minimum 1 hour period. **Input:** 115v, 400 cps. **Output:** 0-10v, 400 cps (phase reversing). **Feedback:** Valve position 0-57.5v, 400 cps. **Environmental Conditions:** −65 to +200°F, 50g shock for 11 millisec., vibration 0.1" double amplitude from 3 to 23 cps, 10g from 23 cps to 10 kc. **Weight:** 10 lbs. **Size:** 12" x 6" x 5".



Precision
Speed Regulator

LIQUID METAL PUMPS

A rotating permanent magnet driven by an external source induces pumping force in the liquid metal within a hermetically sealed system. This concept provides operation without friction-producing rotating seals and provides exceptional reliability and life.

PERFORMANCE DATA: TYPICAL ELECTROMAGNETIC PUMP—**Fluid:** Sodium. **Fluid Temperature:** 1000°F. **Capacity:** 20 lbs min. **Driving Speed:** 40,000 rpm. **Pressure Rise:** 3 psi. **Weight:** 3 lbs. **Size:** 2¾" diam. flange bolt circle, ½" nominal pipe size.

Electromagnetic Sodium Pump

Tapco Group Export Representative:
American Avitron Inc. • Mamaroneck, N. Y.

Advanced engineering projects at TAPCO offer excellent career opportunities for qualified engineers and scientists. Write Personnel Director.

TRW

TAPCO GROUP
Thompson Ramo Wooldridge Inc.

DEPT. EI-1060 • CLEVELAND 17, OHIO

DESIGNERS AND MANUFACTURERS FOR THE AIRCRAFT, MISSILE AND SPACE, ORDNANCE, ELECTRONIC AND NUCLEAR INDUSTRIES

Circle 90 on Inquiry Card

New Products

POWER SUPPLY

New line of tiny, lightweight, plug-in power supplies actuated by sources as small as 1.5 v. penlight cell or a 1.3 v. mercury cell, delivers output voltages as high as 20,000 v. Each unit is about 1 in. in dia. and slightly

shorter than a cigarette. Output currents range as high as 120 μa. Other features include full encapsulation, completely isolated input and output, silicon rectifiers throughout, 7-pin min. plug-in base, and a MIL-approved potentiometer. Three models cover ranges from 1.5 to 6.0 v. at 4 to 65 mils input; outputs from 800 to 20,000 vdc in a wide selection of output-current values. Victory Electronics, Inc., 50 Bond St., Westbury, L. I., N. Y.

Circle 235 on Inquiry Card

RESISTOR STANDARDS

Resistor standards to measure ultra high resistance. Reference resistors to within 1.0% in 6 values between 100 megohms and 10 million megohms. Laboratory standard resistors in 2 tolerances with 5 values between 10

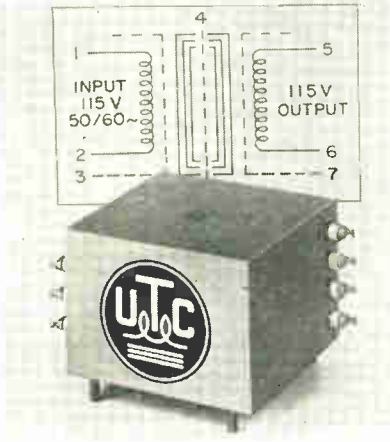
megohms and 100,000 megohms. Precision series are within 10%; the exact series within 1.0% of listed values. Laboratory standard resistors include a temp. curve with each unit. Drift is less than −0.2% during the 1st year. Voltage coefficient is approx. −0.0001% per volt; and temp. coefficient for high megohm units is approx. −0.2%/°F. Mid-Eastern Electronics, Inc., 32 Commerce St., Springfield, N. J.

Circle 236 on Inquiry Card

New Products

ISOLATION TRANSFORMERS

Ultrashielded isolation transformers (hermetically sealed to MIL-T-27A specs.—type TF4RX01YY) simulate battery operation. They are for extremely critical circuits requiring ultimate in isolation for power

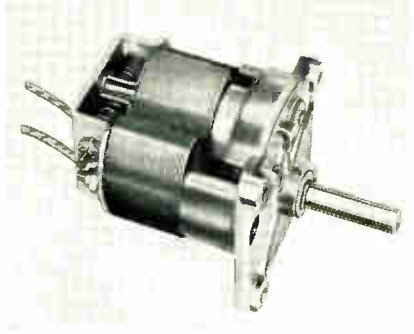


line equipment. The effective capacity coupling between primary and secondary windings is less than 0.1 MMFD. (Even this can be reduced by optimum circuit design). For this purpose shields are individually terminated to allow max. flexibility. United Transformer Corp., 150 Varick St., New York 13, N. Y.

Circle 237 on Inquiry Card

HIGH TORQUE MOTOR

High torque, low speed Rotorac motor with split sec. starting and stopping characteristics, operates from a 60 CPS source and can deliver 6 in-lb of torque at 20 RPM for a 0.75 a, 115 v input. Other features include ability to sustain stall conditions



without damage to the motor or the mechanism and to accommodate reasonable adjustments to the speed-torque characteristic. Airborne Accessories Corp., 1414 Chestnut Ave., Hillside 5, N. J.

Circle 238 on Inquiry Card

New Products

NEUTRON DETECTOR

A new high-temperature ionization chamber for detection of thermal neutrons in the range 2.5 x 10^4 to 2.5 x 10^{10} neutrons/cm^2/sec. Neutron sensitivity of the boron-lined tube—Type WL7606—is 4.4 x 10^{-14} a/Roentgen/-

hr. Gamma sensitivity is 5 x 10^{-11} a/Roentgen/hr. Most notable of the tube's properties is the ability to operate continuously at temperatures up to 500°F. The WL 7606 also employs guard ring construction to minimize signal leakage through insulators and is equipped with type HN connectors. Westinghouse Electric Corp., P.O. Box 284, Elmira, N. Y.

Circle 239 on Inquiry Card

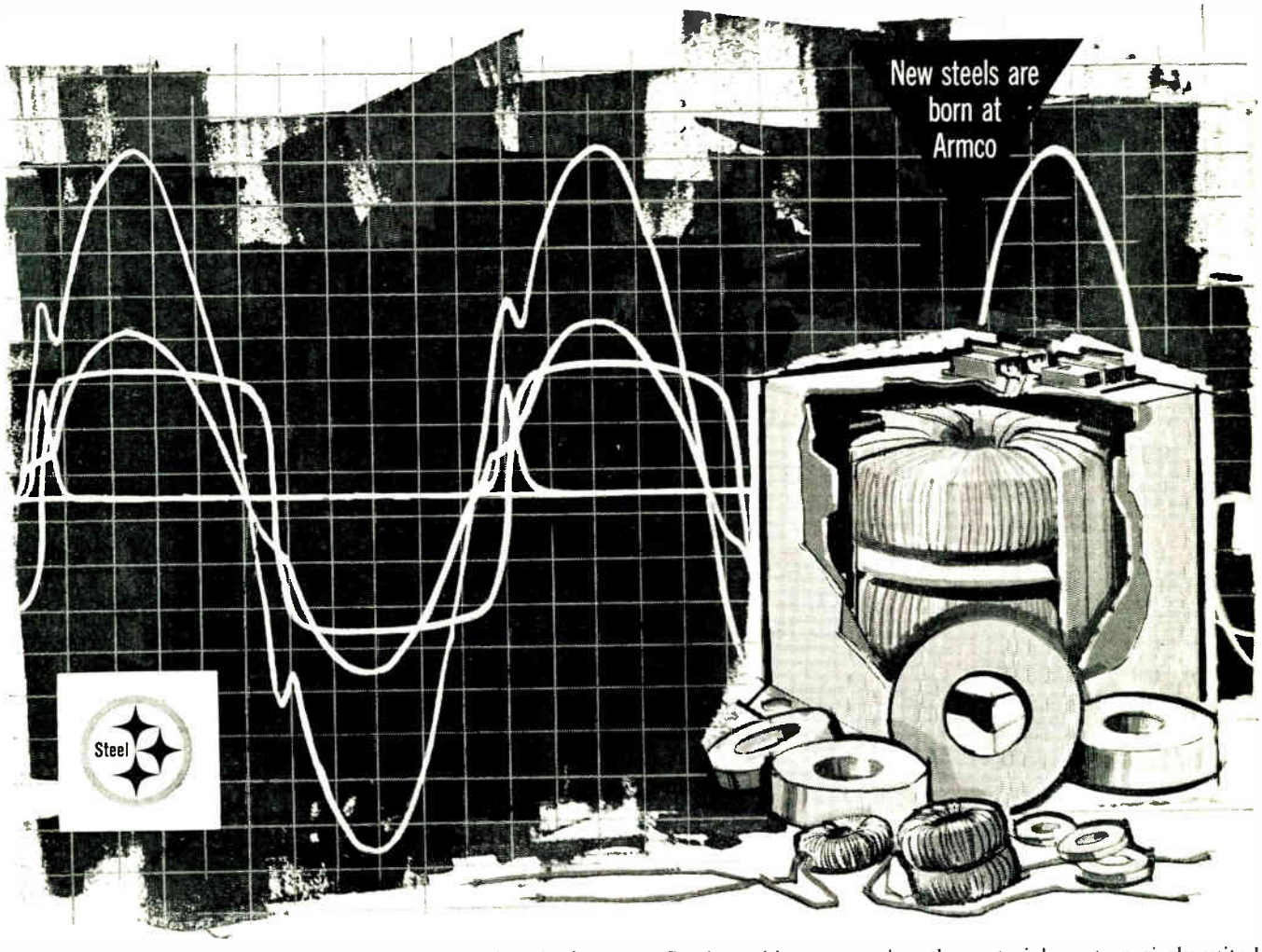
QUARTZ TRIMMER

Miniature high voltage, high temp. quartz Sealcap trimmer offers reliability under high temp. operation, and other severe environmental conditions. Model VCJ337 features: Capacitance range, 2.0 to 10 pf.; 3000 vdc working voltage; 5000 v. dielectric strength; 2 x 10^6 megohms insulation resistance; operating temp. range, −55° to +200°C; temp. coefficient of ±50 ppm/°C; Q of 1500

at 1 MC; Sealcap sealed interior construction locks out atmospheric effects as well as increases insolation resistance and dielectric strength. JFD Electronics Corp., 6101 16th Ave., Bklyn. 4, N. Y.

Circle 240 on Inquiry Card

CORES CAN BE SMALLER AND LIGHTER, ASSURE LOWER LOSSES, REQUIRE LESS COPPER IF MADE OF ARMCO THIN ELECTRICAL STEELS



Exceptional magnetic properties and extensive design data offer opportunities to improve performance and cut cost of magnetic and electronic units for 400 to 2000 cps and higher frequency service.

Armco Thin Electrical Steels offer you these advantages because they have a unique combination of magnetic and physical properties assured by precise processing and control:

- **Exceptionally high permeability**
- **Low hysteresis loss**
- **High lamination factor**
- **Minimum interlaminar loss**
- **Properties fully developed at the mill**

Available in three different grades, Armco Thin Electrical Steels enable you to select the material most precisely suited to your requirements.

Armco TRAN-COR T — A non-oriented grade, available in 7 and 5 mil thicknesses.

Armco ORIENTED T — Best permeability, in rolling direction, 4, 2, and 1 mil thicknesses.

Armco ORIENTED TS — Super-oriented with exceptionally high permeability, 4 mil thickness.

Use the properties of Armco Thin Electrical Steels to improve performance and reduce both the size and cost of your products. Extensive design data is available to help you utilize their advantages most effectively. Just write Armco Steel Corporation, 1410 Curtis Street, Middletown, Ohio, for complete information.

ARMCO STEEL

Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation

Circle 94 on Inquiry Card

New Products

COMBINATION MATERIALS

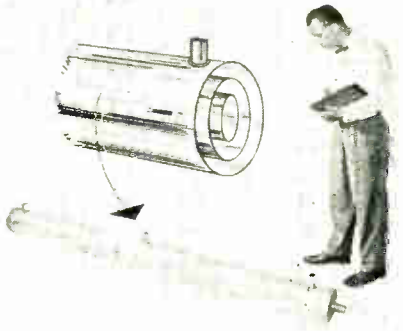
Combination materials for applications requiring the versatility of Phenolite laminated plastic or vulcanized fibre, bonded to other materials. Different combinations can be furnished to meet special requirements. For example: Rubber-Phenolite combinations — resilience, shock

absorption, or the metal sealing characteristics of rubber; Phenolite-Fibre combination—a Phenolite[R] core faced with electrical grade vulcanized fibre provides arc resistance of vulcanized fibre and dimensional stability and mechanical strength of phenolic laminated plastic; Metal-Phenolite combinations—for printed circuits and as a ground of electrostatic shielding and Vulcanized Fibre-Mylar[R] which provides a dielectric strength superior to that of straight vulcanized fibre. Vulcanized Fibre Co., 1060 Beech St., Wilmington 99, Del.

Circle 256 on Inquiry Card

MAGNETIC SHIELD

New 18 piece Netic Co-Netic magnetic shield acts as a divisionary shield against magnetic effects reacting on an electron or proton beam being conveyed axially through the center of the shield. Alloys are stable in vacua. Entire assembly can be incorporated in a system that has to be evacuated. Removable tubulations extend beyond the perimeter and end cap to increase shielding effect in the area of access holes. Unit consists of



3 separate cylindrical enclosures spaced ¼ in. apart. Outer shield is Netic S3 0.049 in. cadmium iridite finish, 2 inner shields are Co-Netic AA. Magnetic Shield Div., Perfection Mica Co., 1322 N. Elston Ave., Chicago 22, Ill.

Circle 257 on Inquiry Card

PERFECT

PROTECTION

AEROVOX "POLYCAP" CAPACITORS

Now . . . get all the advantages of metal-case construction in a lightweight, attractive plastic "Polycap" case that offers exceptional humidity resistant characteristics and prolonged capacitor life.

Exclusive "Polycap" cases provide capacitors completely free of overall wax coatings and consequently no annoying and unsightly lumps, bumps and humps. Uniform in size and appearance means faster and more efficient handling in automatic insertion equipment.

Most important . . . "Polycap" case construction is available to you on many Aerovox capacitor types at prices no higher than inferior conventional type units. "Polycap" capacitors have established new standards of reliability, performance and appearance throughout the industry. Why not investigate these advantages today. Write for complete technical details.

AVAILABLE IN THE FOLLOWING TYPES

PAPER TUBULARS . . . P161N units with electrical and performance characteristics superior to conventional molded tubulars. Available in a complete range of voltage and capacitance ratings and in radial lead construction by specifying P159N.

MYLAR* TUBULARS . . . V161 units for wide apolication in premium priced commercial and military equipments. Operating temperature range from −30°C to +100°C. Complete range of values.

* DuPont Trademark

METALLIZED-PAPER TUBULARS . . . P8292ZN units in miniature sizes capable of operating over a temperature range of −30°C to +100°C. Available in voltages of 200, 400 and 600 VDCW in capacitances from .01 to 2.0 mfd.

ELECTROLYTIC TUBULARS . . . PTT miniature 'lytics capable of handling full size loads in industrial equipment. Ideal for all transistorized circuits. Temperature range −30°C to +65°C. Voltage ratings of 3, 6, 10, 12, 15, 25 and 50 VDCW. For both leads out one end specify PTTD.

AEROVOX CORPORATION

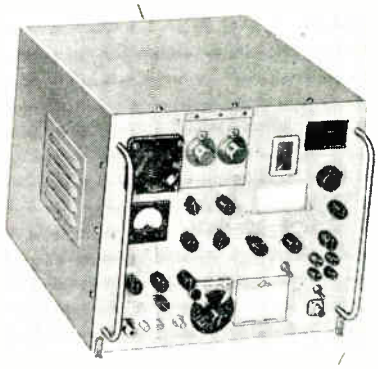
NEW BEDFORD, MASSACHUSETTS

Circle 96 on Inquiry Card

New Products

RADAR TEST SETS

Multipurpose Test Sets for radar systems, operate between 2,700 and 10,500 MC. Each set is a combination of power meter, frequency meter, spectrum analyzer, signal generator and synchroscope. They feature display and power spectrum of modu-



lated and unmodulated r-f signals (amplitude, frequency or pulse modulation); field laboratory measurement of absolute r-f power levels (+5 dbm to +30 dbm); direct reading precision frequency meter; internal and external pulse; FM and CW outputs; synchroscope sweep lengths—5, 20, 50, 250 and 4,000 μsec; single or multipurpose group identification and decoding. Both units meet MIL-T-945A. Polarad Electronics Corp., 43-20 34th St., Long Island City 1, N. Y.

Circle 241 on Inquiry Card

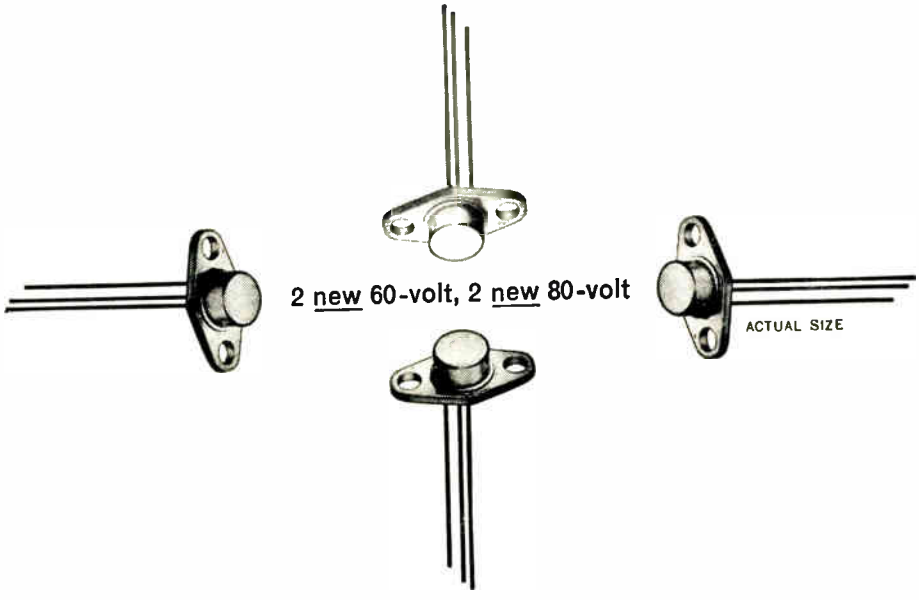
ADJUSTABLE HUB CLAMPS

Expanded line of Ultra-Precision Dynamically Balanced Hub Clamps to meet the more exacting requirements of today's design applications. Designed to insure maximum performance of high speed precision motors, synchros, resolvers and instrument shafts, the clamps are available

from stock in ⅛ in., 3/16 in. and ¼ in. shaft sizes. Conforming to MIL specifications, the clamps are made from heat treated, #416 stainless steel. PIC Design Corp., 477 Atlantic Ave., East Rockaway, Long Island, N. Y.

Circle 242 on Inquiry Card

4 new miniature DELCO POWER TRANSISTORS



NOW, FROM DELCO RADIO, A COMPLETE LINE OF SMALL, HIGH-POWER TRANSISTORS!

	2N1172	2N1611	2N1612	2N1609	2N1610
V_{CS}	40	60	60	80	80
V_{EBO}	20	20	20	40	40
V_{CEO}	30	40	40	60	60
I_C	1.5 A	1.5 A	1.5 A	1.5 A	1.5 A
I_{CO}	200 μ a	100 μ a	100 μ a	100 μ a	100 μ a
H_{FE}	30/90	30/75	50/125	30/75	50/125
V_{Sat}	1.0 V	1.0 V	0.6 V	1.0 V	0.6 V

These four new Delco transistors, plus the 2N1172 40-volt model, offer highly reliable operation in a new range of applications where space and weight are restricting factors.

Designed primarily for driver applications, Delco's versatile new transistors are also excellent for amplifiers, voltage regulators, servo amplifiers, miniature power supplies, ultra-low frequency communications, citizens' radio equipment and other uses where substantial power output in a small package (TO 37) is required.

Special Features of Delco's Four New Transistors: Two gain ranges. Can be used on systems up to 24 volts. Can be mounted with the leads up or down with the same low thermal resistance of 10° C/W. Dissipation up to 2 watts at a mounting base temperature of 75° C.

Available in volume production. Write for full engineering data.

DELCO RADIO
DEPENDABILITY
RELIABILITY

Newark, New Jersey
1180 Raymond Blvd.
MItchell 2-6165

Santa Monica, California
726 Santa Monica Blvd.
EXbrook 3-1465

Chicago, Illinois
5750 West 51st Street
POrtsmouth 7-3500

Detroit, Michigan
57 Harper Avenue
TRinity 3-6560

Division of General Motors · Kokomo, Indiana

Circle 98 on Inquiry Card

New Products

REFLEX KLYSTRONS

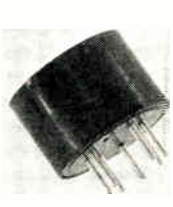
Four new reflex klystrons added to family of ceramic Velocitron tubes. For local oscillator operation in receivers with AFC because of its frequency control characteristics, Type ZV 1011 can operate from 4.0 to 11.0

KMC at amb. temp. of 250°C. Master oscillator and driver tubes, Types ZV 1010X, ZV 1021X, and ZV 1009X operate from 950 to 2,800 MC, 1,000 to 4,000 MC, and 1,700 to 5,000 MC. Requiring no cooling, these 4 tube types feature max. shock and vibration resistance, exhibit virtually no microphonic characteristics, and can be operated CW, pulsed, or FM. Polarad Electronics Corp., 43-20 34th St., Long Island City 1, N. Y.

Circle 243 on Inquiry Card

ELECTRONIC CHOPPERS

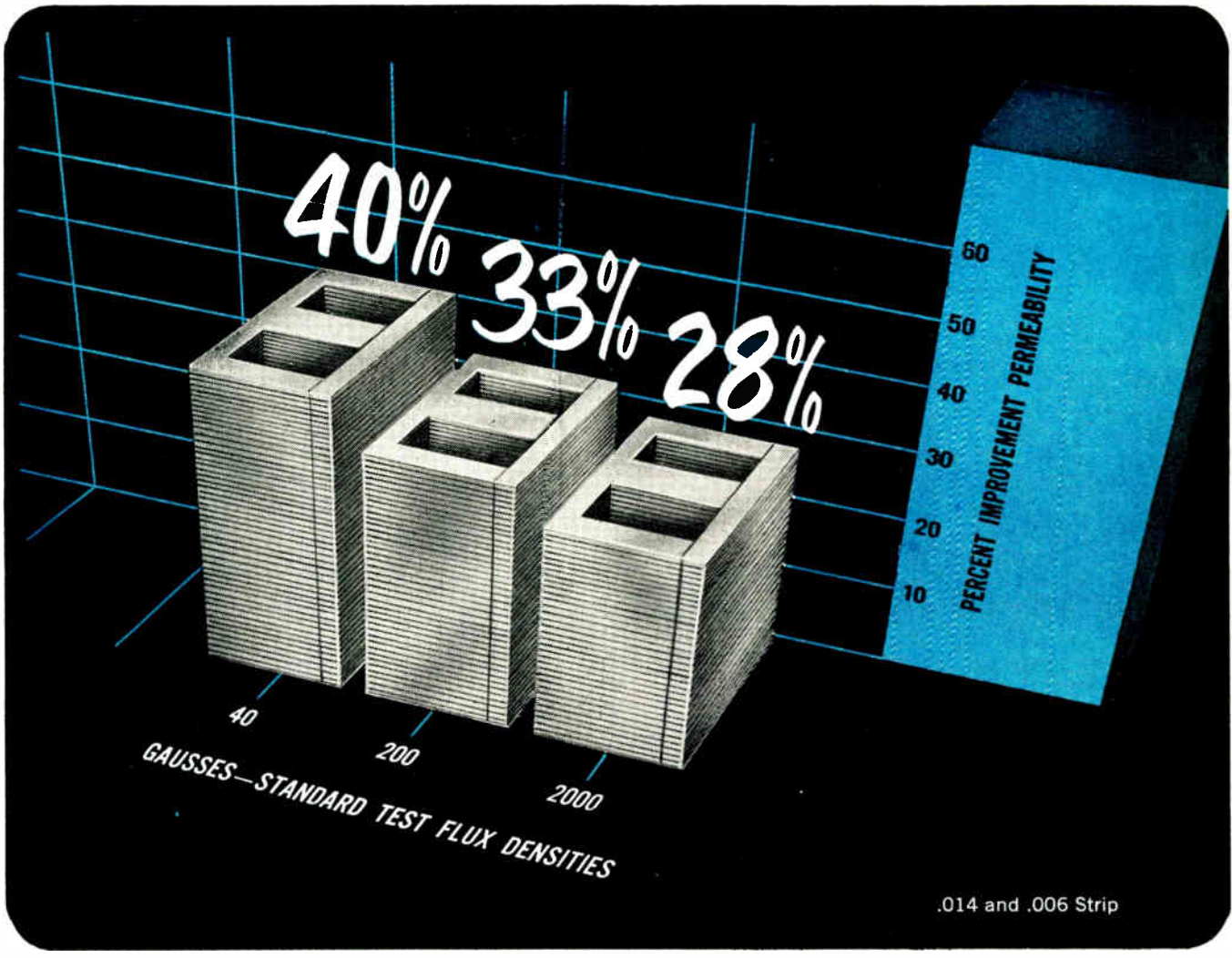
Models 50P, 60P, and 70P choppers are plug-in versions of the Models 50, 60, and 70 solder-in types. These solid-state choppers alternately connect and disconnect a load from a signal source. They may also be used as a demodulator to convert an ac signal to dc. They are capable of linearly switching or chopping volt-



ages over a wide dynamic range which extends down to a fraction of a mv and up to 10 v. Solid State Electronics Co., 15321 Rayen St., Sepulveda, Calif.

Circle 244 on Inquiry Card

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



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

Means new, consistent and predictable magnetic core performance

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

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

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

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

Address Dept. EI-10

WSW 7490

ALLEGHENY LUDLUM

STEELMAKERS TO THE ELECTRICAL INDUSTRY

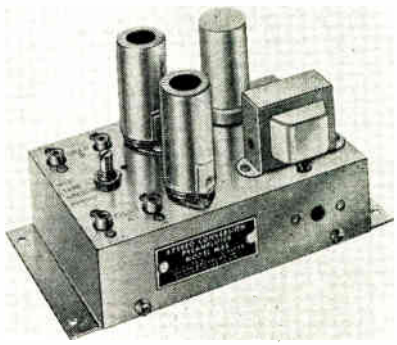
Export distribution, Electrical Materials: AIRCO INTERNATIONAL INC., NYC 17
Export distribution, Laminations: AD. AURIEMA, NYC 4

Circle 101 on Inquiry Card

New Products

STEREO PREAMPLIFIER

Preamplifier, M65, provides the extra voltage "boost" and equalization needed to operate a magnetic cartridge with an amplifier originally designed for a ceramic cartridge. It can also be used as a preamplifier for

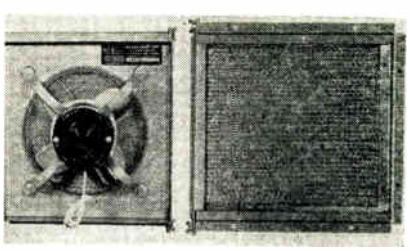


magnetic cartridges and tape playback heads with standard audio amplifiers, and can be used as a microphone preamplifier. A rotary switch on the preamplifier enables selection of any one of these functions: (1) Phono, (2) Special, for converting from ceramic cartridges to magnetic cartridges, (3) Tape, and (4) Microphone. It has its own power supply, and operates from a 117 v. 60 cycle power outlet. Dual input and output jacks accept standard phono plugs. Shure Brothers, Inc., 22 Hartrey Ave., Evanston, Ill.

Circle 245 on Inquiry Card

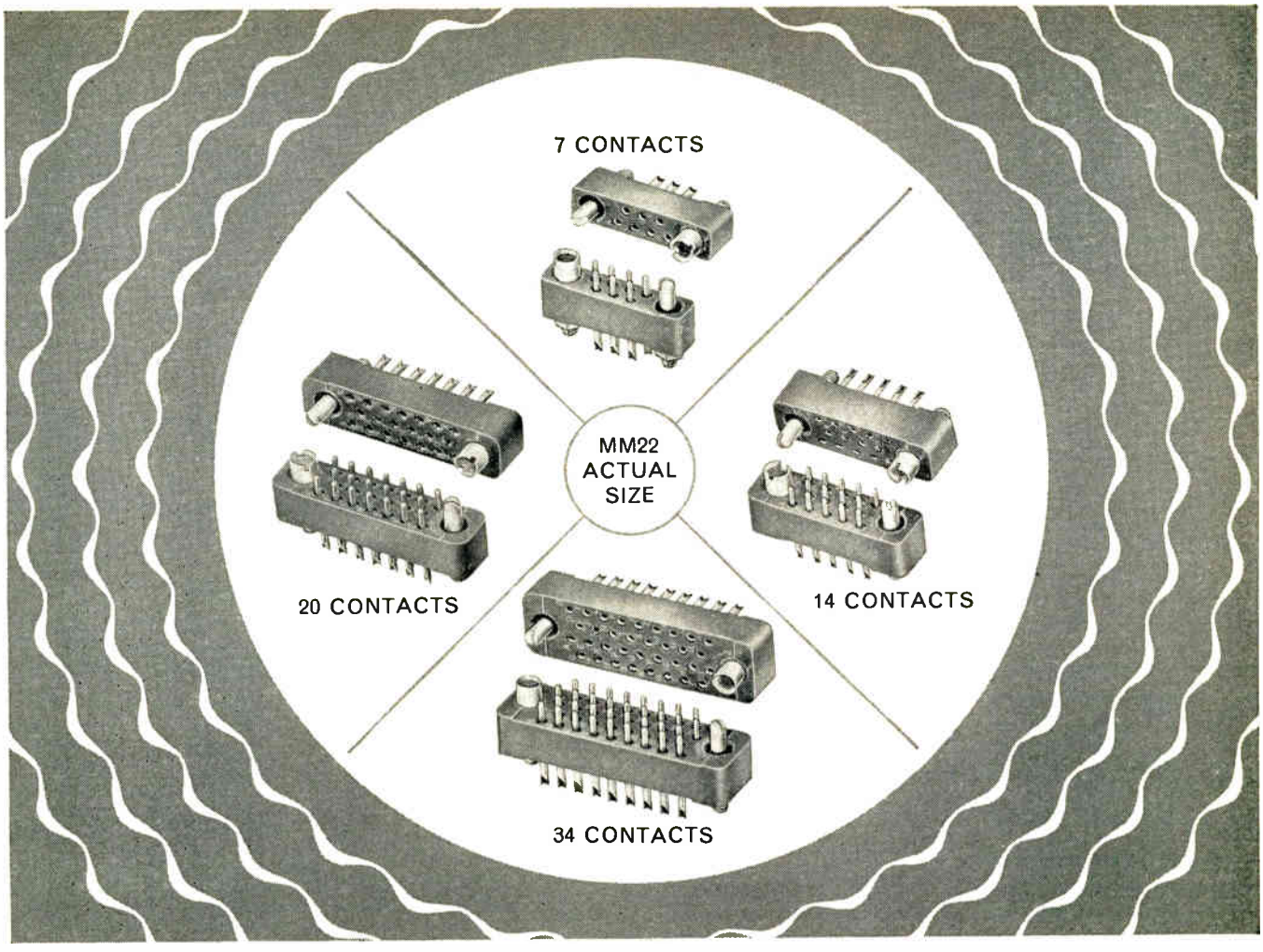
PANEL-MOUNTED FAN

Panel-mounted fan for installation on outside of electronic racks is designed to pressurize the cabinet with air filtered through a permanent, washable-type filter. Model 1PB65W is easily installed from outside the rack and uses a min. of cabinet area. Filter also accessible from outside and may be serviced without remov-



ing fan mounting bolts. It moves 295 CFM and has a ball bearing motor which meets Specs CC-M-636A. Lubricant is a MIL-G-3278 having a temp. range of −62°C to +93°C. McLean Engineering Laboratories, P.O. Box 228, Princeton, N. J.

Circle 246 on Inquiry Card



THESE 'LITTLE GIANTS' WITHSTAND SHOCK AND VIBRATION

Micro-Miniature Ruggedized Continental Connectors

- Smallest size without sacrificing performance
- Available with 5, 7, 9, 11, 20, 26, 29, 34 and 44 contacts
- Reversed guide pin and socket for positive polarization
- Supplied in various molding compounds
- Available with hoods, screwlocks and shells

Continental Connector's Series MM22 precision micro-miniature connectors simplify interconnection of compact sub-assemblies where space limitations demand the smallest components and highest reliability.

ELECTRICAL AND MECHANICAL RATINGS

Voltage Ratings:	Breakdown	Recommended Test
At Sea Level	2400V. RMS	1600V. RMS
At 70,000 Ft.	650V. RMS	425V. RMS

Current Rating	3 Amps
Minimum Creepage Between Contacts	1/16″
Minimum Air Space Between Contacts	.040″
Contacts, Center-to-Center	3/32″
Pin Diameter	.030″
Solder Cup	#22 AWG Wire

Technical data sheets on micro-miniature and other Continental Connectors are available on request. Specify your requirements to Electronic Division, DeJUR-AMSCO Corporation, 45-01 Northern Boulevard, Long Island City 1, N. Y. (Exclusive Sales Agent.)

CONTINENTAL CONNECTORS

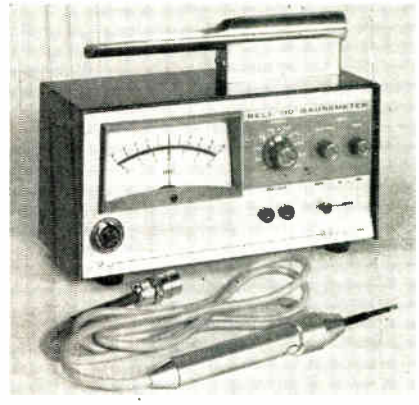
MANUFACTURED BY
CONTINENTAL CONNECTOR CORPORATION
AMERICA'S FASTEST GROWING LINE
OF PRECISION CONNECTORS

Circle 104 on Inquiry Card

New Products

GAUSSMETER

Direct-reading, transistorized gaussmeter, Model 110, measures direction and magnitude of magnetic flux density. The Zero Center Meter indicates direction being read and does away with the reversing switch. The thin wafer of indium arsenide,

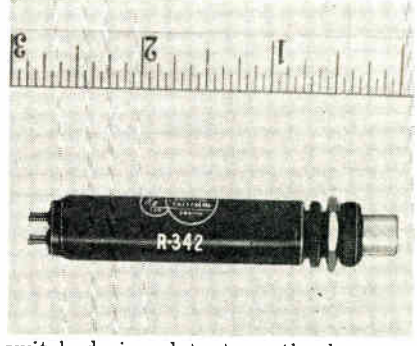


operating on the Hall Effect, makes up the sensing element of the instrument. Material has a temp. coefficient of 0.1%/°C. The 10 full scale ranges are: 1, 3, 10, 30, 100, 300, 1000, 3000, 10,000 and 30,000 gauss. It operates on internal mercury batteries. Dimensions are: 10⅞ x 4⅝ x 8 in. In addition, it has an input connector for different types of field probes and output jacks for recorder, oscilloscope or other type readout. F. W. Bell, Inc., 1356 Norton Ave., Columbus 12, Ohio.

Circle 247 on Inquiry Card

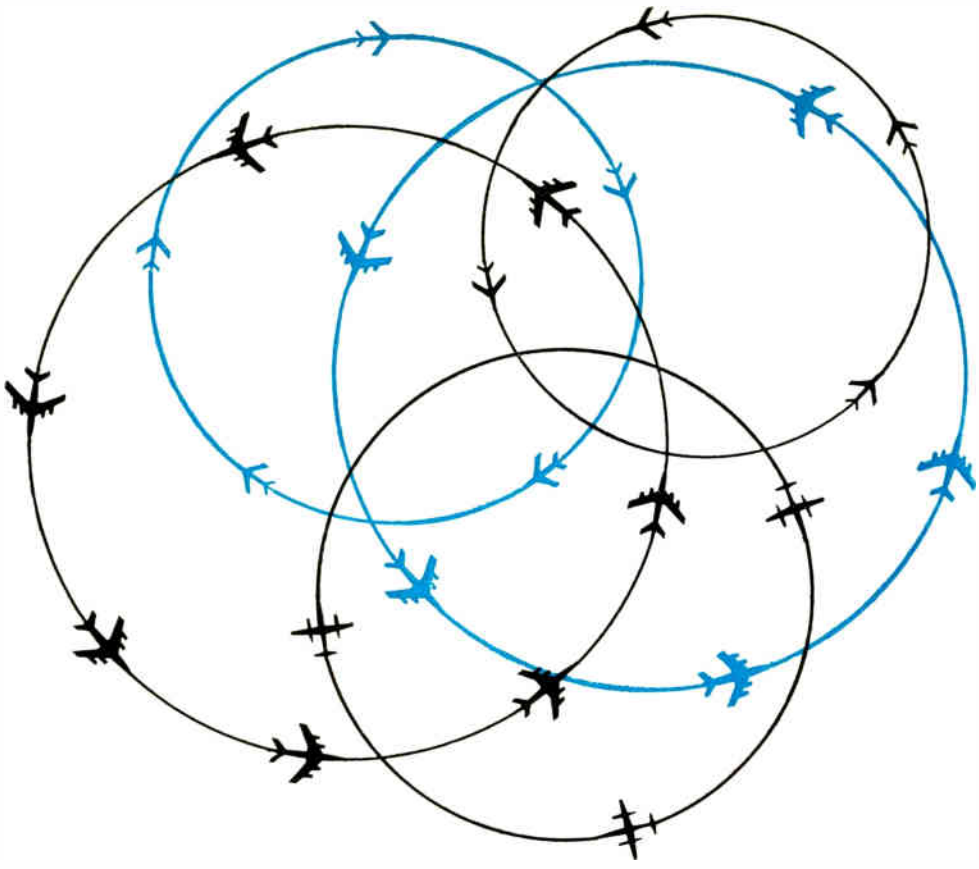
INDICATOR LAMP

Transistorized filament lamp indicator, the Minisig R-342, operates directly from EECO T-Series digital plug-in circuit modules. Unit includes a self-contained transistorized



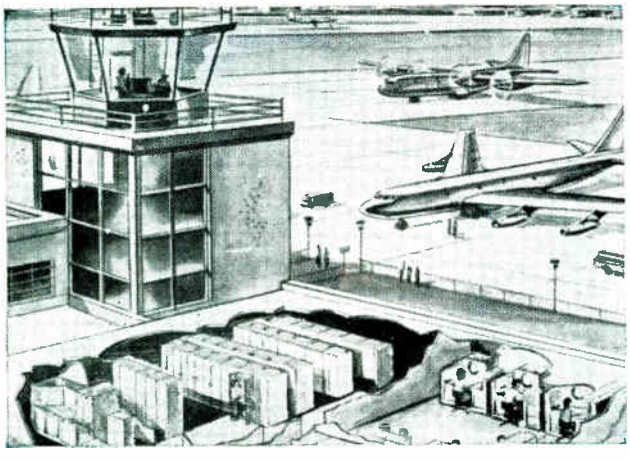
switch designed to turn the lamp on at –3 v (logical input "1"), and to turn the lamp off at –11 v (logical input "0"). Idling current is 2 ma at –12 v and 2 ma at +12 v. Lamp glows brightly when Logic "1" is applied. Power drain is 0.65 ma at –2 v and 42 ma at +12 v. Engineered Electronic Co., 1441 E. Chestnut Ave., Santa Ana. Calif.

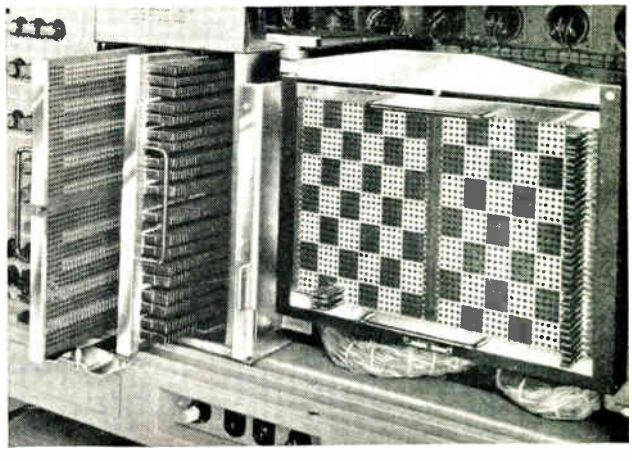
Circle 248 on Inquiry Card



Volscan juggles 24 aircraft with AMP Programming

Reliable is the word for Volscan. Designed and built by Avco's Crosley Division to handle a tough job, it juggles up to 24 aircraft at the same time—6 inbound and 18 outbound. It's big, complex and completely trustworthy. It was this need for reliability that led Crosley engineers to call out the AMP Universal Patchcord Programming System. Used in the Syscom Schedule Correlation Unit AMP Programming shunts such vital data as range, azimuth, slope, level out and no passing zones into the computer. There's a host of unusual features in our Programming Systems that were needed on the Volscan—features that can help you, too, make better, safer equipment: universal, or shielded construction, positive wiping action between pins and springs, almost unlimited versatility and uniform electrical characteristics to meet the most exacting requirements. **Our Patchcord Programming Catalog tells the whole story. Send today.**





AMP INCORPORATED

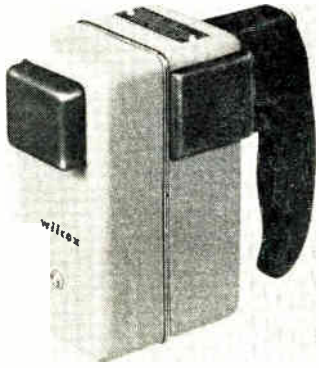
GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

AMP products and engineering assistance are available through subsidiary companies in: Australia • Canada • England • France • Germany • Holland • Italy • Japan

New Products

FUNCTION TESTER

Go-no-go transponder function tester for ground checkout of installed transponders, such as the AN/APX-44. Model 860A is hand-held near the transponder antenna of an aircraft. The signal produced, when the unit

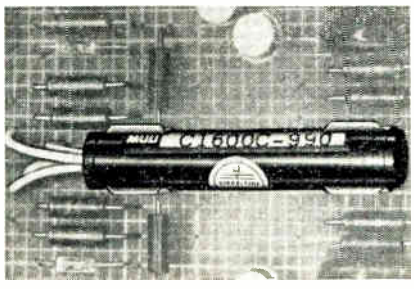


is triggered from within a foot or two of the antenna, activates the aircraft transponder and the activation of a lamp on the portable function tester indicates whether the transponder has transmitted a responding signal. Tester operation provides a check for receiver sensitivity and transmitter output in addition to a partial check of decoder-encoder performance. Tester weighs less than 4 lbs., operates from 4 self-contained standard 1½ v. "D" batteries. Wilcox Electric Co., Inc., 14th & Chestnut, Kansas City 27, Mo.

Circle 316 on Inquiry Card

TUNING FORK MODULE

Design 056 Tuning Fork Resonator is for applications requiring moderate accuracy and where space is severely limited. Size is ⅜ in. dia. x 2⅜ in. long. Weight is 0.8 oz. Frequency range is 350 CPS to 1800 CPS directly, or any audio frequency by use of dividers or multipliers. Accuracy capability is ±0.01% over a moderate temp. range. Temperature range

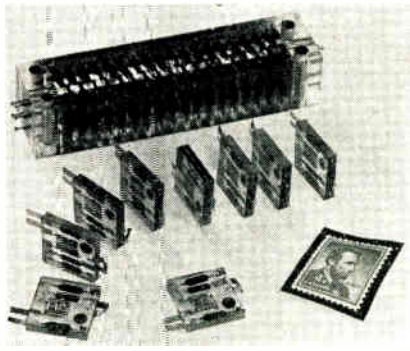


(Oper) is −55° to +100°C. (Storage) −62° to +125°C. Header is hermetic sealed with wire pigtails. It can be used alone or with oscillators, dividers, or multipliers. Gyrex Corp., 3003 Pennsylvania Ave., Santa Monica, Calif.

Circle 317 on Inquiry Card

MAGNETIC SHIFT REGISTER

New wafer-like, postage stamp-size magnetic shift register elements operate at an information rate of 100 KC/sec at a peak shift pulse power of only 0.1 w. Similar serial driven, gated transfer shift register circuits

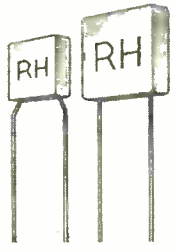


are being designed for use at information rates up to 500 KC. Each element stores a single binary bit of information, and can be assembled in shift register modules up to 10 elements/in. All of the components within each element are arranged in a single plane instead of the conventional 3-dimensional assembly, permitting the shifting function to be accomplished with a single turn on each magnetic core. General Electric Co., Heavy Military Electronics Dept., Bldg. #3, Court St. Plant, Syracuse, N. Y.

Circle 318 on Inquiry Card

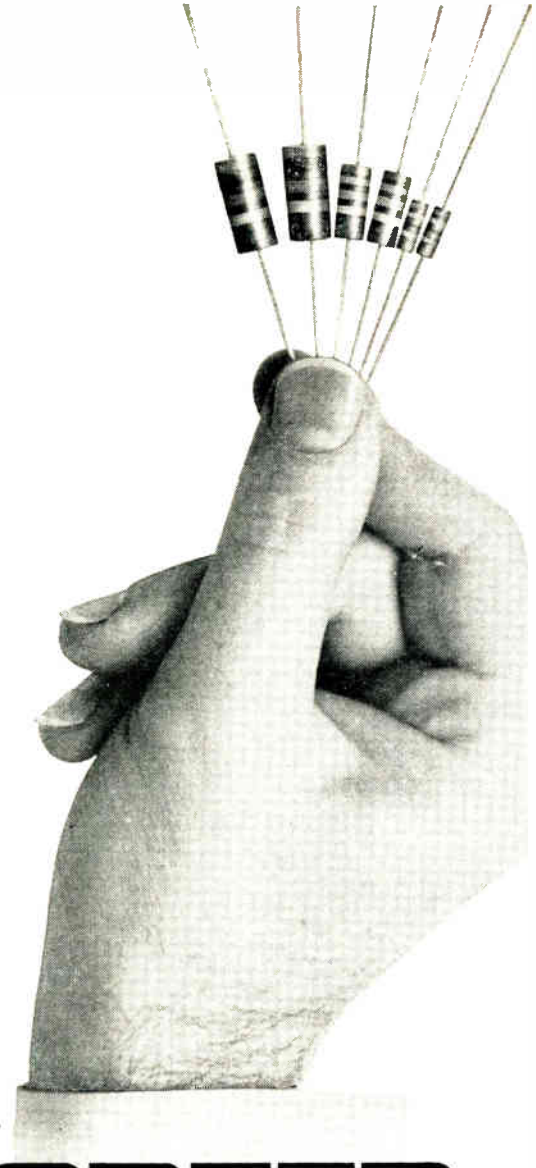
CERAMIC CAPACITORS

Micro-miniature West-Cap "Red Head" ceramic capacitors, Type RHO5 0.200 x 0.200 x 0.100 and Type RHO6 0.300 x 0.300 x 0.100, are completely operational during 95% humidity tests and within specs after 10 temp. shocks between 0 and +150°C. After 1,000 hrs. at 150°C with 200% rated voltage applied, the dissipation factor is less than 2.5% and the insulation resistance is greater than 10



ohms when measured at 25C. For high impact applications, they withstand a 5,000g. shock of short duration. They operate efficiently at altitudes exceeding 25 miles. San Fernando Electric Mfg. Co., 1509 First St., San Fernando, Calif.

Circle 319 on Inquiry Card



for the service
you need...
for the sizes you want...

SPEER RESISTORS

You're sure to find the sizes and types you want in Speer's complete line of 1/2-, 1- and 2-watt fixed composition resistors, which meet or exceed the requirements of specifications MIL RII and RS 172. The fast, efficient service for which Speer has gained a wide reputation can also help you eliminate costly production delays. So next time, specify Speer! *Speer now offers these new sizes:*

Speer Type	MIL Style	Rating in watts	Body		Lead	
			Nominal Diameter	Nominal Length	Wire Size	Nominal Length
SR ½	RC 20	½	.138	.390	A.W.G. # 20	1½
SR 1	RC 32	1	.225	.562	# 18	1½
SR 2	RC 42	2	.312	.688	# 17	1½

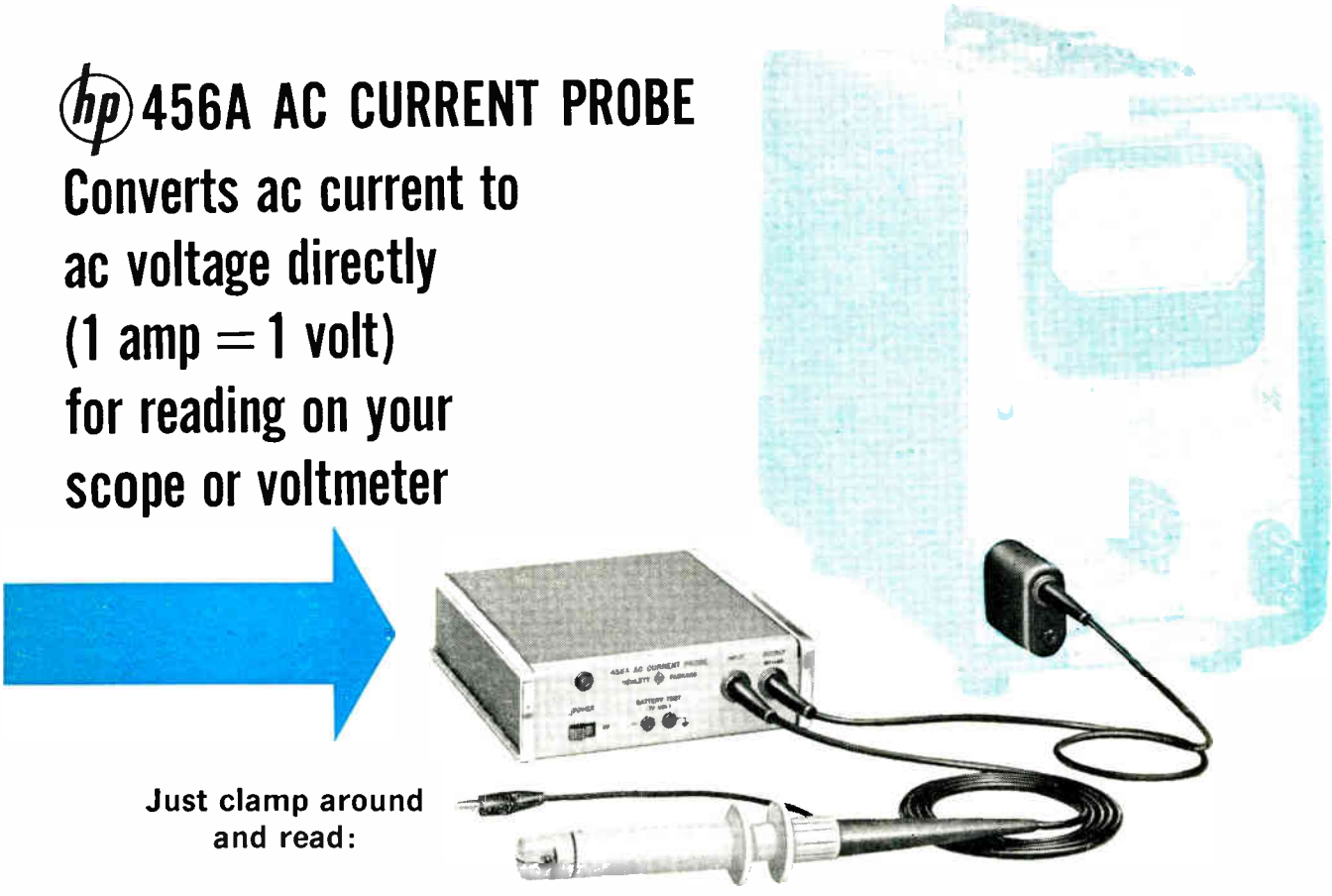
Other Electronics Divisions of Speer Carbon Company
Jeffers Electronics, Du Bois, Pa.
Onondaga Electronics, Syracuse, N. Y.

Speer Resistor Division
Speer Carbon Company, Bradford, Pennsylvania

Circle 109 on Inquiry Card

hp 456A AC CURRENT PROBE

Converts ac current to ac voltage directly (1 amp = 1 volt) for reading on your scope or voltmeter



Just clamp around and read:

Tube circuits . . . . . view current on your scope or measure it with a VTVM

Transistor circuits . . . . . measure small signals dynamically, without clipping leads or circuit loading; study diodes at breakdown

Logic circuits . . . . . measure ac current in presence of dc current

Impedance measuring . . with a dual-channel scope, measure current, voltage magnitude; phase angle

Power measuring . . . . . with dual-channel scope read current, voltage directly, calculate power

Frequency counting . . . . use 456A with counter for clip-on frequency access

And, how about these? . . phase comparisons of ac carrier waveforms; instrument fuse current ratings; cable identification, response of magnetic cores; magnetic field sensing; silicon rectifier peak currents

SPECIFICATIONS

Sensitivity: 1 mv/ma ±1% at 1 KC
Frequency Response: ±2%, 100 cps to 3 MC
±5%, 60 cps to 4 MC
— 3 db at 25 cps and above 20 MC
Maximum Input: 1 amp rms; 1.5 amp peak. 100 ma rms above 5 MC
Maximum dc current: Dc up to 0.5 amp has no appreciable effect
Input Impedance: Probe adds to test circuit only approx. 0.05 ohms in series with 0.05 μh
Equivalent Input Noise: Less than 50 μa rms (100 μa ac powered)
Power: 10 radio mercury cells; approx. 400 hours service normally supplied. Ac supply available
Size: 5" wide, 1½" high, 6" deep, weight 3 lbs.
Price: $190.00; for ac operation $210.00.
hp 456-95A ac supply for field installation $32.00
Data subject to change without notice
Prices F.O.B. Factory

Just clamp the hp 456A probe around a wire under test and view or read ac current directly on an indicating device. Model 456A's 1 mv to 1 ma unity conversion permits direct readings up to 1 ampere rms. The instrument's wide bandwidth permits use with oscilloscopes to view complex current waveforms with rise times to 0.017 μsec. No direct circuit connection is required; there is no loading, no appreciable impedance change in the circuit under test, and the impedance of the test circuit is immaterial.

HEWLETT-PACKARD COMPANY
1028B Page Mill Road, Palo Alto, California, U. S. A.
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CIRCLE THE NUMBERS OPPOSITE THE NAMES OF THE

108 Acme Electric Corporation — Voltage stabilizers
89 Acoustica Associates, Inc. — Ultrasonic cleaning equipment
96 Aerovox Corporation—Plastic-cased capacitors
111 Aetna Life Insurance Company—Industrial life insurance
79 Airborne Accessories Corporation—Miniaturized high-temperature capacitor
171 Alectric Mfg. Co.—Industrial tube tester
101 Allegheny Ludlum Steel Corporation—Electrical steels
19 Allen-Bradley Co.—Discoidal capacitors
20 Allen-Bradley Co.—Potentiometers
100 Allied Radio—Electronic supplies
68 Alpha Metals, Inc.—Flux-filled solder washers
102 American Super-Temperature Wires, Inc.—Wires and cable
107 AMP Incorporated—Patchcord programming system
25 Amperex Electronic Corporation — RF power amplifier tetrode
10 Ampex Data Products Company—Instrumentation tape recorder
83 Amphenol-Borg Electronics Corp., Connector Div.—MIL-type connectors
167 Amplifier Corp. of America—Flutter meter
53 Anderson Controls, Inc.—Miniature solenoids
123 Antenna Systems, Inc.—30-foot parabolic reflector antenna
29 Arco Electronics, Inc.—ELMENCO capacitor distribution
94 Armco Steel Corporation — Electrical steels
127 Arnold Magnetics Corporation — Transistorized power supplies
178 Avnet—Connector Distribution
112 Barker & Williamson, Inc. — Circuit analysis instruments
69 Bead Chain Mfg. Co., The—Tiny metal tubular parts
85 Beckman Instruments, Inc., Helipot Div. —Single-turn potentiometers
21 Bendix Corp., The, Red Bank Division, Semiconductor Products—Power transistors
128 Birtcher Corporation, The — Transistor radiator
154 Bliley Electric Co.—Crystal oscillator
180 Bomac Laboratories, Inc. — Microwave tubes
39 Borg Equipment Div., Amphenol-Borg El. Corp.—Miniaturized precision potentiometers
31 Bourns, Inc., Trimpot Div.—Subminiature trimmer potentiometers
162 Bruno-New York, Industries Corp.—"Pig-tailoring" machine
49 Brush Instruments, Div. of Clevite Corp.—Operations monitors
50 Brush Instruments, Div. of Clevite Corp. —Direct writing systems
86 Bulova Electronics Div.—Precision crystal filters
124 Burnell & Co., Inc.—Crystal filters
16 Bussmann Mfg. Div. McGraw-Edison Co. —Fuses and fuseholders
138 Cambridge Thermionic Corporation—Miniature jacks and plugs
70 Cannon Electric Company — Subminiature plugs
44 CBS Electronics, Semiconductor Operations—High-speed switching transistors
42 Centralab The Electronics Division of Globe-Union, Inc. — Ceramic-to-metal seals
51 Cinch Manufacturing Corp.—Sub-miniature sockets
169 Cinema Engineering — Microminiature precision wire-wound resistors
134 Clare & Co., C. P.—Relay distribution
41 Cleveland Container Co., The—Laminated phenolic tubing
75 Clevite Transistor Div. Clevite Corp.—Power transistors
147 Clifton Precision Products Co., Inc.—Rotary components
103 Columbian Carbon Company — Iron oxides for ferrites
176 Consolidated Resistance Company of America, Inc.—Resistors
155 Consolidated Vacuum Corporation—Shock waveform machine
104 Continental Connector Corp. — Microminiature connectors
158 Continental Electronics Corp.—Video recording and monitor tubes
122 Corning Glass Works—Trimmer capacitors
152 Dage Electric Company, Inc.—Precision hermetic seals
62 Dale Electronics, Inc.—Resistors
157 Dialight Corporation—Multiple indicators
13 Dorsett Electronics Laboratories, Inc.—Subcarrier oscillator for telemetering
66 Du Mont Laboratories, Allen B., Electronic Tube Div.—Cathode ray tubes
22 Du Mont Laboratories, Allen B., Instrument Sales Dept.—Oscilloscope
46 Du Pont de Nemours & Co., Inc., E. I., Freon Products Div.—FREON cleaning solvents
166 EICO, Electronic Instr. Co., Inc.—Electronic kit catalog
149 Eisler Engineering Co., Inc.—Welders and accessories
143 Elastic Stop Nut Corporation of America —Time delay relays
88 Electra Manufacturing Company, Electronics Div.—Miniature resistors
28 Electro Motive Mfg. Co., Inc., The—Mica capacitor
121 ESC Electronics Corp.—Miniature modular computer delay lines
56 Fairchild Controls Corp., Components Division—Potentiometers
91 Fansteel Metallugical Corporation—Solid tantalum capacitors
92 Fansteel Metallurgical Corporation—Silicon power rectifiers
7 Film Capacitors, Inc.—Metallized miniature MYLAR capacitors
175 Freed Transformer Co., Inc.—Inductance bridge & megohmmeter
57 Fusite Corporation, The — Solid glass hermetic terminals
59 FXR, Inc.—Slotted sections
78 Garlock, Inc., Garlock Electronic Products—Electronic components
9 General Electronic Co., Receiving Tube Division—Ceramic tubes
161 General Electric Co., Department—Voltage magnetrons
177 General Electric Co., Silicone Products Dept.—Liquid silicone rubber
98 General Motors Corporation, Delco Radio Div.—Power transistors
116 General Products Corporation—Removable contact connector
105 Gertsch Products, Inc.—Complex ratio bridge
140 Grainger, Inc., W. W.—Electric motors
71 Graphic Systems—Visual control board

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45 Hewlett-Packard Company — Electronic counters
110 Hewlett-Packard Company—AC current probe
24 Hickok Electrical Instrument Co., The—Tube testers
4 Hughes Industrial Systems Div.—Custom engineered harness systems
5 Hughes Industrial Systems Div.—Memory type oscilloscope
3 Hughes Semiconductor Div. — Certified Test Data Correlation Program

PROFESSIONAL ENGINEERING OPPORTUNITIES

Circle number of company on card at right from whom you desire further information.

501 AC Spark Plug, Electronics Division, General Motors Corporation
502 Lockheed Missile and Space Systems Division
503 National Cash Register Company, The

164 Hughes Vacuum Tube Products Div.—Stored energy welding power supply & handpiece
163 Hughes Vacuum Tube Products Div.—Welding power supply
172 Hughes Vacuum Tube Products Div.—Stored energy welding power supply & weld head

159 Ideal Precision Meter Co., Inc.—Precision panel meters
163 Illumitronic Engineering — Plastic rod, tubing and sheet
84 IMC Magnetics Corp.—Hysteresis and torque motors
73 Industrial Electronic Engineers, Inc.—In-line digital readout devices
151 International Resistance Co.—Subminiature rotary trimmer potentiometer
30 ITT Industrial Products Div.—Bar-graph oscilloscope

36 Jennings Radio Mfg. Corp.—High voltage vacuum capacitors
173 Jerrold Electronics Corporation — RF test equipment
179 Johnson Co., E. F.—Molded nylon knobs and dials
63 Jones Division, Howard B. Cinch Mfg. Co.—Plugs and sockets
132 Jones Division, Howard B. Cinch Mfg. Co.—Plugs and sockets

80 Kemet Company, Div. of Union Carbide Corp.—Solid tantalum capacitors
153 Kester Solder Company — Resin-core solder
76 Klein & Son, Mathias—Electronic pliers
148 Krengel Manufacturing Co., Inc.—Hand marking devices
125 Kulka Electric Corporation — Terminal boards

133 Lel, Inc.—Miniaturized mixer-preamplifiers
35 Lenz Electric Manufacturing Co.—High voltage lead wire
82 Lockheed Electronics Company — Electronic components
150 Light Electric Corp. — Custom transformers

58 Magnetics, Inc.—Tape wound cores
131 Manson Laboratories, Inc. — Frequency standard
126 Marconi Instruments—Sweep generator
142 McKinstry Metal Works, Inc.—Panel enclosures
141 Microtran Co.—Transformers
77 Microwave Associates, Inc.—Harmonic generators
181 Miller Company, J. W.—Adjustable RF coils

Employment—Use the handy card below to get more information on the engineering positions described in the "Professional Opportunites" Section which begins on page 214 of this issue.

Postcard valid 8 weeks only. After that use own letterhead describing item wanted. OCT. 1960

PROFESSIONAL ENGINEERING OPPORTUNITIES

Please send me further information on the engineering position I have circled below.

501	506	511	516	521
502	507	512	517	522
503	508	513	518	523
504	509	514	519	524
505	510	515	520	525

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8 Minnesota Mining and Manufacturing Company, Mincon Div.—Instrumentation recorder-reproducer

27 Motorola Semiconductor Products, Inc.—Power transistors

6 Muirhead Instruments, Inc. — Variable freqency oscillators

17 Non-linear Systems, Inc.—Digital voltmeter

23 Oak Manufacturing Co.—Stock switches

61 Ohmite Manufactring Company—Relays

60 Pacific Semiconductors, Inc. — Silicon mesa transistors

146 Panoramic Radio Products, Inc.—Sonic spectrum analyzer

38 Penta Laboratories, Inc.—Beam pentode

15 Philco, Lansdale Div. — High-speed switching transistor

170 Plastic Capacitors, Inc.—Capacitors

145 Polarad Electronics Corp.—Microwave generators

1 Radio Materials Company—Ceramic disc capacitors

12 Raytheon Co., Industrial Components Div.—Decade counter tubes

33 Raytheon Co., Industrial Components Div.—Semiconductor switching device

65 Raytheon Co., Microwave and Power Tube Div.—Klystron

115 Reeves-Hoffman Div. of Dynamics Corp. of America—Transistorized ovens

113 Rockwell Products Corporation—Blind fasteners

135 Rohn Manufacturing Co.—Communication towers

129 Rondo of America, Inc.—Paper packing packs

52 Sangamo Electric Company—Aluminum electrolytic capacitors

67 Sangamo Electric Company—Electrolytic capacitors

18 Sarkes Tarzian, Inc.—Modular silicon rectifiers

43 Scientific-Atlanta, Inc.—Antenna pattern instrumentation

174 Scintilla Division, Bendix Corporation—capacitors

64 Segal Company, Edward—Automatic eyelet attaching machine

137 Shure Brothers, Inc.—Rugged communications microphone

99 SIFCO Metachemical, Inc. — Selective plating equipment

72 Spectrol Electronics Corporation—Solid state voltage converters

109 Speer Carbon Company, Resistor Div.—Fixed composition resistors

144 Sperry Semiconductor Div.—Silicon alloy transistors

2 Sprague Electric Co.—Tubular capacitor

81 Sprague Electric Co.—Transistor switching circuits in building-block form

74 Stackpole Carbon Company—Fixed composition resistors

156 Stanpat Company—Symbols for drafting use

48 Struthers-Dunn, Inc. — Sub-miniature missile relays

136 Sylvania Semiconductor Div. — Silicon voltage variable capacitors

130 Sylvania Semiconductor Div.—Switching transistors

120 Synthane Corporation — Plastic laminates

106 Syntron Rectifier Div.—Silicon power rectifiers

160 Syntronic Instruments, Inc.—Deflection yoke coils

90 Tapco Group Thompson Ramo Wooldridge, Inc.—Electrical power components

11 Taylor Fibre Co.—Laminated plastics

32 Tektronix, Inc.—High-frequency current probe

34 Telechrome Manufacturing Corp.—FM/-FM telemetering transmitter

26 Texas Instruments Incorporated—Silicon mesa transistors

14 Thomas & Betts Co., Inc., The—Connector systems for flat conductor cable

54 Times Wire & Cable Div. The International Silver Co.—Custom cable assemblies

40 Tinnerman Products, Inc.—Speed clip fasteners

117 Trak Electronics Company—Controllable inductors

55 Transitron Electronic Corporation—Silicon mesa diodes

47 Tung-Sol Electric, Inc.—Voltage regulating tube

93 Union Switch & Signal, Div. Westinghouse Air Brake Company—MIL-type relay

114 United Transformer Corporation—Pulse transformers

97 Unitek, Weldmatic Div. — Electronic welder

118 Varflex Corporation—High-dielectric insulating tubing and sleeving folder sample

37 Varian Associates—Power klystrons

139 Vector Electronic Company — Patch boards

165 Vitramon, Incorporated—Porcelain capacitors

95 Waveline, Inc.—Microwave test equipment

119 Westinghouse Electric Corporation Semiconductor Dept.—Switching rectifier

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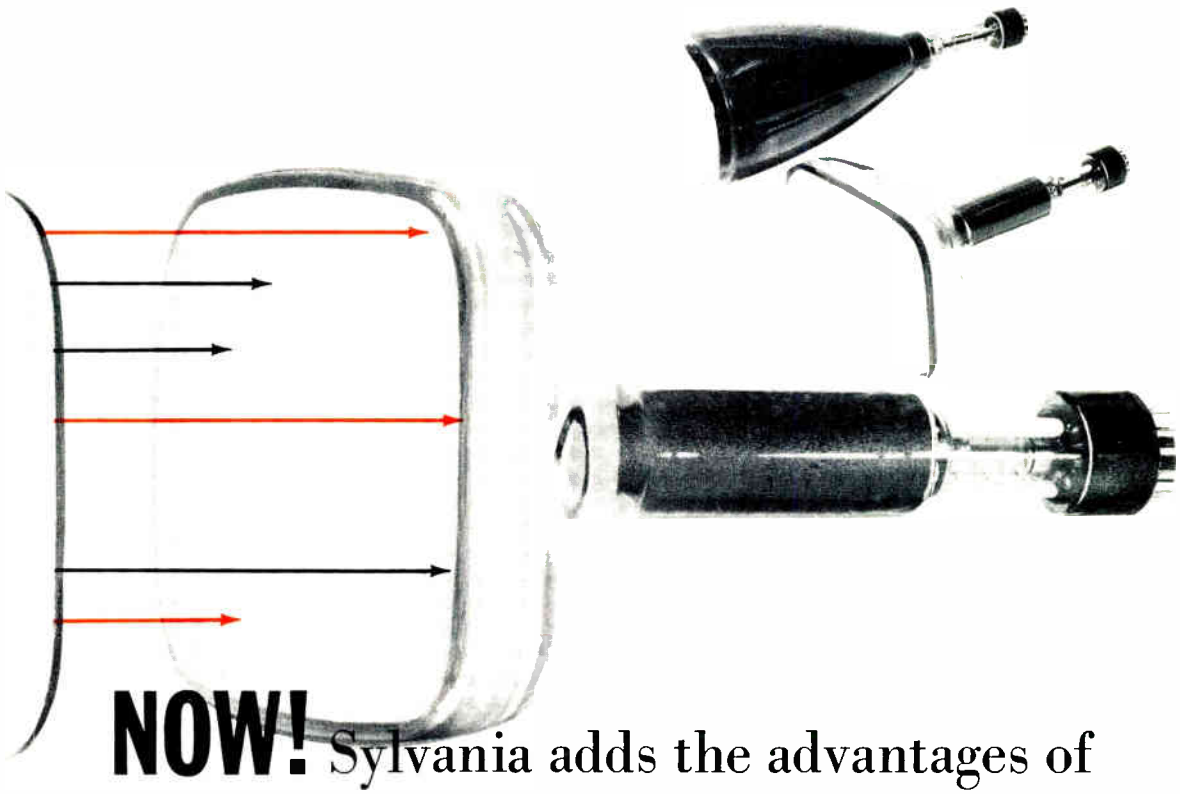
ELECTRON TUBE NEWS

...from SYLVANIA



NOW! Sylvania adds the advantages of

"BONDED SHIELD"

to industrial-military

CATHODE RAY TUBES

- **reduces reflecting surfaces 50%**
- **improves image visibility**
- **protects against breakage**
- **provides wide-angle viewing**
- **simplifies mounting and styling**

Sylvania pioneered the quantity production techniques of laminating "Bonded Shield"—a scratch-resistant, annealed-glass safety cap—to the face of television picture tubes. Drawing upon this vast experience, Sylvania now makes available "Bonded Shield" industrial-military cathode ray tubes—screen sizes from 3" to 27"—on flat and spherical, rectangular and circular faces.

Sylvania "Bonded Shield" one-piece design cuts the number of reflecting surfaces by 50%—reduces specular images, increases apparent light transmission and contrast to provide improved image readability. "Bonded Shield" increases strength of tube face. Reduces the danger of implosion. It eliminates the need for conventional safety glass. Brings image display "out-front" for wide-angle viewing and simplifies cleaning of the tube face (especially important in environmentalized "sealed" equipment). "Bonded Shield" makes practicable reductions in equipment weight and over-all length.

"Bonded Shield" can serve as a usable writing surface. Further, it is possible to permanently etch the bonded safety cap with a calibrated reference scale, thereby reducing view-errors caused by parallax. You can find out more about these and other "Bonded Shield" advantages from your Sylvania Sales Engineer.

NEW "BONDED SHIELD" C.R.T.'s

Sylvania-19ARP4, monitor tube for commercial and industrial TV. 19" tube with 114° deflection, it features an over-all length of only 12" including "Bonded Shield" safety cap; neck length is 5⅛". 19ARP4 is available with specially treated cap that can diffuse reflections as much as 70%.

"Bonded Shield" Type	Equivalent Standard Type	"Bonded Shield" Type	Equivalent Standard Type
ST-2843	16WP4B	ST-3081	12KP4A
SC-3074	5UP1	ST-3082	5FP4
SC-3076	SC-3074*	ST-3083	10FP4A
ST-3077	5QP4	ST-3084	17BP4A
ST-3078	7SP4	ST-3085	24YP4A
ST-3079	7TP4	ST-3086	17HP4B
ST-3080	10SP4		

*Denotes IRE scale printed on face

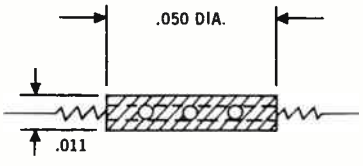


Illustration (top) shows compact dimensions of new low power heater-cathode assembly (below).

NEW! Sylvania C.R.T.'s feature LOW-POWER HEATER –1.5V @ 140mA– open new design areas for battery-powered, portable 'scopes

Continuing Sylvania research into modern materials and techniques has led to a remarkable low-power heater-cathode assembly. It requires only 1.5V @ 140mA —less than 6% of the power normally needed—offering lower tube operating temperatures and low drain from battery or flyback heater supplies.

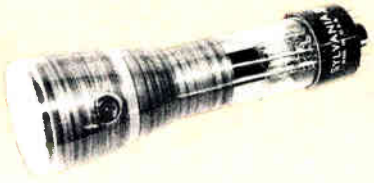
Advanced powder metallurgy processes make possible a flat, pancake-like heater-cathode assembly, only .050" in diameter and .011" thick. Extremely low mass minimizes possibility of damage from vibration and shock.

Sylvania continues expansion of its line of C.R.T.'s utilizing this important heater-cathode development. Current examples include SC-3016 and -3BMP1.

KEY CHARACTERISTICS	3BMP1	SC3016
Heater Ratings	1.5V/140mA	1.5V/140mA
Anode No. 3 Voltage	6600*	— Vdc
Anode No. 2 Voltage	2200*	2750* Vdc
Anode No. 2 Input	6.0*	— Watts
Anode No. 1 Voltage	1500*	1100* Vdc
Face Dimension	3	1⅛ Inches
Over-all Length	10	6 Inches

*Absolute Maximum Ratings

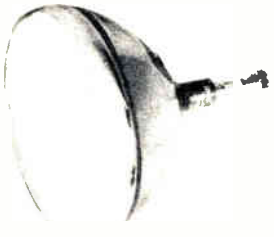
SYLVANIA SC-3016—featuring high deflection sensitivity, compact length of only 6", flat circular 1⅛" face, electrostatic focus and deflection. Available with several different screen phosphors.



SYLVANIA-3BMP1—a 3"-diameter tube with flat, clear faceplate. It offers electrostatic focus and deflection, features post-deflection acceleration. Available with a wide choice of screen phosphors.

SYLVANIA-7AUP7 FOR MARINE RADAR

7" diameter face—short over-all length for compact designs—⅞" diameter neck for reduced deflection power requirements—features aluminized screen for image brilliance—electrostatic focus, magnetic deflection—utilizes 9-pin miniature basing arrangement.



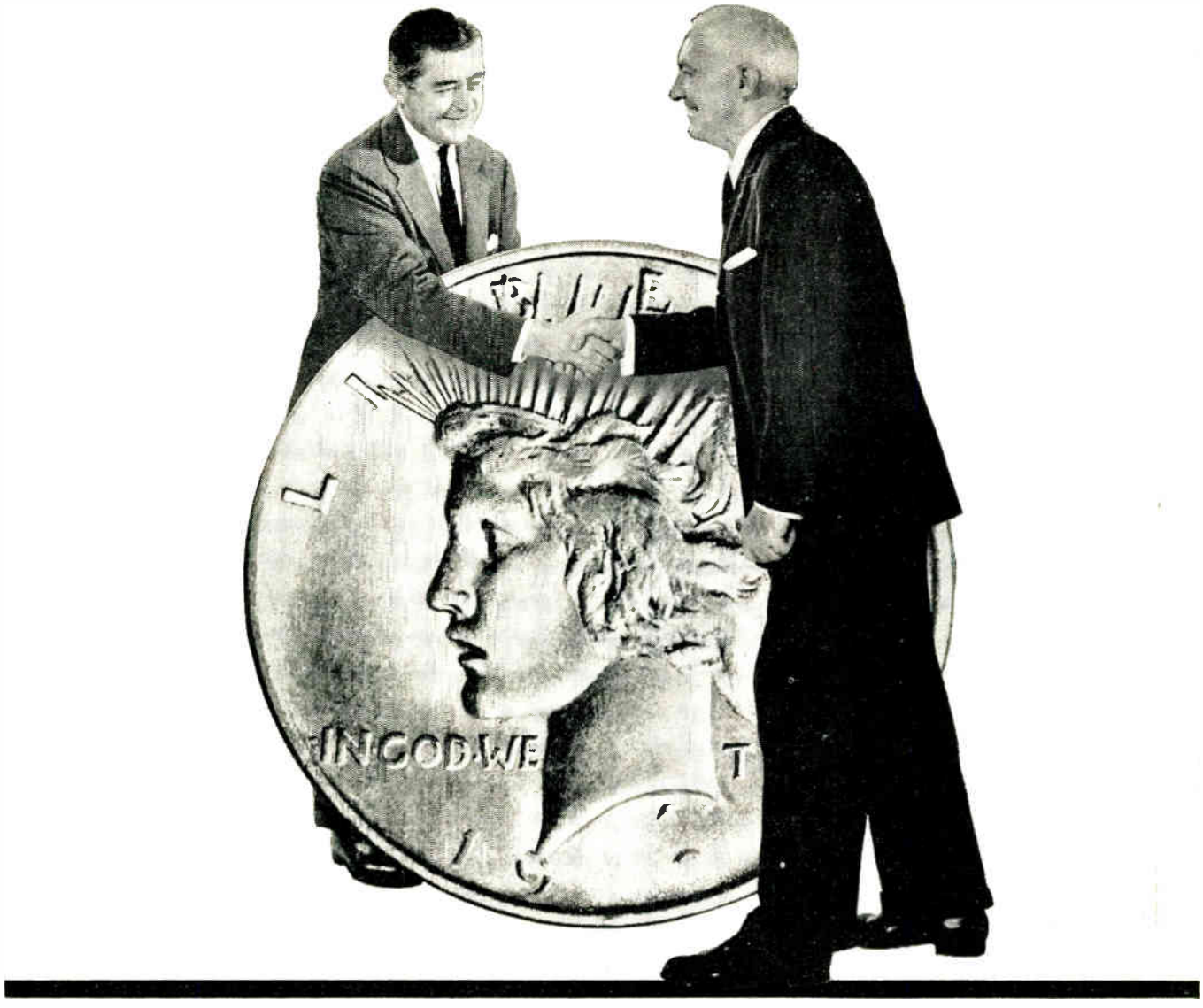
Virtually all popular C.R.T.'s can be supplied with "Bonded Shield" and/or low power heater-cathode assembly. For further information, contact the Sylvania Field Office nearest you. Or, write Electronic Tubes Division, Sylvania Electric Products Inc., Dept. J., 1100 Main Street, Buffalo, N. Y.

SYLVANIA

Subsidiary of GENERAL TELEPHONE & ELECTRONICS

N-8326

Your employees' retirement dollars may be your most productive dollars



The dollars you put into a pension or profit sharing plan for your employees are dollars at work for you. Satisfied employees, assured of a secure future, are an asset to any business.

Morale is improved; older employees can be retired; younger employees promoted; good workers attracted; turnover reduced. But, in addition to providing definite retirement benefits for employees, an Ætna Life Pension or Profit Sharing Trust benefits management — and tax advantages are realized by both employer and employee.

As a leader in the field, Ætna Life will tailor-make a retirement plan to fit your company's individual requirements. Advice of our experienced experts is available without charge or obligation through your Ætna Life office.

Ætna Life Pension and Profit Sharing Plans work for you!

- Improve morale
- Provide for orderly retirement
- Give basis for promotions
- Reduce turnover
- Strengthen public relations
- Offer tax advantages

ÆTNA LIFE
INSURANCE COMPANY
Hartford 15, Connecticut

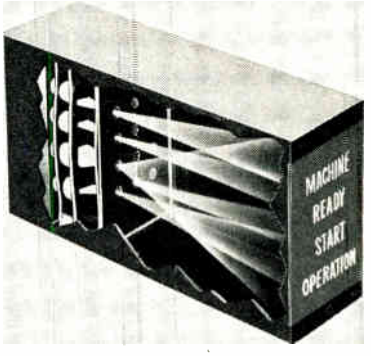
Affiliates: Ætna Casualty and Surety Company
Standard Fire Insurance Company

Circle 111 on Inquiry Card

New Products

DIGITAL READOUT

The Series 80000 Digital Display displays words backlighted with color. It will display words or combinations of words and colors on the screen either by themselves or as background for the word messages. It operates



on a rear-projection principle. Unit contains master condensing lens with 12 individual positions or lenses. When one of the 12 lamps at the rear of the unit is lighted, the lamp projects the corresponding word or color onto the viewing screen at the front of the unit. The word message may be used by itself, or a colored background light may be projected simultaneously to indicate a condition or situation. Dimensions are 3 9/32 x 5¼ x 11 15/16 in. Industrial Electronic Engineers, Inc., 5528 Vineland Ave., N. Hollywood, Calif.

Circle 249 on Inquiry Card

COUNTING SYSTEM

GM counting system in one 19 in. rack mounted unit. The N-250 comprises a Scaler, Ratemeter, and High-Voltage Power Supply. Power required is 115 v, 60 CPS, 20 w. Other specs: (Scaler) Sensitivity, —0.25 v to —5 v adjustable; Display, Five 1 in. glow transfer tubes. (Ratemeter) Time constants, 0.5, 2, 10, and 40 sec.; Accuracy, ±2%. Count rate indication, by front panel meter, 0-1 ma

recorder connection and "Howler"; Count ranges, 6 count ranges to 100,000 CPM max. Hamner Electronics Company, Inc., P.O. Box 531, Princeton, N. J.

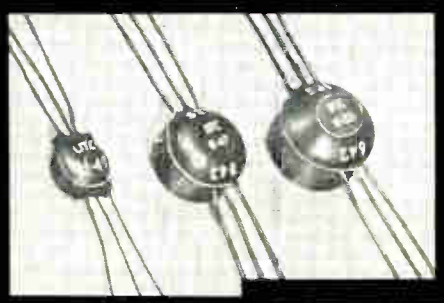
Circle 250 on Inquiry Card

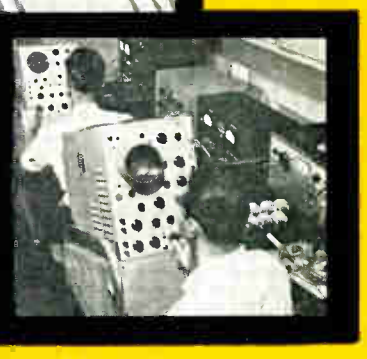
PULSE TRANSFORMERS

FROM STOCK

MINIATURE STABLE WOUND CORE **HERMETIC MIL-T-27A TYPE TF5SX36ZZ**

UTC miniature, wound core, pulse transformers are precision (individually adjusted under test conditions), high reliability units, hermetically sealed by vacuum molding and suited for service from —70° C. to +130° C. Wound core structure provides excellent temperature stability (unlike ferrite). Designs are high inductance type to provide minimum of droop and assure true pulse width, as indicated on chart below. If used for coupling circuit where minimum rise time is important, use next lowest type number. Rise time will be that listed for this lower type number . . . droop will be that listed multiplied by ratio of actual pulse width to value listed for this type number. Blocking oscillator data listed is obtained in standard test circuits shown. Coupling data was obtained with H. P. 212A generator (correlated where necessary) and source/load impedance shown. 1:1:1 ratio.





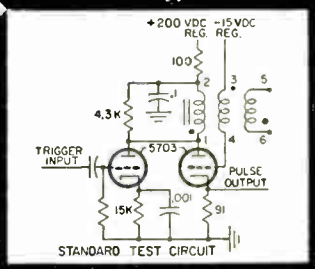
DEFINITIONS

Amplitude: Intersection of leading pulse edge with smooth curve approximating top of pulse.
Pulse width: Microseconds between 50% amplitude points on leading and trailing pulse edges.
Rise Time: Microseconds required to increase from 10% to 90% amplitude.
Overshoot: Percentage by which first excursion of pulse exceeds 100% amplitude.
Droop: Percentage reduction from 100% amplitude a specified time after 100% amplitude point.
Backswing: Negative swing after trailing edge as percentage of 100% amplitude.

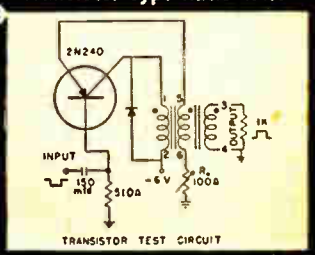
Type No.	APPROX. DCR, OHMS 1-2	3-4	5-6	BLOCKING OSCILLATOR PULSE Width μ Sec.	Rise Time	% Over Shoot	Droop %	% Back Swing	COUPLING CIRCUIT CHARACTERISTICS P Width μ Sec.	Volts Out	Rise Time	% Over Shoot	Droop %	% Back Swing	Imp. in, out, ohms
H-45	3	3.5	4	.05	.022	0	20	10	.05	17	.01	20	0	35	250
H-46	5.5	6.5	7	.10	.024	0	25	10	.10	19	.01	30	10	50	250
H-47	3.7	4.0	4	.20	.026	0	25	8	.20	18	.01	30	15	65	500
H-48	5.5	5.8	6	.50	.03	0	20	5	.50	20	.01	30	20	65	500
H-49	8	8.5	9	1	.04	0	20	10	1	24	.02	15	15	65	500
H-50	20	21	22	2	.05	0	20	10	2	27	.05	10	15	35	500
H-51	28	31	33	3	.10	1	20	8	3	26	.07	10	10	35	500
H-52	36	41	44	5	.13	1	25	8	5	23	.15	10	10	45	1000
H-53	37	44	49	7	.28	0	25	8	7	24	.20	10	10	50	1000
H-54	50	58	67	10	.30	0	20	8	10	24	.25	10	10	50	1000
H-55	78	96	112	16	.75	0	20	10	16	23	.40	5	15	20	1000
H-56	93	116	138	20	1.25	0	25	10	20	23	.6	5	10	10	1000
H-57	104	135	165	25	2.0	0	30	10	25	24	1.5	5	10	10	1000
H-60	.124	.14	.05	.05	.016	0	0	30	.05	9.3	.012	0	0	20	50
H-61	.41	.48	.19	.1	.016	0	0	30	.1	8.2	.021	0	0	15	50
H-62	.78	.94	.33	.2	.022	0	0	18	.2	7.4	.034	0	5	12	100
H-63	1.86	2.26	.70	.5	.027	2	10	20	.5	7.5	.045	0	20	25	100
H-64	3.73	4.4	1.33	1	.033	0	12	25	1	7	.078	0	15	23	100
H-65	6.2	7.3	2.22	2	.066	0	15	25	2	6.6	.14	0	10	20	100
H-66	10.2	12	3.6	3	.087	0	18	30	3	6.8	.17	0	10	20	100
H-67	14.5	17.5	5.14	5	.097	0	23	28	5	7.9	.2	0	18	28	200
H-68	42.3	52.1	14.8	10	.14	0	15	28	10	6.5	.4	0	15	30	200

Note: 0 = Negligible

Vacuum Tube Type Ratio 1:1:1



Transistor Type Ratio 4:4:1



H-45, 46, 60 thru 68 are 3/8 cube, 1 gram **H-47 thru 52, 9/16 cube 4 grams** **H-53 thru 57, 5/8 cube 6 grams**

AND SPECIAL UNITS TO YOUR SPECS

While stock items cover low level uses only, most of UTC's production is on special units to customers' needs, ranging from low levels to 10 megawatts.

Write for Catalog for full details on these and 1000 other stock items

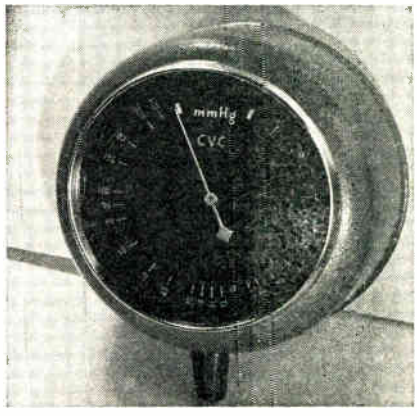
UNITED TRANSFORMER CORPORATION
150 Varick Street, New York 13, N. Y.
PACIFIC MFG. DIVISION: 4008 W. JEFFERSON BLVD., LOS ANGELES 16, CALIF.
EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y. CABLES: "ARLAB"

Circle 114 on Inquiry Card

New Products

VACUUM GAUGE

Addition to line of a mechanical diaphragm gauge for measuring total pressures of gases from atmosphere to 0.2 mm Hg. The GHD-100 is for installation directly to a vacuum system and requires no electrical connections. Its principle of operation is

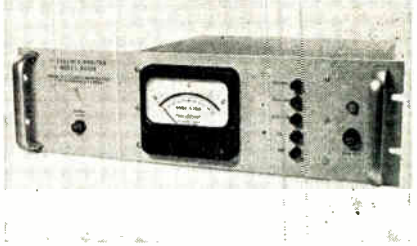


the deflection of a thin metal diaphragm by a change in pressure. The diaphragm is made of corrugated copper-beryllium to add ruggedness and longer life. The large, easily-read circular scale is calibrated in millimeters of mercury. The scale has a non-linear calibration which spreads the 0.2-20 mm region over 180° of the circle. Consolidated Vacuum Corp., 1775 Mt. Read Blvd., Rochester 3, N. Y.

Circle 251 on Inquiry Card

FREQUENCY MONITORS

Series 4000 precision frequency monitors indicate the frequency of a 400 CPS source with an accuracy of 0.01%. Cabinet, portable and rack-mounted versions have 4½ in., 50 μa meter movements and anti-parallax mirror scales. Indicating meters have 3 scale calibrations, each with a 400 CPS center reading: 375-425, 395-405,



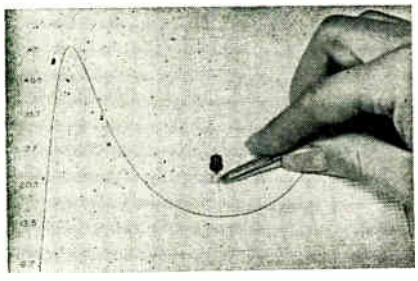
and 399-401 CPS. They will also drive recorders having an impedance of approx. 500 K ohms. Power is 60 CPS, or units may be battery operated. Airpax Electronics Inc., Seminole Div., Ft. Lauderdale, Fla.

Circle 252 on Inquiry Card

New Products

TUNNEL DIODES

New line of extended-range tunnel diodes consists of 14 types—1N2928 through 1N2934—and contains units exhibiting peak currents both above and below the 1 to 22 ma range for tunnel diodes. Peak currents of the new devices range from 470 μa to 100 ma. Standard units available with ±10% peak current tolerance and "A" versions feature ±2% peak current tolerance. The extended-range tunnel diode series features excellent uniformity and stability over

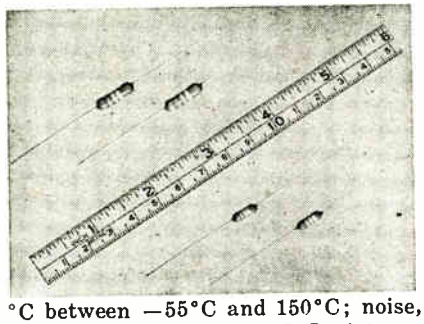


an operating temperature of range of −85°C to +200°C. The units are encased in miniature JEDEC TO-18 packages. Hoffman Electronics Corp., 3761 South Hill St., Los Angeles, Calif.

Circle 253 on Inquiry Card

FILM RESISTORS

One-watt and ½ w high quality film resistors exceed Mil-R-11C and match composition resistor costs. The units, C-20 and C-32, feature a new silicone coating that withstands cleaning solvents used by printed circuit manufacturers. Typical operating characteristics: Derating, full load at 70°C amb. to zero power at 150°C; load life, change in resistance of 1 to 1½% after 1,000 hrs. at 70°C; moisture resistance, change in ohmic value of 0.3%; temp. coefficient, ±150ppm/-

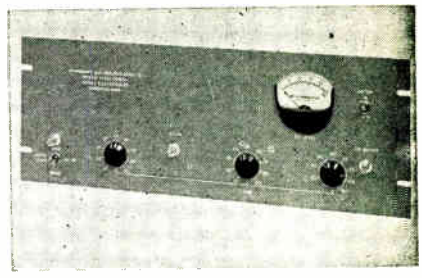


°C between −55°C and 150°C; noise, 0.1 μv/v. of applied signal. Resistance ranges are 56 ohms to 150K ohms for the C-20 and 56 ohms to 470K ohms for the C-32. Corning Glass Works, Corning, N. Y.

Circle 254 on Inquiry Card

COMPRESSED GAIN AMPLIFIER

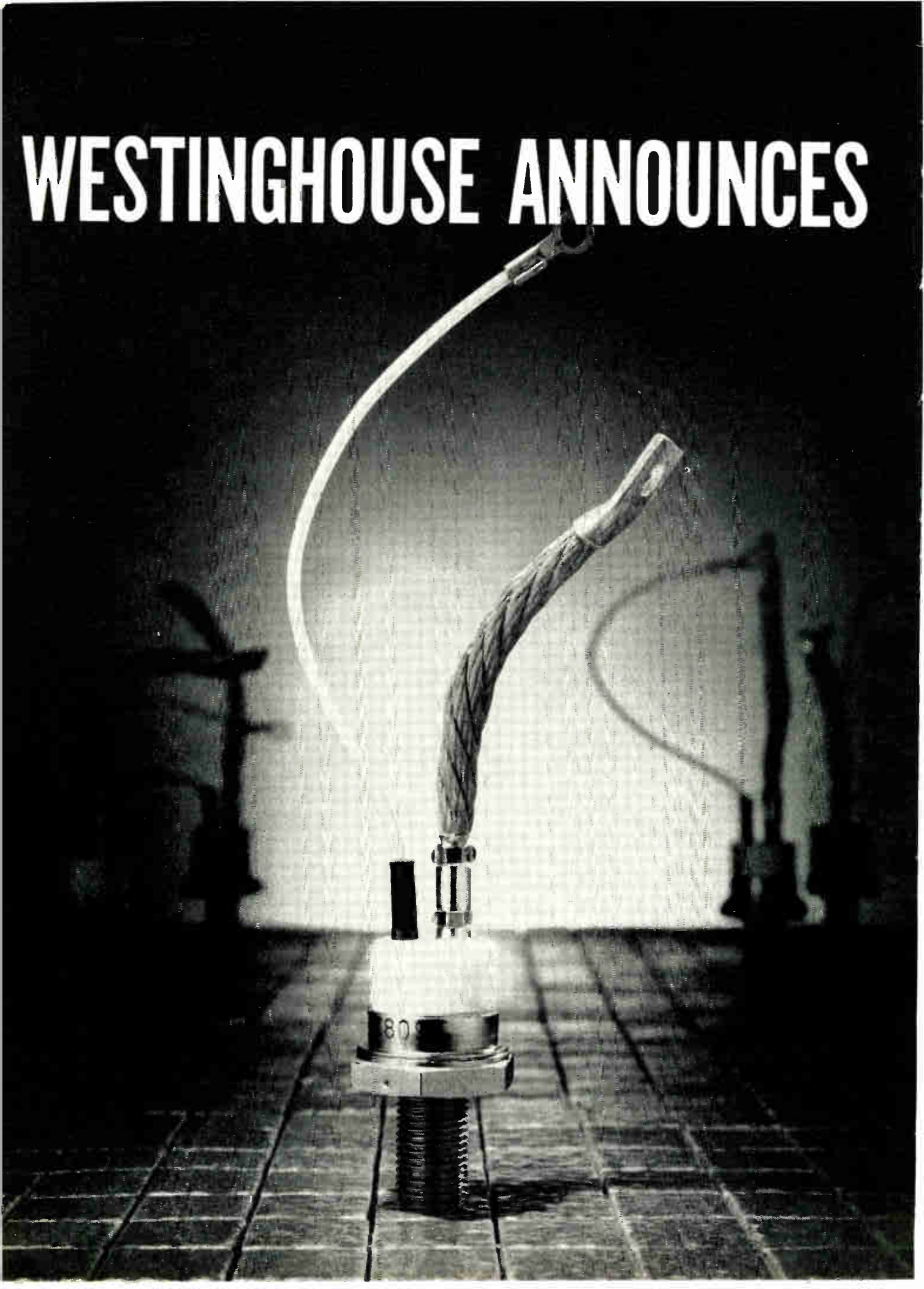
Compressed Gain Amplifier, Model 110, converts input voltage variations into decibel variations. Operating from 10 KC to 50 MC it has a virtually linear transfer characteristic. It is used to measure the attenuation performance of crystal filters, tuned amplifiers, and other frequency selective devices. Front panel control permits selection of either 60 db or 80 db compression. Dc voltage output from the amplifier allows connection to an oscilloscope or VTVM. Features include a front panel overload indicator. Specs are: Input voltage for full compression: range A, 0.5 v. RMS; Range B, 0.1 v. RMS; Input im-



pedance: 500K ohms in parallel with 20 mmf; Power requirements: +250 vdc @ 110 ma; filament 6.3 vac @ 3 a. Hermes Electronics Co., 75 Cambridge Pkwy., Cambridge 42, Mass.

Circle 255 on Inquiry Card

WESTINGHOUSE ANNOUNCES



50 AMP "ROCK-TOP" TRINISTOR[T] CONTROLLED RECTIFIER

PROVIDES MULTI-FUNCTIONAL CONTROL OF CURRENTS AND VOLTAGES WITH FAST SWITCHING TIME AND RESPONSE RATE

New Westinghouse Trinistor "Rock-Top" construction provides high reliability, low maintenance, and positive protection against arcing at high voltages. Design engineers will find the improved electrical characteristics, listed below, can be used to advantage in a wide range of new control and switching applications.

- Lower Thermal Impedance
- Switching time 600 millimicroseconds
- Efficiencies in excess of 95%
- Simplifies circuitry
- Lower forward drop than thyratrons
- Minimum noise levels
- Parameters ideally suited for high-speed static switch functions
- Peak reverse voltage 60-360 volts

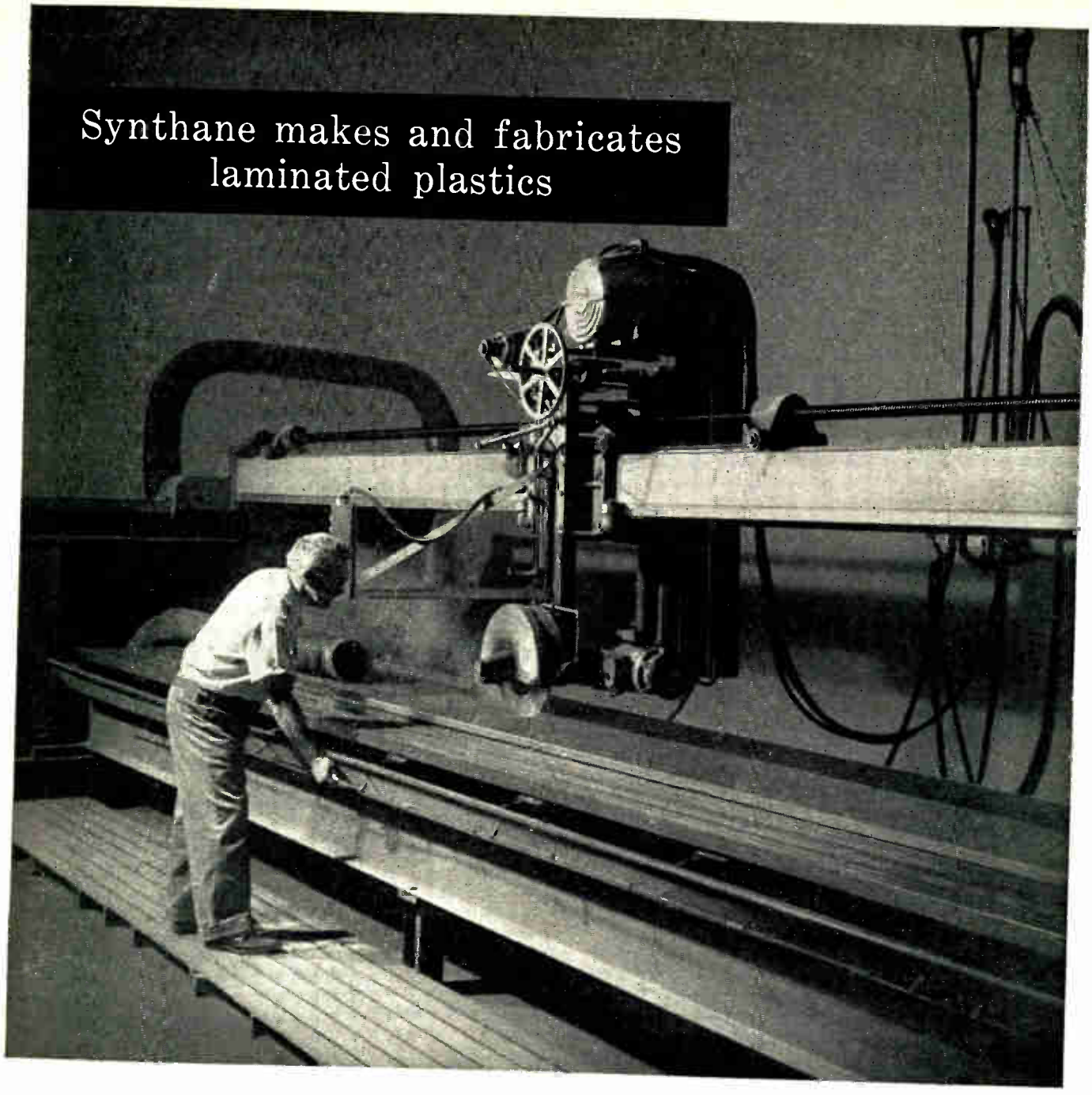
For full information or engineering assistance,
contact your local Westinghouse representative, or write:
Westinghouse Electric Corporation, Semiconductor Dept., Youngwood, Pa.

INDUSTRIAL, MILITARY, AND COMMERCIAL APPLICATIONS INCLUDE: CONVERTERS / VARIABLE FREQUENCY CONTROLS / MOTOR CONTROL / VOLTAGE REGULATION / REPLACEMENT OF MAGNETIC AMPLIFIERS / HIGH POWER MODULATION / INVERTERS / REPLACEMENT OF THYRATRONS

SC-4111A

You can be sure...if it's **Westinghouse**

Circle 119 on Inquiry Card



Why "do-it-yourself" fabrication seldom pays

This is a "long length" saw, especially built to cut sheets of Synthane laminated plastics of over 25 feet in length.

It is extremely improbable that you would ever have sufficient work to make the purchase of such a machine profitable. Yet the long length saw is only one of hundreds of unusual machines necessary for fast, accurate, economical fabrication of laminates.

Without the advantage of special machines and tools, and faced with the possibility of errors, waste, delays, mistakes in tolerances or dimensions —at your expense—you may come to the same conclusion as have nearly all of our customers—buy your laminated plastics from us and have us fabricate them for you. Call any of our representatives—located in all principal cities—for a quotation or write to Synthane Corporation, 11 River Road, Oaks, Pa.

You furnish the print—we'll furnish the part

SYNTHANE CORPORATION OAKS, PENNA.

Sheets • Rods • Tubes • Fabricated Parts
Molded-laminated • Molded-macerated

Circle 120 on Inquiry Card

WASHINGTON News Letter

FINAL PERIOD—The Office of Civil & Defense Mobilization has culminated the long-discussed proposal to solve the FCC's television frequency allocation problem with a flat "No." The problem concerned having either a 50-channel VHF system or 30 contiguous VHF channels by "trading" space in the present ultra-high frequency TV channels with the government in return for very high frequency space now used for government purposes. The OCDM in its response to the Commission, developed after extensive preparation and study with interested government agencies, particularly the Department of Defense, was that the risks of either of the two FCC plans "are too great to be accepted in today's international climate."

HURTS NATIONAL SECURITY—In a letter to FCC Chairman Frederick W. Ford, OCDM Director Leo A. Hoegh emphasized: "It is the position of the Department of Defense, joined by OCDM, that neither of the Commission's plans could be implemented without weakening, to an unacceptable degree, our ability to maintain our national defense security." The FCC proposals would involve dislocation of the primary tactical communication band which is heavily relied upon by the United States military forces and by NATO and SEATO.

HUGE EXPENDITURE—The relocation of military operations elsewhere in the spectrum could not be implemented without expenditure by the U. S. government agencies of in excess of $5,000,000,000 for military operations alone, OCDM stated to the FCC. Both the U. S. military services and the allied NATO and SEATO forces have developed a significant degree of international standardization in the successful military use of frequencies in the affected parts of the spectrum. Neither of the FCC's plans could be effectuated without a major research and development effort. This would mean curtailment of current defense and space programs and diversion of research talent and industrial production from vital weapons systems.

RECONSIDERATION ASKED—The Microwave Section of the Electronic Industries Association recently advised the FCC that it feels the Commission "erred in adopting stricter interim technical standards than required to regulate the contemplated expansion of private microwave within the existing allocation structure." It asked the FCC to amend its recent order adopting interim technical standards for private microwave systems in several respects. The Commission's proposals would work severe economic burdens on the private microwave industry in the redesigning and production of equipment to comply with the new standards to be effective Jan. 1, 1961.

CONELRAD CONTINUITY—A 19-page "continuity of service" plan will enable the President and other top government officials to communicate over the nationwide commercial broadcasting networks with the public in the time of an enemy attack. This plan has been formulated by the National Industry Advisory Committee and approved by the FCC with the concurrence of the Secretary of Defense and the Director of the Office of Civil & Defense Mobilization. The Industry Advisory Committee embraced the domestic and international communications systems, aeronautical communications, broadcasting, consulting engineers, the electronics industry, experimental radio, industrial communications, land transportation, amateur and citizens radio, and public safety services.

FEEDER CIRCUITS—The Conelrad "continuity of service" plan provides that "basic feeder circuits" for the nationwide radio broadcasting networks, to carry government messages and news programs in an attack emergency, will be provided by "one or more of the following means as a backup to normal network landline facilities"—industrial radio microwave grid networks, multiplexed FM off-the-air relays, Bell System "express routes," and regional or state intercity remote pickup broadcast intercommunication networks.

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GLOBAL NETWORK—A three-phase program has been initiated for an improved Global Weather Communications Network to encircle the Northern and Southern hemispheres. Consisting of an unbroken chain of point-to-point radio teletypewriter and landline teletypewriter circuits, the network, under the auspices of the World Meteorological Organization of the U.N., would provide a regular exchange of weather information on a coordinated basis.

DOD TRANSFER—Overall Systems Management of COURIER and ADVENT Communications Satellite Projects totaling $197 million from ARPA to Dept. of Army in accord with Secy. of Defense decision. COURIER, an experimental R&D vehicle, is designed to provide a delayed repeater satellite at a 650-mile altitude, near-equatorial orbit, whereas ADVENT's objective is to conduct necessary R&D to demonstrate feasibility of a microwave communications satellite in a 24-hour equatorial synchronous orbit at a height of 22,300 statute miles.

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15-90	75 musec.	3/8" x 1/2" x 3 5/8"
15-91	20, 10, 10, 5 musec.	3/8" x 1/2" x 3 5/8"
15-92	50 musec.	3/8" x 1/2" x 2 5/16"
15-93	20, 20 musec.	3/8" x 1/2" x 2 5/16"
15-94	10, 5 musec.	3/8" x 1/2" x 2 5/16"

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CIRCUITS

Amplitude-Stable Oscillators with AGC. A. A. Lvovich. "Radiotek," 15, No. 4, 1960. 4 pp. Amplitude-stabilized signal sources are necessary in many technical applications of radio electronics and communications. The article deals with some of the amplitude stabilization characteristics of low-power, high frequency vacuum-tube oscillators (self-esciting and independently excited), whose output voltage of a non-linear device such as a diode or a triode. Merits of several voltage reference techniques are analyzed and evaluated. (U.S.S.R.)

Synthesis of Electronic Filters Based on Working Parameters and Using Zolotarev's Ratio of Two Polynomials. A. F. Ufelman. "Radiotek," 15, No. 5, 1960. 9 pp. A method for filter design with an application of iso-extreme functions of Zolotarev was developed in 1939 by Darlington. Although this method gives the most economical solution, its mathematical complexity prevented it from acquiring wide-spread use. In this article the author presents simpler design formulae. Special functions were eliminated in favor of using tables of Glovatsky. As a result the mathematical calculations are reduced several times compared with the formulae of Grossman. (U.S.S.R.)

Calculation of Magnetic Amplifiers Working with One-Phase and Three-Phase Semiconductor Rectifiers for Active Load and Contrary Electro-Motive Force, A. G. Zdrock. "Avto. i Tel." May 1960. 13 pp. Some ways of transforming one-phase and three-phase rectifying bridges into an equivalent load are proposed. The semigraphical methods of determining main parameters of reactor magnetic amplifiers working for an active load and a contrary electromotive force are considered. (U.S.S.R.)

Rectifier Circuits With Voltage Multiplication, V. M. Cantor. "Radiotek," 15, No. 5, 1960. 5 pp. The performance of a rectifier circuit with voltage multiplication is analyzed on the basis of a simplified method. It is known that the response characteristic of a rectifier circuit with voltage multiplication relative to an a-c input current is equivalent to the response of a rectifier with a capacitive output. Design formulae, which take into account the internal resistance of rectifiers, are obtained, making the above assumption of response equivalence. (U.S.S.R.)

Time Constant Design for a Self-Biasing Limiter Circuit, A. Y. Kornienko. "Radiotek," 15, No. 5, 1960. 8 pp. Various methods for design of the discharge time constant of a self-biasing circuit of simplest limiting circuits are discussed and analyzed. Different methods of selecting time constants are used in cases of diode limiters as compared to vacuum-tube limiters. Formulae for shortest time constants are derived for these limiters. Offered is a practical design of a diode limiter. (U.S.S.R.)

Operation Stability of Closed (or Long) Circuits Based on Logic Elements of Some Types, I. Gashkovetz and N. P. Vasil'Eva. "Avto. i Tel." June 1960. 10 pp. The paper deals with the requirements to input-outputs characteristics of logic elements to provide stable operaion of ring or long circuits consisting of such elements. The conditions which are necessary for getting characteristics of the circuits of such kind consisting of identical logic repeaters or of identical inverters are determined. (U.S.S.R.)

An Analysis of a Mixed π-Network Equivalent Circuit of a Semiconductor Triode and of the y-Parameter Dependence on Frequency, V. K. Labutin. "Radiotek," 15, No. 5 1960. 6 pp. Shown and derived is the variation with frequency of y-parameter associated with a π-network type of a semiconductor triode equivalent circuit. A general family of equations and relations are given, which help in engineering designs of high frequency circuits with semiconductor triodes. Some of the data given is plotted on graphs. (U.S.S.R.)

Design of I.F. Transistor Amplifier, R. Urich and J. Czerniewski. "Prace ITR." Vol. 4, No. 1(10). 34 pp. A measuring method is given of transistor parameters as a function of frequency, emitter current and collector voltage. The design methods of resonance amplifiers based on known transistor parameters and magnetic characteristics of coupling transformers for the required frequency band are described. (Poland.)

The Influence of Nonlinear Resistance on Amplitude Stability of Bridge Oscillator, F. Kaminski. "Prace ITR." Vol. 4, No. 1(10). 15 pp. The paper discusses the influence of nonlinear resistance on amplitude stability of bridge oscillator. Formulae indicating the influence of the type of nonlinear element used on oscillation amplitude deviation are given. (Poland.)

Design Hints for Full-transistorizing AM/FM Receivers, R. Wagner. "El. Rund." June 1960. 3 pp. Basic transistor formulas by Ebers and Moll are quoted and equations thereof are derived for modulation distortion, limiting of oscillation amplitudes, and mixer transconductance. In addition, hints are given for dimensioning mixer stages, showing also transistor limits with respect to modulation distortion. (Germany.)

Two-terminal Network Impedance Curves Through Given Points. Supplements to the Interpolation by PICK and NEVANLINNA, H. Frank. "Nach. Z." May 1960. 3 pp. The problem is to connect a network of resistive, capacititive and inductive elements across 2 terminals so that for a finite number of given frequencies the network presents predetermined impedances. This task is solved by a reduction to the interpolation by PICK

REGULARLY REVIEWED

AUSTRALIA

AWA Tech. Rev. AWA Technical Review
Proc. AIRE. Proceedings of the Institution of Radio Engineers

CANADA

Can. Elec. Eng. Canadian Electronics Engineering
El. & Comm. Electronics and Communications

ENGLAND

ATE J. ATE Journal
BBC Mono. BBC Engineering Monographs
Brit. C.&E. British Communications & Electronics
E. & R. Eng. Electronic & Radio Engineer
El. Energy. Electrical Energy
GEC J. General Electrical Co. Journal
J. BIRE. Journal of the British Institution of Radio Engineers
Proc. BIEE. Proceedings of Institution of Electrical Engineers
Tech. Comm. Technical Communications

FRANCE

Ann. de Radio. Annales de Radioelectricite
Bull. Fr. El. Bulletin de la Societe Francaise des Electriciens
Cab. & Trans. Cables & Transmission
Comp. Rend. Comptes Rendus Hebdomadaires des Seances
Onde. L'Onde Electrique
Rev. Tech. Revue Technique
Telonde. Telonde
Toute R. Toute la Radio
Vide. Le Vide

GERMANY

AEG Prog. AEG Progress
Arc. El Uber. Archiv der Elektrischen Uebertragung
El Rund. Electronische Rundschau
Freq. Frequenz
Hochfreq. Hochfrequenz-technik und Electroakustik
NTF. Nachrichtentechnische Fachberichte
Nach. Z. Nachrichtentechnische Zeitschrift
Rundfunk. Rundfunktechnische Mitteilungen
Vak. Tech. Vakuum-Technik

POLAND

Arch. Auto. i Tel. Archiwum Automatyki i Telemechaniki
Prace ITR. Prace Instytutu Tele-I Radiotechnicznego
Roz. Elek. Rozprawy Electrotechniczne

USSR

Avto. i Tel Avtomatika i Telemakhanika
Radio. Radio
Radiotek. Radiotekhnika
Rad. i Elek. Radiotekhnika i Elektranika
Iz. Acad. Bulletin of Academy of Sciences USSR.

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CIRCUITS (continued)

and NEVANLINNA. This latter problem is additionally treated for this purpose. (Germany.)

An Extension of the Possibilities for Filter Circuit Combinations by Means of Regions with an Imaginary Characteristic Impedance in the Passband and Regions of a Resistive Characteristic Impedance in the Stopband, W. Herzog. "Nach. Z." June 1960. 5 pp. (Germany.)

A Digital to Analogue Converter for the Numerical Control of Synchros, H. G. Lott. "rt." May 1960. 6 pp. In this article the author deals with the application of a 3-phase current transformer having a hexagon and a 6-phase star winding, as a digital to analogue converter, translating decimal input signals into proportional voltage components in position control systems with synchros. (Germany.)

Decoding Circuits Using Semiconductors. E. Oehme. "Hochfreq." April 1960. 9 pp. A number of decoding circuits and the components needed for them are discussed, to get a basis for determining their economic usefullness. The necessary semiconductors for the different functions of the decoding circuit is weighed against the additional capabilities of the circuit. The question is treated, whether a higher transmitting capability or different complex circuits are economic when the effect of noise in the channel is to be minimized. (This article is an abstract of the author's doctor's thesis.) (Germany.)

Basic Transistorized Networks, A. Haidekker. "rt." May 1960. 4 pp. Owing to various specific transistor characteristics considerable advantages can be derived from their application in control system networks. In this contribution a survey is given of the possible uses of transistors by discussing some essential networks, e.g., signal choppers, constant phase amplifiers, power amplifiers, pulse and numerical circuits. (Germany.)

Phase-Shift Oscillator Design for Given Harmonic Distortion, E. A. Freeman. "El. Tech." July 1960. 5 pp. (England.)

Single-Control Element Wien Bridge with Variable L, C or R, E. R. Wigan. "El. Tech." June 1960. 9 pp. A great variety of apparatus uses the Wien bridge as the basis of design; the modified version described here has the same field of application and has the added advantage that the performance of the network is determined by one control-element only, as distinct from the two which are essential to the Wien bridge. (England.)

COMMUNICATIONS

A Classification of Exchange Equipment by Performance Characteristics, H. Muller. "Nach. Z." June 1960. 5 pp. The new performance characteristics as proposed in the form of coefficients by the "Nachrichtentechnische Gesellschaft" facilitate a comparison between the performance conditions of exchange equipments of different sizes and for different loading factors. (Germany.)

Planning the new Broadcast Transmitter at Motala, Ernst Magnusson and Folke Stranden. "Rundfunk." June 1960. 8 pp. The ultimate aerial array will consist of 6 masts, i.e., a central mast of height 250 meters and 5 others arranged in a circle at a radius of 630 meters from the central mast. (Germany.)

Wireless Studio-Control Equipment, A. Rettig, et al. "Rundfunk." June 1960. 11 pp. In addition to describing general aspects and going briefly into experiments carried out to produce a low-frequency installation, the paper describes an amplitude-modulated short-wave installation and a frequency-modulated very-long-wave installation. (Germany.)

Let's Take a Look at the Canadian Radio Technical Planning Board, R. C. Poulter. "El. & Comm." July 1960. 3 pp. A spectacular example of co-operation between industry and government—over 200 electronics engineers serve on the Board's committees and panels. (Canada.)

Film Processing and After-Processing Treatment of 16-mm Films, L. J. Wheeler. "BBC Mono." #30. 14 pp. This monograph, which is based on a paper read at the SMPTE Convention in May 1960, describes a daylight-operated continuous film-processing equipment used in the BBC Television News Film Service, a series of experiments designed to test and compare after-processing treatments, the adoption of Eastman Over-all Wax treatment as a protective coating immediately following the processing operation, and the installation of suitable equipment to provide this service. (England.)

Electronics and Communications in Sweden. "Brit. C&E." June 1960. 4 pp. In 1958, Sweden was one of Britain's biggest overseas markets for radio, television and capital electronic equipment. In 1959, however, Sweden dropped to eighth place in the U.S.'s export table, in spite of the fact that the total amount of Swedish electronic imports increased by 25%. The reasons for this falling-off of trade with one of the most prominent Outer Seven countries, are discussed in detail in a number of articles and special features in the February 1960 issue of the Economic Review published by the British-Swedish Chamber of Commerce in Sweden. The survey below consists principally of extracts from this source. (England.)

COMPONENTS

The Influence of the Combination Current Components on the Selection of the Intermediate Frequency, V. M. Dneprovsky. "Radiotek," 15, No. 4, 1960. 10 pp. A general method is described of analyzing the influence of combination components of a mixer current on the selection of the IF frequency. For different tunable superheterodyne types of receivers, formulae were obtained, allowing to determine the significance of the intermediate frequencies, which prevent reception on additional channels, caused by the mixer current combination components. Two methods of producing the basic signal of the intermediate frequency $fr > fc$ and $fr < fc$ are compared. (U.S.S.R.)

Reliability Characteristics of Resistances and Capacitors, B. S. Sotskov and S. E. Rostkovskaya. "Avto. i Tel." May 1960. 6 pp. Methods of presenting reliability characteristics for resistances and capacitors versus temperature of environment and dissipated power or applied voltage are considered (U.S.S.R.)

Resistivity Tests of Metal Parts of Variable Condenser Type KPOM 450 and Lubricants to High Humidity Tropics, S. Gil. "Prace ITR." Vol. 4, No. 1(10). 7 pp. The aim of the investigation of materials among others the conductive lubricants, preliminary selected in a separate work, and determination of the degree and corrosion intensity on metal parts. (Poland.)

The Properties and the Performance of Tantalum Capacitors with a Solid Electrolyte, W. Ackmann. "Nach. Z." June 1960. 5 pp. Measurement results relating to the temperature response and the frequency response of the capacity and the loss factor in tantalum capacitors are given in this paper. (Germany.)

Problems Relating to Heavy Current Cable Induction in Telecommunication Cables with Insulated Metallic Cable Sheaths, E. Widl "Nach. Z." May 1960. 8 pp. (Germany.)

The Field Effect and its Applications, A. V. J Martin. "El. & Auto." May 1960. 6 pp. Two new devices, based on this effect, have been developed in France: The tecnetron and the alcatron. The tecnetron is already known. It seems to be a potential competitor for transistors, particularly at high frequencies. The alcatron is a new device. It seems to hold promises of obtaining sizeable power outputs at high frequencies. For the first time, the alcatron is the subject of a complete technical description. (France.)

GENERAL

Maximum Noise-proof Features of Systems with Discrete Signals, I. L. Teplov. "Radiotek," 15, No. 4, 1960. 6 pp. This article noise-proof features of systems with discrete signals are determined for coherent and incoherent reception. Maximal noise-proofing is evaluated by recording the correlation of instantaneous noise values. Corresponding to maximum noise-proof features is the so-called limiting extent by which the signal exceeds the noise (during coherent and incoherent reception respectively). Functions are formulated of an ideal receiver realizing maximum noise-proofing. Applied is the most simple method of signal and noise amplitude envelopes. (U.S.S.R.)

Certain Relationships in Systems for Optimum Signal Detection. (Continuation from "Radiotek," 15, No. 2, 1960.) L. S. Gutkin. "Radiotek," 15, No. 4, 1960. 6 pp. This article is a continuation of the article which appeared in "Radiotek," 15, No. 2, 1960. In this final part the author discusses aspects of pulse train detection by means of binary detection and m-alternative recognition and detection. (U.S.S.R.)

Effect of Random Processes on Sampled-Data Systems, G. I. Pyatnitsky. "Avto. i Tel." May 1960. 10 pp. The problems of statistical calculation of sampled-data systems effected by stationary random processes are considered. A particular case of effect of non-stationary random process is analyzed as well. It is shown that the method of statistical linearizing can be used to approximately calculate non-linear system as it is used for calculation of continuous non-linear systems. (U.S.S.R.)

Continuous Difference Counting of Two Non-synchronous Pulse Series, M. Kalthoff. "El. Rund." June 1960. 6 pp. A genuine difference counter in which each decade forms a ring having 10 bistable components and which can be operated in forward and backward directions by 2 separate channels is described. (Germany.)

The Betatron and its Application in Materials Testing, K. W. Kanngiesser. "El. Rund." June 1960. 4 pp. The betatron radiation is highly suitable for non-destructive material testing and will penetrate up to 20 in. of steel. The extremely small focal spot is excellent for fault detection. (Germany.)

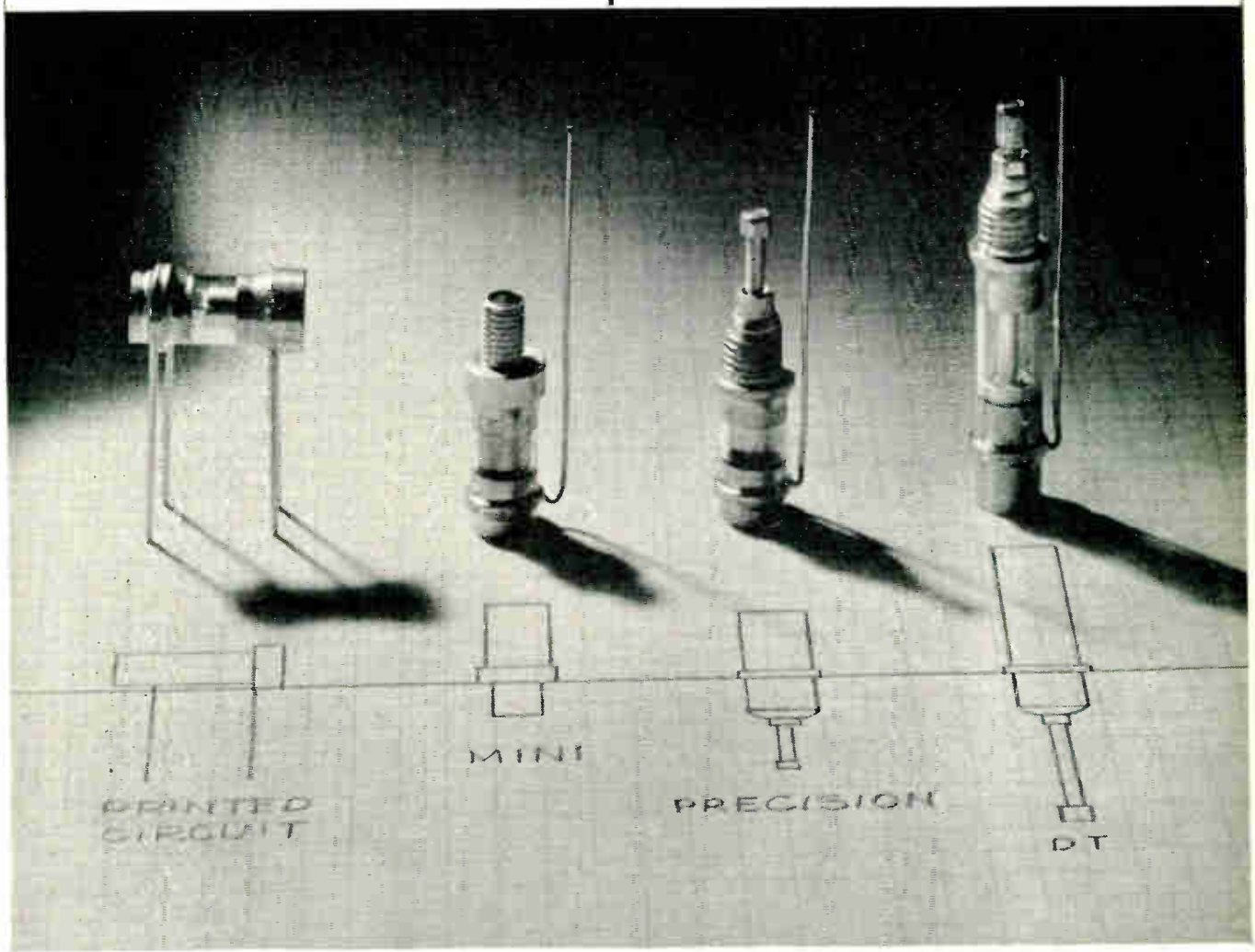
The Measurement of Soil Compression in Filled up Cable Trenches by Means of Gamma Rays from Radioactive Sources, G. Lemm and W. Reusse. "Nach. Z." June 1960. 2 pp. The measuring arrangement for the determination of the density of the soil in filled up cable trenches has been improved on the basis of results from practical field tests. (Germany.)

A Transistorized Radiation Monitor, M. van Tol and F. Bregman. "Phil. Tech." No. 7, 1960. 6 pp. Portable radiation monitors are an obvious case in which transistors can be used to advantage. As measuring instruments, however, the circuit employed must be

(*Continued on page* 186)

TYPICAL VALUES FOR DIRECT TRAVERSE TRIMMERS	
DC Volts	1000
Dielectric Strength	1500
Megohms IR	10^6
Q Factor @ 50 MC	500
TC	±50 to ±100

	Range	Mini-Trimmers	Precision DT	Standard DT
SIZES	0.5-3	—	—	X
	1-4	X	X	—
	1-8	X	X	X
	1-12	X	X	X
	1-18	X	X	—
	1-30	—	X	—



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Sources

(*Continued from page* 184)

so designed that the readings are insensitive to the transistor characteristics (which may shift considerably with changes of temperature). A circuit of this kind is described. (Netherlands, in English.)

An Automatic Dew-Point Hygrometer Using Peltier Cooling, P. Gerthsen, et. al. "Phil. Tech." No. 7, 1960. 5 pp. The most accurate method of measuring the humidity of a gas is to determine the dew point. The cooling required for this purpose can be obtained by utilizing the Peltier effect of a combination of certain semiconductors. A description is given of a dew-point hygrometer based on this principle. (Netherlands, in English.)

Electronic Measurement of Torque, M. Guiot. "El. & Auto." May 1960. 2 pp. It is possible to measure simultaneously torque and speed and obtain power by direct reading. (France.)

Microwave Gain Measurement with Random-Noise Sources, L. G. Sebestyen. "El. Tech." May 1960. 2 pp. It is customary to use a gas-discharge tube noise source on the production line of microwave amplifiers, receivers, etc., not only to obtain noise figures, but also as a "signal generator" for gain measurements. The gain of the amplifier under test appears to be different from the true gain of a noise source is used instead of the signal generator. The reason for this is explained and a diagram is provided which enables the operator to interpret the obtained data correctly. (England.)

Atmospheric Noise Structure Measuring Equipment for 15 kc/s-20 mc/s, C. Clarke. "El. Tech." May 1960. 8 pp. Equipment is described for measuring parameters of atmospheric radio noise as received on an omnidirectional aerial. (England.)

The Screening Micrometer—A New Principle for Measuring Small Movements, B. E. Noltingk. "Brit. C&E." June 1960. 6 pp. Certain limitations of conventional resistive, capacitive, inductive and photoelectric pick-ups are first reviewed. A new type of transducer is then described in which the coupling between coils is varied by a screen moving between them. The sensitivity of the device is such that movements of 1 micron and less can be readily measured. (England.)

Low-Frequency Noise Generator with Gaussian Distribution, D. A. Bell and A. M. Rosie. "El. Tech." June 1960. 5 pp. (England.)

Phase-Measuring Equipment, for V.L.F. Propagation Investigations, G. E. Ashwell and C. S. Fowler. "El. Tech." July 1960. 4 pp. The equipment described was developed to investigate the phase difference between the signals from a single low-frequency (v.l.f.) transmitter received at two sites simultaneously. (England.)

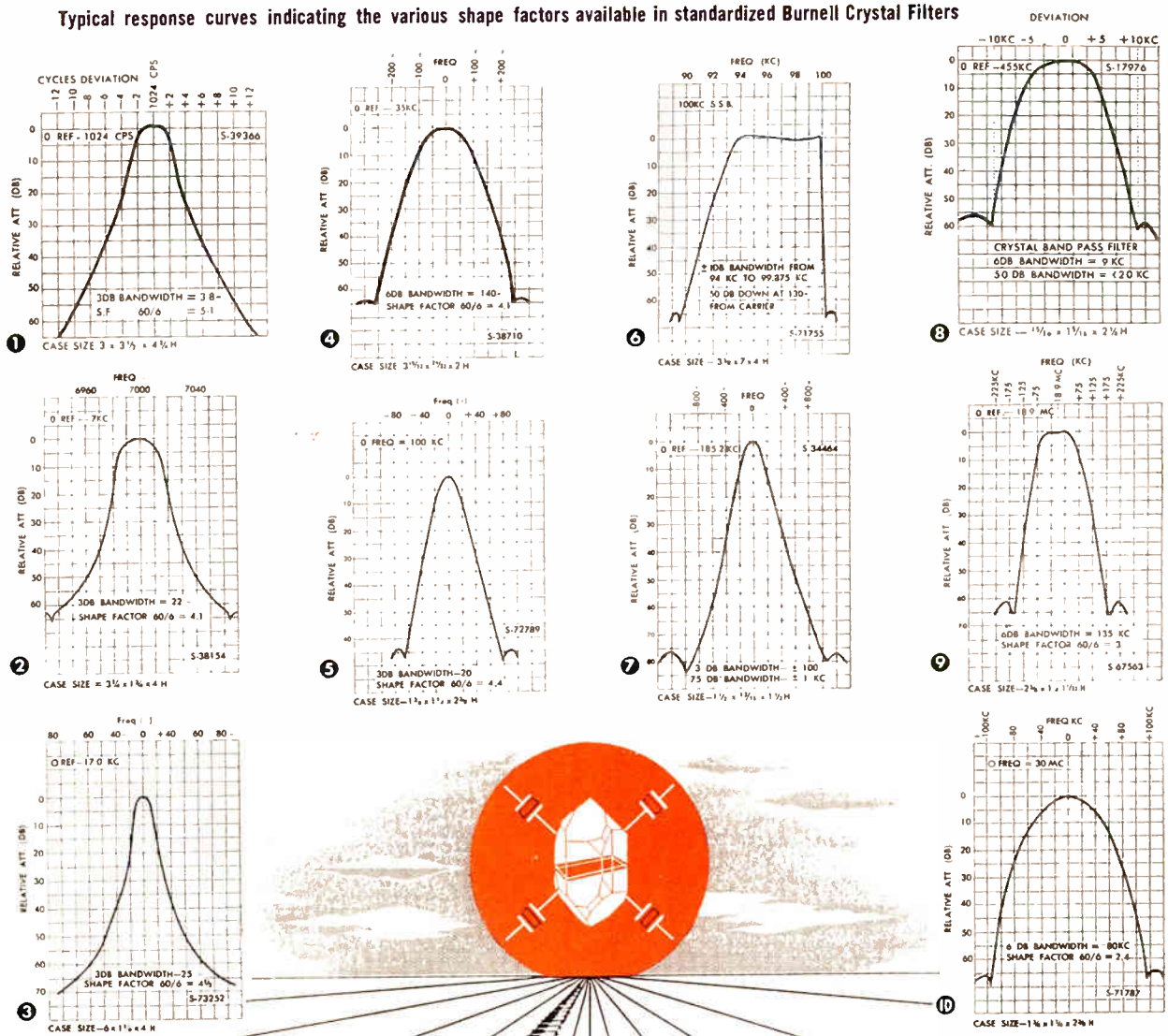
F.R.E.S.C.O.—An Airborne Frequency Meter with Digital Output, John Ackroyd. "Brit. C&E." July 1960. 6 pp. To assist in performing certain high accuracy pressure measurements required in missile development, a vibrating cylinder pressure transducer has been introduced. (England.)

Q of Resonant Cavities Measurement by Phase-Shift Method, M. Y. El-Ibiary. "El. Tech." July 1960. 3 pp. (England.)

B.O.A.C.'s Boeing 707: Communications and Navaids, R. O. Bradley. "Brit. C&E." July 1960. 6 pp. British Overseas Airways Corp. has now taken delivery of the first of its new Boeing 707s and the performance, cabin comfort and decor of these remarkable aeroplanes have been the subjects of wide publicity and acclaim. The aeroplane's radio and radar installation is fully covered in this article. (England.)

(*Continued on page* 188)

Typical response curves indicating the various shape factors available in standardized Burnell Crystal Filters



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Sources

(*Continued from page* 186)

RADAR, NAVIGATION

The Development of Equipment for Bandwidth Compression of Radar Signals by Means of Storage Capacitors and the Applications for Such Equipment, K. Jekellius. "Nach. Z." May 1960. 9 pp. After a summary of the tasks of radar picture links, the redundance in radar video signals is discussed and the optimum integration store for this task is determined. (Germany.)

Infra-Red Radar, Surveillance and Communications, Part I, C. M. Cade. "Brit. C&E." June 1960. 5 pp. (England.)

A Survey of British Marine Communications and Navigation Equipment, S. T. Andrews. "Brit. C&E." June 1960. 10 pp. With its strong maritime interests, Britain is most intimately concerned with the safety of life at sea, and the electronics industry is well advanced in all classes of communications and navigation equipment. This survey presents the essential details of the vast range of such equipment that is currently available from British manufacturers. (England.)

Infra-Red Radar, Surveillance and Communications, Part 2, C. M. Cade. "Brit. C&E." July 1960. 8 pp. In this second section of the article, consideration is first given to the techniques of passive microwave radiometry and far-infra-red surveillance; features common to both include the absence of transmitters and operation upon the radiation emitted by the target purely as a result of its temperature. The article concludes with some notes on infra-red communication links. (England.)

TELEVISION

Two Methods for Determining the Field-strength Values of the Signal and the Noise for Television Reception in Regions with Multipath Reception, H. Bodeker. "Nach. Z." May 1960. 6 pp. (Germany.)

A Contribution to the Choice of the Carrier Frequency as well as of the Bandwidth of the FM Stages and of the Circuit Arrangement of Magnetic-tape Recording Equipment for Television Signals, Wolfgang Dillenburger. "Rundfunk." June 1960. 17 pp. (Germany.)

A Wide-Band Waveguide Directional Coupler, B. M. Mashkoutzev, L. Z. Bensman, A. A. Chochrev. "Radiotek," 15, No. 4, 1960. 10 pp. One of the methods to measure the reflection coefficient of the load, using directional coupling, is to compare fields in the auxiliary branches of the two directional couplers. One of these is adjusted to indicate the incident wave, the other—the reflected wave. Devices based upon this principle may be called reflectometers, with separate indication of the incident and reflected waves respectively. In this work, the authors investigate the requirements for the waveguide parameters, which would insure the necessary precision with which the coefficient of reflection will be measured, for the case of separate indication of the incident and reflected waves. Offered are a method of design and results of experimental analysis of the directional coupler, whose parameters are within allowable limits in the frequency band, exceeding 20% in width. (U.S.S.R.)

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TRANSISTORIZED POWER SUPPLIES

—small, lightweight and regulated

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Units feature constant voltage output as battery discharges. Only 1/5 weight and ½ size of comparable dynamotors. Withstands short circuit indefinitely, input voltage transients of 60 volts for 0.01 seconds, and 50 volts indefinitely at reduced power. Output voltage and frequency drift: ±3.0% from −55° to +71° C. Fully encapsulated and hermetically sealed. A/N Cannon connectors (designated "A"), wire-lead pigtail ("B"), and solder-lead terminals ("C"), are standard.

Model 591H-C

DC to DC	Model 591H-C
Input Voltage:	24-30 VDC
Output Voltage:	25-1200 VDC
Output Power:	60 watts (max.) regulated
Regulation:	±1.0% for 6V line variations ±1.5% for 25% load variations
Ripple:	0.3% RMS
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Model 591AC-B

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Input Voltage:	24-30 VDC
Output Voltage:	115 VAC, 400 cps, 1 phase
Output Power:	50 V.A. square wave
Regulation:	Frequency and voltage: ±1.0% for 6V variations of line voltage; ±1.0% for 25% variations of load
Size and Weight:	3" OD x 3" high; 19 oz.

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Input Voltage (nominal):	24, 26 or 28 VDC
Output Voltage:	115 VRMS (other voltages available)
Output Frequency:	400 cps (other frequencies available)
Output Power:	40 volt-amps (±0.9, minimum, power factor)
Regulation:	Freq. and voltage: ±1% for 6V line variations at specified load
Harmonic Distortion:	4% (Max.) RMS, at any load
Size and Weight:	2½" x 4" x 2½" high; 32 oz.

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HOW TO ORDER:

Specify Model number and letter followed by termination desired (see above), nominal input voltage, output voltage, frequency, and load.

Example:

591J	—	A	—	28	—	115	—	400	—	40
Model		Termination "A", "B", or "C"		Nominal Input Voltage		Output Voltage		Output Frequency		Load—Watts or VA

Relays

(*Continued from page 83*)

Exploded view of the Printact relay shows the basic elements. Printed wiring board is not an integral part of the relay.

cal linkages and return springs eliminates a major source of relay troubles and maintenance costs.

The relay is accurately positioned on the printed circuit board by studs which pass through punched holes in the board. It is held in position by a simple spring. Only the coil terminals require soldering.

Materials Research Center

An interdisciplinary center for basic research in materials has been established at Northwestern Univ. under a contract with ARPA (Advanced Research Projects Agency). The center will study materials' structure and properties—areas are metallurgy, ceramic science, solid-state physics, chemistry, solid-state mechanics, surface phenomena, and polymer science.

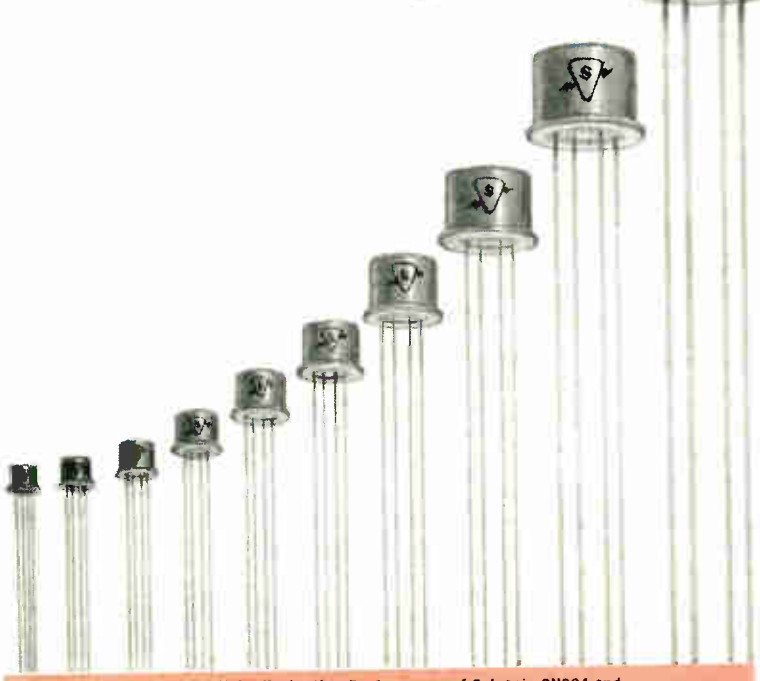
The center will have 18 special labs. New equipment will include an electron microscope and gauss magnet. The purpose is not to develop new materials directly but to uncover new basic information on materials' properties and behavior. Budget will top $2.2 million in about four years. Cornell and the Univ. of Pennsylvania have similar programs.

• *fast speed* • *high breakdown voltage* • *electrical uniformity*
• *excellent stability* • *exceptional reliability*

...outstanding features of

SYLVANIA DRIFT TRANSISTORS

...in switching service!

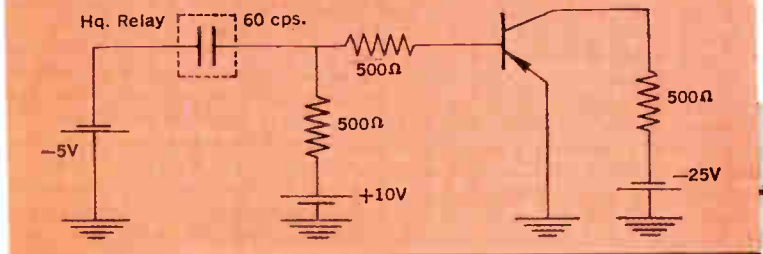


The relatively low base resistance and collector capacitance and the high gain bandwidth products that characterize SYLVANIA DRIFT TRANSISTORS make them especially well-suited to high-speed switching service in electronic computer applications.

Tight guard bands and stringent processing and materials controls assure a high degree of electrical uniformity. Welded seals and continuous life-tests for every "lot" assure extraordinary capabilities under rugged environmental conditions.

Prices and delivery information are available now at your local Sylvania Field Office *or* your local Sylvania franchised Semiconductor Distributor. For technical data write Semiconductor Division, Sylvania Electric Products Inc., Dept. 1910, Woburn, Mass.

Test Circuit for Evaluating Performance of Sylvania 2N604 and 2N645 Drift Transistors in Switching Service with Resultant Data.



Characteristics	Time in mμSec.
Delay time t_d	30-40
Rise time t_r*	10-20
Storage time t_s	120-380
Fall time t_f*	10-20
Turn on (typical)	60
Turn off (typical)	260

*Estimated — rise time and fall time observed in same order as rise time of 'scope.

OUTSTANDING FEATURES OF KEY SYLVANIA DRIFT TRANSISTORS

2N602	10 Mc (min.) gain bandwidth product
2N603	30 Mc (min.) gain bandwidth product
2N604	50 Mc (min.) gain bandwidth product
2N624	20 db pwr gain (min.) at 12.5 Mc. Meets all requirements of MIL-T-19500/82 (SigCorps)
2N643	20 Mc (min.) gain bandwidth product
2N644	40 Mc (min.) gain bandwidth product
2N645	60 Mc (min.) gain bandwidth product
2N1224	17 db pwr gain (min.) at 12.5 Mc
2N1225	15 db pwr gain (min.) at 50 Mc
2N1226	60 Volts V_{CB} version of 2N1224

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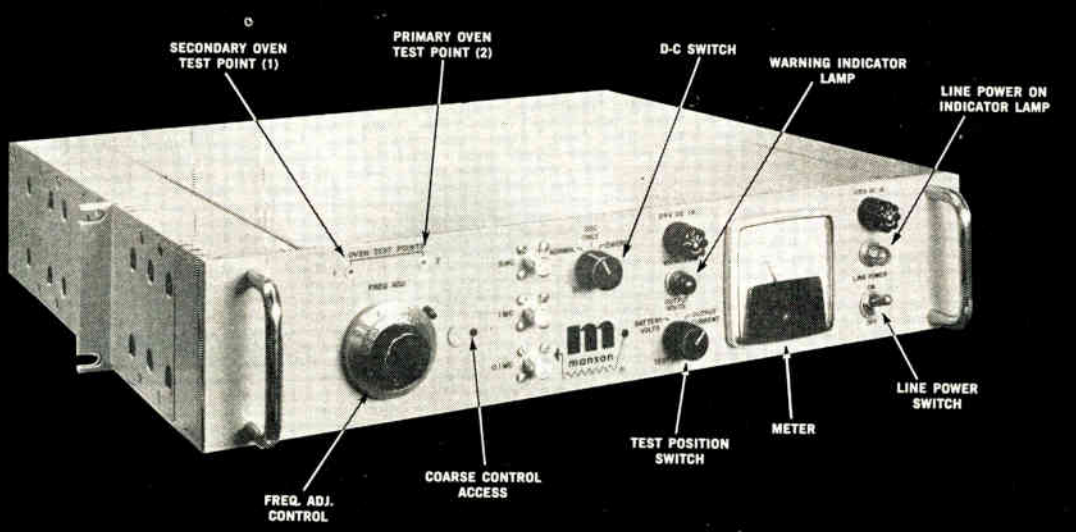
Circle 130 on Inquiry Card



New, Transistorized, Low-Cost

FREQUENCY STANDARD by MANSON!

5 MC, 1 MC and 100 KC HIGH STABILITY FREQUENCY STANDARD, Model RD-180

- **Output Frequencies:** 5 Mc, 1 Mc, and 100 kc.
- **1 Mc and 100 kc (simultaneous) Output Levels:** 1 volt rms +50/−10%.
- **5 Mc Output Level:** 25 mv. into 1K ohm load.
- **Output Impedance:** 1 Mc & 100 kc into 50 ohms.
- **Ambient Temperature Range:** 0°C to 50°C.
- **Ambient Humidity Range:** 0 to 95% RH.
- **Warm-up Period:** 6 hours.
- **Frequency Stability (after 4-month aging) under following conditions:**
  1. ±5 parts in 10^{10} per day.
  2. 25°C Ambient ±25°C: ±5 parts in 10^{10}.
  3. ±20% Change in 50-Ohm Load: ±2 parts in 10^{10}.
  4. 28 vdc Input Changed ±4 vdc: ±1 part in 10^{10}.
- **Frequency Adjustment:** 500 parts in 10^9 total.
  Fine frequency adjustment:
  150 parts in 10^9 for 15 revolutions.
  1 part in 10^8 per revolution.
  1 part in 10^{10} per division (100 divisions per revolution).
  Coarse frequency: 350 parts in 10^9.
- **Input Voltage Requirement:** 115 vac ± 10%, 50-400 cps.
- **Emergency Battery Operating Time (full operation):** 24 hours.
  1. **Temporary Standby (Osc. only):** 48 hours.
  2. **Extended Standby (Coarse Oven only):** 3 days.
- **Overall Dimensions:** 19" wide x 17 3/16" deep x 3 15/32" high.
- **Weight:** 45 lbs. (with batteries).

Data Subject To Revision Without Notice

STABILITY
±5 PARTS IN
10^{10}
PER DAY

The Manson Model RD-180 Frequency Standard provides highly stable output frequencies of 5 Mc, 1 Mc and 100 kc for use in frequency control systems. The design objective was to construct a precision-engineered device with uncompromised reliability and performance.

Included is an emergency battery source to provide continuous operation with automatic switchover in the event of line failure.

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Circle 131 on Inquiry Card

Tele-Tech's ELECTRONIC OPERATIONS

The Systems Engineering Section of ELECTRONIC INDUSTRIES • OCTOBER 1960

SYSTEMS—WISE . . .

▸ The CONELRAD program has been augmented by the FCC to include a continuity of service plan for the Emergency Broadcast System (640 and 1240Kc). In the event of enemy attack, the President and other officials will be able to communicate with the general public prior, during and following same.

▸ **Project Echo's Coordinate Conversion Computer and Digital Servo, built for NASA, by Computer Control Co.'s Western Div., is a key part of JPL's tracking station in Goldstone, Calif. It continuously directed two huge microwave transmitting and receiving antennas to track the 100-foot aluminum-coated satellite orbiting 1000 miles above the earth.**

▸ The Television Code Review Board of the NAB (National Association of Broadcasters), now located temporarily in the Transcontinent Television Corp. offices at 380 Madison Ave., will move to new permanent quarters in Suite 2110 of the Time and Life Bldg., 1271 Avenue of the Americas (Sixth Ave.) around October.

▸ **A new, extremely compact Univac Advanced Electronic Navy Computer, "heart of the new Naval Tactical Data System (NTDS)," collects, processes and evaluates naval tactical data and recommends courses of action in virtually "zero" time. It was developed for the Navy by the Remington Rand Univac Military Div., St. Paul, Minn.**

"PHANTOM" FIELD TESTS

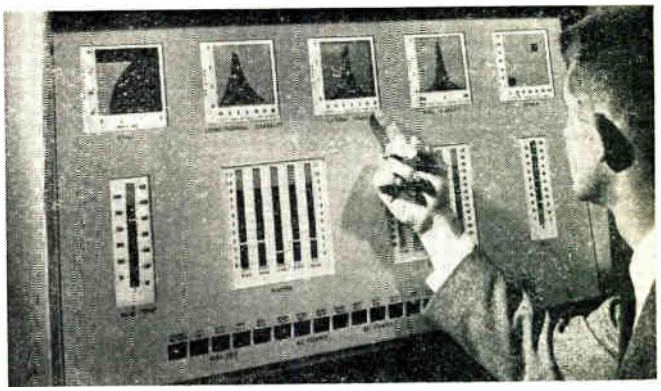
Three-tiered 100-ft. antenna is given final adjustments in order to receive signals at various frequencies during recent field tests of PHANTOM Broad-band Communication System. Antenna was erected at G. E.'s Heavy Military Electronics Dept., Syracuse, N. Y.

▸ **A new Airborne Digital Data Processor, the DP-167 Computer has been developed by Westinghouse Electric Co. for the Military. Consisting of an operand memory, an instruction memory and an arithmetic and control unit plus a power supply, its first application is to a track-while-scan radar detection system to keep track of multiple target information and to display the tactical situation.**

▸ **Feasibility of long-distance transmission on low radiated power, using 20-KC signals, has been established by Boulder Labs' (NBS) new standard frequency radio station (WWVL) at Sunset, Colorado, radiating 15 watts. Signals have been received 9,000 mi. away.**

▸ **Alpha Corp., a subsidiary of Collins Radio Co., Dallas, Texas, is providing the Navy with a communications and data processing system which will permit an entire naval task force to be coordinated almost to the point of operating as one ship. Data links will provide scattered units with target information and coordination of missile power with interceptor aircraft. Other major project contractors are Remington Rand Univac and Hughes Aircraft Co.**

MANNED VEHICLE MONITOR SYSTEM



—tells at a glance the immediate condition of a pilot and the craft he is flying! Designed by ITT for the AF Flight Test Center, Edwards AFB, Calif., the Console comprises two units: Vehicular and Physiological. Vehicular panel indicates structural strain, fuel, power plant behavior, vehicle skin temperature and flutter. Flight Surgeon can tell pilot's heart rate, blood pressure, temperature, breathing rate and volume, and environmental info, oxygen supply, radiation count.

▸ **Aircraft manufacturers and component suppliers have been asked to contribute to the improvement of U.S.O. facilities in areas most needed for off-post G.I. recreation (near rocket and missile bases in remote and isolated areas) by Avco Corp. President, Kendrick R. Wilson, Jr. He is chairman of the New York City U.S.O. Drive. Headquarters is at 236 E. 46th St., N. Y., N. Y.**

▸ First of three BMEWS stations has been completed at Thule, Greenland. The second, the CLEAR station, will be ready next year virtually on schedule, despite strikes, jurisdictional disputes and fire; and preparatory work is being done on the third station at Frylindales Moor in Yorkshire, England. RCA is prime contractor.

▸ **Airborne Identification Coders will be used in all Air Force planes. The airborne transponders provide a selective reply when challenged by an interrogator located at a remote source. Telecomputing Corp.'s Value Engineered Products, Inc., Monterey Park, Calif., has received an $800,000 contract to develop, manufacture and assemble the equipment for AMC, Aeronautical Systems Center.**

▸ "Operation Ballot" is a joint RCA, NBC, C-E-I-R enterterprise to prepare the RCA 501 for processing the 1960 Presidential Election. The computer will project the winner, the electoral vote split; the total popular vote and the popular vote split. These projections will be continually updated throughout election eve.

By JAMES M. McKENDRY,
GEORGE GRANT
and JOHN F. CORSO
HRB-Singer, Inc.
State College, Pa.

Assessing Maintainability

It is a known fact that the cost of equipment maintenance greatly exceeds the initial equipment cost. With the suggestions made here it is possible to reduce maintenance costs by 50%.

IT is known that the cost of maintaining electronic equipment greatly exceeds initial construction costs.[1] The implications of this expense, in terms of both time and money, have become especially important in the field of military electronics. One attempt at improving this situation, which aims at decreasing the number of potential failures, has been termed the "reliability" approach.

Other attempts at correcting the problem have been aimed at something called "maintainability," but the exact meaning of this term has not been clear. We will attempt to specify the term in quantitative fashion, provide empirical estimates of its present status, and suggest techniques for facilitating future improvements in problems of maintainability.

Maintainability Defined

The utility of a definition of maintainability is determined by two main factors: (a) the degree to which it includes all of the basic elements of the maintenance process, and (b) the degree to which maintainability can be quantitatively expressed. Therefore, it will be necessary to describe the actions required of a servicing technician prior to presenting the definition of maintainability.

The servicing of equipment may be conceptualized as a series of functional steps along a time continuum, with each taking some amount of time. The conceptualization is shown diagrammatically in Fig. 1. This figure indicates the steps and the time delays associated with them.

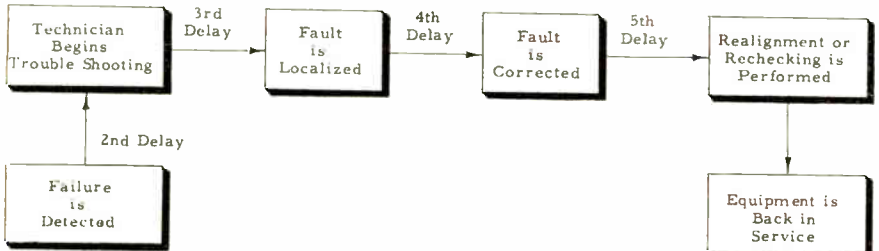


Fig. 1 (above): Diagram illustrates the steps and the time delays associated with equipment failures that occur.

Fig. 2 (below): Chart shows the results of tests to find the amount of time required to effect equipment repairs.

	One Technician	Two Technicians	More Than Two Techs.
Localization Time	30.9	86.2	109
Correction Time	28.2	52.3	124
Number of Cases	72	128	58

There are five delays and, with the exception of the second, all are "unavoidable" since some amount of time has to be spent on each. However, it is possible to reduce the second delay to a point approaching zero if either of two policies is adopted: (a) a technician is always kept on hand, or (b) maintenance actions are simplified to a point where the operator can perform them. It is likely that either, or both, of these policies would be adopted when the value of "down time" was especially important as is the case in certain critical military or civilian equipments. Therefore, the second delay cannot be considered "basic" to the maintenance process.

The four remaining delays associated with the performance of maintenance functions may be grouped under three headings: (a) the first delay can be termed the

This research was supported by the U. S. Navy under Contract N 61-339-330, monitored by the Flight Trainers Division, Human Engineering Department of the U. S. Naval Training Device Center, Port Washington, N. Y. The opinions and conclusions in this report are those of the authors and are not to be construed as reflecting the view or endorsement of the Department of the Navy.

detection time, (b) the third delay is the localization time, and (c) the sum of the fourth and fifth delays is the correction time. The validity of this subdivision of maintenance functions has been supported by empirical data.[3] The authors obtained estimates of the localization and correction times for a sample of 258 electronic failures[a] and found that these two times were almost completely independent, or unrelated. Although no data are available regarding the relation of detection time to either localization or repair times, it seems reasonable to assume that these will also be independent, or at least there is no reason to suspect an interrelation among the three times.

The significance of this partially demonstrated and partially inferred independence is that the three elements can be combined to arrive at a meaningful figure for an equipment's maintainability; and, more important, attempts at increasing maintainability must consider each step as a separate problem requiring a unique solution.

On the basis of this information, it seems reasonable to conclude that *maintainability can be defined as the speed with which troubles are detected, localized, and corrected.* While the definition offered above is merely a logical extension of ideas already expressed, it has certain advantages over previously offered definitions. For example, it has been suggested that maintainability, m, be defined as the mean net time to repair failures, u, expressed as a reciprocal,[6] $M = 1/u$. Also, Munger and Willis have suggested that it is the "rapidity and facility with which preventative maintenance can be performed and malfunctions diagnosed and corrected."[5]

It can be seen that, on the basis of the two criteria suggested for determining the utility of a definition of maintainability, the first of the previously suggested definitions meets one of them by being sufficiently quantitative; but it does not meet the other. The adequacy of the term "repair" is questionable since, if it is taken to include both localization and repair times, it is too gross for use; and, if it is taken to include only repairs without localization, it is too specific for use. While the Munger and Willis definition has a more acceptable content, it lacks a clear statement of how this definition can be quantitatively expressed. For these reasons, the definition offered here seems more acceptable.

Empirical Estimates of Maintainability

An empirical estimate of the present status of maintainability was obtained by having technicians record fault localization and correction times as they serviced electronic failures on training devices. The results of the survey are reproduced in Fig. 2. In order to permit generalization, an attempt was made to chose training devices which were similar to other electronic equipment.

In Fig. 2, it can be seen that disregarding detection time, the average "maintainability" of electronic training devices is approximately 120 minutes. Even if only simple troubles, i. e., those involving one technician, are considered, it is still no lower than approximately 60 minutes. It seems apparent that these time values could stand considerable improvement.

Additional estimates of localization time, e. g., time required to locate a faulty component, were obtained by the authors in another study utilizing technicians.[2] In this case, fault-localization times were carefully recorded as technicians located troubles in two equipments: (a) a simple superheterodyne receiver, and (b) a more complex radar pulse simulator.[b] In addition, two skill levels of technicians were studied: those just completing a basic military electronics course, and those with more advanced schooling and experience.

The time estimates obtained in this study were comparable to those obtained from the failure reports discussed in the previous section. For example, the best average localization time recorded was 20 minutes. But this low value was only for the experienced men.

(*Continued on page* 198)

a. Actually, 362 reports were gathered but some had to be disregarded in certain comparisons since they were only partially completed.

b. The receiver was produced for the Naval Training Devices Center and is available in Training Kit No. 26K-1. The simulator was manufactured by HRB-Singer, Inc. (HRB Pulse Signal Simulator Model No. 6023-01).

Frequency Meter

(Concluded)

shown in Fig. 1. Six transistors are used which operate from a single 1.34v mercury cell. The crystal oscillator is a Pierce oscillator, transistor Q3, whose output is mixed with the generator signal in transistor Q2. The resulting beat frequency output is direct-coupled to amplifier Q1. The output for the oscilloscope is taken at this point.

A bias stabilizing circuit is used with transistors Q1 and Q2 which uses the 0.5v forward drop of silicon diode D1. Additional amplification is provided by transistors Q4, 5, 6 to operate the self-contained loudspeaker. The current drain on the mercury cell varies between 6 and 11 ma depending upon the audio level. A pushbutton switch is provided to conserve the life of the cell.

The crystal oscillator is adjusted to a standard frequency of 1 MC with capacitor C1. A generator signal input of 1 millivolt at 1 MC provides a strong audible tone. The beat-frequency output for the oscilloscope is about 10 mv; an average output of 5 mv is available from 200 KC to 20 MC. The usable frequency range is from 20 KC to 70 MC.

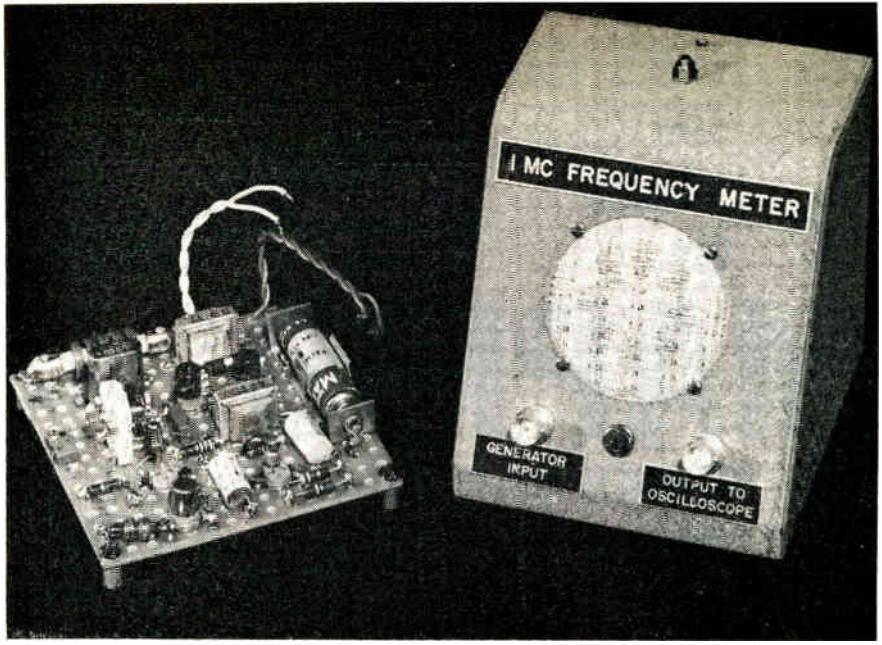


Fig. 2: Comparative size of the frequency meter and the layout of the parts. A fundamental frequency of 1 megacycle is used.

Maintenance

(*Continued from page* 195)

Inexperienced men took considerably longer, and when their scores were combined with those of the experienced men, an average value of 25-30 minutes was obtained.

From the results of both studies, it seems that the current maintainability value for a relatively simple electronic trouble is 60 minutes or more. For more complex troubles, it becomes much higher, about 120 minutes. Unless equipments have extremely low failure rates, these values would result in a great deal of equipment "down time."

Suggestions for Improving Maintainability

The improvement of maintainability is not an easy task which can be accomplished in a casual manner. It is necessary to make a fairly intensive effort before any appreciable results can be obtained. However, the difficulty of making these efforts has been diminished by the publication of some detailed maintainability handbooks.

An early guide to maintainability was written by Folley and Altman.[1] More recently, an exhaustive treatment of this area has been presented in *Maintainability Handbook for Electronic Equipment Design*[4]. This latter reference contains numerous suggestions and summarizes most of the available work on maintainability. The results of new research are also included. Since this handbook is readily available, no specific suggestions will be made in this article. However, some general guidelines will be given.

The authors feel that the present value of maintainability can easily be improved 50% by making a number of specific changes.[c] The first is to use a packaging (construction) method which will enhance maintainability. Some new packaging methods have been devised and evaluated by the authors.[2] One of them has been shown to decrease fault localization time as much as 40% below its present level. In addition, since these new methods use easily replaceable plug-in units, fault correction time should be decreased considerably below its present level. When combined, the savings in both localization time and correction time should result in at least a 50% average improvement in maintainability.

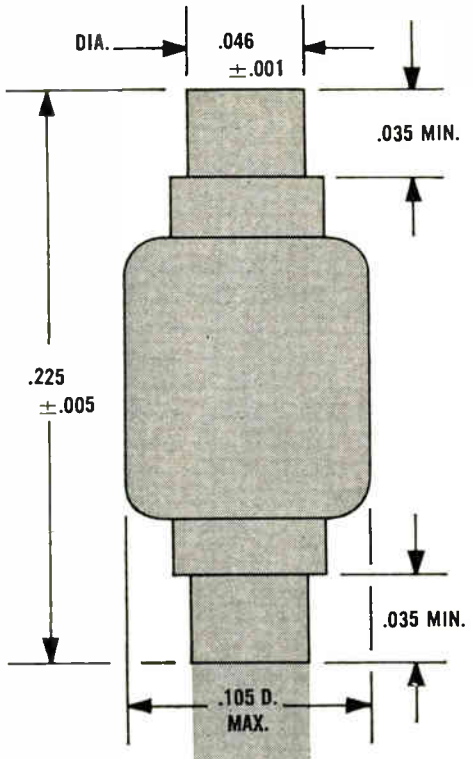
Further reductions in maintenance time can be achieved by the use of special "cookbook" type troubleshooting manuals. This possibility has been discussed in the previously mentioned handbook.[4] Further attention to this problem has been scheduled as part of the U. S. Navy's program on maintenance. Results of this new work should be available within the next year.

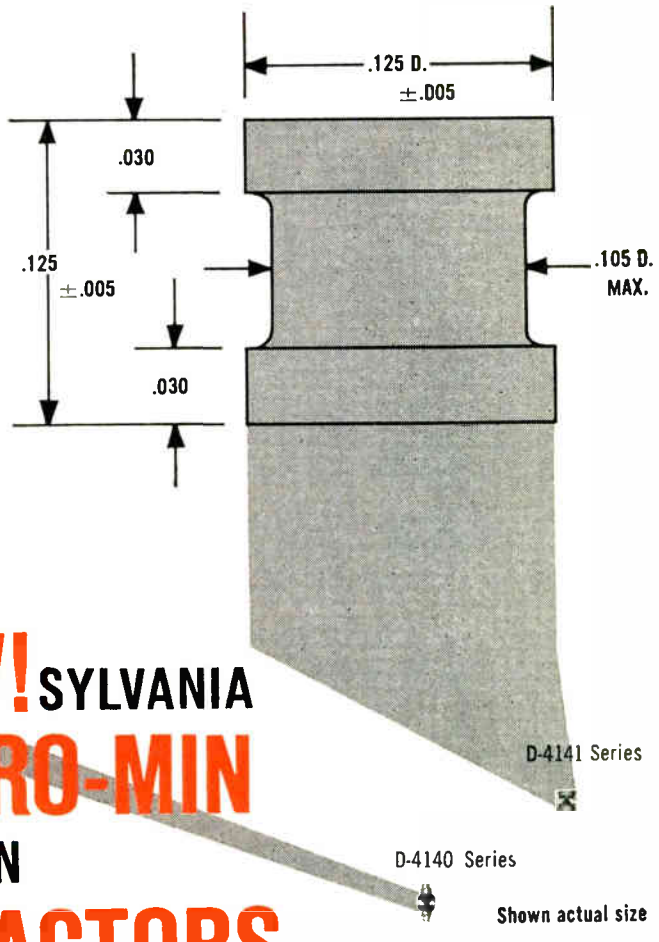
A third suggestion concerns the analysis of the technician's task to insure that the physical and psychological demands placed upon him are reasonable. For example, he may not be able to carry all of the necessary servicing equipment at one time; therefore, valuable time is lost as additional trips are made. Furthermore, the arrangement of servicing operations may not be in a sequence which takes maximal advantage of the technician's habits and preferences.

The final suggestion concerns the minimization of time by the use of automatic fault detection and localization equipment, along with plug-in replaceable units. If this suggestion is followed, the entire servicing time could be reduced to considerably less than ten minutes. However, it must be remembered that the addition of the automatic

(*Continued on page* 202)

c. It is also possible that the need for more than one technician servicing a single trouble might be decreased by application of the same methods.





NEW! SYLVANIA MICRO-MIN SILICON VARACTORS

ELECTRICAL CHARACTERISTICS AT 25° C.

Micro-Min Varactor Type		Junction Capacitance $\mu\mu$f. (max.)	Cut-Off Frequency KMC (min.)
D-4140A	D-4141A	3.0	30
D-4140B	D-4141B	2.0	40
D-4140C	D-4141C	1.8	50
D-4140D	D-4141D	1.4	60
D-4140E	D-4141E	1.0	70

in two easy-to-mount microminiature packages

Sylvania complements its MICRO-MIN microwave diode family with two series of even tinier microwave components—MICRO-MIN VARACTORS—using silicon material and Mesa structure. Both packages are hermetically sealed, use low-loss glass, and offer environmental ruggedness. Electrically similar, they are now available in types with minimum cut-off frequencies ranging from 30 KMC to 70 KMC. 100 KMC types soon will be announced.

VARACTOR series D-4140 features a package with gold-plated precision axial mounting studs and cylindrical glass case. You will find it easy to design a drop-in mounting for D-4140 VARACTORS. VARACTOR series D-4141 utilizes a glass package with gold-plated end caps—suitable for clip-in mounting.

Designing microwave products? Include the advantages of compactness and reliability offered by Sylvania MICRO-MIN VARACTORS. For price and delivery information, contact your Sylvania field office or your local Sylvania Franchised Semiconductor Distributor. Or, for technical data on specific MICRO-MIN VARACTOR types, write Semiconductor Division, Sylvania Electric Products Inc., Dept. 1910 Woburn, Massachusetts.

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CUES for Broadcasters

Tape Unit Modification

EUGENE A. CHASE, Ch. Eng.
WKJG, Fort Wayne, Ind.

An inexpensive modification may be made on Collins Tape Units to prevent the drive motors from running continuously while not in actual use.

Before modification the system is designed so that the motor runs continuously as long as the power switch is on; to turn the power switch off also turns off the audio tubes in the unit requiring at least 30 seconds of warm-up time.

We modified the circuit so that the amplifier was on continuously and the motor started only when a tape cartridge was inserted.

To do this, first remove both wires from the microswitch SW 104 and connect them together. Remove the two wires on the ac switch SW 101 that go to the motor and the solenoid control circuits. Tie these wires on to 1 terminal of SW 104, run a jumper from the other side of SW 104 back to the point on the ac switch where these wires were disconnected. Next remove the ready lamp socket PL 102 and tape the wires so they will not short. Install a neon type 110v ac pilot lamp and socket in place of PL 102 and connect it across the motor circuit. This completes the modification.

We have made this modification and have found no problems with it.

A Modification for Gates RMC 12

GEORGE F. PROVINCE
KBTN, Neosho, Mo.

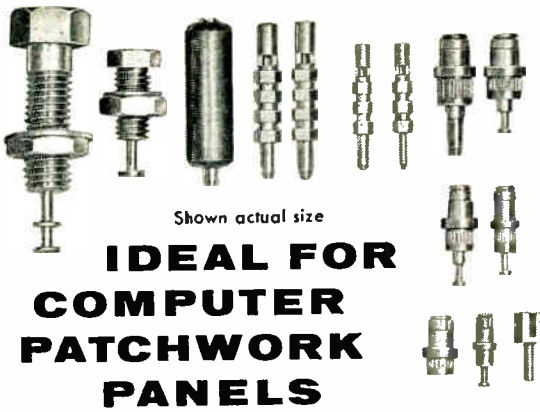
The Gates RMC12 remote control unit has proven itself quite reliable when properly maintained. One item of care, and so stated in their instruction manual, is the weekly frequency alignment of each control oscillator to its respective selective amplifier or receiver.

It is normally necessary for two persons to be available for these adjustments, one at the studio to key and adjust each oscillator, and one at the transmitter site to guide him through these adjustments by monitoring the voltage readings of each selective receiver relay control tube cathode.

This procedure may be reduced to one person who can perform this necessary task quite easily. This is possible only if the station is not making use of all ten remote metering functions. It is felt that most users of the RCM12 will have at least two and probably four steps of their metering selector free. Our system has four unused steps and is thus described.

Connect a 10K to 20K resistor from each cathode of the four 6SN7 relay control tubes of the selective receivers to the last four segments of the receiver stepper. The cathode connections are available at each receiver at its respective female chassis connector. (Refer to your circuit diagram for proper identification.) The stepper section used is that one

(*Continued on page* 204)



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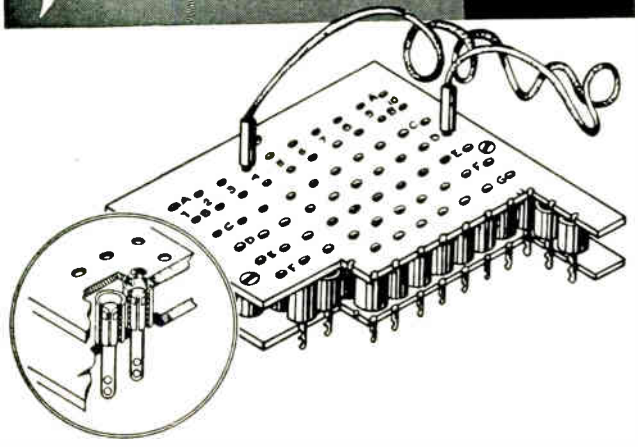

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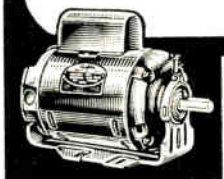

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CUES

(*Continued from page* 200)

which is visible by back view of the chassis. The resistors may be connected in the order of measurement that you desire. This will provide cathode voltages for measurement at the studio. Since original wiring to the stepper terminates at TB-103, pairs #6 through #9, of these four steps, they are unused and the wiring is left intact.

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Connect a lead from TB-1, terminal #9 to the positive or red pin jack. Connect a lead from TB-1, terminal #2 to the negative or black pin jack. For metering, any dc voltmeter of 1000 ohms per volt or better may be used that will indicate from 20 to 30 volts on the same range. To align the oscillators, key each one and dial up that particular cathode voltage readout. A miniature clip type jumper is quite helpful, connecting from the tone amplifier input bus to each oscillator output as required. All of these connections are available at the tone control switches.

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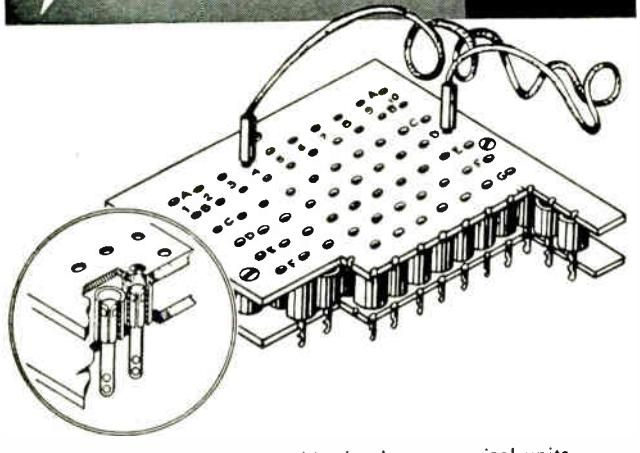

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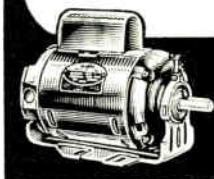

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Maintenance

(*Continued from page* 198)

equipment will not help if it causes more trouble than it corrects, nor will it help if it is inaccurate in operation.

Summary

This article has attempted to evaluate the present status of maintainability. It began with defining maintainability as the speed with which troubles are detected, localized, and corrected. Then, empirical data were cited which estimated that (on the average) sixty minutes are required to service simpler electronic troubles, and 120 minutes or more are required to service more complex troubles. The final section of the paper suggested ways of increasing maintainability. These were of three general types: (a) design changes, (b) improvement of manuals, and (c) study of the maintenance task. Appropriate sources of data, i. e., existnig maintainability handbooks, were discussed briefly.

References

1. Folley, J. D., Jr., and Altman, J. W., *Guide to Design of Electronic Equipment for Maintainability.* Pittsburgh, Pa.: American Institute for Research, 1 April 1956.

2. McKendry, J. M., Corso, J. F., Grant, G., and Scheihing, F., *An Experimental Investigation of Equipment Packaging for Ease of Maintenance.* Port Washington, N. Y.: U. S. Naval Training Device Center, Technical Report 330-1-2, July 1959.

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4. McKendry, J. M., Grant, G., Corso, J. F., and Brubaker, R., *Maintainability Handbook for Electronic Equipment Design.* Port Washington, N. Y.: U. S. Naval Training Device Center, Technical Report 330-1-5, September 1959.

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6. *Proceedings of the EIA Conference on Maintainability of Electronic Equipment.* New York, N. Y.: Engineering Publishers, 1958.

7. Runyon, R. P., *Maintenance Problems Anticipated as a Result of Subminiaturization.* Port Washington, N. Y.: U. S. Naval Training Device Center, August 1957.

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(*Continued from page* 200)

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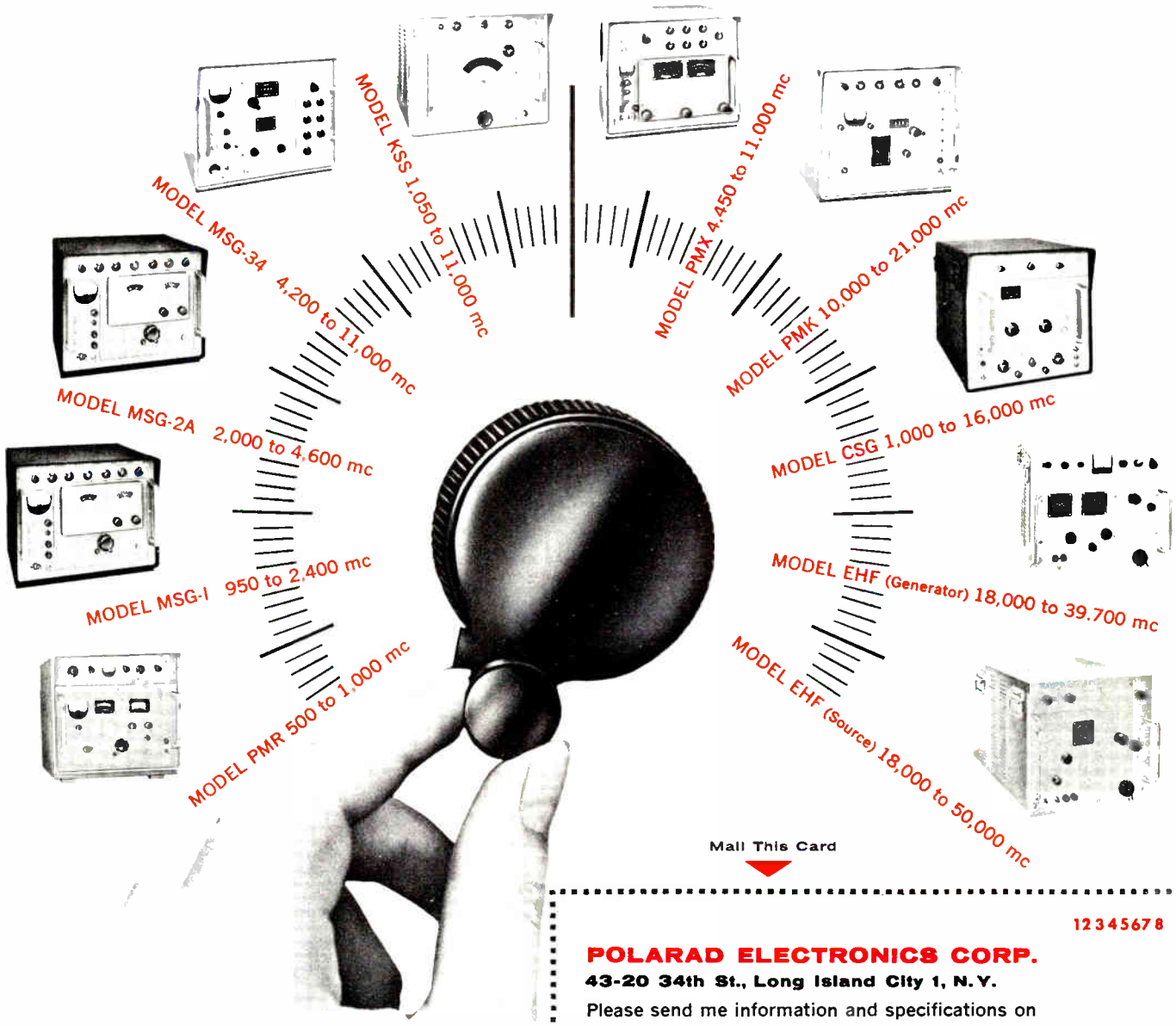

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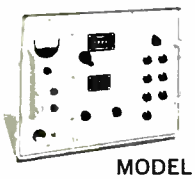

MODEL MSG-34

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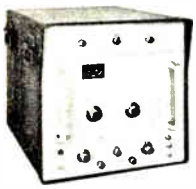

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MODEL PMX

MODEL PMK

MODEL EHF (Generator)

MODEL EHF (Source)

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MODEL MSG-34	4,200 to 11,000 mc	Widest frequency range in a single instrument
MODEL KSS	1,050 to 11,000 mc	Compact high power signal source with plug-in tuning units — internal modulation
MODEL PMX	4,450 to 11,000 mc	Calibrated 1 milliwatt signal generator with complete modulation capability
MODEL CSG	1,000 to 16,000 mc	Higher power sweep generator
MODEL PMK	10,000 to 21,000 mc	Wider modulation capabilities — calibrated 10 milliwatt output
MODEL EHF (generator)	18,000 to 39,700 mc	High frequency signal generator — operates on fundamentals
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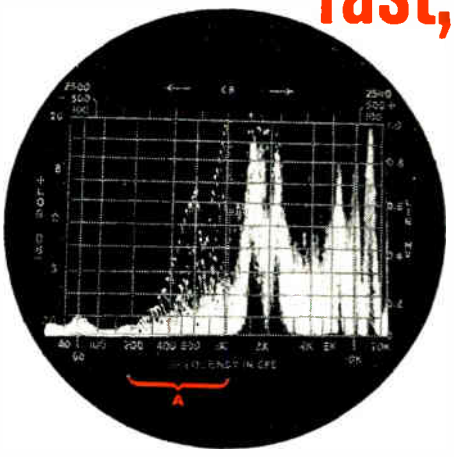

"Coast-down" analysis of Gyro Motor by Model LP-1a Spectrum Analyzer. Area A shows decreasing fundamental frequency, resonant rise and decay, and vibration components over 60 successive scans in one minute.

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SONIC SPECTRUM ANALYZER
20 cps-22.5 kc.

The Model LP-1a "quick-look" helps locate and evaluate discrete or random signals faster and easier by scanning the entire spectrum logarithmically from 40 cps to 20 kc. Once every second it automatically separates, measures and plots the frequency and voltage of waveform components on the calibrated X and Y axes, respectively, of a long persistence 5" CRT.

For very detailed analysis, linear segments 40 to 5000 cps wide, centerable between 0 and 20 kc, may be magnified on the screen.

Amplitude ratios of up ta 40 db can be simultaneously measured.

High sampling rate and panoramic displays assure:

1 Minimum risk of missing weak signals or spectrum holes.
2 Fast measurements by eliminating slow point by point plots.
3 Simultaneous measurement of signals with widely divergent amplitudes and/or frequencies.
4 Continuous analysis of rapid changes in spectral content or design parameters.

Proved in hundreds of research, design and production installations, the LP-1a is a valuable tool for Noise and Vibration analysis • Harmonic and IM Measurements • General waveform studies • Power Spectral Density Analysis • Response Curve Tracing

SUMMARY OF SPECIFICATIONS:

Frequency Range: 20 cps—22.5 kc.
(1) Preset linear frequency scans: any segment width of 200, 1000, 5000 cps centerable from 0-20 kc; Variable from 40 cps to 5000 cps with Auxiliary Function Unit C.
(2) Preset Lag Scan—40 cps to 20 kc.
Frequency Scales: Linear and Log
Center Frequency Control: Calibrated 0-20 kc (used on lin scan)
Dynamic Range: 60 db
Amplitude Scales: Linear and 2 decade log (Expandable to 60 db)
Sensitivity: 500 μv to 500 v for full scale linear deflection
Voltage Accuracy: Lin Sweep (40 cps—22.5 kc): ±5% or ±0.5 db. Log Sweep (40 cps—20 kc): ±10% on lin. ampl. scale, ±1.5 db on log ampl. scale.
Scan Rate: 1/sec., internally generated; adjustable with accessory equipments
Resolution: For log scan, automatically optimized. For lin scan, preset 30, 75 and 170 cps at 200, 1000 and 5000 cps sweepwidth, respectively. Variable from 10 cps to 1 kc with Auxiliary Function Unit C.

HIGHLIGHT FEATURES:

- 1-sec. "quick-look" at entire spectrum (40 cps—20 kc)
- Magnified analysis on reduced sweep widths
- Direct reading frequency—selective voltmeter
- Exceptionally stable circuitry: better than 5 cps/hr.
- Economical
- Simple Operation

dependable CERTIFIED SPECIFICATIONS for accurate data

Write, wire or phone NOW for detailed information and specifications on the Model LP-1a

See Panoramic's growing range of versatile instruments . . . in dynamic action . . . at

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Oct. 19-20—Cherry Hill Inn, Phila.-Moorestown, N. J.

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Panoramic RADIO PRODUCTS, INC.

July, 1960 Gov. Contract Awards

(Continued from page 19)

Computers, range	85,656
Connectors	34,392
Consoles	43,859
Control, intercom	62,904
Controls, radio	210,279
Controls, static	107,417
Converters	650,370
Couplers, antenna	271,116
Data transfer system, radar	2,963,046
Delay lines	53,984
Detectors, radar	225,081
Direction finders	989,575
Discriminators	56,055
Dome, sonar	146,400
Enclosures, electromagnetic shielding	46,537
Feedback assemblies, antenna	327,568
Frequency standards	60,302
Fuel cells	141,259
Galvanometers	90,000
Generators, X-ray	39,817
Generators, special purpose	527,231
Generators, signal	60,988
Gyroscopes	3,123,453
Handsets	37,112
Hardware, electronic	57,339
Headsets, microphone	825,137
Helix coils, antenna	49,716
Homing sets, radar	960,000
Indicators, special purpose	1,302,290
Intercoms	481,387
Intervalometers	95,588
Ion sources	86,850
Isolators, waveguide	81,470
Loran	85,350
Measuring set, trajectory	707,544
Memory system, digital	116,284
Meters, field strength	43,090
Meters, frequency	368,283
Meters, ohm	211,558
Meters, volt	52,864
Meters, watt	67,214
Monitoring systems	275,000
Multicouplers, antenna	49,950
Multimeters	47,699
Multipliers, r-f	49,888
Multiplex equipment	204,340
Oscillators	2,448,260
Oscillators, BW	28,230
Oscillographs	37,932
Oscilloscopes	970,000
Paper, recording	26,460
Phasemeters	290,143
Power supplies	529,369
Pre-amplifiers	42,398
Radar	24,124,696
Radar, doppler	4,424,926
Radiac sets	844,447
Radiometers	60,175
Radio sets	2,127,465
Radomes	803,370
Reactors	26,250
Readouts	100,000
Receiving array, fixed buoy	275,000
Receivers, homing	28,108
Receivers, loran	985,000
Receivers, radio	2,076,728
Receivers, sonar	934.713
Recorders	179,759
Recorder/reproducers	974,264
Recorders, video tape	65,320
Regulators, circuit	12,480
Relays, armature	95,439
Rectifiers	80,984
Resistors, variable	124,873
Simulators, radar signal	171,502
Slides, recording	55,222
Sonar equipment	275,020
Spectrometers	84,585
Spectrometers, mass	45,363
Spectrographs	50,075
Standards, voltage-current	132,320
Stations, call signal	113,555
Suppressors, radar signal	149,416
Switchboard equipment	475,429
Systems, telemetry	28,129
Systems, TV	31,315
Synthesizers	67,200
Tape, electronic	164,819
Tape transport	51,724
Telemetry equipment	1,518,327
Telephone equipment	1,112,679
Teletypewriter sets	204,230
Terminal equipment	177,544
Test sets, radar	568,136
Testers, rocket circuits	29,582
Testers, transponder	1,928,000
Testers, vibration	43,365
Transceivers, radio	1,198,576
Transducers	70,049
Transformers	87,377
Transistors	32,745
Transponders	2,594,775
Transmitters, coordinate data	12,894,376
Transmitters-receivers	1,793,952
Transmitters, rate of flow	37,369
Transmitters, radio	803,325
Tubes, electron	1,211,064
Tubes, klystron	82,500
Tubes, magnetron	452,559
Tubes, thyratron	38,808
Tuners, antenna	45,000
Vibrators	41,644
Wire, electronic	59,770

NEREM Program

(Continued from page 104)

"Component Failure Rates Associated with Installation Environment," D. Earles, Martin Co., Denver, Colorado.
"Proprietory Items—Latent Hazards," D. B. Christian, Bendix, Mishawaka, Ind.
"How Much Component Reliability is Justified," N. Cook, Westinghouse, Baltimore, Md.
"Optimization of Park Application Data," John Youtcheff and Thomas Weir, General Electric, Philadelphia, Pa.

Wednesday Afternoon, November 16, 1960 — **Sheraton-Plaza Hotel**

SPACE ELECTRONICS—II

Chairman: L. M. Hollingsworth, Air Force Combridge Reseorch Laboratory, Bedford, Moss.
"The Able-Five Communicotion System," Paul F. Glaser, Space Technology Lobs, Inc., Los Angeles, Calif.
"Optical Doppler for Spoce Navigation," R. G. Franklin and D. L. Birx, Fronklin Institute, Philadelphio, Pa.
"An Attitude-Control System for a Communications Sotellite," Richard W. Whealan, G. E. Missile Systems, Philadelphia, Pa.
"Geometry of Satellite Communications," F. W. Sinden, Bell Telephone Laboratories Murray Hill, N. J.

Wednesday Afternoon, November 16, 1960 — **Sheraton-Plaza Hotel**

STANDARDS AND MEASUREMENTS

Chairman: R. A. Soderman, General Radio Company, West Concord, Mass.
"Better Standards Through Better Understanding," J. F. Hersh, General Radio Company, West Concord, Mass.
"A Sonic Thermometer for the Measurement of Gas Temperatures," P. Felsenthal, Allied Research Associates, Inc., Boston, Mass.
"Analysis of a Detector Circuit Using a Semiconductor Diode," T. C. Anderson, Hewlett-Packord Company, Palo Alto, Calif.
"Dissemination of Standard Frequency by VLF Transmission," J. C. Williams, Pickard & Burns, Inc., Needham, Mass.

Wednesday Afternoon, November 16, 1960 — **Sheraton-Plaza Hotel**

THE NEW DOD PROGRAM FOR RADIO-FREQUENCY COMPATIBILITY

Chairmon: E. T. Buxton, Jr., Consultant, Concord, Mass.
"Electromagnetic Compatibility Prediction," W. H. Tetley, AFCCDD, Hanscom Field, Bedford, Mass.
"Radio Frequency Control Through Initial Design," C. E. P. Keen, Welex Electronics Corp., Mass.
"New Developments in Microwave RFI Instrumentation," B. Rosen, Polarad Electronics Corp., Brooklyn, N. Y.
"Filters for Harmonic Suppression," V. Price G. E. Microwave Lab, Palo Alto, Calif.

Wednesday Afternoon, November 16, 1960 — **Commonwealth Armory**

ENGINEERING WRITING AND SPEECH

Chairman: A. H. Cross, Raytheon Co., Burlington, Mass.
"Human Responses, A Vitol Link in Communications Progress," B. Dudley, Advanced Development Division, Laboratory for Electronics, Boston, Mass.
"Commercial Instruction Manuals for Electronic Instruments," F. T. Van Veen, General Radio Company, West Concord, Mass.
"Transfer of Technical Information Through Man-to-Man Contact," E. D. Spear, General Electric Company, Syracuse, N. Y.
"How Can We Gain By Improving Our Writing and Speaking Ability," R. Kendall, Raytheon Company, Waltham, Mass.

Wednesday Afternoon, November 16, 1960 — **Commonwealth Armory**

Circuits II

Chairman: S. S. Shamis, New York University, New York City, N. Y.
"Transformer Logic Circuitry," D. Hinkein, IBM, Poughkeepsie, N. Y.
"A Simplified Method for the Determination of the Noise Performance of Low-Frequency Amplifiers," A. E. Sanderson and R. G. Fulks, General Radio Company, West Concord, Mass.
"Low Noise Preamplifier Investigation," J. J. Klein and K. Miller, Radio Corporation of America, Burlington, Mass.
"Design Techniques for Grounded-Grid Amplifiers with Controlled Gain," J. W. Rush, General Electric Company, Owensboro, Ky.

Wednesday Afternoon, November 16, 1960 — **Commonwealth Armory**

(Continued on page 210)

(Continued from page 209)

RELIABILITY SYSTEMS PROBLEMS
Chairman: R. M. Jacobs, Sylvania Electric Co., Waltham, Mass.
"Sub Optimization in Design Of Complex Equipment," H. Knauss, Raytheon Company, Wayland, Mass.
"Planned Replacement," F. Proschon and R. Barlow, Sylvania Electric Co., Mt. View, Calif.
"Reliability Progress: 1950-1960," R. Knight, ARING Research Corp., Washington, D. C.
"Reliability Research: 1960-1965," Lt. Col. T. T. Brundage ARDC Andrews Air Force Base, Washington, D. C.

Wednesday Morning, November 16, 1960 — **Murray Hall, Boston Naval Station**

ASW (Classified Sessions)
(Sponsored by: Bureau of Naval Weapons, Department of the Navy)
Chairman: L. Mautner, Hughes Aircraft Co., Culver City, Calif.
"The Characteristics of Submarine Targets and Their Environments," L. Treitel, Bureau of Ships, Dept. of the Navy, Washington, D. C.
"Review of Non-Sonic Methods of Detection," R. Weller, Stromberg-Carlson Company, Rochester, N. Y.
"Airborne ASW Radar Requirements," W. Van Zeeland, University of Chicago, Chicago, Ill.
"Airborne System Problems in ASW," Lt. Cmdr. H. R. Cody, Naval Air Development Center, Johnsville, Pa.

Wednesday Afternoon, November 16, 1960 — **Murray Hall, Boston Naval Station**

ASW (Classified Session)
(Sponsored by: Bureau of Naval Weapons, Dept. of the Navy)
Chairman: Cmdr. J. S. Rasmussen, Bureau of Naval Weapons, Dept. of Navy, Washington, D. C.
"Magnetic Anomaly Detecting," David Bleil, Naval Ordnance Labs, Silver Spring, Md.
"Monte Carlo Analysis of ASW Target-Weapon Relationship," Theodore Guinn, Douglas Aircraft Co., Inc., El Segundo, Calif.
"IR Wake Detection," G. Ewing, Scripps Institution of Oceanography, Univ. of California.
"The NADC Sonobuoy Program," W. Gleiter, Naval Air Development Center, Johnsville, Pa.

Wednesday Evening, November 16, 1960 — **Sheraton-Plaza Hotel**

NEW FRONTIERS IN SPACE ELECTRONICS
Chairman: E. I. Hawthorne, Avco Corporation, Wilmington, Mass.
Panel Members: L. M. Hollingsworth, Air Force Cambridge Research Laboratory, Bedford, Mass.; D. C. Prim, Convair Astronautics, San Diego, Calif.; M. B. Greenlee, Johns Hopkins University, Silver Spring, Md.; F. W. Lehan, Space Electronics Corp., Glendale, Calif.; W. K. Victor, Jet Propulsion Labs, Pasadena, Calif.; Paul F. Glaser, Space Technology Laboratories, Inc., Los Angeles, Calif.; D. L. Birx, Franklin Institute, Philadelphia, Pa.; R. W. Whealan, G. E. Missiles Systems, Philadelphia Pa.; F. W. Sinden, Bell Telephone Labs, Murray Hill, N. J.

Wednesday Evening, November 16, 1960 — **Sheraton-Plaza Hotel**

ADEQUACY OF TODAY'S ENGINEERING EDUCATION FOR TECHNOLOGY OF THE 60's
Chairman: F. K. Willenbrock, Harvard University, Cambridge, Mass.

Wednesday Evening, November 16, 1960 — **Sheraton-Plaza Hotel**

ENGINEERING MANPOWER UTILIZATION
Chairman: L. Mautner, Hughes Aircraft Company, Culver City, Calif.
Panel Members: INDUSTRY: J. H. Fletcher, Space Electronics Corp., Glendale, Calif.; R. Tait, Sr., General Dynamics Corp., Rochester, N. Y.; J. R. Moore, North American Aviation Inc., Downey, Calif.
Panel Members: GOVERNMENT: R. Adm. E. F. Metzger, BuWeps, Washington, D. C.; Brig. Gen. Terhune, AAFCCDD, Hanscom Field, Bedford, Mass.; Brig. Gen. W. J. Ely, U. S. Army Research-Development, Washington, D. C.

Wednesday Evening, November 16, 1960 — **Commonwealth Armory**

(Informal Discussion Session)

RELIABILITY FORUM
Chairman: R. M. Jacobs, Sylvania Electronic Systems, Waltham, Mass.

(Informal Discussion Sessions)

SEMICONDUCTOR SWITCHING CONCEPTS—THEIR IMPACT ON TOMORROW'S COMPUTER DESIGN

(Continued on page 212)

In PRECISION POTENTIOMETERS if it's news, expect it first from IRC

NEW

Subminiature Rotary Trimmer surpasses environmental MIL tests

You can throw the book—the tough environmental tests of MIL-R-12934B and NAS-710—at IRC 5001 precision potentiometers. These miniature rotary trimmers exceed all applicable MIL requirements. They are completely interchangeable with other makes.

Miniature size: ½" long x ½" diameter. Housing: premium quality metal case. Mounting: bushing or servo. Resistance: 50 to 150,000 ohms. Tolerance: ± 5%. Power: 2 watts at 60°C. Construction: all welded electrical connections.

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(Continued from page 210)

Chairman: Thomas A. Langa, Sylvania Electric Products, Woburn, Mass.
Panel Members: R. H. Baker, Lincoln Lab, MIT, Bedford, Mass.; D. P. Kennedy, IBM, Poughkeepsie, N. Y.; William E. Slusher, Transitron Electronic Corp., Wakefield, Mass.; D. Ackley, Texas Instruments Inc., Dallas, Texas; R. D. Lohman, RCA Laboratories, Princeton, N. J.

Wednesday Evening, November 16, 1960 — **Commanwealth Armory**

(Informal Discussion Session)

WORKSHOP ON ENGINEERING WRITING AND SPEECH

Chairman: T. Farrell, Michigan State University, East Lansing, Mich.

Thursday Morning, November 17, 1960 — **Sheraton-Plaza Hotel**

SOLID-STATE MICROWAVE-OPTICAL PHENOMENA

Chairman: I. Goldstein, Raytheon Missile Systems Division, Bedford, Mass.
"Laser—The Optical Maser," A. L. Shawlaw, Bell Telephone Laboratories, Murray Hill, N. J.
"Microwave Modulation of Light in Paramagnetic Crystals," N. Blaemberger, Harvard University, Cambridge, Mass.
"Survey of Current Millimeter Wave Research," J. Heller, MIT Lincoln Laboratory, Lexington, Mass.

Thursday Morning, November 17, 1960 — **Sheraton-Plaza Hotel**

MICROWAVE NETWORKS

Chairman: D. J. R. Stock.
"Use of Three-Dimensional Plastic Sphere Models for Representation of Impedance Transformations," E. Folke Bolinder, Air Force Research Division (ARDC), Bedford, Mass.
"The Scattering Approach to the Synthesis of Nonuniform Lines," C. B. Sharpe, University of Michigan, Ann Arbor, Mich.

Thursday Morning, November 17, 1960 — **Sheraton-Plaza Hotel**

ELECTRO-HYDRAULIC AND PNEUMATIC CONTROLS—I

Chairman: J. L. Shearer, MIT, Cambridge, Mass.
"Bang-Bang Control of an Acceleration Switching Hydraulic Servovalve," R. J. Gurski, MIT, Cambridge, Mass.
"Electro-Hydraulic Dynamometer and Starter for Laboratory Test Engine," R. L. Van Voorhies, Essa Research & Engineering Corp., Linden N. J.
J. W. Broome, The Oilgear Co., Waltham Mass.
"A Pneumatic-Hydraulic Approach to Point-to Point Positioning," E. C. Brown, Jr., Moog Servocontrols, Inc., East Aurora, N. Y.
"A Servovalve With Flow Feedback and the Dynamic Performance of a System Consisting of the Valve and an Inertia Load," S. Y. Lee MIT, Cambridge, Mass.

Thursday Morning, November 17, 1960 — **Commanwealth Armory**

ANTENNAS

"Phase Correction by Dielectric Slabs in H Plane Sectoral Horn Antennas," M. A. Quddus and J. P. German, Agricultural and Mechanical College of Texas, College Station, Tex.
"Analysis and Synthesis of Far-Field Antenna Patterns," H. Stein, AVCO, Wilmington, Mass.
"The Future of Large Antennas for Space," P. D. Kennedy and R. F. Trainer, Lockheed Missiles and Space Division, Sunnyvale, Calif.
"Automatic Tracking and Antennas for Satellite Tracking," R. C. Baker, Radiation Inc., Melbourne, Fla.

Thursday Morning, November 17, 1960 — **Commanwealth Armory**

TRANSISTORS I

Chairman: W. Smith, Raytheon Company, Burlington, Mass.
"The Saturation Resistance Concept for Transistor Specification and Circuit Design," J. S. MacDougall, Raytheon Company, Needham Heights, Mass.
"Integrated Voltage Reference Amplifier," S. Karandanis, Transitron Electronic Corp., Wakefield, Mass.
"Characteristics and Applications of Complementary Silicon Medium Power Transistors," W. F. Palmer and W. Finneault, Sylvania Electric Products, Inc., Woburn, Mass.
"Simplification of Silicon Diffused-Base-Transistor Equivalent Circuit; Its Use in the Design of Wide-Temperature Range Video Amplifiers," D. O. Oram, Texas Instruments, Inc., Dallas, Texas.

Thursday Morning, November 17, 1960 — **Commanwealth Armory**

PROPAGATION PHENOMENA

"Refractive Effects of Large-Scale Ionospheric

Irregularities," R. S. Lowrence and J. L. Jespersen, National Bureau of Standards, Boulder, Colo.
"Correlation Between Explorer VII Radiation Counts and Ionization Effects," J. D. Kraus, A. G. Herriman and S. R. O'Donnell, Ohio State University Radio Observatory, Columbus, Ohio.
"The Measurement of the Phenomena Associated with Hypervelocity Reentry Into the Atmosphere," G. F. Pippert, MIT Lincoln Lab Lexington, Mass.
"Experimental Investigation of the Electromagnetic Effects of Reentry," W. Rotman and G. Meltz, Air Force Reseorch Division, Bedford, Mass.

Thursday Afternoon, November 17, 1960 — **Sheraton-Plazo Hotel**

TRANSISTORS II

Chairman: H. G. Rudenberg Transitron Electronic Corp., Wakefield, Mass.
"Automatic Transistor Testing," H. S. L. Cameron and P. M. Tipple, Associated Transistors, Ltd. Middlesex, England.
"The Transistor: Today and Tomorrow," E. Wolfendale, Mullard Southampton Works Hampshire England.

Thursday Afternoon, November 17, 1960 — **Sheraton-Plaza Hotel**

ELECTRO-HYDRAULIC AND PNEUMATIC CONTROLS II

Chairman: D. V. Stallard. Feedback Controls, Inc., Natick, Mass.
"Synchronous Control of Acoustic Siren Rotors," F. D. Ezekiel, American Measurement and Control, Inc., Waltham, Mass.
"Amplification by Fluid Stream Interaction," B. M. Horton, Diamond Ordnance Fuze Laboratories, Washington, D. C.
"Basic Characteristics of a Pneumatic Jet-Pipe Valve," K. N. Reid, Jr., MIT, Cambridge, Mass.
"A Pneumatic Flapper Valve Study," R. E. Norwood, MIT, Cambridge Moss.

Thursday Afternoon, November 17, 1960 — **Commonwealth Armory**

COMPONENTS FOR SPACE ELECTRONICS

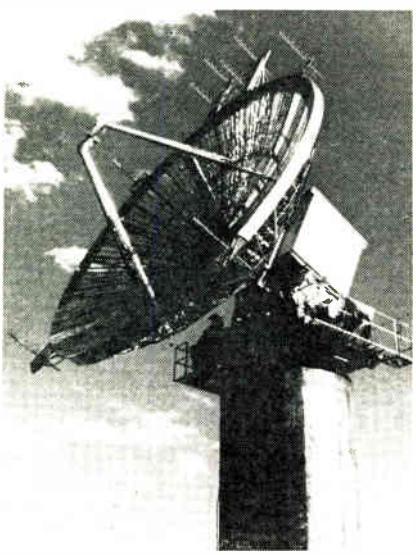
Chairman: G. A. Norton AVCO, Wilmington, Mass.
"Theoretical Comparison of Direct Conversion Space Power Sources," Richard C. Barbera, Raytheon Company, Bedford, Mass.
"A Sun Finder for an Interplanetary Vehicle," H. H. Seword, MIT, Cambridge, Mass.
"High Efficiency Solar Energy Converters," R. Riel, Westinghouse Electric Corp., Youngwood, Pa.
"Fundamental Principles of the Twin-Gyro Controller" D. F. Sellers Vought Electronics, Dallas, Texas.

Thursday Afternoon, November 17, 1960 — **Commonwealth Armory**

INFRARED

Chairman: Carl Faflick, Sylvonia Electronic Products, Inc., Waltham, Mass.
(Survey Reports)

ANTENNA AWAITS "ECHO"



Antenna seeks out signal bounced off Project ECHO balloon. Philco's Western Development Laboratories supplied equipment for the Trinidad-Rome, N.Y. test link that USAF is using to check ECHO technique.

new career opportunities with AC

SENIOR RADAR DESIGN & DEVELOPMENT ENGINEERS

BS or MS degree and radar experience in one of the following specialized areas:

. . . experience in design of blanking circuits, deflection circuits, and video signal amplifiers, plus background in the field of processing of radar information to include smoothing and filtering of radar data as part of human factors engineering.

. . . experience in video and high-frequency computing circuits. For example, phase deflector multiplier circuits, IF amplifier circuits, summing video circuits, magnetron circuits, AFC circuits, and gated video circuits. Capable of design analysis of circuits and correction of design deficiencies. Experience should include packaging, grounding, and shielding of video and RF circuits.

. . . experience in systems engineering on airborne radar equipment.

COMMERCIAL COMMUNICATIONS ENGINEERS

BS or MS in Electronics/Electrical Engineering to perform advanced development, product design, and production engineering of commercial products. Background preferred in VHF and UHF communications, airborne and ground equipment—FM, AM, single sideband, selective signaling encoders and decoders, transistorization of RF, Audio and pulse circuitry.

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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

Demand For Execs Holds Steady—Average 1/Firm

The demand for execs to fill $10,000-a-year jobs with medium-sized companies will hold up during the second half of 1960, says Executive Manpower Corp., 444 Madison Ave., New York 22, N. Y. The management recruitment firm has just polled 191 firms averaging annual sales of $12.3 million.

The poll showed a need for slightly over one exec per firm—about the same ratio as determined in an earlier (Jan. 1960) survey. The need for sales chiefs is leveling off slightly but they are still the most wanted (30.3% of top jobs). Manufacturing production execs rose to second place (22.9% from 15.6%). Engineering execs, now in third position (22.4%) reflected about the same strength as before (21.9%).

How will these positions pay? Most (86.4%) will offer between $10,000 and $20,000 a year; 13.1% of the openings will pay from $20,000 to $40,000.

How are these execs recruited? The companies estimated that 42.3% of the execs hired last year were hired from outside the company. The most favored method of finding them was within the company (32.3%), followed by personal recommendation (22.5%), and from advertising (15.9%). Next in line were those hired from employment agencies, 13.7%) and by management recruiters (8%). Only 6.1% admitted they hired from competitors.

The companies felt that executive engineers would be hardest to find and sales and manufacturing production specialists next toughest.

What is the favorite method of executive compensation? Salary plus bonus was first—followed by

(*Continued on page 238*)

FOR MORE INFORMATION . . . on positions described in this section fill out the convenient inquiry card, page 169.

Seminar For Professors

Eleven professors from eastern and midwestern universities are participating in Hughes Aircraft Co.'s fifth school-industry science and engineering program. The program is held by the Company's Ground Systems Group at Fullerton, Calif. Work is in special fields ranging from digital computers to underwater sound devices.

The aim of the program is to improve college science and engineering courses. The participating professors get challenging and meaningful work experience coupled with lectures, tours, and seminars. The experiments help the professors to provide their students with up-to-date knowledge of industry's advanced developments. Six of the professors have Ph.D. degrees in science or engineering, two are chairmen of electrical engineering departments, and several instruct at the graduate level.

During the last five years, graduates of the program have included 51 college professors, 12 junior college teachers, 26 college graduate students, 48 college undergraduate students, 39 high school instructors and 30 high school pupils.

Expand Facilities

Radiation Dynamics, Inc., has started construction of a second irradiation service vault at its Westbury, L. I., N. Y., plant. The vault will house a 3,000,000 volt electron accelerator with an output of 30 kw of electric beam current.

RCA to Operate Alaskan Communications System

A $5,279,088 contract for operation of a major U. S. Air Force communications network in Alaska has been awarded the RCA Service Company, division of RCA. It covers management and operation of AFALLS (Air Force Alaskan Long Lines System)—better known as the "White Alice" project.

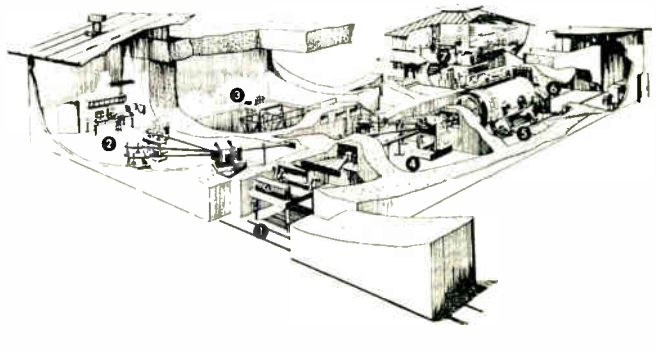
White Alice has been in operation since Nov. 1956. It is a network of radio, microwave, cable and long-line communications connecting principal cities and military installations in Alaska. It is used for relaying aircraft early-warning and other defense information.

Medical TV Internship

The Blonder-Tongue Foundation, Newark, N. J., has awarded an expense grant to the institute for Advancement of Medical Communications for the establishment of a medical TV internship. It will provide doctors and others in the medical field an opportunity to study the latest techniques in closed-circuit TV.

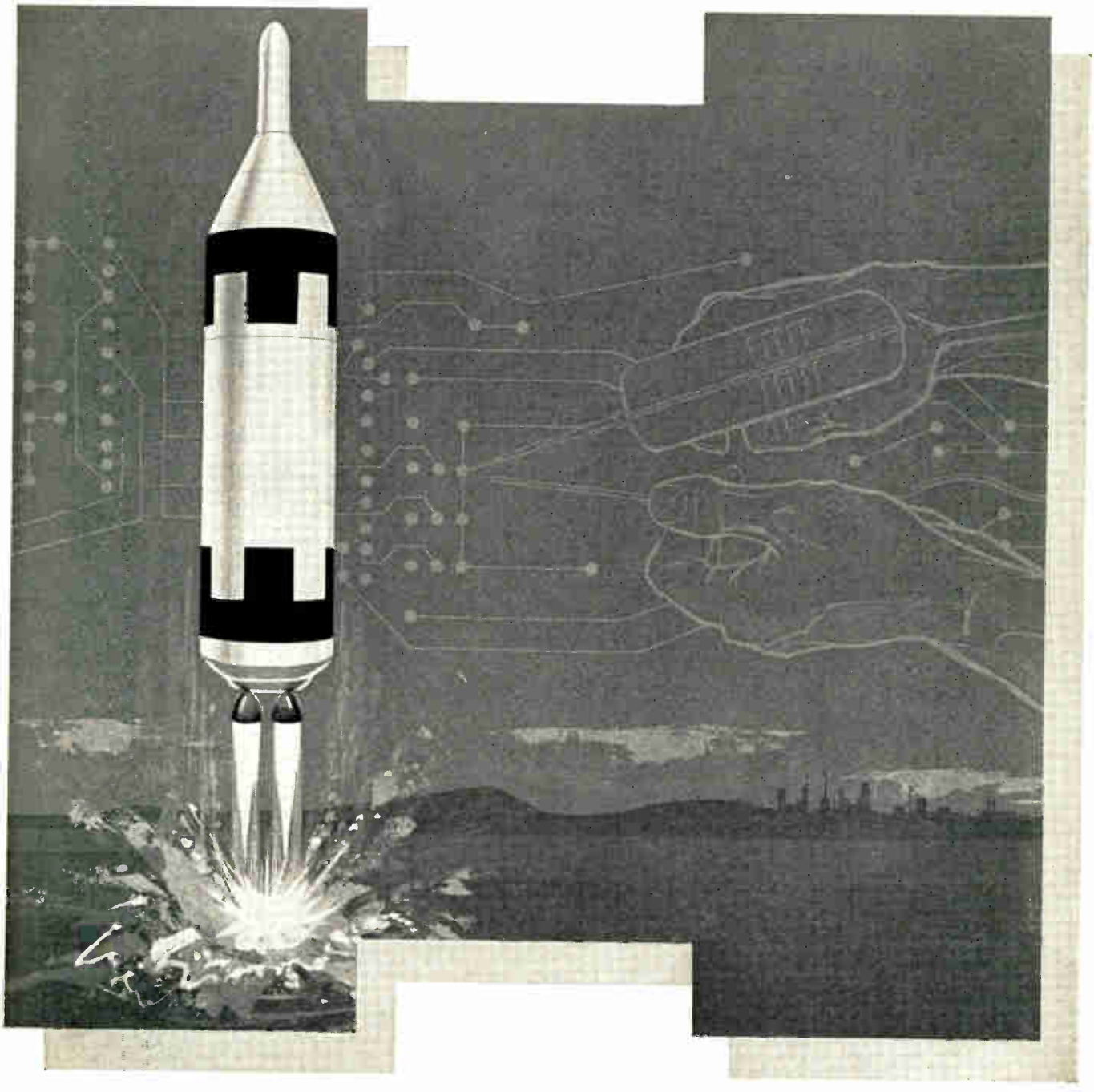
The Foundation has also awarded two grants to the Midwest Airborne Television Project called, Stratovision. One grant is for instructing teachers in using educational TV and the other is to equip a high school to receive programs televised in the project.

SPACE RADIATION FACILITY



Convair Div., General Dynamics Corp. is building this space radiation research facility. 1 is an irradiation cell, 2: nuclear physics experimentation area, 3: neutron test area, 4: steering magnet, 5: accelerator, 6: accessory room, 7: control room. It will have a 3 million volt, 30 kw electron/ion accelerator.

Putting Polaris on a precision



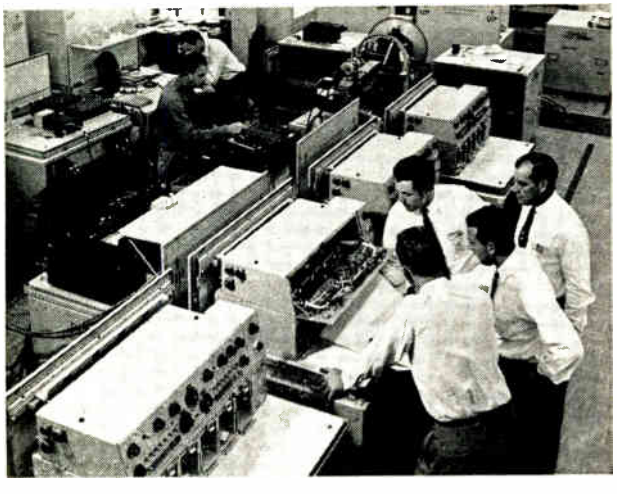
path

Newest of Hughes' many guidance developments is the advanced system for the Polaris. It is designed around a unique computer which directs the missile's course on information received from a precision inertial platform.

Now in production at Hughes, the Polaris guidance package withstood life tests of better than 1500 hours.

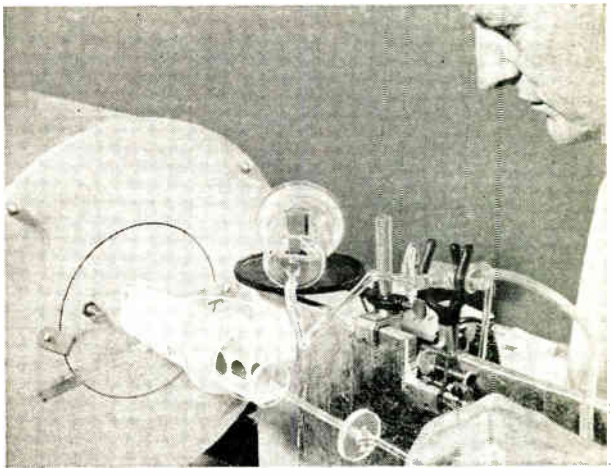
Yet it was not until last February that the real mettle of the Hughes-manufactured Polaris computer was demonstrated. In its first flight test, the Hughes computer worked perfectly.

But Hughes' guidance systems are not restricted to inertial types. Drawing on its experience in the development of infrared-guided Falcon missiles and radar-guided Falcons, Hughes is today working on new applications in these areas.



Revolutionizing the art of electronics manufacturing, *Hughes El Segundo engineers have established an unsurpassed reputation for producing highly reliable electronics control systems.*

This diffusion study *being performed by a Hughes scientist is part of a continuing Hughes Semiconductor R&D Program — a program which has produced some of the most dramatic breakthroughs in the semiconductor art.*



Three factors account for the successful Hughes record in guidance: the high degree of creative freedom given to Hughes engineers, Hughes' outstanding electronics manufacturing facilities and the intensive training which Hughes Field Engineers bring to the field problem.

The broad scope of Hughes' activity in missile guidance is typical of the challenges offered to Hughes engineers. Numerous other projects, in virtually every field of advanced electronics provide equally stimulating outlets for your abilities.

These areas include: miniaturized communications systems, advanced electronic display systems, microminiaturized semiconductors, masers, space vehicles, ASW systems, microwave components and tubes, and radiation handling equipment.

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Write in confidence to Mr. R. A. Martin
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The test set you used or the experiments you performed while preparing your technical paper can be used to increase the effectiveness of your presentation. Closed-circuit projection TV and closed-circuit TV using monitors can be used to actually demonstrate the main points of your technical presentation.

How to . . .

Improve Your Talk With

DEMONSTRATIONS can improve the effectiveness of technical presentations. Experiments are often conducted in the laboratory in support of reviews or "new-to-the-art" presentations, and these experiments provide a source of ready-made test sets which can be used as demonstration equipment. This article describes how to implement demonstrations using closed circuit television, and suggests possible arrangements for effective presentations. Several examples illustrate the techniques.

Arranging CCTV Facilities

Fig. 1 shows the layout for

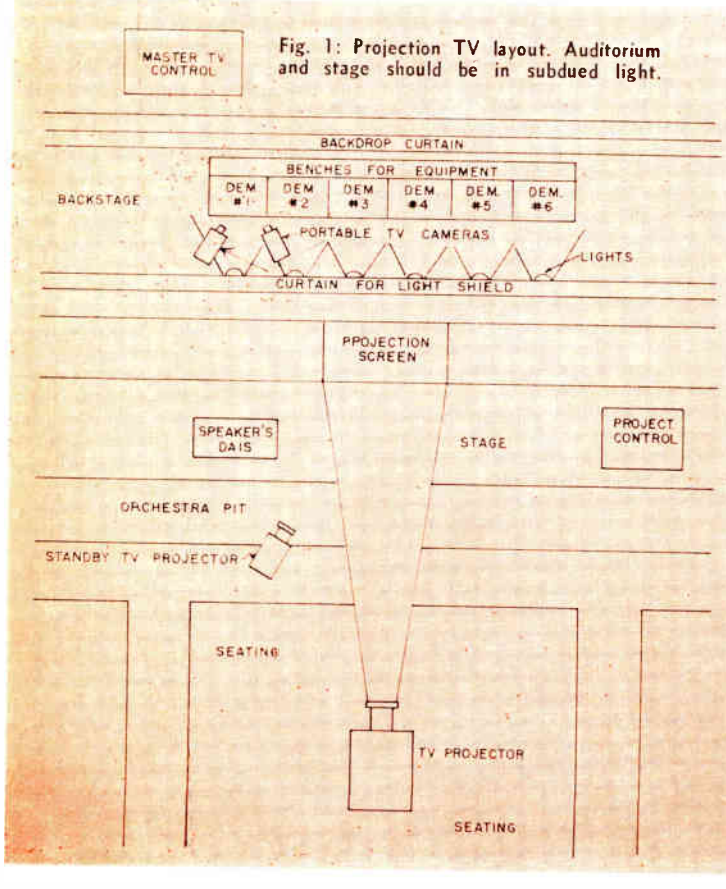


Fig. 1: Projection TV layout. Auditorium and stage should be in subdued light.

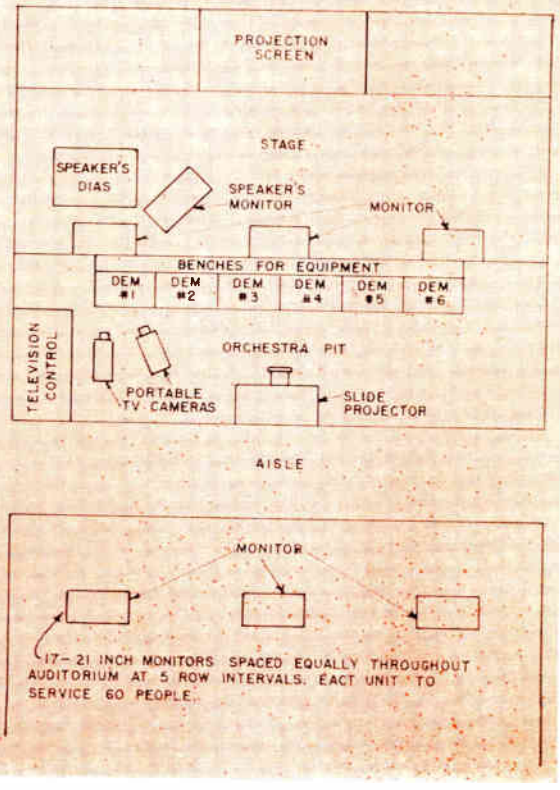


Fig. 2: Using monitors. Demonstrations should be large to show fine detail.

Fig. 3: Typical projection TV set - up. Screen is 16 x 16 feet.

By ROGER C. WONSON
Engineer Advanced Dev.
Raytheon Company
Semiconductor Div.
55 Chapel St.
Newton 58, Massachusetts

Demonstrations

closed-circuit projection TV. The demonstrations are located backstage and are lined-up in order of their appearance. For the picture from the TV projector to be satisfactory, the auditorium and stage must be in subdued light so the screen must be shielded from lights from the demonstration area. To give the appearance of a "live presentation," the screen and curtains can be raised both before and after the talk and also during the intermission. The oral presentation should be planned to allow time for adjusting the cameras and for adjusting the working demonstrations. During this time interval the audience can be prepared for the next demonstration, for example by showing a schematic diagram of the next step with one of the cameras or with a slide projector. Two cameras can be very useful. For example, if one wanted to display the bias conditions and their effect on the circuit, one camera could be showing the bias source with the other camera showing the circuit output and its effect by varying this bias. A loud speaker can be installed for communications between the backstage demonstration crew and the lecturer.

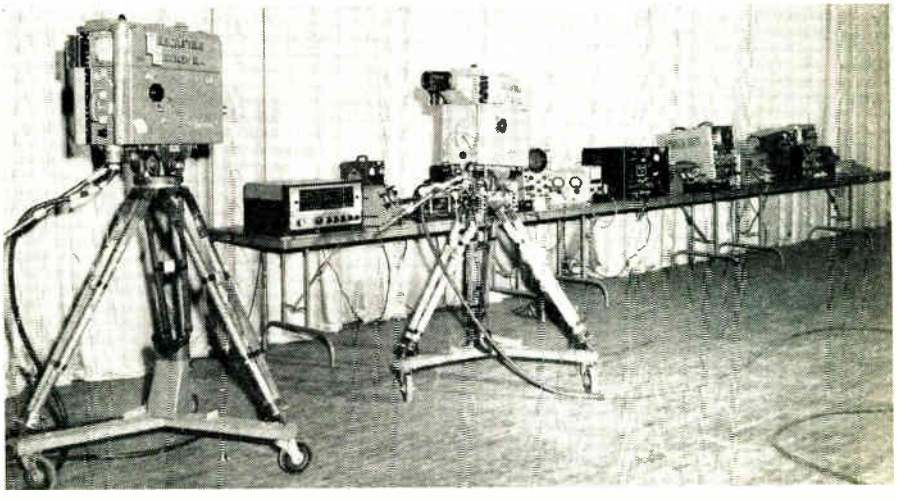
Using Monitors

Fig. 2 shows an alternate arrangement for using CCTV. Here, monitors interspersed throughout the audience are used instead of projected television. The monitors in this particular presentation are twenty inch diameter kinescopes. In this case, the demonstrations should be large enough so that people seated furthest from the monitors can read the fine detail. This, of course, is no problem with projection TV because of the very large size of the screen. With individual monitors the auditorium need not be darkened as much as when projection TV is used; therefore, the demonstrations can be set-up in the orchestra pit or in front of the stage. The same arrangement is used here as is used with projection TV—the demonstrations are lined up so that the camera can be moved from left to right in order of the demonstration appearance.

Tips for the Speaker

Obviously the speaker and the people working the demonstration equipment backstage should be thoroughly familiar with the presentation. The speaker can help the camera crew by informally telling them—during the demonstration—what he wants them to do, and the person on the demonstration equipment can also help the camera crew by pointing to the demonstration under discussion. Whenever possible, one or two trial runs should be

Fig. 4: Back stage demonstrations and camera equipment.



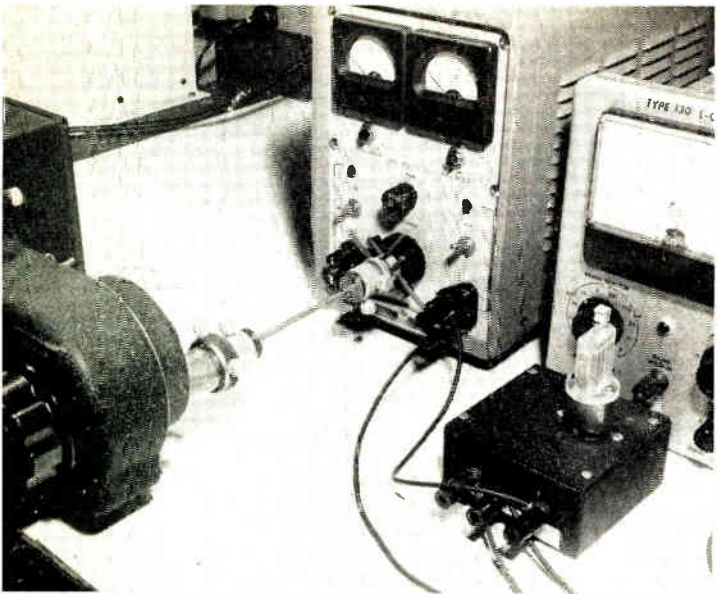


Fig. 5: Demonstration using a mechanical sweep-drive.

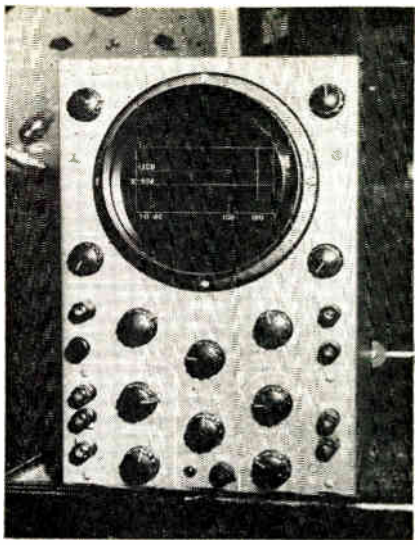


Fig. 6: Oscilloscope presentation uses a special graticule.

Demonstration *(Continued)*

made to smooth out the presentation.

Apparatus

Typical TV projection apparatus is shown in Fig. 3. With this particular apparatus, the projected picture size is approximately 16 x 16 feet. Fine detail such as numbers and figures on an ordinary 5 in. oscilloscope graticule can easily be seen on this screen. Fig. 4 shows the backstage demonstrations and camera equipment. Note that meters and oscilloscopes which are integral parts of normal test apparatus are used. This will be further discussed.

Ideas for Instrumentation

The demonstration ideas outlined here are for a technical presentation of the high-frequency operation of transistors, but the ideas will help in setting up demonstrations for any type of technical demontration. For example: Fig. 5 is a demonstration of apparatus which uses a mechanical sweep-drive connected to a power supply to vary its output. This variable voltage output is applied to the circuit to be demonstrated. Both cause and effect can be displayed on an oscilloscope and meters. These are simultaneously projected on the screen. The mechanical sweep-drive could also be connected to generators or other pieces of test equipment for advantageously showing a particular phenomenon or overall effect. Fig. 6 shows an oscilloscopic form of presentation. Here the oscilloscope graticule is made from a piece of plexiglass. The information is scribed upon the surface of the plexiglass to show the information necessary for the demonstration. Also, meters can be changed or marked to fit the needs of the demonstration.

A Test Circuit

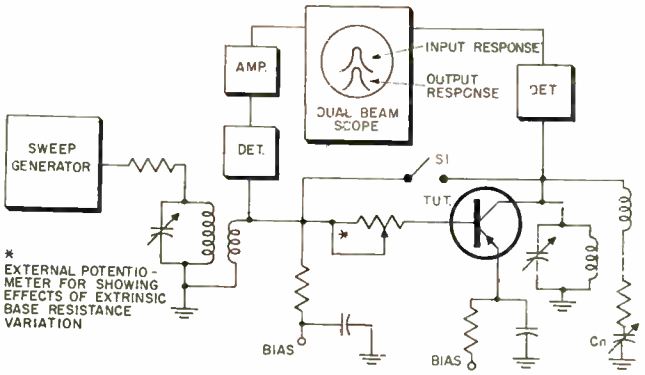
One idea for displaying the performance of a test circuit is shown in fig 7. The main purpose of the display is to show the effects of internal feedback in the transistor under test. This is done by disconnecting the neutralization circuit switch S-1. The swept input and output response is indicated on the dual beam oscilloscope. Without neutralization the ambiguity in the input will be noticeable. The neutralization can be connected and the external neutralizing circuit adjusted for complete cancellation of the internal feedback in the transistor; then the circuit will be neutralized. This whole operation can be performed in front of the TV camera. Bias supply voltages and currents to this circuit can also be varied and the result observed on the dual beam oscilloscope. The ambient temperature of the transistor, or the circuit, can be raised or lowered and the effects displayed. A VTVM can of course be substituted for the oscilloscope showing output voltage level change, but the oscilloscope can show this as well as the change in frequency and band width which the VTVM cannot show. This test circuit arrangement may be an isolated case, but it does exemplify a typical demonstration under actual operating conditions.

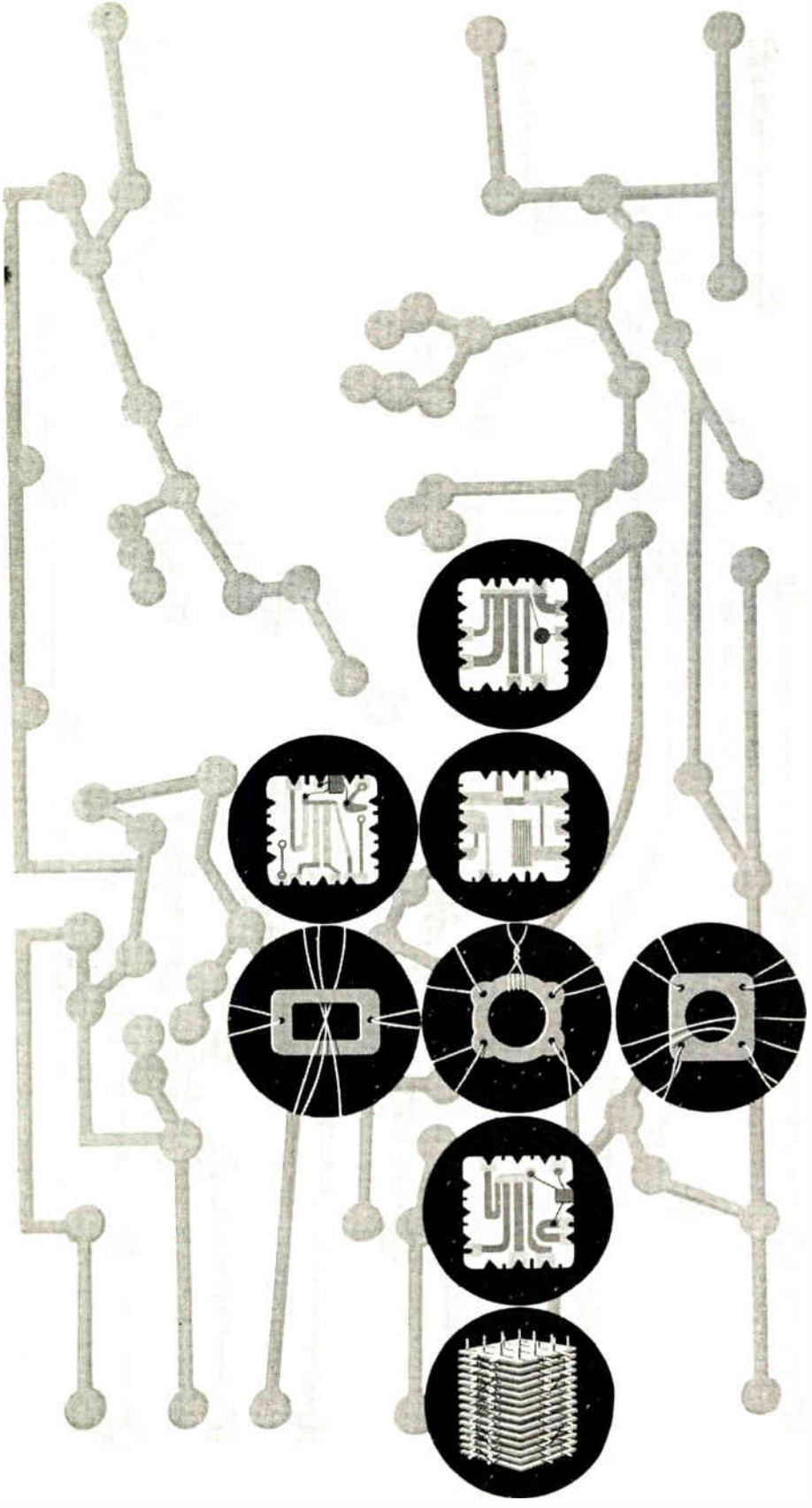
Demonstrating Oscillator Efficiency

Fig. 7 shows an FM transmitter

(*Continued on page* 222)

Fig. 7: Typical operating display circuit.





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Demonstration

(*Continued from page 220*)

operated by a single transistor. This transmitter was constructed in the laboratory as a practical application for measuring oscillator efficiency and mounted in a clear plastic case. Since the internal parts can be seen, it is a good demonstration not only for the test previously mentioned but also for referencing a number of points during the lecture. The output of the FM transmitter is detected by a communications receiver connected to the house sound system. After a few introductory remarks during which time the FM transmitter is

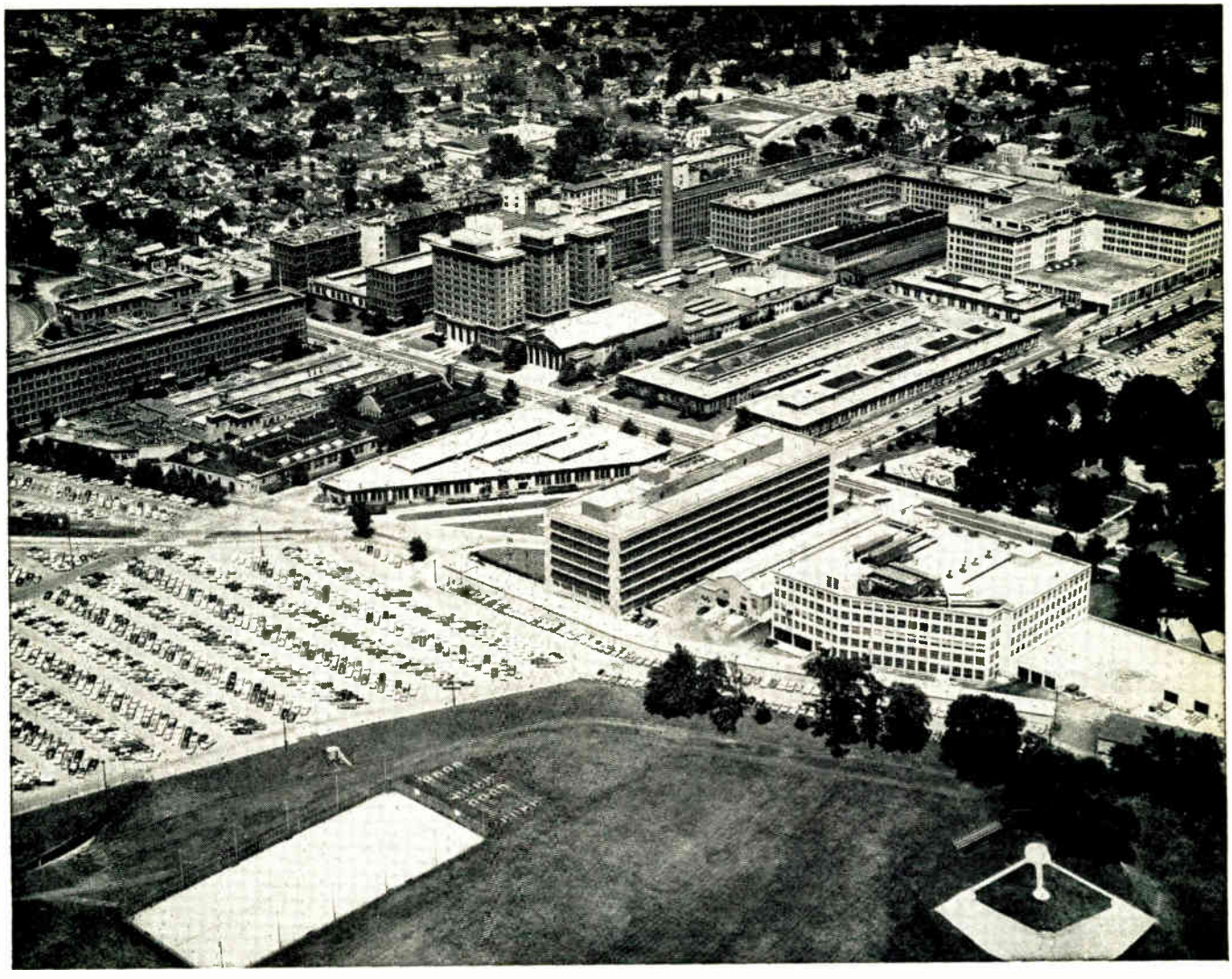
Fig. 8: Author demonstrates transistorized FM transmitter. Transmitter—encased in plastic—was later shown over CCTV.

employed, it is taken back stage and put on top of the receiver for size comparison to be seen over the television system. The camera is then moved in for a close view of the transistorized transmitter so that the internal parts can be seen by the audience. The circuit diagram is shown in fig. 9.

Conclusions

The engineer should consider implementing his talk with any and all of the test sets that he has used in experimentation since the test equipment can help to emphasize the points of discussion. Standard laboratory test circuitry can and should be used. Using oscilloscopes, mechanical sweep-drives, oscillographs, digital read out voltmeters, and in other ways increasing the effectiveness of the demonstration,

(*Continued on page 224*)



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results in better understanding by the audience. Furthermore: the demonstration may prove to be extremely valuable to the laboratory.

This type of presentation is not always practical for short (20-minute-type) technical discussions, but can be very effective for longer (2-hour) lectures.

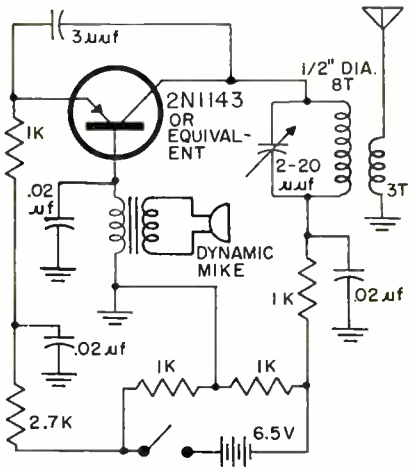

Fig. 9: FM transmitter circuit.

Acknowledgments

The author wishes to thank Mr. Robert Waters, Chairman of the Boston IRE Transistor Workshop Series, and Mr. Daniel Anderson, Chairman of the Chicago IRE Transistor Workshop Series, for being able to participate in their respective programs. Also Mr. Richard Hackenberger who was in charge of facilities of the Boston IRE Section for the television layout, and Mr. Michael Corboy of the Chicago IRE in charge of facilities for television arrangements.

Credit also to Mr. W. Moloney for assisting in the demonstrations and to Mr. E. Adler and Mrs. W. Hall for help in preparing the article.

Solar Energy

Electro-Optical Systems, Inc., has a $94,412 contract from the Air Force's Wright Air Development Div. for the study, design, and fabrication of solar energy concentrator models for space vehicle power system applications.

The company also has a $41,402 contract from Jet Propulsion Lab for a survey program in the application of microelectronics to space vehicle instrumentation systems.

Pressure Sensing

(Continued from page 85)

ducers that are responsive only to dynamic input pressures and are totally insensitive to static pressures. This class of transducer is relatively inaccurate.

The Fairchild 3S-G transducer is a completely new kind of transducer. It not only overcomes the inadequacies of pot and strain gauge-type transducers but combines the best characteristics each has to offer, for both military and industrial applications.

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It is rugged. Designed to meet MIL-E-5272B environments, it can withstand 50 G's vibration to 2000 cps without damage. Through careful material selection, the 3S-G can measure all gaseous and liquid media, including liquid oxygen, strong alkalies, corrosive acids such as red fuming acids, and nitrozene. Where the most severe environments are encountered, such as at rocket test stands, the 3S-G transducer is also available in a super-rugged design. In either version, standard or rugged—the solid-state circuitry—mechanically isolated from the case—is insensitive to case distortions encountered in normal handling and mounting.

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News of Mfrs' Representatives

E. V. Roberts & Associates, Los Angeles, Calif.—appointed sales rep for Pesco Products Div., Borg-Warner Corp. in California, Arizona, New Mexico and Nevada.

Pacific Automation Products, Inc., 1200 Airway, Glendale 1, Calif., has appointed **Associated Air Services,** Dallas, Texas as its Custom Electronic Cable Div. rep in Texas, Oklahoma and Kansas. Other newly appointed firms are: **Harlan J. Weisler & Associates,** St. Louis, Mo.; **Griffin & Pipe Co.,** Dayton, Ohio; **Eugene C. Bleich Co.,** Orlando, Fla.; **Ray Johnston Co.,** Seattle, Wash.

Clevite Transistor Products, a subsidiary of the Clevite Corp., has appointed **John F. Wattles & Co.,** 7210 Red Road, Miami 43, Fla., as its newest sales rep., to represent them in Florida and Alabama.

P. J. Engineering Sales Co., Watertown, Mass.—appointed New England sales rep for Semiconductor Div. of Syntron Co., Homer City, Pa.

Bob Boniface of Neely Enterprises, (right), retiring President of the Southern California Chapter of the Electronic Representatives Association, receives an engraved gavel from Jack Berman, new President of the Chapter.

Pyramid Electric Co. has appointed two manufacturers representative firms, namely: **Stang Sales Corp.,** 271 Columbus Ave., Tuckahoe, N. Y. for the five boroughs of New York, Westchester County, N. Y. and Northern N. J.; and **Kelly-Schmitz-Winkler Associates,** 407 W. 74th St. Terrace, Kansas City 14, Mo. for Midwest territory: Iowa, Kansas, Missouri, Nebraska and Southern Illinois.

George Stevens Mfg. Co. has appointed **Raymond Kimball,** 35 N. Raymond Ave., Pasadena, Calif., its exclusive West Coast Technical and Sales Representative.

Burnell & Co., Inc., Pelham Manor, N. Y. has named **David Launt** its Syracuse, N. Y. manufacturers rep. Also, in the tri-cities area of N. Y.

Joe Vatter—named District Sales Manager of new Cannon Electric Co. Sales Engineering Office at 4508 Allisonville Rd., Indianapolis, Ind.

Weldmatic Div. of Unitek Corp., 950 Royal Oaks Drive, Monrovia, Calif., has appointed **Tech-Ser, Inc.** to represent the division in California, Nevada and Arizona.

Lebell - Warren Associates, San Francisco, Calif.—named sales reps for Birtcher Corp. in Northern California and most of Nevada.

James B. Lovell — appointed sales rep for Central District of Silicone Products Dept., G.E. His office location is 540 S. 1st St., Milwaukee, Wis.

J. B. Lovell

K. O. Brown

American Super-Temperature Wires, Inc., Winooski, Vt., a subsidiary of Haveg Industries has appointed the **K. O. Brown Co.** at 4516 Manning Lane, Dallas 20, Texas, as its manufacturing rep. in Texas.

Hamilton & Bayle Associates, Inc., 3350 Republic Ave., Minneapolis 26, Minn.—appointed sales rep for Centralab, the Electronics Div. of Globe-Union, Inc.

David M. Bradfield, 2375 Hampton Ave., St. Louis, Mo., will represent G. E.'s Insulating Materials Dept. in Missouri, Kansas, Arkansas, Louisiana, Oklahoma, Texas, and Southern Illinois.

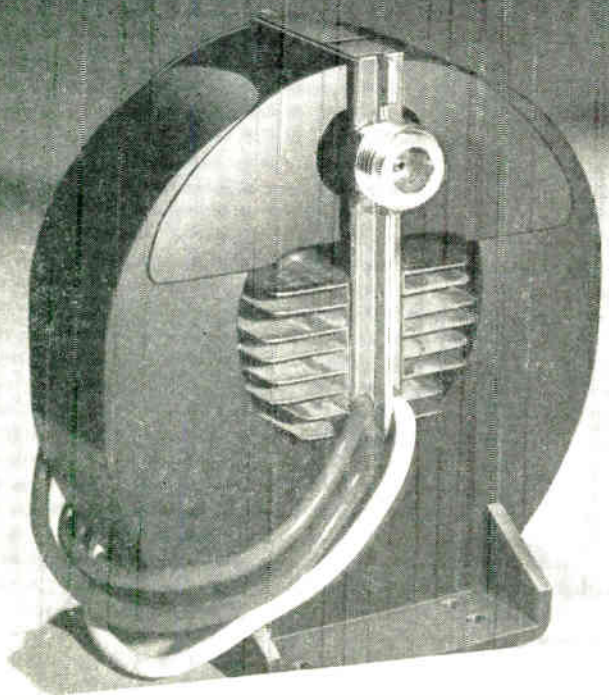
The Daven Co., subsidiary of General Mills, Inc., Livingston, N. J., has appointed **C. W. Mauldin Co.,** 441 W. California Ave., Palo Alto, Calif., to represent Daven in Northern Calif., Nevada and Hawaii.

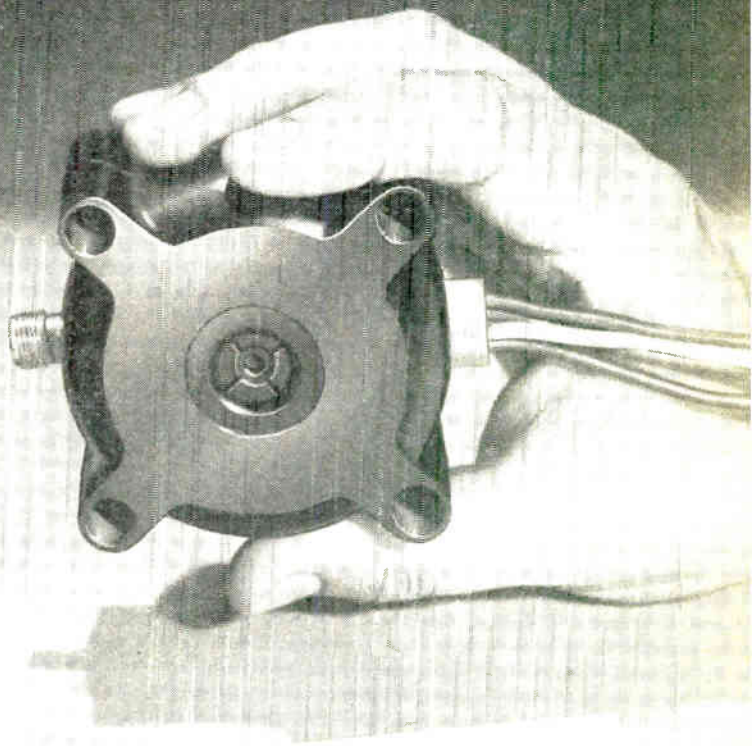
William D. Gannon—appointed District Manager of Stromberg-Carlson's Commercial Products Division High Fidelity Sales in Indiana, Kentucky and Southwestern Ohio.

Wood Clemons Co., Minneapolis, Minn.—named to represent Components Div. of Fairchild Controls Corp., a wholly-owned subsidiary of Fairchild Camera and Instrument Corp., in the Minnesota area.

General Electric Offers . . .

2 New Compact, Lightweight VTM's





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Industry News

George C. Connor—elected Senior Vice President-Marketing of Sylvania Electric Products Inc., a subsidiary of General Telephone & Electronics Corp., N. Y., N. Y.

Richard W. Cook and **Joseph P. D'Arezzo** — elected Vice Presidents (former, Deputy Group Exec., Gov't Products Group; latter, Director of Planning) for American Machine & Foundry Co., N. Y., N. Y.

Harold T. Ashworth—named Director of Manufacturing for Raytheon Co., Waltham, Mass.

H. T. Ashworth

L. T. Levisee

L. James Levisee—appointed Assistant to General Manager as Diversification Director, Hughes Aircraft Co., Culver City, Calif.

D. A. Wilkinson—named Manager of newly formed Product Planning and Market Research sub-section at G. E. Co's. Light Military Electronics Dept., Utica, N. Y.

Kenneth Talbot—named Sales Manager of Technical Ceramics for General Ceramics Div., Indiana General Corp., Keasbey, N. J.

Donald L. Ganson (Eastern Physicist)—heads transistor sales for Pacific Semiconductors, Inc., Culver City, Calif.

Irving Silberg—appointed General Sales Manager for Kay Electric Co., Pine Brook, N. J.

Jules Cardon—named Manager of Gov't Sales by Servo Corp. of America, Hicksville, N. Y.

Vincent Neisius—appointed to newly created position, National Computer Sales Manager for Packard Bell Computer Corp., Div. of Packard Bell Electronics Corp., Los Angeles, Calif.

Kenneth J. Carlson — named Vice President and General Manager of the Daven Co., Livingston, N. J., a subsidiary of General Mills.

Industry News

John S. McCullough—appointed Director of Marketing for Litten Industries Electron Tube Div., San Carlos, Calif.

Paul S. Smith—named to establish and manage a new technical information service for Motorola's Consumer Products Div., Chicago, Ill.

William H. Herrman — appointed Manager of Advertising and Sales Promotion for Stromberg - Carlson's Electronics Div., Rochester, N. Y., Div. of General Dynamics Corp.

Nicholas De Falco—appointed General Manager of Industrial Electronics Div., Allen B. Du Mont Labs Div's., Fairchild Camera and Instrument Corp., Clifton, N. J.

N. De Falco

A. H. Sonnenschein

A. H. Sonnenschein—appointed Assistant to the President, Polarad Electronics Corp., Long Island City, N. Y.

Jess E. Dines—appointed Manager of new West Coast Engineering Office in Los Angeles, Calif. for Foto-Video Electronics Corp., Cedar Grove, N. J.

Edward F. Finn—appointed Product Manager of Pos-E-Kon Div., Thomas & Betts Co., Elizabeth, N. J.

John E. Brennan—named Staff Assistant to President, Garlock Inc., N. Y., N. Y.

J. A. O'Brien—appointed National Sales Manager of Electronics (Continental Connector) Div., DeJur-Amsco Corp., L. I., N. Y.

John A. Staluppi—named Eastern Regional Sales Manager, Eli ("Mike") Mitchell—appointed Western Regional Sales Manager for International Rectifier Corp., El Segundo, Calif.

Allan L. Merken—appointed General Manager of George Rattray & Co., new subsidiary of Instruments for Industry, Inc., Hicksville, N. Y.

Joseph H. Schellman—elected Vice President of Controls Company of America, Schiller Park, Ill.

Industry News

Ralph J. Hovey—appointed Plant Superintendent of Packaged Electronics Div., Amphenol-Borg Electronics Corp., Broadview, Ill.

Darrell V. Jarvis—appointed Marketing Manager of Burlington, Iowa, Div. of International Resistance Co., Phila., Pa.

Earl J. Shelton — appointed Manager of newly formed High-Power Tube Div., Eitel-McCullough, Inc., San Carlos, Calif.

W. Walter Watts (Group Exec. Vice President)—elected Chairman of the Board and President of RCA Sales Corp., N. Y., N. Y.

W. W. Watts

E. T. Collinsworth

Even T. Collinsworth, Jr.—elected Vice President of Fansteel Metallurgical Corp., and subsidiaries, North Chicago, Ill.

Manny Intoci — appointed Production Manager of Telectrosonic Corp., Telectro Industries Corp., Long Island City, N. Y.

James Cronk—appointed Controller of Custom Cable and Electronics Systems Facility, Pacific Automation Products, Inc., Glendale, Calif.

John F. Ordway, Jr.—promoted to Market Analyst for Clevite Transistor, Waltham, Mass.

James O. Haning—joins West Coast Sales Staff of FXR, Inc., Woodside, N. Y.

Ralph T. Dosher, Jr. — appointed Manager of Automation Products Dept., Texas Instruments Incorporated Geosciences & Instrumentation Div.'s Instrumentation Group, Houston, Texas.

K. A. Ray — joins Semiconductor Div. of Hoffman Electronics Corp. as Solar Product Manager.

Thomas A. Guerin—appointed Product Line Manager for Scientific and Process Instruments Div., Beckman Instruments, Inc., Fullerton, Calif.

Personals

Bruce R. McFadden—named Engineering Manager for Packaged Electronics Div., Amphenol-Borg Electronics Corp., Broadview, Ill.

Dr. Sidney L. Simon — appointed Chief Engineer, Missile Electronics and Control Div., RCA Defense Electronic Products, Burlington, Mass.

Frank J. Skwarek—heads new Defense Products Div. as Vice President of Engineering at Polarad Electronics Corp., L. I., N. Y.

Robert H. Davis—named Chief Engineer, Microwave Dept., Motorola's Communications and Industrial Electronics Div., Chicago, Ill.

Franklin B. Jayne—appointed Manager of Engineering, Ordnance and Electronics Dept., Turbo Machine Co., Lansdale, Pa.

Harlan Tripp—named Director of Research and Engineering, Vitramon, Inc., Bridgeport, Conn.

H. Tripp

M. E. Hines

Marion E. Hines—appointed to new position of Senior Scientist at Microwave Associates, Inc., Burlington, Mass.

Chester Kirka—promoted to Chief Engineer of the X-Ray Tube Section, Machlett Labs, Inc., Subsidiary of Raytheon Co., Springfield, Conn.

Burton D. Hatch—appointed Consultant and Manager of new design and standards engineering operation in G.E.'s Missile and Space Vehicle Dept., Phila., Pa.

Maury I. Marks — named Senior Systems Engineer at Hill Electronics, Inc., Mechanicsburg, Pa.

Dr. Joseph R. Feldmeier—appointed Associate Director of Research, Philco Corp., Phila., Pa.

James H. McGarry—appointed Director of Manufacturing for Mechanical Div., General Mills, Minneapolis, Minn.

Circle 169 on Inquiry Card

Operate Tracking Station

The Chance Vought Range Systems Div., Dallas, Tex., has contracted to operate the Project Mercury space capsule tracking station in the Hawaiian Islands. The 15-month contract with NASA totals $900,000.

The new tracking station is 15 mi from Kekaha, Hawaii (at an elevation of 3,000 ft). Its principal function will be to track the Mercury manned satellites scheduled for launching next year. It is number 12 in a 17-station worldwide system. The station will also be used by the Navy for other tracking and monitoring operations.

Polaris Missile Trainer

General Electric Co. has delivered the first production model of the Polaris Fire Control Trainer to the Navy. For training ballistic missile sub crews, it simulates submerged launchings of the intermediate-range Polaris. The trainer, connected to the fire-control system, allows its attack party to practice complete launching operations on the same equipment that would be used to fire an actual missile.

Circle 171 on Inquiry Card

Circle 170 on Inquiry Card

Personals

Dr. Martin Schilling . . . new Vice President, Engineering & Research, Raytheon Co., Waltham, Mass.

Richard Douglas . . . Chief Engineer, U. S. Engineering Co. Div., Litton Industries, Van Nuys, Calif.

William S. Aiken . . . Director of Engineering, The Thompson-Ramo-Wooldridge Products Co. Div. of The Thompson Ramo Wooldridge, Inc., Beverly Hills, Calif.

John C. Beckett . . . to General Manager and Chief Engineer, Palo Alto Engineering Co., Subsidiary of Hewlett-Packard, Palo Alto, Calif.

Ira Kamen . . . named President, Portland Industries, So. Portland, Me. (new company).

Ira Kamen

Dr. I. I. Rabi

Dr. Isidor I. Rabi, Physicist, becomes technical consultant, Loral Electronics Corp., New York, N. Y.

Dr. Jona Cohn . . . to Chief Engineer, Applied Research; **Theodore Saltberg** . . . Ass't Chief Engineer, Digital Electronics Section, and **Robert D. Mohler** . . . Ass't Chief Engineer, Product Research Section, Communications Div., Motorola, Inc., Chicago, Ill.

Donald E. Garrett . . . to Manager, Advanced Development Engineering, T.V. Receiver Dept., General Electric Co., Syracuse, N. Y.

Dr. Edward M. Pritchard . . . to Director of Engineering, Military Systems—Stavid Div., Lockheed Electronics Co., Plainfield, N. J.

Paul A. Scholz, has been named Manager, Defense Projects, at Radio Corporation of America's West Coast Electronic Center at Van Nuys, Calif.

Dr. Daniel H. Goodman has been appointed Manager of the Mountain View Components Laboratory, Mountain View, Calif., a facility of the Special Tube Operations of Sylvania Electric Products.

"CALL FOR PAPERS"

Prof. Group on Human Factors in Electronics, IRE, for March, 1961 issue. Topic: "Automation of Human Functions" Manuscripts to Guest Editor: Dr. Thomas Marill, Bolt Beranek and Newman, Inc., 50 Moulton St., Cambridge 38, Mass.

1961 Int'l Solid State Circuits Conf., 8th Annual Meeting, IRE, AIEE, Univ. of Pa. Feb. 15-17, 1961, Univ. of Pa. campus and Sheraton Hotel, Phila., Pa. Abstracts—300 to 500 words in length and key illustrations; plus 50-word summaries (doubled spaced typing) in triplicate on or before Oct. 14, 1960. Forward to: Jerome J. Suran, Bldg. 3, Room 115, G. E. Co., Syracuse, N. Y.

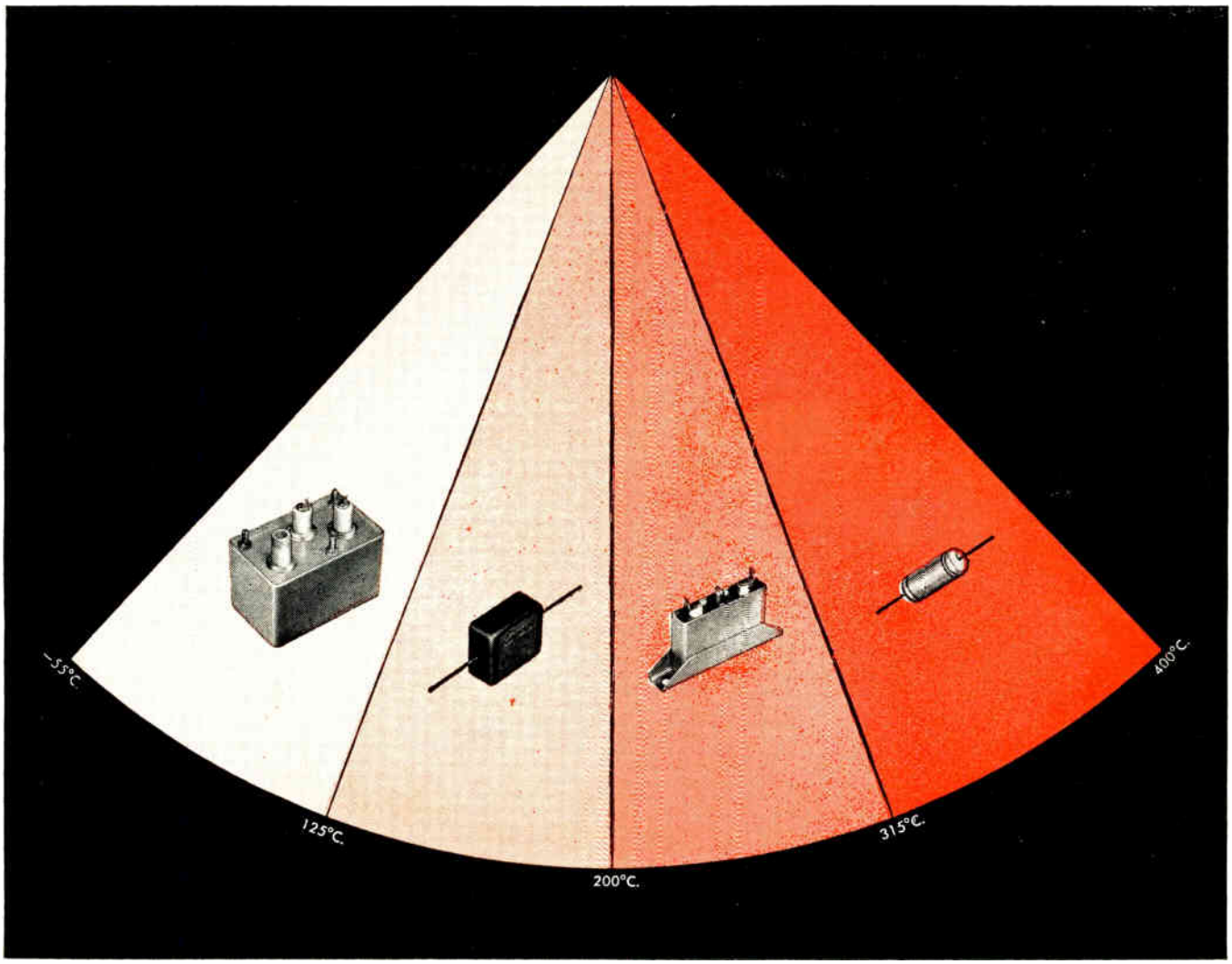
1961 Int'l Convention, IRE, March 20-23, 1961, Waldorf-Astoria Hotel and New York Coliseum, N. Y. 100-word abstract in triplicate with title, name and address, 50-word summary in triplicate with title, name and address. Indicate tech. field. Original papers only to Dr. Gordon K. Teal, Chairman, 1961 Tech. Prog. Comm., The Institute of Radio Engineers, Inc., 1 East 79th St., N. Y. 21, N. Y., by Oct. 21, 1960.

1961 Nat'l Symp. of Prof. Group on Microwave Theory and Techniques, IRE, May 15-17, 1961, Sheraton Park Hotel, Wash., D. C. Original papers in all fields of Microwave Research, Development and Application. 500-word summaries by Dec. 12, 1960, to: Gustave Shapiro, Chairman, Tech. Prog. Comm., Eng'g Electronics Sec., Nat'l Bureau of Standards, Wash. 25 D. C.

The Electrochemical Society, Inc., Apr. 30, May 1-4, 1961, Claypool Hotel, Indianapolis, Ind.; Abstracts, not to exceed 75 words in length. Submit in triplicate to Society Hdqs. not later than Jan. 2, 1961. Indicate Symp. and author's name. Send complete manuscripts to Mgt. Editor of Journal, same address.

1961 Winter Conv. on Military Electronics, IRE, Feb. 1-3, 1961; Los Angeles, Calif. 100-word abstracts, 500-word summaries. Submit to: Dr. J. Myers, Hoffman Elec-

(Continued on page 236)



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tronics Corp., Military Products Div., 3717 S. Grand Ave., Los Angeles 7, Calif. by 15 Nov., 1960 for perusal of Tech. Prog. Comm.

American Society for Testing Materials Annual Meeting, ASTM, June 25-30, 1961, Chalfonte-Haddon Hall, Atlantic City, N. J. Deadline for papers is January, 1961.

39th Annual Conv. of Nat'l Assoc. of Broadcasters & Broadcast Engineering Conf., May 7-11, 1961, Shoreham & Sheraton Park Hotels, Wash., D. C. Deadline for submission of topics for engineering papers is 15 Dec. 1960. Contact A. Prose Walker, Mgr. of Engineering, NAB, 1771 N St. N. W. Wash., D. C. for more info.

Conf. on Reliability of Semiconductor Devices, 12-13 Jan. 1961, Western Union Audit., 60 Hudson St., N. Y. Papers and Abstracts accepted during June & July, 1960 submit to Prog. Comm. no later than 1 Nov. 1960 for publishing in "Proceedings." Forward to John E. Shwop, Chairman, Prog. Comm., U. S. Army Signal Supply Agency, 225 S. 18th St., Phila. 3, Pa. Attn: Prod. Dev., 15th floor.

ELECTRONIC INDUSTRIES Advertisers — October 1960

This index is published as a convenience. No liability is assumed for errors or omissions.

A

Acme Electric Corporation 234
Acoustico Associates, Inc. 148
Aerovox Corporation 155
Aetna Life Insurance Company 173
Airborne Accessories Corporation 138
Alectric Mfg. Co. 232
Allegheny Ludlum Steel Corporation 159
Allen-Bradley Co.
Insert following pg. 32
Allied Radio 158
Alpha Metals, Inc. 128
American Super-Temperature Wires, Inc. 160
AMP, Incorporated 163
Amperex Electronic Corporation 39
Ampex Data Products Company 21
Amphenol-Borg Electronics Corp.
Borg Equipment Division 56
Connector Division 142
Amplifier Corp. of America 160
Anderson Controls, Inc. 107
Antenna Systems, Inc. 186
Arco Electronics, Inc. 45
Armco Steel Corporation 153
Arnold Magnetics Corporation 189
Avnet 238

B

Barker & Williamson, Inc. 174
Bead Chain Mfg. Co., The 128
Beckman Instruments, Inc., Helipot Div. 144
Belden Manufacturing Co. 55
Bell Telephone Laboratories 40
Bendix Corp., The
Red Bank Div., Semiconductor 35
Scintilla Div. 235
Birtcher Corporation, The 190
Bliley Electric Co. 213
Bomac Laboratories, Inc. ..... Inside Back Cover
Bourns, Inc., Trimpot Div. 47
Bruno-New York, Industries Corp. 228
Brush Instruments, Div. of Clevite Corp.
Insert following pg. 66
Bulova Electronics 145
Burnell & Co., Inc. 187
Bussmann Mfg. Div. McGraw-Edison Co. 30

C

Combridge Thermionic Corporation 201
Cannon Electric Company 129
C&S Electronics, Semiconductor Operation 61
Centralab, The Electronics Division of
Globe-Union, Inc. 59
Cinch Manufacturing Corp. 101
Cinema Engineering 232
Clare & Co., C. P. 197
Cleveland Container Co., The 58
Clevite Transistor Div. Clevite Corp.
Insert following pg. 132
Clifton Precision Products Co., Inc. 208
Columbian Carbon Company 197
Consolidated Resistance Company of
America, Inc. 236
Consolidated Vacuum Corporation 224
Continental Connector Corp. 161
Continental Electronics Corp. 225
Corning Glass Works 185

D

Dage Electric Company, Inc. 212
Dale Electronics, Inc. 123
Diolight Corporation 225
Dorsett Electronics Laboratories, Inc. 27
Du Mont Laboratories, Allen B. 36, 126
Du Pont de Nemours & Co., Inc., E. I.
Freon Products Div. 64

E

EICO, Electronic Instr. Co., Inc. 160
Eisler Engineering Co., Inc. 209
Elastic Stop Nut Corporation of America 202
Electra Manufacturing Company
Electronics Div. 147
Electro Motive Mfg. Co., Inc., The 44
Engineered Electronics Company 14
ESC Electronics Corp. 182

F

Fairchild Controls Corp.
Components Div. 110, 111
Fansteel Metallurgical Corporation 150, 151
Film Capacitors, Inc. 230
Freed Transformer Co., Inc. 236
Fusite Corporation, The 113
FXR, Inc. 117

G

Garlock, Inc. 137
Garrett Corporation, The 222
General Electric
Power Tube Dept. 227
Receiving Tube Dept. 28, 29
Silicone Products Dept. 236
General Motors
AC Spark Plug, Electronics Div. 214
Delco Radio Div. 157
General Products Corporation 176
Gertsch Products, Inc. 162
Grainger, Inc., W. W. 201
Graphic Systems 130

H

Hamilton Watch Company
Precision Metals Div. 146
Hewlett-Packard Company 62, 63, 166
Hickok Electrical Instrument Co., The 38
Hughes Aircraft Company
General Offices 216, 217
Industrial Systems Div. 10, 11
Semiconductor Div. 9
Vacuum Tube Products Div. 229, 231, 233

I

Ideal Precision Meter Co., Inc. 225
Illumitronic Engineering 228
IMC Magnetics Corp. 143
Industrial Electronic Engineers, Inc. 131
International Resistance Co. 211
ITT Industrial Products Div. 46

J

Jennings Radio Mfg. Corp. 52
Jerrold Electronics Corporation 164
Johnson Co., E. F. 238
Jones Division, Howard B. Cinch Mfg.
Co. 124, 204

K

Kemet Company, Div. of Union Carbide
Corp. 139
Kester Solder Company 213
Klein & Son, Mathias 135
Krengel Manufacturing Co., Inc. 209
Kulka Electric Corporation 188

L

Lel, Inc. 204
Lenz Electric Manufacturing Co. 51
Light Electric Corp. 210
Lockheed Electronics Company 141
Lockheed Missiles and Space Div. 221

M

Magnetics, Inc. 115
Manson Laboratories, Inc. 192
Marconi Instruments 188
McKinstry Metal Works, Inc. 234
Microtran Co. 202
Microwave Associates, Inc. 136
Miller Company, J. W. 212
Minnesota Mining and Manufacturing Co.
Mincom Div. 17
Motorola Semiconductor Products, Inc. 42, 43, 45
Muirhead Instruments, Inc. 13

N

National Cash Register Company 223
Non-linear Systems, Inc. 31

O

Oak Manufacturing Co. 37
Ohmite Manufacturing Company 121

P

Pacific Semiconductors, Inc. 118, 119
Panoramic Radio Products, Inc. 207
Penta Laboratories, Inc. 54
Philco, Lansdale Div. 18
Plastics Capacitors, Inc. 232
Polarad Electronics Corp.
Insert following pg. 204

R

Radio Corporation of America ..... Back Cover
Radio Materials Company ..... Inside Front Cover
Raytheon Company
Industrial Components Div. 25, 49
Microwave and Power Tube Div. 125
Reeves-Hoffman Div. of Dynamics Corp.
of America 176
Rockwell Products Corporation 174
Rohn Manufacturing Co. 195
Rondo of America, Inc. 190

S

Sangamo Electric Company 105, 127
Sarkes Tarzian, Inc. 32
Scientific-Atlanta, Inc. 60
Segal Company, Edward 124
Shure Brothers, Inc. 200
SIFCO Metachemical, Inc. 158
Spectrol Electronics Corporation 130, 131
Speer Carbon Company, Resistor Div. 165
Sperry Semiconductor Div. 203
Sprague Electric Company 6, 140
Stackpole Carbon Company 132
Stanpat Company 224
Struthers-Dunn, Inc. 66
Sylvania Electric Products, Inc.
Electronic Tubes Div.
Insert following pg. 170
Semiconductor Div. 191, 199
Synthane Corporation 180
Syntron Rectifier Div. 162
Syntronic Instruments, Inc. 226

T

Topco Group, Thompson Ramo Wooldridge,
Inc. 149
Taylor Fibre Co. 24
Tektronix, Inc. 48
Telechrome Manufacturnig Corp. 50
Texas Instruments Incorporated 41
Thomas & Betts Co., Inc., The 16
Times Wire & Cable Div. The International
Silver Co. 107
Tinnerman Products, Inc. 57
Trok Electronics Company Div. of CES
Laboratories, Inc. 177
Transitron Electronic Corporation 108
Tung-Sol Electric, Inc. 65

U

Union Switch & Signal, Div. Westinghouse
Air Brake Company 152
United Transformer Corporation 175
Unitek, Weldmatic Div. 156

V

Vorflex Corporation 177
Varian Associates 53
Vector Electronic Company 201
Vitramon, Incorporated 230

W

Waveline, Inc. 154
Westinghouse Electric Corporation
Semiconductor Dept. 178, 179

EXEC'S Demand

(Continued from page 215)

straight salary and salary plus merit raise. Salary plus stock option took fourth place and then salary plus commission or override. The least popular plan was salary plus deferred payment.

What was the average age of the execs? 61.7% were between 45 and 50. Ages 40 and 55 each had 15.3% of the total; age 60 had 4.5%; age 35 had 1.7% and age 65 had 1.1% of the total.

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Form Controls Section

Stromberg Carlson's Electronics Div., Rochester, N. Y., has formed a department for development, production and marketing of solid-state control systems for nuclear reactors. These will include: neutron measuring channels, flow and temperature channels, safety systems, data logging, special purpose computer systems, radiation monitoring systems, and information display systems. Don D. Welt has been appointed product manager.

Lease Scientific Instrument

Educational institutions, laboratories, and other users may now rent scientific instruments such as electron microscopes from RCA's Communications and Controls Div. There is no down payment. Prorated credit for part of each month's rental may be applied toward outright purchase.

CRIMEA AND PUNISHMENT

At the height of the famous Charge of the Light Brigade, no less than 23 of the radar's tubes malfunctioned simultaneously. (And no wonder — for this was the year 1856 — 91 years Before Bomac.) The calamity not only left the Light Brigade totally in the dark, but it very nearly lost the battle and the radar unit itself. Only the heroic action of an anonymous radio operator, later reported missing, kept the unit from falling into Russian hands.*

Many years later, however, there appeared in England a man named Roland Stone, who claimed to be the missing radio operator of Balaklava. He was given a hero's welcome and was scheduled to receive the Victoria Cross for valor. He would have, too — except for a sharp-eyed, hawk-nosed man named Sheerluck Domes who happened to read about Stone in the newspaper.

Domes rushed to see the Queen and managed to gain entrance just as Stone was about to receive his reward.

Before the startled Queen could say a word, Domes was flashing a telegraph key under Stone's nose. "If you're a radio operator," he hissed, "send me some code!" Stone stammered for a moment. His hands dropped helplessly to his sides.

"You see, your majesty!" Domes said triumphantly. "This man is no radio operator. He wouldn't know a dot from a dash if he met them in Covent Garden. Off with his head, I say."

After they had led Stone away, the Queen marveled: "But Domes, how could you be sure this man was an impostor? All you knew was his name."

"That," said Sheerluck, "was all I had to know. After all," he went on, "a man named Roland Stone simply couldn't be a radio operator."

"Why not?" asked the Queen.

"Because," the great man said, "a Roland Stone gathers no Morse."

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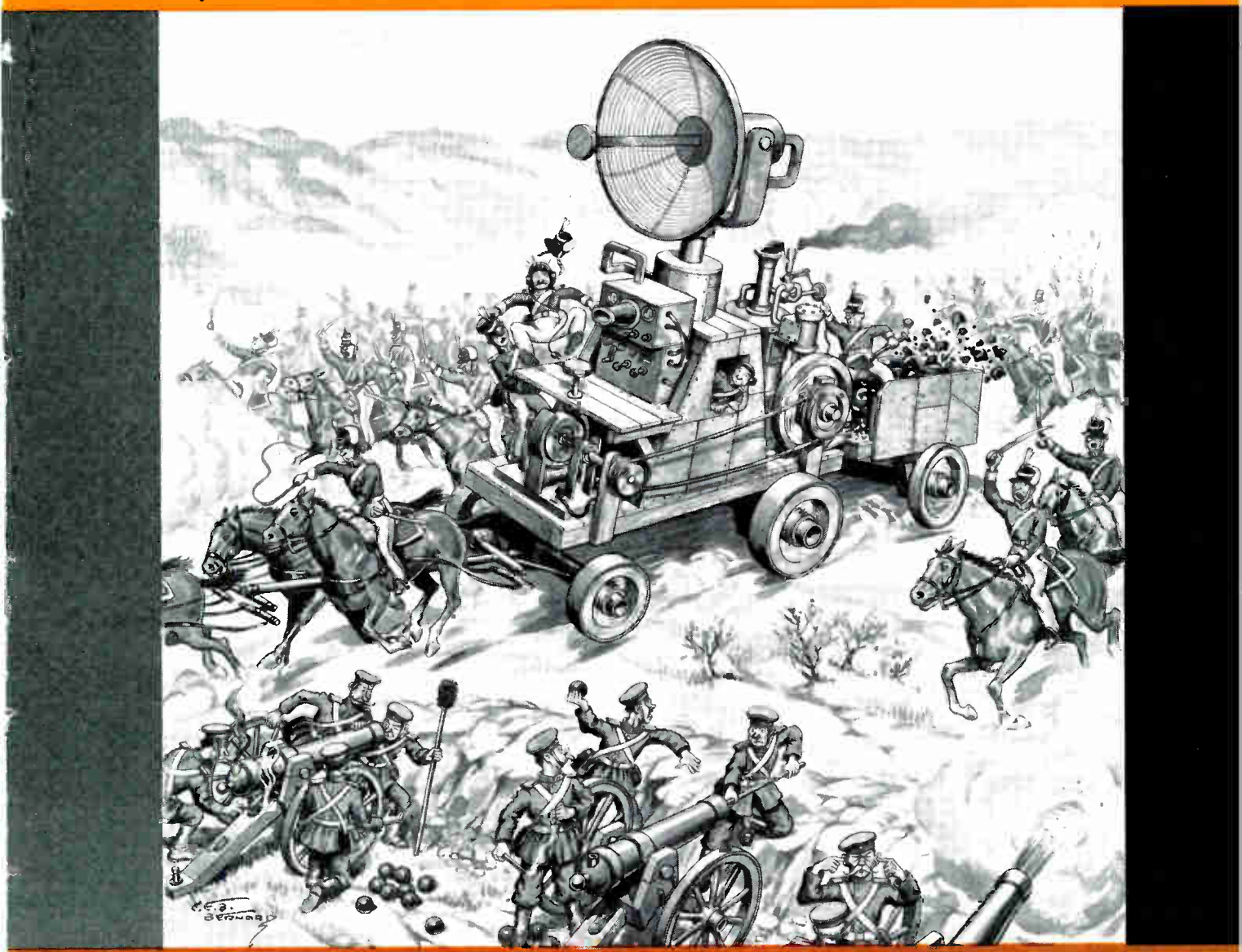

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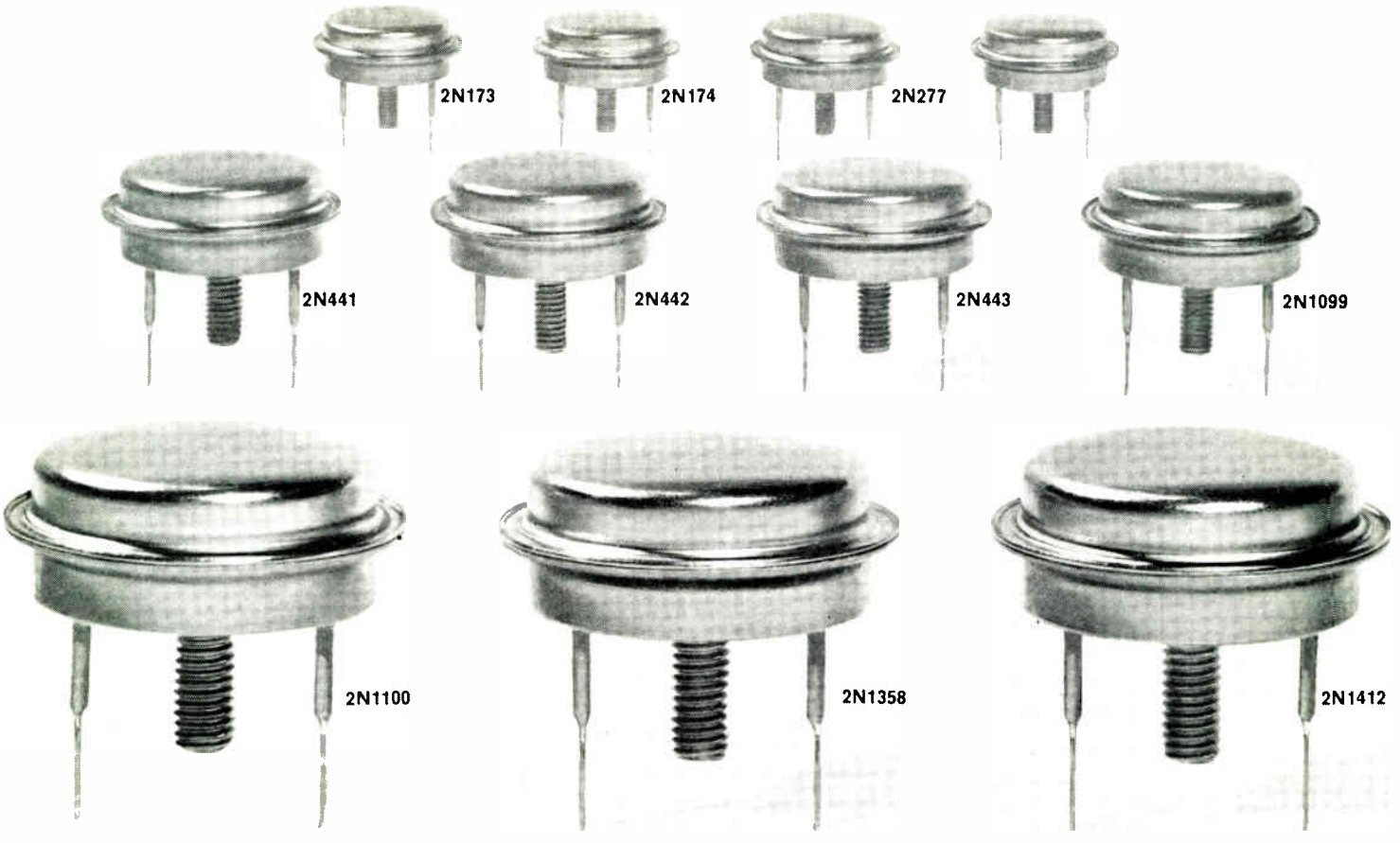
Circle 180 on Inquiry Card



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