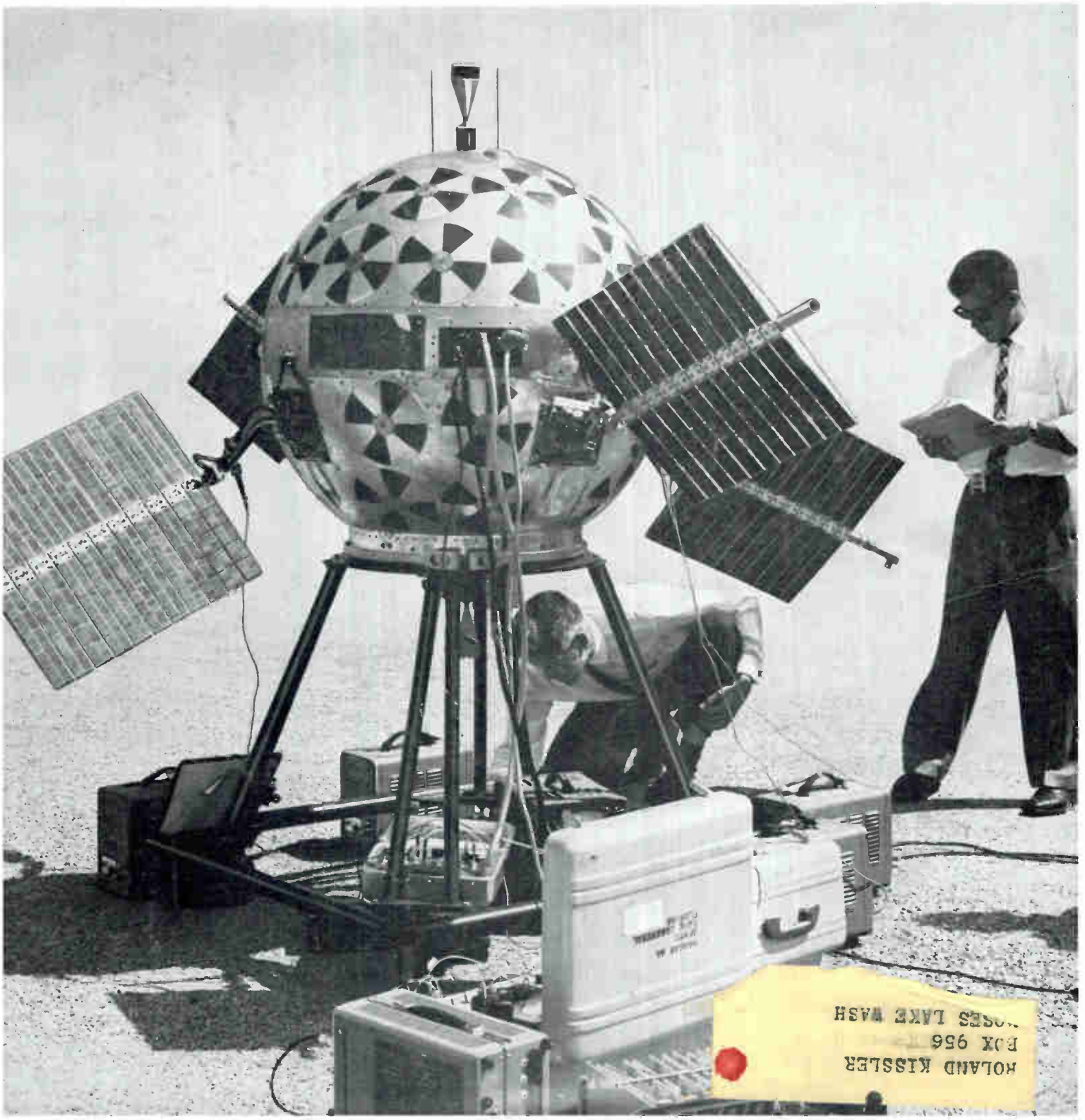
October 28, 1960

electronics

Testing lunar satellite scheduled to be fired next month. Paddle wheels hold solar cells; dazzle paint controls temperature. *See p 63*

Pinwheel sounder explores ground-scatter propagation. *See p 74*

A McGraw-Hill Publication **75 Cents**



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For general purpose R/L/C measurements

Ranges: R: 1mΩ to 10 MΩ
L: 1μh to 1000 h
C: 1 pf to 1000μf
D: 0.001 to 50 (at 1kc)
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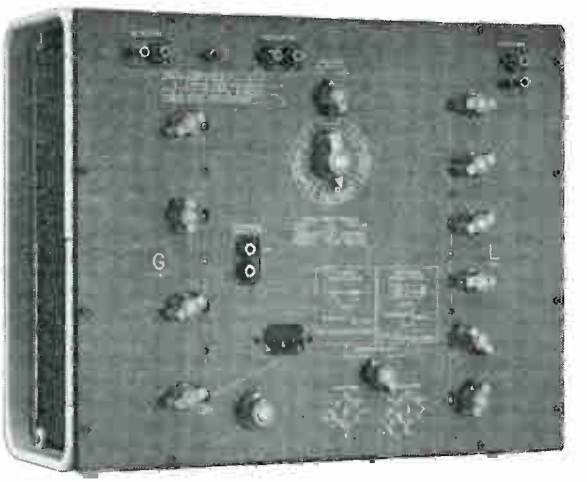
Basic ±1% accuracy
Built-in null detector
Built-in 1-kc oscillator; bridge useful to 20kc with external sources



Type 1632-A Inductance Bridge . . . $950

For precise measurement of inductance

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(minimum indication is 0.0001 μh)
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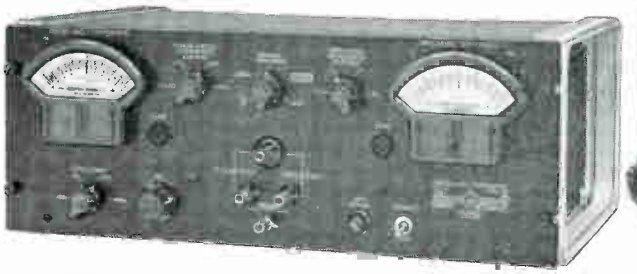

Type 1605-A Impedance Comparator . . . $800

For rapid measurements of impedance and phase angle without manual balancing

Panel meters indicate percent difference in impedance magnitude and phase angle between unknown and external standard

Ranges: Z: 2Ω to 20MΩ
ΔZ: ±0.01% to ±10%
Δθ: ±0.0001 to ±0.1 radian

Accuracy: ±0.01%
Built-in 100c, 1kc, 10kc, and 100kc frequency sources.

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For VHF-UHF measurements of transistors, tubes, networks and components

Frequency Range: 25 to 1500 Mc

Biasing Provisions: Built in for use with external d-c sources. Maximum current, 250 ma; maximum voltage, 400 volts.

Measurement	Range	Accuracy (from 150-1000 Mc)
Voltage and current ratios (R)	0-30	$2.5\,(1+\sqrt{R})\% + 0.025$
Transimpedance (Z_{21})	0-1500 ohms	$2.5\left(1+\sqrt{\frac{Z_{21}}{50}}\right)\% + 1.25$ ohms
Transadmittance (Y_{21})	0-600 mmhos	$2.5\left(1+\sqrt{\frac{Y_{21}}{20}}\right)\% + 0.5$ mmho
Impedance (Z_{11})	0-1000 ohms	$2.0\left(1+\sqrt{\frac{Z_{11}}{50}}\right)\% + 1.0$ ohm
Admittance (Y_{11})	0-400 mmhos	$2.0\left(1+\sqrt{\frac{Y_{11}}{50}}\right)\% + 0.4$ mmho

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October 28, 1960

electronics

A McGraw-Hill Publication 75 Cents

W. W. MacDONALD, Editor

BUSINESS

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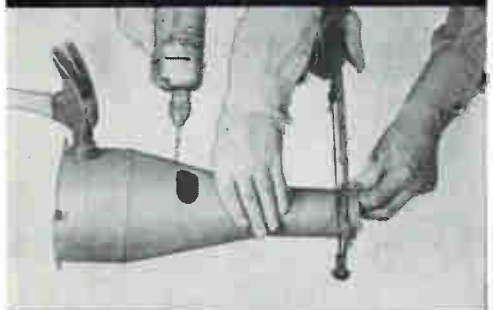
THE RECORDING THAT WASN'T

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

Burton browne advertising

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

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



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

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

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

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

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

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

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

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

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

MAGNETIC SHIELD DIVISION PERFECTION MICA CO.

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Originators of Permanently Effective Netic Co-Netic Magnetic Shielding

ARNOLD 6T CORES: PROTECTED AGAINST SHOCK, VIBRATION, MOISTURE, HEAT... AVAILABLE FROM STOCK

The hermetically-sealed aluminum casing method developed exclusively for Arnold 6T tape cores is packed full of advantages for you . . . *performance-improving and cost-saving advantages.*

It is compact: you can design for minimum space/weight requirements. It's extra-rigid to protect against strains. And it gives you maximum protection against environmental hazards. Arnold 6T tape cores are guaranteed against 1000-volt breakdown . . . guaranteed to meet military test specs for resistance to shock and vibration . . . guaranteed also to meet military specs for operating temperatures. They require no additional insulation before winding, and can be vacuum-impregnated afterward.

And now a NEW Arnold service: immediate delivery on your prototype or production requirements for Deltamax 1, 2 and 4-mil Type 6T cores in the proposed EIA standard sizes (see AIEE Publication 430). A revolving stock of approximately 20,000 Deltamax cores in these sizes is ready for you on warehouse shelves. Subject to prior sale, of course, they're available for shipment *the same day your order is received.*

Use Arnold 6T cores in *your* designs. Technical data is available; ask for Bulletin TC-101A and Supplement 2A (dated June '60). ●Write *The Arnold Engineering Company, Main Office and Plant, Marengo, Ill.*

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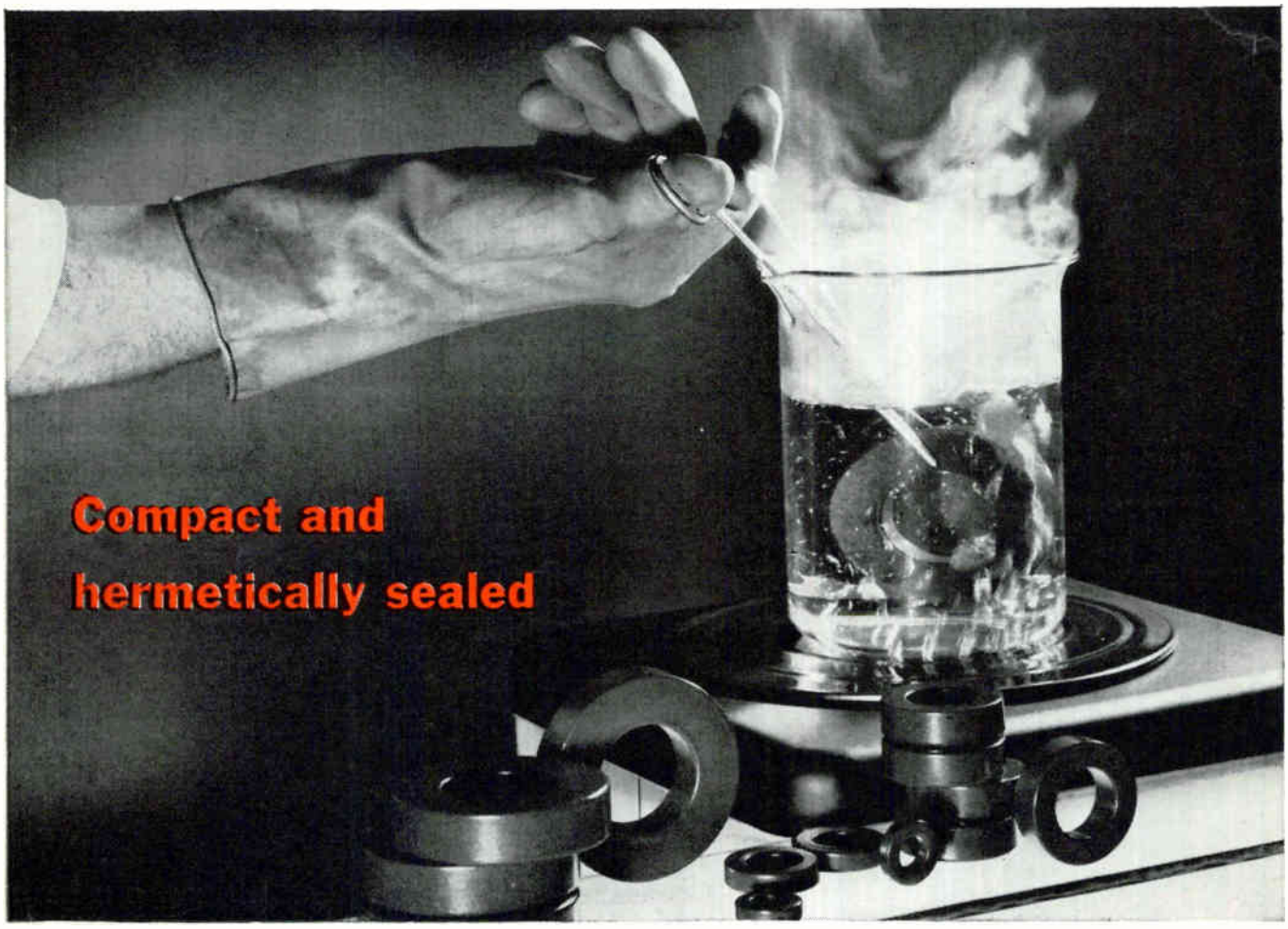

CROSSTALK

electronics

Oct. 28, 1960 Volume 33 Number 44

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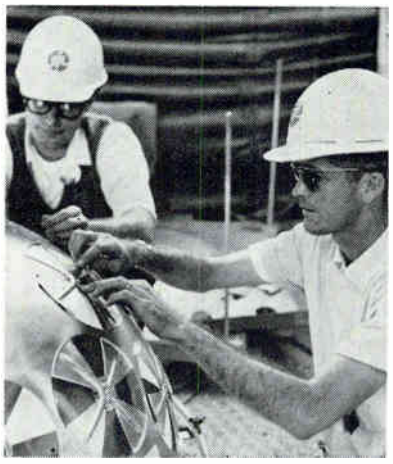

ABLE-5 LUNAR SATELLITE. Engineers in the accompanying photograph are attaching the temperature-control vanes to the Able-5 payload on the launch stand. Scheduled to be launched towards the latter part of November, Able-5 will carry 50 of the vanes to keep the internal temperature of the payload within a range of 40 to 85 F. For details of the temperature control system, as well as a description of the experiments and instrumentation, turn to the article on p 63 by P. F. Glaser and E. R. Spangler of Space Technology Labs.

EUROPEAN EXPANSION by U.S. electronics companies is going on at a brisk pace. In most cases, spokesmen for manufacturers say they are setting up shop abroad to be nearer new markets opening up in Europe. Some say they will place their companies in positions of cooperation with European economy by being on the scene, rather than competing with it by trying to supply European markets from the U.S.

Much of the expansion thinking comes in the wake of the Common Market planning that would give a favorable edge to goods manufactured in member nations. To get some idea of the pace of growth abroad, Associate Editor Emma has been speaking with manufacturers, financial men and government officials. Read the story on p 30.

ELECTRONIC WATCH. This week you will be seeing the first news announcements of the Bulova Watch Company's electronic watch, the Accutron. Because it contains no escapement or balance wheel, the watch does not tick. Its barely audible hum is caused by the vibrations of an inch-long tuning fork. This electromagnetic tuning fork is controlled by a transistorized circuit, powered by a 1.3-volt mercury cell that lasts a year. The accuracy is guaranteed to be within one minute a month. (For kings, there's a platinum model at $2,500; for jacks, stainless steel at $175.) To see a photograph of the watch, drawings of its internal mechanism, and a schematic of the circuit, turn to Assistant Editor Gray's article on p 35.

Coming In Our November 4 Issue

SOLID-STATE MASER. In the four years since the solid-state maser amplifier was first proposed, it has made significant contributions to space radar, space communications and the improvement of existing electronic systems. Even so, the maser's potential is only starting to be realized; researchers are working on new types, new materials, circuit design, auxiliary apparatus and microwave power supplies.

In our next issue, J. W. Meyer, associate head of the radar division at MIT Lincoln Lab, discusses the systems applications of solid-state masers. His informative article outlines the problems of designing circuits with masers and brings you up to date on the progress in maser research since his previous article in ELECTRONICS (p 66, April 25, 1958).

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CK6611	1.25 volts	20 mA	30 volts	30 volts	0*	1,000 μmhos
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*Grid Resistor = 5 megohms

**Grid Resistor = 2 megohms

RAYTHEON

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INDUSTRIAL COMPONENTS DIVISION

COMMENT

Electronics Probes Nature

I have read with considerable interest the report "Electronics Probes Nature" (p 53, July 29). You have done an excellent piece of work in compressing, within thirty pages or so, a vast amount of knowledge concerning our planet and solar system.

It is encouraging to note that the science of electronics is sensitive and amenable to the requirements of the various branches of knowledge—including space technology, meteorology, oceanography and the like. Certainly, without the great advances which are constantly taking place in the art of electronics, the other disciplines would be badly handicapped.

Please accept my warmest congratulations on your excellent report.

H. G. DOLL
SCHLUMBERGER WELL SURVEYING CORP.
RIDGEFIELD, CONN.

Japanese Instruments

. . . Your story "Japan Probes Instrument Market" (p 40, Sept. 30) demonstrates one service that ELECTRONICS seems peculiarly able to render. I mean the ability to place one development in perspective by reporting it side by side with another, as you reported the New York show side by side with the one in Moscow . . .

D. D. CAPELLE
NEW YORK

I want you to know how very pleased the group from Japan were with the story "Japan Probes Instrument Market." It was a smashing story and the pictures were excellent.

One amusing sidelight on it all took place last Friday. We had set up an interview with another magazine, and as the reporter would ask a question, Mr. Horiguchi would say "read the article that came out this week." It didn't even matter that the approach the reporter was pursuing was different from yours . . .

DUNNIE KAYES
GRANT ADVERTISING
NEW YORK

Well, Mr. Horiguchi ought to know. As head of the instrument group, he had given us most of the information that went into the article. Of course, the sidelights cabled to us from McGraw-Hill's Moscow bureau chief Conine greatly helped to put the New York instrument show into a proper perspective.

Electromechanical Devices

We read with interest your comprehensive coverage of the field of electromechanical devices ("Electromechanical Devices and Systems for Electronics," special report beginning on p 57, Sept. 30). We note, however, an error in the section devoted to electromechanical readout on p 79 where you have transposed the identification of the Liquidometer spiral scale indicator with the Bendix tape type indicator (Fig. 1, B & C).

This is not to suggest that Liquidometer does not also manufacture servo-driven tape indicators. Liquidometer has developed multiple display tape type indicators for indicating fuel sequences on at least one advanced model of aircraft. Other Liquidometer indicators of this type have been developed to display exhaust gas temperatures and angular displacement.

SANFORD SOLARZ
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LONG ISLAND CITY, N. Y.

Kelvin and Kilos

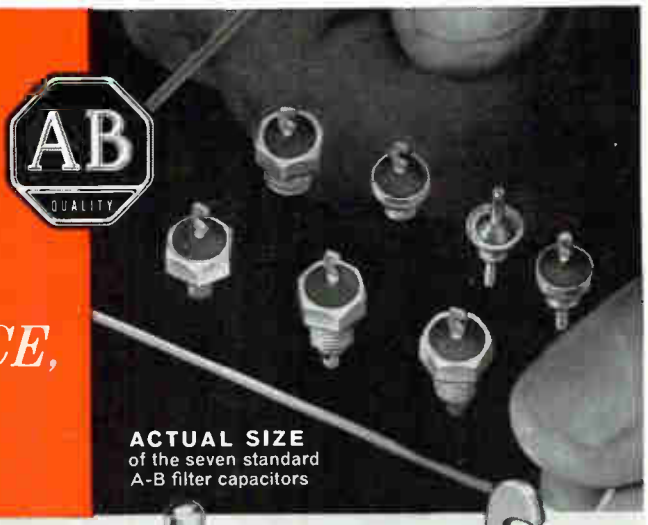
I am interested in the article ("Future Developments in Engineering," p 159, Mar. 11) by T. Emma and M. F. Wolff.

On p 163, I am uncertain as to what frequency the designation "30 K" means, and I am also hazy as to whether or not transmission through the air could be accomplished at that frequency.

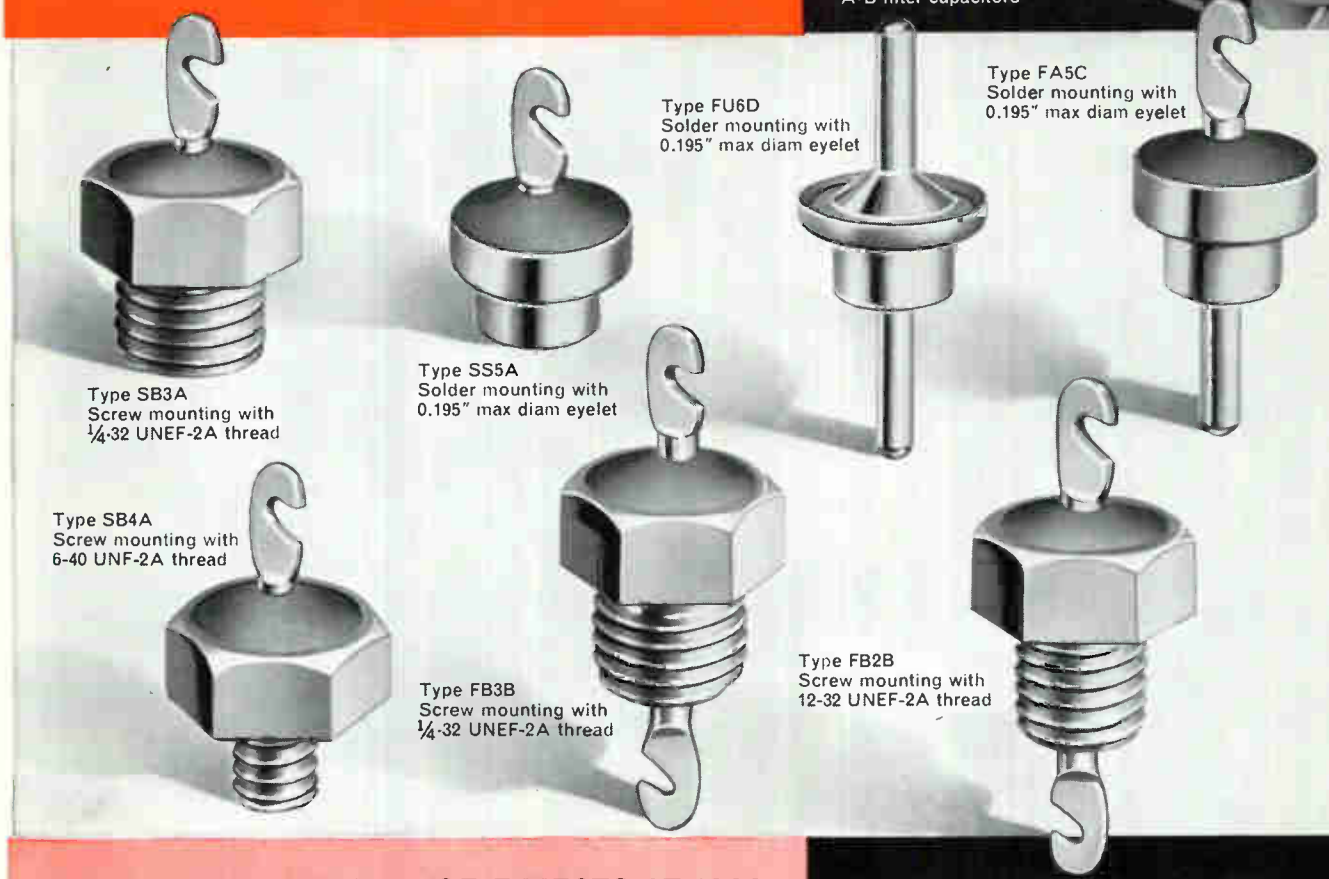
F. VINTON LONG
TEXAS EASTERN TRANSMISSION CORP.
SHREVEPORT, LA.

Authors Emma and Wolff referred to a temperature of 30 degrees on the Kelvin scale, not 30 kilocycles. It's certainly a possible confusion; this is one time the context didn't make it clear.

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



ACTUAL SIZE of the seven standard A-B filter capacitors



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 attentuation of undesired radiation.

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

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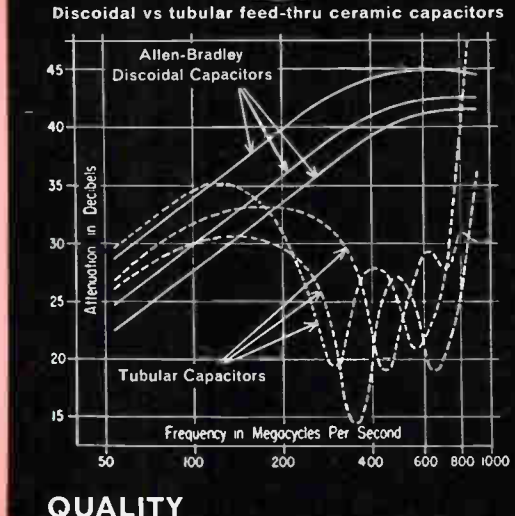

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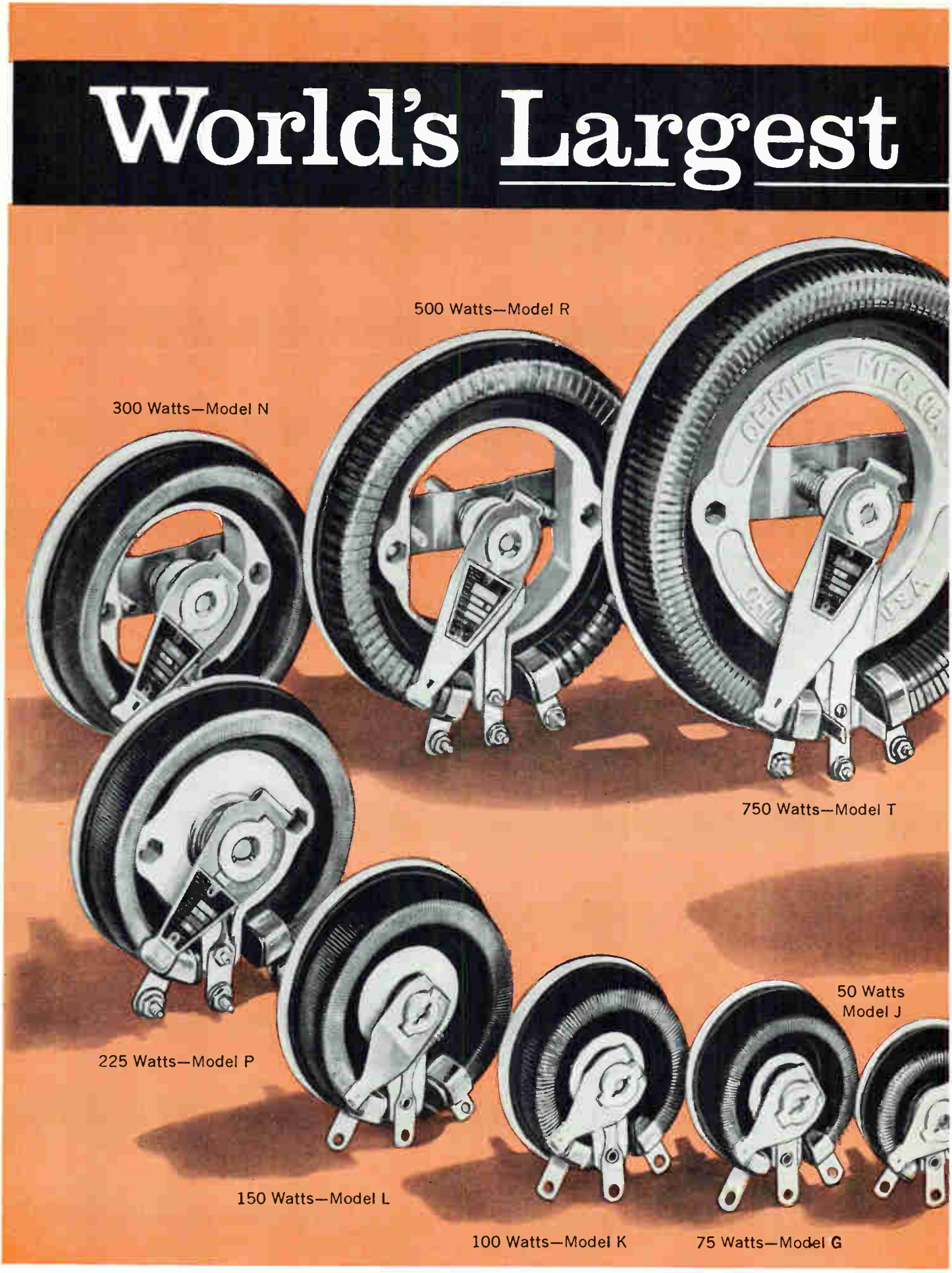
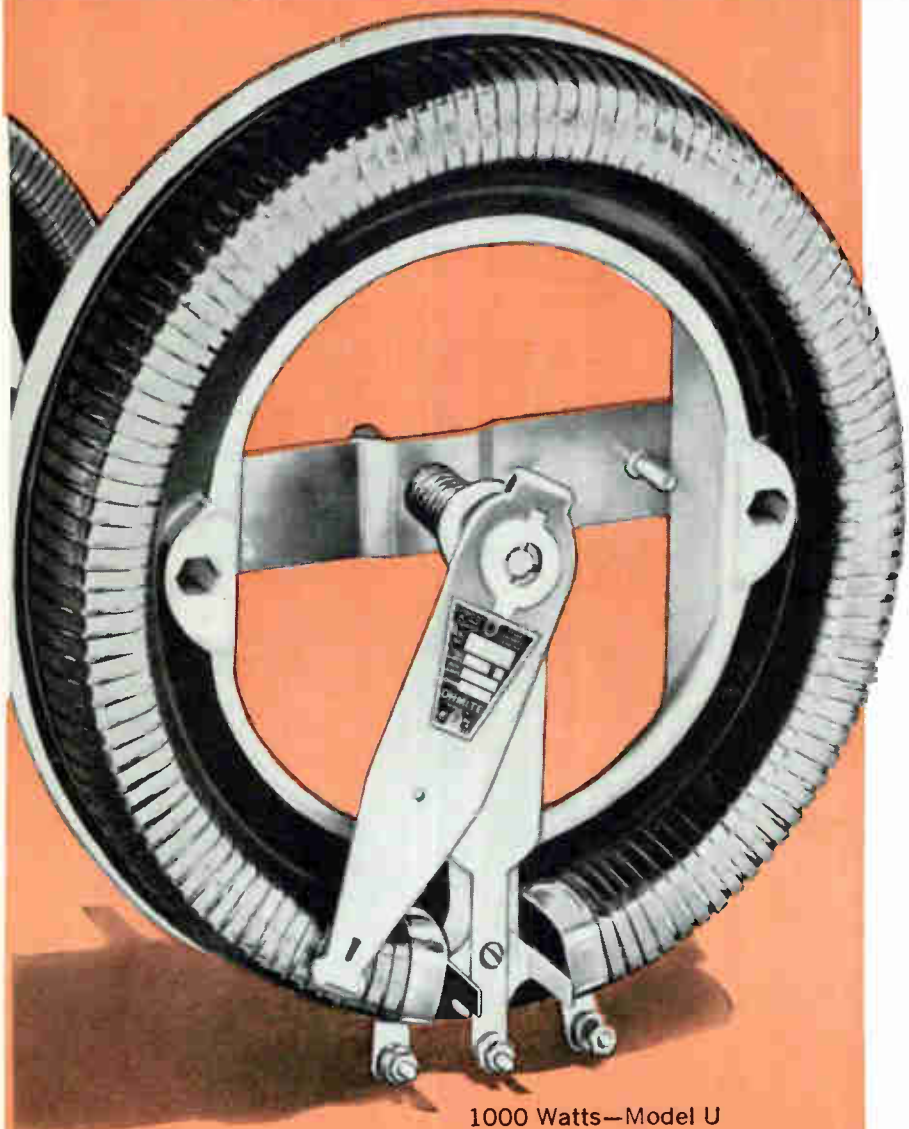


Selection

---SIZES
--VALUES
--STOCK UNITS
---SPECIAL FEATURES



1000 Watts—Model U

OHMITE offers the largest and most varied assortment of power rheostats ever developed.

You can choose from 413 *stock* commercial sizes and types ranging from 12½ to 1000 watts . . . or from over 400 *stock* MIL-R-22A sizes and values, with "special fast delivery" on *all* other MIL units. You can find, for example, scores of different shaft styles, sizes, configurations—already engineered and waiting. Literally, hundreds of other special features take care of any rheostat application envisioned today.

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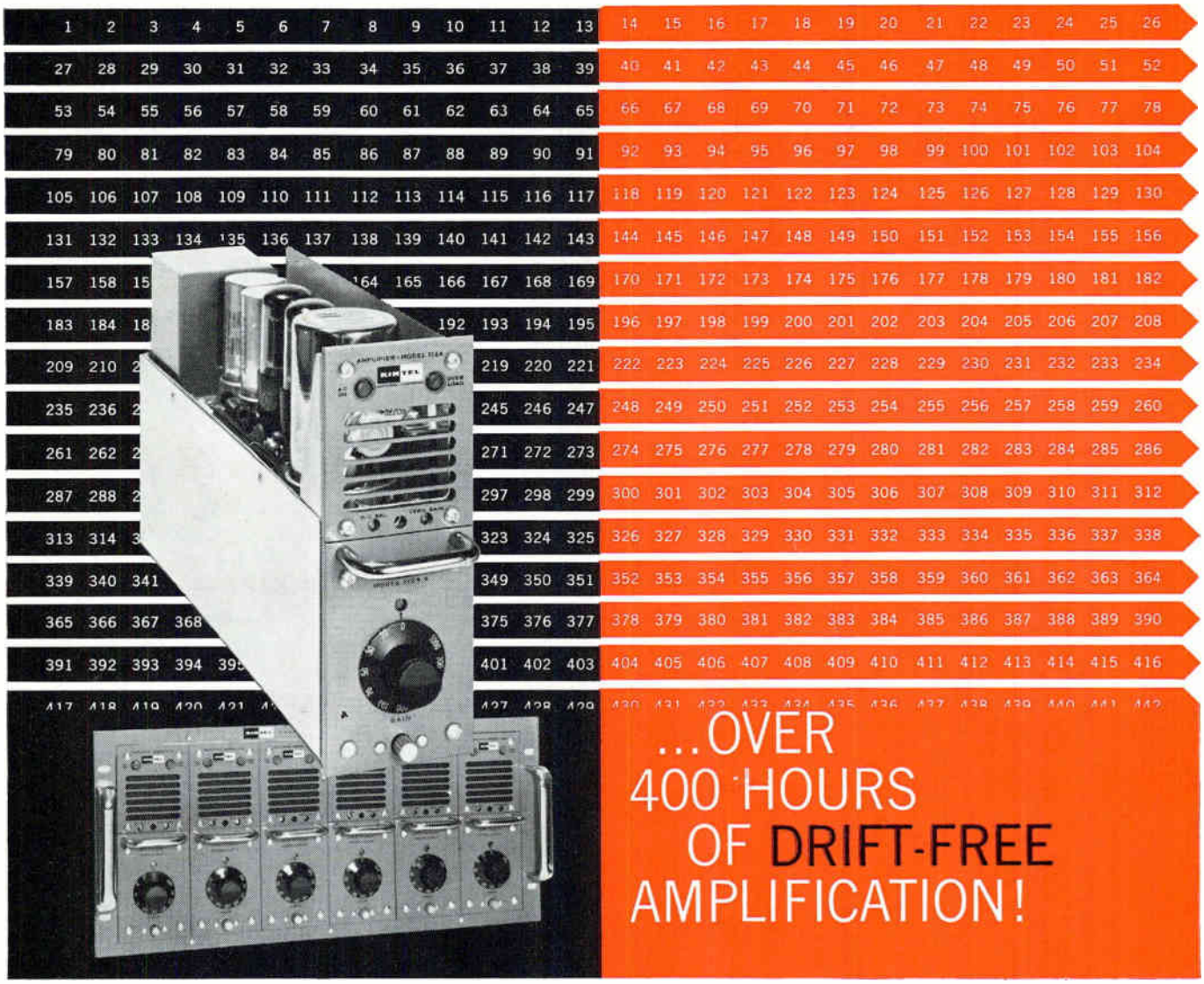
Micromodules



Less than 2μv of drift for over 400 hours of continuous operation! That's just one of the many outstanding features of KIN TEL's new 112A wideband DC amplifier—the unit that is the successor to KIN TEL's 111 series DC amplifiers. Frequency response is from DC to beyond 40 kc, output capability up to 45 volts. It has an integral power supply, fits the same cabinets and modules, and can be used to replace any KIN TEL Model 111 amplifier.

HIGH ACCURACY. The 112A amplifies microvolt-level signals from DC to 2 kc with a gain accuracy of ±0.5% on any gain setting, better than ±0.01% accuracy on individual gain settings by means of the Micro-Gain adjustment.

RELIABILITY. Overall dissipation has been reduced and reliability enhanced by replacing the tubes used in the 111 amplifier power supply with silicon rectifiers in the 112A. Special heat-conducting shields, heat sinks, and an improved mechanical layout further improve cooling efficiency. Polystyrene capacitors are used in all critical areas. Rugged, militarized components are used wherever compatible with required performance characteristics. Write today for technical information or demonstration.

PRICES:

112A Amplifier with a 112A-A plug-in unit that permits 10 gain steps from 20 to 1000 with 1 to 2 times vernier adjustment at each step...$625

112A Amplifier with a 112A-B plug-in unit that converts the amplifier to a +1 unit having an input impedance over 10,000 megohms, a gain accuracy within ±0.001%...$615

195 Single amplifier cabinet...$125

191A Single amplifer 19" rack module...$150

190 Six amplifier 19" rack module...$295

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ELECTRONICS NEWSLETTER

Planning Research Effort In Organic Semiconductors

RESEARCH PROGRAM in semiconductor phenomena of organic structures will be undertaken by Southwest Research Institute, San Antonio, Tex., according to reports reaching ELECTRONICS. The program will study charge-transfer mechanisms in organic materials, then attempt the synthesis of compounds having improved semiconductor possibilities.

Pyrolosis (heat treatment) and ionizing radiation will be investigated as methods of altering electrical characteristics. Institute spokesmen say they're interested for several reasons: raw materials are abundant and cheap; synthesis and purification are easier than with inorganic materials; organic compounds are capable of handling high voltages and currents and can be deposited easily as thinfilms.

Attitude Sensor Uses No Rotating Parts

ATTITUDE SENSOR employing no rotating parts was reported last week by ITT Laboratories in San Fernando, Calif. The device utilizes four tiny mirrors mounted on leaf-type vibrating springs to pick up the magnified image of the earth or other object. Each mirror has its own light detector which may be a photocell, solar cell, or infrared detector. Mirrors are driven synchronously by a speaker voice coil with operating frequencies between 50 cycles and 10 Kc, selected according to detector speed.

Mirrors are mounted 90 deg apart; signals from opposing mirrors are amplified, rectified, and compared. Zero signal output means that the object is directly on the desired optical axis. Imbalance in signals indicates an out-of-vertical condition; corrective action is taken, in the case of a satellite application, through servomechanisms operating on stabilization controls. The prototype sensor uses eight transistors.

ITT says the sensor consumes 0.01 watt, will last 5 to 10 years in space and weighs less than half a pound. Rotating-type sensors use 4 to 8 watts and are relatively short-lived because of bearing and lubrication problems.

Main use, say ITT scientists, is in satellite stabilization systems, but firm predicts device will be widely used in stellar navigation.

Small Business Profits From Computerized Design

MEDIUM-SIZED COMPUTERS will permit small manufacturers to save $3 out of every $4 required for designing new product lines or modifying existing products, according to demonstrations going forward this week in Chicago. A special computer design seminar at the Knickerbocker Hotel on Wednesday showed 45 small-business enterprises how it's done.

Reduction of transformer design time from four days by hand to half an hour by computer will be demonstrated by Leroy Carson of the Mattern X-Ray division of Land-Air. Case histories from four companies report how small and medium-sized computers can help small companies increase output, save material costs, standardize product lines, give sales departments accelerated service on custom jobs.

Three-Nation Symposium Discusses Noise Problems

LOW-NOISE RECEIVERS are the subject of an extraordinary three-nation interchange at MIT's Lincoln Laboratory this week. A hundred scientists are meeting in the 5-day conference on the use of low-noise circuits in radar and allied equipment, which is sponsored by Britain's Royal Radar Establishment, Canada's Defense Research Board and the U. S. Department of Defense Research & Engineering division.

Symposium stresses the problems of the noise environment, noise measurements, and low-noise components and systems. British and Canadian papers report work on solar noise in uhf receivers, noise in quantum-mechanical amplifiers, beam-cooling of quadrupole amplifiers, variable-reactance amplifiers for a uhf troposcatter receiver, performance of a 10-cm radar using a maser, variable-capacitance diode parametric amplifiers for telecommunications, and use of an X-band maser in an airborne radar.

Bell System Sets Up Large-Scale Data Net

LARGE-SCALE DATA COMMUNICATIONS system operating over regular telephone lines was announced last week in New York City. The Hardware Mutuals-Sentry Life insurance group will use the data network, reportedly among the largest of its type.

The regular Bell System Data-Phone will be used to couple computers to the telephone lines. Data-Phone converts digital data to telephone tones, permits preset automatic transmission as well as manual operation at rates up to 1,600 words a minute over regular local or long distance lines at regular rates.

Philippines Establish Radar Warning Network

REPORTS from the Orient say that the Philippine and U. S. air forces will jointly install and man an extensive radar network in the Pacific island chain. First of several long-range radars will be operating before yearend on northern Luzon.

From the northern tip of Luzon, the 250-mile-range sets will be able to see about as far as Taiwan, can provide air warning against activity originating on the China mainland but will not be able to probe the mainland itself.

U. S. is also helping beef up anti-submarine defenses of the Philippine Republic, whose military budget for fiscal 1960 (ended last July) was only $82 million.

Reactor Puts Out Billion-Watt Bursts

NUCLEAR REACTOR with electronic instrumentation and fuel elements that permit pulsing a normal out-

put of 100 Kw to billion-watt levels for bursts of a fraction of a second was dedicated last Friday at the University of Illinois. The reactor, of the Triga type, was financed jointly by the Atomic Energy Commission and the university.

Machine will be used both for teaching and research in nuclear engineering, and to provide irradiation facilities for university users. Pulse capability should be useful in research into effects of pulsed gamma radiation on electronic equipment, hot research subject just now. General Atomic division of General Dynamics built the reactor, provided a self-limiting safety feature which automatically cuts back whenever output rises above normal.

Northwestern to Survey R&D In Midwest

SURVEY of midwestern electronics research and development will soon be announced by Northwestern University, according to spokesmen for the school. Northwestern and other midwest organizations are currently fighting charges by Stanford's Frederick Terman that neglect of basic research and development—in favor of making more money from established products—causes heavy emigration of midwestern scientists and engineers to East and West coasts.

Latest University of Michigan placement report shows that more graduates preferred to work in the midwest this year, rather than on West coast. Proportion of graduates starting in midwest increased from 52 to 60 percent, while those going to West coast declined from 23 to 16 percent—"probably reflecting a reduction in the number required by aircraft industry."

Four Institutes Advise On Ballistic-Missile Defense

NATION'S DEFENSE braintrusters, four strong, have been formed into a technical advisory group for ballistic-missile defense to give advice on various aspects of Advanced Research Projects Agency's project Defender.

The four institutes—MIT's Lincoln Laboratory, Stanford Research Institute, Cornell Aeronautical Laboratory and University of Michigan's Willow Run Laboratory are all involved in ballistic-missile defense work under ARPA contract. The advisory group's purpose will be to advise the ARPA missile defense office on Defender, whose aim is to discover adequate means to counter tomorrow's operational missiles.

Two representatives from each lab will serve on the group, one as principal, the other as alternate. ARPA has appointed Charles Cook, the agency's research chief for missile defense, as executive secretary of the advisory group.

Transmission System Uses Positive Error Detection

INFORMATION THEORY underlies a system developed by New York University for adjusting rate of transmission to specific channel conditions. The system grew out of contract from USAF's Cambridge Research Labs, uses a simple error-detecting code with positive go-no go feedback to maintain a low error rate.

Each transmission consists of a message plus parity-check digits. The receiver accepts the message only if the message and its check digits match. If the transmitter does not receive an acceptance signal from the receiver, it retransmits the message. For 30 check digits (out of 100 to 200 in the total message-code group), the probability of acceptance of a code group containing a transmission error is about one in ten million.

NYU and AF/CRL both feel that the proposed system approaches the ideal match between transmission rate and channel capacity for a given error probability.

Second U. S.-Japan Computer Venture Coming

SECOND joint computer-manufacturing enterprise may be in the works in Japan. Recent accord between Ministry of International Trade & Industry and IBM (see "Japan Plans More Computers," ELECTRONICS, p 40, Sept. 23) increases Remington Rand's hopes for approval of a technological exchange agreement with the Mitsui combine.

The agreement would see an exchange of knowhow and production facilities among Remington Rand, Nippon Remington Univac, Mitsui Bussan (Japan's largest trading company) and Tokyo Shibaura, which is affiliated with both General Electric and the Mitsui Bank. Nippon Remington Univac was set up to sell U.S.-made equipment in the Orient; the aim now is to manufacture computers through either NRU or some second venture.

Ownership of NRU is shared 30 percent by its U.S. parent, 50 percent by Mitsui Bussan and 20 percent by Toshiba. MITI, which disapproves generally of majority ownership by foreign enterprise, looks with favor on the present set-up. Tokyo observers think the ministry may even permit RemRand to take controlling interest in any manufacturing venture so that the firm can pass IBM patent data along to its associates; RemRand's present cross-license agreement with IBM permits it to share IBM technology only with organizations in which it holds more than 50 percent interest.

Hydrogen Maser Makes Accurate Atomic Clock

SCIENTISTS at Harvard University have used a hydrogen maser to make a clock which promises to be 100,000 times as accurate as even the atomic clocks.

Device uses a paraffin-lined quartz box to keep high-eneregy hydrogen atoms from dropping to lower energy levels. Scientists find that one high-energy atom can endure some 10,000 bumps, giving it a high-energy lifetime of about a second. The bulb is used as the source of 21-cm radiation of great stability and purity of tone. Its nearly perfect monotone, Harvard physicists say, promises to make the maser clock a new standard for time or frequency.

Accuracy has not yet been measured, since the only way to test its accuracy is to build another identical clock and see how well they keep time with each other. A second maser clock is now being built. Eventually, the researchers hope to prove the device accurate to one part in 10^{15}.

THE FIRST

2-3 WATT

215 TO 260 MC

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Crystal controlled corrected phase modulation ±125 KC deviation. High efficiency —over 30%. Dimension 2.6" diam. x 3.0" thick or 2.6" x 2.6" x 3.0" thick.

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VECTOR Manufacturing Company, Inc., Southampton, Pennsylvania

TELEMETRY COMPONENTS AND SYSTEMS

WASHINGTON OUTLOOK

GOVERNMENT POLICY on the use of space for commercial communication is a long way from being resolved. A Congressional policy squabble is certain to erupt in the next session. The present administration has not yet decided on a firm course. Two basic problems are involved: whether a company can legally buy and launch its own rockets; and what frequencies are to be allocated for satellites.

The proposal made recently by National Aeronautics & Space Administrator T. Keith Glennan (see ELECTRONICS *Newsletter, p* 11, *Oct.* 21) *partly answers the first question. He envisions a system under which a company would take a satellite payload to the government and have it placed into orbit for an agreed fee. The same relationship would be used in tracking the satellite once it was launched. This scheme, however, would involve considerable technical scrutiny of the commercial programs by Washington.*

The system would have two advantages: the government would control satellite launchings for safety's sake; the communications industry would be saved the nearly prohibitive expense of setting up its own rocket launching and tracking facilities.

The question of allocation of frequencies is more complex because of its international implications. It was discussed at the International Telecommunications Union's last winter meeting in Geneva, and is slated for more definitive discussion at ITU's next meeting in 1963. An earlier session may be called if technical advances force the issue. Meanwhile, individual member governments and special committees are working up proposals for the ITU.

The problem of frequencies for satellites has four major categories: transmission between earth and space; transmissions for research in propagation characteristics; radioastronomy; and communications between two or more space vehicles outside the earth's atmosphere.

FEDERAL COMMUNICATIONS COMMISSION has begun putting into effect its policy of opening up more frequencies in the 890-Mc region for private microwave. Last week it disposed of the last objection to the policy—AT&T's claim that these frequencies should be reserved for use in future space communications.

In effect, the FCC says that it does not really know what space needs will be but assumes that the necessary frequencies will be available when the time comes, partly from successful doubling up of space and ground communications on the same frequencies. The Commission had already disposed of the common carriers' claim that their business would be wrecked if private business were to set up their own communications.

The new order begins to implement a policy first proposed in 1956 and delayed by protests and hearings since then. Among its biggest benefactors wil be the big trucking companies, which will now be able to get radio licenses. Minute Maid also has been trying to get an application for years to connect its orange groves and processing plants.

Spokesmen say they do not expect a tremendous spurt of new business for electronics, but that the way is now paved for steady expansion in the microwave field.

FUTURE OF PAY-TV may hinge on the success or failure of the experimental run under consideration by FCC. The Commission holds hearings this Friday on whether to permit the three-year trial in Hartford, Conn. Probability is that the Commission will approve. RKO General will operate the experiment, using Zenith's system of decoders on the tv sets. Zenith will supply the equipment at cost, with a $7.50-$10 installation fee and monthly rental up to $3.

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120 watt output, fully regulated for high power transistor and other applications!
Fully adjustable output with current limiter for safe low power applications!
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High order of line, load and temperature regulation for maximum stability!
Meets all specs from 0 to 55°C!

New hp 722AR provides fully regulated output 0 to 60 v, 0 to 2 amps. Noise and ripple are less than 250 μv rms. Continuously adjustable safety circuit limits maximum current flow, prevents overload damage to transistors under test. Remote sensing terminals are provided so that the ohmic resistance of the supply lead does not affect regulation. Temperature-stable components insure dependable, "within spec" performance from 0 to 55°C. Good temperature stability also assures constant, reliable output. Load regulation less than 5 mv for 0 to 2 amps change. Load voltage and current meters and three-terminal output are provided (pos. or neg. to ground or floating). Output terminals duplicated front and rear. Floating output permits series connection for higher voltages. And the hp 722AR costs only $525.00!

OTHER hp REGULATED AND KLYSTRON POWER SUPPLIES:

hp 711A Laboratory Power Supply, 0 to 500 v @ 100 ma, $250.00 (cabinet), $255.00 (rack mount); hp 712B Power Supply, 0 to 500 v @ 200 ma, $365.00 (cabinet), $350.00 (rack mount); hp 715A Klystron Power Supply, Beam 250 to 400 v @ 50 ma, Repeller 0 to 900 v, $300.00; hp 721A Transistor Power Supply, 0 to 30 v, 150 ma, $145.00.

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

SPECIFICATIONS, hp 722AR

Rated Output:	0 to 60 v dc 0 to 2 amps dc
Line Regulation:	Less than 2.5 mv for ± 10% line voltage change; any output between 0 and 60 v.
Load Regulation:	Less than 5 mv for 0 to 2 amps change; any output between 0 and 60 v.
Noise and Ripple:	Less than 250 μv rms
Output Vernier:	Range, 1.3 v; resolution, 5 mv.
Temperature Stability:	Better than 0.02%/°C or 5 mv/°C, whichever is larger
Temperature Range:	0 to 55°C for operation within specifications
Output Impedance:	Dc: Less than 2.5 milliohms Ac: Less than 5 milliohms in series with 4 μh
Output Meters:	Voltage: 0 to 60 v, one range Current: 0 to 2.5 amps, one range
Protection:	Output current limiter continuously adjustable from less than 100 ma to 2.2 amps
Cooling:	Forced air
Size:	19" wide, 5¼" high, 12" deep
Weight:	Net 34 lbs.
Price:	$525.00

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- High gate sensitivity 20 μa to fire
- Covers current range from 1 ma to 200 ma @ 75°C ambient
- Voltage ratings up to 200 volts available
- Temperature range: −65°C to +150°C

CIRCLE 220 ON READER SERVICE CARD

NEW! TO-5 PACKAGE CONTROLLED RECTIFIERS

Two series of diffused silicon PNPN bistable switching devices with very low triggering requirements and micro-second switching.

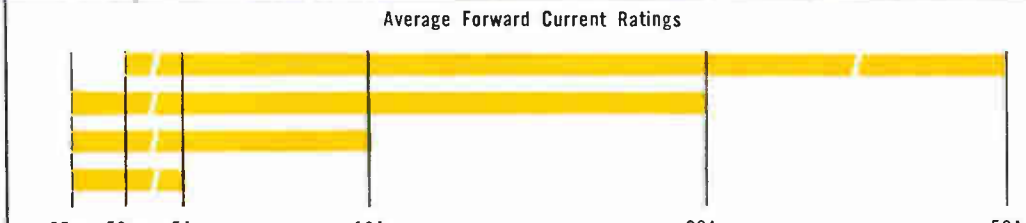
TCR251-TCR4001 series featuring:

- Low leakage: 100 μA @ 125°C case
- High gate sensitivity: 200 μA @ 25°C
- Low Holding Current: 5 mA maximum @ 25°C
- Current rating: 1 amp at 80°C case or 600 ma at 25°C ambient
- Voltage ratings: Up to 400 volts

Plus **2N1595-2N1599** series with same current and voltage ratings

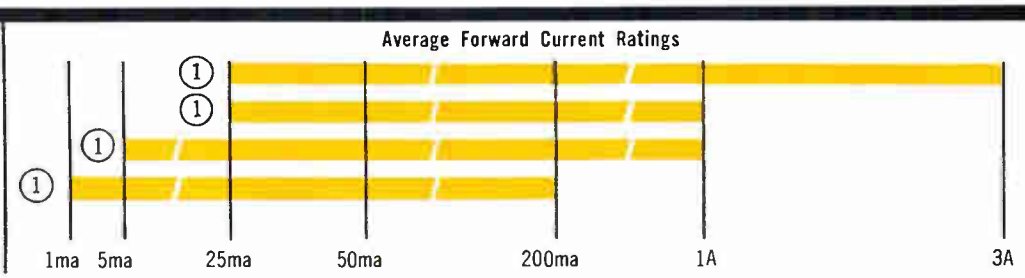
CIRCLE 221 ON READER SERVICE CARD

Series	Package
TCR 550	1 1/16 hex base
TCR 520	11/16 hex base
TCR 510	11/16 hex base
TCR 505	7/16 hex base



2N1600	7/16 hex base
2N1595	TO-5
TCR 251	TO-5
TSW 31S	TO-18

(1) Maximum Holding Current Values



The complete Transitron line of Controlled Rectifiers and Controlled Switches includes the following higher current types:

NEW! 2N1600-2N1604 and TCR505-TCR4005 series diffused Silicon Controlled Rectifiers

- Current ratings: 3 amps at 80°C case; 1 amp @ 125°C case
- Voltage ratings: Up to 400 volts
- Package: 7/16" hex base

CIRCLE 222 ON READER SERVICE CARD

10 Amp Series

- Current ratings: 10 amps @ 25°C case; 5 amps at 100°C case
- Voltage ratings: Up to 400 volts
- Package: 1 1/16" hex base

20 Amp Series

- Current ratings: 20 amps @ 25°C case; 10 amps at 100°C case
- Voltage ratings: Up to 400 volts
- Package: 1 1/16" hex base

CIRCLE 223 ON READER SERVICE CARD

NEW!

50 Amp Series

- Current ratings: 50 amps at 100°C case
- Voltage ratings: Up to 400 volts
- Package: 1 1/16" hex base

CIRCLE 224 ON READER SERVICE CARD

RECTIFIERS & SWITCHES

INDUSTRY'S BROADEST LINE!

Binistors / Transwitches

THE BINISTOR

(bý-nis-tor)

Transitron's new silicon NPN Tetrode offers simpler, more reliable, more economical switching and storage circuitry. The key parameters of this bistable, negative resistance device are determined by external circuitry, providing remarkable stability and uniformity over wide temperature ranges. The signal and output swings are compatible with present transistor and diode circuits. Two series are available: The wide temperature range or military types and the commercial and industrial computer types. The stability and uniformity of each unit in the military series is absolutely guaranteed by the method of specification at critical temperatures (−65°C and +150°C).

CIRCLE 225 ON READER SERVICE CARD

ABSOLUTE MAXIMUM RATINGS

	3N56	3N57
Collector to Emitter Voltage (V_{CE})	15 Volts	15 Volts
Collector Current @ 25°C (I_C)	30 mA	30 mA
Storage & Operating Ambient Temp. Range	−65°C to +150°C	−55°C to +100°C

3N56 MILITARY TYPE

SPECIFICATIONS & TYPICAL CHARACTERISTICS (At Noted Ambient Temp.)

TURN-ON	AMBIENT TEMP	MIN.	TYPICAL	MAX.	TEST CONDITIONS
D.C. Collector Saturation Voltage (V_{CE})	−65°C	—	0.46	1.0 V	I_C = 10mA, I_b = + .5mA*
	+25°C	—	0.7	1.0 V	V_J = 4V, R_J = 3K
	+150°C	—	1.2	1.5 V	supply
Critical Injector Current ($I_{i\ crit}$)	−65°C	0	.38	.5 mA	I_C = 10mA, I_b = − 50μa
	+25°C	0	.28	.5 mA	
	+150°C	0	.21	.5 mA	
	−65°C	0	1.10	1.5 mA	I_C = 0.25mA, I_b = − 50μa
	+25°C	0	0.86	1.5 mA	
	+150°C	0	0.40	1.5 mA	
TURN-OFF Base Cutoff Current (I_{bo})	−65°C	—	—	—	V_{CE} = 15 volts, V_{JE} = + 13 volts
	+25°C	—	.020	0.2 μA	V_{BE} = − .6 volts
	+150°C	—	2.0	10.0 μA	

3N57 COMPUTER TYPE

SPECIFICATIONS & TYPICAL CHARACTERISTICS @ 25°C

TURN-ON	MIN.	TYPICAL	MAX.	TEST CONDITIONS
D.C. Collector Saturation Voltage (V_{CE})	—	0.7	1.0 V	I_C = 10mA, I_b = + .5mA* V_J = 4V, R_J = 3K supply
Critical Injector Current ($I_{J\ crit}$)	0	.28	0.5 mA	I_C = 10mA, I_b = − 50μa
	0	.86	1.5 mA	I_C = 0.25mA, I_b = − 50μa
TURN-OFF Base Cutoff Current (I_{bo})	—	.020	.2 μA	V_{CE} = 15 volts, V_{JE} = + 13 volts V_{BE} = − .6 volts

*Unit must switch on under the above conditions; however, actual V_{CE} measurement is made with I_b = − 50μa

THE TRANSWITCH

A PNPN bistable silicon computer element that can be turned on and off with gate current. The device is available in the TO-18 package, and is designed for miniaturized memory circuits, ring counters, shift registers, controlled rectifier drivers, and flip flop equivalents. A 100 ma series (TSW-31A-TSW-201A) has been added to the Transwitch series. Both series (50mA and 100mA) are available in voltage ratings up to 200 volts. For commercial and industrial applications, the SW-30 type is now available. This unit, especially designed for lower temperature applications, features maximum collector current rating of 30mA and maximum voltage rating 30 volts.

CIRCLE 226 ON READER SERVICE CARD

ABSOLUTE MAXIMUM RATINGS

	SW-30	TSW-31 thru TSW-201	TSW-31A thru TSW-201A
Forward current I_f	30 mA	50 mA	100 mA
Operating temp. range	−55°C to +85°C	−55°C to +125°C	−55°C to +125°C

SPECIFICATIONS (AT 25°C)

	SW-30	TSW-31 thru TSW-201	TSW-31A thru TSW-201A
Max. Saturation Voltage (V_S)	1.5 V @ 30 mA	1.5 V @ 50 mA	2 V @ 100 mA
Max. Forward "OFF" Current (I_{CGO})	10 μA	10 μA	10 μA
Max. Reverse Current (I_R)	10 μA	10 μA	10 μA
Max. Forward "OFF" Current (I_{CGO})	50 μA @ 85°C	50 μA @ 125°C	50 μA @ 125°C
Max. Reverse Current (I_R)	50 μA @ 85°C	50 μA @ 125°C	50 μA @ 125°C
Max. Gate Voltage to Switch "ON" ($V_{G\ ON}$)	1.0 V	1.0 V	1.0 V
Max. Gate Current to Switch "ON" ($I_{G\ ON}$)	1.5 mA	1.0 mA	1.0 mA
Max. Gate Voltage to Switch "OFF" ($V_{G\ OFF}$)	−5.0 V	−4.0 V	−6 V
Max. Gate Current to Switch "OFF" ($I_{G\ OFF}$)	−8.0 mA	−10 mA	−20 mA
Max. Holding Current (I_H)	10.0 mA	5.0 mA	7.0 mA

In writing for further information on all these devices, refer to the following bulletin numbers:

Controlled Rectifiers & Switches		Binistor & Transwitch	
TSW-31S series	Bulletin # TE-1356E	TSW-31A	Bulletin # TE-1357B-1
TCR-251 series	Bulletin # TE-1356D	TSW-31	Bulletin # TE-1357B
2N1595 series	Bulletin # TE-1356C	SW-30	Bulletin # TE-1357E
2N1600 series	Bulletin # TE-1356B-1	3N56	Bulletin # TE-1360A
TCR-505 series	Bulletin # TE-1356B	3N57	Bulletin # TE-1360B
10 amp series	Bulletin # TE-1356A-1		
20 amp series	Bulletin # TE-1356A		
50 amp series	Bulletin # TE-1356AA		

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Veeder-Root READOUT Bulletin

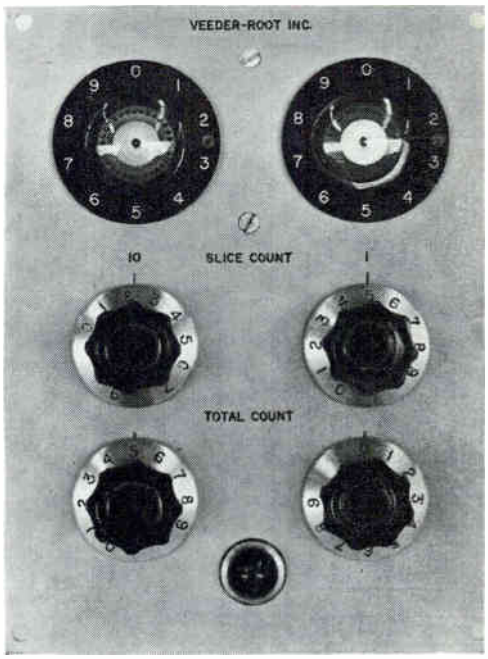
New Electronic Counters provide simplified operation, automatic control for Original Equipment

Veeder-Root Electronic Predetermining Counters are now being used to improve machine efficiency by providing varying degrees of automatic control as original equipment.

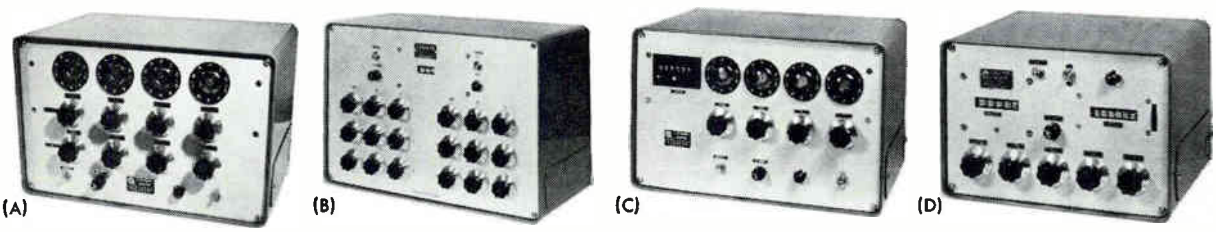
These new electronic counters count electrical impulses. This makes them extremely versatile — and suited to design innovation — because these pulses can be supplied by photoheads, snap-action switches, mechanical contactors, impact and proximity switches, and the like. Photohead actuation alone has almost limitless application potential, and is ideal for high velocity, non-contact counting at any stage of a machine's operation.

The predetermining action — which actuates machine controls, signals, etc., — can run the extreme from a single stop motion, with only one bank of selector knobs all the way to multiple banks which are used to set up a series of stop motions, usually sequentially. There is no theoretical limit on the number of banks (or sequential stops) that can be provided. Counting speeds are available up to 5000 counts per second, and even higher in special applications. Instantaneous reset and automatic recycling are also valuable features.

Some of the many possible counter variations are shown below. Both the 1804 Series, Electronic, and 1601 Series, Electric, Counters are providing this type of control as original equipment on a variety of machines, from bacon slicers to plastic film extruding machines. Design and engineering assistance is available to help achieve maximum operating efficiency for your equipment.

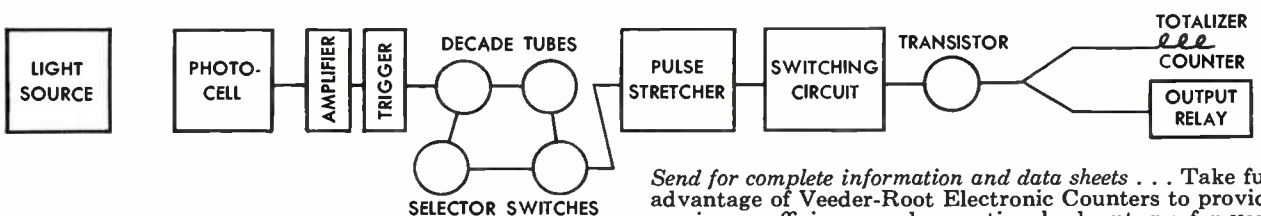


This is a panel mounted Series 1804 Predetermining Counter designed to control operation of a bacon slicing machine. Top bank of knobs is preset to number of slices in each package, other set controls total number of units or packages.



These are a few of the variations in predetermining control available with the Veeder-Root Series 1601 Electric and 1804 Electronic Counters. **(A)** For measuring film footage; when number on top set of dials is reached machine is slowed down, then stops when lower number is reached. **(B)** Series 1601 Counter, designed for sequential control based on six preset quantities. **(C)** A four figure counter incorporating a batch totalizer. **(D)** Series 1601 Counter with five figures, one set of preset numbers and a totalizer for counting cycles or batches.

Simplified Schematic of the Veeder-Root Series 1804 Electronic Counter



Veeder-Root Electronic Counters are designed to your specific requirements. These are some of the many operations now being performed with this modern control method.

measuring	batching mixes	packaging rolls
bin loading	can counting	coil winding
pill packaging	bread slicing	labeling machines
tube cut off	cap counting	nail packaging
bag counting	flow measurement	conveyor control
tool control	predetermining revolutions	

Send for complete information and data sheets . . . Take full advantage of Veeder-Root Electronic Counters to provide maximum efficiency and operational advantages for your equipment. Contact your nearest Veeder-Root Counting Engineer, or write direct.

Veeder-Root

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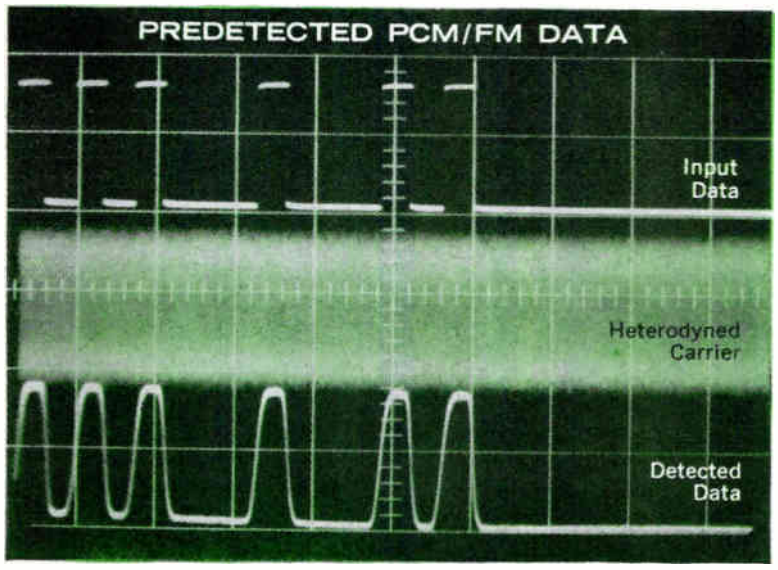
VRO-24



5.0-mc IF carrier heterodyned down to 750 kc. Random-spaced pulses, 20 μs on-20 μs off-type information. Sweep rate: 50 μs/cm.

ONLY THE MINCOM CM-100 IS NOW PERFORMING OPERATIONAL PREDETECTION RECORDING

...and actually doing it at defense facilities as you read this advertisement

Months of exhaustive field testing prove that the Model CM-100, Mincom's latest instrumentation recorder/reproducer, is capable of performing predetection recording on an everyday operational schedule. Because of the CM-100's 1-megacycle response and constant phase equalization at all speeds, an original IF signal of 5.0 mc can be heterodyned so that the carrier and its sidebands fall within the system's frequency range.

Standard Production Model

In this standard production model, Mincom has reduced the series elements before data storage to receiver and mixer only, one step from the antenna. CM-100 thus records and reproduces the sidebands and carrier swing of a receiver intermediate frequency—and it does this with FM, FM/FM modulation, PCM and PCM/FM.

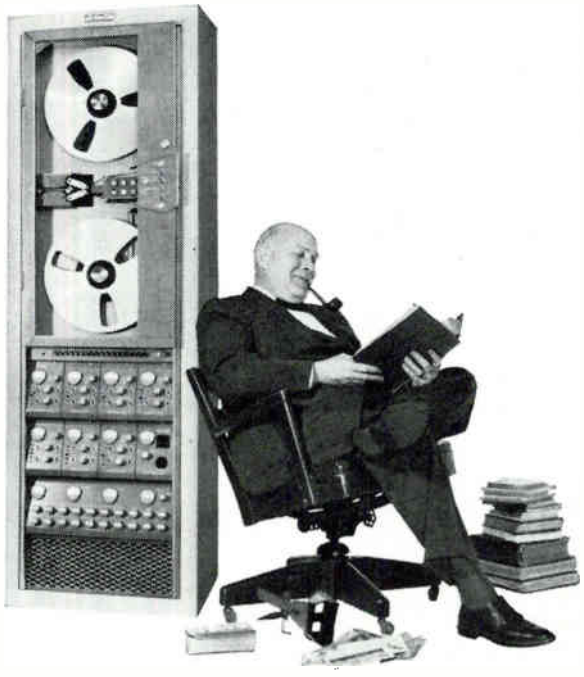
Compatible Recording, Phase Equalization

With Mincom's predetection reception and playback, recording ground stations can be universal in the sense that all types of data systems can be handled by the same equipment. Uniform phase equalization at all speeds means that recorded predetected signals can be reduced in speed and studied with consistently good pulse response, using tunable discriminators.

Versatile System

The Mincom Model CM-100 does the work of two magnetic tape systems by storing both analog and pulse data with equal facility. It is also capable of recording and reproducing greater bandwidths at slower speeds, making possible longer recording times—from 3 hours and 12 minutes at 62.5 kc—7½ ips, to 12 minutes recording 1 mc—120 ips.

Interested? Write today for brochure.



3M COMPANY ...WHERE RESEARCH IS THE KEY TO TOMORROW

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Collins Reports Record Year

SALES AND EARNINGS of **Collins Radio Company** are now reported higher than in any previous period of company history. Sales of $190,837,000 were 62 percent higher for the fiscal year ended July 31 than in the previous year. Net income of $6,560,596 was up 76 percent over fiscal 1959. Earnings for the 1960 fiscal year were $3.04 per common share, based on 2,149,172 common shares outstanding at the year end. Last fiscal year, earnings were $3,530,845, or $1.87 a share based on 1,885,881 shares outstanding at that time. Commercial and foreign government sales of the company increased 79 percent from $28 million to $50 million and are now five times those of five years ago.

General Instrument Corp., Newark, N. J., announces that net profits for the six-month period ended Aug. 31, 1960 increased 63 percent over the same period a year ago. Sales rose four percent. Company backlog, which rose 56 percent, reached a peak of nearly $50 million. Sales for the period were $26,452,782, as against $25,381,254 a year ago; earnings before taxes were $2,177,368, compared with $1,329,100 last year. Net profit after federal taxes was equal to 56 cents per share on 1,773,523 shares outstanding, an increase of 63 percent over last year.

Rimak Electronics, North Hollywood, Calif., reports sales last month of nearly $190,000. New production contracts in September reached $182,000, nearly $20,000 higher than the company's previous monthly high last year.

Garrett Corp., Los Angeles, Calif., for the year ended June 30, 1960, reports highest sales and earnings figures in company history. Sales were $223,824,326, a 15-percent gain over last year's $193,641,345. Net profits after taxes were $5,776,584, a 21-percent gain over the $4,767,796 reported for 1959. Per share earnings reached $5.42 for the 1,064,971 shares outstanding at yearend, up from $4.48 last year on the same number of shares. In the period, the company paid cash dividends of $2.20 per share, or 40.3 percent of net earnings. Sales in the commercial and foreign fields were up 50 percent to a total of $74 million from last year.

Atlantic Research Corp., Alexandria, Va., reports sales of $5,985,215 for the first half of 1960. This is a rise of 75 percent over last year's equivalent figure of $3,429,010. Net earnings rose 67 percent to $329,482, or 42 cents per share, up from last year's first-half figures of $196,895 or 26 cents per share. Part of these earnings and sales increases result from the establishment of Jansky & Bailey and Desomatic Products as divisions of the company during the period. Bulk of company sales derived from research and development projects, with product sales accounting for 25 percent of new business.

Polarad Electronics, New York, announces record high sales and earnings for the year ended June 30, 1960. Sales were $15,072,833, a gain of 27 percent over the volume of $11,900,206 attained the year before. Net income after charges and taxes was $731,640; this is 54 percent more than the previous high of $475,186 established a year earlier. Fiscal earnings were 27 cents per common share based on an average of 1,302,542 shares, adjusted for a two-for-one stock split in June of this year and for the full conversion of the company's six-percent convertible subordinated notes.

Marshall Industries, San Marino, Calif., reports net earnings of $48,974, equal to 10 cents per share for its first full year of operation ended May 31, 1960. Second-half revenues rose 40 percent above the first half, contributing $1,818,277 to the $3,270,551

total for the year. First-quarter figures for 1961 show a continuation of the trend, according to G. S. Marshall, president, with net profits after taxes at $35,017, or 7 cents a share.

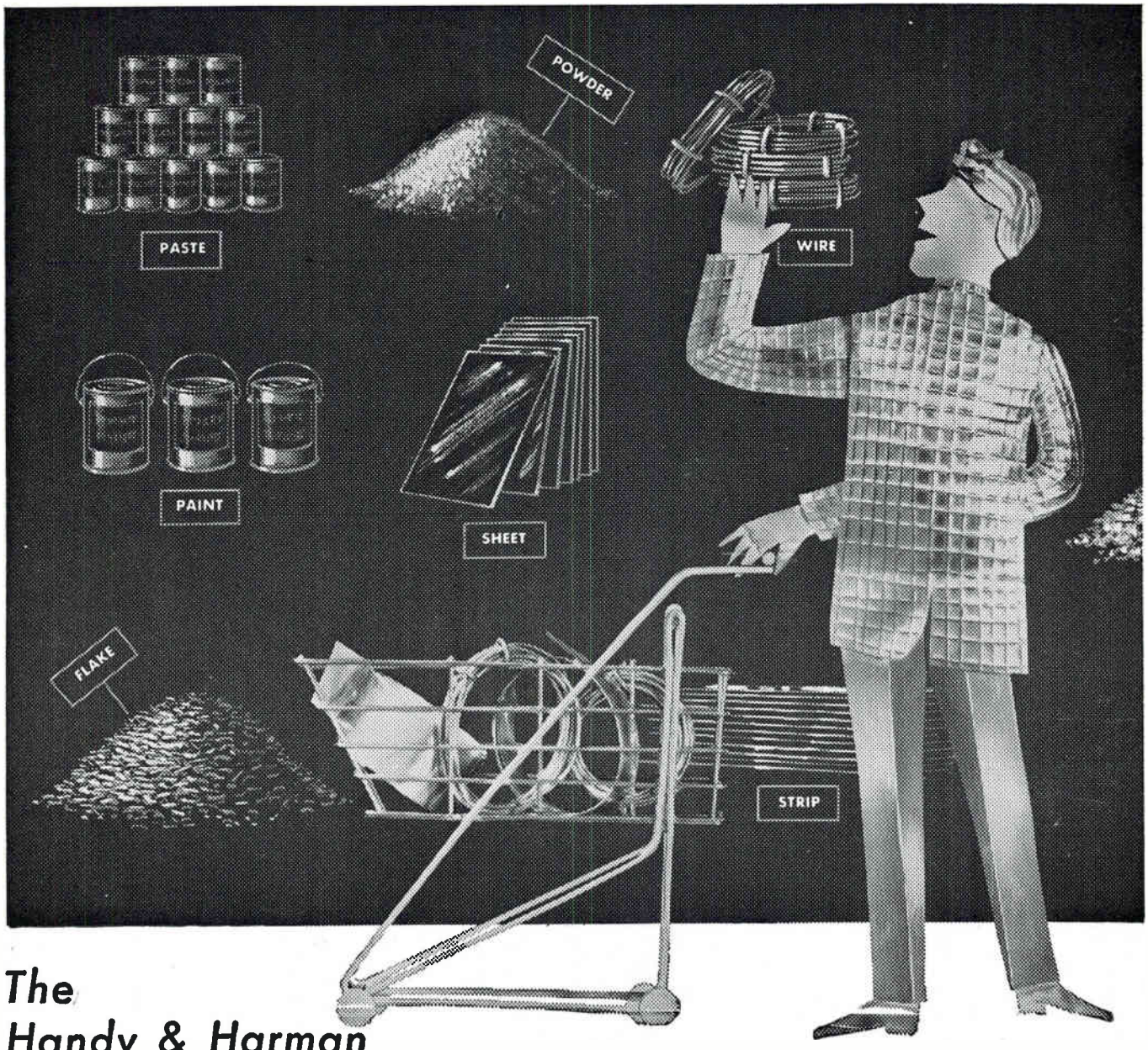
International Business Machine Corp., for the nine months ended Sept. 30, 1960 reports net earnings of $119,088,057 after estimated U. S. federal income taxes. This is equivalent to $6.51 a share on the 18,302,058 shares outstanding at that date. These figures compare with net earnings after taxes for the corresponding period a year ago of $101,684,050, equivalent to $5.57 a share on 18,257,133 shares then outstanding. Net earnings for this year's nine-month period were $246,188,057, compared with $210,560,050 in the corresponding 1959 interval.

Amphenol-Borg Electronics, Chicago, announces that its stock is now listed on the Pacific Coast Stock exchange. The ticker symbol assigned is **ABE**. The company anticipates that the move will increase share ownership on the west coast, where it operates a plant in Los Angeles to produce connectors for aircraft and missile applications.

25 MOST ACTIVE STOCKS

	WEEK ENDING OCTOBER 14, 1960 SHARES (IN 100's)	HIGH	LOW	CLOSE
Ampex	1,201	23 7/8	20 3/4	23 3/8
Gen Tel & Elec	1,148	27 3/8	26 1/4	26 1/2
Int'l Tel & Tel	710	41 1/8	37 5/8	40 1/2
Gen Electric	701	75	72	74 1/4
Sperry Rand	559	20	19 3/8	19 7/8
Audio Devices	544	25	21 7/8	24 3/8
RCA	530	54 3/4	52 1/2	54 3/8
Westinghouse	452	51 5/8	48 7/8	50 3/8
Elec & Mus Ind	430	6 5/8	6 3/8	6 1/2
Litton Ind	411	80 3/4	73 1/2	79
Zenith	388	109	102 1/4	107 3/8
Avco Corp	376	14 3/8	13 3/4	14 1/8
Beckman Inst	367	89 3/4	82 1/4	85 3/4
Gen Instrument	363	36 1/4	32 1/4	35 1/8
Gen Dynamics	332	39 1/8	37 1/8	38 5/8
Philco	287	20 3/8	19	19 7/8
Standard Kollsman	265	21 7/8	19 3/8	21
Motorola	258	67	63	64 3/4
Univ Controls	250	16 3/8	15 5/8	16
Collins Radio	248	51	47	49 1/4
Amer Bosch Arma	236	15 3/4	14 7/8	15
IBM	221	530 1/2	513	528 1/2
Telautograph	218	18 1/4	16 3/8	17 1/8
Texas Inst	210	181 3/4	171 1/2	172
Transitron	204	36 5/8	34 1/2	35 3/8

The above figures represent sales of electronics stocks on the New York and American Stock Exchanges. Listings are prepared exclusively for ELECTRONICS by Ira Haupt & Co., investment bankers.



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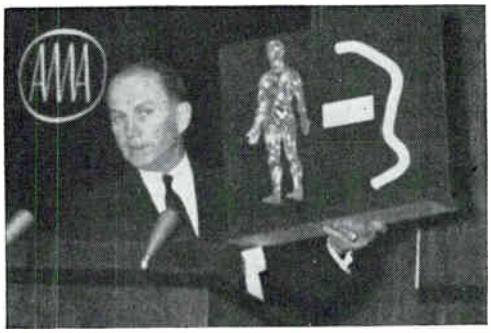


Gen. James M. Gavin, USA (Ret.)

Expert Discusses Space Age Costs

ONE OF THE NATION'S outstanding men of the missile and space age, General James M. Gavin, USA (Ret.), now president of Arthur D. Little, Inc., management consultants, recently said costs of missile and space exploration are growing far beyond expectations.

Gavin was speaking to a group of leading American business executives attending the American Management Association meeting on Developing Business Opportunities in Space Technology.

Addressing himself to the broad picture, Gavin stayed away from estimating size of space markets. But, he said costs of meeting military and civilian needs for missile and space equipment may be a tremendous burden to the people of the United States.

"There is only one road," he said. "Technical breakthroughs resulting from space and missile R&D work will create many new civilian products—both electronic and non-electronic." He told management men that if they got behind these new products they could generate the tax revenues to supply the cost of the program. The only alternative, he said, is a whole-hog planned economy.

Dr. Albert Stone

Ray Frankel

Fred Stein

Wall St. Fund Gets Authorities' Opinions

DR. ALBERT STONE, assistant to the director of applied physics lab, Johns Hopkins U., speaking at a meeting of electronics experts who advise Energy Fund Inc., flatly contradicted the position taken recently by Electronics Industries Association's military planning committee. He sees little indication that rate of growth of DOD expendi-

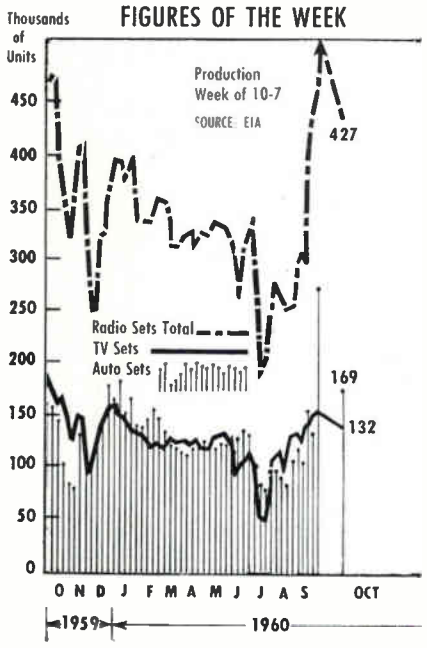
tures for military and space will slow down in the coming year.

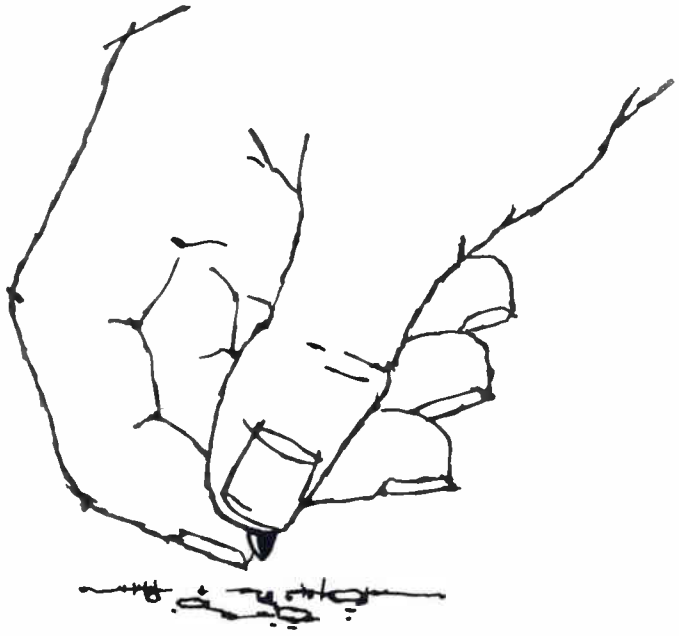
"Costs are so high and money need is so great", Stone said, "We will find ourselves in a planned economy with money devoted to consumer products sharply decreased by bureaucratic decision." Stone said money requirements of space will mean "less butter, more guns."

Other expert advisers at the investment company meeting included Fred Stein, electronics expert of Argus Corporation, investment counselors; Walter Gutman, electronics industry researcher; and Raymond Frankel, investment executive.

Frankel stressed the opportunities for big companies to make money out of systems business. Speaking of the electronics industry as a whole, he also pointed out that profit margins are dropping, though sales are holding. He thinks companies subject to price drops are in an especially vulnerable position. Profitable areas he recommended for the future are information read-in and read-out, fuel cells and magnetohydrodynamics.

Stein said some scientific instrument firms don't lend themselves to mass production. Therefore, they are in a good position to protect themselves against a growing price cutting trend in industry, he said.





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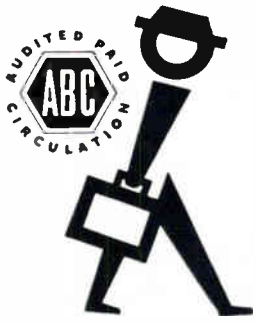

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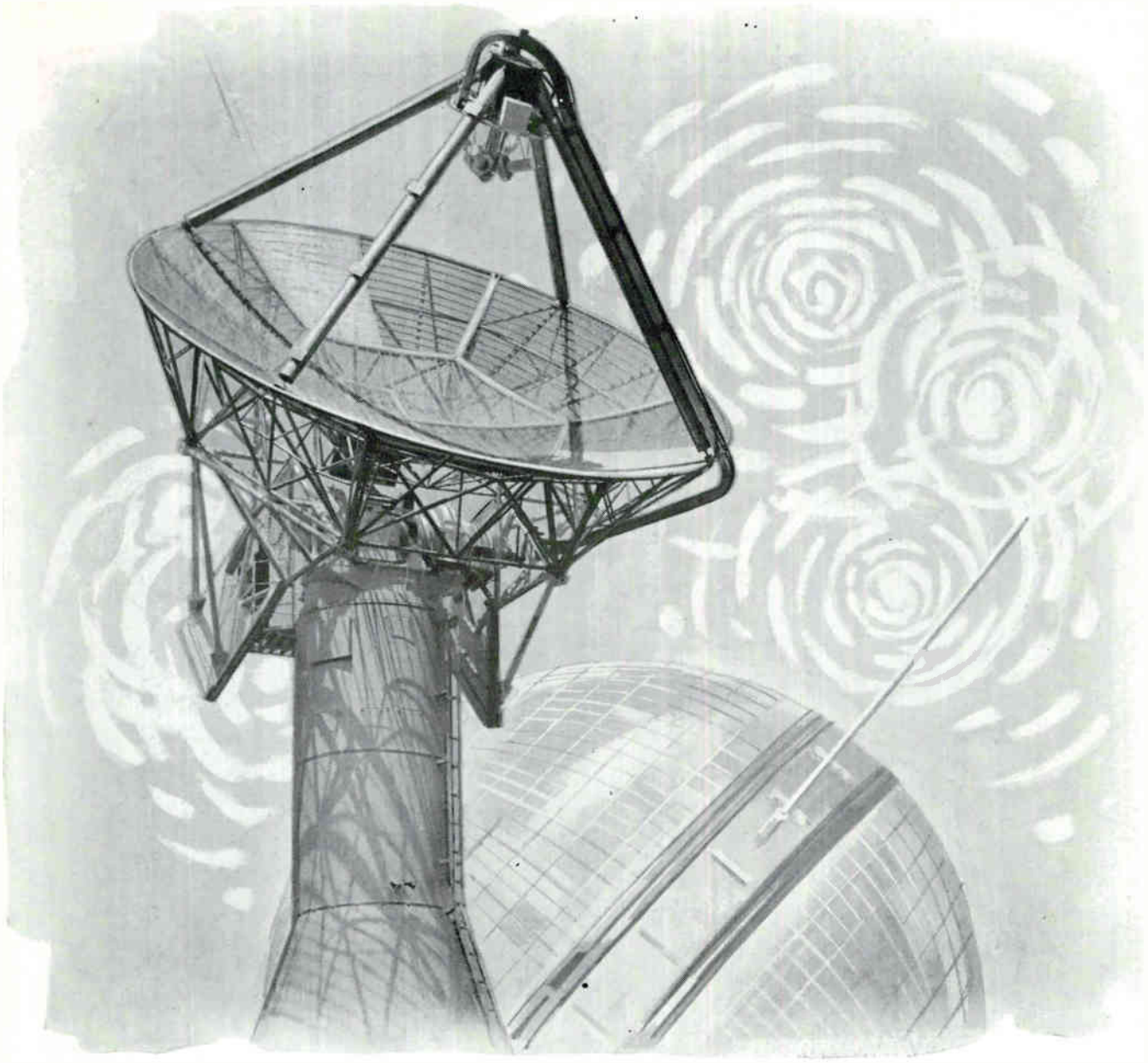

THEY RELY ON RADIATION FOR UNUSUAL CAPABILITIES IN ANTENNA SYSTEMS

Most of the information transmitted from all U. S. satellites, space probes and missiles is received by antenna systems we at Radiation designed and built. We're proud of this fact, of course; but its point here is that Radiation offers unusual capabilities in the research, development and fabrication of RF systems. The ground antennas of Project Courier are an example.

The Army Signal Research and Development Laboratory assigned us the task of designing and building these vital links with the Courier satellite.

Each antenna consists of a multi-frequency feed, 28-ft. parabola, tower and instrumentation. The antenna is a conically scanning automatic target acquisition and tracking system used for two-way communications with the Courier satellite.

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Antenna systems like this are but one of Radiation's many capabilities in the field of advanced electronics. A resume of others is found in our latest "Capabilities Report." Write for it. Radiation Incorporated, Dept. E-10, Melbourne, Florida.

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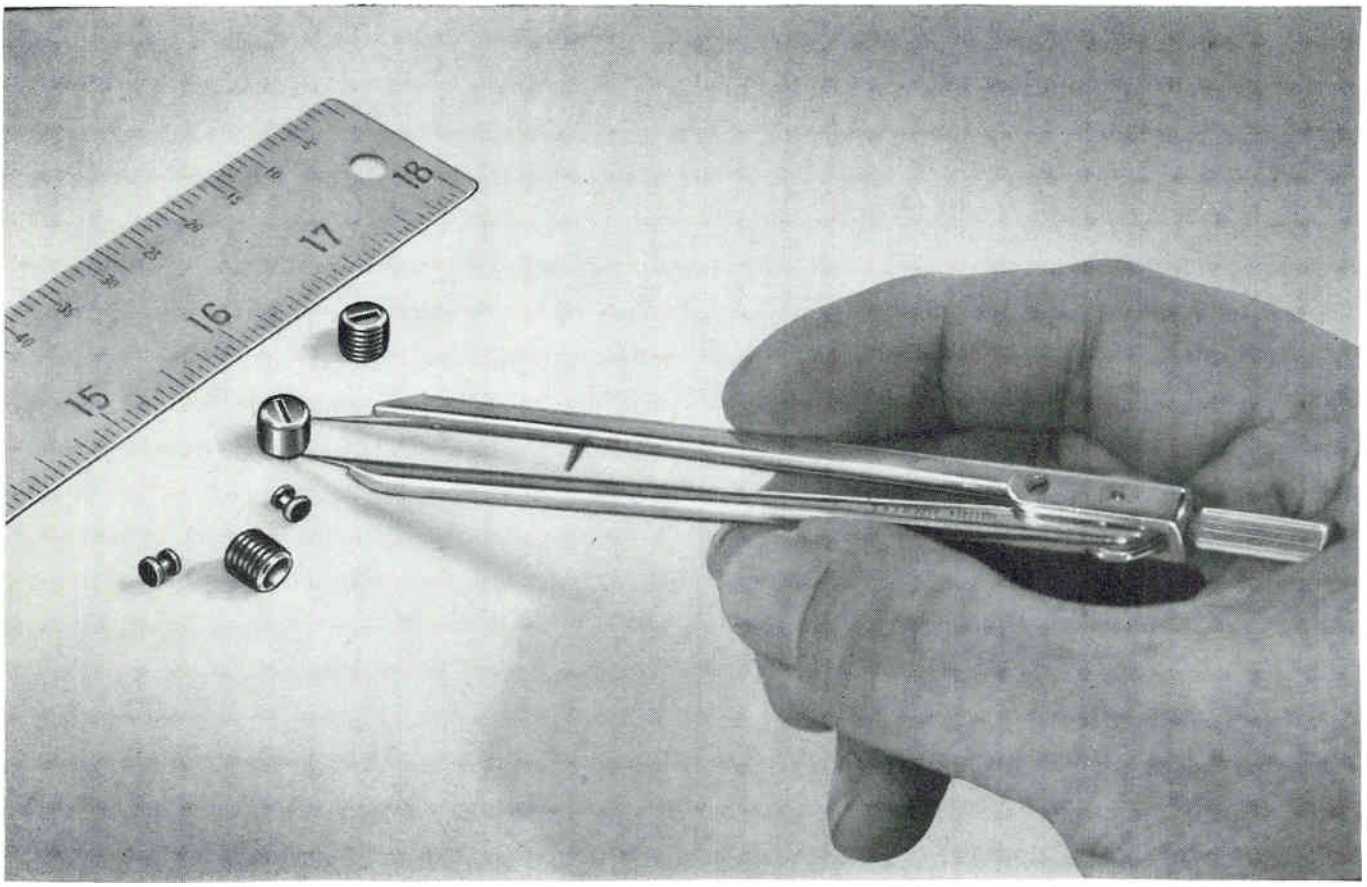
Threaded Cup Core and Bobbin for Miniaturized IF Transformer and Coil Applications



Now you can design miniaturized IF transformers and coils for AM-FM radio and television applications, and maintain high "Q" and effective permeability factors.

This new G-C threaded cup core and ferrite bobbin assembly has closely held mechanical tolerances for precision screw adjustment, and allows close coupling factor between the coil and core.

For RF coil applications, G-C offers a complete line of threaded cores operating in frequency ranges up to 65 mcs. G-C threaded cores are available from stock in Q-1 and Q-2 material; pitch sizes from ¼–28, 10–32 and 8–32; lengths from ¼" to 1⅛" with hex, square or screw-driver holes.

Write for additional information on the miniaturized threaded cup core F1266 and bobbin F1270 and data on G-C stock cores. Please address inquiries to Section E.

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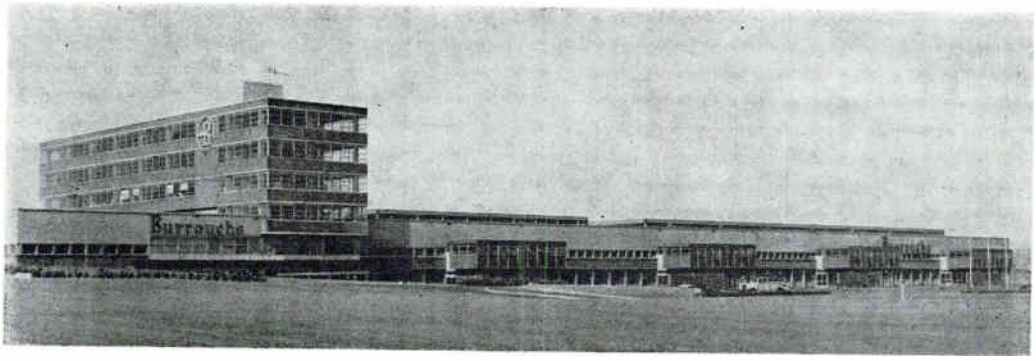
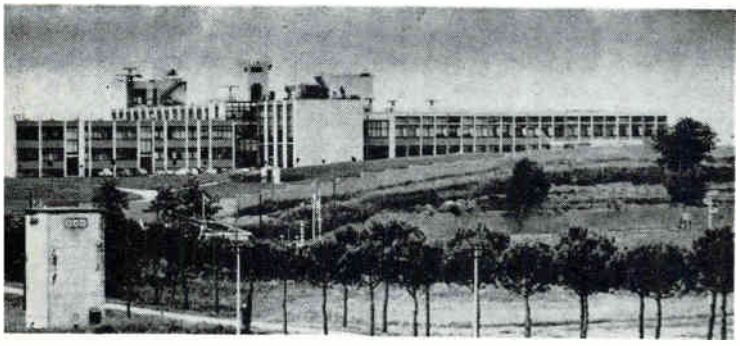
U.S. Plants Spread Out in Europe

Growing numbers of American electronics firms are finding new markets overseas by constructing new facilities or merging with companies there



Burroughs in SCOTLAND



Raytheon in ITALY

IBM in GERMANY

EUROPEAN EXPANSION by U. S. companies is continuing at a brisk pace as 1960 enters its last quarter. Industry expenditures for European plant sites, facilities-in-being, and new construction are higher than ever before, with predictions that 1961 will see even further rises.

U. S. Department of Commerce lists show a substantial number of overseas installations in electronics enumerated in this article. Talks with manufacturers who operate overseas indicate that more than half of them have set up in Europe with the primary interest of acquiring new markets. The second most important factor mentioned is higher profits. Only a few mention lower labor costs.

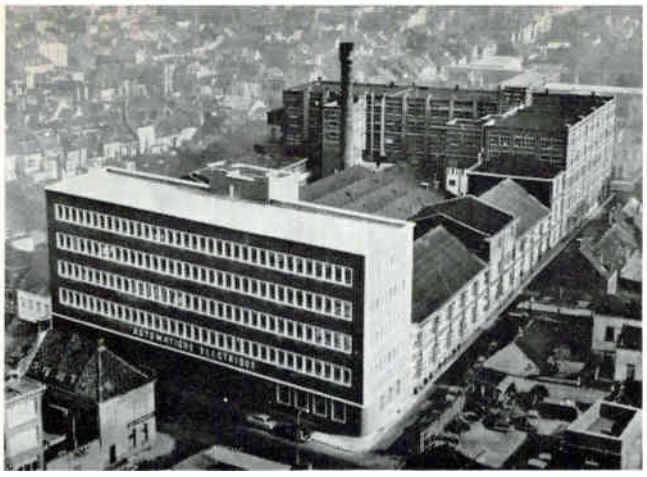
Some indications of the magnitude of this expansion for all industry can be seen in a recent survey by McGraw-Hill Department of Economics. The survey covers about three fourths of U. S. total figures. Respondents say they're spending some $2.4 billion for property, plants and equipment abroad this year. About 88 percent of the money is being spent to put up new facilities; the rest will buy existing installations.

Most of the money is being spent in the Common Market countries (France, West Germany, Italy and the Benelux nations). Other European countries outside the Common Market are also sharing in the expansion.

Many U. S. electronics firms have entered the European arena by establishing entirely new plants and starting from scratch with recruiting, production and marketing. Others have established themselves by mergers with existing companies and outright purchases of overseas firms. Some U. S. companies have concluded licensing agreements with European companies to manufacture and market their products.

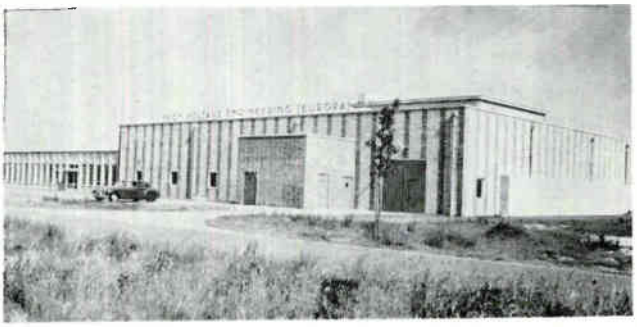
Well established European trademarks are often transferred to U. S.-licensed products in these agreements. On the other hand, if a U. S. trademark is well reputed in Europe, it is usually included as part of the licensing agreement.

Raytheon's second Italian venture, undertaken earlier this year (see ELECTRONICS, p 11, July 8), illustrates one way U. S. companies set up overseas operations. The New England firm joined with Finmeccanica, one of Italy's largest industrial organizations, and Societa Edison, an important Italian elec-



Automatic Electric in BELGIUM

High-Voltage Engineering in HOLLAND



tronics firm, on a 40-40-20 basis. The resulting company, Selenia S.A., will make the Italian-contracted portions of the Hawk missile, now in use by NATO forces. Raytheon's investment in Selenia was $3 million. The firm has headquarters and laboratories near Rome and factory facilities near Naples, also makes radar equipment, industrial controls, facsimile transmission equipment, microwave gear and other electronic goods.

The latest available information on Italy indicates that 13 electronics firms have established facilities in the country since the start of the Common Market. They include AMP, Fairchild Camera. International Rectifier, IBM, Minnesota Mining & Manufacturing, Northrop, Philco, Raytheon, RCA, Robertshaw-Fulton, Sylvania, Thomas Electronics.

In West Germany, 17 companies have established facilities since the start of the Common Market.

Litton Industries, for example, has acquired a majority interest in Fritz Hellige GmbH, a German electronics manufacturer, this year.

RCA has concluded an agreement with TV set maker Saba, for the mutual exchange of technical research data. General Dynamics this year established General Atomic Europe GmbH in Dusseldorf with an investment of 100,000 Marks (about $24,000). The new firm has already concluded licensing agreements with other German companies.

Otarion, Ossining, N. Y., has purchased the plant of the German company Deutsche Akustik, and Kollsman Instrument has established a subsidiary, Kollsman Instrumenten GmbH. It is reported the new German company already has some options on German government contracts.

Bendix entered a joint venture this year with Elektrizitaetgesellschaft and established Teldix GmbH which will conduct research and development and assume responsibility for European sales of control equipment.

Other U. S. electronics companies now established in West Germany include Burroughs, Electronics Corp. of America, IBM, Marchant, Minneapolis-Honeywill, MMM, National Cash Register, Perkin-Elmer, RCA, Remington Rand, Sperry.

Belgium, indicated as having 15 U. S. electronics companies since the start of the Common Market, includes in its roster Automatic Electric, Burroughs, Thomas A. Edison International, IBM, Minneapolis-Honeywell, National Cash Register, Remington Rand, Westrex.

Burndy Corp. established its first overseas plant in Belgium at Antwerp two years ago to produce connectors. Last year, the company opened a second Belgian plant at Malines. Nuclear Development Corp. has a two-year old investment in Belgium, NDA Europe, which is a joint venture between it and Societe Generale des Minerais.

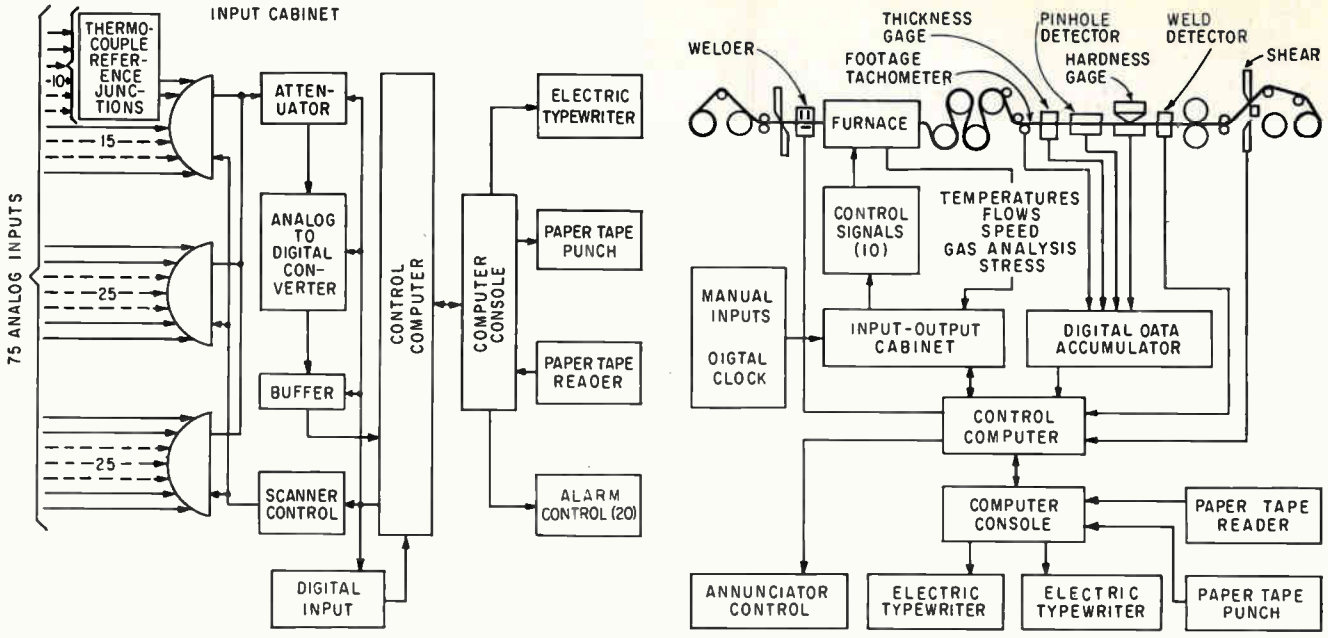
The Netherlands now has some 19 U. S. electronics companies. One of these is High Voltage Engineering, which last year established a $290,000 facility in Amersfoort to produce nuclear research equipment. Central Scientific Co., Chicago, in the Netherlands since 1959, is manufacturing laboratory equipment and precision instruments there. Another Illinois company, Controls Co. of America, has doubled its plant in Holland for the third time since 1955. Plans for the company's next expansion include a new factory in France slated for completion in December of this year. The Dutch plant now covers some 70,000 sq ft and employs between 400 and 500 workers. Among other companies now in the Netherlands are Burroughs, Curtiss-Wright, Fairchild, Fisher & Porter, Foxboro, IBM, Texas Instruments.

Included in Britain's roster of U. S. Electronics firms are Borg-Warner, Briggs Mfg., Burroughs, Daystrom, GE, Ingersoll-Rand, IBM, Minneapolis-Honeywell, Philco, RCA, Remington Rand, General Telephone & Electronics.

France too has her share of companies with Eimco Corp., Burroughs, Ingersoll-Rand, IBM, Remington Rand and General Telephone & Electronics among others.

Switzerland has seen about two dozen installations by U. S. companies in recent years, according to Commerce Department figures. Spain has eight electronics firms of U. S. origin and Portugal, half a dozen.

In Scandinavia, Norway has three U.S. electronics firms operating within her borders since the start of the Common Market, Sweden has four, and Denmark has seven.



GE process computer systems for iron ore sintering (left) and annealing line (right) provide multifunctional control

Steelmen Testing New Computer Systems

More hot-rolling mills are installing equipment. Applications in tin-plating, sintering, continuous annealing are coming

THIS IS what steel industry men are saying about electronics this week:

(1) Electronic automation is in phase 1 in the steel business. Equipment being used is in the R&D and evaluation stage. Computers systems are being tried one at a time. Nobody's really rushing, but everyone's really interested.

(2) Computers have already proven themselves valuable. And even while new computer systems are being installed and tested in hot-rolling mills; other applications are hoving into view. These include tin-plating, sintering and continuous annealing.

RCA has a computer system controlling a tin-plate line capable of speeds up to 3,000 feet per minute. The system controls deposit of tin on steel and the operation of cutting shears at the end of the line. The shears keep metal lengths exactly equal, add length to make up for sections rejected for defects such as pin holes. This system is being evaluated at Jones and Laughlin.

A GE-installed hot-strip mill control system requires only three manual inputs—steel grade, delivery speed and desired finished gage. The system obtains other information automatically, performs calculations, checks mill setup and watches the bar move from stand to stand. Data is logged and processed for use by production control, quality control, accounting, engineering and management.

Daystrom will install next year a computer control system for a hot-strip mill of National Steel at Detroit, Michigan. United Engineering, builders of the new mill, have designed it to operate with 25-ton input slabs that are 9½ inches deep, 80 inches wide and 15 feet long. At the output, the mill will deliver continuous rolls of sheet metal up to 3,000 feet long at a peak speed of 3,000 feet per minute. Calculated output will be 450,000 tons a month. The control computer for this mill will scan, log, indicate and control over 1,000 variables from furnaces through coilers. Two hundred analog signals, 700 contact closures, and 100 computer-generated control signals will be used to improve strip characteristics, increase output and gather information about mill operation.

Cold slabs of metal are fed into the reheat furnaces for even heating of 2,000 F. The slabs are discharged onto a continuously controlled roller table. The slab is descaled at the first breaker, rolled out to proper thickness and width in five roughing stands, descaled again, rolled to final gage in seven finishing stands, cooled by sprays on the runout table to 1,200 F, and finally coiled. The computer adjusts roll setting of the roughing and finishing stands. The computer control system also monitors furnace conditions, rougher control positions, finisher control positions, bearing temperature, oil pressure, slab temperatures, slab locations, slab dimensions and finished sheet dimensions. The system actuates an alarm if any condition is out of safe operating limits. In addition, the system logs metallurgical grade code and finished weight and will periodically print out calculations such as average furnace temperatures, total fuel flow and hydraulic water pressure.

However, while the mill is under computer control, manual control of any computer-controlled function is possible. To determine responsibility, the computer records when manual intervention is made and when the computer resumes control.

The economic pattern of the steel industry has been likened by R. W.

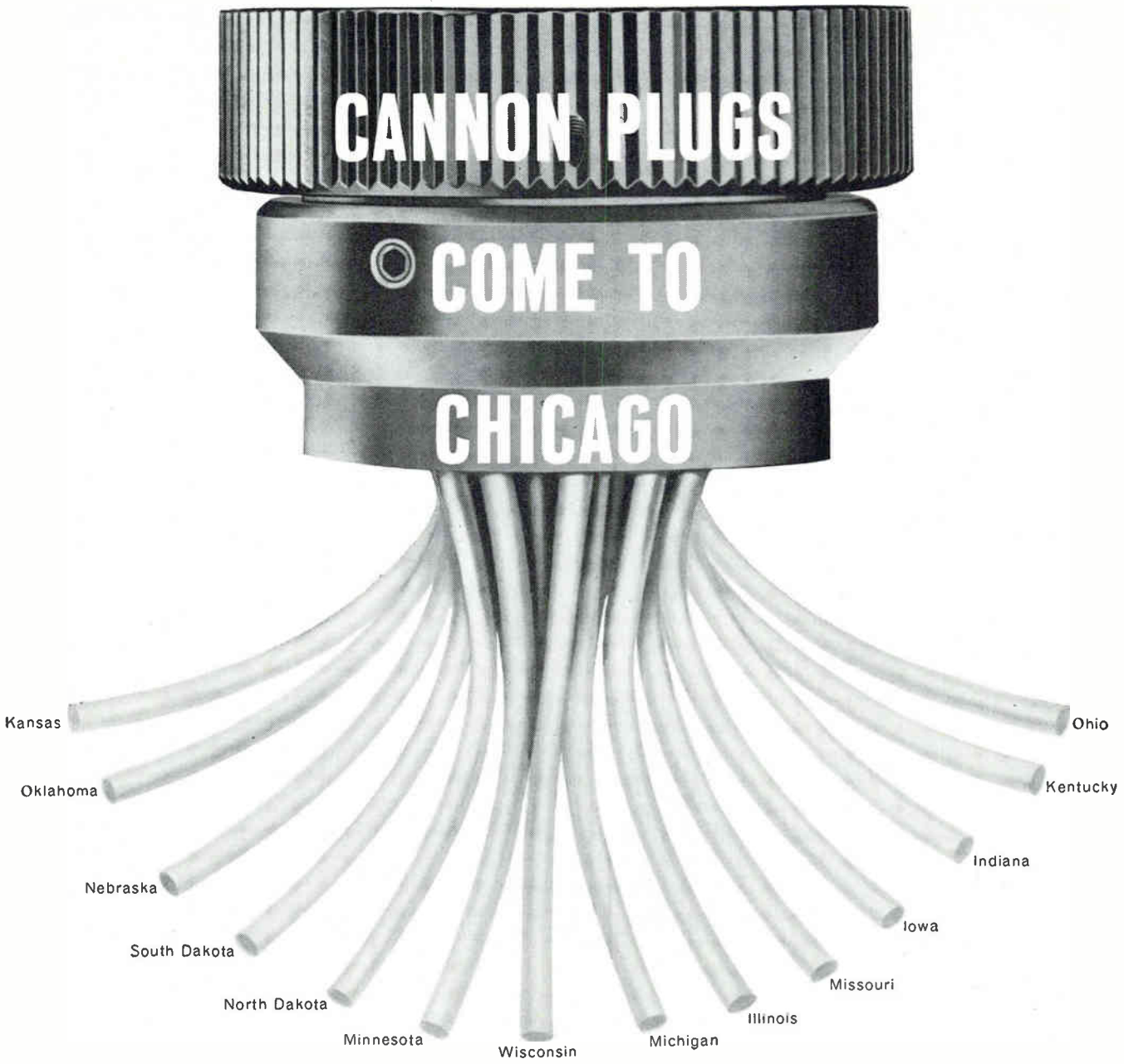
Kirkland, of GE's Industrial Engineering Operation, to textiles. He said that higher wages, competition from efficient foreign mills and new materials supplanting steel for many applications are offering serious problems in domestic and foreign market competition. Computer control systems, he indicated, can help steel mills operating at or near the breakeven point to attain the few percentage points reduction in cost that can make the difference between profitable or unprofitable operation.

Computer control systems must be distinguished from data handling systems that also use digital circuits. Computer control systems not only record data such as defects, lengths and thicknesses as do data-handling systems but also generate signals to correct process machinery. The amount of resulting prime quality product is referred to in the steel industry as yield. Increase in yield is a key point in selling computer control systems to steel industrialists.

Experts feel that increased yields will enable system payoff in a few years' time.

Computer control systems have to-date been applied mainly to large rolling mills and steelmaking processes since small improvements there show large economic benefits. Control of tin-plating, sintering, and continuous annealing is being studied. Use of computers may even help achieve the best materials balance between coke, ore and limestone in the charge of a blast furnace.

Computers handling a large number of variables in closed-loop systems are usually digital. They must be able to convert to digital form analog electrical signals received from indicating devices associated with the process. Selection of the right sensory devices is vital; without proper signals computer control is impossible. Therefore, the computer manufacturer must adopt the system approach. He must know steelmaking processes and the sensory devices that will work best with them. The applications engineer also plays an important role in determining system scope and operating range for automatic control and in establishing an operating program to obtain the greatest benefits.



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To give you still better service, a new Cannon facility has been established in Chicago — with an inventory of Cannon Plugs tailored to the needs of the Midwest area! The Chicago store joins Cannon Service Stores already operating in Anaheim, California and Salem, Massachusetts — serves industrial requirements and also provides a backup for distributors... gives 48-hour delivery plus freight savings. The recently announced Cannon District Sales Office operates in conjunction with the new Service Store, will provide you with *quick* answers to *any* plug problem. Another reason why you should always consult the world's largest manufacturer of plugs for all your requirements

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This Watch Doesn't Tick—It Hums

Hands are set by raising and turning the semicircular handle at the rear of the watch. The 1.3-v mercury cell, which lasts a year, is replaced by removing a cap that can be unscrewed with a dime

AN INCH-LONG tuning fork vibrating at 360 cps is the heart of an electronic wristwatch unveiled this week by Bulova. The hum is barely audible when the watch is held to the ear. The watch, named the Accutron, has no mainspring, escapement, balance wheel, hairspring or winding mechanism. It has only 12 moving parts, compared to 19 in a hand-wound watch or 26 in a self-winder.

The manufacturer guarantees the watch in normal use to not gain or lose more than one minute a month, which equals two seconds a day. Prices run from $175 to $2,500, with most of the dozen men's models in the $250 to $400 range.

The tuning fork (A) has a cup of magnetic iron extending outward from each tine. In each cup is a cone-shaped magnet, and between the cup and cone is a coil wound on a plastic form. The coils, which are attached to the pillar plate and do not move, are 0.15 inch long and 0.18 inch in diameter, and are each wound with 300 feet of 0.0006 wire.

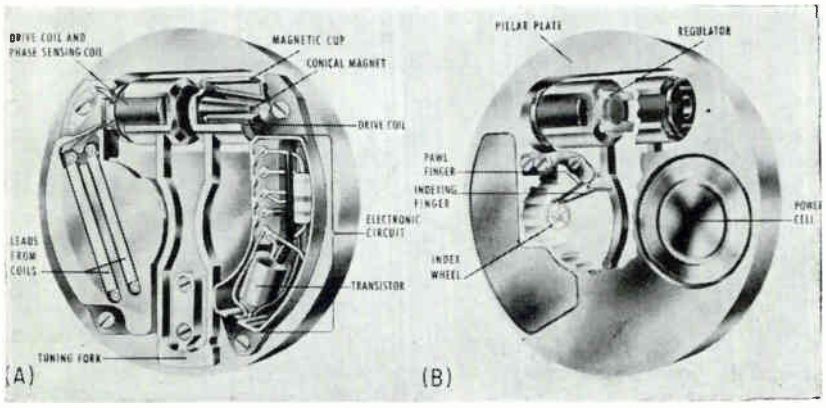
Current passed through the drive coils causes them to become electromagnets and either attract or repel the magnet and cup assemblies, depending on polarity. One drive coil has 8,000 turns of wire on it, the other has 6,000. The remaining 2,000 turns on the second coil comprise a phase-sensing coil that determines the instant for applying pulses of current to the drive coils to maintain tuning fork vibrations. The electronic circuit assembly (A) is a transistor switch that delivers a current pulse at the right time to the drive coils.

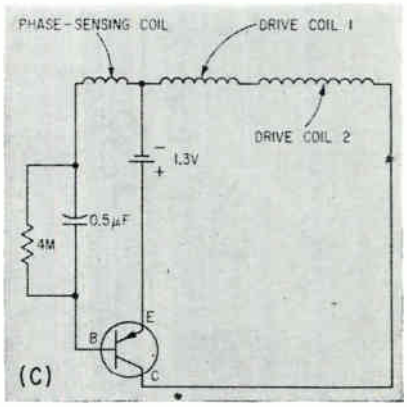
Attached to one tine of the fork is a finger-like index spring (B). At the tip of the spring is a jewel that engages ratchet teeth on the index wheel. The tuning fork advances the index wheel one tooth for each cycle of vibration, and the index wheel turns the gear train connected to the watch hands. The second hand seems to move in a smooth sweep, yet it is actually advancing 360 times each second. The pawl finger is another jewel-tipped spring, which holds the index wheel in position during the return stroke of the index finger. The index wheel is 0.095 inch in diameter and 0.0015 inch thick, with 300 ratchet teeth. The regulator (B) is used by a jeweler to adjust the frequency of the tuning fork by changing its effective length.

The electronic circuit (C) uses 8 microwatts of power. The circuit consists of two related halves, with the transistor and power cell common to both. The transistor delivers a current pulse on each cycle to the drive coils in the right half of the circuit. Amplitude control is provided by the interaction of the a-c induced in the drive coils with the power cell voltage.

The left half of the circuit triggers the transistor at the proper instant to deliver current to the drive coils. The a-c induced in the phase-sensing coil is added to the power cell voltage to charge the capacitor. The current flows through the base of the transistor, which acts as a diode rectifier. The resistor causes the capacitor to leak, recharging the capacitor once each cycle by the peaks of the a-c induced in the phase-sensing coils. These recharging pulses cause the base circuit to conduct momentarily and operate the transistor switch, delivering current pulses to the drive coils to maintain the tuning fork vibrations.

A timer similar to the watch is aboard the orbiting Explorer VII satellite, its 8 ounces replacing 30 pounds of otherwise necessary equipment. The timer was designed to turn off the satellite transmitter at a preset time.





Basic mechanism of the Accutron is shown from the front (A) and from the rear (B). The electronic circuit and coil assembly comprise a replaceable modular unit. The transistor in the electronic circuit (C) is a special Raytheon type

Plan 1½-Ton Orbiting Observatory

TWO 1½-TON ORBITING astronomical observatories (OAO) (ELECTRONICS, p 58, July 29) will be built by Grumman Aircraft Engineering Corp. for the National Aeronautics and Space Administration under a $23-million contract.

Instrumentation will be bought under separate contracts.

Astronomers will use telescopes in the OAO space platform to study cosmic phenomena—x-rays, ultraviolet, and infrared rays—obscured to ground observatories by the earth's atmosphere.

Grumman proposes an eight-sided satellite, 9½ ft high and 6½ ft in diameter. It will weigh about 3,200 lb, including 1,000 lb of experimental equipment. The satellite will be a standardized shell containing stabilization, power, and telemetry instruments into which one or more separate experiments can be fitted for each flight. Astronomical equipment with reflecting mirrors up to 36-in in diameter will be mounted in a cylindrical chamber running through its length.

Two flight model OAO's will be built. The first will be delivered in 2½ years. NASA plans to launch the first OAO in late 1963 from the Atlantic Missile Range into a 500-mi circular orbit with an Atlas-Agena B vehicle.

The satellite will have a stabilizing system to lock astronomical equipment on the star, sun, or planet it is observing. Using its fine pointing control, it will be able to track a star with an accuracy of 0.1 sec of arc—roughly the equivalent of locking on to a basketball 500 miles away.

According to Grumman's Walter Scott, chief of space sciences dept., "The stabilization equipment in the OAO will be so sensitive it would detect the coursing of blood through the human body were there one on board the satellite. It is so precise that it will facilitate a better pointing accuracy than that of any existing large observatory on earth."

A satellite command system will receive ground signals to point and operate the satellite and its experiments. It will verify commands it receives and store commands for execution as long as two hours later.

A tv tube will transmit pictures to ground stations to verify the direction in which the satellite is pointed.

The telemetry system will use both wide-band and narrow-band channels to accommodate tv signals and digital or analog data. A "memory" will store at least 100,000 bits of information from the experiments for later readout when the satellite is over ground stations. NASA's minitrack network will track the OAO radio beacon, command its experiments, and receive its telemetry. Large dishes will be erected at several minitrack stations for this purpose. The satellite transmitters will have a 2,500-mi line-of-sight range.

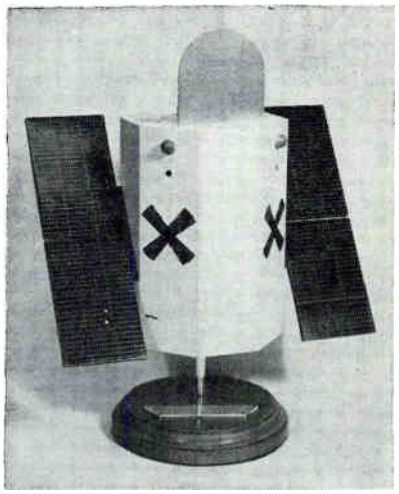
Paddles covered with solar cells will generate the 350 watts of power required to operate the experiments and satellite equipment.

Among the experiments NASA is planning for OAO flights are:

Smithsonian Astrophysical Observatory's proposal to use several eight-inch telescopes, each coupled with a video tube to map ultraviolet radiation over the entire sky. Hydrogen, over a thousand times more prevalent than all other elements combined in the universe, shows its presence more strongly in the ultraviolet region. Also because baby stars probably have strong ultraviolet emissions, it is hoped to learn more about how stars are born.

The University of Wisconsin's proposal is to measure the brightness of ultraviolet emissions from the stars. This data will lead to information on temperatures and structures of stars, as well as their life histories.

NASA's Goddard Space Flight Center's proposal is to use a 36-inch mirror and spectrometer to study emissions from a wide range of celestial bodies. Sounding rocket flights have indicated areas in the sky which are particularly bright with ultraviolet radiation invisible to optical and radio telescopes. This experiment is designed to further investigate these areas.



Eight-sided satellite will weigh 3,200 lb and measure 9½ ft by 6½ ft

Princeton University Observatory proposes to use a 24-in mirror and spectrometer to study cosmic gas and dust by observing them against the stars. A spectrometer can determine the effect of cosmic gas dust upon the radiation from a star. This experiment will indicate whether the elements occur in the same relative proportion everywhere in space.

Harvard University's proposal is to make spectrographic studies of solar activities to further understanding of sun-earth relationships.

NASA called the first meeting of astronomers interested in an orbiting astronomical observatory in Feb., 1959. In August, preliminary specifications drawn up by the NASA Ames Research Center were distributed to industry. Ames engineers built a full-scale stabilized platform to study problems involved in orienting the satellite.

A request for proposals in May, 1960, brought expressions of interest from more than 90 companies; 11 formal bids were submitted on July 5.

For these applications too...

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- INDUSTRIAL CONTROL
- MEDICAL ELECTRONICS
- NUCLEAR ELECTRONICS
- COMMERCIAL SOUND

SELECT FROM 11 NEW TYPES DESIGNED BY CBS ELECTRONICS

CBS 7548	Practical secondary-emission pulse amplifier with 4 ns rise time at 1 amp.	CBS 7732	Stable high-gain r-f pentode replacing 6CB6.
CBS 7721	Frame-grid, wide-band pentode with gain-bandwidth product of 465, Gm of 35,000, and I_b of 22 ma.	CBS 7733	Stable high-perveance video pentode replacing 12BY7A.
CBS 7728	Stable medium-mu twin triode replacing 12AT7.	CBS ECC88/6DJ8	High-gain, low-noise, frame-grid twin triode.
CBS 7729	Stable high-mu twin triode replacing 12AX7.	CBS E88CC/6922	Ruggedized version of ECC88/6DJ8.
CBS 7730	Stable medium-mu twin triode replacing 12AU7.	CBS E280F/7722	Frame-grid, wide-band pentode with gain-bandwidth product of 362, Gm of 26,000, and I_b of 20 ma.
CBS 7731	Stable vhf triode-pentode replacing 6U8.		

Watch for more "new-concept" Instrument Tubes by their originator . . . CBS Electronics.

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CBS Instrument Tubes are designed, manufactured and tested for critical instrumentation use. But their advantages of extreme stability without need for expensive screening and "burning-in" by you . . . their 10,000-hour guaranteed life . . . tight characteristics . . . and premium construction . . . also result in the finest tubes ever produced for most other applications. You profit also from important savings in tube costs made possible by elimination of shock and vibration controls not required.

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Only in CBS Instrument Tube versions of standard receiving tubes, will you find all these advantages:

- Stable characteristics
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- Maximum value and performance per dollar for critical sockets

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*Include unique 100-hour life assurance tests . . . comprehensive 1000-hour life tests . . . 5000-hour informational life tests.

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GOLD-PLATED BASE PINS

The high-conductivity gold-plated base pins used on all CBS Instrument Tubes typify their built-in premium quality.

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Underwater Acoustics Data Revealed

SAN FRANCISCO—Four sessions and 35 papers were devoted to underwater acoustics, at the 60th meeting of the Acoustical Society of America here last weekend.

Approximately 300 authorities in the field of acoustics attended. Nearly 200 papers were presented, making the conference the biggest in the society's history.

Virtually every aspect of acoustics was touched at the three-day conference. Subjects ranged from miniscule analysis of speech intonation and study of the hearing and perception process to the broader architectural functions of acoustics.

But emphasis seemed to be on underwater acoustics.

Of primary interest was a paper by Waldo K. Lyon of the Navy Electronics Lab at San Diego, the first unclassified general release of some of the sonar information gathered by the nuclear submarine USS Nautilus on her voyage under the arctic ice cap.

The use of sonar as an exploratory and navigational tool in underwater arctic voyages is invaluable, but has been restricted by lack of information on acoustic properties of sea ice. Experiments carried out by the Nautilus revealed that while acoustic properties of sea ice change greatly with temperature and history of growth, upward refraction is the dominant and stable sound transmission condition in the Arctic ocean.

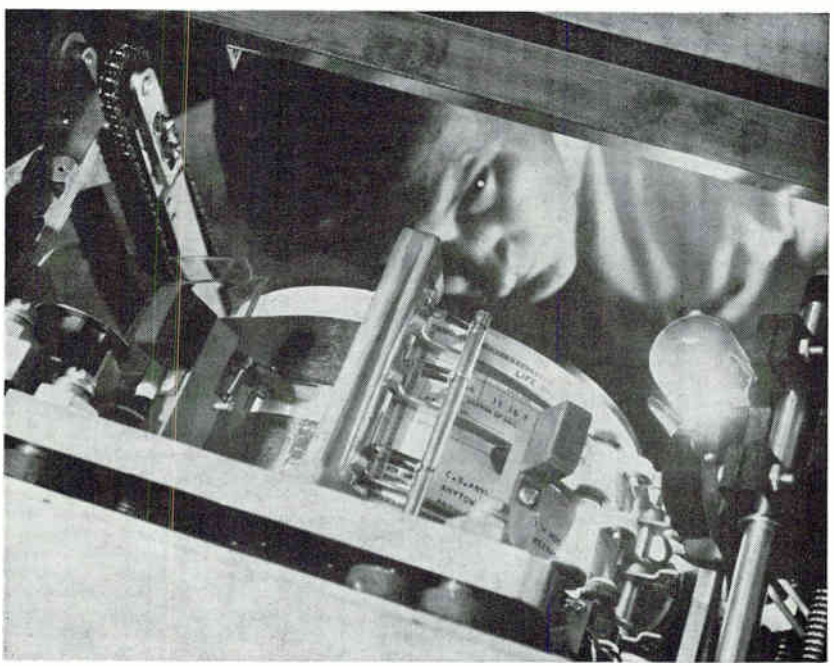
An example of a specific principle uncovered is that in the 15- to 50-Kc region, sea ice acts primarily as a volume scatterer of sound rather than as a sound reflector.

Papers on propagation and processing of underwater signals were presented with emphasis on specific techniques and on measurement.

In another area, advances on several fronts in automatic speech recognition were announced.

W. C. Dersch of IBM described a new approach in which the beginning of the spoken word was downgraded in importance in favor of an unambiguous reference point at any position in the word. The beginning of the word could then be extrapolated electronically. This approach was said to reduce complex-

Machine Reads Numbers to Computer



New IBM 1418 optical character reader scans typewritten or printed numbers in ordinary ink. Feeds data directly into 1401 computer memory

ity in decision logic of the reading device.

A segmentation scheme for use in a speech recognition computer program was described by James W. and Carma D. Forgie of Massachusetts Institute of Technology.

Success in recognition of spoken English numerals was described by George Sebeastyen of Litton Industries.

Digital Instruments Prominent at Show

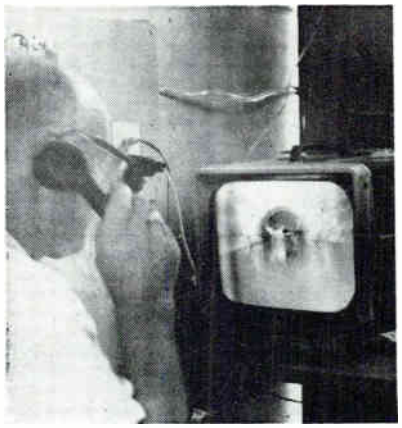
CHICAGO—TEST INSTRUMENTS displayed recently at the National Electronics Conference underlined the trend to digital display. Several varieties of digital voltmeters, ohmmeters, and cathode-ray oscilloscopes were shown.

In components, a definite trend is observable towards microminiaturization.

Molecular electronic circuits attracted big crowds; they were discussed at three of 35 technical sessions. Among the nearly 300 displays were off-shelf microminiaturized circuit modules. One miniaturized chopper measured only 21/64 × 21/32 × 5/8 inches, weighed 9 grams; its contacts were rated at 2 ma, 10 v.

A three-part proposal to the computer industry recommended standardizing graphical symbols for logic diagrams, algebraic symbols for logic equations and printed graphic symbols. Joint committees of the two electrical-engineer fraternities presented the proposal and also released a preliminary draft of a dictionary for switching-theory terms.

Arthur Stern, manager of GE's electronics lab, told conference-goers that component manufacturers could lose much of their business if molecular electronics leads equipment makers to produce their own integrated structures. Manufacturers are beginning to find it hard to say where components stop and circuits begin in molecular blocks. Component makers might find it prohibitive to expand their scope by acquiring the necessary new technologies and facilities, he suggests.



Camera and light assembly (left) readied for lowering in manhole. Monitor (above) shows interior view of sewer to operator in truck

Tv System Spots Sewer Leaks

A CLOSED CIRCUIT television network is saving hundreds of thousands of dollars in municipalities plagued by hard-to-find sewer leaks.

The tv camera, 18 in. long and 5 in. wide, replaces human inspectors in exploring sewer pipes. It pinpoints leaks with enough accuracy to make repairs possible without tearing up pavements, walks or detouring traffic.

To perform a tv inspection, a worker enters a manhole and floats a rope through the sewer line to the next manhole. The rope is then used to pull through a small-diameter steel cable. In turn, the cable draws through a 40-watt fluorescent lamp which lights up the sewer.

Behind the lamp is the tv camera which transmits pictures of the sewer line interior as it is pulled through. Leaks and other faults seen by the camera are transmitted to a monitor screen inside a truck parked above. The picture is scanned by city sewer engineers and the leaks noted.

Along with his bill, the operator of the inspection service submits Polaroid photographs of the tv screen views. By shooting pictures before and after he repairs the leak, the operator has proof of his work to submit.

Communications between men in manholes, those working to plug up the leak, and the operator who sees the results on tv, are carried on via a two-way intercom and sound-powered telephone.

In Hollywood, Fla., where cost of tearing up streets to locate and seal sewer leaks was estimated at $250,000, city officials say the tv camera unit did the job for $35,000—and without obstructing traffic.

Some Florida cities are using the tv survey method to collect photographic proof for use in court cases involving negligent contractors.

Photographs of defects, backed by expert cost estimates, usually constitute sufficient evidence for suits, city officials say.

St. Petersburg, for example, has a sanitary system representing an investment of more than $20 million. City officials estimate $1,500,000 in repairs are needed.

The closed circuit tv system is expected to help pinpoint how much of this is due to normal service and how much to corner-cutting.

CONTROLS COMPANY of AMERICA develops first solid-state moisture-sensing system.

New magnitude of reliability introduced to moisture control field

Here's a new system that precisely measures moisture content—with proven reliability. In fabrics . . . organic or inorganic compounds . . . mixes — in fact wherever moisture is a problem this system offers appliance and industrial engineers a new standard of accurate moisture control.

The control continuously measures moisture content with an instantaneous control response and can be used for high volume applications or single batch units. Controls Company moisture-sensing systems are already in production.

In designing their moisture-sensor, quality conscious engineers at Controls Company of America in Schiller Park, Ill. specified TI transistors with linear beta, high power gain and low distortion characteristics.

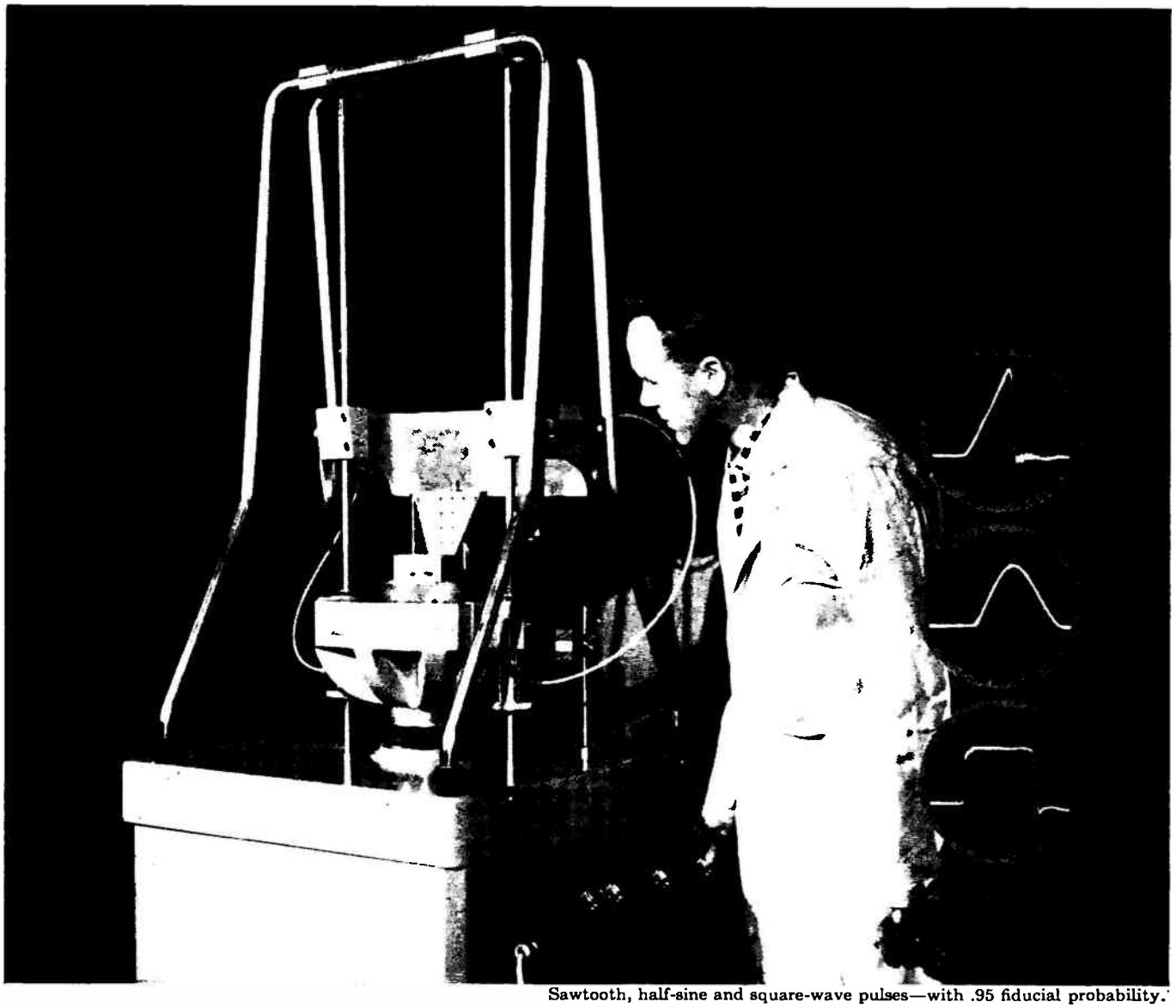
Quality TI transistors for your particular application are available in production quantities through your TI distributor or TI sales office.

SEMICONDUCTOR – COMPONENTS DIVISION

TEXAS INSTRUMENTS

LIMITED — DALLAS ROAD · BEDFORD, ENGLAND

INCORPORATED — 13500 NORTH CENTRAL EXPRESSWAY · DALLAS, TEXAS



Sawtooth, half-sine and square-wave pulses—with .95 fiducial probability.

Avco Shock Test Machine offers . . .

widest variety of pulse shapes available

for faster environmental tests with unmatched repeatability

Avco's precision Shock Test Machine SM-010 is a mechanically simple device that reproduces shocks such as those encountered in missile flight. And it produces these shock pulses faster than with conventional machines.

The SM-010 is extremely accurate. It will produce an unusually large number of different shock pulses with a 2.5% repeatability and a .95 fiducial probability. A complete testing cycle, handling specimen loads up to 100 lbs. requires only 7 seconds. No readjustment is required. In addition, normal shocks usually met in handling and shipping are easily reproduced.

Easy to install, simple and safe to operate, Avco's SM-010 offers these other advantages:

- **Provides sawtooth, quarter-sine, half-sine, square and triangular pulses as required**
- **Exclusive design rebound brake as standard feature**
- **Exclusive specimen carriage permits greater variety of tests, ideal sawtooth pulses**
- **Meets rigid specs of Ballistic Missile Environmental Test Requirements**
- **Shock pulses up to 3000 g's for transistor testing**
- **Can be operated by unskilled, non-technical personnel after brief instruction**
- **Needs no special foundation or installation; base only 2 feet square**
- **Accessory package available**

Other shock test machines with capacities from 25 to 500 lbs., producing essentially identical shock pulses, are also available. For more information, contact your nearest representative—offices located throughout the continental United States and the world. Or, if you prefer, write: *Industrial Products Subdivision, Research and Advanced Development Division, Avco Corporation, Wilmington, Mass.*

AVCO

Research & Advanced Development

'Voice' Buying More Transmitters

NEXT YEAR the Voice of America will get at least a dozen powerful new short-wave transmitters. Some of these will probably be installed in the heart of Africa.

General Electric is building 12 quarter-megawatt transmitters for VOA. The first six will go in early in 1961 at Greenville, N. C. The transmitters, with a tuning capability over the 3 to 28-Mc frequency range, will beam programs to Europe, Africa, the Middle East and South America.

Later in 1961, GE will deliver the six remaining units. Meanwhile, Gates Radio of Quincy, Ill., will deliver two 50-Kw transmitters. These eight transmitters may become part of the Voice of America's Mid-Africa relay station to be built outside of Monrovia, capital city of the West African republic of Liberia.

Recently Page Communication Engineers, Washington, D. C., division of the Northrop Corp., got a contract for architectural and engineering design of the Liberian station. The relay station is scheduled to have six 250-Kw transmitters and two 50-Kw units. It will give the Voice of America coverage of Africa and supplementary coverage of parts of Central Europe and the Middle East.

It will also permit relay around the world to other VOA stations, of broadcasts originating in Washington, D. C.

Estimated total cost of this new station is $12,627,000. This includes the value of equipment available from other projects, such as the electric power generating gear. The transmitting site will occupy a total of 1,400 acres in the Monrovia area. Plans also call for an additional 350 acres to be used for receiving.

The GE transmitters will use water-vapor cooled tubes in high-power circuits. The tubes are produced by Machlett Laboratories. The final power amplifier, run grounded grid, uses two of these tubes. There is one in the driver and two in the modulator. There are several smaller vapor-cooled tubes elsewhere in the transmitter.

The high-level modulator features autotransformer coupling to the r-f circuit to allow extended low-frequency audio response. The power supply for the transmitter uses silicon rectifiers exclusively.

The heat generated in the r-f tank is dissipated by water cooling, and the small pump used also maintains water level in the vapor-cooled tubes.

MIT Now Studying Varactor-Maser Hybrid

HYBRID of the varactor diode and the maser is under study at MIT's Lincoln Laboratory. Lab scientists think that a maser amplifier stage following a parametric down convertor may have useful features in some special defense systems.

Noise temperature would not be greatly enchanced by the conversion loss, because of the small conversion frequency ratio, and also because of the low noise temperature of the maser stage of the hybrid. The parametric stage has a good power-saturation recovery characteristic, is particularly resistant to saturation problems if the pump is gated off in the presence of a strong signal.

Intra-Site Amplifier

Technician speaks to personnel at Snark production plant over Norcom system by Northrop Corp.

MEETINGS AHEAD

Oct. 26-28: Non-Linear Magnetics and Magnetic Amplifiers, AIEE, PGIE of IRE, Bellevue-Stratford Hotel, Philadelphia.

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

Oct. 27-28: Electron Devices Meeting, PGED of IRE, Shoreham Hotel, Washington, D. C.

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

Oct. 31-Nov. 2: Electronic Techniques In Medicine & Biology, PGME of IRE, AIEE, ISA, Sheraton Park Hotel, Washington, D. C.

Oct. 31-Nov. 4: Seventh Institute of Electronics in Management, American Univ., Washington, D. C.

Nov. 4: Automatic Data Processing Systems, Institute of Electronics in Management, American Univ., Wash., D. C.

Nov. 14-17: Magnetism & Magnetic Materials, AIEE, AIP, ONR, IRE, AIME, Hotel New Yorker, New York City.

Nov. 15: Product Engineering & Production, PGPEP of IRE, Contact D. Ehrenpreis, 325 Spring Street, New York City.

Nov. 15-16: Mid-American Elect. Convention, MAECON, Hotel Muehlebach, Kansas City, Mo.

Nov. 15-16: Northeast Electronics Research & Engineering Meeting, NEREM, PGPT of IRE, Commonwealth Armory, Boston.

Nov. 28-29: National Assoc. of Broadcasters, Fall Conf., Biltmore Hotel, New York City.

Nov. 30-Dec. 2: Electronics Exposition, Long Island Electronics Manufacturers Council, Roosevelt Raceway Exhibit Hall, Westbury, L. I., N. Y.

Dec. 1-2: Vehicular Communications, Annual Meeting, PGVC of IRE, Sheraton Hotel, Phila.

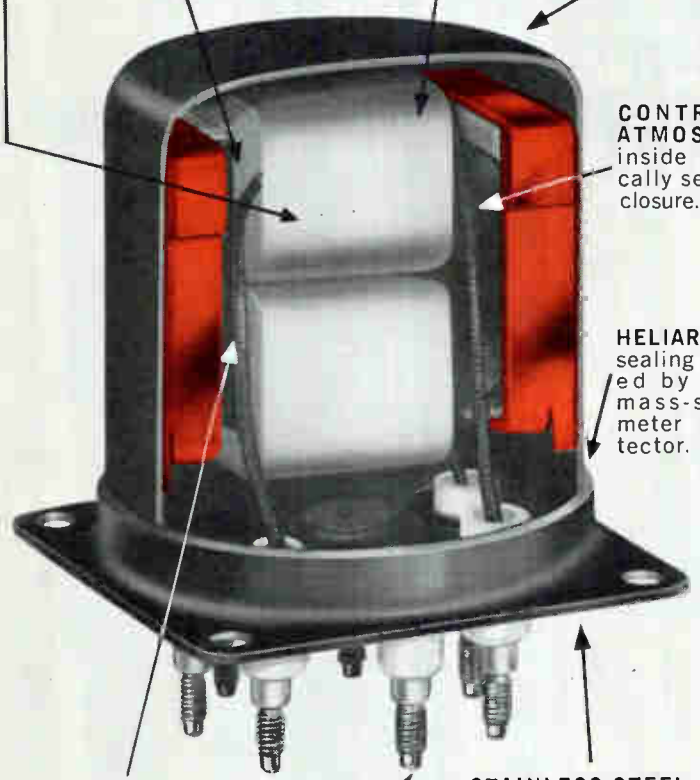
Raytheon Transformer Talk

COLLOIDAL SILICA SOL impregnation and/or foam-potting with hollow ceramic spheres.

VOLATILES REMOVED by degassing in high vacuum at high temperature.

GLASS FIBER INSULATION, mica or aluminum winding forms, heat cleaned to remove organic residues.

BLACK OXIDE FINISH on interior and exterior surfaces of case for better heat transfer.



CONTROLLED ATMOSPHERE inside hermetically sealed enclosure.

HELIARC WELD sealing inspected by helium mass-spectrometer leak detector.

PURE SILVER or chromium-plated copper wire insulated with a glass fiber or ceramic coating.

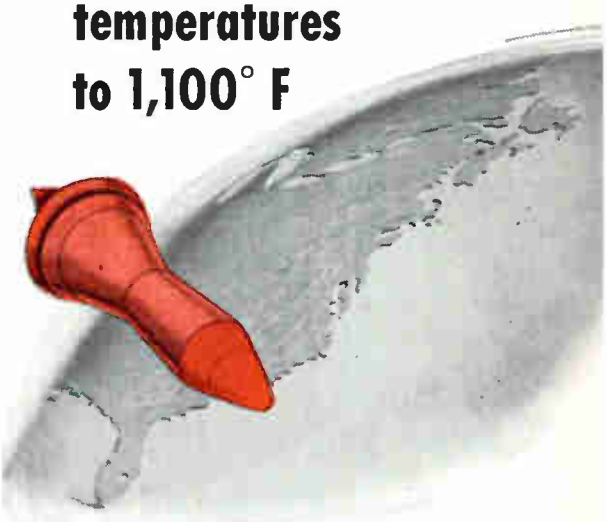
STAINLESS-STEEL construction of case and structural members for minimum weight.

ALUMINA TERMINALS protected against oxidation by special plating process.

WITHSTANDING DULL-RED HEAT CONDITIONS is one of the requirements for the new transformers now being developed at Raytheon. The nine construction features that make this possible are indicated above.

WRITE FOR 16-PAGE BOOKLET on Raytheon transformers or for specific help on your particular requirements.

New Raytheon transformer will resist nose cone temperatures to 1,100° F



Raytheon is now building transformers capable of withstanding temperatures such as those encountered in a re-entering missile's red-hot nose cone.

The unit pictured at left resists temperatures up to 1,100°F which is 700 degrees higher than units presently in use. The goal for units now under construction at Raytheon is a minimum operation time of 2,000 hours with an internal temperature 200 degrees above the ambient of 900 degrees.

To accomplish this, Raytheon has developed new construction techniques and high-temperature resisting wire and insulating materials.

For further information on high-temperature transformers please write, stating your specific requirements, to the address below.

RAYTHEON COMPANY
Magnetics Operations
Microwave & Power Tube Division
Foundry Avenue
Waltham 54, Massachusetts
In Canada, contact Raytheon Canada Limited, Waterloo, Ontario

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Excellence in Electronics

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TRANSPARENT (NO AMBER TINT) SLEEVING...

Resinite EP-69C VINYL INSULATION SLEEVING

for easy identification of coded wires

New Resinite EP-69C, a transparent sleeving without amber tint, permits easy identification of color-coded wires and full readability of printed coding. An all-purpose material, EP-69C is available in conformance to MIL-I-631C (Grades a and b, Class I and II, Cat. 1) and AMS-3630-B. EP-69C surpasses all MIL-I-631C requirements. For samples and performance data call your Resinite Distributor or write:

RESINITE DEPARTMENT

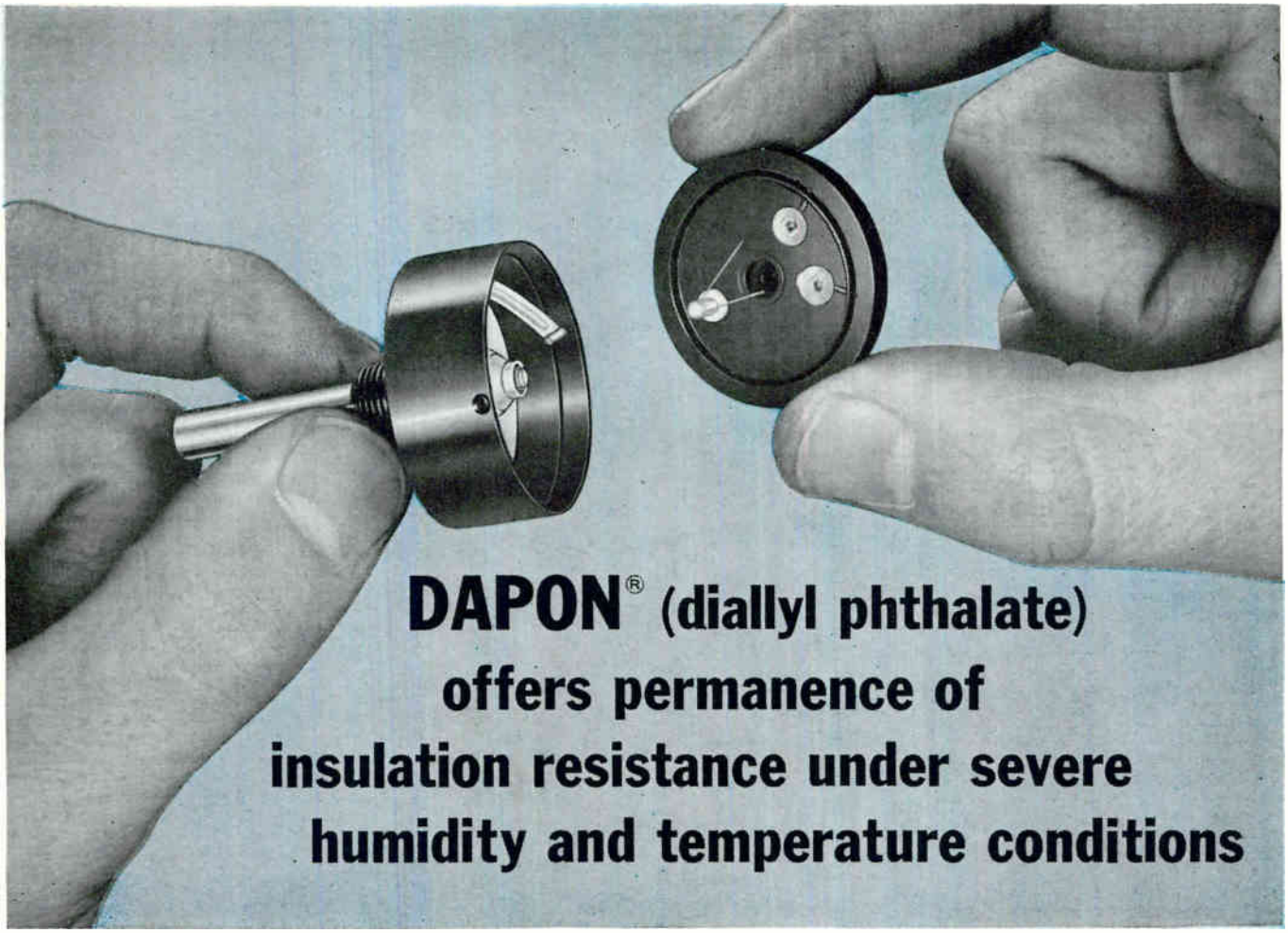
THE BORDEN CHEMICAL COMPANY

1 Clark St., North Andover, Mass. • P.O. Box 430, Compton, Calif.

CHECK THESE PROPERTIES

- **High Dielectric:** 900 volts/mil. (.016″ wall. Other wall thicknesses proportionate.)
- **Wide Temperature Range:** —75°F to 185°F (—60°C to 85°C).
- **Flame, Fungus, and Corrosion Resistant.**
- **No Tackiness:** Slips easily over wires for harness assemblies.
- **Full Size Range:** #20AWG through 2½″ID.
- **5 Colors:** Transparent, black, white, red, blue.
- **Soft-Wound Spooling:** Exclusive Resinite packaging delivers full-round (not flattened) sleeving.

Resinite—specialists in vinyl sleevings and tubing for the aircraft, electronics and pharmaceutical fields.



DAPON® (diallyl phthalate) offers permanence of insulation resistance under severe humidity and temperature conditions

This plastic is ideal for applications where changes in humidity can affect electrical values. DAPON can prevent costly "in service" failures in electrical and electronic components.

A new molded plastic potentiometer produced by New England Instrument Company features exceptional resistance to humidity, high reliability and low noise. A raised conductive plastic ring is used in place of resistance wire in these miniature units. The new potentiometers are ideal for servo and instrumentation applications where long life and extreme accuracy are important factors.

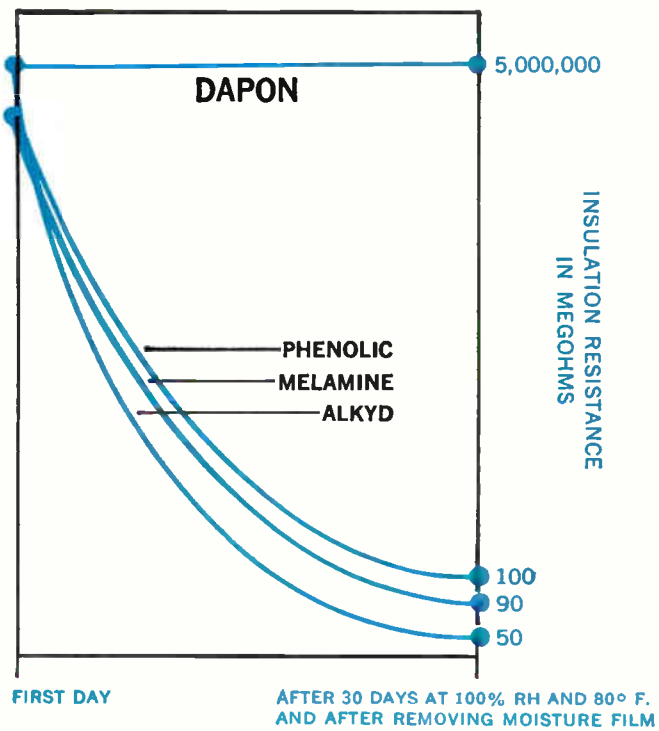
The solid resistance element, insulating base and silver terminal leads are molded in one operation with DAPON (diallyl phthalate) Resin. Result: a single, almost indestructible precision unit.

New England Instrument chose DAPON because of its superior electrical and physical properties, and its low moisture absorption. DAPON also molds easily around metal inserts without cracking, and withstands extremes of temperature, vibration and shock.

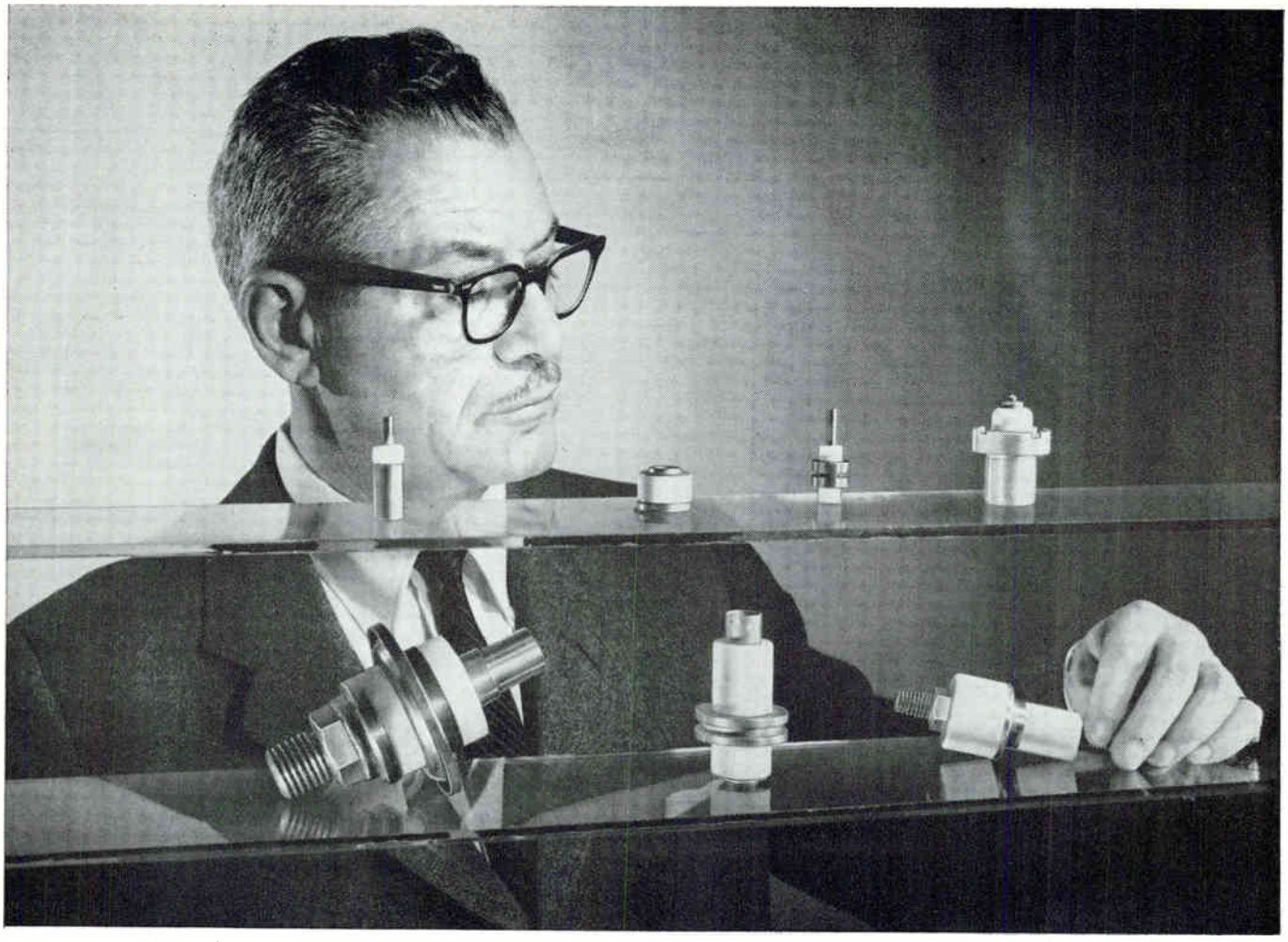
Specify DAPON (diallyl phthalate) Resin when you need:

- Low dielectric loss
- High dielectric strength
- Superior dimensional stability
- Excellent arc resistance
- High volume and surface resistance after high humidity-high temperature conditioning

Write for FMC's data sheet containing technical information about DAPON, suggested uses for this resin, and the names of DAPON compounders.



FOOD MACHINERY AND CHEMICAL CORPORATION
Dapon Department
161 East 42nd Street, New York 17, New York



Engineering hints from Carborundum

Use KOVAR® Alloy to solve problems in sealing to ceramics

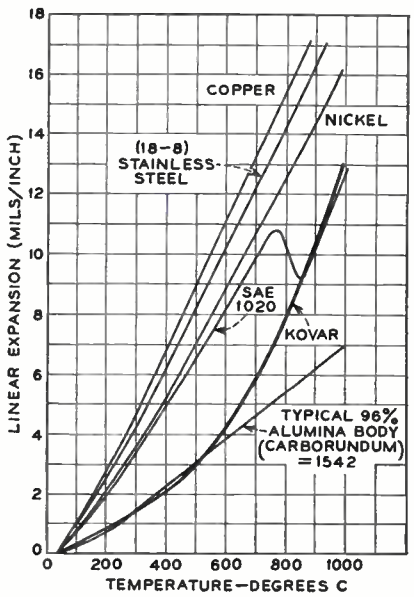
KOVAR, the original 29% nickel, 17% cobalt, 54% iron alloy, was developed for sealing to low expansion glass, but is now being used extensively for making pressure and vacuum tight seals with metallized ceramics of the low expansion type.

The curves at right show the expansion of KOVAR compared with a representative high alumina ceramic body. The expansivity match up to 500 C is very close, and the difference in expansion at higher temperatures is closer than with most common metals and alloys.

The fact that KOVAR is slightly higher in expansion at elevated temperatures is an actual advantage when the ceramic is on the inside of the unit since the resulting joint is placed in compression. The degree of compression is slight compared with that resulting from the use of a metal of higher expansion.

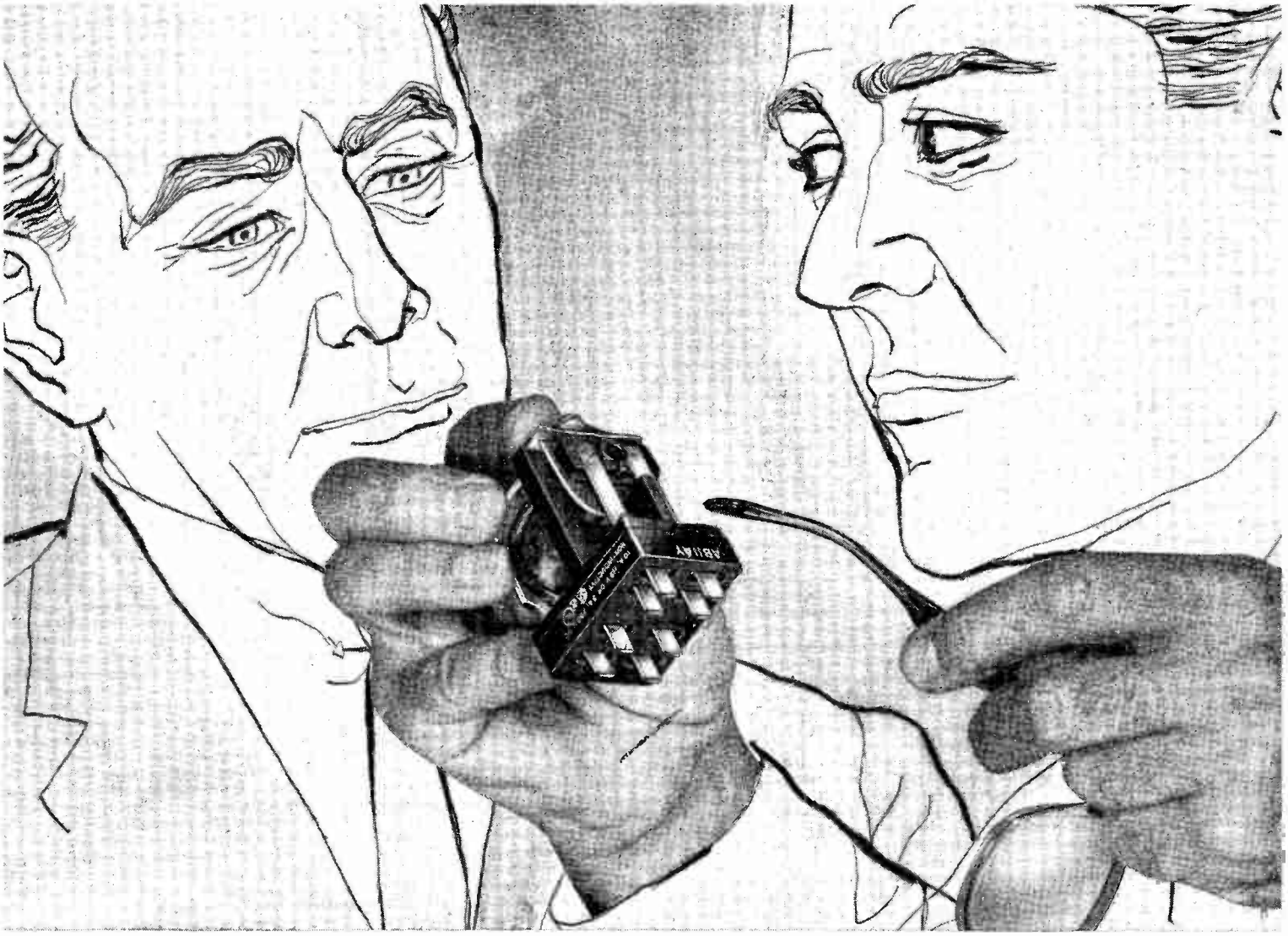
While a considerable difference in expansivity can sometimes be tolerated with the metal on the outside of thick sections of ceramic, this is not the case when the ceramic section is thin. Closer compatibility of expansivity, such as is obtained with KOVAR, is also required when the metal is on the inside of the ceramic or for sandwich or end type seals where both tensional and shear stresses must be kept to a minimum.

KOVAR alloy is stocked in a variety of sizes of rod, wire, tubing, sheet, cups and eyelets. Your inquiries are invited for prices, technical information and recommendations on specific problems. Write Dept. E-100 Latrobe Plant, Refractories Division, The Carborundum Company, Latrobe, Pa.



For permanent vacuum and pressure-tight sealing...count on

CARBORUNDUM®



appearances are not deceiving

THIS P&B 10-AMP RELAY IS AS RELIABLE AS IT LOOKS

Our AB relay looks rugged . . . and it is. You can specify it for 10 amp switching and confidently expect 100,000 cycles. Yet it is compact, easily mounted, and does not require special handling. Installation is simple, using your preference of screw terminals (adapters), quick connects, or dip soldering.

Designers specify the AB for air conditioners and other products where dependable, continual service is paramount.

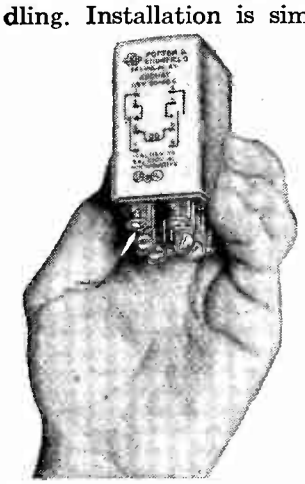
These standard AB and ABC relays are listed by Underwriters' Laboratories and Canadian Standards Association:

Type	Arrangements	Type	Arrangements
AB7AY	DPST-NO	ABC7AY	DPST-NO
AB8AY	DPST-NC	ABC8AY	DPST-NC
AB11AY	DPDT	ABC11AY	DPDT

Coil voltages: 6, 12, 24, 115 and 230 volts AC, 50/60 cycle.
Contact rating 10 amps, 115 volts AC or 5 amps, 230 volts AC noninductive.

U/L File E-29244 CSA No. 15734

Write for complete data or contact your nearest P&B sales engineer.



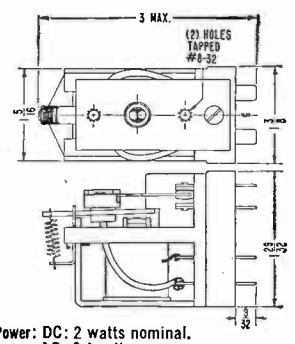
ABC Series—AB series can be supplied enclosed in sturdy metal dust cover, $1\frac{31}{64}$" x $2\frac{25}{32}$" x $2\frac{3}{32}$".

AB AND ABC RELAYS ENGINEERING DATA

GENERAL:
Insulation Resistance: 100 megohms minimum.
Life: 3 million cycles (mechanical).
Breakdown Voltage: 1500 volts rms between all elements and ground.
Temperature Range: DC: −55 to +45°C.
AC: −55 to +45°C.
Weight: AB—5 ozs. ABC—7 ozs.
Terminals: Fit ¼" quick-connect terminals, or may be applied to printed circuits using dip soldering. Screw adapters furnished on request.
Enclosure: ABC: Heavy duty dust cover.
Dimensions: $1\frac{31}{64}$" x $2\frac{25}{32}$" x $2\frac{3}{32}$".

CONTACTS:
Arrangements: DPDT
Material: ¼" dia. silver. Other materials available.
Load: 5 amps at 230 volts AC or 10 amps at 115 volts AC noninductive.
10 amps at 28 volts DC.

COIL:
Voltage: DC: 6 to 110 volts.
AC: 6 to 230 volts.



Power: DC: 2 watts nominal.
AC: 6.4 volt-amps.
Resistance: 35,000 ohms max.
Duty: Continuous: DC coils will withstand 6 watts at +25°C.

MOUNTINGS:
AB: Two 8-32 tapped holes on 1¼" centers.
ABC: One 8-32 stud ⅜" long and locating tab.

P & B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR

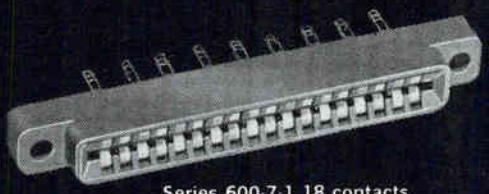
AMF

POTTER & BRUMFIELD

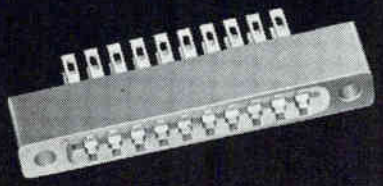
DIVISION OF AMERICAN MACHINE & FOUNDRY COMPANY, PRINCETON, INDIANA

IN CANADA: POTTER & BRUMFIELD CANADA LTD., GUELPH, ONTARIO

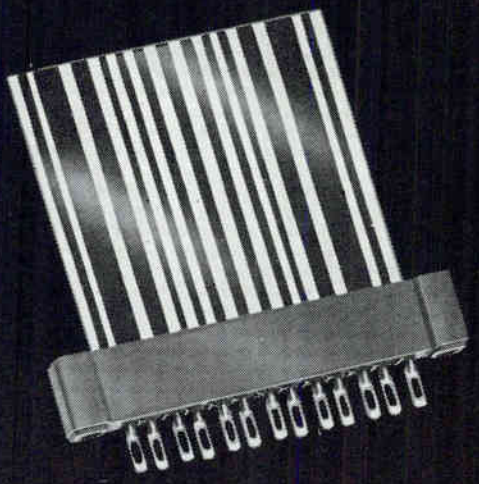
ACTUAL SIZE



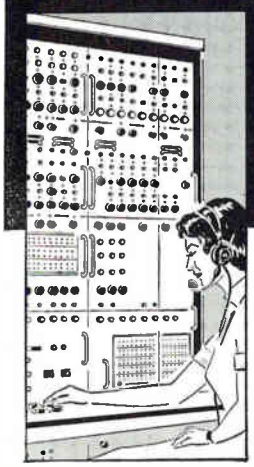
Series 600-7-1 18 contacts
for 3/64" PC board or cable



Series 600-4PC10 10 dual contacts
for 1/32" PC board or cable



Series 600-4PCSC13 13 contacts
for 1/32" PC board or cable



Continental Connector
MINIATURE PRINTED CIRCUIT CONNECTORS

Continental printed circuit connectors and "Bellowform" contacts are covered by patent number 2,875,425

WHERE RELIABILITY IS A MUST

and space limitations are critical . . .
specify Continental Miniature PC Connectors

Series 600 precision miniature printed circuit connectors provide a positive, space-saving connection between printed circuitry and conventional wiring, through printed circuit boards, tape cables or plug-mounted sub-assemblies.

SERIES 600-7-1. For 3/64" printed circuit board or tape cable. 18 contacts for #24 AWG wire. Solder lug terminations are staggered to simplify soldering operations.

SERIES 600-4PCSC13. For 1/32" printed circuit board or tape cable. 13 staggered contacts accommodate #22 AWG wire. Module design permits stacking of any reasonable number of single units. Contacts have minimum spacing with maximum contact wiping surface.

SERIES 600-4PC10. Accepts 1/32" printed circuit board or tape cable. Double row of 10 contacts with solder lug terminations provides a total of 20 connections. For #22 AWG wire. Overall length only 1 7/8".

Continental Connector's "Bellowform" contacts are used in this series and provide coil spring action grip that clasps the printed circuit board firmly over the entire contact area regardless of board tolerance variations.

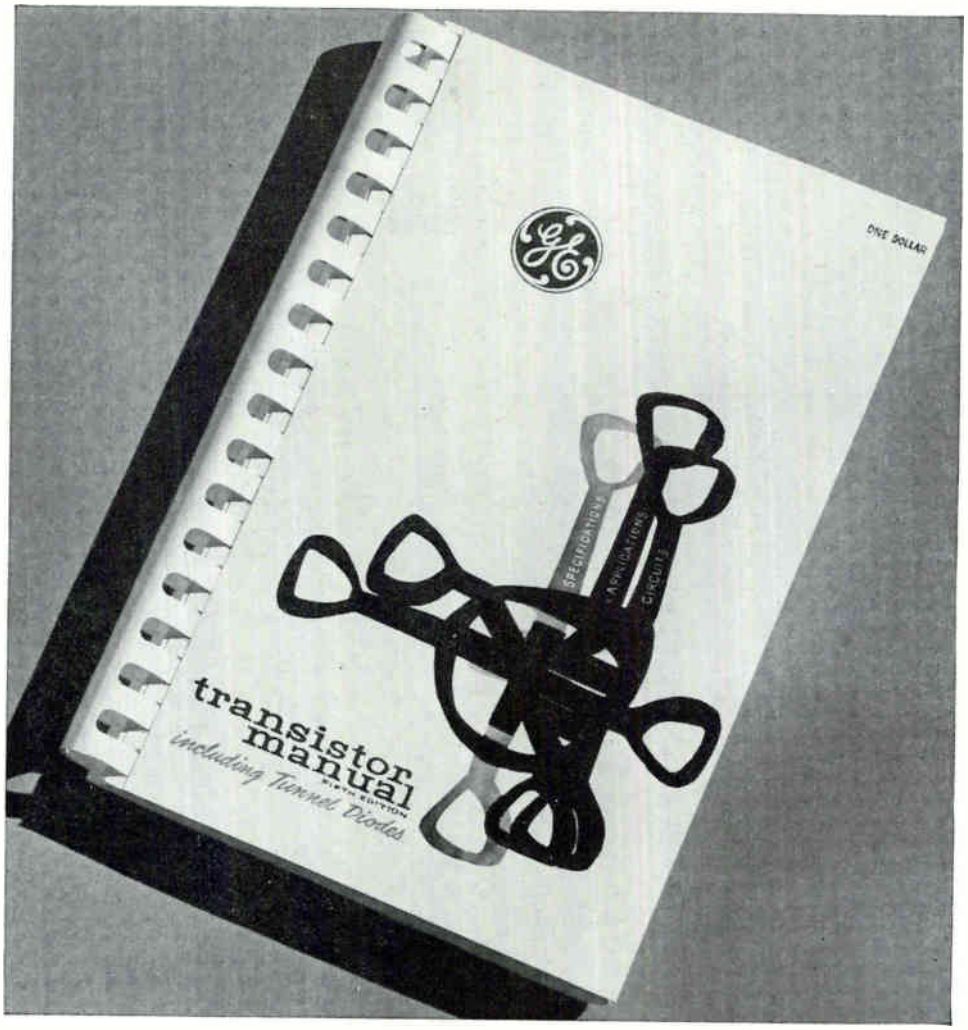
Contact material is spring temper phosphor bronze with gold plate over silver plate. Body molding compound is glass reinforced Diallyl Phthalate (MIL-M-19833, Type GDI-30, green color).

Technical literature on Continental Connector Series 600 Miniature PC Connectors is available on request. Write to Electronics 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

NEW FIFTH EDITION OF AN INDUSTRY CLASSIC



GENERAL ELECTRIC TRANSISTOR MANUAL

Featuring two new chapters on the tunnel diode. This is one book in the transistor field you can't afford to be without . . . because it's the one reference that is constantly being revised and brought up to date to serve your needs.

The greatly expanded new Fifth Edition has 93 more pages . . . new material on tunnel diode theory and switching circuits . . . tunnel diode amplifiers . . . feedback and servo amplifiers. Sections on the silicon controlled rectifier, power supplies, transistor and rectifier specifications have been expanded.

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GENERAL ELECTRIC

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Send me the enlarged new 5th Edition (320 pages) of the General Electric Transistor Manual. I enclose $1.00. (No stamps, please.)

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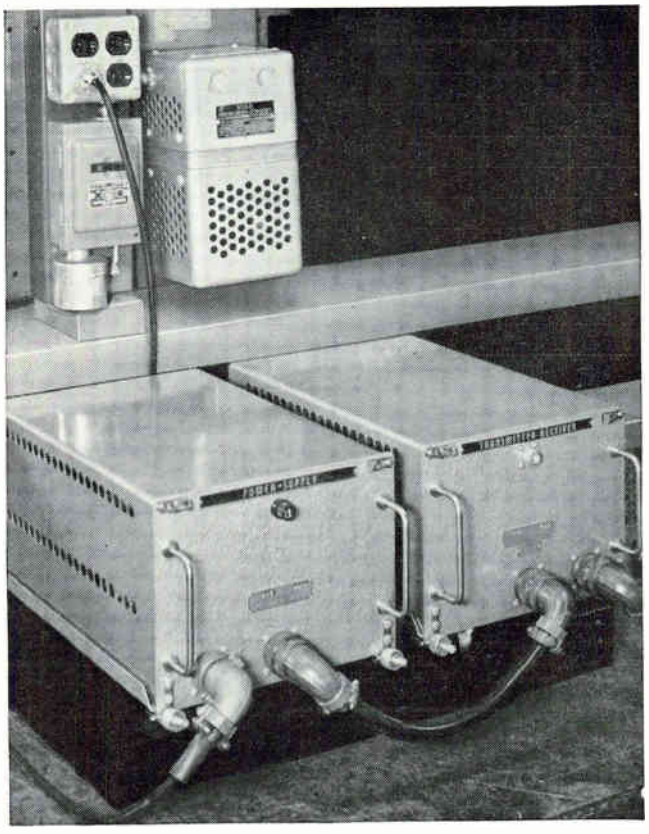
CIRCLE 51 ON READER SERVICE CARD 51

Above—*Sola plate-filament transformer is built-in component of B & W Associates lie detector. It supplies plate and filament voltage regulated within ±3% even when line voltage varies from 100 to 130 volts . . . helps assure accurate operation in field.*

Below—*Railway Communications Inc. uses Sola line voltage regulator to improve performance and reliability of this Rycom combination transmitter-receiver. Regulator delivers 118 volts stabilized within ±1% under line voltage variations as great as ±15%.*



Build it in or add it on . . . Sola voltage regulation helps your equipment give full-rated performance

Whether you build it in as a component or add it on as an accessory, a Sola static-magnetic voltage regulator soon pays for itself by keeping your equipment operating at its designed capability.

These units provide a stabilized output voltage even when input voltage varies over a considerable range, and give you eight important advantages over electronic or motor-driven regulators:

1. **Ultra-fast response time of 1.5 cycles or less reduces effects of transients.**
2. **No moving or renewable parts or routine maintenance.**
3. **Automatic, continuous regulation; no manual adjustments.**
4. **Protection against accidental short circuits and excessive overloads for unit and its load.**
5. **Versatility: Step-up, step-down, plate, plate-filament, transistor-voltage ratios are available to permit substitution in place of non-regulating transformers.**
6. **Simple, compact design; light weight.**
7. **High degree of isolation between input and output circuits.**
8. **Negligible external magnetic field.**

This is the Sola Standard Sinusoidal Constant Voltage Transformer, shown in its usual accessory-type structure. It continuously regulates output voltage within ±1% under line voltage variations of ±15%. Because its output is essentially a commercial sine wave (less than 3% total rms harmonic content at any load above 25% of rating), it is ideal for exacting laboratory applications and instrument calibration, and with equipment sensitive to wave shape . . . designed d-c voltage levels in the load are not affected.

The entire line of sinusoidal regulators is now available at prices formerly charged for static-magnetic regulators without the patented Sola harmonic-free circuit.

This is the Sola Normal-Harmonic Constant Voltage Transformer, shown in component-type structure, with end bells and separate capacitor. It offers the same reliability and ±1% regulation as Type CVS (above), and is suitable for the many applications where a commercial sine wave voltage supply is not required. It is widely used for voltage regulation on filaments, solenoids and relays.

Because prices of these normal-harmonic units have been substantially reduced, voltage regulation may now be possible in many of your applications.

Sola static-magnetic voltage regulators are available in a wide selection of mechanical structures and ratings in over 40 stock models, and your custom designs can be delivered in production quantities.

Write for Bulletin 7K-CV

SOLA

SOLA ELECTRIC CO.
Busse Rd. at Lunt

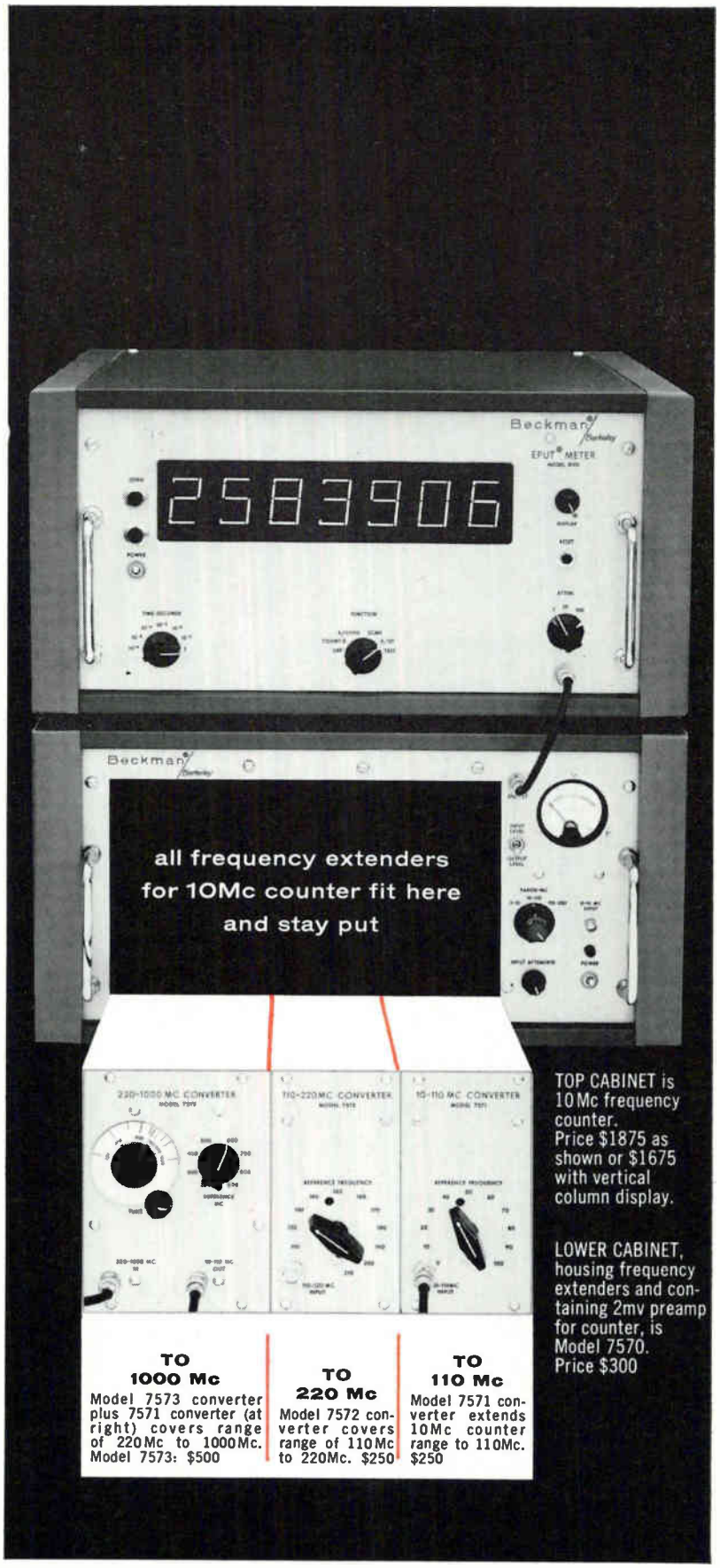
BPC

A Division of Basic Products Corporation
Elk Grove, Ill.

measure rf to 1000 mc without replacing plug-ins

It's all here in two easily-movable cabinets — a digital frequency-measuring system of wider range and lower price than any comparable equipment on the market. The counter in the top cabinet measures all frequencies from 10 cps to 10Mc. Heterodyne converters—added to the bottom cabinet as you need them—extend range to 110Mc, 220Mc or 1000Mc. ● This provision for expanding the system simply and economically makes the equipment a wise long-term investment. Buy only the range you need now, rest assured that you can cover higher frequencies whenever need arises. ● Accuracy is .00004% or better from 1Mc to 1000Mc. Sensitivity is unequalled: 2mv from 10Kc to 10 Mc, 10mv to 110Mc, 20mv to 220Mc and 1mw to 1000Mc.

WRITE FOR DETAILED TECHNICAL BULLETINS ON MODEL 7570 SERIES



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INSTRUMENTAL IN YOUR FUTURE 25 YEARS 1935-1960

T27

Now you can specify two great coaxial connector trademarks

AMPHENOL and ipc from the industry's largest manufacturer:

RF PRODUCTS

A NEW EXPANDED FACILITY OF THE AMPHENOL-BORG ELECTRONICS CORPORATION

Here's how the world's largest manufacturer of coaxial connectors can now serve you better—

Offering the broadest line of coaxial connectors available from one source, **RF PRODUCTS** can now provide:

- **Widest selection of UG types.**
- **Most extensive non-UG line in the industry, including special connectors designed and built to meet your specific requirements.**
- **Local availability—your local authorized Amphenol distributor will soon have many specified IPC connectors available from stock.**

A NEW DIMENSION in RF products capability—consolidating the design and production facilities of Amphenol Cable and Wire, Amphenol Coaxial Connectors, Industrial Products-Danbury Knudsen. Address all requests to:

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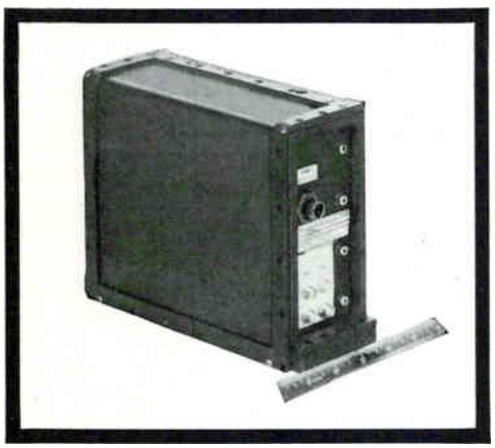
DANBURY, CONNECTICUT Pioneer 3-9272

A DIVISION OF AMPHENOL-BORG ELECTRONICS CORPORATION

3M COMPANY CHEMICALS

THE RAW MATERIALS OF PROGRESS

FC-75 SHOCK-PROOFS "HI-FI SET" FOR ATLAS MISSILE



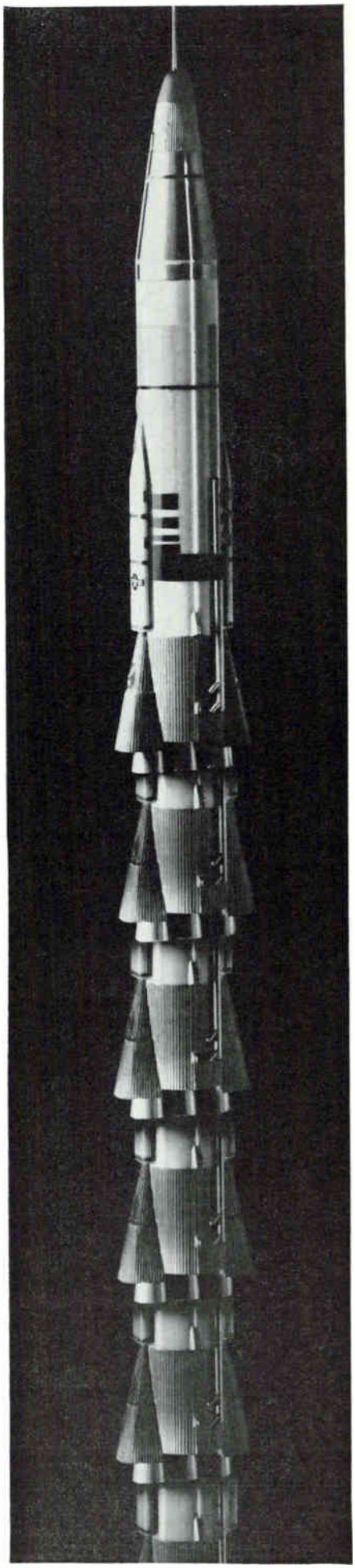
The Atlas climbs toward outer space! Inside, a delicate instrument—an inertia compensated telemetering device, shown left—is at work. Manufactured by the Speidel Corporation of Providence, Rhode Island, this sealed unit contains a continuously operating magnetic tape recorder that is capable of reporting, via telemetry as required, pre-selected conditions that a missile might encounter, i.e.: temperatures, strains, stresses, vibrations, air pressures.

The problem: find a protective "cushion" that will isolate the telemetering device from the missile's violent motion and even a fall to earth, yet permit it to operate accurately and with great sensitivity.

The answer: 3M Brand Fluorochemical Inert Liquid FC-75. Why? FC-75 protects the tape and all associated moving parts of the tape transport from vibrations, shocks, acceleration. And, at the same time, FC-75 remains stable over the entire temperature span of the missile's effective range. It has a pour point of less than minus 100°F., will not break down even at 750°F.

Furthermore, FC-75 undergoes no chemical or electrical changes. It is completely compatible with various materials such as metals, plastics, elastomers, even above the maximum practical temperatures permissible with other dielectric coolants. Therefore, it will not attack the recording tape or any other part of the telemetering mechanism.

FC-75 is ideally suited for many uses in the field of missiles and rocketry because it is nonexplosive, nonflammable, nontoxic, odorless and noncorrosive. It is one of 300 specialty chemicals from 3M serving industry and country. For complete performance characteristics, write today, specifying area of interest to: 3M Chemical Division, Dept. KAX-70, St. Paul 6, Minnesota.



CHEMICAL DIVISION

MINNESOTA MINING AND MANUFACTURING COMPANY

...WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY

Extra quality at no extra cost with Bendix Semiconductors

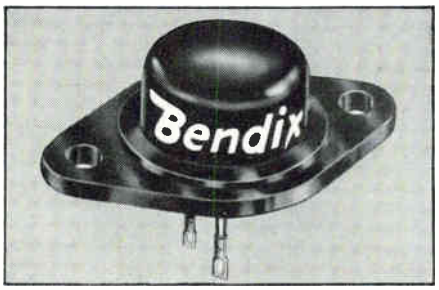
Bendix Bulletin

NEW 25-AMP DAP TRANSISTORS SWITCH IN MICROSECONDS

High Current–Fast Switching–High Voltage —give engineers wider design latitude

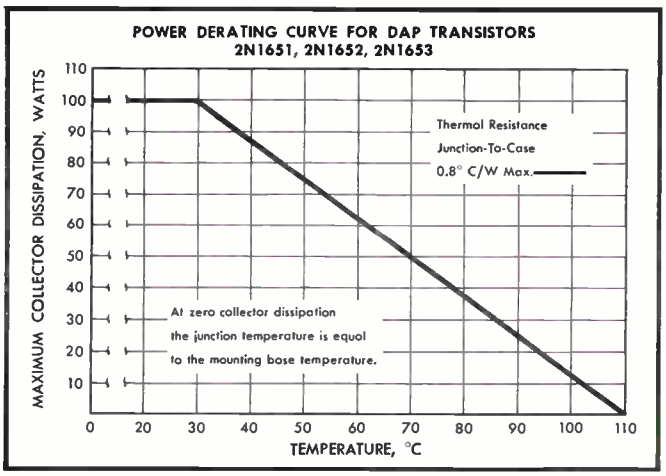
The new 25-amp germanium PNP Bendix® Diffused Alloy Power DAP® transistor line—with its microsecond-fast, higher-current switching (typically 5 μsec at 25 amperes)—frees engineers from the design restrictions set up by ordinary germanium alloy transistors. *Only* Bendix offers such a high-current, high-speed DAP transistor line.

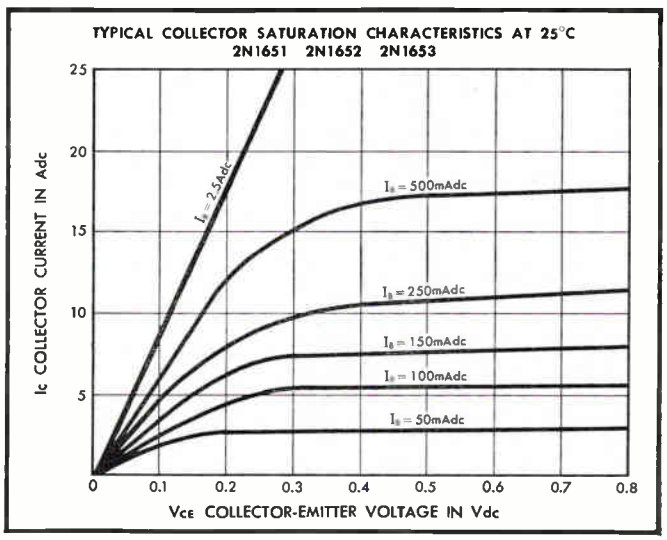
But high current is by no means the whole story. Bendix DAP transistors make possible increased circuit stability over a wider range of temperatures—from −60°C to +110°C. They are also rated at higher collector-to-emitter breakdown voltages, while providing lower input resistance, controlled current gain, and lower saturation voltages. In short, here is a special high-frequency, high-voltage line that opens the door to many new design ideas and applications.



For details on our complete line of power transistors, power rectifiers, and driver and MIL-type transistors, write on your letterhead for your BENDIX SEMICONDUCTOR CATALOG.

ATTENTION ENGINEERS: Write our Employment Manager for information about challenging opportunities we offer in semiconductors.





ABSOLUTE MAXIMUM RATINGS

TYPE NUMBERS	Vce Vdc	Vcb Vdc	Veb Vdc	Ic Adc	Pc W	T Storage °c	Tj °c
2N1651	−60	−60	2.0	25	100	−60 to +110	110
2N1652	−100	−100	2.0	25	100		
2N1653	−120	−120	2.0	25	100		

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

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SEMICONDUCTOR PRODUCTS
Red Bank Division
HOLMDEL, NEW JERSEY

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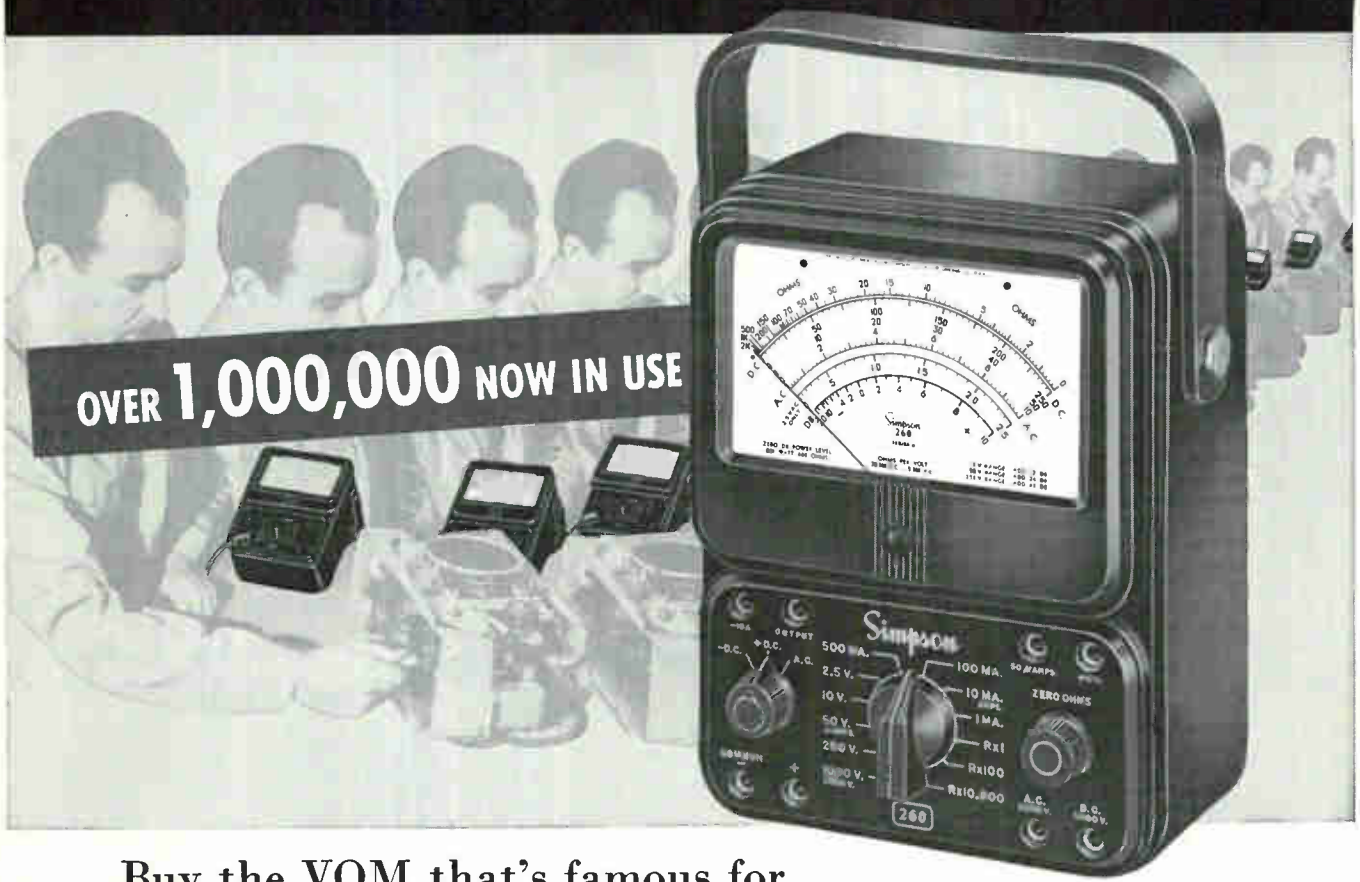
The SIMPSON 260 TRADEMARK outsells all other VOMs combined!



Buy the VOM that's famous for ruggedness and dependability

260
VOLT-OHM-MILLIAMMETER
AC-DC
$43.95
Complete with Leads and Operator's Manual

Proof that the 260* is your *best investment* comes from hundreds of thousands of users who have made it the leading VOM over the years. But convince yourself! Take a 260 apart. Check the workmanship and materials. Examine the components. Analyze the circuits. Then put it through its paces in actual day-in-day-out service. You'll soon discover why the 260 is the world's best seller. See your Electronic Parts Distributor for the *preferred* VOM.

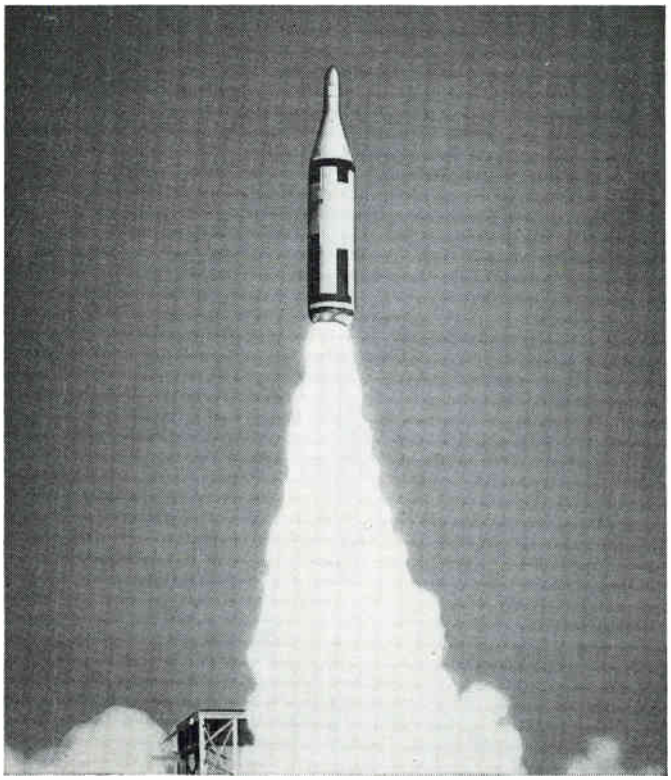
D.C. Voltage (20,000 ohms-per-volt): 0-250mv; 0-2.5 v; 0-10 v; 0-50 v; 0-250 v; 0-1000 v; 0-5000 v.
A.C. Voltage (5000 ohms-per-volt): 0-2.5v; 0-10 v; 0-50 v; 0-250 v; 0-1000 v; 0-5000 v.
A. F. Voltage (with 0.1 uf internal series capacitor): 0-2.5 v; 0-10 v; 0-50 v; 0-250 v.
Volume Level in Decibels (Zero DB equal to 1 milliwatt across a 600-ohm line): −20 to +10 DB; −8 to +22 DB; +6 to +36 DB; +20 to +50 DB.
D.C. Resistance: 0-2000 ohms (12 ohms center); 0-200,000 ohms (1200 ohms center); 0-20 megohms (120,000 ohms center).
Direct Current: 0-50 ua; 0-1 ma; 0-10 ma; 0-100 ma; 0-500 ma; 0-10 amp.

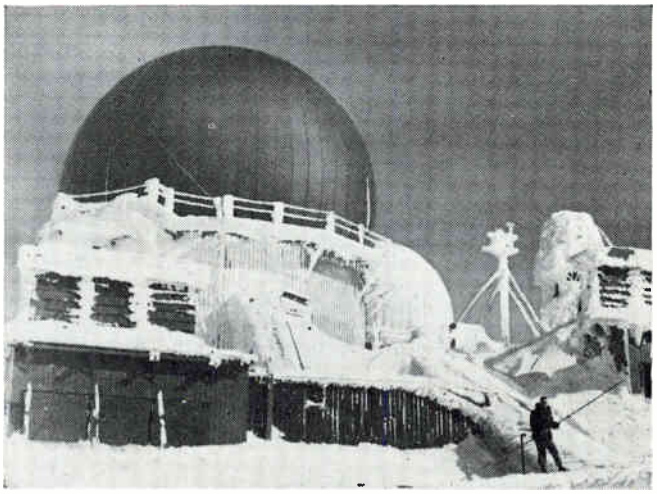
*Trademark

Simpson ELECTRIC COMPANY

5203 W. Kinzie St., Chicago 44, Ill.
Phone: EStebrook 9-1121
In Canada: Bach-Simpson Ltd.
London, Ontario

In Arctic cold...



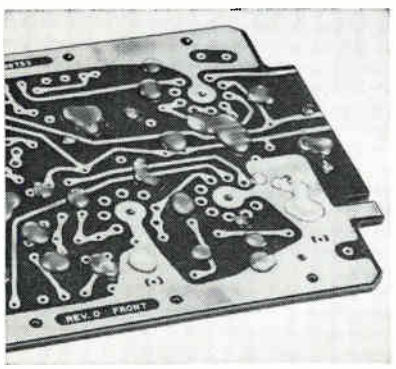


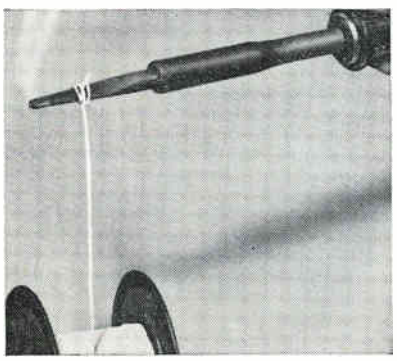
General Electric Silicone Fluids offer reliability from —65°F to 400°F as liquid dielectrics and heat transfer media in aircraft, missiles and ground installations. Excellent dielectric properties are virtually unchanged over wide ranges of temperature and frequency.

or missile heat...

G-E Silicone Rubber Insulation is used in missiles and space vehicles because of its excellent insulating properties, resistance to temperature extremes, moisture and ozone and its long-time stability in storage.

G-E silicone insulations do the job!





RTV* Liquid Silicone Rubber comes in a wide range of viscosities for potting, encapsulating, impregnating and sealing. RTV resists heat, cold, ozone, moisture; protects against high-altitude arc-over.
*Room Temperature Vulcanizing

G-E Silicone Varnishes provide excellent protection against moisture and high operating temperatures. Applications include conformal protective coatings for printed circuits, resistor coatings, transformer impregnation, etc. New varnishes cure at low temperatures.

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Silicone Rubber Wire Insulation withstands soldering heat without damage; matches or exceeds vital properties of insulation costing three times as much. Provides long service life at 500°F; momentarily withstands temperatures up to 5500°F. Flexible as low as —150°F, it resists moisture, ozone, nuclear radiation.

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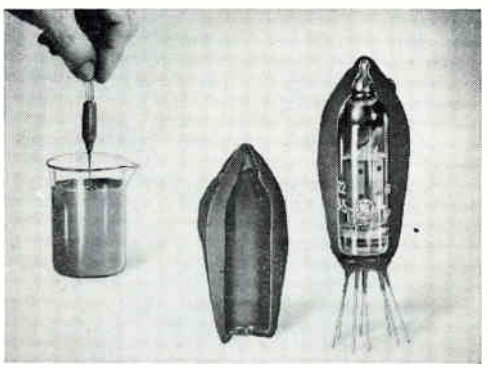

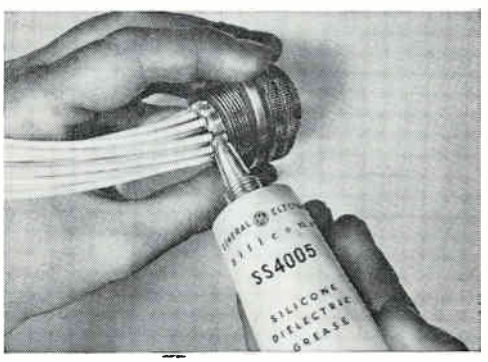

GENERAL ELECTRIC

RMC "JL" DISCAPS

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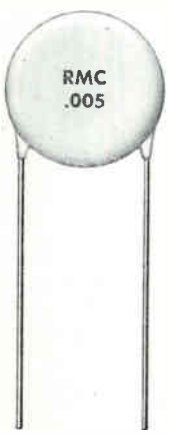
adaptable to temperature extremes!



Type JL DISCAPS are engineered for applications where capacitors must exhibit minimum capacity change over wide variance in temperature. Between −60° and +110° C Capacity change is only ±7.5% of capacity at 25° C. Type JL DISCAPS are rated at 1000 V.D.C. and are available with capacity tolerances of ±10% or ±20% at 25° C. Write on your letterhead for information on these and other high quality DISCAPS.

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FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

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longer life...

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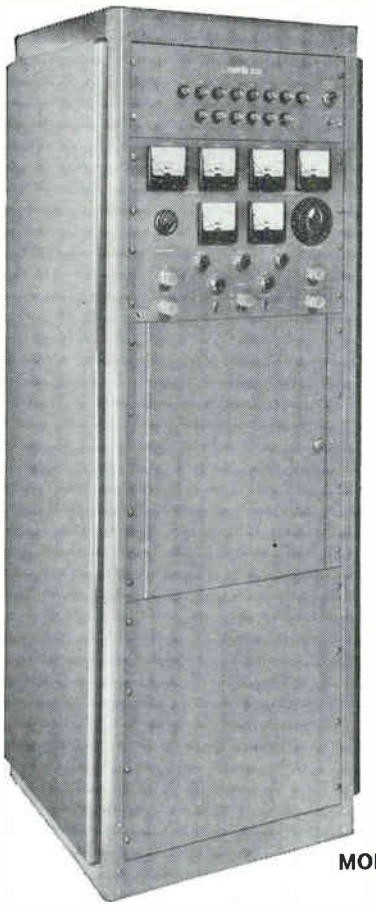

MODEL 10002
35 KV

Specify NARDA Microwave Modulators

Here's a line of new Microwave Modulators, designed to operate a maximum number of existing magnetrons, without any alterations to the modulator. In addition, provision has also been made for quickly converting the unit to handle any new or uncommon pulse microwave tubes.

Models 10001 and 10002 are designed to handle high-power magnetrons with provision for internal mounting of the tube. Model 10003 is designed for pulsing low-power magnetrons of the type now used in beacon transmitters and for low-power commercial pulse applications.

Since all units utilize silicon rectifiers and diodes, you can expect increased life and more reliable operation. At the same time, over-all size has been considerably reduced. Every Narda Microwave Modulator is complete with built-in safety provisions, built-in meters and viewing connectors for all principal parameters, a continuously variable repetition rate, and a standard pulse width of 1 microsecond (other widths available on special order) on Models 10001 and 10002; continuously variable on Model 10003.

The specifications below indicate those characteristics of the three new models which vary from each other. The listing of features indicates those features common to all models. For additional information, and a copy of our free catalog, write to us at Dept. E-9.

SPECIFICATIONS

Narda Model #	Maximum Peak Pulse Power	Pulse Width (Microseconds)	Maximum Duty Cycle # at Maximum Power	Size H x W x D
10001	18KV@20A	1*	0.001	38x22x18
10002	35KV@40A	1*	0.001	67x24x24
10003	4.5KV@2A	0.5-2.2†	0.002	8½x18x12

* Other values of pulse width can be readily substituted.
† Pulse width is continuously adjustable over given range.
\# Internal continuously variable trigger generator for adjusting repetition rate and duty cycle.

FEATURES

Built-in Meters:
High voltage power supply voltage
High voltage power supply current
Magnetron filament supply voltage
Magnetron filament supply current
Clipper average supply current*
*Models 10001 and 10002

Viewing Connectors (BNC):
Magnetron pulse voltage
Magnetron pulse current
Primary pulse voltage*
Thyratron pulse current*
PFN charging voltage*
*Models 10001 and 10002

Output sync pulses (BNC Connectors):
Positive
+ 50 v min. at 2 sec.
Negative
— 25 v min. at 2 sec.

Input sync (BNC Connectors):
Sine wave:
20 v RMS min.
Pulse:
20 v at .25 sec min.

the narda microwave corporation
HIGH POWER ELECTRONICS DIVISION
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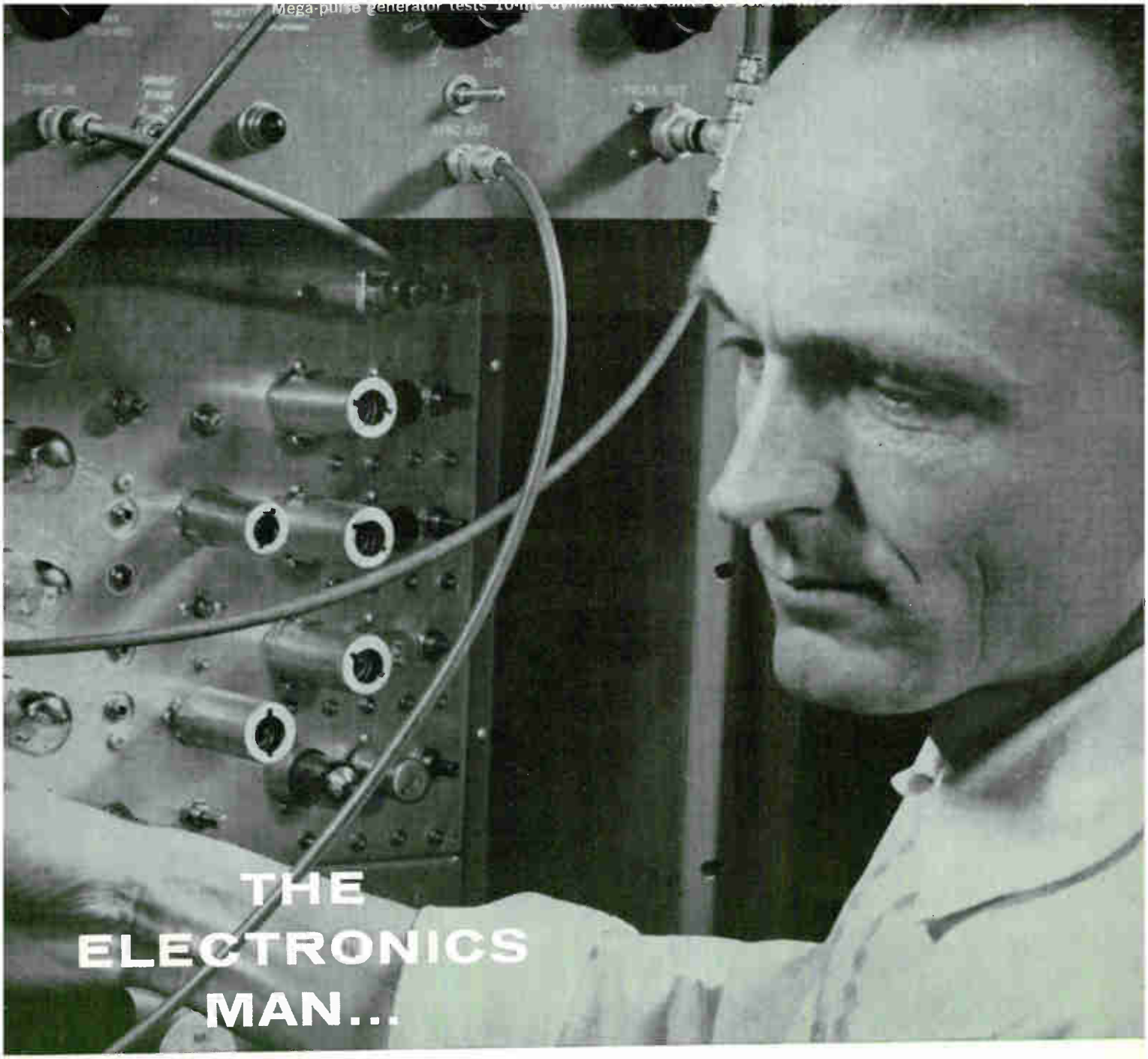

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You can see at any purchasing meeting how the electronics industry differs from most—It's in the conversation! The President may discuss the fine points of circuit design with the research engineer. The production engineer may suggest a choice of components to the design man. The difference is that men from areas of management, design, production and use can and do influence purchase of electronic suppliers.

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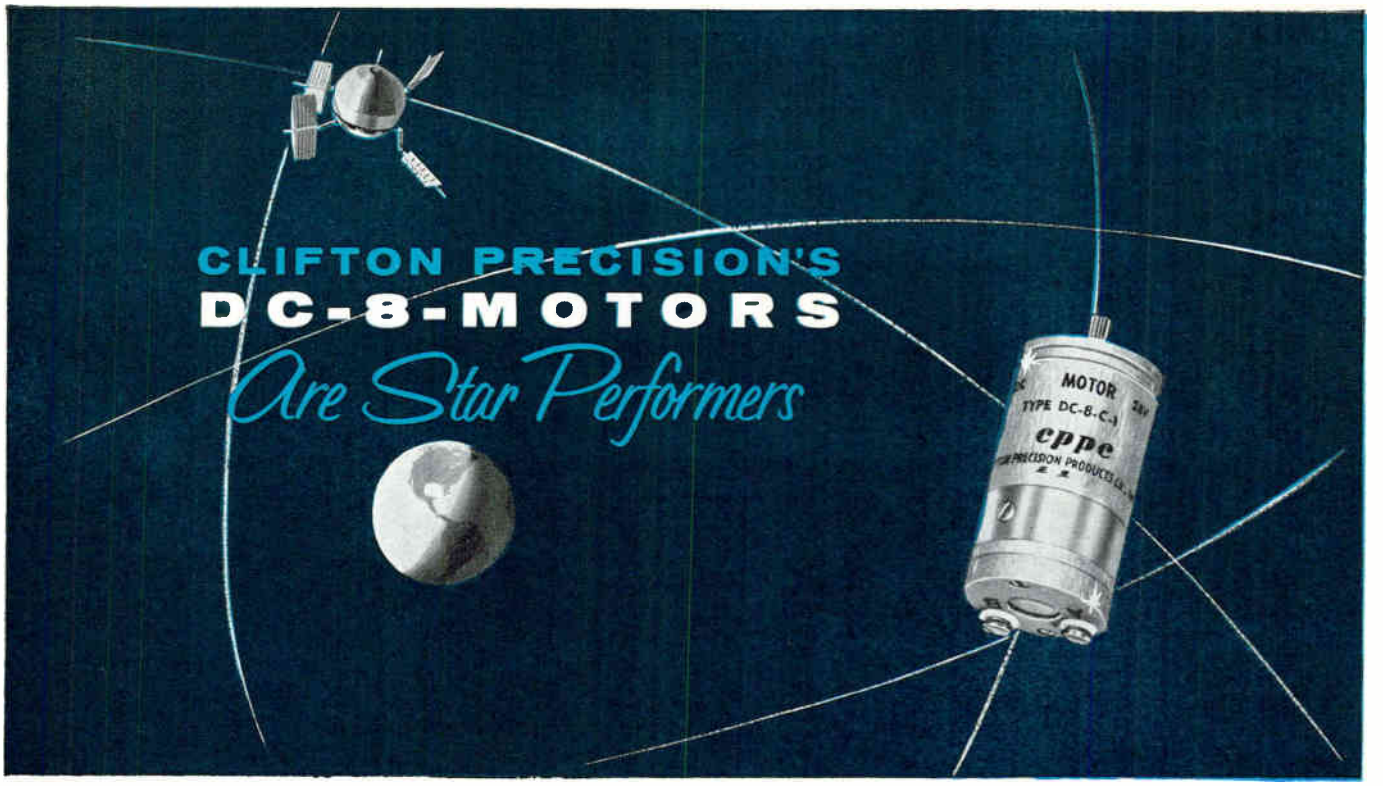

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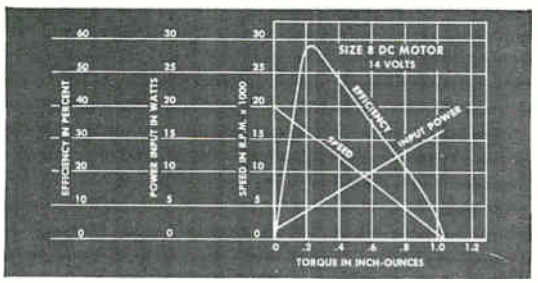
*without overhaul



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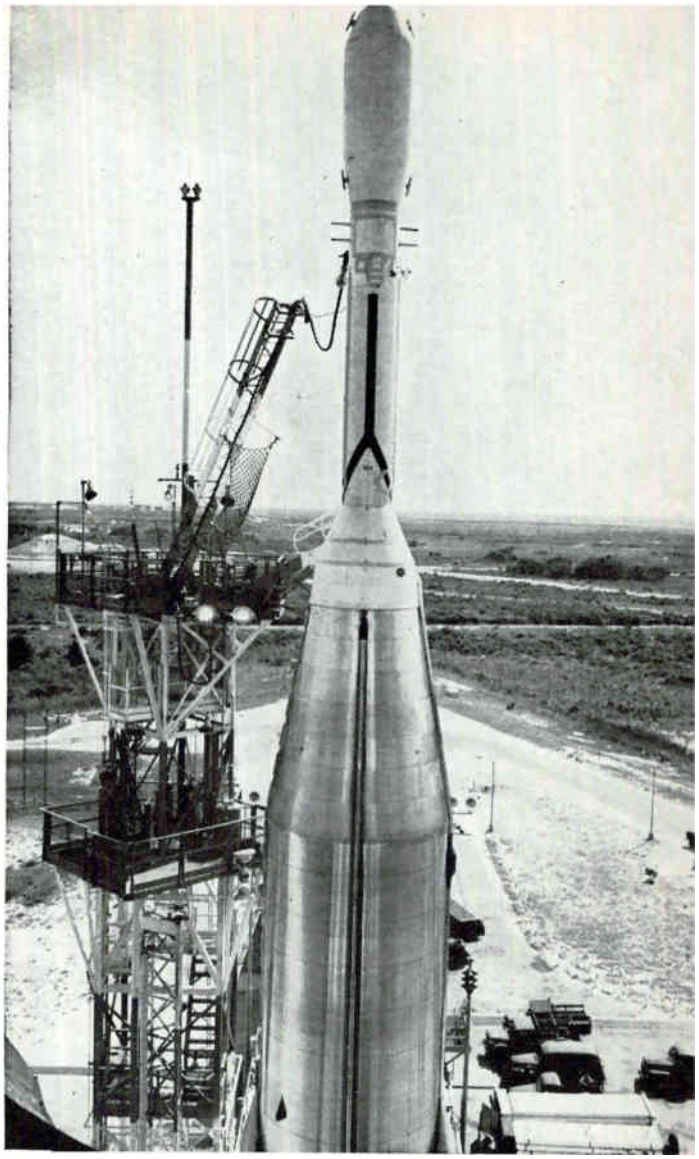
electronics
October 28, 1960

Payload Design for A Lunar Satellite

The Able-5 lunar satellite is the largest and most sophisticated of the NASA/USAF Able series of space probes. Measuring nearly nine feet between paddle tips and nearly five feet between fore and aft antennas, it weighs approximately 390 pounds



Top stages of the Able-5 vehicle

By P. F. GLASER,
E. R. SPANGLER,
Space Technology Laboratories, Inc.,
Los Angeles, California

PRINCIPAL GOAL of the Able-5 program in placing a scientific observatory in a relatively close (nominal perilune 1,400 miles, apolune 2,500 miles above the surface of the moon) lunar orbit is to provide scientific data about the moon, its immediate environment and the space between the earth and the moon.

The equipment carried aboard permits nine sets of experimental measurements. These are a cosmic-ray telescope, scintillation spectrometer, ion chamber and Geiger-Mueller tube, low-energy scintillometer, spin-coil magnetometer and phase comparator, flux-gate magnetometer, plasma probe, micrometeorite detector and space environment effects experiment.

The largest share of experimental sensors on Able-5 is devoted to radiation measurements. These are designed to measure radiation in an energy spectrum ranging in energy per particle from 200 electron volts up to greater than 75 Mev.

Radiation will be measured by five experiments: a low-energy scintillometer prepared by STL; a scintillation spectrometer prepared by STL and Goddard Space Flight Center, a University of Chicago cosmic-ray telescope, the University of Minnesota ion chamber and Geiger counter and the Ames Research Center plasma probe. The experiments will determine the relative abundance of the different species of charged particles and indicate their energy distribution.

The low-energy scintillometer measures the total flux of electrons of energy greater than 50 Kev and of protons of energy greater than 450 Kev. The detector is an anthracene crystal whose light pulses are detected by a multiplier phototube. The detector is shielded from the front by an aluminum cap 1.35 gm per cm^2 thick through which a hole 0.11 inch in diameter admits radiation. A window in the payload shell admits radiation to the detector. To decrease noise in the output, the scaling circuit is biased above the random noise of the multiplier phototube.

A scintillation spectrometer developed jointly for Able-5 by the Goddard Space Flight Center and STL generates an energy spectrum of protons of energies greater than 2 Mev and electrons of energies greater than 350 Kev. The unit

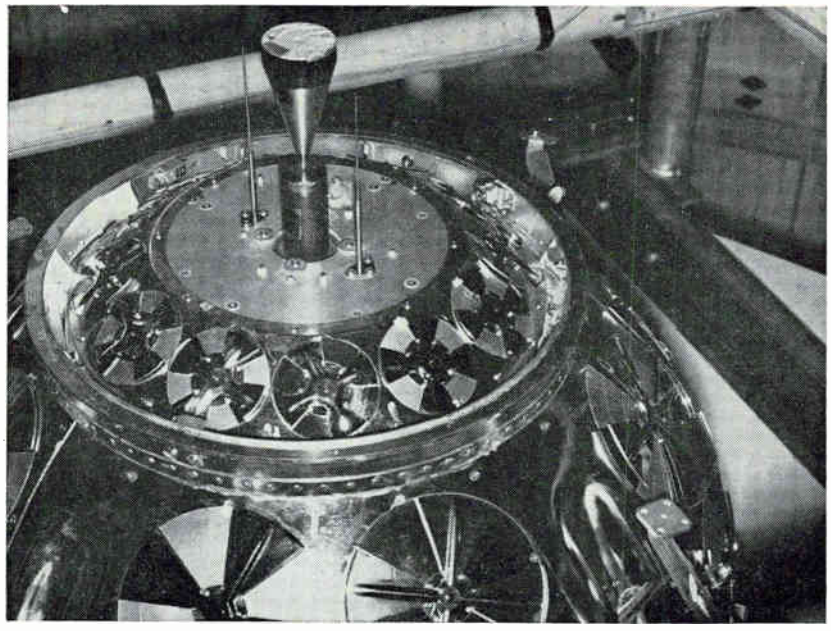


FIG. 1—Aft end of satellite showing temperature-control vanes and one pair of uhf stainless steel antennas mounted near attitude-control rocket

consists of an inorganic scintillator crystal of cesium iodide doped with plutonium, a multiplier phototube, collimator, combined high gain-low gain pulse amplifier, pulse-height analyzer, scaler storage and pulse shapers.

The crystal in the sensor unit faces radially out from the payload through a two-inch window in the payload shell. An aperture stop opens on command from the ground (after transit through the terrestrial radiation zone) and increases the geometrical factor by 10^5. The bias level is changed by a signal from the digital telemetry unit and is telemetered to the ground. The output is scaled by 2^1 and 2^{10} at the 1 or 8 pps readout rates and 2^2 and 2^8 at the 64 pps readout rate.

The cosmic-ray telescope, provided by the University of Chicago, contains a bundle of seven small proportional counters arranged as a central counter surrounded by six outer counters. A cylindrical lead shield of 5 gm per cm^2 areal density encloses the counters. The counters are filled with argon and methane to a pressure of about 600 mm. The center counter is connected to an amplifier with a threshold setting of about 1 mv that in turn operates a scaler chain of 2^9. Adjacent outside counters are connected to form two groups of three. The output of each of the side groups is applied to a separate amplifier each having a 1-mv threshold. The output of all three amplifiers activates a triple-coincidence circuit that drives a 2^9 scaler chain.

The counter sensitivity is almost isotropic. A single event corresponds to a charged particle traversing one outer counter and stopping in the central counter. Such an event triggers the 2^9 scaler chain. A triple event corresponds to a charged particle traversing one outer counter, the center counter, and stopping in or traversing a counter in the other group of three (that is, the particle may pass through or be absorbed in the last counter). The single counter rate is also sensitive to secondary radiation formed in the vehicle.

The combination of ionization chamber and Geiger counter provided by the University of Minnesota measures the flux of electrons and protons.

Both the flux of particles and the ionization produced by the particles are measured.

The ionization chamber is of the integrating type used extensively on University of Minnesota balloon flights. It consists of a four-inch sphere filled with argon gas to an absolute pressure of approximately seven atmospheres. Ions are collected by a quartz rod, the upper end of which is coated with Aquadag. The conducting rod is charged to a positive potential of 225 v by an 8-micron, gold-coated quartz fiber mounted on a side arm. When the fiber is connected to the positive potential it is attracted to the rod, charging the system to the full potential of 225 v. The fiber is then repelled by the electrostatic charge of the system. As the central rod collects electrons formed by ionizing radiation in the argon gas of the chamber, its potential drops and the fiber moves back until it is close enough to be attracted by the image charge. The fiber then recharges the rod and the charging pulse actuates the external circuit. Thus each pulse from the chamber represents the collection of approximately 2×10^{-10} coulomb.

The second detector used by the University of Minnesota is a small halogen Geiger counter containing a mixture of neon and halogen gases to a pressure of approximately 20 mm of mercury. The data are processed in the same manner as the ion chamber and a scale factor of 2^9 is used.

The radiation sensor with the lowest energy threshold is the plasma probe provided by the Ames Research Center. This equipment measures the flux of low-energy protons (0.2 to 20 Kev) by a slit, electrostatic analyzer and electrometer that collects the protons and develops a voltage across a high impedance proportional to the flux of protons. The analyzer consists of a pair of hemispherical concentric plates across which an electrical field varying from a few volts to 3,000 v is applied. For any given voltage the analyzer accepts protons which are approximately ±15 percent of the energy of the proton which traverses the analyzer along a median trajectory. It becomes necessary to change the voltage across the plates successively in steps of approximately 15 percent. Such a change is commanded by a pulse from the telemetry unit and synchronized to the plasma probe experiment readout. The plasma probe shows a geometrical sensitivity of ±80 degrees measured from the normal to the slit in the long direction of the slit, and ±6 degrees measured from the normal and in the normal plane at right angles to the slit. Consequently, the plasma probe possesses a fan beam of sensitivity. As the payload spins the fan sweeps across about 95 per-

cent of the possible directions of arrival of protons impinging on the payload. The plasma probe generates signals that measure the peak and the average proton flux and delivers these signals to the digital telemetry unit.

The search-coil magnetometer shows a sensitivity of approximately 0.3 gamma (3×10^{-5} gauss) for a steady field and about 2 gamma for varying fields. It consists of a mumetal core wound with 5,000 turns of No. 40 copper wire. This coil is mounted on the end of a solar cell paddle spar in line with the longitudinal axis of the spar. The output of the coil is coupled to a transistorized amplifier tuned to the nominal spin rate of the vehicle. In a steady magnetic field the amplifier output is sinusoid at a frequency equal to the spin rate. The magnetometer has a nonlinear transfer function that allows measurement of fields from less than 1 to about 1,000 gamma.

By using the 2.8-rps spin of the vehicle and knowledge of the orientation of the axis of this spin, the magnitude of the magnetic field and the direction of field can be deduced. A comparator that measures the phase between the output of a photodiode sun scanner, or aspect indicator, and the output of the search-coil magnetometer determines the direction of the field perpendicular to the spin axis. When data proportional to the flux-gate magnetometer output are related to the search coil output and the phase comparator information, the vector direction of the ambient field can be computed.

The flux-gate magnetometer consists of a probe mounted along the longitudinal axis of the solar cell paddle spar and the circuit chassis. The output voltage is a linear function of the field being measured. Three range scales— ±32 gamma, ±320 gamma and ±3,200 gamma— can be designated by ground command. Also by command, a bucking current can be applied to effect discrete steps of 40 gamma. In-flight calibration of the electronic system can also be made by ground command by shorting out the core secondary. The flux-gate magnetometer measures the ambient field parallel to the payload spin axis.

The micrometeorite experiment measures the density and to an extent the energy spectrum of dust particles encountered in space. Impacts are detected with microphones located on two plates on the outer payload shell. Impulses equivalent to two ranges of momenta are electronically selected by counting impulses after different degrees of amplification and discriminating against certain pulse amplitudes. Two ranges of pulses are selected representing momenta greater than about 10^{-4} gm cm per sec and momenta greater than 3×10^{-3} gm cm per sec.

The components of the integrated

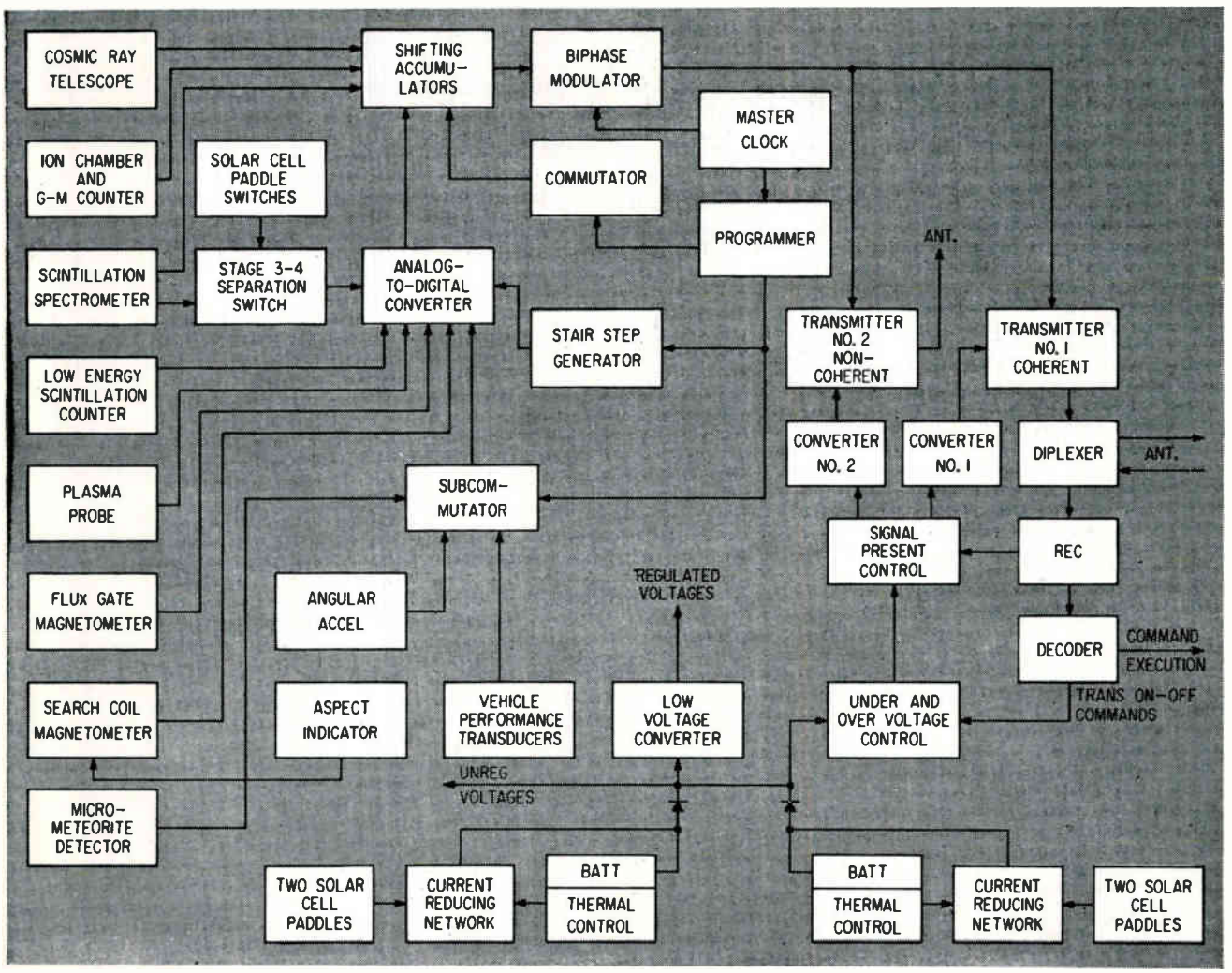
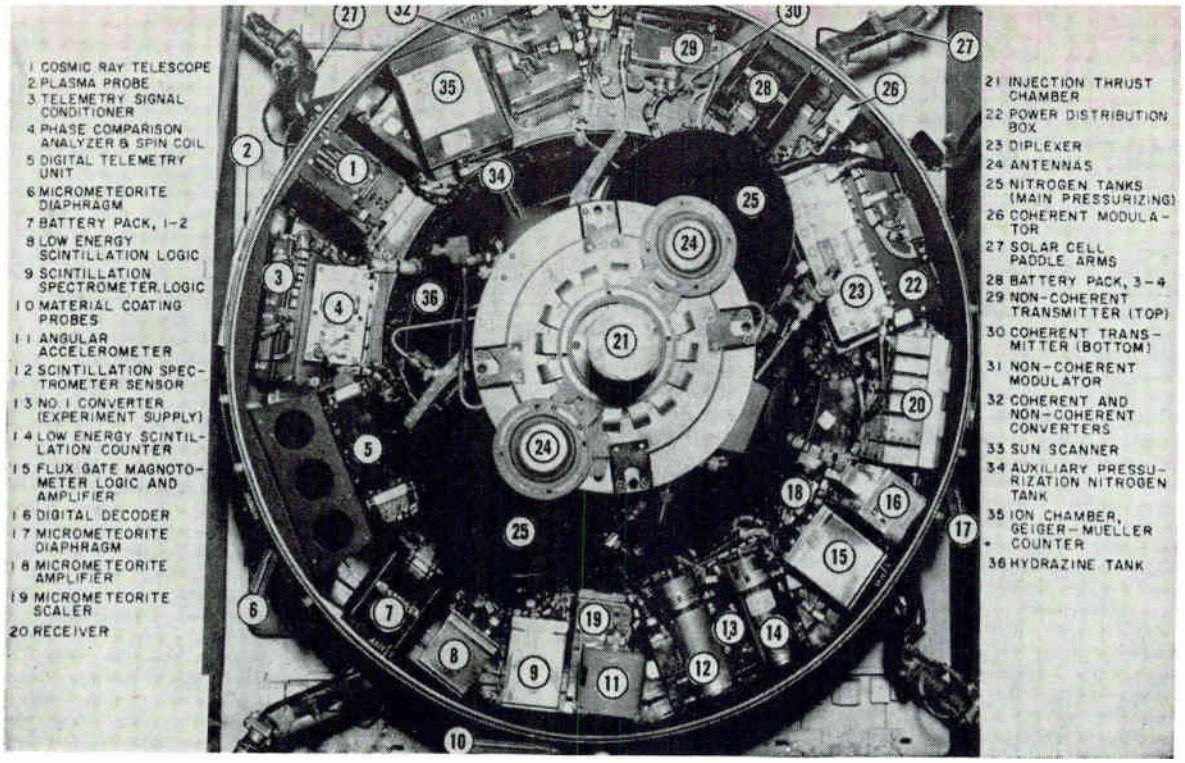


FIG. 2—Functional block diagram of lunar satellite showing interconnection of scientific experiments



Interior arrangement of lunar satellite viewed looking aft

tracking, telemetry and command system in Able-5 are a command receiver, two 1.5-watt transmitters, airborne Telebit unit and two uhf quarter-wave dipole stub antennas, one pair forward for one transmitter, another aft for the second transmitter (see Fig. 1). These antenna arrays are of stainless steel to withstand the heat of the rocket, the forward and aft nozzles of which are between the antenna pairs. The coaxial cable is made from electroless nickel-plated stainless steel components, and the spacers are made of silicon fiberglass to withstand the heat. The radiation pattern for the antennas is omnidirectional and polarization is vertical to the mounting surface. The diplexer is a bandpass device with more than 50-db isolation between transmitter and receiver.

The payload command receiver is a transistorized double-conversion, phase-lock-loop unit that gives a coherent output at 2/17 of received frequency. The receiver operates continuously and since its 250-cps bandwidth is considerably less than the frequency uncertainty of the received signal, it repeatedly sweeps over a range of 20 Kc searching for a carrier, with a sweep period of 30 seconds. When the receiver acquires and locks on a signal from the Earth, the sweeping stops and the receiver can then accept any of 20 possible commands. The receiver has a sensitivity (based on a 12-db noise figure) of about −130 dbm.

Signals from Earth to the payload are transmitted by a high-power carrier at uhf frequencies phase-modulated with a 512-cps subcarrier. Amplitude modulation of the subcarrier with a coded train of 13 pulses provides information to the digital command system.

The Able-5 receiver accepts a c-w signal from Earth, and after processing delivers it to the coherent transmitter at 2/17 the received frequency. The coherent transmitter accepts the signal from the receiver, multiplies it eight times in frequency and amplifies it to a 1.5-watt level for retransmission to the ground at uhf frequencies as shown in Fig. 2.

The resultant signal is modulated with a 1,024-cps subcarrier containing the time-multiplexed, pulse-code-modulated output of the digital telemetry system. Biphase modulation is employed to impress the telemetry output on the subcarrier.

Range rate is measured on Earth to accuracies of better than 1 ft per sec by extracting the doppler frequency shift between the transmitted and received signal after correcting for the frequency offset introduced by the vehicle transponder. Tracking in angle is performed by nodding the ground antenna alternately in elevation and azimuth. Angular accuracies of about 0.2 degree are possible.

The second payload transmitter, also at 1.5 watts, is operated from its own crystal oscillator. Frequency of this transmitter is offset 100 Kc from the nominal transmitted frequency of the coherent transmitter.

Telemetry is impressed on the noncoherent signal as on the coherent. The noncoherent transmitter operates from liftoff until commanded off. During launch, the coherent transmitter filaments are on, but the B+ voltage is not applied until paddle erection. The coherent transmitter operates without the telemetry subcarrier until commanded. At execution of this command the telemetry subcarrier is applied to the coherent signal, and remains throughout the lifetime of the payload.

Following command on, either the coherent or noncoherent transmitter is operated by ground commands. If the payload receiver is locked to a ground carrier signal, the coherent transmitter operates. If the receiver is not locked on to a ground carrier, the noncoherent transmitter operates.

An overvoltage-undervoltage relay is provided to turn off the trans-

mitters if battery voltage drops below 15 volts. The overvoltage control turns on the transmitters if voltage rises sufficiently to insure satisfactory operation, if commanded.

The digital telemetry unit (Telebit) accepts both analog and digital inputs. The converted information at its output appears as a binary-coded subcarrier (1,024 cps) that then phase modulates the transmitters.

The binary output of the system occurs at a synchronous rate and is composed of repeating sets of frames of words. For Able-5, 11 words a frame are used. One word of each frame is used as a frame sync and is read out as all zeros, while the rest of the words are coded with the digital representation of the input information. Each word contains 12 pulses. The first two pulses (for information words) are always coded the same (zero, one) and define the start of a word; that is, these two pulses provide a word sync. The other 10 pulses take on any combination of binary values to represent a number from 0 to 1,023, or divide into subwords of six or four bits.

A 12-bit combination binary counter and shift register, referred to as a shifting accumulator, is provided for each word. Pulses from a digital experiment are applied directly to the counting input of a shifting accumulator, while an analog input is applied to an analog-to-digital converter, whose output is then applied to a shifting accumulator. An electronic commutator running synchronously at the word rate, gates 12 shift pulses to each shifting accumulator during one word interval each frame.

These shift pulses cause the information in the shifting accumulator to be delivered to the biphase modulator. At the same time, the output of the digital shifting accumulators is returned to the input so that after 12 shift pulses the state of the shifting accumulators is exactly as it began. The outputs of all the shifting accumulators are connected through gates. Since only one is shifting at a time no interference results.

The conversion of analog to digital information is done by a digital ramp and a voltage comparison circuit. Conversion results from counting the number of steps in the ramp below the level of the analog input voltage. The counting is done in a shifting accumulator just as for digital experiments.

The biphase modulator accepts the pulses emerging sequentially from the shifting accumulators and produces a subcarrier whose phase shifts by 180 degrees each time a binary ONE is to be transmitted. This biphase-modulated subcarrier is then delivered to the coherent transmitter for phase modulation upon the carrier.

The pulses which cause the electronic commutator to step and the shift registers to shift originate in the programmer, and the programmer in turn receives its excitation from the master clock (see Fig. 2). Application of an outside signal derived from the digital command decoder causes the pulse rate of the digital telemetry system to change.

NEW MOON SHOT PLANNED

At 11:13 a.m. on September 25, 1960, this satellite was launched from Cape Canaveral, Florida. Due to malfunctioning of the second stage explosive bolts, the satellite and upper rocket stages arched over at about 200 miles altitude and are believed to have burned up in the Earth's atmosphere over the Indian Ocean.

Another attempt with a similar satellite will be made towards the latter part of November, 1960

The Able-5 power supply system is modeled on that designed for the previous Able space probes, Explorer VI and Pioneer V. The system consists of solar cells mounted on four extended paddles to convert solar energy to electrical energy, storage batteries and converters.

The payload storage batteries consist of two packs of 14 hermetically sealed, nickel-cadmium cells each. The cells in each pack are connected in series and the two packs connected in parallel isolated by diodes. Each pack has a nominal output of 18 v and 3.5 ampere-hour capacity. Part of the power developed in the solar cells is immediately consumed in experiments. With a 1.5-w transmitter operating without solar-cell charging current, the batteries can operate for a maximum design time of about four hours. The nominal power available from the solar cells is approximately 30 w. Two switches are provided with these battery packs to prevent thermal runaway that is likely with nickel-cadmium cells when they are overcharged. The switches open when battery temperature rises above 100 F, thereby removing the charge current until the temperature drops.

Optimum performance of Able-5 requires that its internal temperature remain within a range of 40 to 85 F. The optimum ratio of absorptivity of sunlight energy to emissivity of heat for the general area of the skin has been calculated, and the polished aluminum appearance of the satellite is the result. Radiators are used at those sites in the payload where heat will be generated by operation of the transmitters or converters. A unique active temperature control system rotating vanes over circles of alternating white and blue has been placed over the skin surface so that the minimum value of controlled area to total area projected from any direction is 36 percent.

These vanes are attached through bimetallic springs to the payload skin. The tension of the spring is sensitive to the temperature at its location and dictates the angle at which the vanes stand. At one extreme (about 75 F) a vane completely exposes the white areas; at the other extreme (about 50 F) the vanes move through 45 degrees to expose the blue areas completely.

As an adjunct to the temperature control system an experiment is carried on Able-5 to test the effects of the space environment on three coatings. Three one-inch aluminum spheres jutting from the payload near the equator are each covered with a thin coating of a relatively high heat absorptance, a relatively high heat emittance and a combination of relative low values of both of these properties. Temperature sensors in each of these spheres, the first in the range 100 to 430 F, the second −150 to 50 F, and the third 130 to 330 F, provide a measurement of the changing properties of the materials while they are exposed to the space environment.

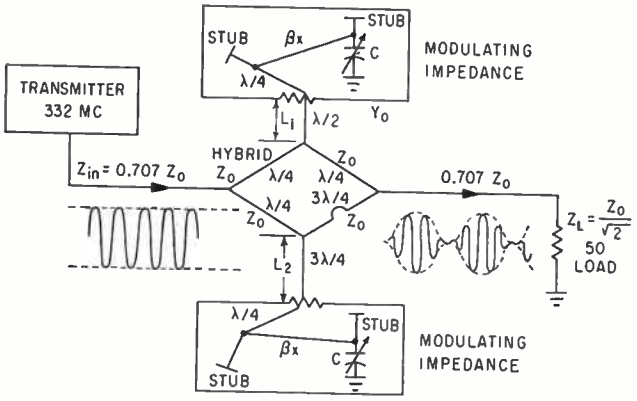


FIG. 1—Block diagram shows hybrid and two modulating impedances forming the modulator

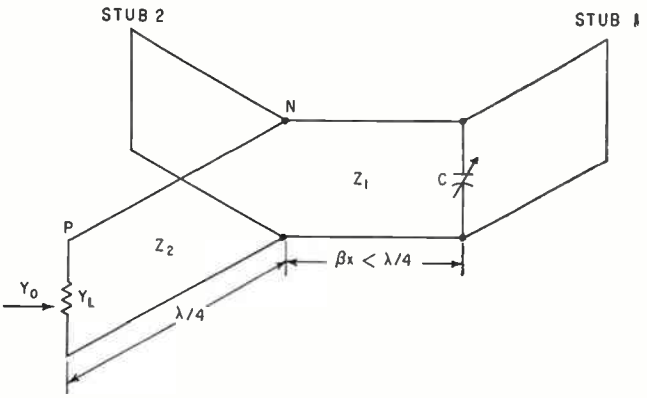


FIG. 2—Paddle-wheel capacitor is represented by variable C in impedance system configuration

Mechanical Modulator Uses

By JOSEPH HABRA, U. S. Science Corporation, Los Angeles, Cal.

THE GLIDE SLOPE PROJECTOR is a landing guidance system that depends on transmitting a glide path at a predetermined vertical angle with the runway. A combination of radiation patterns is produced, resulting in two modulated signal areas: 150 cps below the glide path and 90 cps above. To maintain the pattern accurately, phase and frequency stability, reliability and constant modulation depth are of utmost importance. In ensuring these, the mechanical modulator shows definite advantages over conventional modulation systems.

Modulation is effected by the special variable capacitor shown in the photograph. A paddle wheel rotates between the fixed plates of the capacitor thus varying the dielectric constant; modulation frequency is determined by motor speed and the number of paddles on the rotating wheel.

The modulator has three major parts as indicated in Fig. 1: a $3\lambda/2$ hybrid and two modulating impedances. These latter are identical and set up the boundary conditions for a modulated output.

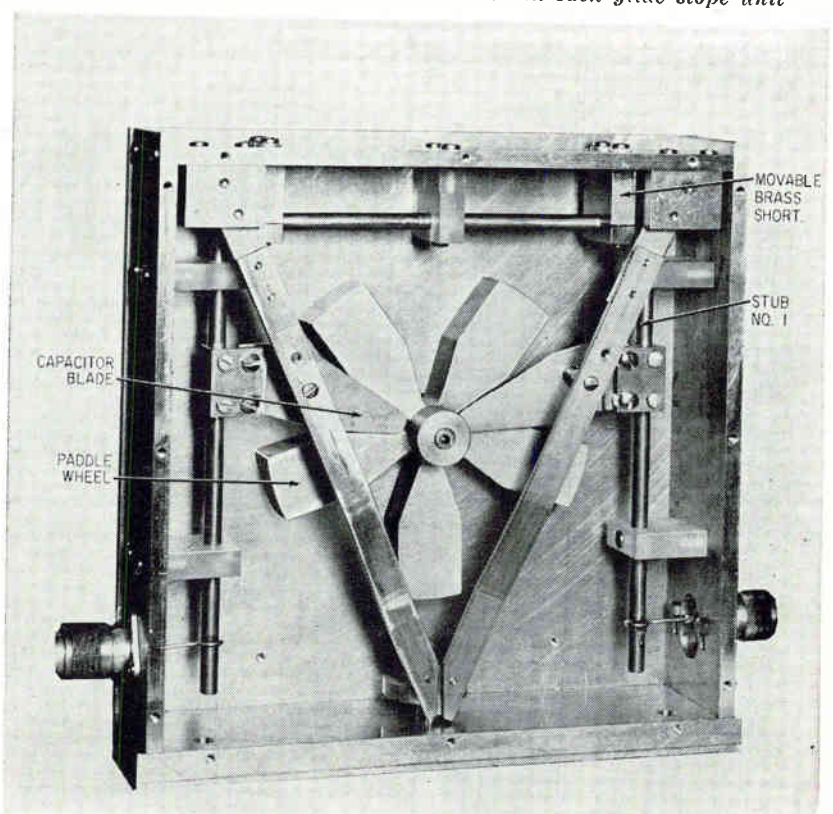
The hybrid is built of coaxial transmission line for minimum attenuation and dielectric losses. The hybrid impedance is 70.7 ohms; transmitter input impedance and load impedance are 50 ohms each. The modulating impedances are placed at precise distances from the hybrid, as shown in Fig. 1. Modulation occurs when the difference between distances L_1 and L_2 is exactly one-quarter wavelength; therefore $L_1 = \lambda/2$ and $L_2 = 3\lambda/4$.

The modulating system could have many different configurations, each with a specific capacitance variation for a distortionless sinusoidal modulation. Of the possibilities investigated, one configuration was chosen as having suitable control over the modulation and power output. Its major advantage is the small capacitance variation, 3 to 6 picofarads. The circuit is shown in Fig. 2.

Variable capacitor C is formed by a blade and ground with a paddle wheel rotating between them. Paddle-wheel rotation varies the dielectric constant of the capacitor. The capacitance function C has two parts: capacitance due to the common area between the wheel and the blade, and the stray capacitance which has its greatest effect when the wheel and blade are out of mesh.

Two boundary conditions exist.

Photograph shows casing, paddle wheel, capacitor blade and stub that varies modulation. Two modulators are used in each glide slope unit



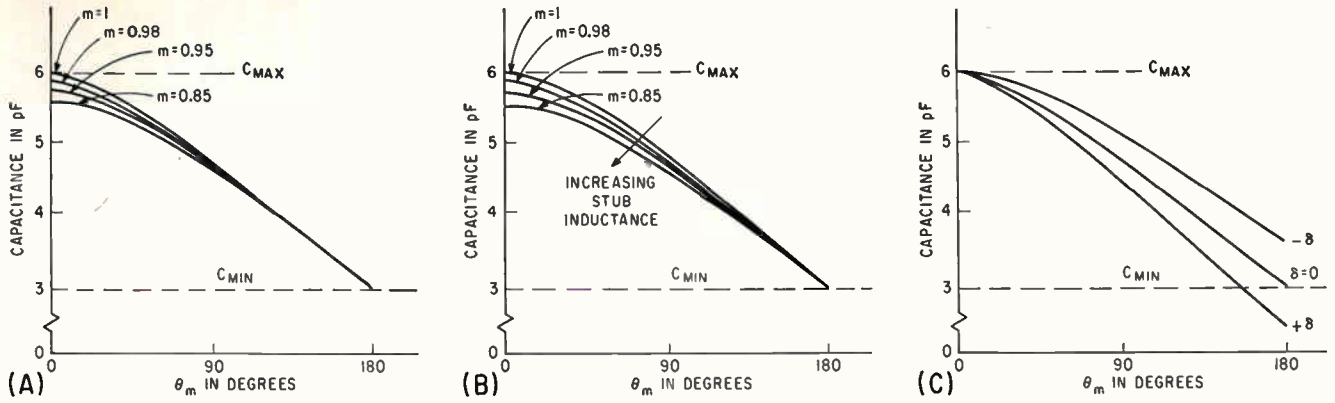


FIG. 3—Capacitance variation versus modulation angle is plotted in (A) and (B) for different modulation indexes, and varies modulation. Two modulators are used in each glide slope unit

Variable Capacitance *Paddle-wheel mechanism provides reliable modulation at constant frequency for landing guidance system*

A high impedance at point P (Fig. 2) corresponds to C_{max} of the variable capacitance. A zero impedance or short at P corresponds to C_{min}. The first stub has an inductive reactance equal to the reactance of C_{max}. The second stub inductive reactance is set equal to the capacitive reactance of the transmission line Z_1 at point N when C equals C_{min}.

Assuming negligible loss in the hybrid, the internal impedance Z_{in} of the hybrid is

$$Z_{in} = \frac{Z_0}{\sqrt{2}} = Z_{load} = \text{constant.}$$

This is important since a constant impedance is presented to the transmitter output. If hybrid input impedance is not constant, reflection will result and hybrid efficiency will decrease rapidly.

Assuming transmitter voltage V_s and output voltage V_L

$$\frac{V_L}{V_s} = \frac{1}{2}\,\frac{y_a - \sqrt{2}}{y_a + \sqrt{2}}$$

$$= 1 - \frac{m}{2}\,(1 + \cos\theta_m)$$

where y_a is the normalized value of modulating system admittance Y_a and m is the modulation index. Since the aim is a sinusoidally modulated output, the voltage ratio value is set to a sinusoidal function as in the right-hand member of the equation. Only one value of y_a can give a sinusoidal output.

The value of C_{max} determines a condition corresponding to maximum modulation (zero voltage for 100 percent modulation). There is only one condition for the system:

$$\frac{1}{\omega C_{max}\tan\beta x} < Z_1 < \frac{\tan\beta x + 1/\tan\beta x}{\omega(C_{max} - C_{min})}$$

Assuming $C_{max} = 6$ pf, $C_{min} = 3$ pf, $Z_1 = 150$ ohms, $Z_2 = 50$ ohms, $x = 45$ deg and the frequency is 332 Mc, the capacitor variation is given by

$$C = 6 - \frac{1}{0.334 + 0.665\sqrt{\dfrac{0.125}{[1 - (m/2)(1 + \cos\theta_m)]^2}} - 0.125}$$

This capacitance is plotted in Fig. 3A. The paddle wheel should duplicate this capacitance for a distortionless modulated output. Decreasing the modulation from 100 percent affects only the maximum value of capacitance C_{max}. Lowering C_{max} without changing C_{min}, as shown in Fig. 3A, will control carrier modulation.

Stub No. 1 (Fig. 2), when varied, will change the maximum value of capacitance while C_{min} remains constant. The capacitance function for zero distortion for small changes of stub inductance is plotted in Fig. 3B.

Comparing Fig. 3A and Fig. 3B shows that the modulation of the carrier can be controlled by varying the stub inductance, but since the capacitance of the two figures is not exactly the same, a small output distortion is introduced.

The effect of varying stub No. 2 is plotted in Fig. 3C. Changing the stub reactance will vary the minimum capacitance without altering the maximum value. This will change only the carrier amplitude or power and will not affect the modulation, which is a function of C_{max}. This power change is at the expense of some increase in distortion. The second stub, then, is a means for varying the carrier power output while the first stub is a means for varying modulation.

The shape of the paddle wheel and blade are designed to give the correct capacitance curve at 95 percent modulation. Changing the modulation between 85 percent and 100 percent will then give a distortion figure at least 25 db below the fundamental.

The distortion introduced by mechanical tolerances of ±0.010 in. was determined analytically to be −26 db. This compares well with the figure of −24 db found in the laboratory.

Assuming the paddle wheel and blades were shaped to give an ideal capacitance variation corresponding to 95-percent modulation, the distortion introduced by setting the modulation at 95 percent by the stub was computed as −24 db. This checks closely with laboratory results. The first harmonic is the most appreciable: 6.3 percent. The second dropped to 0.9 percent, the third to 0.2 percent.

Bluebird Racer's Telemetry System

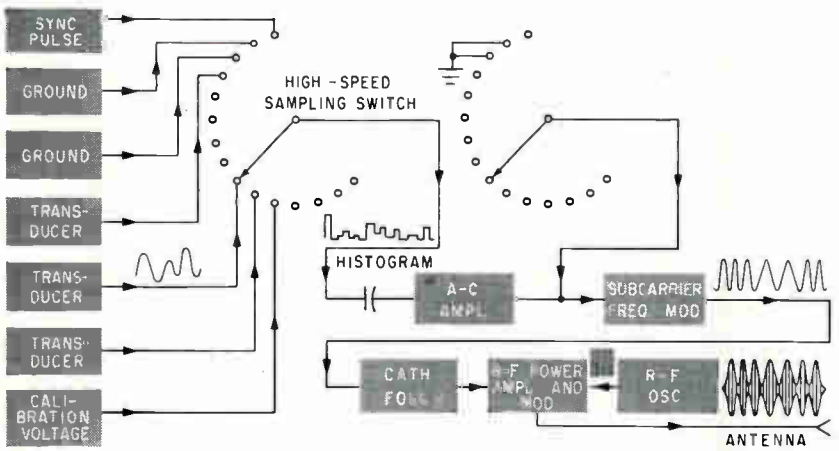


FIG. 1—Block diagram of transmitter. There are actually 18 transducers whose outputs are scanned by the sampling switch

Telemeter built into Donald Campbell's Bluebird racing automobile gives remote indication of the car's performance. Information thus derived provides a permanent record for future reference and also permits the ground team to warn the driver of incipient danger

By A. D. RUNNALLS,
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THE BLUEBIRD 4,000-bhp jet-powered racing automobile that Donald Campbell was to have driven on his attempt to beat the world land speed record, as we now know, overturned and was wrecked during a trial run on September 16. Mr. Campbell was fortunately not badly injured, even though Bluebird was traveling at over 300 mph. (See editorial box.)

Built into this automobile, in addition to some 40 instruments on the control panel, was a comprehensive telemetry system that transmitted information about Bluebird's behavior to the base camp. Eighteen transducers at critical locations throughout the vehicle structure converted pressures and temperatures and other information into electrical analog signals, which were rapidly transmitted to the engineering team over a line-of-sight signal path.

At the time of the crash the telemetry equipment was working perfectly and from the results and visual observations, the causes of the disaster were deduced. These are dealt with in the editorial box.

A total of eighteen channels for information-flow are used, leaving four channels for synchronization, grounding and calibration, plus two spares. Information transmitted includes temperature of gearboxes and bearings; oil and jet pipe temperatures; oil pressures and positions of suspension and track rod systems.

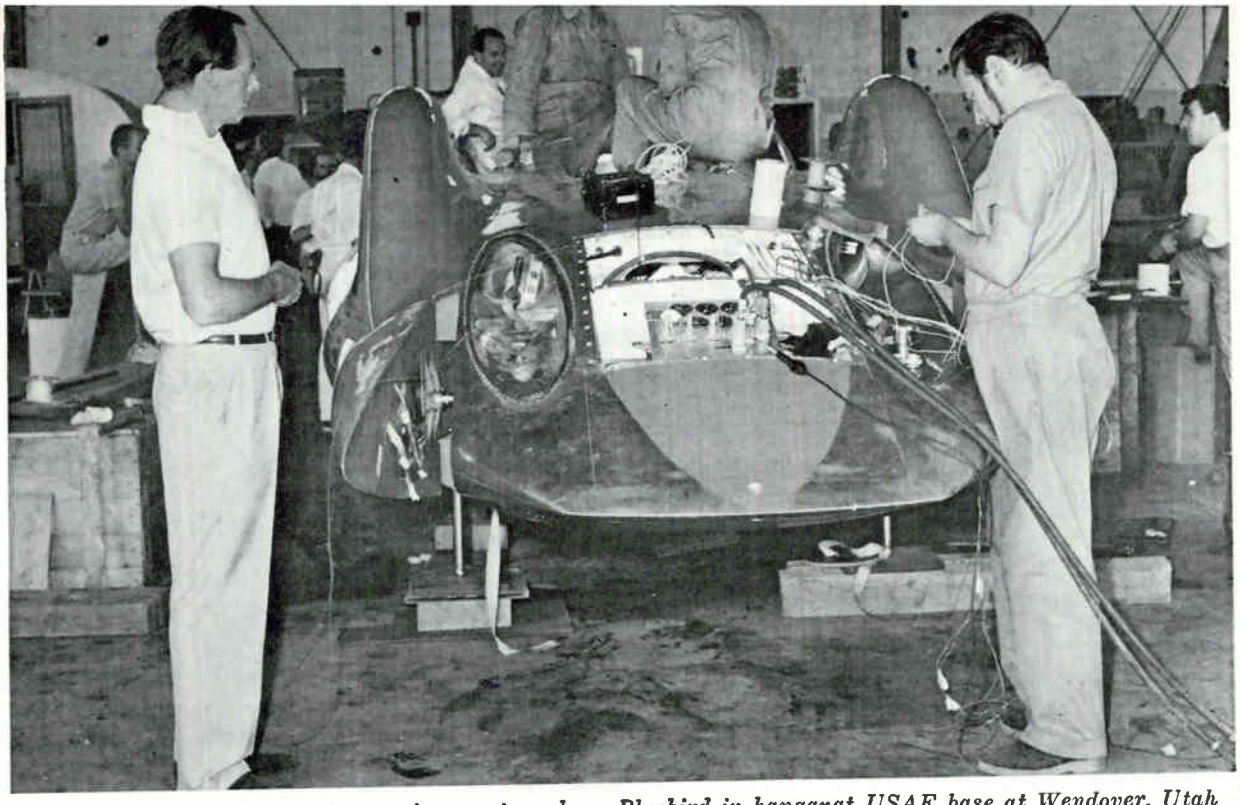
A block diagram of the transmitter unit is shown in Fig. 1. The transducers are connected to cir-

WHAT HAPPENED

The hopes of the British racing team, led by British Speed King Donald Campbell, to beat the world's land speed record of 394.196 mph (set by the late John Cobb in 1947) were wrecked when the Bluebird racing automobile overturned at the Utah Salt Track on September 17, 1960 while traveling at 300 mph. The prominent record to come out of this attempt, in fact, must be for a driver to have survived an automobile accident at that terrific speed.

Campbell was making his fourth test run in 24 hours when the accident occurred. He had completed one run along the 11.5 miles of desert track, reaching an unofficial speed of 300 mph, and was on the return run when the accident occurred. The vehicle hit a patch of loose salt at a speed (according to the telemetry equipment) of 360 mph and went into a drift. In correcting for this drift, it appears that the car got out of control and ultimately overturned.

Campbell himself escaped serious injury and was taken immediately to Toole Valley Hospital, about 80 miles away from the track. He suffered a severe head-blow and collected a variety of cuts and bruises in addition to two honorable black eyes. When taken from the Bluebird cockpit, Campbell is recorded as muttering: "I'm all right, don't worry". One can envisage his crew murmuring "dashed bad show, what," in sympathy with him.



Donald Campbell (left) watches engineers at work on Bluebird in hangar at USAF base at Wendover, Utah

cuits that are individually designed to suit the transducers. Outputs from these circuits are d-c and low-frequency signals, which are fed to a multiplexing switch.

The multiplexing device is a two-bank sampling switch that rotates at 12,000 rpm, enabling signals to be sampled at 200 a second. The output from the first bank of the sampling switch is capacitor-coupled to a transistorized amplifier that has a gain of 500; this gain decreases by 0.4 percent for an increase in temperature of 10 degrees C. Drift, together with any change in the sensitivity of the modulator, is compensated in the receiving equipment.

Segments 1 and 2 on both banks of the sampling switch are connected to ground; thus d-c restoration is made after amplification by the a-c amplifier.

After amplification the multiplexed signal modulates the frequency of a subcarrier oscillator, thence, it amplitude-modulates the uhf transmitter. A maximum of 3.5 watts mean power at 460 Mc may be obtained from the transmitter. The output from the transmitter is fed to a blade antenna on one of the wheel blimps.

A block diagram of the telemetry receiving equipment is shown in Fig. 2 on the next page.

The receiving antenna is a six-element Yagi array using a folded half-wave dipole, and is mounted on a 45-foot mast to maintain line-of-sight transmission over the 15-mile track. The antenna is matched to the receiver at the frequency of transmission.

The receiver is a conventional uhf type. A low noise r-f amplifier is incorporated using a single

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Eyewitnesses to the accident say that the car skidded about a mile, and strewed the desert-track with debris for twice that distance, before finally coming to rest: a record that must surely surpass that of the Jersey Turnpike.

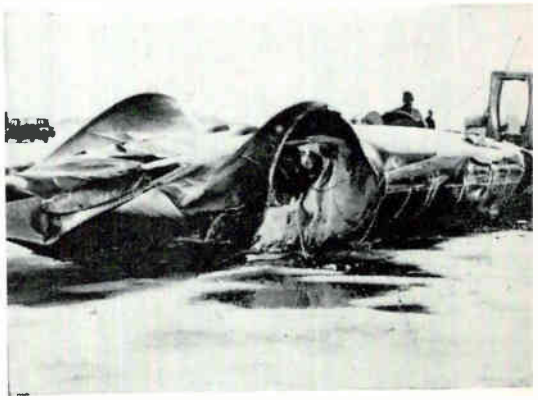
According to Peter Carr, Campbell's relief driver and right-hand man, it will be easier to build a completely new vehicle rather than to try to patch up the wreckage of Bluebird II. Construction on a new Bluebird is already underway, in fact, and Campbell, not daunted by trivial mishaps such as an accident at 360 mph, is set to try again in the summer of 1961.

We wish him luck.

This week McGraw-Hill World News in Salt Lake City wired as follows:

"Telemetry system gave good information there no major wheel spin. Engine running perfectly; nothing unusual in suspension or steering or in strain.

Also told how fast Bluebird was going, which 360 mph. By adding up what telemetry provided on basis of what did not happen, experts were able to deduce what did happen. Story is that there was certain amount of side wind and while Campbell was in process of correcting for this, Bluebird hit patch of loose salt and spun off track."



A2521 tube. An overall noise temperature of 3,000 K and a bandwidth of 4.5 Mc is obtainable for a gain of 95 db. The detected signal is passed from the receiver into a Travis-Round discriminator. This unit uses two circuits tuned to frequencies above and below the center frequency of the subcarrier.

After discrimination, the signal is a stepped voltage and it is displayed on a cathode-ray tube for strobing. The synchronizing channel triggers the time base of the cathode-ray tube.

At the strobing stage, channel 2 of the discriminator output is clamped to ground. Since channel 2 is also connected to ground at the transmitter, this eliminates zero drift. Gain drift through the system is compensated by strobing the calibration channel and adjusting a gain control on the receiving equipment to keep the calibration level constant, the calibration level being displayed on a meter after strobing. These two safeguards keep long-term zero drift and gain drift to a minimum.

The strobing unit comprises five printed circuit boards, each housing four identical circuits, including cathode followers and control potentiometers. For the demultiplexing circuits to operate accurately, the triggered display timebase has a constant amplitude.

This constant-amplitude timebase is fed to the input of the strobing units. A circuit of one of these units is shown in Fig. 3. The timebase is r-c coupled into the unit and a d-c level is then set by adjusting potentiometer. Transistor Q_1 is an emitter follower and it drives a Schmitt trigger circuit formed by Q_2 and Q_3. The output from the Schmitt trigger is a square wave with a repetition rate determined by the timebase frequency. The mark-space ratio is controlled by the variable d-c level input.

Capacitor C_1 and resistor R_1 form a differentiating circuit that changes the square-wave output from the Schmitt trigger to positive and negative-going pulses. The positive-going pulse triggers a one-shot multivibrator. This results in a square-topped gating pulse that may be moved anywhere along the timebase by adjusting the level of variable d-c input.

To establish the position of this strobe or gating pulse relative to the beginning of the sampling switch cycle, the pulse is fed to the grid of the cathode-ray tube. This causes the trace to be brightened at the position of the pulse on the timebase. Thus the gate pulse or strobing pulse can be positioned accurately to any channel.

Transistor Q_6 is a gating amplifier and is normally cut off. When the gating pulse from Q_5 is applied to the base of Q_6 it conducts and the selected part of the discriminator output is passed to the cathode follower. To prevent the voltage at the emitter of Q_6 decaying excessively between the arrival of successive strobing pulses, the gate signal is fed into a high resistance. As it is impossible to achieve a sufficiently high input resistance with transistors, and yet retain a simple circuit, a vacuum tube cathode follower is used.

The output from the cathode follower is a series of voltage steps. The stepped output is fed to a low-pass filter with a cut-off frequency of 60 cps. The output from the filter now contains only frequency components up to 60 cps and the stepped character is removed.

After strobing and filtering, the signals are visually displayed and recorded. The visual display consists of a cathode-ray tube with a slow timebase and a long-persistence phosphor face, together with a meter display. Rapidly varying quantities, such as strain gage outputs, are displayed on the cathode-ray tube and the slowly varying quantities are displayed on the meters. The recorders used with this equipment are of the ultraviolet type, which enables the trace to be examined within seconds of recording.

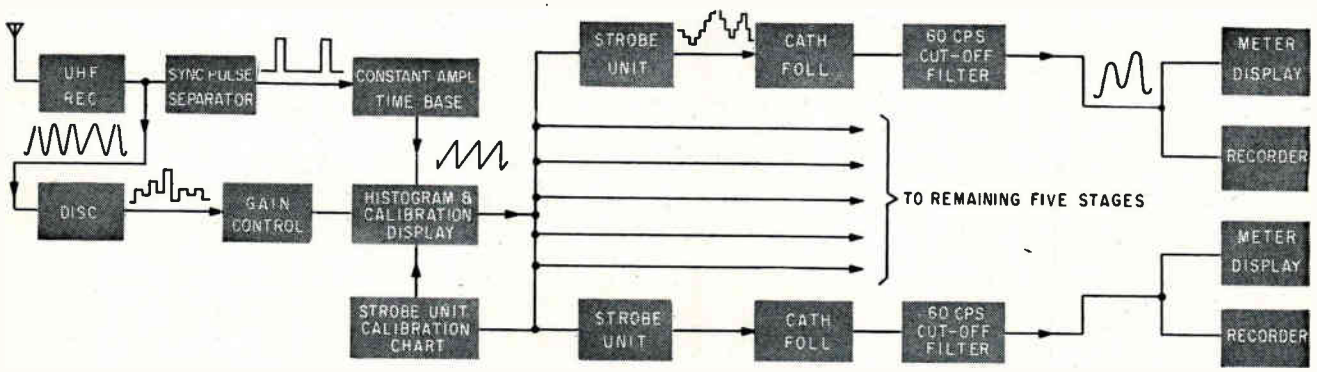


FIG. 2—Receiver passes the composite incoming signal to the strobing system, which decodes the 18 sets of readings for subsequent display and recording

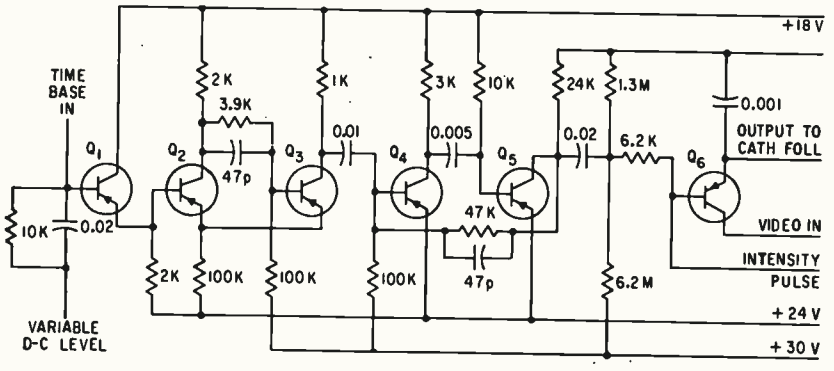
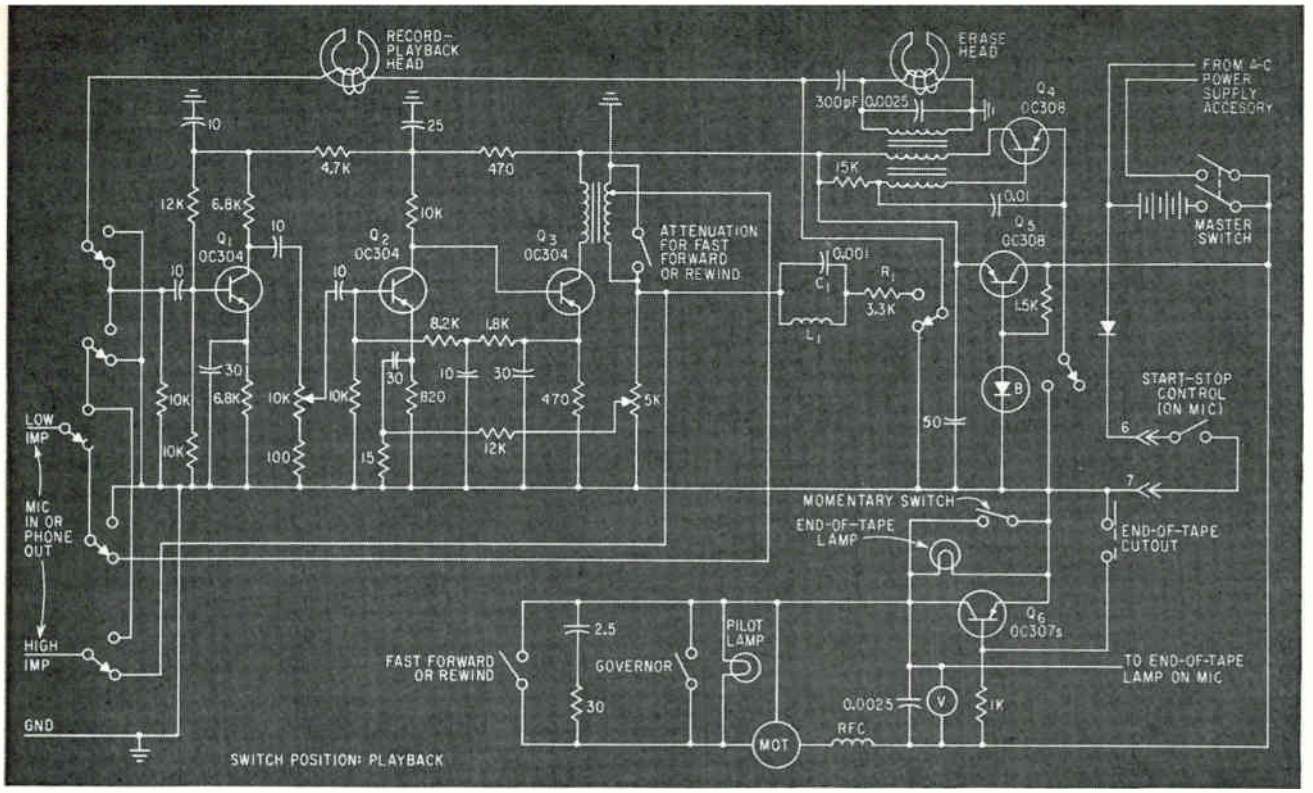


FIG. 3—Variable input level to each strobe unit governs the part of the telemetry signal that is selected for processing and recording



Amplifier voltage is regulated by transistor Q_5 and the Zener diode. Transistor Q_6 functions as an on-off switch for starting and stopping the recorder with the microphone switch, or for stopping the recorder by the metallic coating at both ends of the tape

Pocket-Size Dictating Machine

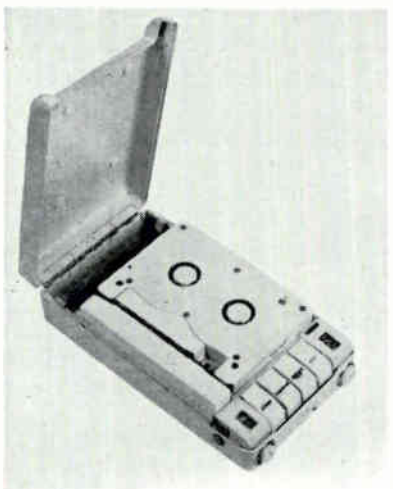
By L. HANNEMANN,
Protona, GmbH. Hamburg, Germany

MINIATURE six-transistor tape recorder from West Germany features a two-track tape magazine and transistorized voltage regulators. A tape speed of $1\frac{7}{8}$ inches a second allows a maximum recording time of 30 minutes a track. After recording one track, the magazine is turned over to record the second track.

The amplifier is a three-stage resistance-coupled design. A variable negative a-c feedback from the output transformer to the emitter of second-stage transistor Q_2 increases the linearity of the amplifier characteristic, and at the same time the amplification is adjusted to the rated value of 74 db. Negative d-c feedback from the emitter of Q_3 to the base of Q_2 stabilizes the operating point and provides a high output-stage amplification.

During recording, the record-playback head receives a 34-Kc bias through a 300-pF capacitor from the erase head, which is located in the resonant circuit of high-frequency generator Q_4. To avoid distortion the high-frequency bias is kept from the amplifier by a filter consisting of capacitor C_1 inductor L_1 and resistor R_1.

Amplifier voltage is regulated by transistor Q_5 and a Zener diode. Transistor Q_6 acts as an on-off switch for the recorder. Frequency response of the recorder is 250 to 4,500 cps at 3 db down.



Battery-operated recorder weighs 2 lb and measures $3\frac{5}{16} \times 6\frac{11}{16} \times 1\frac{9}{16}$

The tape magazine of the Minifon Attache can be removed at any time without the tape having to be rewound. A three-digit counter with reset wheel locates any spot on the tape. When dictation has been interrupted, a slight pressure on the rewind key will repeat the last syllables of the previous recording. The microphone can be used as an earphone. Fast forward and rewind speed is 56 inches a second.

Metallic coating at both ends of the tape stops the motor and lights red lamps in the recorder and at the microphone. The motor is restarted by depressing a pushbutton control, which closes a momentary switch in the motor control circuit to override the end-of-tape cutout. A start-stop control on the microphone closes the battery circuit, and must be in the start position for the recorder pushbutton controls to operate. When an earphone or other listening accessory is connected to the input-output socket, pins 6 and 7 are shorted to close the battery circuit.

Improved Communications Using

When communication is difficult or impossible over the great-circle Article describes instrumentation for research into the propagation phe

By R. T. WOLFRAM,
Research Engr., Communication Group, Stanford Research Inst., Menlo Park, Cal.

WITH MORE AND MORE communication channels crowding the radio spectrum, engineers and scientists are reexamining many neglected propagation phenomena. Among them is the phenomenon of non-great-circle propagation. Non-great-circle propagation is basically multihop, ionospheric radio propagation along paths other than the great-circle between transmitting and receiving stations. The mechanism responsible for this phenomenon is the scattering of radio energy in many directions from the earth's surface that follows reflection of this energy by the ionosphere.

This article describes a radio sounding system for studying the characteristics of non-great-circle propagation and gives the results obtained. The sounder system consists of a radio transmitting station operating at Bozeman, Montana, and a receiving station at Palo Alto, California. The antennas at the two stations were programmed to scan all possible propagation paths in a five-minute period. The equipment has been named the pinwheel sounder because of the scanning pattern of the antennas.

The transmitting station at Bozeman was operated by personnel of the Electronics Research Laboratory at Montana State College. Figure 1A shows the relative positions of the transmitting station and the receiving station. A 32.98-Mc carrier was frequency modulated with a 500-cps tone. Frequency modulation was chosen because it was easy to apply to the transmitter and afforded a measure of interference rejection. It was desired to limit the receiver bandwidth to approximately 3 Kc. Thus a deviation of 1 Kc and a modulating frequency of 500-cps were chosen. The 500-cps modulating signal also simplified the operation of the signal presentation unit at the receiving station. The signal was amplified by a 1.5-Kw power amplifier and fed to a three-element Yagi antenna. The antenna was mounted approximately one wavelength above ground on a motor-driven rotating mechanism. A rotating joint coupled the coaxial transmission line to the antenna. The mechanism was rotatable on command at 0.2 rpm. The measured horizontal radiation pattern of the antenna is shown in Fig. 1B. The vertical pattern was not measured but the approximate theoretical pattern is shown in Fig. 1C.

Operation of the transmitter and antenna drive mechanisms was programmed by an electrical timing unit. Every half-hour the timing unit would start the transmitter and the antenna drive mechanism, allow the antenna to make one revolution, and then stop both units. The antenna was started and stopped each time at an azimuth of 180 deg (true bearing). The timing unit used a 1-rpm synchronous motor for a timing standard. An electromagnetic counter, energized once each minute by a switch actuated by the 1-rpm motor, counted the 30-minute intervals between the start of successive operating periods.

A switch, actuated by a lobe on the antenna support shaft, was used to stop the antenna. The timing unit was synchronized with WWV once a day.

The receiving station was located in the S.R.I. field site area at Palo Alto. The equipment consisted of a three-element Yagi antenna and drive mechanism, antenna-drive

SIGNIFICANCE OF NON-GREAT-CIRCLE PROPAGATION

In the research described in this article, groundscatter propagation produced consistent signals that had sufficient strengths to support a number of communication channels. This suggests systematically using groundscatter propagation to improve communication systems. Substituting antenna-azimuth variation for channel switching could reduce frequency-channel requirements or the need for increased transmitter power where these methods are used to maintain communication over a great-circle path. Even when the great-circle path is useful, having other paths available may help reduce the effects of interference.

Groundscatter propagation may cause serious errors in the results obtained from radio direction-finding equipment in the h-f band.

Although valuable data have been obtained, more extensive investigation and experimentation will be required before the phenomenon can be used effectively. Observations for longer periods on different frequencies, investigation of the fine structure of the received signals and operation of experimental communication links to determine realizable information capacities and develop operating techniques will be required

Groundscatter Propagation

path between two stations, it may be feasible over non-great-circle paths. nomenon which creates these paths and gives results of investigations

timing unit, radio preamplifier, receiver, demodulator, signal strobe generating unit, unblanking generator, and cro display and recording unit. The antenna and drive mechanisms were identical to those at the transmitting station except that the receiving antenna rotated at 2 rpm, ten times as fast as the transmitting antenna.

Every half hour, at the start of each five-minute operating period, the antenna-drive timing unit would start the antenna, allow it to rotate ten revolutions, and stop it at the starting position (0 deg true bearing). Two antenna-actuated pressure-operated switches were used for control; one energized an electromagnetic counter, and the other stopped the antenna. The timing unit also controlled the recording camera and the clock lights. The signals received by the antenna are fed to a low-noise preamplifier and crystal-controlled converter (Fig. 2A). The 10.7-Mc converter-output signal is then fed to a receiver (Collins Model 51J4) which has a 3-Kc wide mechanical filter in the i-f amplifier. The 500-Kc i-f output from the receiver feeds the f-m demodulator. This unit consists of a 500-Kc i-f amplifier stage, f-m discriminator, audio amplifier and synchro driver. The 500-Kc input signal is amplified and demodulated by the discriminator. The 500-cps output from the discriminator is then amplified and applied to the synchro driver. The driver's output now goes to synchro-generator and unblanking circuits which reproduce it on a cro ppi display. The displayed signal, whose length from cro center to cro edge is proportional to signal strength, rotates in synchronism with the Bozeman antenna.

The synchro generator (type 5G) is so geared to the antenna drive, that it rotates at one-tenth the

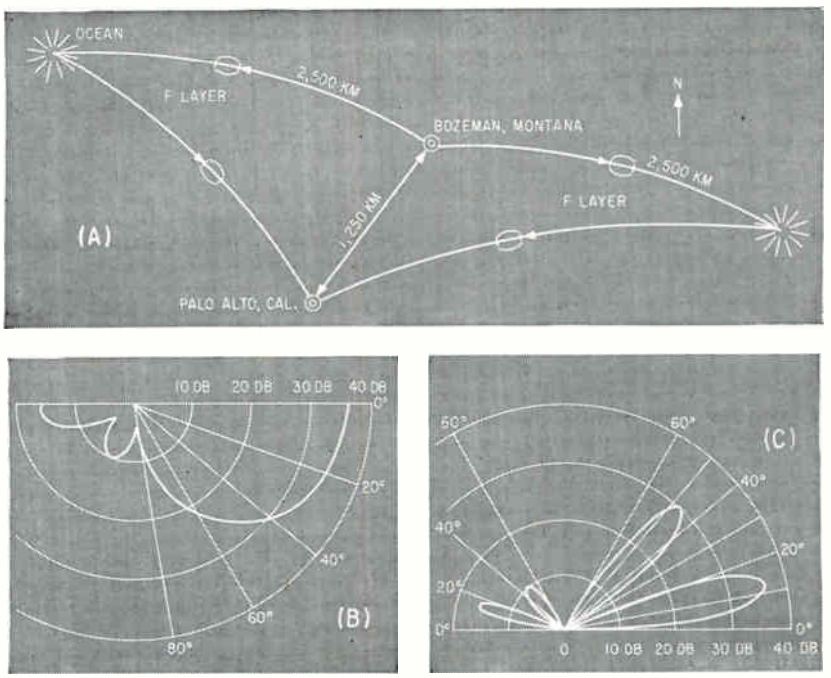
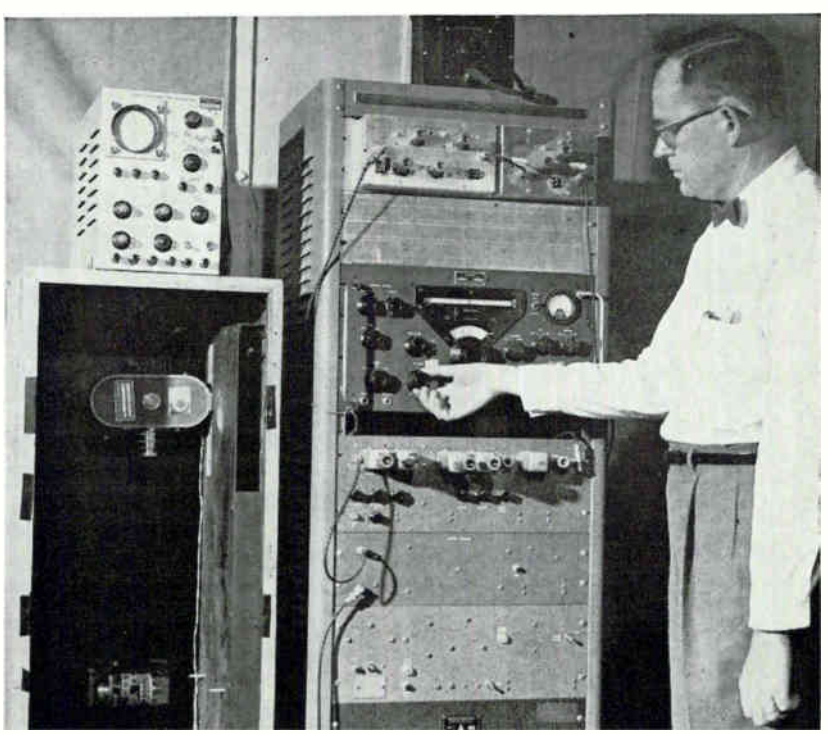


FIG. 1—Great-circle and non-great-circle paths between Bozeman transmitter and Palo Alto receiver (A). Half of symmetrical horizontal antenna pattern of transmitter (B) and its vertical antenna pattern (C)

Author adjusts the Palo Alto receiver. The cabinet at the left, whose cover has been removed, houses cro display and recording camera



speed of the receiving antenna (that is, it rotates at the speed of the Bozeman transmitting antenna). The synchro driver circuit in the f-m demodulator unit is a cathode follower having a low output impedance. The circuit feeds the 500-cps audio signal to the rotor of the synchro generator. The 60-cps synchro generator operated well at 500 cps. The rotor of the synchro is resonated to 500 cps with a capacitor, resulting in a tuned filter having a 3-db bandwidth of approximately 50 cps. This narrow bandwidth minimizes interference.

The 500-cps signals induced in the stator windings of the synchro are amplitude modulated by rotation of the rotor (Fig. 5). The signal across any two stator terminals varies from zero to a maximum and then to zero again as the rotor is rotated 180 deg, the signal amplitude being proportional to the sine of the angle of rotation from the position of zero output. Two maximums and two zeros will thus occur during one complete revolution of the synchro rotor. However, every 180 deg of rotation at each zero crossing the stator signal shifts in phase by 180 deg with respect to the rotor signal. This phase shift can be used to differentiate between the two 180-deg rotation sectors. The modulation envelope of the signal from any pair of stator terminals is 120 deg out of phase with the envelope from the other two signals. That is, the three positions of the rotor which induce maximum amplitude, in-phase, 500-cps signals across each of the three pair-combinations of stator terminals are 120 deg of rotation apart. Therefore the three modulation envelopes are a set of three-phase sine-wave signals.

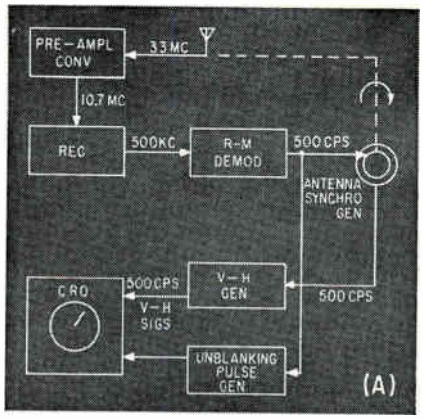
To generate a rotating strobe on the cathode-ray-tube a set of two-phase envelope signals is required. The V-H generator (Fig. 2B) converts the three-phase signals to a set of two-phase signals. One of these signals is applied to the vertical deflection plates and the other to the horizontal plates of the cro, producing a rotating line through the center of the cro tube. The length of the line is proportional to the amplitude of the 500-cps signal applied to the synchro rotor. Without the unblanking pulse generator, this rotating line would extend from the center in equal and opposite directions. The unblanking pulse generator unblanks the cro during every other half-cycle of the 500-cps signal. Because the line on the tube face is the 500-cps signal sweeping back and forth, half of the line, outwards from the center, is blanked out.

A schematic of the unblanking pulse generator is shown in Fig. 2C. The unblanking signal is produced by repeated amplifying and clipping of the 500-cps signal from the synchro driver. The square wave output is applied to the control grid of the display crt. The balancing controls are adjusted for a symmetrical square wave to ensure that the unblanked strobe line will start from the center of the crt face. Sufficient amplification is used so that an unblanking pulse of adequate amplitude is generated by all signals exceeding the noise level.

The phase controls shown in Fig. 2B compensate for differences in 500-cps phase shift in the vertical and horizontal channels of the V-H generator. They are adjusted for an in-phase condition between the vertical and horizontal output signals. This ensures that the strobe is a line rather than a half ellipse. Thus, a strobe line has a length proportional to the received signal strength and, when properly calibrated, a bearing equal to the bearing of the Bozeman antenna.

The cosmic antenna noise averaged 12 db above the 50-ohm receiver noise. Receiver gain was set for a noise level of 4 mv at the input to the f-m demodulator unit. Full deflection of the strobe line from the center to the edge of the crt required a 500-cps voltage at the synchro rotor of 15 v rms. The voltage level of the frequency-modulated r-f input signal to the f-m demodulator unit is approximately 1/20 of the level of the 500-cps output signal to the synchro rotor. An r-f input signal to the f-m demodulator of 15/20 = 0.75 v rms (750 mv) is required for full deflection. The signal-to-noise voltage ratio corresponding to full deflection of the strobe line on the crt face is then equal to 750/4, or approximately 45 db (3-Kc bandwidth); one-half of full deflection corresponds to a s/n ratio of 39 db.

The cro was mounted in a light-



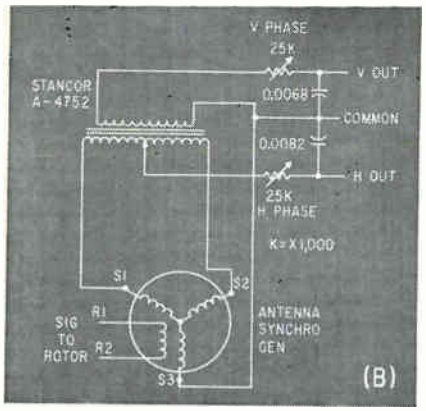
tight box with a modified movie camera. The camera was modified by coupling a Ledex rotary actuator to the film-advance sprocket and shutter mechanism so that energizing the actuator once opens the shutter and energizing it a second time closes the shutter and advances the film one frame.

On the hour or half-hour, the timing unit starts the antenna drive motor, connects the unblanking signal to the grid of the display crt, and energizes the camera control circuit. The camera control energizes the actuator for approximately one second, thus opening the camera shutter. At the end of the five-minute operating period the timing unit stops the antenna drive motor, disconnects the unblanking signal, and deenergizes the camera control. This causes the actuator again to be energized, closing the shutter and advancing the film.

During August and September, observations were made for 17 days. Equipment was on 24 hours a day, except for time off for film-changing and malfunctioning.

Signals propagated over the great-circle path, the strength of ing 4 days, covering a total time of 7½ hours. Signals were recorded during 5 days, covering a total time of 18½ hours, at antenna bearings which indicated the occurrence of a non-great-circle propagation path east of the stations. During October, observations were made during 22 days. Great-circle propagation was negligible, but numerous instances of non-great-circle propagation were recorded.

The histograms in Fig. 3A and B show the distribution of October 1959 occurrences of the two non-great-circle propagation paths. This data is based on two five-minute observing periods an hour and as-



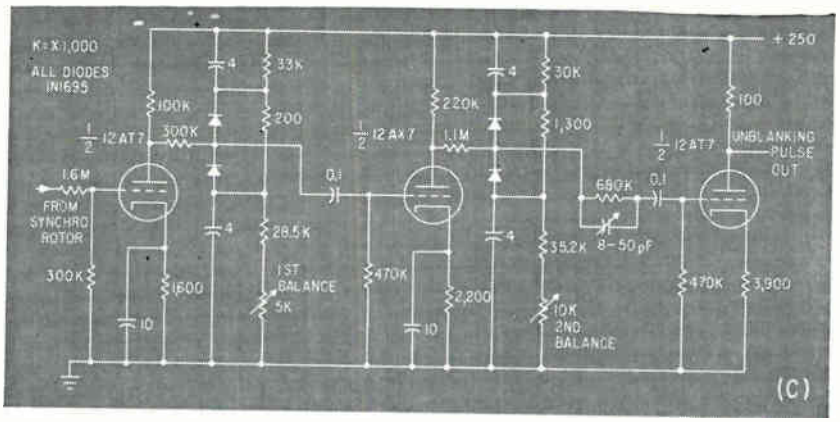


FIG. 2—Strobe length seen on receiver's cro varies with signal strength (A). The V-H generator produces vertical and horizontal drives to cro (B). Unblanking pulse generator (C)

sumes relatively constant propagation conditions between the observing periods. Although the majority of the occurrences of the two paths lasted throughout most of the daylight hours of the days on which they were recorded, when these paths were observed only during part of the day the eastern path occurred during the morning hours and the northwestern path occurred during the afternoon and evening hours. The average on-path signal level of the recorded signals propagated over the two paths during the five-minute observing periods was approximately 40 db above the ambient noise level.

Examples of the three signal paths as presented on the pinwheel-sounder display are shown in Fig. 4. An azimuth overlay referenced to true north has been superimposed on the display photographs to determine antenna bearings for the signals received. The signal strobe line on the cro rotates one revolution during each five-minute operating period, in synchronism with the Bozeman antenna. The outer azimuth circle is labeled from 0 to 360 deg and determines the Bozeman antenna bearing. Since the Palo Alto antenna rotates ten times during each five-minute operating period, the inner azimuth circle is labeled from 0 to 360 degrees over each 36-degree segment of the outer circle; therefore the inner circle can determine the bearing of the Palo Alto antenna for any signal strobe on the display.

Because the antenna at the Bozeman transmitting station has a relatively wide beamwidth (56 deg) a number of signal strobes 36 deg apart will appear on the display even when only one propagation path is involved. The amplitude of any one of the strobes will be de-

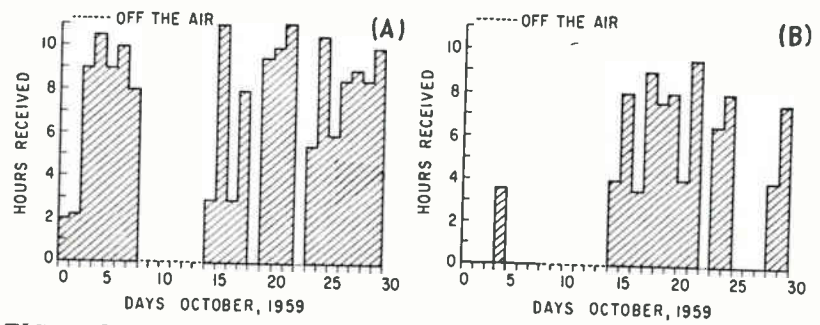
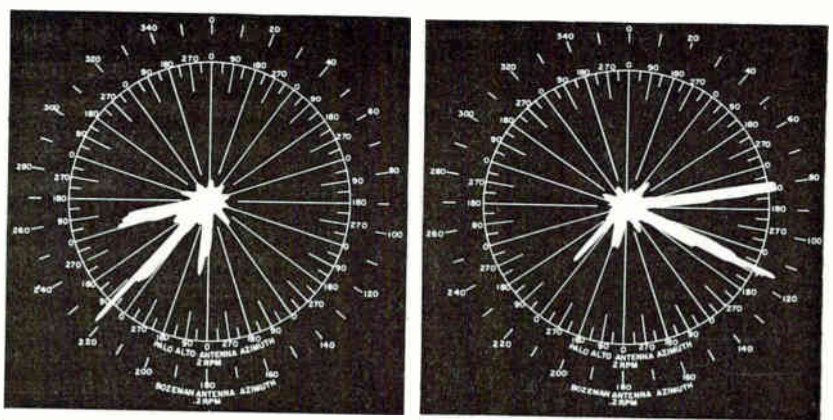
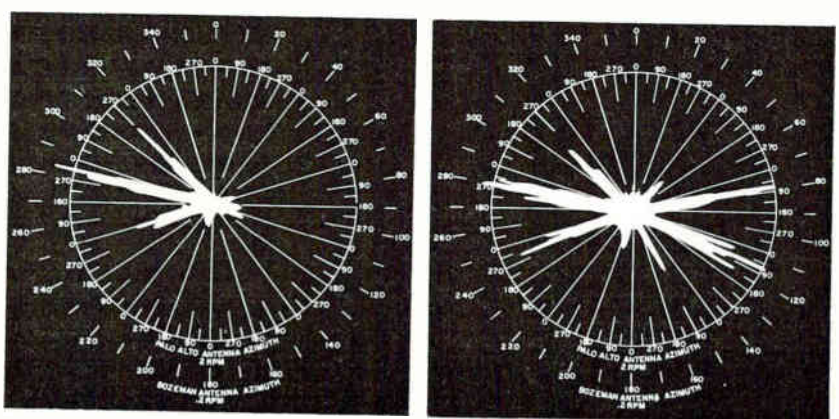


FIG. 3—Hours of reception of 33-Mc signals above 20-db over the eastern path (A) and of 33-Mc signals above 20-db over western path (B)



(A) 1 SEPT. 1959, 1930 PST

(B) 27 OCT. 1959, 0900 PST



(C) 16 OCT. 1959, 1700 PST

(D) 26 OCT. 1959, 1130 PST

FIG. 4—For 33-Mc transmission, (A) shows great-circle path, (B) an eastern path, (C) a western path, (D) simultaneous east and west paths

termined by the amplitude of that section of the Bozeman antenna pattern directed towards the propagation path while the Palo Alto antenna is scanning across that path, and by the path losses between the two antennas. If it is assumed that the path losses are constant during the scanning period, then the peaks of the signal strobes will outline the Bozeman pattern. The direction of the maximum point of this outline on the outer azimuth circle will then indicate the Bozeman antenna bearing for that propagation path. Each strobe will be a representation of the Palo Alto antenna pattern but compressed in width by one-tenth. The direction of any one of the signal strobes on the inner azimuth circle will indicate the Palo Alto antenna bearing for the propagation path. Maximum deflection of the strobe line, corresponding to a signal-to-noise ratio of 45 db is indicated approximately on the display photographs in Fig. 4 by the 0.2 rpm designation.

An example of great-circle propagation is shown in Fig. 4A. At Palo Alto, the Bozeman bearing is approximately 40 deg. At Bozeman, the Palo Alto bearing is 228 deg. If an outline is mentally drawn around the peaks of the signal strobes the maximum amplitude point on the outline will be directed along a bearing of approximately 228 deg on the outer azimuth circle. This then is the bearing of the Bozeman antenna for the signal path displayed as shown in Fig. 4A. The center of each of the three predominant signal strobes is directed along a bearing of approximately 40 deg on the inner azimuth circle. This is the bearing of the Palo Alto antenna for the signal path of Fig. 4A. The s/n of the center (on-path) signal strobe is approximately 43 db.

Examples of non-great-circle propagation are shown in Fig. 4B, C, and D. The experimental observations show the frequent occurrence of propagation of 33-Mc radio signals over non-great-circle paths from Bozeman to Palo Alto. The antenna bearings show that these signals were propagated primarily over two paths, one involving a ground reflection area approximately 2,500 Km east of the stations, and the other involving a reflection area approximately the same distance northwest of the stations. The distances and the maximum useable frequencies in the areas during the observing periods make it probable that the signals were propagated by two two-hop paths, each path involving two F-layer reflections and one ground reflection as diagrammed in Fig. 1.

For a given path length, when the operating frequency coincides with the maximum useable frequency (muf) for the path, the received signal intensity is a maximum because of the focusing effect in the ionosphere. If the operating frequency is fixed, the path length required for maximum field intensity will depend upon the muf. As the muf decreases from that required to propagate over the great-circle path the optimum path length increases, and longer, non-great-circle, paths must be used. For a two-hop path to be observed, each non-great-circle F-hop of the path must have a path-length corresponding to the antenna radiation angle—approximately 2,500 Km for a 12-deg radiation angle—and also must have at its midpoint an muf of approximately the operating frequency, 33 Mc.

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(3) C. F. Edwards and K. G. Jansky, Measurements of the Delay and Direction of Arrival of Echoes from Near-by Short-Wave Transmitters, *Proc IRE* 29, p 322, 1941.

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HISTORY OF EFFORTS AT NON-GREAT-CIRCLE PROPAGATION

Scientists and eperimenters have long been aware of radio propagation over paths other than the great-circle path between stations. In 1928 Taylor and Young[1] described studies of h-f radio propagation in which non-great-circle propagation paths were observed. The mechanism of groundscatter was even then proposed as a possible explanation for the phenomenon, although it was not until twenty years later that this theory was generally accepted.

In 1939 Feldman[2] reported on tests between London and New York on 5 to 15 Mc, using steerable antenna arrays, and told of numerous instances of received signal bearing deviations up to 80 degrees off the great-circle path. It was noted that voice communication was satisfactory during much of the non-great-circle propagation. In 1941 Edwards and Jansky[3] discussed reception of 10 to 20 Mc pulse transmissions over multihop groundscatter paths, at a point 50 Km from the transmitter.

In 1955 Mitchell[4] reported on the communication capabilities of ground-scattered propagation, describing experimental observations of non-great-circle propagation and discussing methods of establishing communication circuits. In 1956 Hedlund, Edwards and Whitcraft[5] reported on groundscatter experiments in which backscatter sounders were used to verify non-great-circle propagation paths, and successful voice communication was carried out over such paths. Amateur radio operators have also reported successful communications over non-great-circle paths. Throughout the 1950's Japanese workers, notably Miya, Kanaya and Ishikawa,[6,7,8] made observations and studies of groundscatter effects on long distance h-f propagation. Large bearing deviations were observed on the London-Tokyo, Hawaii-Tokyo, and other communication circuits, and a new method of propagation prediction was devised that included the effects of non-great-circle propagation. These reports indicated the possible importance of this phenomenon, and stimulated interest in conducting systematic investigation

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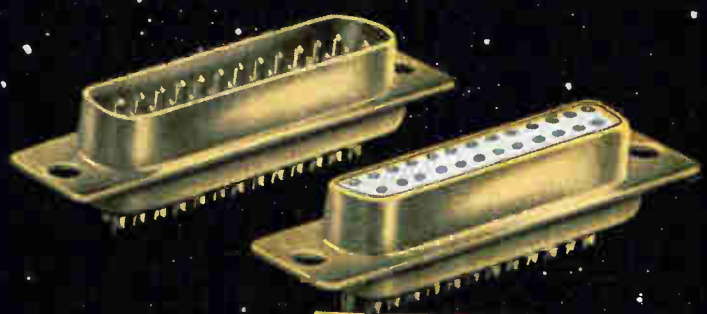

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How to Design Silicon Diode AND Gates

Factors in the design of silicon diode AND *gates are discussed and a chart is presented for quick determination of gate load resistor to obtain a given threshold voltage. The chart will indicate whether a given threshold voltage can be obtained at all; if it cannot, a more complex circuit will in general be required*

By FREDERICK E. KIRKLAND, Western Electric Co., Winston-Salem, North Carolina

PRINCIPAL factors in AND gate design are input or source loading, threshold voltage and the loading effect of the output load on the gate. Both input and output loading are undesirable and the gate must be designed to minimize these effects. Threshold voltage is the output of the circuit when the gate is closed; ideally, threshold voltage would be zero but practical circuits of the simplest type will have a threshold of a few volts. The characteristics of the circuit being driven determine what threshold is allowable in a given application.

Silicon diodes are used in many AND gates because they are reliable, have fast switching action and low capacitance. A typical silicon diode begins to conduct when the voltage across it reaches about 0.3 volt and is essentially in full conduction at 0.5 volt, as shown in Fig. 1A. Although diode voltage drop remains approximately constant as current increases, the constant drop sets a lower limit on gate threshold voltage.

Design techniques will be illustrated by an example. Figure 1B shows a three-legged AND gate for which the components are to

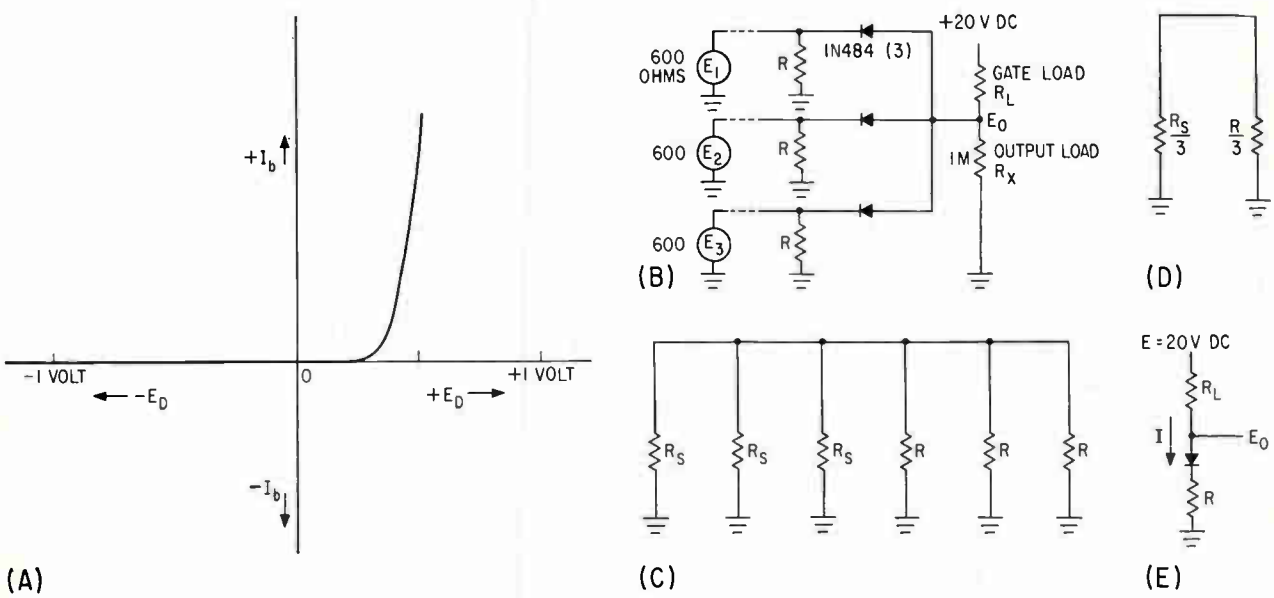
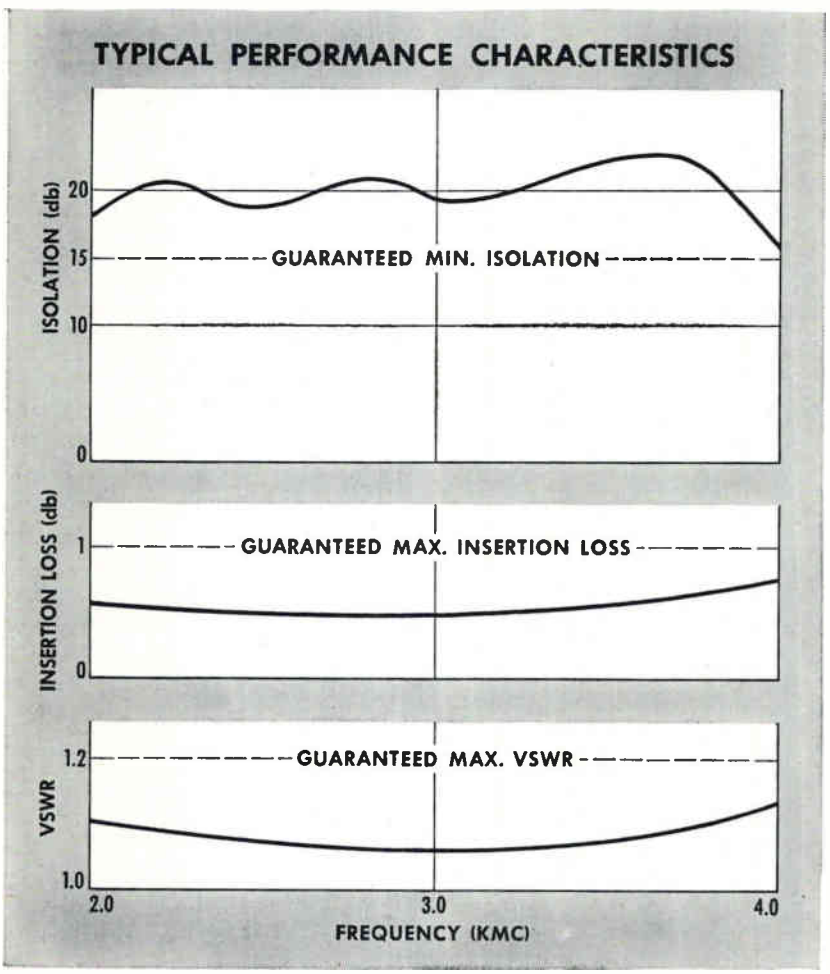


FIG. 1—Typical silicon diode characteristic (A); basic three-branch diode AND *gate (B). Simplified schematics (C), (D) and (E) are discussed in the text*

Microwave Component News from SYLVANIA

Octave Bandwidth Coaxial Isolators from 1-11 kmc



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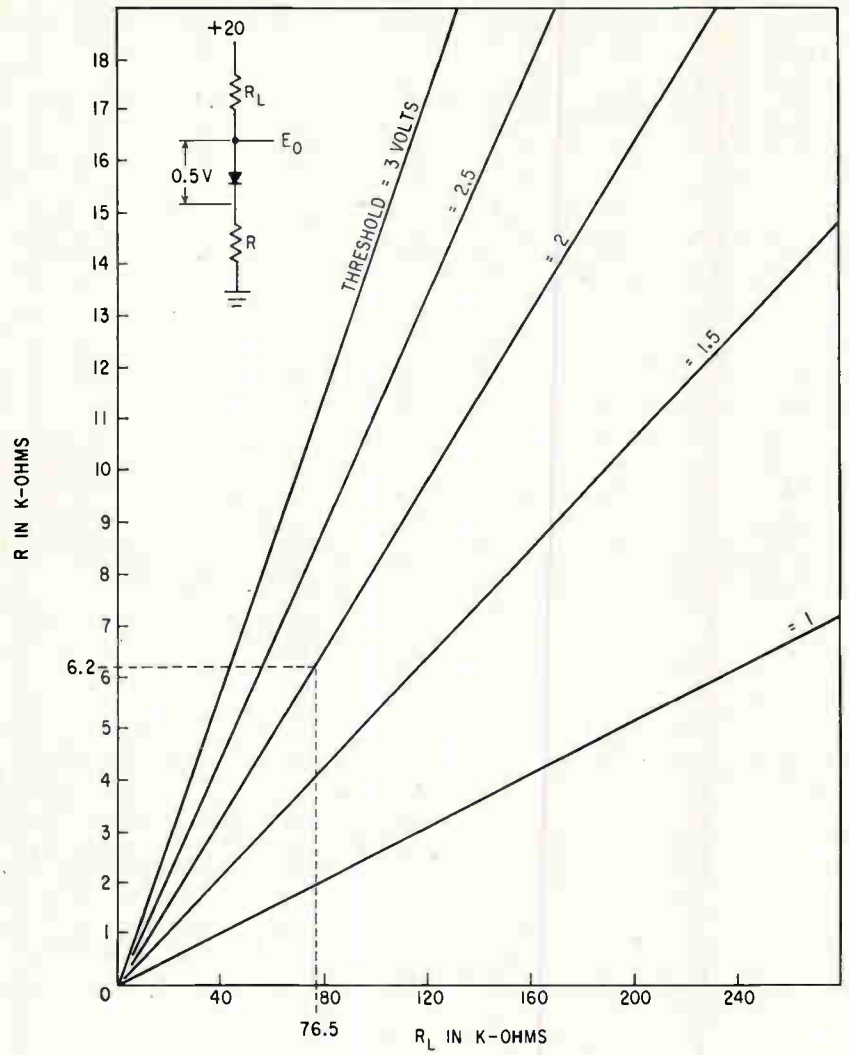


FIG. 2—In the example discussed in the text, R was found by calculation to be 6,200 ohms. From this value of R and the given threshold voltage, R_L is determined

be specified. Each of the three input branches has a source impedance of 600 ohms. Each source will furnish a positive square-wave input pulse of 20 volts amplitude and 100 microseconds width at a pulse repetition rate of 1,000 pps. The output load of one megohm must not distort the AND gate output and maximum threshold voltage is to be +2 volts. Similarly, the AND gate is not to load the pulse sources.

The gate is open when all three driving pulses are present. For this condition, the diodes block the input signals and the major part of the gate supply voltage is delivered to the load. If only two inputs are present, gate supply voltage feeds through the unblocked diode and through its associated resistor R to ground. Resistor R is much smaller than output load resistor R_L and is essentially a short across it. But resistor R is also much smaller than gate load R_L, with the result that most of the supply voltage appears across R_L and output to the load is close to zero. Output voltage with the gate closed, or threshold voltage, cannot actually be zero because of the finite drop across R and the constant drop across the conducting diode.

When all three diodes are conducting, source impedance and branch resistors are in parallel, as shown in Fig. 1C. Since all the source resistances are equal (600 ohms), all leg or isolating resistors can also be equal and Fig. 1B reduces to Fig. 1D.

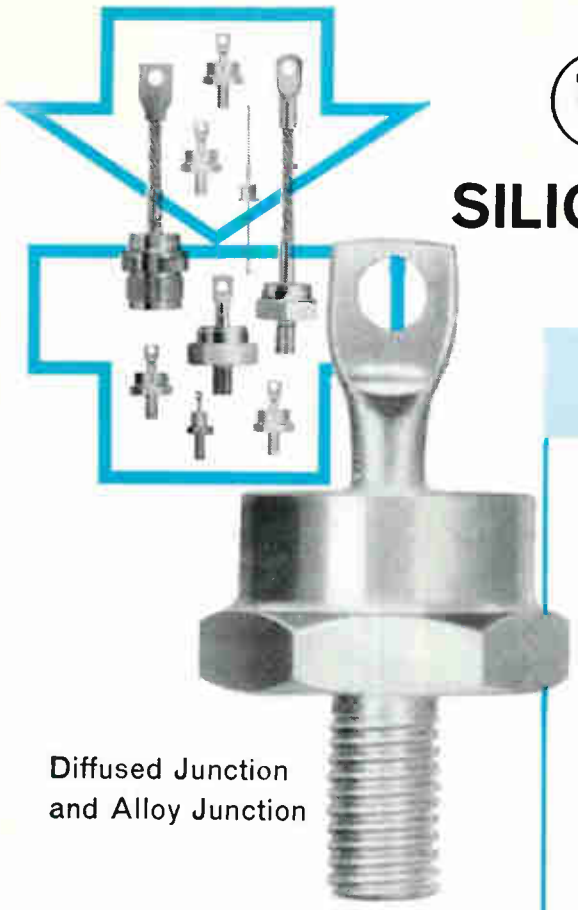
Source loading will be minor if $R/3 \geqq 10\ R_s/3$. This condition is met if $R \geqq 10\ R_s$; thus $R = 10\text{x}600 = 6{,}000$ ohms. The next larger standard resistor of 6,200 ohms is satisfactory.

Maximum threshold voltage occurs when there are input pulses to all diode branches except one. For this condition, only one diode is conducting and output voltages is determined by the voltage divider circuit of Fig. 1E. Voltage drop across the diode is essentially constant and may be considered to be a 0.5 volt battery. Therefore, $E_o \cong ER/(R + R_L) + E_d$. This equation is plotted in Fig. 2 for various threshold values.

The maximum value of threshold voltage in the example is to be +2 volts. The value of R has been calculated to be 6,200. Resistor R_L can be determined from Fig. 2. Find 6,200 ohms on the R scale and go horizontally to the 2-volt threshold curve. Resistor R_L is determined from the horizontal scale and is found to be 76,500 ohms. The next highest standard value is 82,000 ohms, which is satisfactory.

By making R_L large with respect to R, the threshold voltage can be made lower and lower. The limit is set by the output load, which in the example is one megohm. Therefore, the loading effect on the AND gate is negligible for the values found but R_L could not be increased beyond about 100,000 ohms.

Neglecting diode capacitance, output pulse rise time will be approximately $T = 2.2R_LC_o$, where C_o is the output capacitance of the gate. It takes approximately 2.2 time constants for a capacitor to charge from 10 to 90 percent of full charge.



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250- mA 150°C Ambient Temperature	1N538	200	750 mAdc @ 50°C 250 mAdc @ 150°C	250 μAdc	0.5	
	1N540	400	750 mAdc @ 50°C 250 mAdc @ 150°C	250 μAdc	0.5	
	1N547	600	750 mAdc @ 50°C 250 mAdc @ 150°C	250 μAdc	0.5	
1 Amp 150°C Case Temperature	1N253	100	1.0 Adc	100 μAdc	—	
	1N254	200	0.4 Adc	100 μAdc	—	
	1N255	400	0.4 Adc	150 μAdc	1.0 ▲	
	1N256	600	0.2 Adc	250 μAdc	—	
20 Amp 140°C Case Temperature	1N1191	50	20 Adc	5 mAdc	.55 Full cycle avg. 150°C case temp.	250
	1N1192	100	20 Adc	5 mAdc	.55	250
	1N1193	150	20 Adc	5 mAdc	.55	250
	1N1194	200	20 Adc	5 mAdc	.55	250
	1N1195	300	20 Adc	5 mAdc	.55	250
	1N1196	400	20 Adc	5 mAdc	.55	250
	1N1197	500	20 Adc	5 mAdc	.55	250
	1N1198	600	20 Adc	5 mAdc	.55	250
25 Amp 150°C Case Temperature	CS-120Z	50	25 Adc	5 mAdc	.55 Full cycle avg. @ 150°C case temp.	350
	CS-120A	100	25 Adc	5 mAdc	.55	350
	CS-120B	200	25 Adc	5 mAdc	.55	350
	CS-120C	300	25 Adc	5 mAdc	.55	350
	CS-120D	400	25 Adc	5 mAdc	.55	350
	CS-120E	500	25 Adc	5 mAdc	.55	350
	CS-120F	600	25 Adc	5 mAdc	.55	350
35 Amp 140°C Case Temperature	1N1183	50	35 Adc	10 mAdc	0.6 full cycle avg. @ 140°C case temp.	500
	1N1184	100	35 Anc	10 mAdc	0.6	500
	1N1185	150	35 Adc	10 mAdc	0.6	500
	1N1186	200	35 Adc	10 mAdc	0.6	500
	1N1187	300	35 Adc	10 mAdc	0.6	500
	1N1188	400	35 Adc	10 mAdc	0.6	500
	1N1189	500	35 Adc	10 mAdc	0.6	500
	1N1190	600	35 Adc	10 mAdc	0.6	500

	Type	Peak Reverse Voltage (Volts)	Average Forward Current	Maximum Reverse Current*	Fwd. Voltage Drop** (Volts)	Surge Current† (Amps)
50 Amp 150°C Case Temperature	CH116Z	50	50 Adc	20 mAdc	1.1	500
	CH116A	100	50 Adc	20 mAdc	1.1	500
	CH116B	200	50 Adc	20 mAdc	1.1	500
	CH116D	400	50 Adc	20 mAdc	1.1	500
	CH116F	600	50 Adc	20 mAdc	1.1	500
70 Amp 150°C Case Temperature	1N1396	50	70 Adc	15 mAdc	1.3	1500
	1N1397	100	70 Adc	15 mAdc	1.3	1500
	1N1398	150	70 Adc	15 mAdc	1.3	1500
	1N1399	200	70 Adc	15 mAdc	1.3	1500
	1N1400	300	70 Adc	15 mAdc	1.3	1500
	1N1401	400	70 Adc	15 mAdc	1.3	1500
	1N1402	500	70 Adc	15 mAdc	1.3	1500
70 Amp 150°C Case Temperature	CH109Z	50	70 Adc	30 mAdc	1.3	1500
	CH109A	100	70 Adc	30 mAdc	1.3	1500
	CH109B	200	70 Adc	30 mAdc	1.3	1500
	CH109C	300	70 Adc	30 mAdc	1.3	1500
	CH109D	400	70 Adc	30 mAdc	1.3	1500
	CH109E	500	70 Adc	30 mAdc	1.3	1500
80 Amp 150°C Case Temperature	1N1291	50	80 Adc	30 mAdc	1.3	1500
	1N1292	100	80 Adc	30 mAdc	1.3	1500
	1N1293	200	80 Adc	30 mAdc	1.3	1500
	1N1294	400	80 Adc	30 mAdc	1.3	1500

▲ Max. fwd. voltage drop @ 0.5 amp., 25°C case temperature
* Full cycle average for rectifier operating into inductive or resistive load at rated current and voltage
** 50 amp units @ 100 amps D.C. and 25°C;
70 and 80 amp units @ 150 amps D.C. and 25°C
† Max. half sine wave peak current for one cycle @ 60 cps
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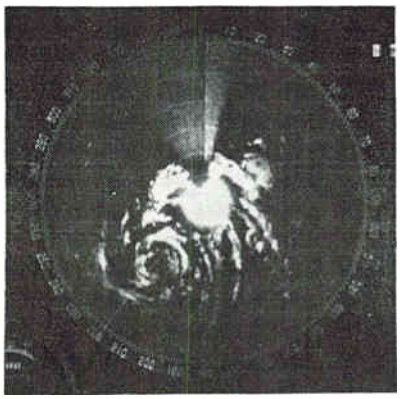
Radar Contours Rainfall Distribution

RAINFALL contouring is provided by a new Japanese weather radar. Distribution of rainfall exceeding predetermined levels is displayed on a PPI. A parametric amplifier used in the receiver reduces noise so that resolution is considerably better than comparable systems with conventional amplifiers. The improved noise figure also permits operation over greater ranges.

The radar installation was completed just before typhoon 16 hit the islands. The system, designed and developed by Toshiba, is located at Muroto on Shikoku Island. It was operated during the big typhoon and forms a part of a complex of weather radar systems used throughout the chain of Japanese islands by the National Meteorological Bureau.

Noise figure of the receiver is said to be only 4 db and bandwidth is 3.2 Mc. The parametric amplifier alone has a noise figure of 2.7 db. The S-band system operates at a signal frequency of 2,740 Mc, and pump power for the parametric amplifier is 110 mw at a frequency of 6,700 Mc.

The single-cavity type parametric amplifier is resonant at both signal frequency and idler frequency. Pump frequency is controlled by a separate knob from that controlling signal frequency to get the correct idler frequency. A variable-capacitance germanium diode is used as the nonlinear reactance element.



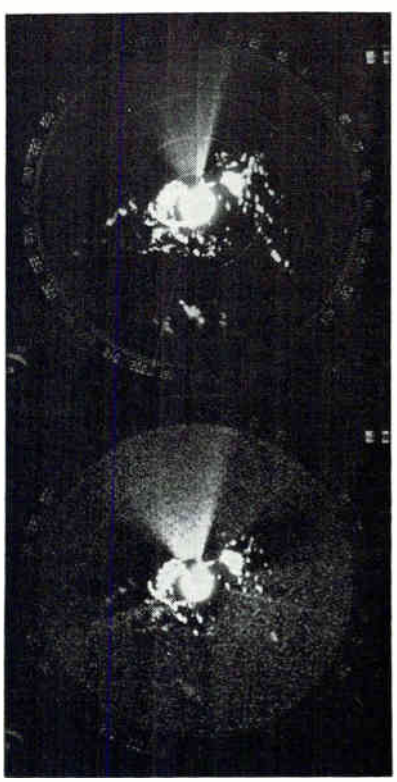
Typhoon 16 in Japan appears on PPI of new weather radar

The ferrite circulator, used to isolate signal input from amplified output, was found to contribute to stability of the amplifier. Insertion loss of the circulator is 0.4 db, while isolation in the reverse direction is 25 db.

The pump circuit is equipped with both agc and afc. These precautions were taken because of the 330-ft separation of the radar and observation room and to offset possible deterioration in performance of the klystron oscillator over a period of time.

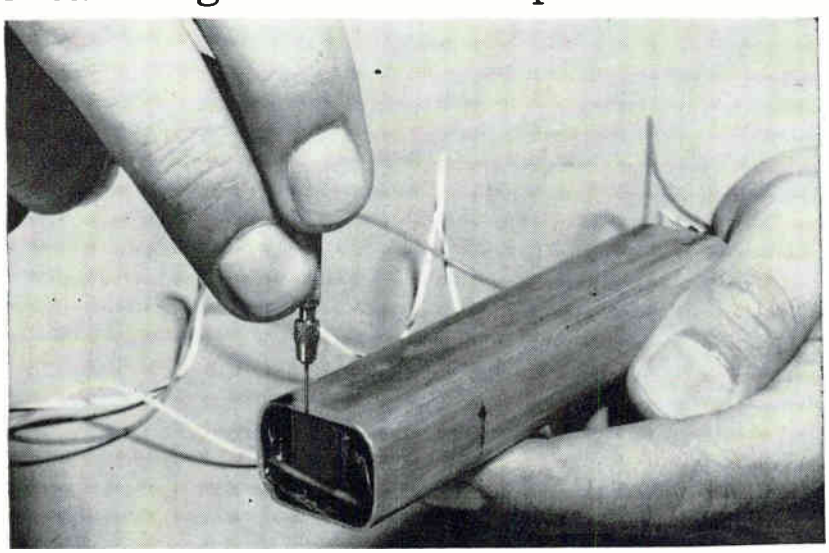
The transmitter using a pulsed magnetron provides 600 Kw peak power output at a pulse repetition frequency of 220 pps and pulse width of 2 microseconds. The antenna, which uses a 13.7-foot aluminum reflector, has a gain of 37 db with a beamwidth of 1.7 degrees. The transmitted beam is scanned in azimuth at an angular velocity of 10 rpm, and beam elevation angle is −2 to 10 degrees.

The radar is capable of operating at a range of 933 miles. However, because of cloud heights and location of the site, a maximum range on the 12-inch PPI of only 249 miles was necessary. The indicator is equipped with counters so that 16-mm photographs of the display



Low-noise performance of radar receiver with parametric amplifier at top is compared with presentation with comparable system at bottom using conventional amplifier

Measuring Radiation in Space Cabins



Silicon radiation detectors with amplifiers were developed by Hughes Aircraft for USAF School of Medicine to telemeter radiation data from simulated crew cabins in high-altitude balloons and ICBM's

(POWER SUPPLY-WISE)
KEPCO'S "SM GROUP" sets a new transistorized design standard

In Performance — These 15 new transistorized voltage regulated power supplies reconcile ruggedness and wide power capability (without mag-amps) with excellent ripple reduction, regulation, and negligible transient response characteristics.

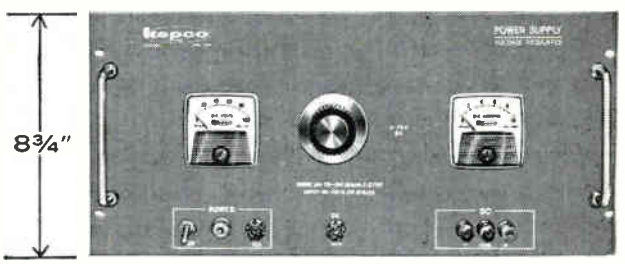
In Reliability — Unique "fail-proof" design inherently protects series "pass" transistors from damaging overloads (dissipation requirements of pass elements actually reduced under high load demand or short circuit).

Size-Wise — New sophisticated circuit simplicity permits greater reduction in size (without "shoehorn" techniques). Five wide voltage ranges, in three panel height groups scaled to popular power requirements. All models standard rack width 19", depth 13".

MODEL	DC OUTPUT VOLTS	DC OUTPUT AMPS.	PANEL HEIGHT
SM 14-30	0-14	0-30	8¾"
SM 36-15	0-36	0-15	
SM 75-8	0-75	0-8	
SM 160-4	0-160	0-4	
SM 325-2	0-325	0-2	
SM 14-15	0-14	0-15	5¼"
SM 36-10	0-36	0-10	
SM 75-5	0-75	0-5	
SM 160-2	0-160	0-2	
SM 325-1	0-325	0-1	
SM 14-7	0-14	0-7	3½"
SM 36-5	0-36	0-5	
SM 75-2	0-75	0-2	
SM 160-1	0-160	0-1	
SM 325-0.5	0-325	0-0.5	

REGULATION: 0.1%*

(RIPPLE: 1 Mv. rms.)



Model SM75-8M

Model SM325-1M

Model SM36-5M

INPUT REQUIREMENTS FOR ALL MODELS: 105-125 VAC, 60±½ cps.

METERS OPTIONAL: Model Nos. listed in table are for unmetered units. To specify metered units, add "M" to Model No. (e.g. SM 14-30M)

***0.01% REGULATION MODELS AVAILABLE ON SPECIAL ORDER.**

FOR DETAILED SPECIFICATIONS ON MORE THAN 150 STANDARD MODEL POWER SUPPLIES SEND FOR KEPCO CATALOG B-601

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would also record time and range. An adapter was also used to photograph the display at 10-second intervals. A microswitch was incorporated in the antenna drive system to synchronize picture taking with antenna rotation.

An iso-echo contour computer indicates rainfall distribution of different intensities on the PPI. Amplification in the receiver is logarithmic and covers a range of 40 db. At each 5-db level throughout the 40-db range, the area is shown at which rainfall is of sufficient intensity to appear on the PPI.

Thermoelectric Cooling Improves Noise Figure

THERMOELECTRIC refrigeration may provide a practical solution to the problem of cooling variable-capacitance parametric amplifiers. Cooling the diode in the parametric amplifier to liquid nitrogen temperature significantly improve noise figure. However, the cooling systems conventionally used for this purpose are much larger than the amplifiers and they require considerable maintenance.

The possibilities of thermoelectric refrigeration were discussed in a paper by M. Uneohara and R. Wolfe of Bell Telephone Laboratories at the recent Electron Devices Meeting, PGED of IRE, in Washington. A thermoelectric refrigerator would operate with limited attention and could readily be built into the amplifier without appreciably increasing over-all dimensions of the package. However, the lowest temperature achieved at Bell so far is about 200 K with a two-stage refrigerator.

Research at the laboratory indicates that excess noise temperature of the diode decreases more rapidly beginning from room temperature than from lower temperatures. Therefore thermoelectric refrigeration might be very useful in applications requiring a modest improvement in noise temperature.

To evaluate this approach to cooling, a two-stage thermoelectric refrigerator was built for a parametric amplifier operating at 6 Gc. The refrigerator was made with

Bi_2Te_3 alloy thermo-elements. With zero load, the refrigerator achieved a temperature difference of 90 C below room temperature.

In the amplifier, excess noise temperature was 170 K at room temperature. When the refrigerator reduced temperature to 235 K, excess noise temperature in the amplifier improved by dropping to 114 K. With the best GaAs or Si diodes and minimum cavity loss, it should be possible to reduce excess noise temperature to a much lower level.

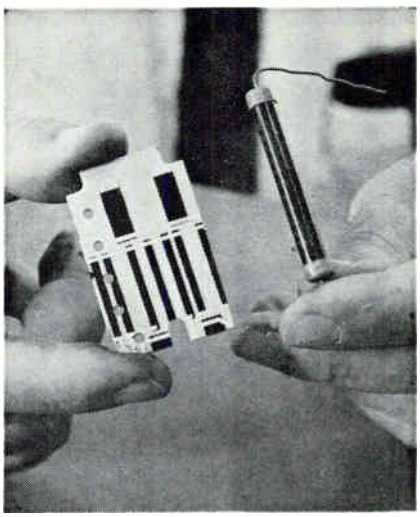
Inside-Chest Heart Stimulator Is Safer

MINIATURIZED heart stimulator can be inserted inside the chest to overcome heart stoppage. Conventional pulse stimulators have been carried externally with platinum leads connected to electrodes inserted in the heart ventrical.

The compact stimulator was announced by physicians at Beth Israel Hospital, Boston, for use on patients suffering from Stokes Adams disease. This illness is characterized by sudden and sometimes fatal heart stoppage resulting from the absence of natural impulses. An artificial heart stimulator to provide the missing natural stimuli was developed in 1952 at Beth Israel by Dr. P. M. Zoll. However, it was carried externally by the patient.

Highly stable silicon transistors helped in designing a package small enough for use internally. However, special mercury batteries wth a shelf life of five years made an internal stimulator feasible. As the batteries begin to run down, the pulse rate of the patient slowly decreases. Surgery is required to replace the batteries, but it is hoped that batteries with even longer life will result from current missile research.

Several advantages accrue from inserting the stimulator inside the chest cavity. Damage or external disturbance to the stimulator or to the leads going in to the heart are much less probable. Leads passing from outside to inside the body also present the danger of infection.



In laboratory demonstration, thin film of resistor composition is applied to ceramic base by stencil screen and squeegee (left). Stencil is removed from ceramic base leaving film of resistor composition ready for firing (center). Uses of new composition include ceramic printed circuits and resistor rods (right) where resistor paste is applied to a ceramic rod, fired and then spiralled to resistance value by a diamond wheel

Resistor Films for Printed Circuits

REACH FOR HIGH TEMPERATURE APPPLICATIONS

NEW RESISTOR COMPOSITIONS, applied on glass or ceramics by firing, have been carefully evaluated and are now being offered on a full production basis.

The resistor compositions, developed by Du Pont, are specially treated powders dispersed in a suitable organic vehicle. They can be applied by dipping, brushing, spraying, or screen printing. The coating is then oven dried for five minutes at 238 to 266 F. Resistance value reproducibility can be achieved by controlling thickness of the resistor film and uniformity of substrate smoothness. The films are relatively insensitive to moisture, abrasion, and to reasonably high ambient temperature (275 F).

The result of a five-year research effort, the new compositions are available in three resistance values: 500; 3,500; and 10,000 ohms/sq. per mil thick film. The film can be blended to obtain intermediate values.

The designer is no longer limited by the physical shape of resistor materials. The resistor now can be fitted to the circuit by varying composition, which should be particularly useful in miniature circuits.

Electrical properties are reproducible, and tests show that fired printed patterns and coated rods have abrasion and impact resistance similar to fired silver coatings.

Characteristics of resistor compositions are shown in the table below:

Resistor Film Characteristics

Temp. coeff...	±350 ppm/C. from −55C. to +125C.
Voltage coeff..	less than .02%/v neg.
Humidity exposure...	±1% change after 250 hrs. @ 95% relative humid. (unprotected film)
Overload.....	±0.5% change with standard short time overload.
Temp. cycling	±1% change after (5 cyclings from −55C. to +125C.)
Load life.....	±2% change after 1,000 hrs. at 70C. at full load.
High temp. exposure...	resist. increased slowly above 150C.
Dip soldering effects.....	negligible.

Karl A. Williams, manager of DuPont's Ceramic Products Division, said that the resistor composition research program was undertaken to develop resistors based on glass frit and metal powders as a natural complement to their line of silver compositions, which Du Pont has sold to capacitor and electronic component manufacturers for more than 25 years.

Several patents on the resistor compositions have been issued and others are pending. Research is now underway at Du Pont's Perth Amboy, N. J., Ceramics Laboratory to develop compositions with higher and lower resistance values.

At present, screen printing and dipping compositions are being sold in each of the three resistance values at $8 a troy ounce for 100 ounce quantities. Initially, smaller amounts will be available at this price for trial purposes.

A thin film is the ideal physical form for resistors, offers electrical advantages at the higher frequencies, and small size. Desirability of the film approach is evidenced by extensive work devoted to the development of inorganic resistors produced by vacuum-depositing

New from Sarkes Tarzian

HIGH VOLTAGE

Silicon Cartridge Rectifiers

Latest in the growing line of Sarkes Tarzian semiconductor devices are High Voltage Silicon Cartridge Rectifiers in two series. Each series includes 18 different types with operating temperatures ranging from —55°C to 150°C ambient. The units feature low voltage drop and low reverse current.

Ferrule Mounted Series (S-5490 thru S-5507)

This high voltage series is equipped with a ferrule type mounting of silver plated brass and is available in both hermetically sealed glass or phenolic tubing. The units range in sizes from 1 3/16" to 6 1/16", have maximum rectified DC output currents varying from 45 to 100 milliamperes, and peak inverse voltage ranging from 1500 to 16,000 volts.

Axial Lead Series (S-5518 thru S-5535)

This high voltage series is equipped with axial leads, with units ranging in size from ½" to 2½" and lead lengths varying from 1" to 2½". Peak inverse voltage starts at 1000 volts up to 10,000 volts, with maximum RMS input voltage ranging from 420 to 7000 volts. Maximum average rectifying currents at 25 degrees C vary from 70 to 250 MA, and at 100 degrees C, from 25 to 100 MA.

Both series are immediately available in production quantities! For additional information on the new Sarkes Tarzian High Voltage Silicon Cartridge Rectifiers, write Section 5652A.

Sarkes Tarzian is a leading producer of semi-conductor devices in production quantities, including silicon power rectifiers, silicon tube replacement rectifiers, selenium rectifiers, modular silicon rectifiers and zener voltage regulators. Application engineering service is available without cost or obligation.

(FERRULE MOUNTED SERIES)			
Operating Temperature Range—55°C to 150°C Ambient		Max. Ratings Half Wave Res. Load at 75°C Ambient	
JEDEC TYPE	S. T. TYPE	PEAK INVERSE VOLTS	MAX. RECTIFIED DC OUTPUT MA
1N1133	S-5490	1500	75
1N1134	S-5491	1500	100
1N1135	S-5492	1800	65
1N1136	S-5493	1800	85
1N1137	S-5494	2400	50
1N1138	S-5495	2400	60
1N1139	S-5496	3600	65
1N1140	S-5497	3600	65
1N1141	S-5498	4800	60
1N1142	S-5499	4800	50
1N1143	S-5500	6000	50
1N1143A	S-5501	6000	65
1N1144	S-5502	7200	50
1N1145	S-5503	7200	60
1N1146	S-5504	8000	45
1N1147	S-5505	12000	45
1N1148	S-5506	14000	50
1N1149	S-5507	16000	45

When ordering phenolic tubing as a substitute for glass tubing, add the letter "P" to S. T. Type No.

MAXIMUM RATINGS				
Operating Temperature Range —55°C to 150°C Ambient				
JEDEC TYPE	S. T. TYPE	PEAK INVERSE VOLTS	MAX. RMS INPUT VOLTS*	MAX. RECT. DC OUTPUT (MA) @100°C
1N1730	S-5518	1000	700	100
1N1731	S-5519	1500	1050	100
1N1732	S-5520	2000	1400	100
1N1733	S-5521	3000	2100	75
1N1734	S-5522	5000	3500	50
1N2373	S-5523	600	420	100
1N2374	S-5524	1000	700	100
1N2375	S-5525	1500	1050	100
1N2376	S-5526	2000	1400	100
1N2377	S-5527	2400	1680	75
1N2378	S-5528	3000	2100	75
1N2379	S-5529	4000	2800	50
1N2380	S-5530	6000	4200	50
1N2381	S-5531	10000	7000	25
1N2382	S-5532	4000	2800	75
1N2383	S-5533	6000	4200	50
1N2384	S-5534	8000	5600	35
1N2385	S-5535	10000	7000	35

* Derate 50% for capacitive load in half wave circuits.
For capacitive, motor, or battery loads, derate DC current by 20%.

SARKES TARZIAN, INC.

World's Leading Manufacturers of TV and FM Tuners • Closed Circuit TV Systems • Broadcast Equipment • Air Trimmers • FM Radios • Magnetic Recording Tape • Semiconductor Devices

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very thin metallic films on ceramic substrates.

Complete technical information on the resistor compositions is found in Du Pont Electrochemicals Department Bulletin CP 6-860, and in a technical paper by K. H. Ballard, of Du Pont's Perth Amboy, N. J. Division.

Improved Phosphor For Picture Tubes

A NEW PHOSPHOR for television picture tubes which provides production advantages to tube manufacturers and improved quality in finished picture tubes, has been introduced by the Chemical and Metallurgical Division of Sylvania Electric Products Inc. Sylvania is a subsidiary of General Telephone & Electronics Corporation.

David E. Lundy, product sales manager for phosphors and chemicals, said the new phosphor, designated CR407, offers improved rewet adherence qualities which simplify application of the phosphor to the face of the picture tube. He said the phosphor also has improved resistance to contamination from impurity elements during the production process.

Another advantage claimed for the new phosphor, is increased resistance to ion burn which sometimes creates a spot on the face of the picture tube due to constant focusing of the electrons on a small screen area as the set is turned on and off.

Ultra Pure GaAs Offered By Swiss Firm

THE AVAILABILITY of a new grade of ultra pure gallium arsenide suitable for semiconductor devices, is announced by Chimel S. A. a Geneva, a Switzerland firm specializing in the manufacture and sale of electronic chemicals.

The significant properties of the Chimel gallium arsenide are mobilities greater than 4,800 at room temperature and resistivities of 0.005-0.03.

Gallium arsenide is now used experimentally and in limited com-

mercial runs for electronic devices such as transistors, diodes, tunnel diodes, variactor diodes, solar cells and computer diodes.

It is expected that its sales will grow in view of its favorable properties, particularly in high frequency and high temperature applications.

A Chimel market survey indicates that by 1966, between 12 and 16 percent of the world semiconductor material consumption will be accounted for by gallium arsenide.

In addition to supplying polycrystalline and monocrystalline material, Chimel is giving out a limited number of licenses for the manufacture of ultra pure gallium arsenide outside of Switzerland.

Chimel is a leading European supplier of pure silicon in bulk, single crystals and slices.

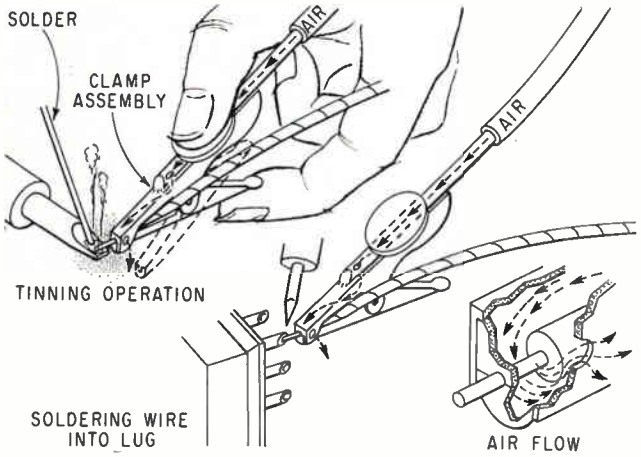
Microwave Oscillator Insensitive to Radiation

PRINCETON, N. J.—RECORD POWER outputs have been reported for a new RCA experimental electron device. Called a tunnel-diode microwave oscillator, the device has been made relatively insensitive to nuclear radiation.

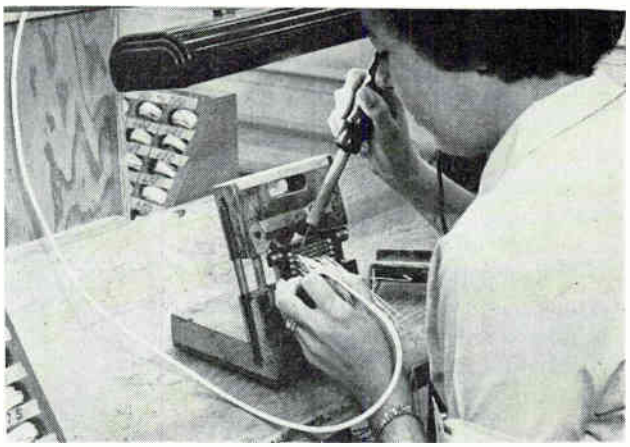
According to Fred Sterzer, an engineer at RCA's Electron Tube Division microwave engineering activity, the oscillator is a new type signal source. It's expected to find extensive use in communications, radar, and telemetering systems operating in radiation areas. It makes possible the generation of low-power microwave signals in a device small in size and light in weight.

Besides being resistant to atomic radiation, rugged, and compact, the oscillator needs very modest power-supply requirements. It can be easily tuned either by mechanical or electrical means.

Sterzer says RCA is working on several tunnel-diode microwave oscillators which operate over the frequency range from 300 to 8000 megacycles. Power outputs of 10 mw have been obtained from these devices at 600 Mc, two milliwatts at 1,600 Mc, 0.7 mw at 2,800 Mc, 0.2 mw at 5,500 Mc, and 0.01 mw at 7,100 Mc.



Details of clamp design and application in tinning and soldering of stranded wire



Clamp is handy for soldering wires in miniature assemblies such as high-density plugs

Air-Cooling Wire Stops Solder Wicking

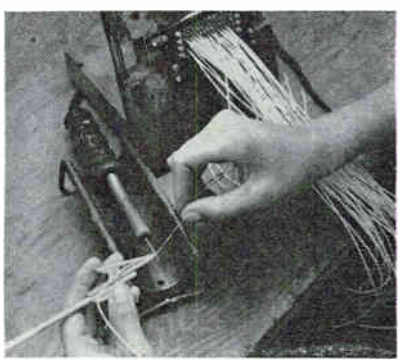
By JOSEPH D. KELLER,
Group Leader, Metallurgical Research, Manufacturing Engineering Department, The Martin Co., Orlando, Fla.

SOLDER WICKING and stiffening of stranded wire can be eliminated by air-cooling the wire as it is tinned and soldered into place. The soldering tool illustrated was designed by the Manufacturing Research and Development Section of this department after tests showed that conventional heat sinks would not reliably prevent wicking.

Wicking occurs when the copper wire reaches the melting point of solder, allowing the solder to flow, by capillary action, toward and under the wire insulation. Wire that has wicked stiffens in the wire lug connection area, detracting from the reliability of the joint and possibly jeopardizing missile performance.

Tests of heat sinks were made in the following manner. Insulation was stripped from ¾ inch of a stranded wire. The heat sink under test was placed in the center of the stripped portion of the wire. A Chromel-Alumel thermocouple was connected on each side of the sink. The wire was tinned with a soldering iron in the usual manner. Temperatures on each side of the sink were plotted.

None of the sinks tested absorbed heat sufficiently to keep wire temperature below the solder's melting point. Wicking frequently occurred. A sink clip with a water-soaked pad was effective in some tests, but posed water corrosion problems.



Air under slight pressure is fed through hose on clamp assembly. Operator is tinning wire before soldering it into connector

Investigations of air-cooling with a slight, steady flow of air indicated this method would be effective, and the air-cooled clamp was built. Wires tinned and soldered with the clamp contained no internal or external wicking. When insulation was peeled away from tinned wires, all strands, including the center strand, were free of solder.

The clamp design allows the air to be in intimate contact with all the wire strands and to exhaust without chilling the solder joint. Since the tool is light, small and flexible, it can be used on miniature assemblies. High-density plugs containing 40 tubular connectors in a square inch can be soldered.

Another advantage of air-cooling is that it maintains the strength of the wire by preventing annealing. Tensile strength is preserved by keeping the wire below recrystallization temperature. The method is used in production of Bullpup, Pershing and Lacrosse missiles.

Monitor Wire Enamel By Capacitance Bridge

CAPACITANCE BRIDGE method of monitoring insulation thickness on enameled wire is being used at a plant in Albertfava, Hungary, according to a report by McGraw-Hill World News, Vienna. The method is said to increase production and quality of wire.

A cylindrical capacitor is formed by passing the wire through a mercury-filled vessel (Fig. 1). The electrodes are the mercury and

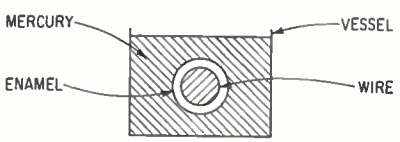
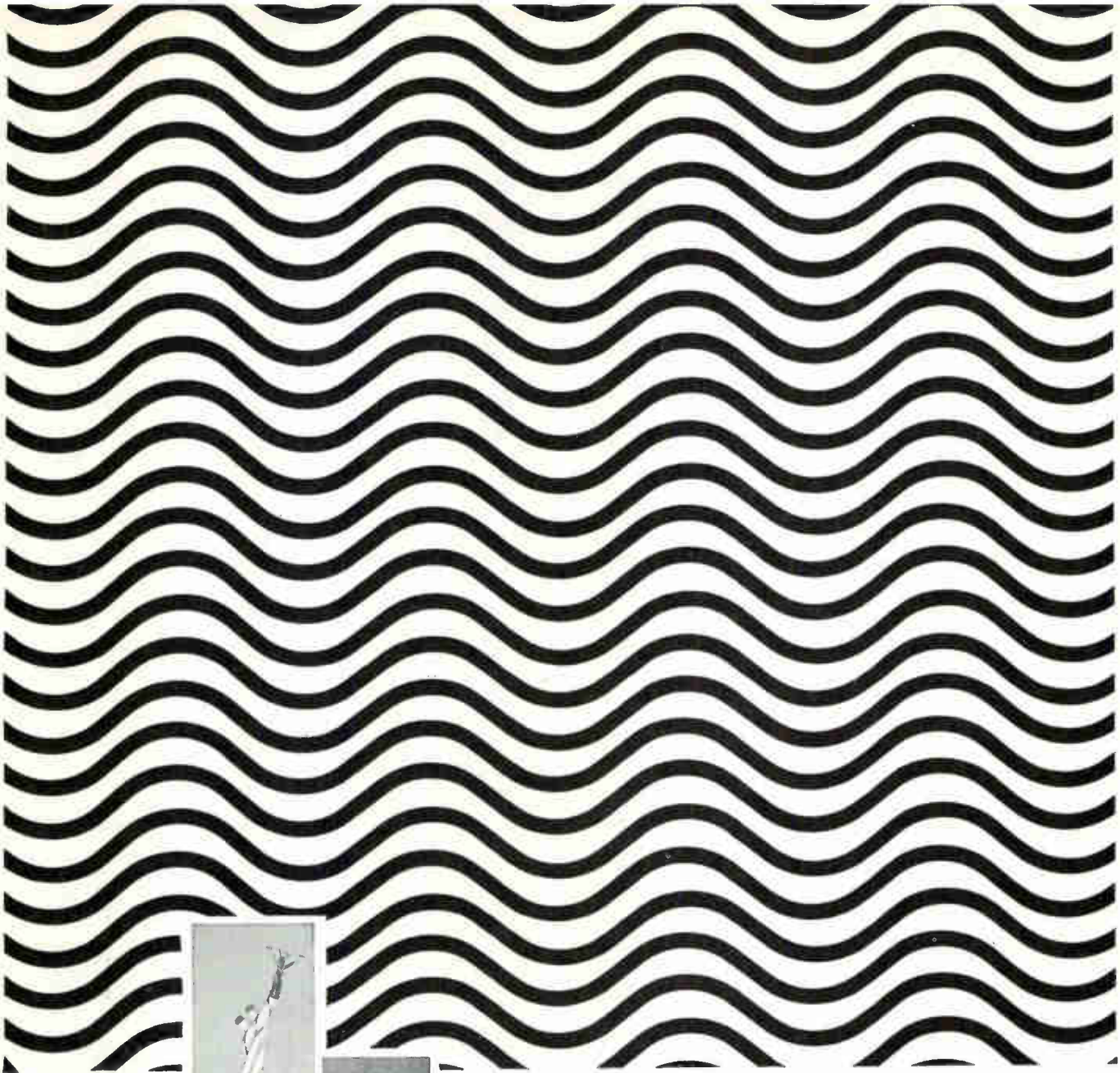


FIG. 1—Capacitor is formed by wire, enamel and mercury



At Hitemp–Quality is not an illusion

The illustration above is a clever art illusion. The illusion of comparable quality that different brands of wire and cable give is also clever. To the naked eye, they seem identical.

Most brands of wire and cable may be produced with similar materials and equipment. One brand, however, will outlast, outperform the others — Hitemp.

The reason? Because Hitemp has the greatest store of experience in the industry—two modern production facilities that are second to none—and more than one-fourth of its entire work force devoted solely to inspection and quality control.

Hitemp products are for you, the wire and cable user who requires quality and reliability that is fact, not illusion.

Hitemp is a Division of Simplex Wire & Cable Co.

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CIRCLE 93 ON READER SERVICE CARD

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wire, while the enamel is the dielectric. The bridge is formed by connecting the mercury, grounded wire, fixed capacitor and variable capacitor to the secondary coil of a differential transformer (Fig. 2). The sum of the enamel's capacitance and the adjusting capacitance equals the fixed capacitance.

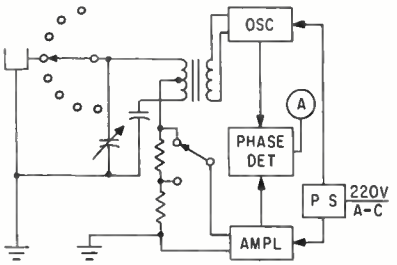


FIG. 2—Original bridge and detector setup

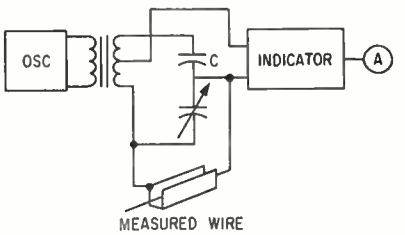


FIG. 3—Simplified version of instrument

The differential transformer is supplied from a transformer in the plate circuit of a phase-shift oscillator generating 800 cps. The oscillator contains a 6AU6 miniature pentode with a 6AQ5 power pentode as an amplifier. The oscillator also supplies reference voltage to the phase detector, which uses a 6AL5 twin diode.

Output voltage of the bridge is indicated on a phase-sensitive vacuum tube voltmeter. The vtvm's reference voltage and the bridge supply both originate in the same power supply, a 6X4 miniature rectifier. The polarity of the d-c output voltage, therefore, corresponds to the direction of enamel thickness deviation. The reading is proportional to the amount of deviation. Scale linearity is provided by a shunt crystal diode or specially-shaped pole shoes on the indicating milliammeter.

If a double enamel layer is measured, the output voltage of the bridge goes directly to the 2-stage amplifier (6AU6). For a single layer, a voltage divider is employed. The selector switch enables the unit to monitor 8 enameling lines.

A simplified version of this in-

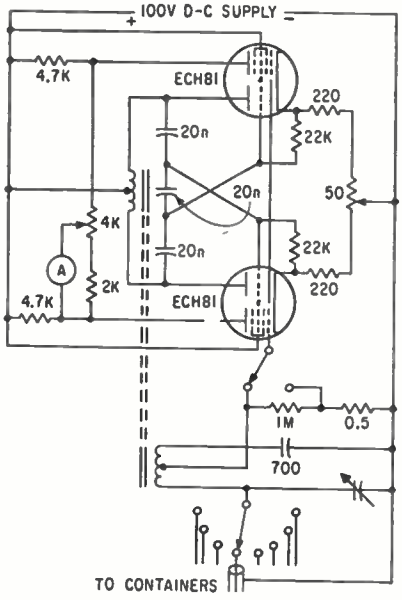


FIG. 4—Circuit uses only 2 mixer tubes

strument has been designed (Fig. 3). Its circuit (Fig. 4) contains a pair of ECH 81 mixer tubes (ed. note: European tube; American type is 6AJ8 receiving triode heptode) in a push-pull oscillator circuit. The mixer grids receive voltages of opposite phases. The plate circuit transformer supplies the differential bridge. The bridge's output voltage controls the joined first grids of the mixers.

Under this arrangement, a capacitance deviation in one direction causes a plate current difference in the opposite direction. The plate circuits of both tubes form a d-c vacuum tube voltmeter. A milliammeter with specially-shaped poles shoes indicates the imbalance.

Details of this instrument were reported in *Hungarian Heavy Industries* by engineers of the Budapest Polytechnicum's Institute for Telecommunications.

Teflon Marker

Compound made by Plastic Associates, Laguna Beach, Calif., produces dark, temperature-resistant carbon film in Teflon surfaces. Squeeze bottle can be used like crayon to make identifying marks or machining guides

New On The Market

Data Processor

BASIC SYSTEM IS EXPANSIBLE

NEW electronic data processing system is a solid-state, low-cost computer expansible from a basic system of limited capacity to a powerful full-scale system. The computer accepts and delivers large volumes of information in all common business-machine media at high speeds.

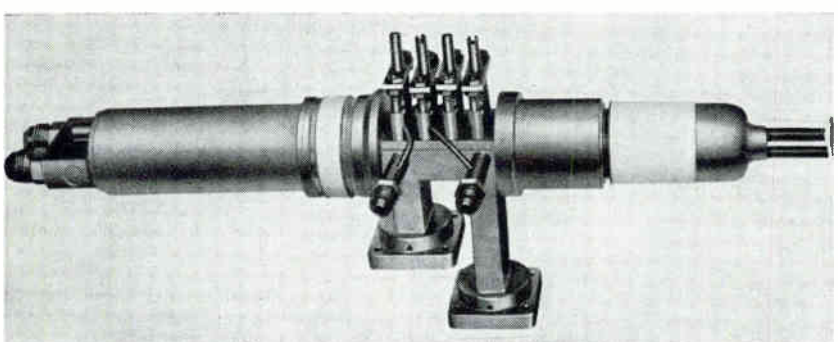
The system may include from one to eight magnetic tape files, with maximum storage of 21 million alpha-numeric characters or 31 million decimal digits.

Input system for the class 315 may include up to four magnetic character sorter-readers, a punched card reader, a paper tape reader and console typewriter as well as the magnetic tape handlers. The output system may include up to four line printers and card punches in any combination, a paper tape punch, the console typewriter and the magnetic tape handlers. Input, output or memory components not incorporated in the original system may be added as required.

To permit maximum efficiency in the use of input and output units (time sharing), the peripheral units can interrupt a program automatically. The sorter-readers, the card punches, the card reader, and the high-speed line printers have the ability to interrupt the main program to demand processor attention when they have completed an operation previously assigned to them. Thus input-output units may be kept running at maximum rate while the processor is performing some other job.

The data processor is being introduced by The National Cash Register Co., S. Main at K. St., Dayton, Ohio.

CIRCLE 301 ON READER SERVICE CARD



Amplifier Klystrons

HIGH C-W POWER AT X-BAND

HIGH c-w band power at X-band frequencies is available in the new VA 849 series of amplifier klystrons by Varian Associates, 611 Hansen Way, Palo Alto, California.

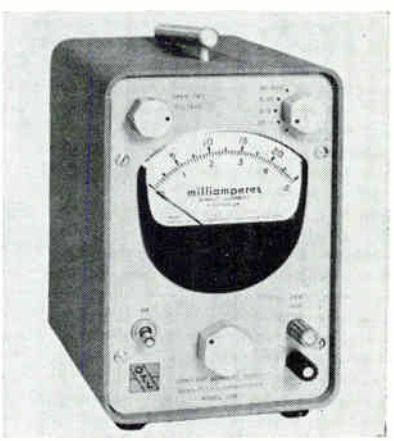
Rated at 20 kilowatts, the tubes cover a frequency range of 7.125 to 8.5 Gc and can be tuned over a 60 Mc range. The four-cavity tubes have been tested to more than 25 kilowatts. The series was designed for applications requiring very low a-m and f-m residual noise.

Tuned for high efficiency, power gain is 37 db and bandwidth is a minimum of 30 Mc; synchronously tuned power gain and bandwidth are 53 db and 15 Mc respectively. Tubes are focused electromagnetically, are self-centering in the focusing electromagnet and no critical focusing adjustments are necessary.

Applications for the tubes are in repeater satellites, moon-bounce signalling, radio astronomy and communications via clouds of tiny orbiting needles. Other applications include c-w radar and illuminator service.

Cooling is provided by water applied to the collector and the body of the tube, with eight gallons per minute of flow required for the collector and two gallons per minute for the tube body and focusing electromagnet.

CIRCLE 302 ON READER SERVICE CARD



Constant Current Supply

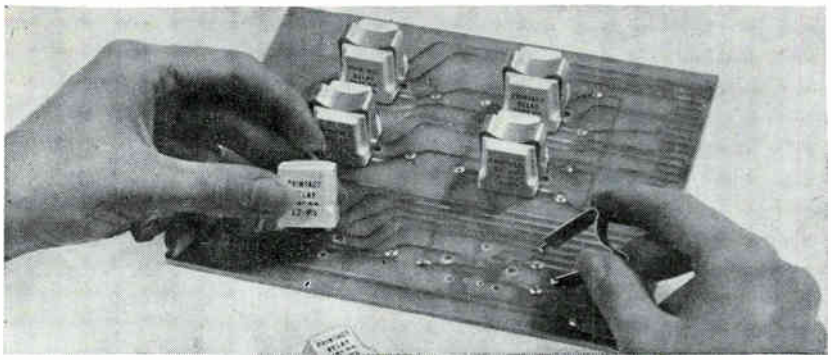
HIGHLY REGULATED

A WIDE RANGE transistorized supply providing constant current is available from Quan-Tech Laboratories, Inc., 60 Parsippany Blvd., Boonton, N. J. The supply, Model 151B, covers 0.05 to 500 ma in four ranges, is regulated to within 0.25 percent for 0 to 20 volts to load and has 0.25 percent regulation for 105 to 125 volt input. Ripple and noise are below 50 microamps for peak output and as low as 1.5 microamps on lower ranges.

Open circuit voltages may be set

to desired maximum values and checked on meter, preventing overload damage to externally connected equipment. Provision is made for modulating the d-c output current with an external modulating source. The highly-regulated constant output of the device makes it especially useful in applications such as semiconductor testing, diode-aging and life tests, beta tests, potentiometer and current sensitive relay testing, electrolytic work, strain gage systems, and other applications. Price is $290.

CIRCLE 303 ON READER SERVICE CARD



Permanent Magnet Relay

FEATURES PRINTED CONTACTS

PERMANENT magnet, printed contact relay series has been announced by the Components Division of Executone, Incorporated, 47-37 Austell Place, Long Island City, New York.

The relays use preadjusted bar contacts in an armature and moving contact assembly that makes contact with conductors on the printed circuit board. Applicable to printed circuits, the relays are designed to save space and weight and to speed assembly. Switching combinations to three-pole double-throw are possible.

A ceramic permanent magnet is the heart of the magnet motor assembly. Application of an electromagnetic field opposing the field of the permanent magnet causes the relay to operate. Absence of springs and mechanical linkages eliminates adjustments and gives high reliability. The entire magnetic motor assembly is molded in high-impact plastic.

Motor and the armature contact assembly are essentially dust proof when mounted on the printed wiring board; they can be completely protected from environmental effects by sealing the plastic encased unit to the printed circuit board with epoxy cement.

The compact Printact relay is easily mounted on the printed circuit with a simple spring clamp and is accurately positioned by three plastic studs that project into the board. Only the coil terminals are soldered.

Power consumption for a three-pole relay is 500 milliwatts at 6, 12, or 24 volts, d-c; operating time is 10 ms; contacts are rated from dry circuit to 2 amp; weight is 0.8 ounce; dimensions are $\frac{7}{8}$ by $\frac{7}{8}$ by $\frac{13}{16}$ inch.

CIRCLE 304 ON READER SERVICE CARD

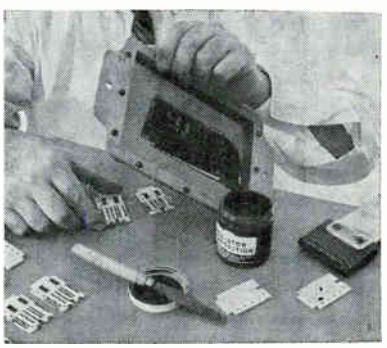
Mesa Transistors

EPITAXIAL UNITS SWITCH FASTER

PRODUCTION of a new family of germanium mesa transistors has been announced by Sylvania Electric Products Inc., 730 Third Ave., N. Y., N. Y. The epitaxial transistors consist of thin semiconductor layers epitaxially (derived from the Greek "settling on") deposited on low resistivity substrates of germanium. Performance of the epitaxial units, including saturation voltage, switching speed and collector capacitance, is superior to conventional germanium mesa transistors.

First units to incorporate the new process are germanium diffused base mesa transistors, types SYL2300 and SYL2301. The new devices, available in production quantities within one month, are electrically similar to conventional mesa transistor types 2N702 and 2N711, but with improved performance in saturation voltage and switching time. For equivalent transistor dimensions, saturation voltage at a collector current of 50 ma is reduced by a factor of 3.5 (typically 0.15 volt at 50 ma for the new epitaxial units), and typical switching storage times are reduced by a factor of 4. Experimental epitaxial silicon mesa transistors that resemble 2N696 and 2N697 family have also been developed. At 25-degrees Centigrade these units displayed saturation voltage as low as 0.02 volt and storage time as low as 30 nanoseconds at 150 ma collector current.

CIRCLE 305 ON READER SERVICE CARD



Resistance Materials

PRINT ON CERAMIC

RESISTOR compositions are available in three resistance values: 500-, 3,500-, and 10,000-ohms per square per mil thick film, and can be blended to obtain intermediate values. Applied to ceramic dielectric bases by ordinary dip, brush, or stencil screen technique, the composition is then fired in an oven to obtain a durable surface.

Electrical properties of the resistors are reproducible and tests show that fired printed patterns and coated rods have abrasion and impact resistance similar to fired silver coatings. Resistance values exhibit excellent stability under varying conditions of humidity, temperature, overload and voltage. Some specifications are: temperature coefficient of ± 350 ppm per deg C from −55 to + 125 C; voltage coefficient less than 0.02 percent per volt, negative; resistance

changes ± 2 percent after 1,000 hours at 70 C at full load.

The result of a five-year research program, the resistors are based on glass frit and metal powders. Several patents on the resistor compositions have been issued and others are pending.

At present, screen printing and dipping compositions are being sold in each of the three resistance values at $8 a troy ounce for 100-ounce quantities. Initially, smaller amounts will be available at this price for trial purposes, from Ceramics Products Div., E. I. du Pont de Nemours & Co., Perth Amboy, N. J.

CIRCLE 306 ON READER SERVICE CARD

Differential Amplifier
BIOLOGICAL RESEARCH

FIRST in a series of miniaturized instruments for medical electronics application, the B-30ATP Bio-pack is in use at universities, space laboratories and medical centers. The device may be used in the laboratory or in the field.

The units incorporates a high gain, low noise differential amplifier (B-30A) and a companion f-m

transmitter (B-30T) operating at low power on the 88 to 108 Mc band. Suitable for acquisition and local telemetry of all bio-electric signals from the microvolt to millivolt range, either unit may be used individually or combined in one package.

The amplifier has an input impedance of 500 kilohms, a common mode rejection exceeding 50,000 to 1, gain of 10,000, and an equivalent input noise level of 4 microvolts peak to peak. Frequency response between half-power points is 0.4 cps to 10 Kc minimum.

The transmitter has a voltage sensitivity of 50 to 70 millivolts for 100 per cent deviation, an input impedance of more than 100 kilohms, and is sensitive to signals from d-c to over 10 Kc. Required current is 4 ma at −9 v.

Delivery time is 45 days, cost is $550. The unit is manufactured by Computer Systems Laboratory, Litton Systems, Inc., 5500 Canoga Avenue, Woodland Hills, Calif.

CIRCLE 307 ON READER SERVICE CARD

Electrostatic Voltmeter
10-V TO 50-KV SCALES

AN ELECRONIC electrostatic linear voltmeter with a range from 0 to 50,000 v d-c is now being produced by B. K. Sweeney Mfg. Co., 6300 E. 44th Ave., Denver, Colorado. The unit accurately measures d-c voltages as low as 0-10 volts and as high as 0-50,000 volts with no circuit loading. It can be considered a zero current device because it is voltage-operated.

The Model 1170 uses no electrometer tubes or high megohm resistors, and while designed for all weather, rough, general use, still has laboratory accuracy. Jeweled pivots or fragile balances are not used and no dehydration agents are required to maintain its ten billion megohm resistance, even under adverse conditions. Input capacitance is constant and less than 10 pf in all ranges. The instrument cannot be damaged by over-ranging.

Input resistance is 10^{13} ohms up to 100 v and 10^{16} ohms up to 50,000 v d-c. Stability is better than 2 percent in 24 hours at normal ambient temperatures, repeatability is 1 percent, accuracy is ± 2 percent, resolution is ± 1 percent by calibration with standard voltage source.

CIRCLE 308 ON READER SERVICE CARD

Literature of the Week

PORTABLE POWER SUPPLY Mid-Eastern Electronics, Inc., 32 Commerce St., Springfield, N. J. New two-page bulletin describes a miniature portable power supply designed for remote programming and experimental work with transistor circuitry.

CIRCLE 316 READER SERVICE CARD

CAPACITORS John E. Fast & Co., a subsidiary of the Victoreen Instrument Co., 3598 N. Elston Ave., Chicago 18, Ill., has prepared a bulletin describing its complete line of capacitors. Included among the new types described are the high reliability series 134T capacitors which fully comply with MIL C-14157B and the series 9FM units that provide mylar film dielectric plus a plastic case.

CIRCLE 317 READER SERVICE CARD

SEMICONDUCTOR ALLOYS Alpha Metals, Inc., 56 Water St., Jersey City 4, N. J. The physical properties of gold-germanium, gold-silicon and gold-antimony alloys are described in a series of technical data sheets (No. 8-10). The sheets, designed for semiconductor engineers, are specially punched to fit a variety of binder styles.

CIRCLE 318 READER SERVICE CARD

CIRCUIT BREAKERS Airpax Electronics Inc., Cambridge Division, Cambridge, Md. Bulletin B-97 is a four-page folder containing an illustrated description of the series 500 miniature, hermetically sealed, inverse time delay, magnetic circuit breakers.

CIRCLE 319 READER SERVICE CARD

MAGNETIC LATCHING RELAYS Babcock Relays, Inc., 1640 Babcock Ave., Costa Mesa, Calif. Bulletin BR-594 describes the BR-9 magnetic latching relays, provides full electrical and mechanical data and illustrates all types of standard mounting configurations.

CIRCLE 320 READER SERVICE CARD

PANEL METERS Helipot Division of Beckman Instruments, Inc., 2500 Fullerton Road, Fullerton, Calif. A 4-page, 2-color folder lists 92 standard models of the company's voltmeters, ammeters, milliammeters and microammeters in each of three sizes, 2½ in., 3½ in. and 4½ in.

CIRCLE 321 READER SERVICE CARD

VOLTAGE REGULATORS Raytheon Co., Keeler Ave., South Norwalk, Conn. A new catalog provides complete specification data for 2,020 standard magnetic voltage regulator models. It also offers vital information to guide manufacturers in selecting and using regulators in d-c power supply design.

CIRCLE 322 READER SERVICE CARD

CONTROL COMPONENTS GUIDE International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa. A recent booklet contains illustrations and complete specifications for a line of products which include military telemetering pressure transducers, high accuracy pressure transmitters, high voltage pressure transmitters and displacement position transducers.

CIRCLE 323 READER SERVICE CARD

TEST INSTRUMENTS B&K Instruments, Inc., 3044 West 106th St., Cleveland 11, Ohio, has released a 24 page catalog listing its complete line of integrated instruments for automatic measurement of sound, vibration and strain.

CIRCLE 324 READER SERVICE CARD

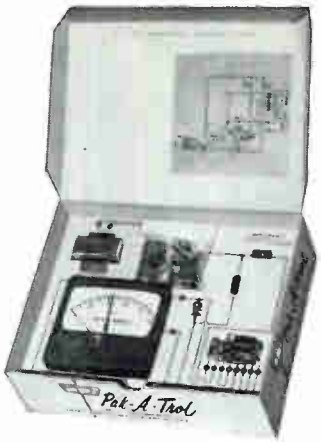
SYNCHRONOUS MOTORS The Superior Electric Co., 83 Laurel St., Bristol, Conn. Data sheet No. 1, 4 pages, gives an explanation of the use of Slo-Syn synchronous motors as d-c stepping motors. It explains and graphically shows stepping principles of permanent magnet type motors.

CIRCLE 325 ON READER SERVICE CARD

D-C POWER SUPPLY Krohn-Hite Corp., 580 Massachusetts Ave., Cambridge 39, Mass. A 4-page illustrated brochure describing a new ultra-high regulation transistorized d-c power supply has recently been published.

CIRCLE 326 ON READER SERVICE CARD

NEW AUTOMATIC CONTROLLER KIT



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CIRCLE 202 ON READER SERVICE CARD

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counting tubes

and counting tube circuits

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CIRCLE 103 ON READER SERVICE CARD

Martin Plant Gets New Look

CLOSELY ALLIED with changes in the electronics organization during the last year at the Martin Company is the conversion of the old airframe facility at Baltimore, Md., to a modern electronics production environment (picture).

This reflects the electronics-industry outlook at Martin, says John J. Slattery, general manager of the firm's Baltimore Electronics division. Electronic activity other than that connected with missile production is very evident at Martin, he points out.

Worker efficiency has been increased through new lighting, greater cleanliness, and color control. Tied-in with the modernization effort is the establishment of a quality control procedure on a per-worker basis.

Martin plans to double its military electronics output by 1965 and to get into industrial electronics that year, says Slattery. No plans are being made for consumer electronics.

The present organizational setup has at its center the Advanced Program Group, which is responsible for evaluating all developments by electronics engineers in the corporation's divisions. The group reports directly to the corporate vice president in charge of engineering.

Electronics engineers at Martin make up approximately 40 percent of the total engineerng manpower, numbering between 7,800 and 7,900.

Among areas where electronics will be required to do effective work in industry, says Slattery, are: tabulating of drawing information on tape or cards; control of chemical milling to reduce "skins"; machines to cut contours beyond human emotional capacities.

In addition to the heavy industries with their demand for data processing systems, he thinks the chemical and petroleum industries will be prominent industrial electronics customers, calling for control gear having specially designed translational units and for process control using shared-time techniques.

Martin's electronics sales during the past year were $55 million, out of a corporation total of $600 million. Of this, $5 million were in prime contracts.

Nems-Clarke Company Changes Name

AFTER more than a half a century in the design and manufacture of precision electronics, Nems-Clarke Co., Silver Spring, Md., and Los Angeles, Calif., has changed its name to reflect its activities.

Company will now be known as Vitro Electronics, a division of Vitro Corp. of America. The Nems-Clarke designation will be retained as a trade name for Vitro Electronics equipments.

The new name is only a small part of broad plans which will include the expansion of Vitro's operations in electronics. Plans are now being completed for additions to the Nems-Clarke products line in new areas of electronics.

New Company Formed In Massachusetts

POLYSTRUCTURES, INC., recently incorporated in Stoneham, Mass., will engage in research, development, and manufacture of reinforced plastic and foam plastic products. President and treasurer of the firm, M. M. Hannoosh, has been group leader of the development engineering group at MIT Lincoln Laboratory.

Company will operate in the areas of encapsulation of electronic components and chassis, design and manufacture of radomes and of plastic antennas, development work in materials research, and plastic foam dispensing equipment.

Emerson Electric Mfg. Elects Executive V-P

WILLIAM L. DAVIS has been elected executive vice president of Emerson Electric Mfg. Co., St. Louis, Mo. He will serve as general manager of the Electronics and Avionics division, which produces a wide variety of advanced electronics systems and missiles for the military services. He will also be responsible for cost control programs and will continue to head corporate engineering and development. Emerson now has four subsidiaries in its corporation.

Chester Lob Takes New Post at GE

CHESTER G. LOB has been named manager of General Electric's new traveling-wave tube product section, with headquarters in Palo Alto, Calif. The new product sec-

research

design

production

management

It's used more by all 4!

Because a BUYERS' GUIDE must contain *more* than product listings. The 26-man editorial staff of **electronics** has boiled down over-all marketing, materials, specifying, and design data pertinent to the entire industry into a valuable 64-page Reference Section available in no other electronic buying guide or directory. It gives a broad picture of who buys what, and where, in the electronics industry . . . an exclusive in electronic directories.

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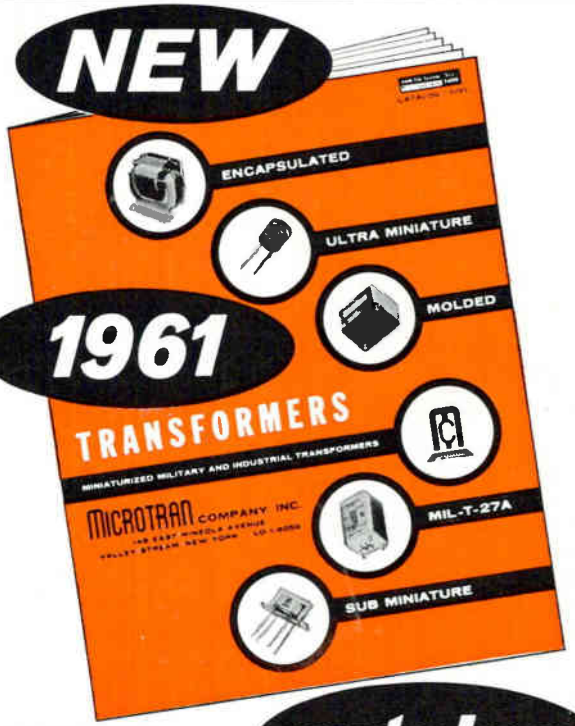

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tion will report to the power tube department, but will be a completely integrated organization responsible for design, development, manufacture and marketing of microwave products, principally twt's.

Prior to this appointment Lob was manager, low power traveling-wave tubes, at the Palo Alto Microwave Laboratory.

Rondou Assumes New Position

JOHN K. RONDOU has been named president and general manager of Computer Measurements Co., Sylmar, Calif., a division of Pacific Industries. He was formerly vice president and general manager.

Prior to his appointment as vice president, earlier this year, Rondou had been sales manager since 1957. Before that time he was in charge of organizing engineering and production facilities for Computer Measurements Company's present line of digital counting, timing and frequency measuring equipment.

Chemprint Corporation Begins Production

A NEW electronics firm, Chemprint Corp., has begun production in its Menlo Park, Calif., plant-headquarters, a facility for manufacturing printed circuits. The company will produce precision plated circuit boards for military and industrial uses: in missile guidance systems, aircraft, computers, radar and other electronic equipment. All phases of production will be carried out in the Menlo Park plant.

Chemprint Corp. began operating with a staff of 25, most of whom are specialists in chemistry, processing engineering or quality control. The company expects to operate with a full staff of 120 in the next few

months, according to Richard J. Kuri, vice president and general manager.

Taylor Fibre Announces Two Appointments

HARRY L. HILDEBRAND, formerly manager of the fabricating division of Taylor Fibre Co., Norristown, Pa., has been named manager of process and design engineering, and John G. Musselman, Jr., formerly general machining foreman at SKF Industries, has been appointed new manager of the fabricating division.

Ruppel Becomes V-P At Allied Control

ELECTION of Henry M. Ruppel to vice president in charge of production engineering at Allied Control Co., Inc., has been announced. He will be responsible for production engineering and quality control at all Allied control plants in Glendale, Calif., Plantsville, Conn., Wauregan, Conn., and New York City.

Ruppel joined Allied Control in 1944 and since 1947 has been chief engineer of the Relay Division. Prior to joining the company, he was engaged in an engineering and administrative capacity in the electrical manufacturing plant of Cutler-Hammer, Inc., for 16 years.

Announce Formation Of New Company

FORMATION of a new company, Filtronics Corp., Chicago, Ill., was announced recently in a statement by Evangelos Argoudelis, vice president and director of engineering. The firm was set up to provide highly selective crystal filters and L-C type electrical filters to de-

signers of modern communications equipment.

Argoudelis was formerly associated with the applied research department of Motorola, Inc.

New Company Elects President

BENJAMIN B. CRAVENS has been elected president of Microwave Corp. of America, a new electronics company which will research, develop and manufacture waveguide components and related electronic assemblies in Stamford, Conn.

Cravens was formerly associated with Raytheon Mfg. Co. and other major electronics manufacturers.

Dechert Dynamics Forms Electronics Division

FORMATION of an electronics division under the direction of Donald W. Black has been announced by Joseph P. Dechert, president of Dechert Dynamics Corp., Palmyra, Pa.

Black formerly was the manufacturing manager of International Telephone & Telegraph Company's components division.

The new division will concentrate on the development and production of hermetic seals, transducers and other electronic components widely used in industry and in space exploration.

Avien Establishes Antenna Department

ESTABLISHMENT of an antenna department for the immediate manufacture of the patented Bogner antenna system with unique characteristics and special applicability for space communications and uhf

ground communications, has been announced by Avien, Inc., Woodside, N. Y.

Avien president, Leo A. Weiss announced that the department will be headed by the inventor of the antenna, and its patent holder, Richard D. Bogner.

Control Instrument Appoints Myers

JAMES E. MYERS has been appointed assistant manager of Control Instrument Co., Brooklyn, N. Y., a wholly-owned subsidiary of Burroughs Corp. He had previously served as manager of administration and planning.

H. S. Burns Takes Over Newly-Created Post

HAROLD S. BURNS, president of Pickard & Burns, Inc., a subsidiary of the Gorham Mfg. Co., Providence, R. I., has been elected to the newly created position of vice president for electronics of the parent company. He will continue as president of Pickard & Burns.

In 1947 Pickard and Burns founded a consulting engineering partnership that was succeeded by the present corporation of which Burns has been president since 1952.

Dalmo Victor Company Hires Ernest Iufer

ERNEST IUFER has joined the electronic systems division of Dalmo Victor Co., Belmont, Calif. He brings to the position of senior project engineer nine years' experience as chief engineer of the Naval Degaussing Station, Kingston, Wash.

PHYSICAL CHEMIST

Electronic Materials

We are expanding our company-supported program of basic research and advanced development of new materials and their applications for the electronic industry. A position is available for a qualified scientist or engineer to join a technical group that has already achieved a leading position in electroluminescent and photoconductive materials and devices and is expanding its interests into new materials for other electronic uses. His assignments will be primarily directed toward advancing the state-of-the-art in utilization of materials in multi-layer logic devices. This requires not only a thorough knowledge of the chemistry of electronically active materials but also some familiarity with electronic circuitry and the techniques of ceramics and graphic arts.

To the scientist interested in a challenging non-military technical assignment affording outstanding potential for significant scientific accomplishment we can offer a dynamic program and complete facilities in a stimulating professional climate. While specific related experience is desirable, we would also be interested in talking to a person who has complete formal training in chemistry, and has some familiarity with electronic components and circuitry.

Please submit resume to Mr. F. J. Loyer

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Research Division of a well-known West Coast military products corporation needs a manager-scientist in static energy conversion system. Recent promising developments dictate an acceleration of technical effort with comparable management and marketing support. Should have working knowledge of plasma physics and solid state physics; be familiar with chemistry, nucleonics and materials technology to pursue investigations in thermionic energy conversion. Would require Ph.D. or equivalent, management and marketing ability coupled with substantial technical experience. Direct your confidential inquiries to

P-5407, Electronics
1125 W. 6th St., Los Angeles 17, Calif.

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See pages 594, 595 of 1960 Electronics Buyers' Guide for a more complete listing

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SECTION HEAD—Electronics $18-$20,000

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14 E. Jackson Blvd., Chicago 4, Ill. WA 2-7580

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LOOKING FOR USED/SURPLUS ELECTRONIC EQUIPMENT/COMPONENTS?

For on up-to-date listing of such equipment see Searchlight Section of October 14th.

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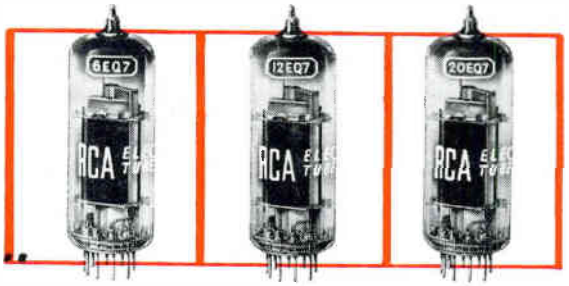

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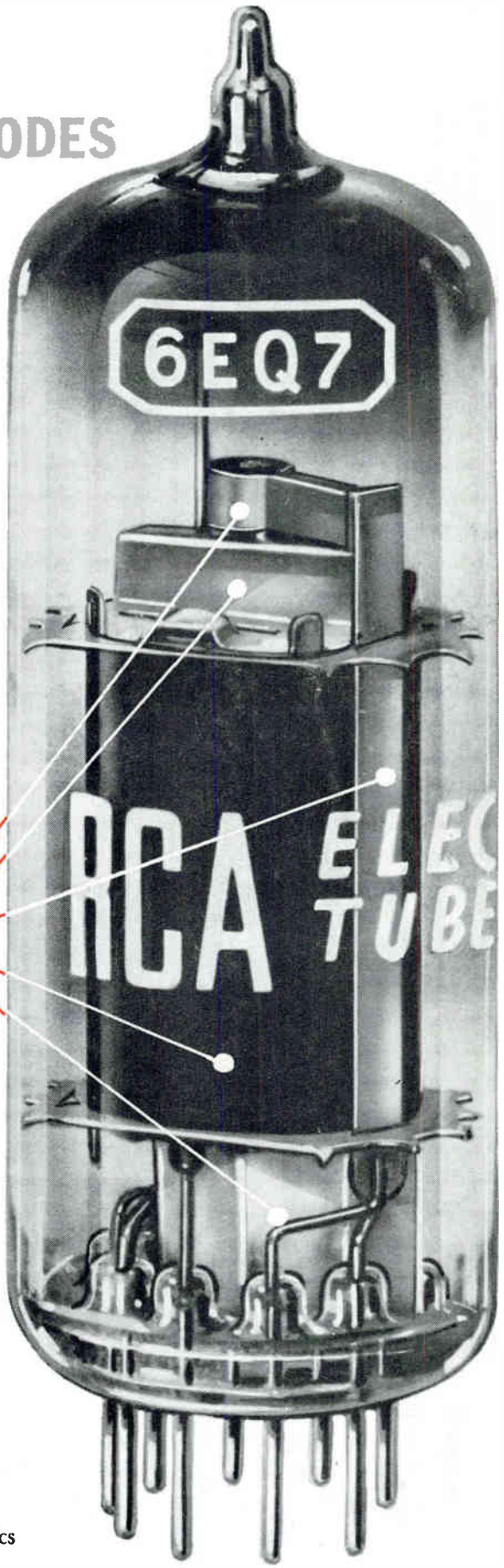

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