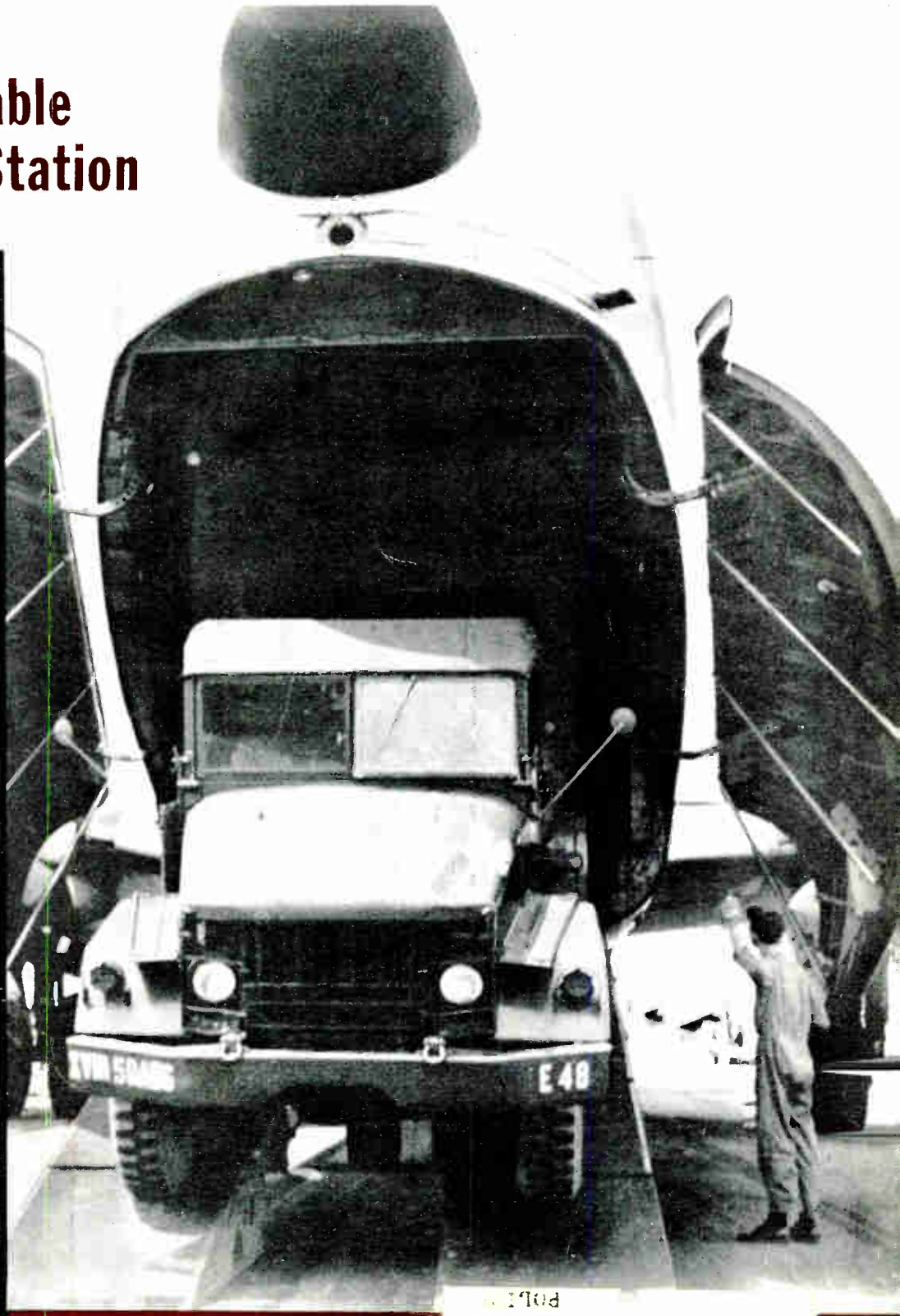
AUGUST 28, 1959

electronics

A McGRAW-HILL PUBLICATION VOL. 32, No. 35 PRICE SEVENTY-FIVE CENTS

Air-Transportable Army Radio Station



What's Ahead in ... g?

Creative Microwave Technology

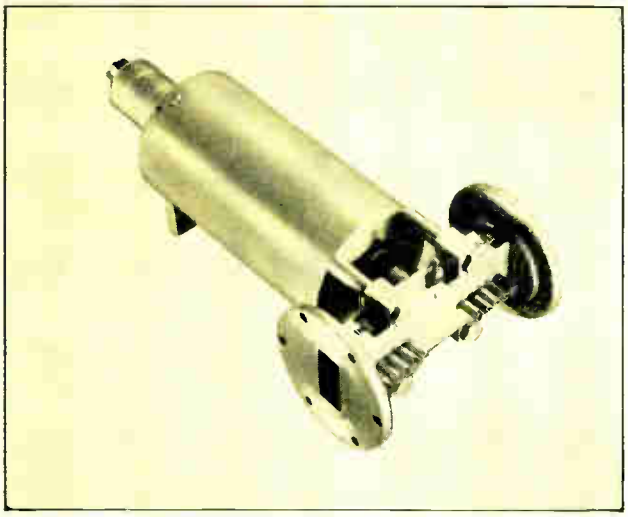
Published by Microwave and Power Tube Division, Raytheon Company, Waltham 54, Mass., Vol. 1, No. 6

NEW 5-WATT TRAVELING WAVE TUBE DESIGNED FOR MICROWAVE RELAY LINKS

The versatile modulation characteristics of this broadband power amplifier are particularly well suited for microwave communication applications. The tube, identified QK-542, is a permanent-magnet focused CW type, operates in the 5,900 to 7,400 Mc frequency range, and has a nominal saturated power output of 5 watts.

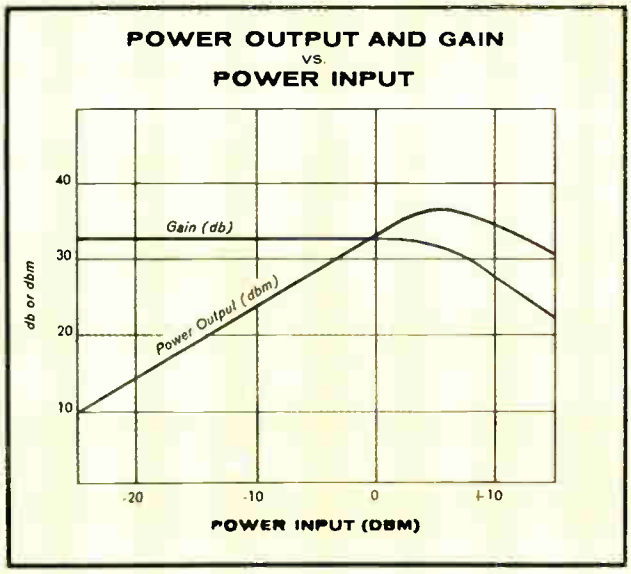
High amplification over a wide range of power levels results in small-signal gain of up to 35 db. A special control electrode facilitates low-voltage pulsed or amplitude modulation.

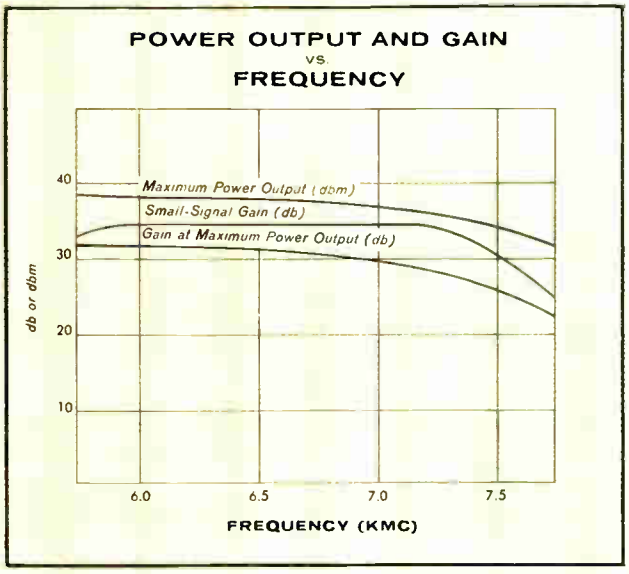
The tube is supplied with an integral waveguide coupler package which accommodates UG 344/U waveguide-type flanges. When supplied with an optional coaxial output coupler package, tube will operate over the 4,000 to 8,000 Mc range.



Typical Operating Characteristics

Frequency Range	5,900 to 7,400 Mc
VSWR (Input and Output)	2.1:1 max.
Small-Signal Gain	32 to 35 db
Gain (Saturation)	25 to 27 db
Power Output	5 watts





You can obtain detailed application information and special development services by contacting: Microwave and Power Tube Division, Raytheon Company, Waltham 54, Massachusetts

Excellence in Electronics

RAYTHEON

A LEADER IN CREATIVE MICROWAVE TECHNOLOGY

electronics

AUGUST 28, 1959

A McGRAW-HILL PUBLICATION
Vol. 32 No. 35

Issue at a Glance

Business

Engineering

Departments

ELECTRONICS PROGRESS THROUGH CHEMISTRY AND METALLURGY

*From actual Photomicrographs (375X)

This is stretching it pretty fine!

• Drawing extremely fine wire in large quantities and to close tolerances is a fine art at Sylvania. It is also a scientific business, largely because Sylvania engineers designed their own precise machines and methods that carry out the many operations from heavy swaging to final spooling.

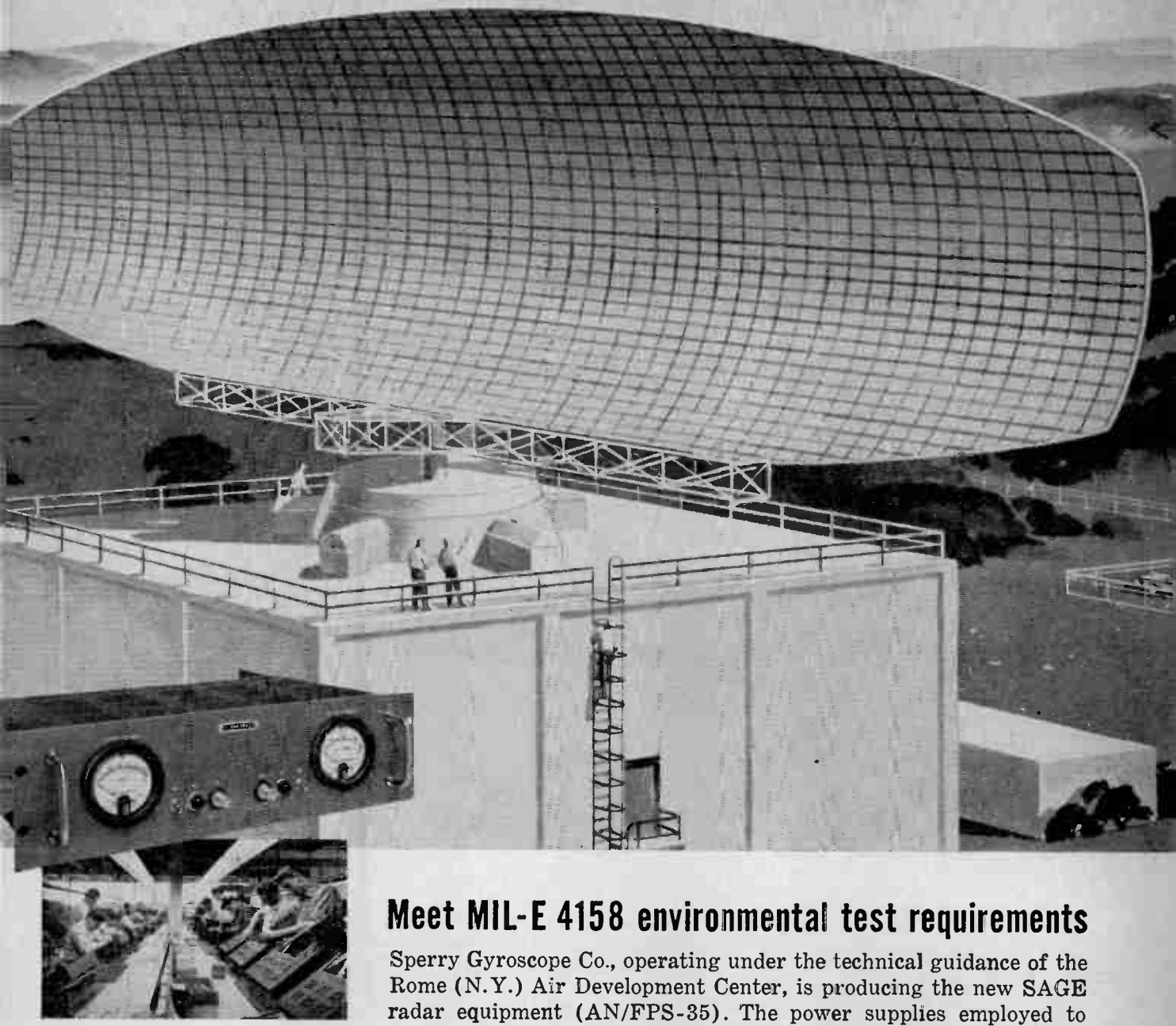
One ten thousandth inch diameter is about as fine a tungsten wire as any Sylvania customer has needed so far . . . molybdenum down to .0005" . . . and that is something of a record in fineness! Sylvania wires of exceptionally small diameters are playing a vital part in further reducing the dimensions and fostering new design concepts of electronic tubes. When even finer wires are required, Sylvania will be ready to produce them!

Meanwhile, the wheels are busily turning, supplying fine molybdenum and tungsten wires of all sizes . . . black, cleaned or plated. They're all subject to rigid quality control, from basic chemical forms to packaging. Prices are right too, as an inquiry will show you.

SYLVANIA ELECTRIC PRODUCTS INC.
Chemical & Metallurgical Div.
Towanda, Penna.

SYLVANIA
Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

Lambda Power Supplies specified for newest radar installation



"Off-the-shelf" Lambda power supplies —modified only with special panels, MIL meters and tubes—will be part of the complex radar equipment housed in the 85-foot tower at Thomasville, Alabama, one of four identical installations.

Meet MIL-E 4158 environmental test requirements

Sperry Gyroscope Co., operating under the technical guidance of the Rome (N.Y.) Air Development Center, is producing the new SAGE radar equipment (AN/FPS-35). The power supplies employed to power transmitters and receivers must be able to pass stringent tests.

Sperry's choice: Lambda's COM-PAK,® already widely used as a component in many rocket and missile programs.

All Lambda stock industrial power supplies are made to MIL quality and *guaranteed for five years*. They are pictured and described in a new 32-page catalog. Write for your copy.

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INDEPENDENCE 1-8500 CABLE ADDRESS: LAMBDATRON, NEW YORK

CIRCLE NO. 3 READER SERVICE CARD

electronics

August 28, 1959 Vol. 32, No. 35

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Postmaster: please send form 3579 to Electronics, 330 W. 42nd St., New York 36, N. Y.

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SHOPTALK . . . editorial

GOVERNMENT BUSINESS. Word coming out of Washington indicates that it will be tougher to do business with the government in the months immediately ahead.

Uncle Sam has $4.8 billion to spend in the coming year. But he wants more for his dollar.

The Defense Department is under pressure particularly with respect to contractors who get their business by negotiation, as opposed to those who bid competitively. Obviously, a lot of electronic equipment is sufficiently complex and unique to make competitive bidding difficult.

For a long time, such pressure came largely from Congress. Recently the General Accounting Office got into the act too. Statements have been made in several quarters to the effect that two dozen firms may have overcharged the government, and in some few instances this could be true.

But a close look reveals that many of the alleged overcharges are readily corrected accounting errors amounting in some cases to only a few dollars. And the government isn't saying when it came out on the long side of a clerical error.

Contractors have recently been penalized for exhibiting horsesense. For instance, the government placed an order for parts, then followed it later with an additional order for the same part. The manufacturer combined the two orders and saved money in production. The government came around later and demanded the money thus saved.

In another case the government awarded a fixed-price contract. When it was learned that the contractor had made a substantial profit, there was that little man with his hand out again.

But what about the firms who bid too low and lose money on a deal like this? To what extent are they reimbursed?

Manufacturers are in business to make a profit. They expect a fair return on their investment and a just reward for their skill and enterprise. They are not by and large out to "take" the government—but they are not in business for their health either.

W W MacDonald

Editor

Coming In Our September 4 Issue . . .

ELECTRON BOMBARDMENT. An exciting new technique for processing high-melting-point refractory materials is assuming great importance to our industry. Electron bombardment heating provides a degree of flexibility and versatility hitherto unmatched by high-frequency induction or radiation methods. A. Lawley of the University of Pennsylvania, tells how the method has been advanced to include zone refining of various materials of exceptional purity, beam melting and beam welding. Crystals of such materials as vanadium, niobium and tantalum have been successfully refined by this method.

SOLID-STATE MICROWAVE SOURCE. A nonlinear element used as a harmonic frequency multiplier is the basis of a solid-state microwave power generator described by M. M. Fortini and J. Vilms of the Philco Corporation. Using a transistor oscillator at 250 mc and a diode harmonic multiplier, they have devised a source of 2-kmc power readily usable as a local oscillator in a microwave receiver.

SPRAGUE® RELIABILITY in these two dependable wirewound resistors

MINIATURE

Blue Jacket®

VITREOUS-ENAMEL POWER RESISTORS

Sprague's new improved construction gives even greater reliability and higher wattage ratings to famous Blue Jacket miniature axial lead resistors.

A look at the small *actual sizes* illustrated, emphasizes how ideal they are for use in miniature electronic equipment with either conventional wiring or printed wiring boards.

Get complete data on these dependable minified resistors, **write for Engineering Bulletin 7410.**

TAB-TYPE BLUE JACKETS: For industrial applications, a wide selection of wattage ratings from 5 to 218 watts are available in Sprague's famous Tab-Type Blue Jacket close-tolerance, power-type wirewound resistors. Ideal for use in radio transmitters, electronic and industrial equipment, etc. **For complete data, send for Engineering Bulletin 7400A.**

NEW SMALLER SIZE

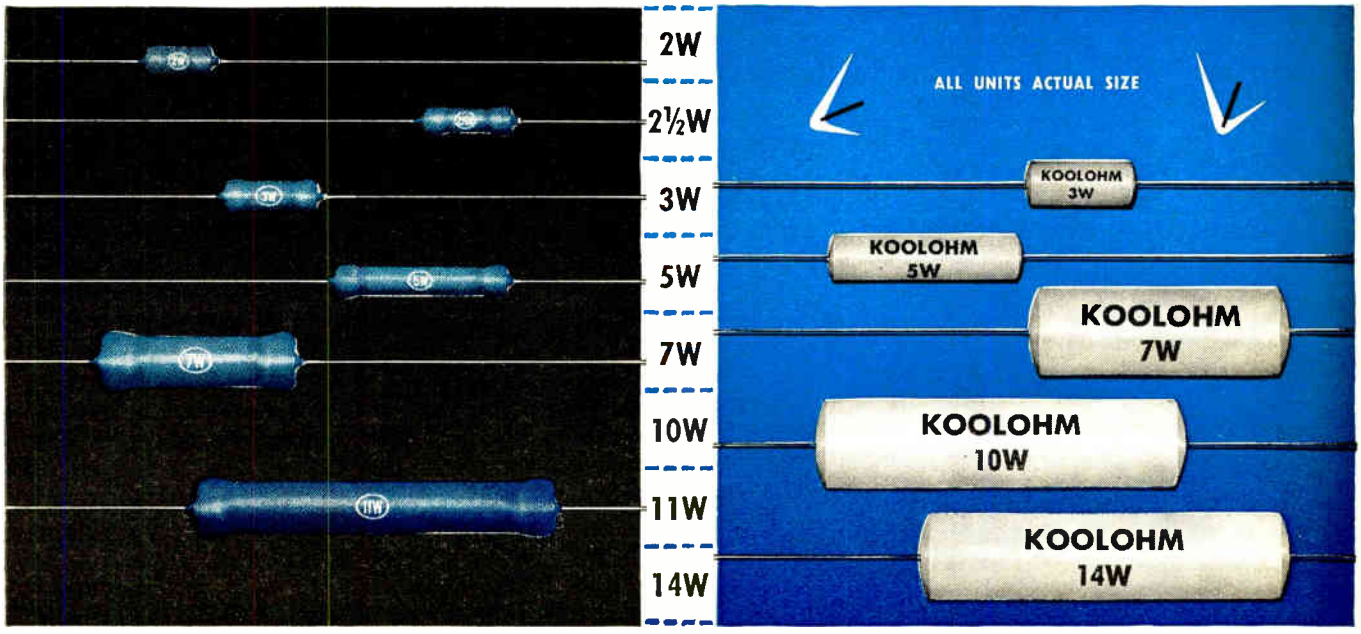
KOOLOHM®

INSULATED-SHELL POWER RESISTORS

New Koolohm construction features include welded leads and winding terminations—Ceron ceramic-insulated resistance wire, wound on special ceramic core—multi-layer non-inductive windings or high resistance value conventional windings—sealed, insulated, non-porous ceramic outer shells—*aged-on-load* to stabilize resistance value.

You can depend upon them to carry maximum rated load for any given physical size.

Send for Engineering Bulletin 7300 for complete technical data.



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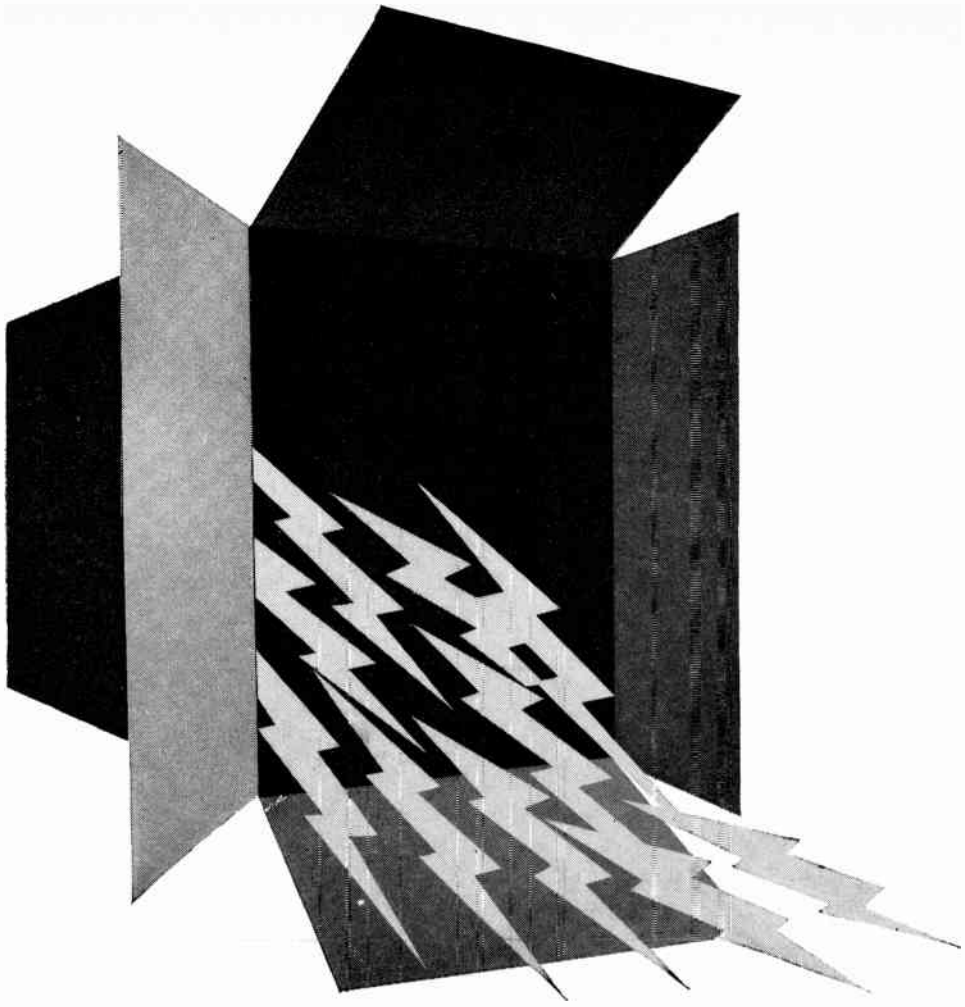

Power in "packages"—for every power need

ITT's unique concepts in power conversion bring new efficiency and economies

PUSH a button—throw a switch! Out of ITT "packages" of power come the exact voltages for countless electronic applications.

Power in static "packages" provides vital military equipment with the utmost in dependable power supply—gives industry uninterrupted DC service and saves the cost of DC generators and their upkeep.

ITT's new idea in power supply

Among the many important areas where ITT "package" power systems are meeting the highest standards of performance are space and aviation.

ITT "packaged" power controls landing gear, operates navigation, communication, counter-measures, missile-launching and the many other systems that give our jets combat capacity.

All DC power for the supersonic B-58 comes from an ITT integrated power system—a *first* in the industry.

ITT-designed power systems serve the B-52 and other famous aircraft, as well as ground-based and seaborne electronic systems.

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From these major contributions to military power supply, ITT System companies have developed complete capabilities for engineering modular-type, "building block" power systems for the most sophisticated needs of industry.

ITT "packaged" power concepts embrace every field of manufacturing. Hundreds of equipment designs are ready at ITT to meet the broad and expanding range of today's DC applications—from the simplest DC motor to the most complex techniques for automation and data processing systems.

If you require DC output for *any* purpose, investigate these unmatched capabilities. For complete information, write to ITT Industrial Products Division, 15191 Bledsoe Street, San Fernando, California.

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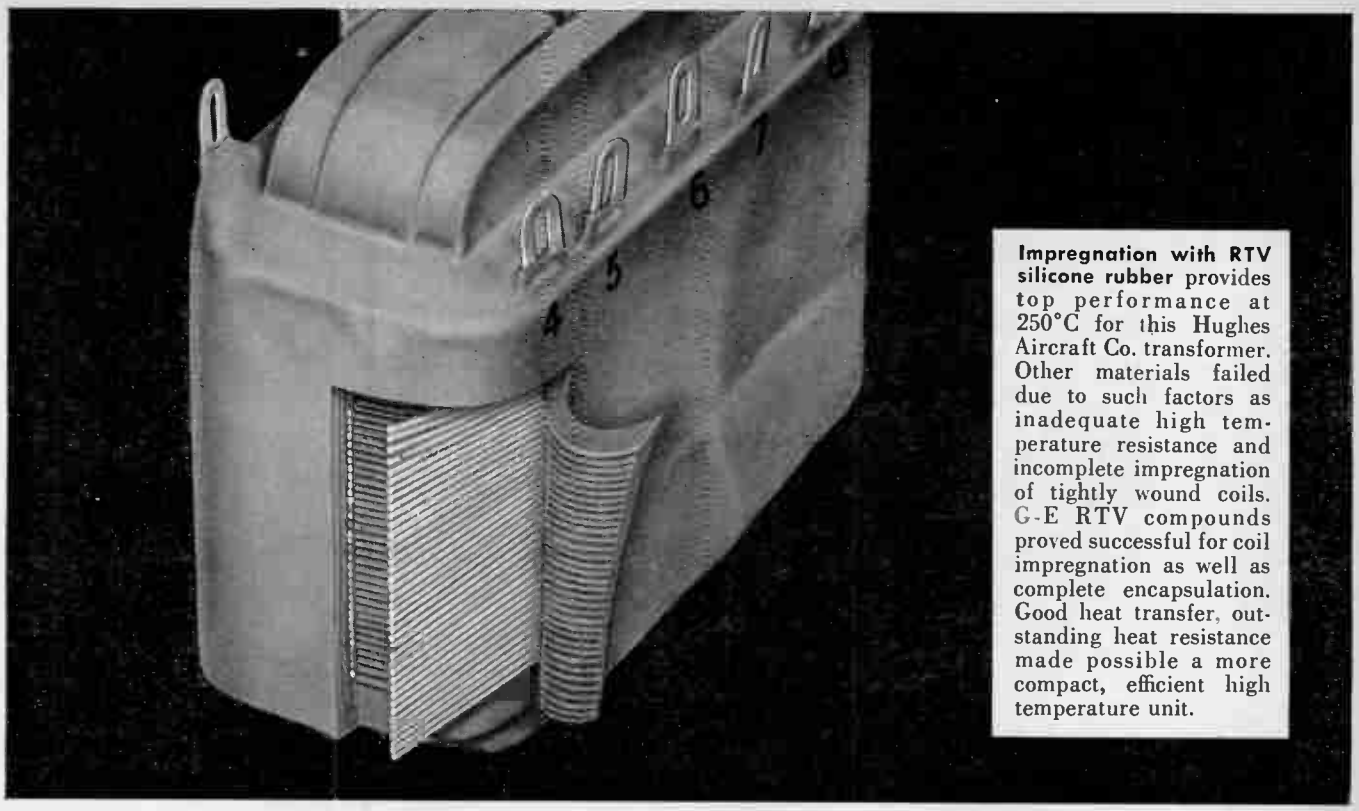


Impregnation with RTV silicone rubber provides top performance at 250°C for this Hughes Aircraft Co. transformer. Other materials failed due to such factors as inadequate high temperature resistance and incomplete impregnation of tightly wound coils. G-E RTV compounds proved successful for coil impregnation as well as complete encapsulation. Good heat transfer, outstanding heat resistance made possible a more compact, efficient high temperature unit.

Added protection, easier application with General Electric RTV silicone rubber insulation

Outstanding heat resistance and electrical properties combined with room temperature cure

New resilient, shock-absorbent RTV sponge offers improved shock and vibration protection at elevated temperatures; permits easier fabrication than previous methods of cutting, inserting and sealing sponge in place. With RTV, just add sponging and curing agents to compound and mix.

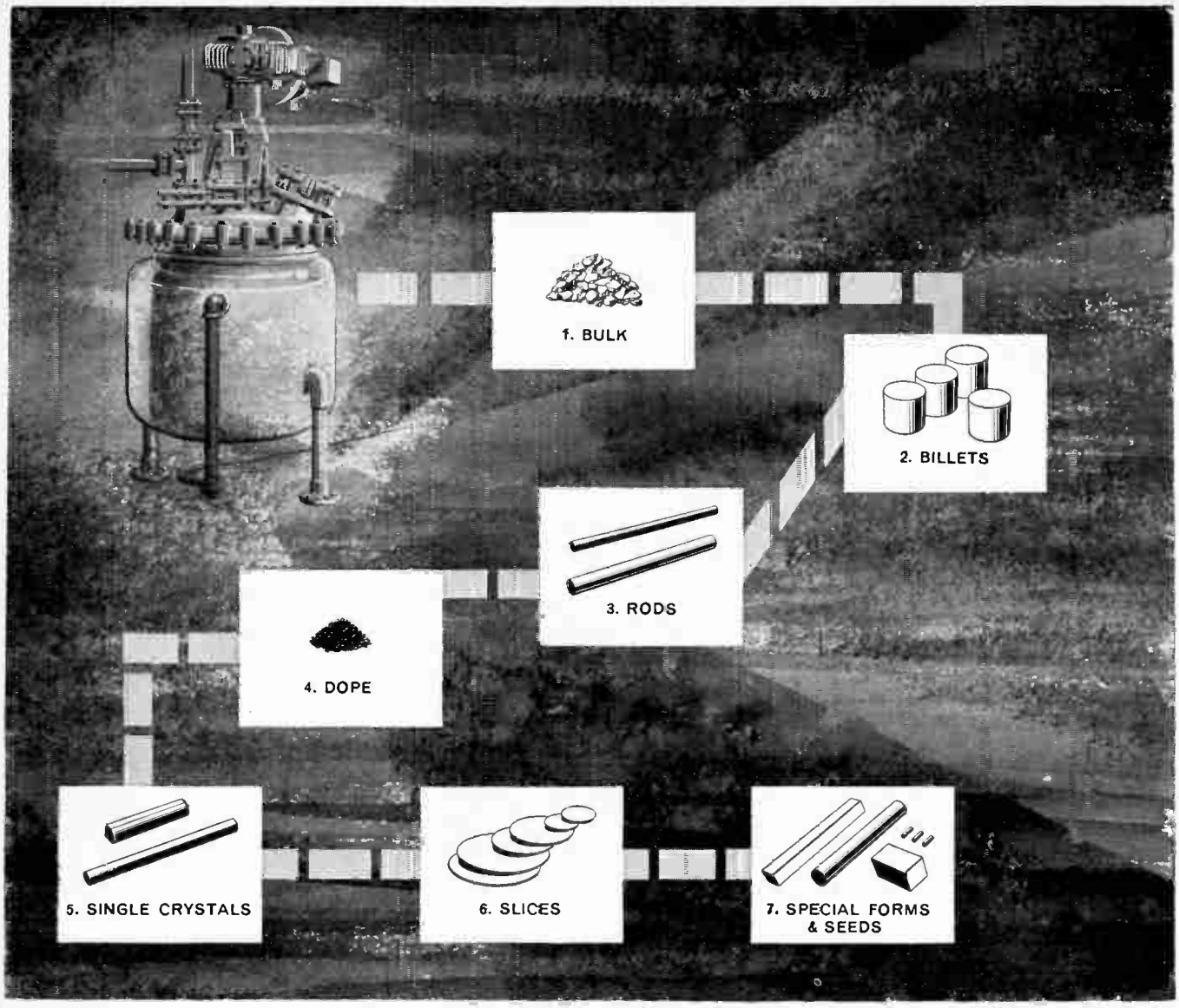
Protection from high altitude arc-over and corona is provided for this cathode ray tube by encapsulating all lead wires with RTV (room temperature vulcanizing) silicone rubber. Designed for airborne operation and installed in a non-pressurized section of the aircraft, tube is protected from arc-over and corona at altitudes up to 70,000 feet.

Extended service life for motors through RTV encapsulation of stator windings, introduced by General Electric motor departments. RTV's resistance to moisture and other contaminants enables these dripproof motors to meet certain applications formerly requiring totally enclosed units. RTV has low viscosity, rapid cure.

For application data and samples of General Electric RTV silicone rubber, write General Electric Company, Silicone Products Department, Section N98, Waterford, New York

GENERAL ELECTRIC

Silicone Products Department, Waterford, New York



SILICON... *any way you want it!*

Is there any good reason why you shouldn't obtain all forms of silicon you want from a *single* source?

Up to now the answer to that question was simple: No one firm offered a complete silicon supply facility.

But that is no longer true because from Allegheny you can now obtain silicon in every form. Here are the facts:

1. BULK — The bulk polycrystalline silicon you get from Allegheny comes in four grades, three semiconductor, one solar. Each requires a minimum of doping, exhibits a high degree of uniformity and shows a significantly low boron level.

2. CAST BILLETS — Cut to charge size for Czochralski furnaces and in standard sizes up to 2" in diameter.

3. CAST RODS. — For float zoning, you get uniformly dense cast rods in standard sizes up to 1", with lengths entirely dependent on your requirements.

4. MASTER DOPING ALLOYS — These are made from extremely pure silicon, using 99.999% or better elemental dope. They are alloyed in different ranges, and in homogeneous lots of sufficient size to allow for long term standardization in your production doping procedures.

5. SINGLE CRYSTALS — Custom processing of single crystals is a basic service from Allegheny. We will dope to your specifications and grow in Czochralski or float zone furnaces, again depending on application.

6. SLICES — You can get slices to meet any surface requirement since Allegheny has both the know-how and facilities for slicing, lapping, and finishing. And 100% testing is your assurance that the slices completely meet your specifications.

7. SEEDS & SPECIAL FORMS — You tell us your mounting and other physical requirements and we will provide the shapes and forms, cut ultrasonically. All seeds are oriented optically to ½° (or better) to the (111), (110), or (100) plane.

Analyze your current silicon supply arrangements. Consider that *only* Allegheny provides every form of silicon you need. Doesn't it look like now is a good time for you to get all the facts from the people at Allegheny? Write, wire, or phone.

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CRYSTAL CAN

5 amp Relay

GENERAL FEATURES

Contact Arrangement:
Two pole double throw.

Contact Rating:
d-c non-inductive—low-level
up to 5 amperes at 29 volts.

a-c non-inductive—low-level
up to 2 amperes at 115 volts.

a-c or d-c inductive—1 ampere
at 29 volts d-c and 115 volts a-c.

Initial Contact Resistance:
.05 ohms maximum.

Minimum Operate Sensitivity
100 milliwatts with a contact
rating of 2 amperes non-inductive.

Ambient Temperature:
−65°C to +125°C.

Dielectric Strength:
1,000 volts rms at sea level.
450 volts rms at 70,000 feet.
350 volts rms at 80,000 feet.

Insulating Resistance:
10,000 megohms minimum.

Vibration:
5-28 cps at 0.5 inch double
amplitude and 28-2000 cps at 20 g.

Shock: 50 g operational. 100 g mechanical.

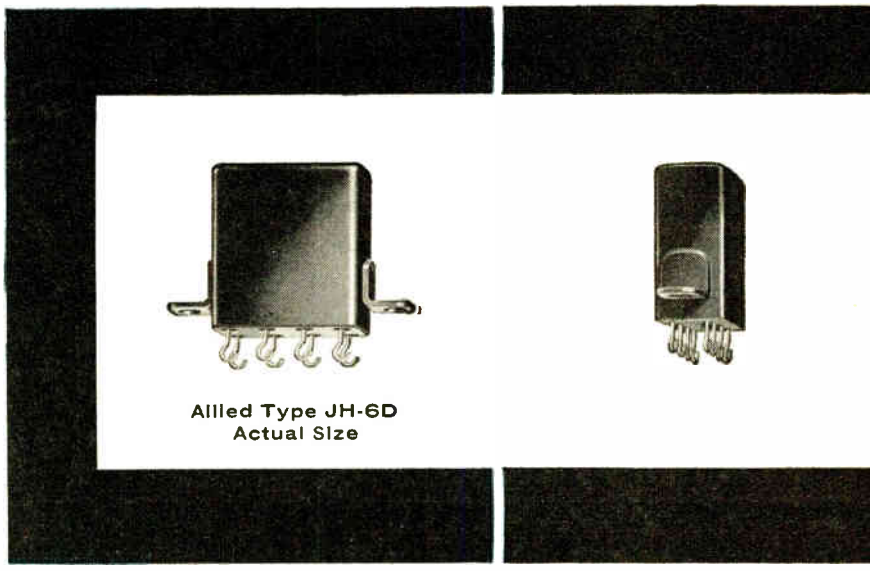
Operate Time:
10 milliseconds or less at rated voltage at 25°C.

Release Time:
5 milliseconds ar less at rated voltage at 25°C.

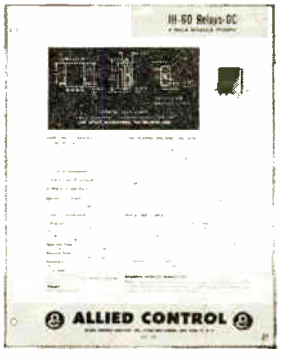
Maximum Over-all Dimensions:
height 1.0" length 0.8" width 0.4".

Terminals:
0.2 inch grid spaced. Plug-in printed circuit
and hooked type solder terminals.

Weight: 0.8 ounces maximum.



Allied Type JH-6D
Actual Size



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Bulletin
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CIRCLE NO. 9 READER SERVICE CARD

Engineers tuning EIMAC klystron amplifier at WESCON find it non-critical, reliable

For one of the few times outside field applications and test installations, engineers had an opportunity to tune an Eimac Klystron amplifier on the air during WESCON in San Francisco in August.

The klystron amplifier was operated at 800 megacycles with output power of one kilowatt. Engineers tuning this equipment were impressed with the simplicity of its non-critical operation. Participants found Eimac's external cavity klystrons as easy to tune as a lower frequency negative-grid amplifier.

This dramatic demonstration featured the same type of Eimac Klystron already famous for outstanding long-life, reliability and performance in such troposcatter systems as Dew Line, White Alice and Texas Towers.

An animated display depicting the effect of velocity modulation on electron flow illustrated the circuit isolation and thermal safety factors that make klystrons ideal for UHF microwave applications.

A wide selection of Eimac klystrons, reflex klystrons, traveling wave tubes and negative grid tubes were displayed. Exhibits of Eimac's advanced work in traveling wave tubes were of particular interest to engineers confronted with rugged environmental applications.

For detailed information on latest Eimac developments, write to our Amateur Service Department for your copy of "What's New With The Electron . . . 1959."

EITEL-McCULLOUGH, INC.

Eimac

SAN CARLOS, CALIFORNIA

CIRCLE NO. 10 READER SERVICE CARD

ELECTRONICS NEWSLETTER

COMPENSATED AVALANCHE DIODE just announced is an example of how molecular engineering is pushing forward the technical frontier of voltage regulation. The device, introduced at WESCON by Shockley Transistor, subsidiary of Beckman Instruments, is a three-layer silicon device. The compensated avalanche diode is said to exhibit several operating advantages: dynamic resistance has been reduced to less than 1 ohm in the current range of 20 to 80 ma, down to zero resistance at one point; temperature coefficient is low; and considerable noise reduction has been achieved. Sample batches of the new device have been produced, with large quantities to be available in October. Characteristics are achieved by adding another junction to the conventional *p-n* diode in such a way as to give it transistor action combined with avalanche multiplication.

BRUSHLESS ALTERNATOR using silicon diodes has been developed by MacFarlane Engineering Co. Ltd., Glasgow, Scotland. The alternator is of the revolving field, non-salient pole type, is no bigger than conventional generators, has no brushes, sliprings or commutators. Exciter field is supplied by transistor preamp in conjunction with Zener-diode reference circuit. Exciter puts out 3-phase supply to rotating rectifier consisting of sealed silicon diodes, capable of operating over wide temperature range and mounted on fins designed to keep them cool. Rotating rectifiers supply the main alternator field.

Transportable search radar for use by Marines in amphibious assault operations will be built by Radio Corp. of America under $11,226,174 contract from Bureau of Ships. Purpose of the new UPS-1 will be to search the sky for aircraft. A six-man team can assemble the system in 15 minutes, have it warmed up and operating in another 15 minutes. The UPS-1 breaks down into nine watertight packages, each of which can be carried by two men.

ARCTIC SIGNAL DROPOUTS are being isolated by Air Force ionospheric researchers for intensive study. "If you were guiding a flock of missiles, complete disappearance of the signals for five minutes or so could be fatal," comments an AF scientist. Phenomenon detected during Arctic blackout studies was at first linked with certain changes in propagation mode. It is now attributed to thermal expansion of ionospheric layers in the early morning. When sunrise hits the F_2 region, the layer expands and ionization is so thinned that it does not support reflection—gas expands faster than ionization increase rate. Dropouts have occurred at several frequencies from 12 to 18 mc during backscatter experiments from Thule AFB to Fairbanks, were also observed on several Voice of America broadcasts.

AIRBORNE GRAVITY METER just announced permits measurment of gravity in the air to an accuracy which the developers say is adequate for geodetic and certain geophysical purposes. New device, from which a gravity contour map can be obtained, was jointly announced by Fairchild Camera & Instrument Corp., LaCoste-Romberg Co. of Austin, Tex., and Gravity Meter Exploration Co. of Houston. Firms say it will mean more accurate maps, missile orbit calculations.

Wall street datacenter to open next March will be the first of about 25 computer centers that IBM will establish in major cities. Plan is a departure from the company's policy of monthly leasing of data-processing gear. Each center will house a transistorized 7070 system, with customers providing their own programmers and operators.

INDUSTRIAL COMMERCIAL ELECTRONICS can grow to a $6-billion market by 1970. That's what H. Leslie Hoffman, president of Hoffman Electronic Corp., told the annual meeting of the Western Electronic Manufacturers Association last week. He said this market, which grew from $676 million in 1950 to $2.46 billion this year, is our industry's greatest new market. Hoffman predicts today's $4,475-billion military electronics volume could reach $9 billion to $10 billion by 1970 due to a higher electronic content in the defense budget rather than a bigger total defense budget. Other estimates: consumer-entertainment segment should grow from this year's $2.6-billion level to a 1970 volume of $3.8 billion; component parts, repairs and services will jump from this year's $2.6 billion to $3.6 billion by 1970.

Airborne radar for surface search, developed for Navy's Bureau of Aeronautics by Texas Instruments, will be produced by TI on a $9.4-million contract. The long-range AN/APS-80 will be installed in large patrol craft starting this fall. System is designed to detect surfaced subs, pick up disturbances created by surfacing or by emergence of the snorkel. Radar's display unit can be used as a plotting board to simplify tracking.

ELECTRONIC COMPUTER INDUSTRY in Japan may finally get its long-awaited public subsidy. Japanese Ministry of International Trade and Industry (MITI) has announced plans for a $4-million corporation, with private enterprise and government participating equally, to produce computers. MITI feels that now is the time for all-out effort, since no private Japanese concern is big enough to compete effectively in the world computer market. Plans call for manufacture of 50 computers in fiscal 1960, 100 in fiscal 1961, and increments of 50 each year through fiscal 1964. Five-year plan also aims for speedy modernization of industry, adoption of automation.

WASHINGTON OUTLOOK

WASHINGTON—THE NAVY'S EXPERIMENTAL "high frequency ionospheric back scatter" currently basking in nationwide publicity is not expected to affect Pentagon plans for a third BMEWS station. That's the word from a top-level Defense Department electronics expert. He says the third BMEWS site is being considered as "a separate question" from Project Tepee (code name for the new Navy technique).

Nevertheless, there's still no definite decision for the third site. The issue will be settled during the next few months as the 1961 military budget is put together.

But as the situation stacks up now, the Air Force will probably get the go-ahead to build the third BMEWS installation. At least $400 million has been contracted out so far for R&D on BMEWS gear.

Major BMEWS contractors are: RCA (prime for the detection system), Western Electric (prime for the communications system), GE, Goodyear Aircraft, Continental Electric, D. S. Kennedy, Andrew Corp., Varian, Eitel-McCullough and Simplex Wire & Cable. Construction of stations at Clear, Alaska, and Thule, Greenland, are going ahead full blast.

Pentagon sources describe Project Tepee as still in the technique searching stage. So far, they say the technique has been demonstrated only in a limited fashion. They stress that even if an operational detection system is developed around h-f ionospheric back-scatter reflection technique, its unlikely that other detection systems will be replaced. Meanwhile, work on Project Tepee will continue this year at a $1-million spending level within the present budget.

- **The Senate Small Business Committee** will investigate complaints of small defense contractors that they suffer competitive disadvantages in bids for both military and commercial business against larger rivals who possess military-furnished production equipment and facilities.

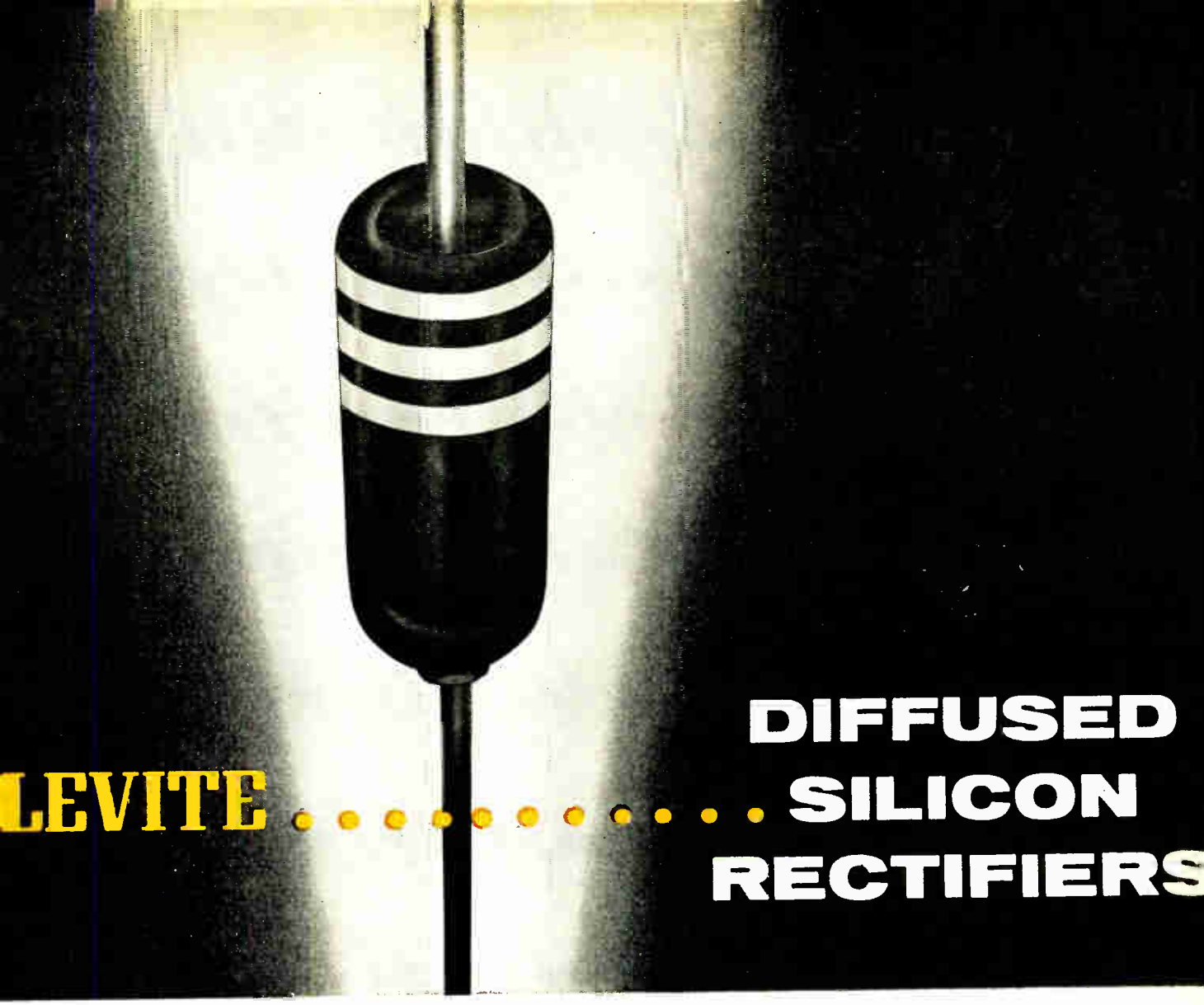
  Committee staff men say charges have been made that military contracting officers favor companies already tooled up at government expense in competition for new orders. Even more significantly, they say, the competitive edge may be carried into civilian markets if large contractors get to use idle military-owned gear for commercial work.

  Also, the committee is readying a report criticizing large contractors who keep work that could be subcontracted. The report will emphasize economic advantages of subcontracting.

- **Washington insiders** say the Department of Labor will issue its definition of the aircraft and missile industries in a month. This will be the first step in the aircraft industry's plea that electronics firms in missile work be required to pay the same minimum wages as the aircraft makers.

  In case of a delay in getting the definition issued, aircraft and electronics companies plus the two major unions involved will get a chance to look over the Pentagon's secret breakdown of missile contractors by industry. This is the report on which the Labor Dept. definition is to be based.

  Sources say the report is inconclusive and demonstrates no clear-cut edge to either industry. As one insider comments, "The definition will turn out to be either a purely political decision, or it will be a compromise."



CLEVITE DIFFUSED SILICON RECTIFIERS

TECHNICAL DATA:			
Diode Type	Maximum DC Inverse Operating Voltage (volts)	Maximum Average Forward Current @ 25°C (ma)	Maximum Forward Voltage Drop @ 25°C (volts @ ma)
1N645	225	400	1.0 @ 400
1N647	400	400	1.0 @ 400
1N649	600	400	1.0 @ 400
1N677	100	400	1.0 @ 400
1N681	300	200	1.0 @ 200
1N683	400	200	1.0 @ 200
1N685	500	200	1.0 @ 200
1N687	600	200	1.0 @ 200

Clevite offers silicon rectifiers designed for maximum reliability in the severest military and commercial applications.

Check these features:

- **HIGH DISSIPATION — 600 mw**
- **SUBMINIATURE GLASS PACKAGE**
- **HIGH VOLTAGE — up to 600 volts**
- **HERMETICALLY SEALED**
- **HIGH TEMPERATURE OPERATION — up to 150 ma at 150°C**

For details, write for Bulletin B217A-3

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Cleveland Graphite Bronze • Brush Instruments • Clevite Electronic Components • Clevite Harris Products • Clevite Ltd. • Clevite Ordnance • Clevite Research Center • Texas Division • Intermetall G.m.b.H.

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CLEVITE
TRANSISTOR PRODUCTS
241 CRESCENT ST., WALTHAM 54, MASS.
TWinbrook 4-9330

CIRCLE NO. 13 READER SERVICE CARD

The care and feeding of a missile system

It takes more than pressing a button to send a giant rocket on its way. Actually, almost as many man-hours go into the design and construction of the support equipment as into the missile itself. A leading factor in the reliability of Douglas missile systems is the company's practice of including all the necessary ground handling units, plus detailed procedures for system utilization and crew training. This complete job allows Douglas missiles like THOR, Nike HERCULES, Nike AJAX and others to move quickly from test to operational status and perform with outstanding dependability. Douglas is seeking qualified engineers and scientists for the design of missiles, space systems and their supporting equipment. Some immediate openings are described on the facing page. Please read it carefully.

Alfred J. Carah, Chief Design Engineer, discusses the ground installation requirements for a series of THOR-boosted space probes with Donald W. Douglas, Jr., President of DOUGLAS

MISSILE SYSTEMS ■ SPACE SYSTEMS ■ MILITARY AIRCRAFT ■ JETLINERS ■ CARGO TRANSPORTS ■ AIRCOMB ■ GROUND-HANDLING EQUIPMENT

New Stock Split Planned

DIRECTORS of the **Magnavox Co.**, Ft. Wayne, Ind., are recommending to company shareholders a stock split on a two-for-one basis. A vote will be taken at the company's annual meeting slated for Oct. 28. Stockholders will also be asked to vote on an increase in authorized shares from 2 million to 3½ million. Also slated is a stock dividend of 37½ cents per share payable on Sept. 15 to stockholders of record Aug. 25.

• **Theta Instrument Corp.**, Saddle Brook, N. J., announces investment of $50,000 by **Payson & Trask** for expansion. Investment is in the form of 10-year subordinate notes with option to buy common stock. Theta manufactures test equipment for servo components. The firm produces a full line of gear which measures synchro and resolver component performance as units or as systems. The firm reports expectations of doubling sales during the coming year.

• **Lockheed Aircraft Corp.**, Burbank, Calif., reports completion of plans to acquire 100-percent ownership of the assets and business of **Stavid Engineering**, Plainfield, N. J., subject to approval by Stavid stockholders. Target date for the operation is Sept. 28. The two firms have been discussing these plans since last May. If the plan becomes final, Stavid's assets and business will continue under the Stavid name with present personnel and policies.

• **Electronic Specialty Co.**, Los Angeles, has announced plans to acquire **Systems Laboratories Corp.**, Sherman Oaks, Calif. a firm in the field of design and analysis of space-age weapons systems. If acquisition plans are approved by stockholders, SLC will operate as a division of Electronic Specialty, which has also recently acquired Technicraft Laboratories in Connecticut and Electrical Engineering & Manufacturing Corp. of Los Angeles.

• **Laboratory For Electronics**, Boston, reports gross income for the fiscal year ended April 24, 1959 as more than double last year's. The 1959 total is $20,400,000 as compared with 1958's $9,429,000. Net income of $578,000 for this fiscal year is more than ten times last year's.

• **Motorola, Inc.**, Chicago, announces net sales for the second quarter of this year increased 49 percent over second quarter 1958. This year's second quarter net sales total is $65,214,062. Net earnings totaled $3,269,944, four times higher than last year. Second quarter sales were 2.4 percent higher than first quarter for this year and earnings were up 25 percent.

25 MOST ACTIVE STOCKS

WEEK ENDING AUGUST 14

	SHARES (IN 100's)	HIGH	LOW	CLOSE
Avco Corp	1727	14⅜	12⅞	14
Gen Tel & Elec	1161	78½	75½	76⅛
Sperry Rand	1132	24⅜	23¼	24
Intl Tel & Tel	1115	36	33	34¾
Raytheon	1088	51⅛	45¾	49¼
El-Tronics	1058	1¾	1⅛	1¾
Texas Instr	931	131¾	115	128¼
Zenith	931	109⅝	97½	105
RCA	890	64⅝	60½	63½
Gen Dynamics	714	51¼	49⅜	51¼
Emerson	650	16⅞	14⅛	15¾
Philco	593	26¼	23	25¾
Hoffman Elec	583	28⅜	23⅞	27⅛
Gen Electric	567	81⅝	79⅛	81½
Dynamics Corp	496	10⅜	8¼	10
Elec & Mus Ind	486	7⅛	6⅞	7⅛
Litton Ind	482	112¼	102	107½
Univ Control	460	17⅞	16¾	17½
Reeves Soundcrft	435	9¼	8½	9
Beckman Instr	389	58⅞	53¼	55¾
Siegler Corp	389	30¾	26¼	29
Lear	379	15¾	14⅛	15
Westinghouse	358	92⅛	87¾	92⅛
Burroughs	344	33½	32¼	32⅜
Muntz TV	335	2⅝	2⅜	2½

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.

NEW PUBLIC ISSUES

	No. of Shares	Issue Price
Foto-Video Labs	150,000	2*
Dynex Inc.	120,000	5
Cubic Corp.	105,000	12
York Research	150,000	3

* approx.

STOCK PRICE AVERAGES

(Standard & Poor's)	Aug. 12, 1959	July 15, 1959	Change From One Year Ago
Electronic mfrs.	87.95	100.92	+54.5%
Radio & tv mfrs.	111.15	115.18	+112.6%
Broadcasters	99.29	105.25	+51.1%

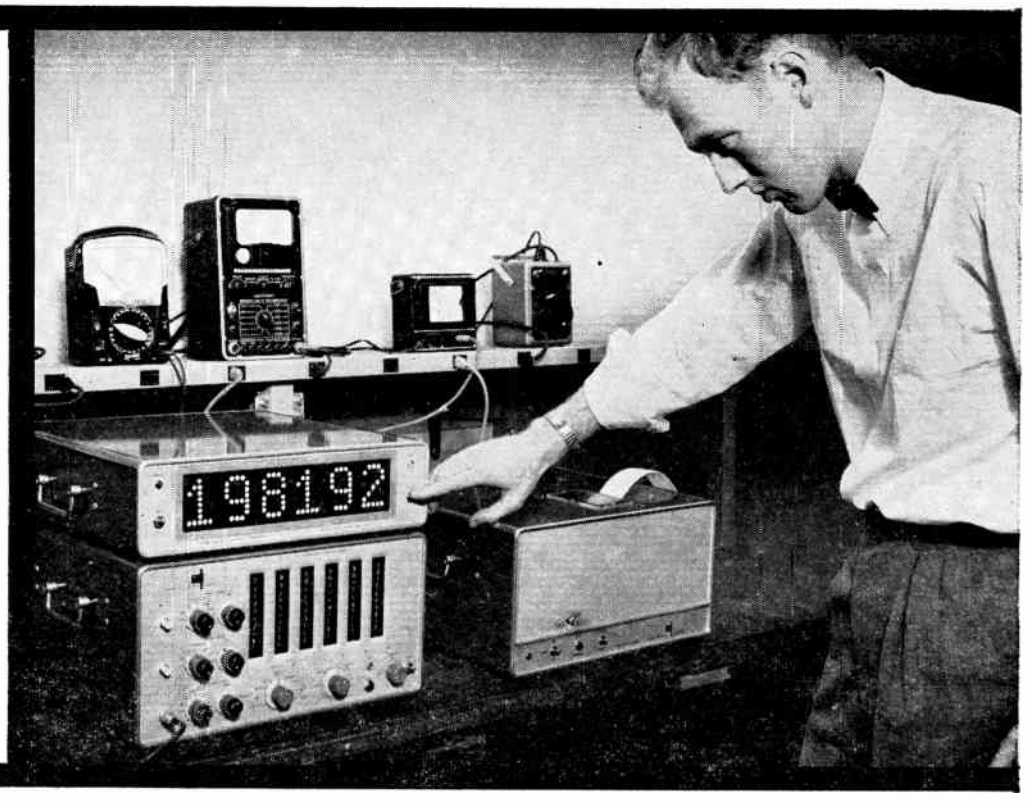
Count, Read, Print

with CMC's COMPLETE NEW PACKAGE

UNIVERSAL COUNTER & TIMER
0 cps to 1 mc
3 microseconds to 1,000,000 seconds

READABLE READOUT
Inline-Inplane, up to 12 presentations per second

FAST PRINTER
Permanent printed record at 4 lines per second



CMC's complete counting, timing, and frequency measuring system for laboratory and industrial use.

KEY SPECIFICATIONS

	Model 226A Universal Counter & Timer	
Ranges		
Frequency	0 cps to 1 mc.	
Time Interval	3 μsec to 10^3 sec	
Period	10 μsec to 10^6 sec	
Accuracy	$\pm$1 count $\pm$ crystal stability	
Crystal Stability	$\pm$3 parts in 10^9 per week	
Sensitivity (all functions)	0.2 v rms	
Oscilloscope Trigger Level Marker Signals	Start and stop channel trigger level adjustment for time interval measurement of complex wave forms; trigger level adjustment for amplitude discrimination in frequency and period measurement.	
Decimal Point Indication	Automatic	
Price (f.o.b. factory)	$1100.00	
	Model 400C Digital Printer	**Model 401A In-Line Readout**
Capacity	6 digits—Up to 12 digits optional	6 digits
Max. Cycling Rate	4 lines per second	12 presentations per sec.
Digit Size		1⅜" W x 2¼" H
Accuracy	Identical to counting instrument	
Input Requirements	4 line 1-2-2-4 code from counting instrument (adaptable to 1-2-4-8)	
Price (f.o.b. factory)	$950.00	$870.00

Now, at the lowest cost in the industry, you can get high quality advanced counting, timing, and frequency measuring instrumentation from CMC.

Using CMC's new *readable* readout and fast printer working in combination with the Model 226A 1 mc Universal Counter and Timer, you can measure, read, and record frequency, frequency ratio, period and time interval. Thru the use of standard transducers, basic physical quantities such as pressure, velocity, acceleration, displacement, flow, rps, and rpm can be measured, read, and permanently recorded. The Model 226A is also a convenient secondary frequency standard providing a time base for other instrumentation. All instruments feature unitized construction for structural strength and reduced weight.

Compare these key specifications before you choose.

For a demonstration, contact your nearest CMC engineering representative. For complete technical information, please write Dept. 188

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A Division of Pacific Industries, Inc.
12970 Bradley Ave., Sylmar, California

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GENERAL SALES MANAGER

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TWO FORWARD STEPS
IN VOLTAGE REGULATION
WILL SAVE YOU MONEY

Over four years of development, design and improvement of manufacturing methods in the Sola labs and plant have finally resulted in two advances in the voltage regulating field:

> A new "standard" Sola Constant Voltage Transformer provides famous Sola ±1% regulation, along with SINUSOIDAL OUTPUT AT NO PRICE PREMIUM OVER OTHER MAKES OF STATIC-MAGNETIC REGULATORS.
>
> Many "normal-harmonic" types of the Sola CV have been REDUCED IN PRICE, thus opening to you the benefits of supply voltage regulation in new fields where cost has heretofore been a deterrent.

The new Sola Standard Sinusoidal Constant Voltage Transformer affords all the proved benefits of a static-magnetic regulator. It provides output voltage regulation of ±1% for line voltage variation as great as ±15%. It provides completely automatic and continuous regulation, with output having less than 3% rms harmonic content.

In addition to the improved output wave form, the new design is substantially smaller and lighter than previous models. Because of design and production innovations, it is relatively compact compared to other equipment for comparable ac voltage regulation. It costs about the same as previous models which did not have sinusoidal output. This sine wave output feature at such a low cost permits use in many applications requiring harmonic-free input where previously the cost was prohibitive.

The sinusoidal output feature contributes to ease of selection and ordering. The buyer merely selects the stock unit whose output capacity equals or exceeds the desired equipment input. Formulae based on sinusoidal wave shape may be used in designing related load

... please turn page

... continued from preceding page

circuitry. The Sola Standard Sinusoidal CV Transformer is available in nine stock output ratings from 60va to 7500va.

The "Normal-Harmonic Type" -- the familiar "Sola CV" -- had become the "standard of the industry" for static-magnetic voltage regulation by virtue of its outstanding performance for over fifteen years. Now it, too, has been given a comprehensive re-design treatment which has yielded the same kind of weight and size reduction secured in the new sinusoidal type -- and without sacrificing the performance for which it was widely recognized.

Cost savings from this four-year program of refinement are NOW PASSED ON TO YOU in the form of appreciable price reductions on many of the most popular ratings. You can now consider the benefits of closely-regulated supply voltage for your equipment at less cost than ever.

With electrical control systems and components continuing to increase in number and complexity, and imposing more rigid reliability requirements, these new Sola Constant Voltage Transformers provide many advantages and virtually unlimited application. They are ideal where utmost reliability is required, with no transformer maintenance.

We would welcome the opportunity to provide you with more detailed information. Please write for Sola Product Bulletins for data on our stock models. Or write or call for full information on custom units for specific requirements, available in production quantities. Your request will be promptly handled.

Sincerely,

SOLA ELECTRIC CO.

Nelson P. Marshall

Nelson P. Marshall
General Sales Manager

VERSATILE

Multi-channel—telegraph A1 or telephone A3

STABLE

High stability (.003%) under normal operating conditions

RUGGED

Components conservatively rated. Completely tropicalized

FROM GROUND TO AIR OR POINT TO POINT

Here's the ideal general-purpose high frequency transmitter! Model 446, suitable for point-to-point or ground-to-air communication. Can be remotely located from operating position. Coaxial fittings to accept frequency shift signals.

This transmitter operates on 4 crystal-controlled frequencies (plus 2 closely spaced frequencies) in the band 2.5-24.0 Mcs (1.6-2.5 Mcs available). Operates on one frequency at a time; channeling time 2 seconds. Carrier power 350 watts, A1 or A3. Stability .003%. Nominal 220 volt, 50/60 cycle supply. Conservatively rated, sturdily constructed. Complete technical data on request.

Now! Complete-package, 192 channel, H.F., 75 lb. airborne communications equipment by Aer-O-Com! Write us today for details!

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A-131

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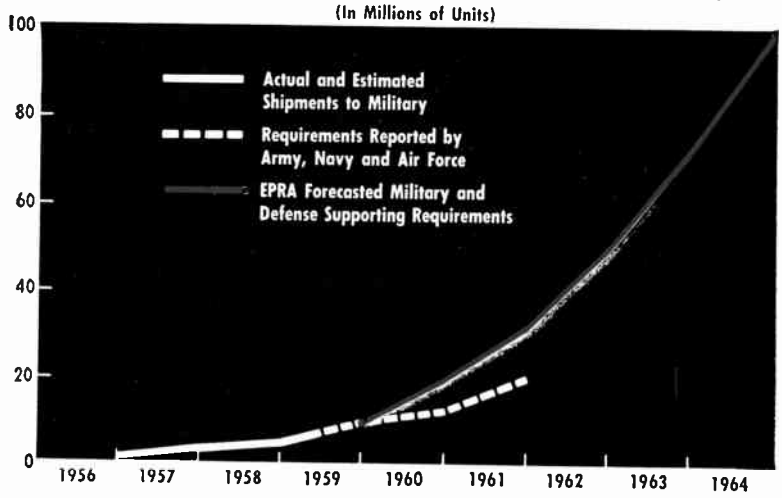
PROJECTED MILITARY TRANSISTOR REQUIREMENTS
(In Millions of Units)



Military Transistor Needs To Rise

ELECTRONIC Production Resources Agency's recently issued report on Military Transistor Requirements will gladden the hearts of market-minded members of the electronics industry. Copies are available from the DOD agency, Washington 25, D. C.

It lists the minimum transistor requirements by type of the Army, Navy and Air Force for the period July 1959 to December 31, 1961—a total of 38 million units and 565 transistor types. Air Force requirements are 21.7 million units; Navy — 12.1 million; Army — 4.2 million.

In addition, EPRA forecasts the total demand for military transistors through 1964. The agency expects that military demand will be at the annual rate of 100 million units by end of 1964 as shown in the chart above. This compares with estimated overall military demand of 7.5 million units at mid-1959 and 10 million units at end of this year.

EPRA's chart forecasts exceed the requirements reported by the Army, Navy and Air Force through 1961, also shown on the chart, as they include, in addition to the requirements of the three services, the needs of defense supporting groups such as FAA, NASA and NSA.

Summary highlights of the report are listed in the summary tabulation and graph, discussed above. But, the meat of the report is in the following detail tables which list the transistor unit requirements for each service by six-month intervals over the two and a half year period ending Dec. 1961.

Following tabulation lists the unit requirements for 32 transistors in heaviest demand. These account for 80 percent of total military requirements.

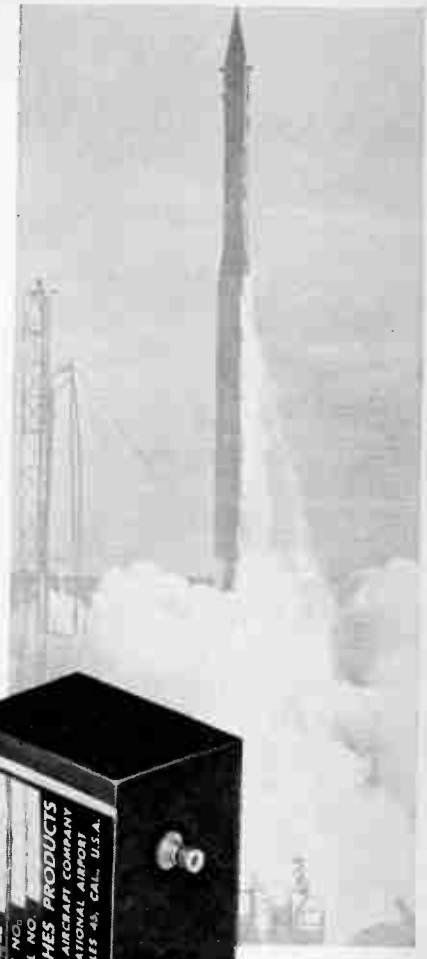
2N43/A	475,999	2N501	2,803,034
2N122	251,379	2N559	1,389,066
2N217	663,930	2N560	743,640
2N219	229,589	2N582	411,131
2N269	386,780	2N1103	1,633,565
2N317	239,126	2N1104	1,374,903
2N335	222,175	2N1105	273,297
2N338	203,127	2N1106	894,527
2N343	296,017	2N1115	266,776
2N384	478,456	2N1122	938,016
2N393	1,237,268	2N1135	2,580,044
2N396	6,300,169	NAA317	386,271
2N398	475,380	GT-792	239,493
2N404	766,516	T1073	995,895
2N428	248,406	TA-1711A	210,959
2N499	291,060	L5129	2,808,277

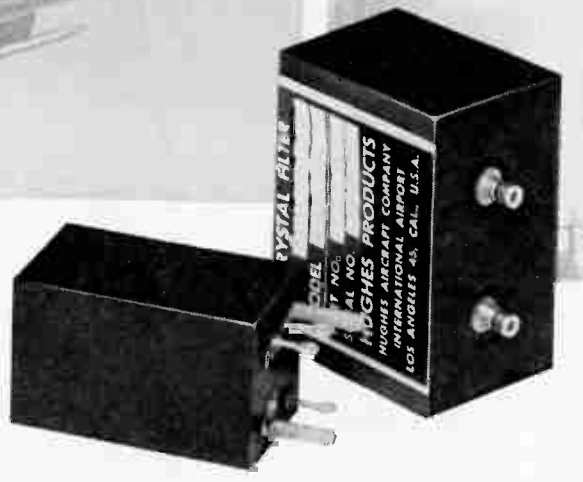
EPRA may soon issue more details on transistor requirements. It has prepared data on military usage by significant types, systems and major assembly which is currently under security classification review. A spokesman for the agency also indicates the possibility of future issuance of studies of military requirements for other components.

FIGURES OF THE WEEK

LATEST WEEKLY PRODUCTION FIGURES

(Source: EIA)	Aug. 7 1959	July 10 1959	Change From One Year Ago
Television sets	121,581	73,087	+6.1%
Radio sets, total	184,692	198,096	+9.8%
Auto sets	39,219	71,369	−8.1%





If you're looking for a high-performance crystal filter

At your service is a group of highly talented Hughes Crystal Filter engineers who specialize in solving difficult network problems. These men can design and produce a crystal filter to meet your most exacting requirements! In addition, Hughes offers you tremendous production capacity—over 10,000 filters per month of a single type. With Hughes Crystal Filters you get:

Precise Selectivity—Eliminates cross talk between channels, makes new systems possible.

Small Size—Reduces overall equipment size, makes filter more reliable by eliminating air space, results in higher stress factor.

High Frequency—Saves circuit costs, eliminates the need for double conversion. Center frequencies 30 kc to 40 mc.

Low Passband Ripple—Eliminates errors in information, enables end equipment to be more precise.

Wide Temperature Stability—Provides flexibility of use, contributes to high reliability.

Low Insertion Loss—Enables system to operate on low signal level—thereby combating noise and cutting circuit costs.

To avail yourself of the Hughes applications engineering service, or for additional information concerning performance levels please write: HUGHES PRODUCTS, *Industrial Systems Division, Marketing Dept., International Airport Station, Los Angeles 45, California. For Export, write: Hughes International, Culver City, California.*

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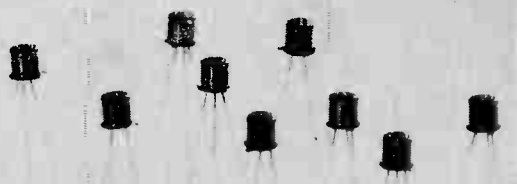
SEMICONDUCTOR DEVICES • STORAGE TUBES AND DEVICES • MICROWAVE TUBES • VACUUM TUBES AND COMPONENTS • CRYSTAL FILTERS • MEMO-SCOPE® OSCILLOSCOPES • INDUSTRIAL CONTROL SYSTEMS



NEW FAIRCHILD 2N706 provides

TRANSISTOR LOGIC OF MAXIMUM

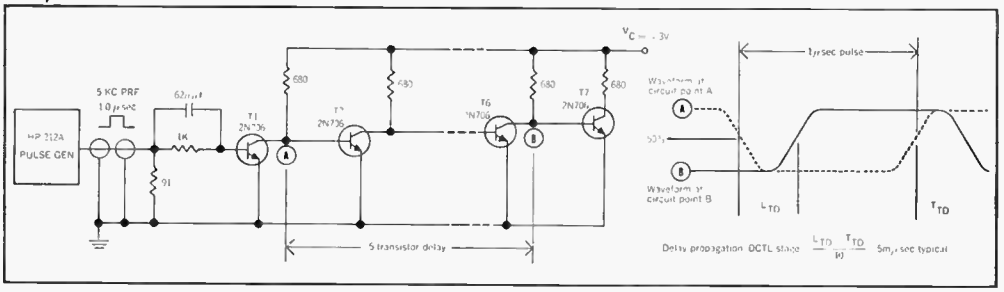
Saturating high-speed silicon logic ends the need to sacrifice one requirement in favor of another. The Fairchild 2N706 diffused silicon mesa transistor is as fast as the fastest germanium — and in addition has the inherent advantages of silicon. This combination fulfills all these logic-circuit design objectives:

SPEED	**10 megapulse operation saturated**
	25 megapulse operation nonsaturated
	Guaranteed low storage
RELIABILITY	**Large power reserve: 150 mW dissipation at 100° C ambient (no heat sink)**
	300° C stabilization of all units
	Rugged mesa construction
CIRCUIT SIMPLICITY	**Saturating logic with fewer components**
	3 to 5 milliampere current level
	Small JEDEC TO-18 outline

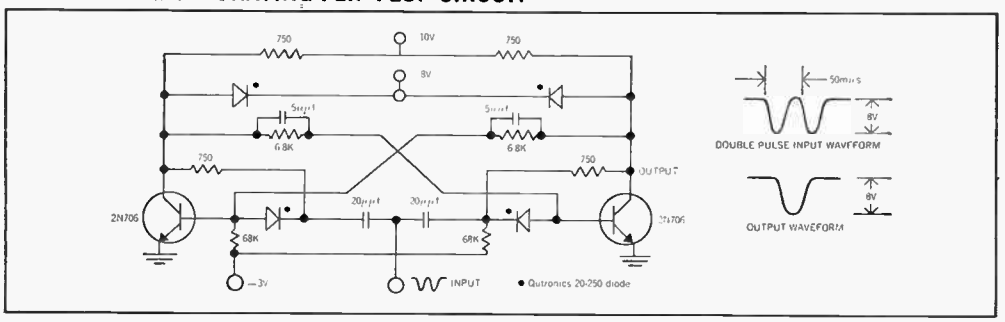
Fairchild's 2N706 provides optimum performance in the most-used logic circuit configurations and has a broad current and power range that covers many alternate approaches. It is ideally suited for high-density modular equipment because of its small size and its high performance in simple, low-power saturated circuits. The 10 megapulse speed is conservative, applying specifically to saturating logic and a 3 to 5 milliampere current level.

SPEED, RELIABILITY, SIMPLICITY

5 mμ SECOND PROPAGATION DELAY PER STAGE IN DIRECT COUPLED LOGIC



20 MEGACYCLE SATURATING FLIP-FLOP CIRCUIT



RATINGS AND CHARACTERISTICS (25° C) — 2N706 NPN DIFFUSED SILICON TRANSISTOR

Symbol	Characteristics	Rating	Min.	Typ.	Max.	Test Conditions	
V_{CBO}	Collector to base voltage	25 v					
V_{EBO}	Emitter to base voltage	3 v					
	Total dissipation, 100° C free air ambient	150 mw					
h_{FE}	D.C. pulse current gain		15			$I_C = 10mA$	$V_C = 10v$
$V_{BE(SAT)}$	Base saturation voltage				0.9	$I_C = 10mA$	$I_B = 1mA$
$V_{CE(SAT)}$	Collector saturation voltage			0.3	0.6	$I_C = 10mA$	$I_B = 1mA$
h_{fe}	Small signal current gain at f = 100 mc			4		$I_C = 20mA$	$V_C = 10v$
C_{ob}	Collector capacitance (140Kc)			3.5 pf	6 pf	$I_E = 0mA$	$V_C = 10v$

For specification sheets, write Dept. A-8

FAIRCHILD
SEMICONDUCTOR CORPORATION

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YORKSHIRE 8-8161 • TWX: MOUNTAIN VIEW CAL 122

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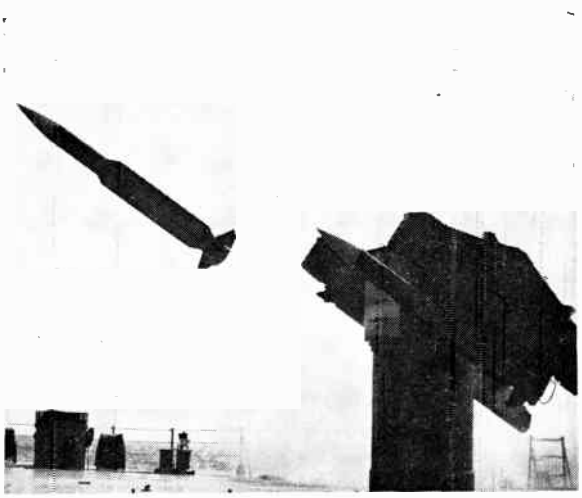


Weapon systems such as Army's new tactical air defense system, AN/MSQ-18, (right) now being deployed overseas, and Navy's ship-to-air Tartar missile, which will join the fleet next year, make bright . . .

Military Market Prospects

Despite defense spending level-off, electronics' share of the defense dollar will continue to rise due to increasingly sophisticated weapons systems. Contractual agreements, however, will get stricter

THE ELECTRONICS INDUSTRY'S biggest customer—the military—has had its checking account replenished with more than $4.5 billion for the year ending next June 30. The money is earmarked for both R&D and production of electronic equipment. This is slightly more than the sum Congress appropriated last year.

Actual expenditures on military electronics will run even higher than the new appropriation sum.

As most Pentagon budget experts see it now, total military spending will level off close to the $41-billion level in the near future. This is the rate of expenditures recorded in fiscal 1959, the rate predicted for the current year, and the rate set in preliminary budget schedules for fiscal 1961. In all, electronics accounts for about 25 percent of the total budget for military hardware.

Congress tinkered with individual defense projects. Funds for Nike-Zeus, Army arms procurement, antisubmarine defenses, and ICBM's were hiked. Budget for a super aircraft carrier, for the Mace, Nike-Hercules and Bomarc missiles, and Air Force ground radar replacement were slashed. But the administration's major defense proposals were accepted by Congress.

Expenditures for electronics, however, are expected to continue to inch up. The reason: electronics' increasing share of the dollar for aircraft and tactical military gear.

Dealings with Contractors

While this year's battle over the military budget is over, a new political fracas over procurement is shaping up in Washington which is sure to have an impact on military electronics contractors.

A new tone of hostility toward large defense contractors is apparent in Washington these days.

Congress is grappling with a way to clamp new restrictions on the industrial giants who produce for the Pentagon—the means by which they land their military contracts, the amount of profit they earn and the way they run their business.

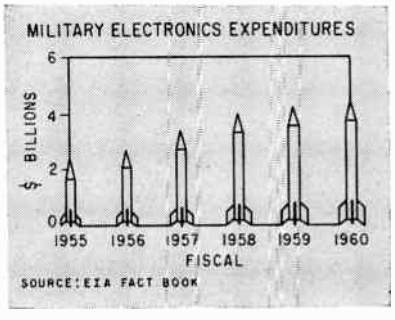
The lawmakers are investigating the concentration of military business among fewer companies; curbs on competition under "weapons-system management;" and the hiring of retired military brass by the big munitions makers.

General Accounting Office's recent claim that 26 Air Force and Navy contractors overcharged the Pentagon a total of $42.2-million on contracts in the past two years has put the spotlight on such issues.

Next year, a full-blown special Congressional inquiry into all facets of the multibillion-dollar-a-year munitions business will be conducted. The recent Renegotiation Act Extension authorized such a study.

Already, criticism from Congress has made a dent in procurement policy of the Air Force, the heaviest-spending service and chief target for all the criticism.

First, the Air Force has watered



down emphasis on weapons-system management. On major aircraft and missile projects, it plans to (1) freeze designs more quickly and contract directly with subsystem producers; (2) "break out" standard items such as compressors, motors, generators and the like from a system project for competitive bidding when volume production of the end-item is authorized; (3) conduct separate design competitions for major subsystems.

Criticism of the Air Force's system management scheme — from Congress, industry, and from within the Pentagon itself—has centered on the charge that Air Force contracting officers have "abdicated control" to the weapons-system primes, that the greater centralization of power in the hands of the primes has "stifled" competition for subcontract work.

But even more significantly, the Air Force is switching signals in the earlier stages of weapons-system management.

Up to now, the Air Force has allowed the winning team captain to pass on—with few if any questions asked—the associate prime contracts and the major subcontracts to the other companies who took part in the team bid proposal.

Now the Air Force is stressing its right to select one or more members of a team and to reject others.

More Cost Control

The Air Force's second reaction has been a tightening up on the review of cost estimates and price proposals made by contractors. Over 200 auditors have been added to the Air Force's payroll. In addition, the Air Force is taking a close look at price negotiations between its prime contractors and their subcontractors.

In some cases, prime contractors bought off-the-shelf components from their suppliers, told the Air Force these were specially designed items manufactured on a subcontract, and claimed the conventional prime-contractor profit allowance on subcontract work.

In other cases, the prime contractor failed to tell the Air Force his cost had been reduced on certain components now in heavier-volume production, continued to charge off the original higher price.

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with Cleco's 3-in-1 drill-screwdriver-nut runner

With the Cleco 10 Series Drill-Screwdriver-Nut Runner you save money because:

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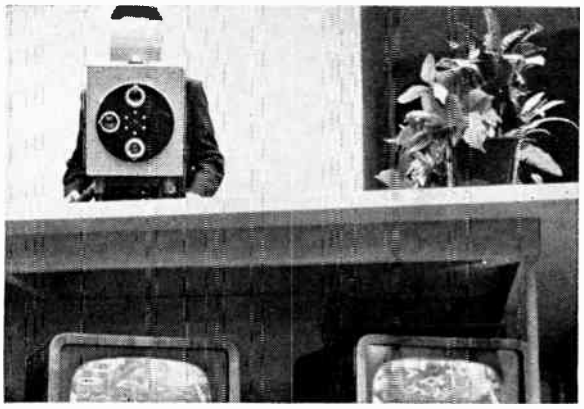

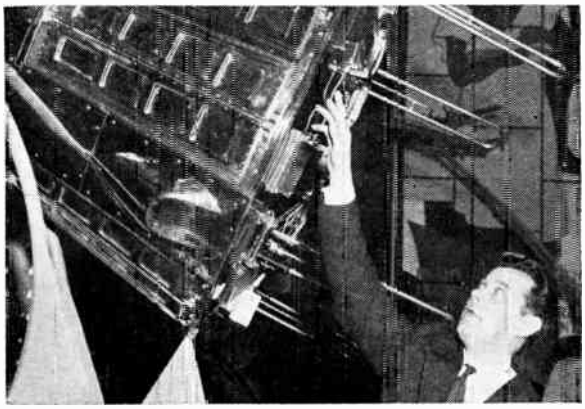

Soviet test instruments check out tv sets as well as sputnik gear. Sophistication of test equipment is clue to electronics progress . . .

How Good Is USSR Test Gear?

By **A. J. REYNOLDS,** Technical Information Corp., New York, N. Y.

THE LEVEL of Soviet electronics development was indicated to some extent by 30 pieces of test equipment at the Soviet Exhibition which closed this month in New York.

Of special interest were signal generators, oscilloscopes and vtvm's, these being among the basic tools of the electronics engineer.

Signal Generators Similar

In the case of signal generators, performance of the Russian units is close to that offered by Western manufacturers. The frequency range of the Russian units is, in general, more restricted than that of their Western counterparts. The reason for this probably lies in the lack of sales considerations in the USSR. Restricted range signal generators are easier to design and produce but are difficult to sell here.

Several signal generators shown use a common attenuator component. Four vhf-through-microwave generators use an essentially similar power supply and modulation unit. The modulation unit provides a main pulse, between 0.5 and 17 microseconds in length at a 100-cps to 4-kc pulse repetition frequency, together with a variably delayed sync pulse output. Outputs are calibrated in microwatts and output impedance of 75-ohms is used up to 1,000 mc.

Vtvm's occasioned mild surprise. One sensitive amplifier type is 10 mv full-scale and within specification to 10 mc. A diode type has a familiar ring to its specifications. They start: frequency range 20 cps —700 mc, input capacitance 1.5$\mu\mu$f. This specification can be met by at least half a dozen Western vtvm's.

The picture is different in the case of oscilloscopes. Three were on display. One was a wideband type 6 db down at 1,000 mc. It has no vertical amplifier, the tube sensitivity being 50 volts per centimeter. The fastest time base speed, however, is 10 millimicrosec for a full 10 cm sweep.

The second unit is a d-c to 1 mc (at 30 mv/cm) general purpose instrument; the third scope was a dual channel-wideband type. Time calibration for all three units is sine-wave Z-axis modulation.

Pulse generators seemed to be advanced in their specifications. One, the GJ-1, produces a pulse length variable from 7 millimicrosec to 500 millimicrosec. Width accuracy is 5 percent ±2 millimicrosec. Rise and fall times are quoted as 6 and 10 millimicrosec respectively. The prf is variable from 10 cps to 10 kc. A second type, the GJ-4M, is a highly accurate double pulse generator with a precision delay between the two pulses.

Various microwave equipments, mainly in X band, were also shown by the Soviets. A precision standing wave detector uses a common carriage and interchangeable slotted sections. Various X-band loads, attenuators and phase shifters have specifications comparable to the familiar U. S.-made types. The only spectrum analyzer shown covers a range of 30 to 1,000 mc.

One instrument, not commercially available here, is a signal generator voltage calibrator with frequency coverage up to 1,000 mc. This unit uses a wideband mixer and a standard attenuator operating at an intermediate frequency.

Automatic Testers Displayed

Instruments for automatic testing of radio and television equipment furnished a surprise to some. The radio version accepts a complete receiver in its access jig and performs a routine of 43 measurements. These include all the receiver parameters usually measured in final test. Failure of a test causes an audible alarm and the test number to be printed out on paper tape. Repeat tests can be set up by dialing the appropriate number on a telephone dial.

The television version has facilities for 12 checks.

The pattern of the USSR electronics industry appears to be one of a small number of specialized plants, each producing a limited range of instruments. Production types are decided by a regional economic committee which also maintains an inspection facility and critically examines cost closures when a batch is complete.

Army Show Stresses

Communications, surveillance gear and weapons for footsoldiers dominate AUSA meeting

WASHINGTON — ANNUAL MEETING of the Association of the U. S. Army earlier this month proved there are few modern weapons that don't rely on electronics.

Matter of fact, electronics dominated the exhibits at the show, with missiles and rocketry taking a second place. Lt. Gen. Arthur G. Trudeau, Army's chief of R&D, told the 3,500 who came to the meeting that electronics can be expected to surge beyond the boundaries of imagination within the next two years.

Trudeau added that size reductions achieved through such programs as the Signal Corps' micromodule project now permit cramming 700,000 parts in a cubic foot of space, compared with 7,000 a few years ago. Miniaturized radio systems and computers, he pointed out, are now outperforming their specifications.

Army Secretary Wilber M. Brucker commented on recent Signal Corps developments for effective battlefield surveillance and in advancing space science. According to Brucker, the Nike-Zeus, the only ICBM countermissile now in development, has reached a "high state of development."

(At the same time, Sperry Gyroscope revealed in New York that it has been working for two years on a high-power target-tracking radar transmitter for Nike-Zeus under a $4-million R&D subcontract from Bell Telephone Laboratories.

(The radar will obtain data for automatically directing the countermissile onto its target. Army Ordnance Missile Center is directing the development of the Nike-Zeus, with Bell Labs holding prime contractual responsibility.)

Missiles for Ground Troops

Convair division of General Dynamics showed the new Redeye guided missile at the AUSA meeting. The Redeye is designed to protect ground troops from low-flying craft on strafing or bombing missions. It is launched from a bazooka-like carrier (photo) 4 ft long, about 3 in. in diameter, weighing about 20 lbs.

Redeye guided missile is designed to protect ground troops from strafing and bombing

When a soldier detects a target, he aims the launcher at it; a buzzer in the gripstock tells him when the missile is ready to fire. When the target is in range, he fires; the booster burns out in the launcher tube, propelling the missile out of the tube. Delay before ignition protects the soldier from the main blast.

Missile Monitor

The "vest-pocket" tactical air defense system AN/MSQ-18 was given its first public demonstration on the lawn of the Sheraton-Park Hotel in Washington. The MSQ-18 is a piece of the larger Hughes Aircraft system for coordination of surface-to-air missile batteries called Missile Monitor.

Missile Monitor, one Army spokesman pointed out, differs from Missile Master (another missile fire-control system) in its mission. The latter system is meant for continental U. S. defense; Missile Monitor is designed to work with the field army.

Battlefield surveillance radars

such as Hazeltine's TPS-25 and Sperry's PPS-4 (see "New Radar Tells Target's Sex," ELECTRONICS, p 33, Aug. 14) were also shown at the AUSA show. Not on display was the AN/TPS-21 radar, 235-unit developed by the Navy and adopted by the Army for medium-range (5,500-11,000 yd) battlefield surveillance.

ARTOC Tactical System

These surveillance radars are part of the ARTOC project (Army tactical operations central), being developed for the Army by Aeronutronics division of Ford Motor Co. ARTOC is meant to give field commanders faster and more positive control of dispersed tactical elements than has hitherto been possible, includes surveillance, communications and electronic warfare (countermeasures) systems.

Drones are also a key part of surveillance operations, and several were displayed or discussed at the AUSA meeting. The SD-1 and SD-2 low-endurance drones are now operational, and limited quantities are being evaluated in the field.

SD-4 medium-endurance drone, called Swallow was revealed for the first time at the show. It is a pilotless jet, delta-winged, which can swoop over the battlefield and acquire data by radar, tv, photography or with infrared sensors. Developed by Republic Aviation, it will normally be used at corps level.

Automatic Switchboard

Cross-section models of the SD-5, built by Fairchild Engine & Airplane as a long-endurance drone, were also on display. SD-5 is also a delta-wing pilotless turbojet, can carry advanced types of sensors for longer missions than the SD-4, will function at army level.

New communications gear on display included ITT's Digicom, an automatic switchboard that bypasses damaged communications lines and reroutes messages according to priority over fastest available circuits. It can handle information from computers, radar, teleprinters, tape readers and telemetering systems.

How far can an engineer go at AC?

In a company so deeply involved in space age instrumentation projects . . . where you can grow through the finest "in house" training . . . where a new advanced R & D group is now operating—here, at AC, you can go as far as your imagination and initiative will take you.

Three advanced education programs can help you enhance your professional status. These are offered in addition to AC's educational assistance programs for men who wish to study for advanced degrees in nearby universities.

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AC's new R & D Group is devoted to the Research and Development of advanced systems and components. Current programs include many vital projects. Interplanetary navigation and guidance. Digital computer development. Advanced inertial sensors. Passive electromagnetic detection, surveillance and navigation systems. Guidance systems for ballistic missiles, space vehicles and aircraft.

If you are a graduate engineer in the electronics, electrical or mechanical fields, or if you have an advanced degree in mathematics or physics, you may be able to participate in these programs. For more details, write the Director of Scientific and Professional Employment, Mr. Robert Allen, Oak Creek Plant, Box 746, South Milwaukee, Wisconsin.

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AC SPARK PLUG ❀ THE ELECTRONICS DIVISION OF GENERAL MOTORS

Biax Promises Speed, Economy

New ferrite element for computers operates in multimegacycles, costs "few cents each"

LOS ANGELES—BIAXIAL FERRITE component for high-speed pulse applications was revealed here earlier this month by Aeronutronic division of Ford Motor Co.

The new magnetic device, dubbed Biax by inventor C. L. Wanlass, makes use of flux interference between orthogonal magnetic fields.

Biax units (photo) are small bars of ferrite material, 0.05 in. square by 0.085 in. long. Two holes, each 0.02 in. square, are formed into the bar orthogonal to each other.

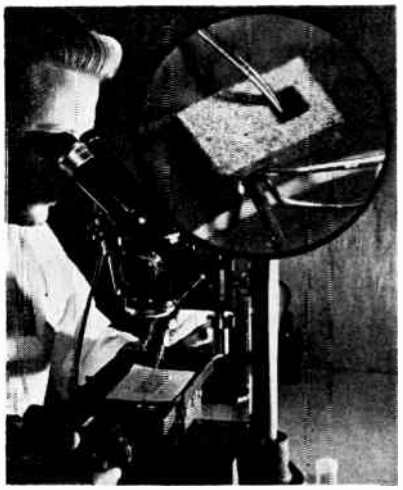
The units are made in two configurations. In one, the holes are separated by 0.02-in. thickness of material. In the other, the holes are tangent, sharing a common throughway. The former is used as a memory element, the latter as a switching or gating element.

Key advantages of the biaxial device over standard ferrite cores are that the memory element can be interrogated without destroying the stored information; and the logical element can be switched at multimegacycle rates without undue heating. Biax elements have been interrogated more than 100 billion times at 10 mc without loss in output signal. Operational gate and flip-flop circuitry has been developed and tested and 2 and 5 mc.

When used as a memory element, one hole in the biaxial bar operates as a storage axis and the other is used for interrogation. Flux interference takes place in the material between the holes. No normal magnetic coupling occurs between conductors passing through separate holes because of their orthogonal relationship.

Information lines and a sensing line pass through the storage axis. Information is stored by conventional coincident-current techniques, setting up a flux pattern in one direction or the other around the storage hole.

A pulse on the interrogating line then sets up a nondestructive interference with the existing flux, rotating the domains in the material between the holes. The sense of the rotation is picked up by the sensing line for readout. When the interrogation pulse has passed, the stored field resumes its former orientation.



Seen through microscope, tiny Biax has spaced orthogonal holes

In logic circuitry, the direct interference of the two orthogonal fields is used to perform gating functions. Gating signals are applied to one axis; a strobe and the output line pass through the other. If—and only if—all gating signals are "true," the strobe couples into the output line. Since the two apertures are tangent, the fields interfere destructively and information is not retained in the element.

In a flip-flop circuit, one biaxial element can substitute for from 6 to 10 semiconductors. In a typical computer, 3,000 biaxial elements might substitute for 12,000 to 15,000 semiconductor diodes or transistors.

Spokesmen told ELECTRONICS that the units will cost only a few cents each, are already in mass-production, and should reduce the cost of logic circuitry by a factor of 10. A complex of 200 flip-flops and 3,000 gates can be crammed, the company says, into $\frac{1}{10}$ cu ft.

MEETINGS AHEAD

Aug. 31-Sept. 1: Elemental and Compound Semiconductors, Tech. Conf., AIME, Statler Hotel, Boston.

Aug. 31-Sept. 2: Army-Navy Instrumentation Program, Annual Symposium, Douglas Aircraft and Bell Helicopter, Statler-Hilton, Dallas.

Sept. 1-3: Association for Computing Machinery, National Conf., MIT, Cambridge, Mass.

Sept. 3-6: Air Force Association's National Convention, Exhibition Hall, Miami Beach, Fla.

Sept. 7-12: Machine Searching and Translation, International Conf., Western Reserve Univ. and Rand Devel. Corp., Western Reserve Univ., Cleveland, O.

Sept. 14-16: Quantum Electronics Phenomena, Office of Naval Research, Shawanga Lodge, Bloomingburg, N. Y.

Sept. 15-17: Electronic Exposition, Twin Cities Electronic Wholesalers Assoc., Municipal Auditorium, Minneapolis.

Sept. 17-18: Engineering Writing & Speech, Dual National Symposium, PGEWS of IRE, Sheraton-Plaza Hotel, Boston; Ambassador Hotel, Los Angeles.

Sept. 17-18: Nuclear Radiation Effects in Semiconductors, USASRDL, Western Union Auditorium, New York City.

Sept. 21-25: Instrument-Automation Conf. & Exhibit, ISA, International Amphitheater, Chicago.

Sept. 22-24: Industrial Nuclear Conf., Armour Research Foundation & NUCLEONICS (McGraw-Hill), Morrison Hotel, Chicago.

Sept. 23-25: Non-Linear Magnetics and Magnetic Amplifiers, AIEE, ISA, PGIE of IRE, Shoreham Hotel, Washington, D. C.

Sept. 23-25: Residual Gases in Electron Tubes and Related High-Vacuum Systems, International Symposium, Italian Society of Physics, Como, Italy.

Oct. 12-15: National Electronics Conference, IRE, AIEE, EIA, SMPTE, Sherman Hotel, Chicago.

Mar. 21-24, 1960: Institute of Radio Engineers, National Convention, Coliseum & Waldorf-Astoria Hotel, New York City.

There's more news in ON the MARKET, PLANTS and PEOPLE, and other departments beginning on p 76.

QUIET...

as the whisper of a butterfly's wing...

because low noise and low hum are essential to hi-fi preamplifier performance, designers specify twin-triode

RCA-7025

The grace, lightness, and delicacy of the butterfly in flight seem to capture the *mood of quietude* so essential, so sought after by designers and by devotees of high-fidelity music reproduction.

Developed for high-gain, resistance-coupled "preamp" applications, high-mu twin-triode RCA-7025 is specially controlled for low noise and hum. A helical hairpin-type heater in each unit minimizes hum. In addition, RCA-7025 has an exceptionally sturdy cage assembly featuring short, stiff stem leads, oversized side-rods and micas of special design to reduce noise and microphonics.

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Hughes Research and Development Laboratories
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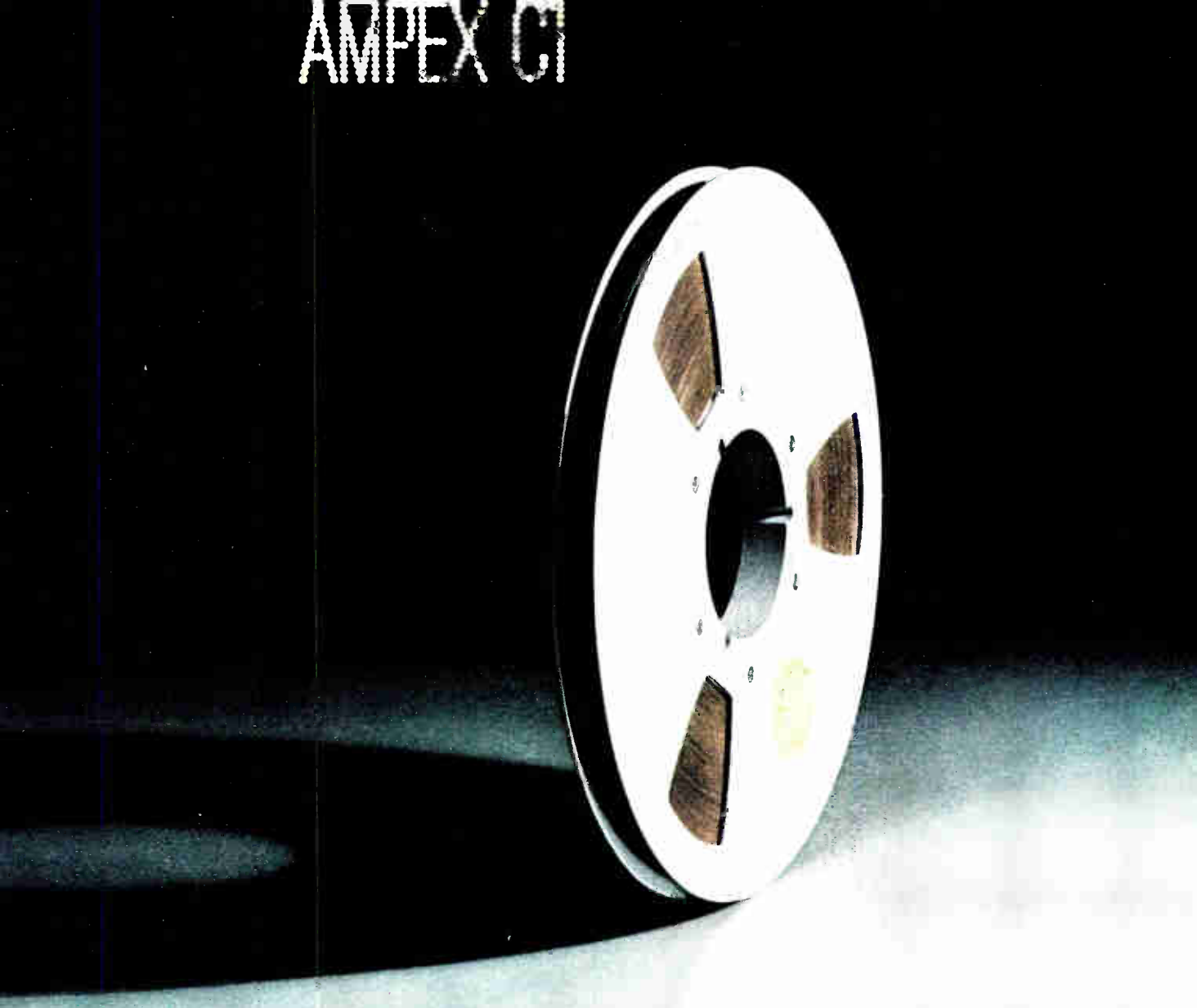
- ☐ DEVELOPMENT
- ☐ PRODUCT ENGINEERING
- ☐ TECH. ADMIN.
- ☐ SYSTEMS
- ☐ FIELD TEST
- ☐ OTHER:_____
- ☐ _____

I have had professional experience in the following specific areas:

- ☐ CIRCUIT ANALYSIS AND DESIGN
- ☐ DIGITAL COMPUTERS
- ☐ GUIDANCE DEVICES
- ☐ MICROWAVES
- ☐ STRESS ANALYSIS
- ☐ INDUSTRIAL DYNAMICS
- ☐ MATERIALS
- ☐ SYSTEMS ANALYSIS
- ☐ R-F CIRCUITS
- ☐ RELIABILITY
- ☐ ATOMIC AND/OR SOLID STATE PHYSICS
- ☐ INSTRUMENTATION
- ☐ ELECTRO-MECHANICAL DESIGN
- ☐ OTHER:_____
- ☐ _____
- ☐ _____

I have had a total of _____ years of experience.



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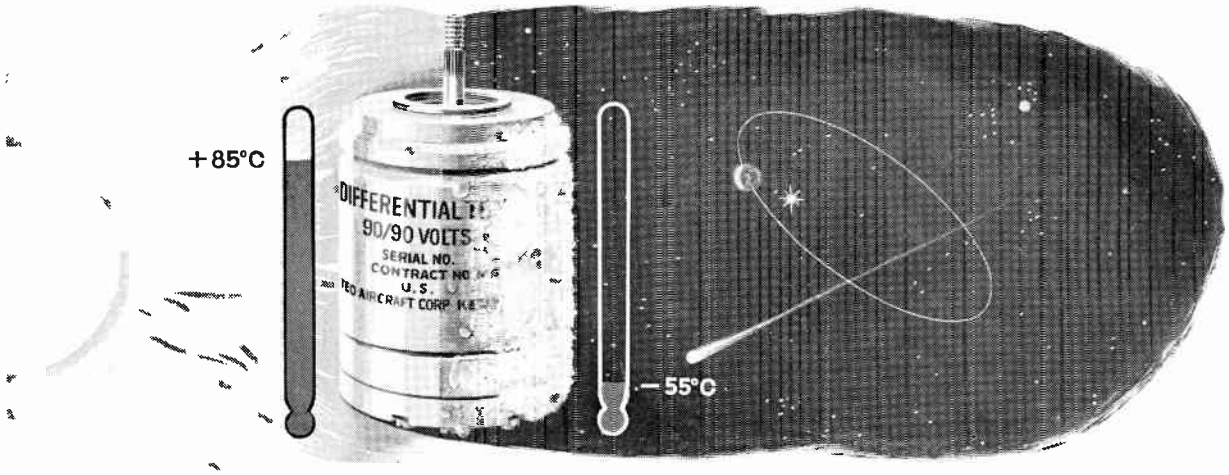
CAN A SYNCHRO MAINTAIN ACCURACY



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Synchros have to take punishment. They are often exposed to blistering heat and stratospheric cold . . . and they still must operate accurately.

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Ketay is the *only source* currently manufacturing and shipping a complete line of the new Mil-type synchros. They are available in production quantities in sizes from 8 to 23, with 60 cps units as small as size 15. Because of their superior accuracy, with some units offering 3′ accuracy at room temperature, Ketay synchros one or more sizes smaller than previously required may often be used.

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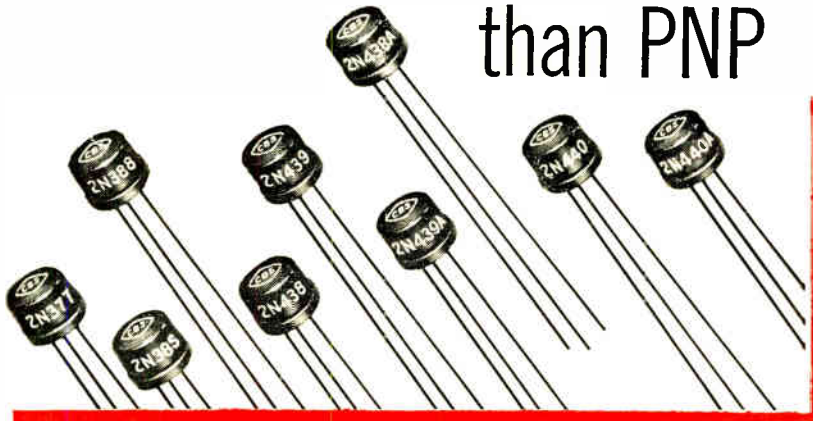
NPN switching transistors PROVE MORE RELIABLE than PNP

Some design engineers specify PNP switching transistors because they consider them inherently more reliable. Actually NPN transistors can give you superior reliability along with their well-known higher speed. Life tests covering hundreds of thousands of CBS NPN alloy-junction germanium switching transistors proved this during the past year. See graphs comparing these transistors with typical military-approved PNP transistors.



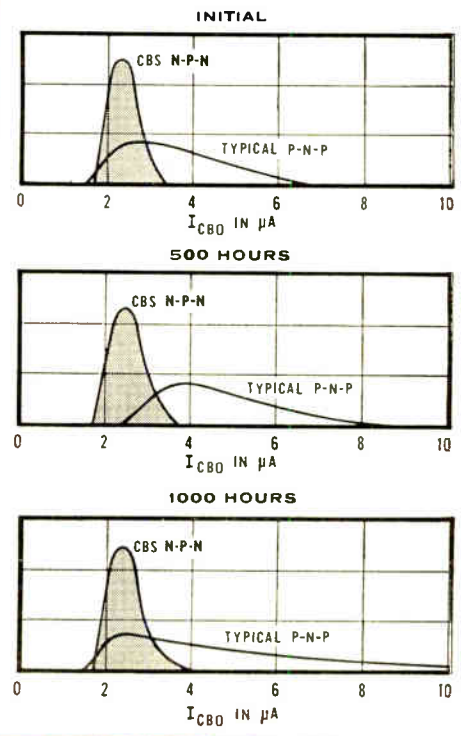
CBS NPN Switching Transistors

Type	Minimum BV_{CBO} (Volts)	Dissipation @ 25°C (Milliwatts)	Minimum h_{FE} @ I_C (Ma)		Typical $f_{\alpha b}$ (Megacycles)	Application
2N306	20	50	16*	1	1	Audio Driver
2N312	15	75	25	10	2	Switching
2N356	20	100	20	100	3	Core Driver
2N357	20	100	20	200	6	Core Driver
2N358	20	100	20	300	9	Core Driver
2N377	25	150	20	200	5	Core Driver
2N385	25	150	20	200	6	Core Driver
2N388	25	150	30	200	8	Core Driver
2N438	30	100	20	50	4	Logic Circuit
2N438A	30	150	20	50	4	Logic Circuit
2N439	30	100	30	50	8	Logic Circuit
2N439A	30	150	30	50	8	Logic Circuit
2N440	30	100	40	50	12	Logic Circuit
2N440A	30	150	40	50	12	Logic Circuit
2N444	15	100	10*	1	1	Switching
2N445	15	100	20*	1	3	Switching
2N446	15	100	30*	1	8	Switching
2N447	15	100	50*	1	10	Switching
2N556	25	100	15	10	1	Core Driver
2N558	15	100	20	10	3	Core Driver
2N634	20	150	15	200	8	Switching
2N635	20	150	25	200	12	Switching
2N636	20	150	35	200	17	Switching
2N1000	40	150	25	100	9	Core Driver
2N1012	40	150	40	100	5	Core Driver

*h_{fe} (a.c. gain)

Operating and storage temperature, T_j = −65 to +85°C

Comparative Life Tests
NPN vs. PNP Switching Transistors.



The superiority of CBS NPN transistors is achieved by special processing: For example, advanced surface chemistry techniques seal out moisture and contamination. Precise control of alloying produces high back voltages. Thorough bake-out stabilizes gain. The result is reliable NPN computer-type switching transistors featuring fast switching . . . high voltage . . . low cutoff current . . . and low saturation resistance . . . in a welded JETEC TO-9 package

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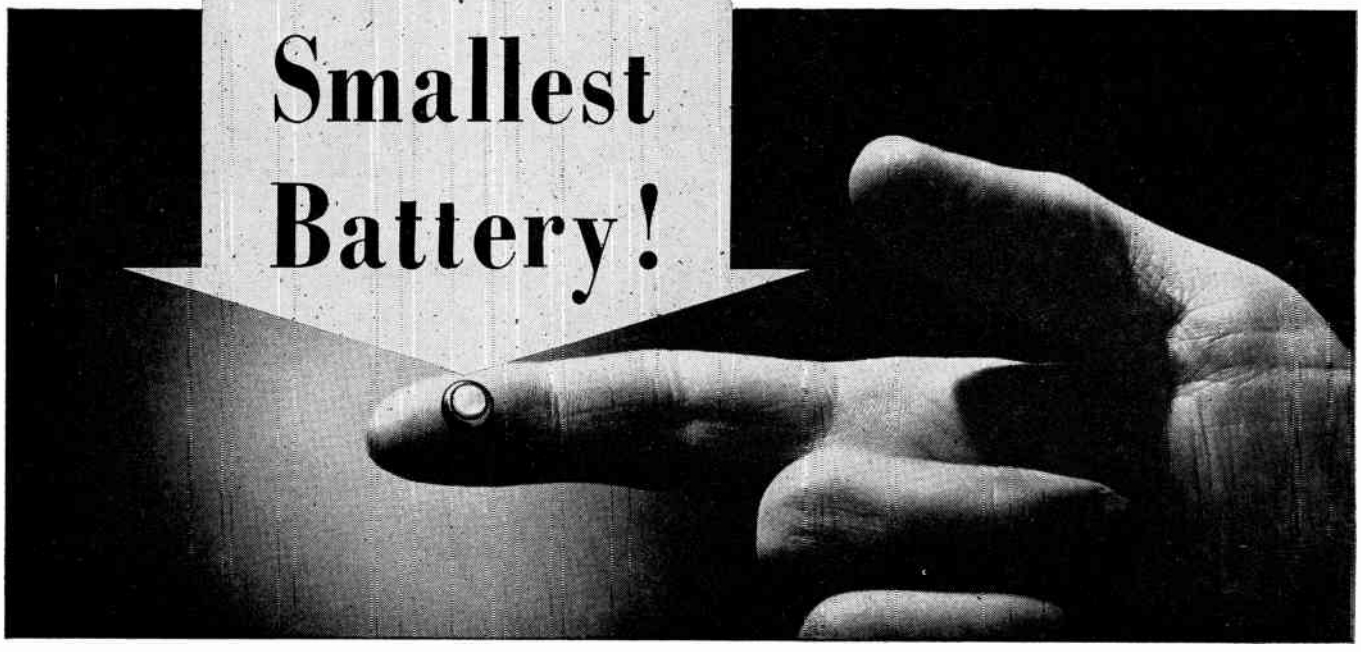

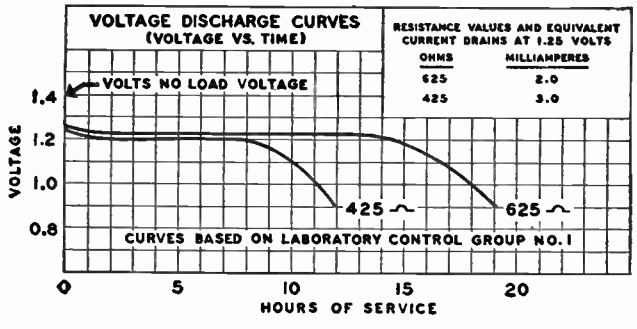

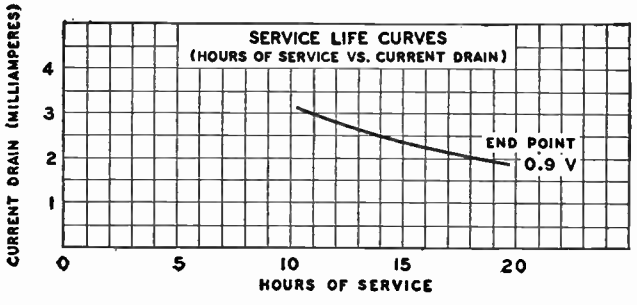

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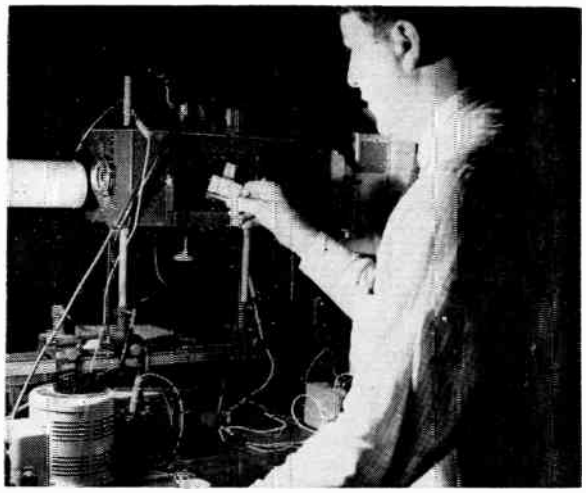


Coauthor Rennert inserts persistent internal polarization (p.i.p.) sample in housing as he prepares to test the effects of electromagnetic radiation and external fields on electrical energy storage in phosphors

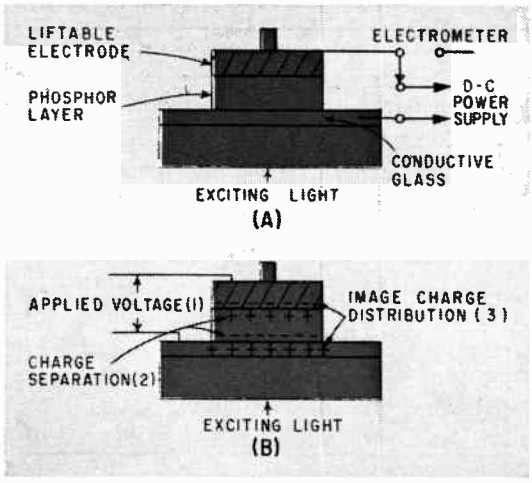


FIG. 1—Cross section of p.i.p. sample is shown in (A). Sequence of polarization (B) is: (1) application of voltage and excitation; (2) persistent charge separation in phosphor layer; (3) image charge distribution after grounding

Data Storage and Display With Polarized Phosphors

Research in photoconductors shows that a phenomenon known as persistent internal polarization may be used to store data on a phosphor by producing a separation of charges with d-c fields and radiation

By H. P. KALLMANN and J. RENNERT,
Physics Department, Institute of Mathematical Sciences, New York University, N. Y.

A PHENOMENON known as persistent internal polarization (p.i.p.) in phosphors shows promise in applications to information storage in computer memories and facsimile production processes. In both of these applications, information is impressed on the phosphor by producing a separation of charges in the phosphor body by d-c fields and radiation. The temporal sequence of irradiation and field depends on the specific application.

Data stored in the form of electrical polarization or the lack of it, can be reversibly retrieved by reirradiation in the absence of external fields, and may be read out on electrical measuring instruments. The stored information may be partially or totally erased by radiation, heat, a-c fields or combinations of these. It is also possible to obtain permanent visible records of the p.i.p. stored information by electrophotographic dyed resin powder development techniques.

HOW P.I.P. WORKS—This polarization is exhibited by many organic and inorganic phosphors, single crystals and in phosphor powder layers deposited alone or imbedded in a variety of polymeric matrices. The materials need merely exhibit different conductivities with and without excitation and should have some barrier at least at one electrode.

When two sides of the unexcited phosphor are

contacted by external electrodes and a field is applied, the phosphor's behavior is quite similar to an ordinary dielectric between two conductors; however, if the phosphor is exposed to exciting radiation, mobile charges are created and the application of an external field causes their migration through the phosphor. Electrons move toward the external anode and positive holes to the cathode, but because of trapping of these charges, a considerable number of them amass near the electrodes.

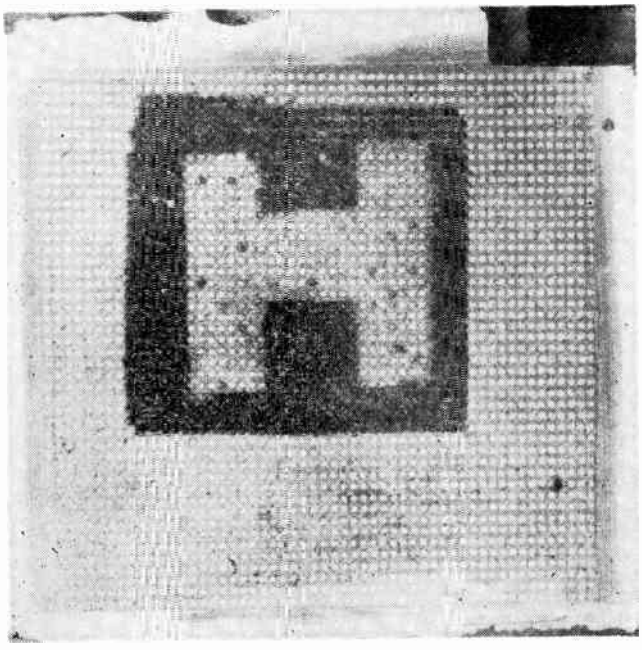
Removal of the exciting radiation results in a steep reduction in the number of mobile charges. Subsequent external voltage removal leaves the trapped charges in their trapped sites. Thus, a negative charge layer is found in the photoconductor persisting near the positive electrode and a positive layer near the negative electrode. Image charges at the external electrodes equilibrate with the nearest charge layers in the photoconductor on grounding, as shown in Fig. 1.

CHARGE LIBERATION—Liberation of the image charges which are approximately equal in magnitude and opposite in sign to those in the adjacent phosphor layer provides a means of measuring the internal charge separation. This liberation is done by either of the following methods. In the first, one of the external electrodes is merely lifted from the phosphor layer until the attraction between the charges in the phosphor and the electrode becomes insignificantly small. Thus, the image charge is freed. In the second method, irradiation of the polarized phosphor without the external field mobilizes charges. These mobile charges move so as to cancel the internal electric field produced by the charge separation. As a result, the image charges, no longer bound to the nearest charge layer in the phosphor body, are released.

Table I—Persistent Internal Polarization of Different Photoconductors[a]

Material	Sample Size	Polarizing Volts	Radiation	Time (min)	Charge (coulombs/cm²)
ZnCdS powder	28 mg/cm²	200	Visible	2	1.52×10^{-8}
ZnCdS powder (waxed)	25 mg/cm²	200	Visible	2	16.3×10^{-8}
Single CdS crystal	0.25 mm thick 15 mm² area	200	Infrared $\lambda>1\mu$	5	2.15×10^{-8}
Fused anthracene	80 μ thick 8 cm² area	80	Ultraviolet (near)	5	1.7×10^{-8}

(a). Polarization measurements in these samples were obtained after both polarizing electrodes had been kept at ground potential for one minute after excitation and external field application.



Crude negative photocopy appears on p.i.p. plate prepared by dispensing positively charged resin powder over latent image. Much higher quality reproduction is actually obtainable

The simultaneous application of approximately 200 v d-c and light excitation in a typical persistent internal polarization layer produces separated charge concentration between 10^{-8} and 10^{-7} coulombs/cm². Some results on various materials are shown in Table I. The sample capacitances are in the order of 10^{-11} farads/cm². The energy storage obtained in this way amounts to 10^{2} to 10^{3} ergs/cm² in typical zinc cadmium suffide layers. The energy release produced by radiation is quite efficient. It is possible to store even larger energies by use of special phosphor-imbedding matrices.

Polarization decays exponentially in dark storage, and half-lives which depend on the particular material are between 10^{3} to 10^{4} minutes under uncontrolled atmospheric conditions at room temperature, experiments show.

PREPARING P.I.P. LAYERS—The photoconductor powder is suspended in a solution containing a small amount of polymeric binder and is allowed to settle on a transparent conductive substrate. The solvent is allowed to evaporate and the exposed phosphor face is then contacted by either a movable or permanently connected electrical conductor depending on the particular application.

To produce a p.i.p. charge separation, the phosphor is exposed to any exciting radiation, which may be gamma rays, ultraviolet or visible radiation; simultaneously, from 50 to 500 v d-c are applied to the external electrodes. As an alternative, the field may be applied after irradiation. This is possible because many of the phosphors store excited electrons for extended time intervals. Charge displacements by external fields are possible as long as the phosphor remains energized.

After grounding of the external electrodes, charge separation persists as long as the phosphor remains in the dark.

MEMORY ELEMENT—The capacity of p.i.p. material for large energy storage per unit volume, the extended storage life as well as the complete reversibility of p.i.p., make it extremely useful for writing, storing or retrieving information. The stored energy, or lack of it, serves as the written message.

Two methods of information writing with p.i.p. will be described. The read-out process is the same for both and can be performed in fractions of a microsecond with the aid of a scanning beam of radiation. The access time to each bit is expected to be as fast as the reading beam can be directed to a location on the memory plate.

SELECTIVE IRRADIATION—The memory device consists of a normal p.i.p. plate. Writing is accomplished by selective irradiation of locations on the plate while an external d-c field is applied. Thus the information is stored on a location in the form of internal polarization which persists. This information may be read out any time thereafter. For this purpose, the respective phosphor locations are irradiated without external field present, and the magnitude of the released image charge for a specific location, which corresponds to the internal polarization, is measured. Its size supplies the information written on this location.

The feasibility of this approach has been demonstrated in the laboratory by applying an external voltage of 50 v d-c to the external electrodes on opposite faces of a partially de-excited p.i.p. plate for 10 seconds. During this period the phosphor is excited by a 2-microsecond light flash from an xenon flash tube to impress a polarizing light signal. After temporary grounding, one of the external electrodes is connected to the grid of a cathode-follower circuit whose output is fed into an oscilloscope. The arrangement is shown in Fig. 2. The written polarization information is read out by flash exposing the polarized plate and measuring the release voltage signal. In the writing process, if only an external voltage is applied to the p.i.p. plate without a writing light flash, a charge release of only one-third of that with flash is observed. This can be reduced by de-exciting the phosphor prior to application of voltage, or by applying the voltage for shorter time intervals. In this way the ratio of the read-out signal for written and unwritten phosphor locations can be increased. The stored polarization information is erased by exciting the phosphor without an external field.

SELECTIVE DEPOLARIZATION—Another method of writing starts with a uniformly polarized p.i.p. plate as the blank memory element. This is prepared by the application of a d-c voltage across a p.i.p. layer, preferably accompanied by uniform irradiation. Information is written on this memory plate by selective irradiation in the absence of an external field. This destroys the internal polarization of the exposed location. Hence, the stored data consists of the absence of polarization. The data is read out by sequential irradiation of specific locations. A small polarization release signal is produced by written locations and a large release signal by unwritten locations. This method of persistent internal polarization writing appears to be the most efficient.

P.I.P. PHOTOGRAPHY—In addition to data storage in computer memories, p.i.p. plates may be used in photoreproduction processes, producing an image of the intensity distributions of a beam of radiation. Such an image may be permanently recorded on a p.i.p. plate. Radiation may be in a region from gamma rays to the middle infrared. A latent image is produced by the radiation made visible by scanning each elemental area and observing polarization release voltage.

In one method, a light beam scans the latent image. This releases image charges to the grid of a cathode follower whose output is fed to an oscilloscope. When the sweep of the cro is coupled to that of the light-release scanning beam, and the released signal is fed into the Z-axis of the scope, beam intensities cor-

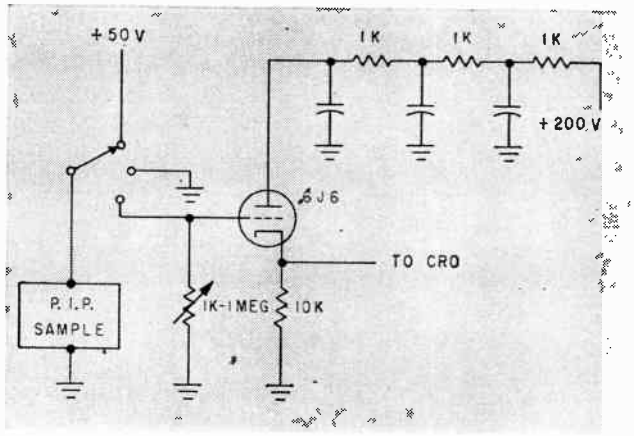


FIG. 2—Simple cathode follower circuit for read-out of polarization signals

respond to the polarization of irradiated locations. In this way, a visible image is seen.

It is also possible to obtain a permanent visible picture of the latent p.i.p. image by applying a dyed charged resin powder to the phosphor face. The powder adheres as the result of coulomb attraction in areas of high charge density.

ADVANTAGES—P.i.p. photography has a number of advantages over electrophotography. The latent image may be produced with or without the application of an external voltage. Any voltage used may be of the order of 100 v or less, while electrophotography requires kilovolts for operation. Since the charge separation in the sensitized plate is internal, it is stabilized against decay from atmospheric moisture. Either positive or negative reproductions may be produced. Flexibility of operations, in addition to the large range of magnitude of useful external voltages, permits control over the sensitivity of the process. Finally, the technique can be used for continuous tone as well as line reproduction work.

The support of the Office of Naval Research (Contract NOnr 285(25)), the Atomic Energy Commission (Contract AT (30-1) -1480) and the National Carbon Research Laboratories (Contract 8-8546-706) is gratefully acknowledged.

Improved Nondestructive

Method of measuring metal wall or plating thickness or detection of subsurface cracks and voids uses induced eddy currents. Variation of probe-to-specimen spacing is compensated by using two different induction frequencies

By W. J. McGONNAGLE, C. J. RENKEN and R. G. MYERS, Argonne National Laboratory, Lemont, Ill.

APPLICATION of eddy-current techniques to nondestructive testing is always hindered by the difficulty in separating desired information from irrelevant information which is always present. The effect of small variations in distance between the test probe and the specimen must be suppressed. Variations in probe-to-specimen spacing can be mechanically controlled by specially designed probes or electronic compensation may be used. In the system to be described, eddy currents of two different frequencies are induced in the specimen. One frequency is used to obtain the required information while the other is used to compensate for the variation in probe-to-specimen spacing and other undesirable effects. This dual-frequency eddy current system was developed for measuring the thickness of cladding on reactor fuel elements.

The system may be used for measurements of plating thickness, wall thickness of metal tubing and detection of subsurface cracks and voids.

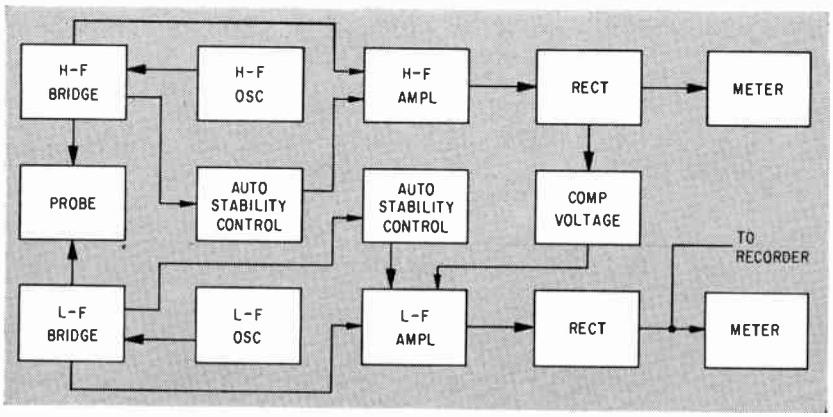


FIG. 1—Automatic stability contral maintains amplifier autput constant. High-frequency-channel compensating valtage controls low-frequency-channel gain

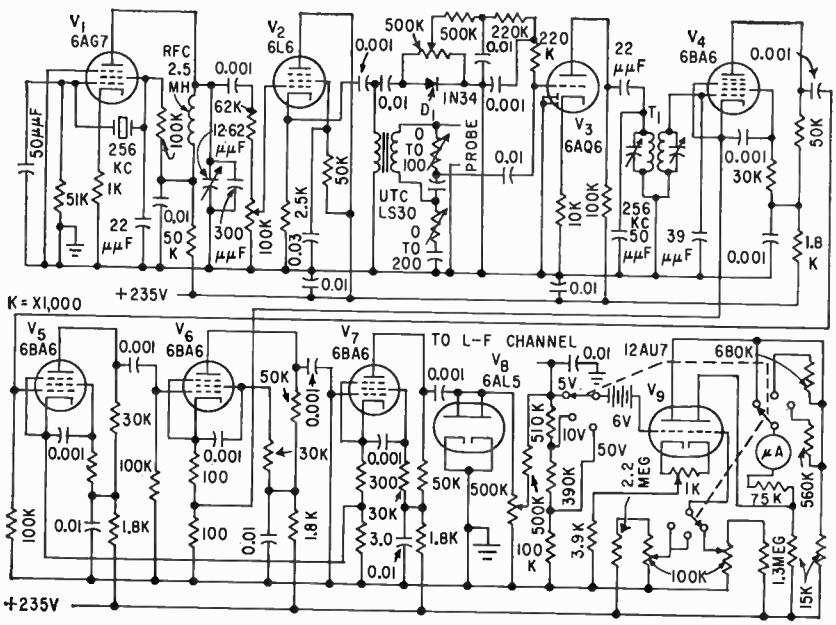


FIG. 2—High-frequency channel uses transformer T_1 to remave any law-frequency components induced in the circuit. Crystal-controlled oscillator operates at 256 kc

High-Frequency Channel

Figure 1 shows the dual-frequency eddy current system. The low-frequency channel obtains information concerning the thickness of the cladding material while the high-frequency channel is used to compensate for variations in probe-to-specimen spacing.

In the high-frequency channel, a sinusoidal voltage of 256 kc is generated and applied to the probe winding. It was experimentally found that at this frequency the depth of penetration was small compared to the cladding thickness. The probe forms part of a bridge circuit which is balanced when the probe is removed from the specimen. Any change in the probe field causes a change in the apparent impedance of the probe. This unbalances the bridge and causes a voltage to appear at the bridge output. Changing the spacing between the probe and specimen produces a change in probe impedance and consequently an output

Testing by Eddy-Currents

voltage. This output voltage is amplified, rectified and displayed on a monitor.

Low-Frequency Channel

The low-frequency channel operates similarly to the high-frequency channel. Frequencies in the range of 25 to 50 kc were found to be satisfactory. The low-frequency-channel amplifier gain is varied by a d-c voltage supplied from the high-frequency channel output. Thus, a change in probe-to-specimen spacing varies the gain of the low-frequency channel to compensate for variations in probe-to-specimen spacing.

The sensitivity of the low-frequency channel to changes in clad thickness is a function of probe-to-specimen spacing. The voltage produced by the high-frequency channel compensates for variations in probe-to-specimen changes and low-frequency channel sensitivity.

Probes of different inductances can be used if the bridge is balanced and high and low-frequency channel gains are adjusted.

Referring to the circuit diagrams shown in Figs. 2 and 3, note that the probe is a common element of each bridge. Consequently, the low-frequency is present in the output of the high-frequency bridge and the high-frequency is present in the output of the low-frequency bridge. Undesirable frequencies must be filtered out of each channel. High-frequency voltage is filtered out of the low-frequency channel by low-pass filter L_1, C_1 and C_2. Transformer T_1 performs the similar function for the high-frequency channel. The oscillators should provide a voltage with less than 5-percent distortion. Changes in oscillator output amplitude are compensated by diodes D_1 in each channel. A portion of the oscillator outputs should provide a voltage to V_3 of each channel. Changes in oscillator output changes the gain of each stage thus maintaining the output of the V_3 stage independent of random variations of oscillator output.

The conveyor and probe are shown in Fig. 4. The conveyor uses skewed rollers with rubber tires to rotate the specimen and provide lateral motion. Roller pitch is set so that each portion of the specimen is inspected with some overlap.

Calibration was made by machining an amount of cladding from a fuel rod. The amount machined off was determined by measuring the cladding thickness with a measuring microscope before and after machining. The sensitivity of the instrument was adjusted so that it measured the incremental change correctly, going from the machined portion of the fuel rod to the unmachined portion. Two sources of possible errors arise at this point. The machining creates a standard of slightly different diameter than the actual rod. This amounted to only about 0.8-percent diameter change, too small to cause any significant error since the instrument compensates for the small diameter changes. The other error arises because eddy-current measurements cannot be made at the rod end due to end effects, while optical measurements can be made only at the end. Consequently, it is necessary to assume that cladding thickness at a short distance from the end is the same as that of the end. Once the instrument sensitivity is adjusted to the proper value, a fuel rod of very uniform cladding is found and used as a standard for all subsequent measurements.

Technical development of the instrument was carried out by C. J. Renken and R. G. Myers.

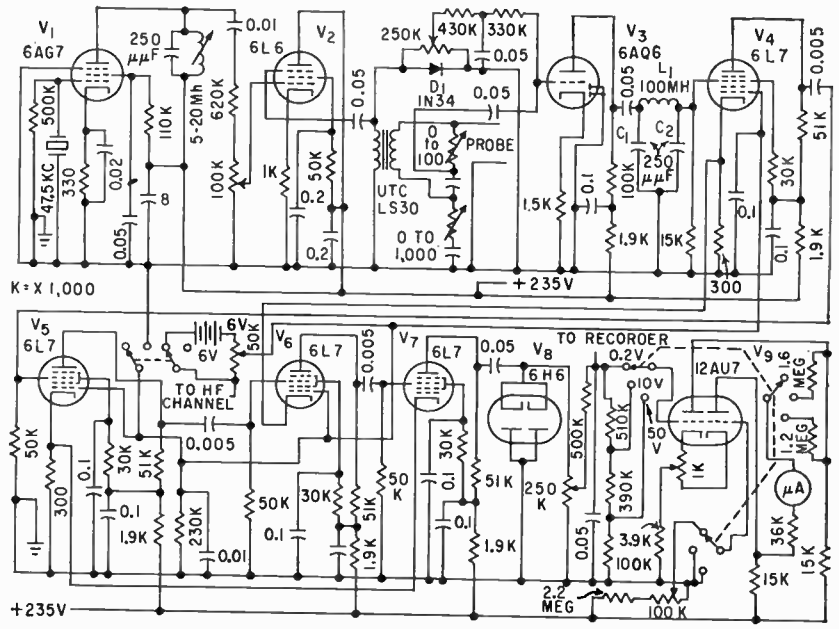


FIG. 3—Low-frequency channel operates at 47.5 kc. Low-pass filter at input of V_1 removes any induced high-frequency components

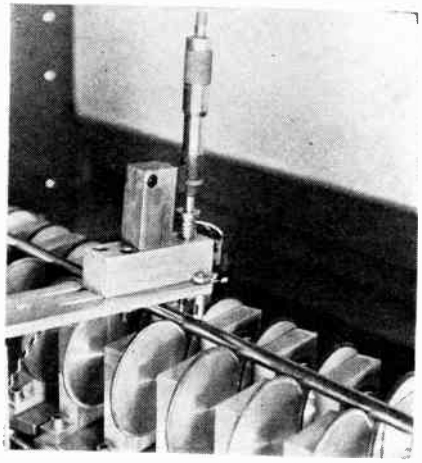


FIG. 4—Fuel rod being measured moves past probe at 40 in/min. Rubber-tired skewed rollers rotate specimen and provide lateral motion

Signal Corps personnel examine teletypewriter equipment.

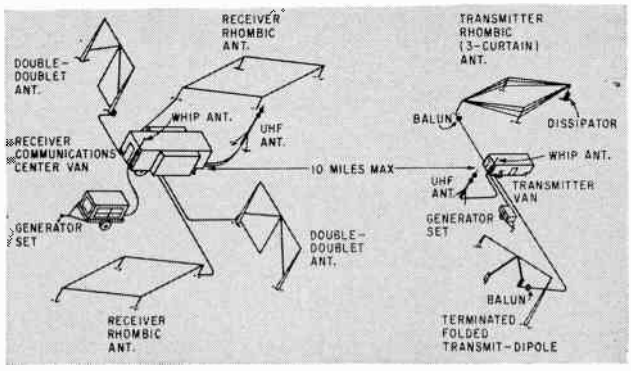


FIG. 1—Typical installation of AN/TSC-16 communications central

Mobile Radio System

BRUSH-FIRE WARFARE requires immediately establishing direct communications between task force commanders and Washington. This can be done with the Army's new AN/TSC-16 communications central—a long-range, mobile radio communications system that provides 16-teletypewriter and three voice channels.

Need for the TSC-16 was demonstrated last summer when U. S. forces landed in Lebanon. At that time the best direct communications equipment was a fixed-station system requiring six weeks to transport overseas and install in the field. Furthermore, it provided only four teletypewriter and no voice channels.

The TSC-16 can be assembled from storage and loaded into two C-124 aircraft within 12 hours. On arrival, it can be made ready for interim operation in about four hours. In two days, when the rhombic antennas have been installed, the central will be operating at maximum reliability over distances of 3,000 miles. Thus, from any spot on the globe the TSC-16 will be within range of one of the high-power radio communications centers that make up the Army's global communications system. This means that a combat commander can be put into reliable, multichannel contact with the Pentagon in a matter of hours. If necessary, he can pick up the phone and talk directly to the Secretary of Defense.

Consisting of a twin-single-sideband 10-kw transmitter and receiving equipment, the TSC-16 is contained in two vans—one for the transmitter and the other for the receiver-communications center. Figure 1 is a pictorial diagram of a typical installation.

Nine operators are required to operate all of the equipment.

Twin-Single-Sideband Operation

Maximum use of the single transmitter is obtained by using independent sideband transmission. The 6-kc upper and lower sidebands are split into two 3-kc speech channels, providing four channels for voice or teletypewriter. Since each teletypewriter channel requires about 100 cycles and the spacing between channels is 170 cycles, all 16 teletypewriter channels can be put on one 3-kc channel.

In a typical operation, one channel can be used for transmitting the 16 teletypewriter channels, the second for direct long-distance voice communication, and the third for facsimile operation. The remaining 3-kc channel could then be used as a long-distance order wire to keep the operator in contact with the receiving station, thereby allowing him to receive reception reports and make any required adjustments. A flexible patching system allows for any combination of the four channels and also permits connecting extra teletypewriters, facsimile machines, or telephones into the system.

A block diagram of the twin-single-sideband system is shown in Fig. 2. The upper and lower sidebands are transmitted together with the reduced carrier, but each of the sidebands contains different intelligence. Mark and space pulses from the sending teletypewriter circuits in the receiver-communications van are applied to the frequency shift tone keyers. The keyer output signals are fed to the lower

The Front Cover

One of the two vans containing the Army's TSC-16 equipment is loaded onto a C-124 aircraft. The two vans, together with their tractors and 30-kw a-c generators, weigh about 70,000 lb.

At left, is a teletypewriter operator in the receiver-communications center van. This van has expandable sides which can be opened to provide additional working space.

At bottom, a pneumatic antenna mast is being erected. These masts consist of several telescoping tubes which are raised by a hand air pump. As each section rises under the effect of air pressure, it is locked to the one beneath it by a locking collar. Thus, the erected antenna does not depend solely on air pressure for support. The masts are lowered by opening a valve at the base to let out the air and then unlocking the collars in reverse sequence

New communications system uses single-sideband, 10-kw transmitter and transistorized teletypewriter equipment to link field commander with Army's global radio network

By WILLIAM HARNACK,
Project Engineer, Communication Systems Division, Adler Electronics, Inc., New Rochelle, N. Y.

Has 3,000-Mile Range

portion of the upper sideband input of the twin-single-sideband transmitter. Speech signals are applied to the lower sideband input.

When receiving, the multiplexed signals are applied to the single-sideband converter for sideband separation. The upper and lower sideband signals are demultiplexed into two channels each. Frequency shift tone converters provide d-c neutral teletypewriter pulses for the receiving teletypewriter circuits.

The receiver - communications center van and the transmitter van are spaced 2 to 10 miles apart to avoid interference and reduction in receiver sensitivity. Information between the two vans is carried on a uhf link operating in the 900-mc region. A duplex circuit permits simultaneous two-way communication. The four 3-kc channels are multiplexed into one uhf link.

Speech Transmission

A typical setup for microwave phone transmission is shown in Fig. 3. Speech and 20-cps ringing signals from the transmitting and ringing circuits of the telephone set are applied to the telegraph-telephone converter. The ringing signals are converted to 1,600-cps ringing signals and the speech signals are amplified.

Circuits in the converter differentiate between ringing signals and speech signals. These signals are then applied to the telephone terminal, where they modulate a 12-kc carrier frequency. The lower sideband of the 12-kc carrier frequency is applied to the transmitter for radio link transmission to the transmitter van. In the transmitter van, the lower sideband of the 12-kc carrier frequency is detected by the receiver and applied to a second telephone terminal for demodulation. The demodulated ringing and speech signals are then applied to the channel 2 input to the multiplexer. The multiplexer output is applied to the upper sideband input to the transmitter.

When receiving, the signal from the doublet or rhombic antennas is detected by the receiver and applied to the single-sideband converter for sideband separation. The upper and lower sideband signals then go to separate demultiplexers. The speech demultiplexer separates the intelligence contained in the upper sideband. The 1,600-cps ringing and speech signals appearing at the output of the demultiplexer are applied to the telegraph-telephone signal converter. The 1,600-cps ringing signals are converted to 20-cps ringing signals and the speech signals are amplified and sent to the telephone set.

Teletypewriter Transmission

Typical radio teletypewriter operation is shown in Fig. 4. In transmitting, signals from the keyboard teletypewriter in the receiver-communications van are mixed with enciphering information from a

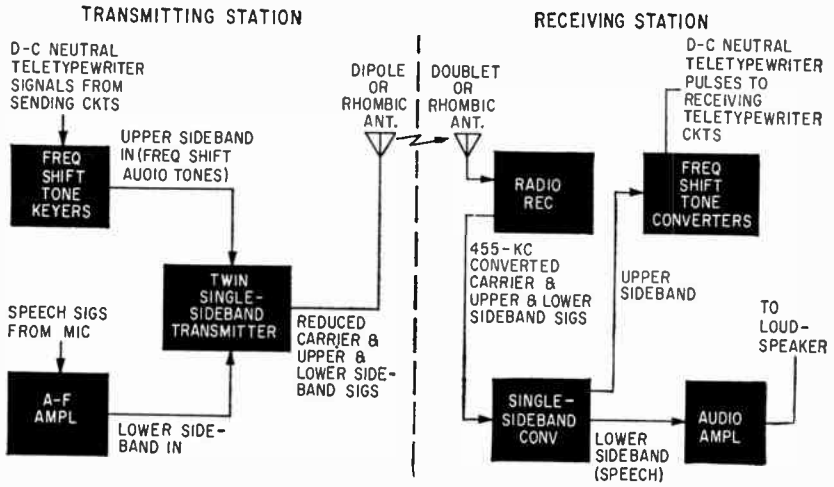


FIG. 2.—Twin-single-sideband system uses partially suppressed carrier

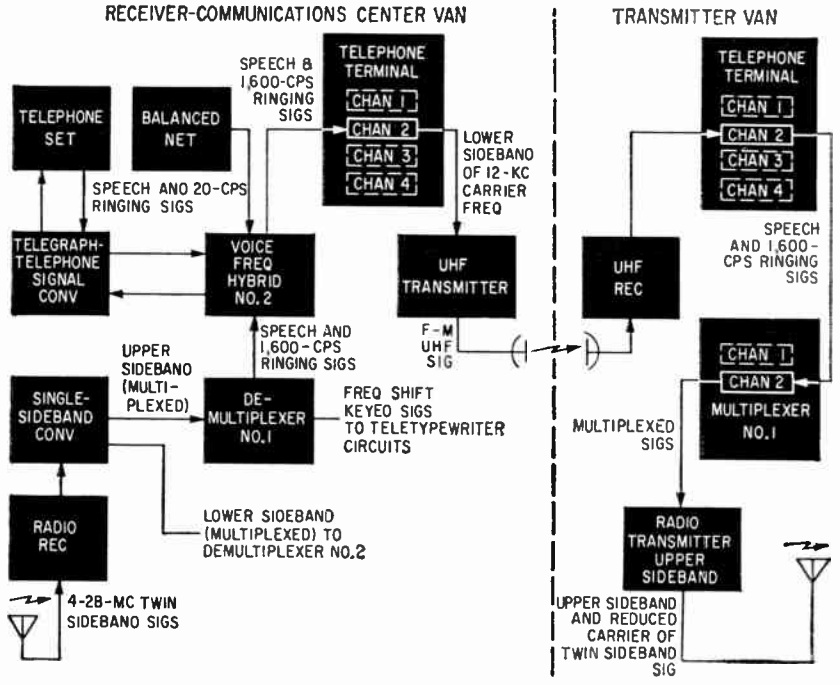


FIG. 3—Phone communication signal flow

standard cryptographic assembly using perforated tapes. The enciphered mark and space teletypewriter signals are then sent to the frequency shift tone keyer. A mark signal produces a frequency shift 42.5 cps above the carrier, a space signal 42.5 cps below. The frequency shift keyed signals modulate an 8-kc carrier frequency (channel 1) whose lower sideband is applied to the uhf transmitter for radio-link transmission to the transmitter van.

In the transmitter van, the uhf signal containing the lower sideband of the 8-kc carrier frequency is detected by the receiver and applied to a telephone terminal for demodulation. The demodulated teletypewriter signals are then applied to the channel 1 input to the multiplexer. These signals are multiplexed with any speech or facsimile signals that are applied to the channel 2 input. The output of the multiplexer is applied to the upper sideband input to the transmitter.

When receiving, the incoming diversity signals are applied to two radio receivers and single-sideband converters for sideband separation. The upper sideband outputs are applied to demultiplexers, which separate the information contained in the upper sideband into two channels: teletypewriter channels (frequency shift keyed signals) and speech or facsimile signals.

The frequency shift keyed signals are applied to a converter which changes them to d-c neutral teletypewriter signals. The two d-c neutral teletypewriter signals are applied to a diversity combiner, which selects the stronger signal and sends it to the cryptographic assembly.

Transistorized Teletypewriter

Much of the central's compactness is due to the use of transistors in the multiple-channel teletypewriter keying and converting equipment. This equipment consists of frequency shift tone keyers, frequency shift tone converters, and diversity combiners. Because these units are transistorized, they can be mounted in one rack without producing excessive heat.

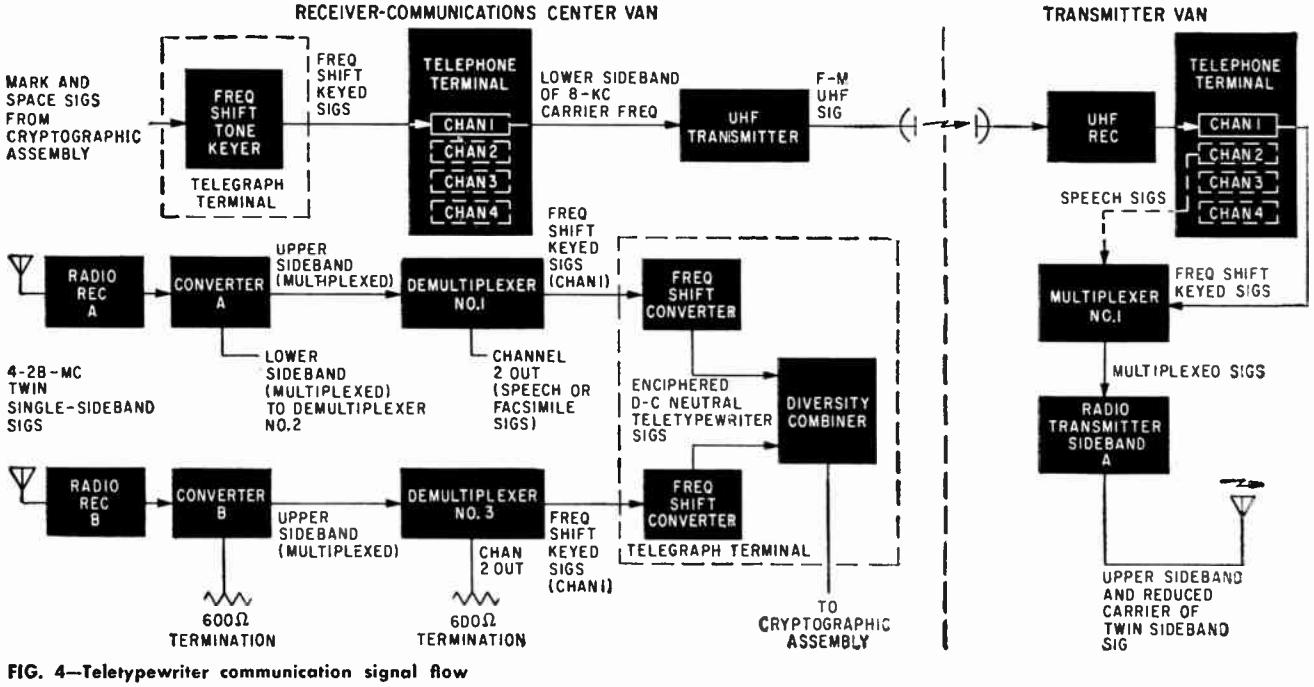


FIG. 4—Teletypewriter communication signal flow

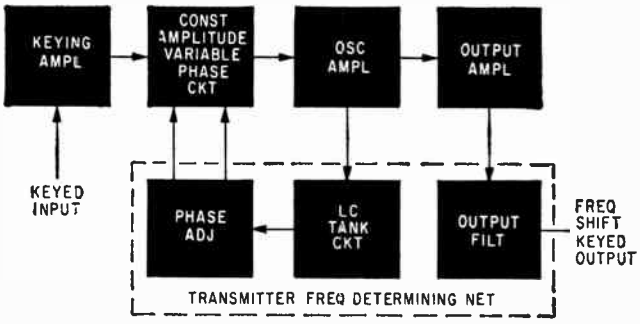


FIG. 5—Frequency shift tone keyer uses variable-phase, constant-amplitude feedback loop to shift oscillator frequency ±42.5 cps

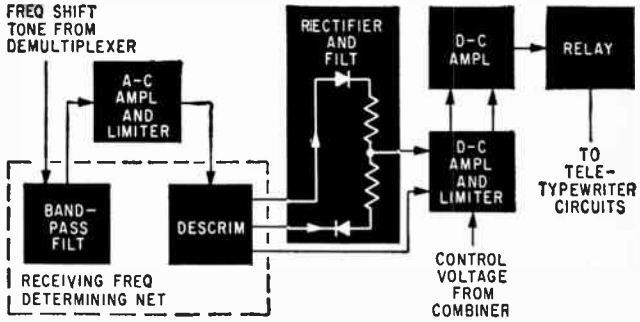


FIG. 6—Frequency shift tone converter handles large instantaneous signal level variations without introducing errors

Figure 5 is a block diagram of the frequency shift tone keyer. The keying input is applied to the keying amplifier, causing it to assume a conducting or nonconducting condition. The amplifier output controls the phase of the variable-phase, constant-amplitude stage. The output of this stage completes the oscillation loop which also includes the oscillator amplifier and LC tank circuit. The feedback loop shifts the oscillator frequency ±42.5 cps about the desired channel center frequency without appreciable frequency transients.

If the keying input is such that the keying stage advances the phase of the variable-phase stage, then the frequency of the LC network shifts to a higher value to cancel the phase shift. Conversely, if the keying stage retards the phase, then the network frequency shifts to a lower value. The separation between these two frequencies is determined by adjustments provided in the frequency-determining plug-in network.

The frequency shift tone from the oscillator amplifier is applied through the output amplifier and filter to a 600-ohm unbalanced line. The output filter permits up to 18 keyers to be placed in parallel.

Tone Converter

The frequency shift tone converter uses a simple balanced limiter circuit following demodulation to achieve a discriminator frequency output characteristic closely approximating an ideal step function. Thus, by reducing the mark to space transition for a few cycles off center frequency, signal distortion due to noise or bandwidth restriction is minimized. Balanced limiting amplifier circuits followed by diode limiters allow the converter to handle large instantaneous signal level variations without introducing errors into the tone conversion.

As shown in Fig. 6, the incoming frequency shift tone is first passed through a bandpass filter to remove noise and interference and then fed through an amplifier and limiter. The limiter output is a push-pull square wave which is fed into a two-inductor discriminator for demodulation. The signal from each coil is full-wave rectified to minimize signal distortion, and the outputs of the two full-wave rectifiers are differentially combined. The resultant signal is applied to a balanced d-c amplifier which requires only a small fraction of the available signal to produce full output. This arrangement has the effect of slicing a small portion from the center of the discriminator signal, thus producing a full mark or space output condition from a small part of the frequency deviation of the incoming signal. The d-c amplifier serves as a proper impedance and voltage coupler between the d-c limiter and the external load.

The input filter and tuning network of the phase shifter amplifier are mounted together on a subassembly package which plugs into the converter package. Thus, the basic converter unit can be used for any keying speed or tone frequency by selecting the proper receiving frequency determining network.

Diversity Combiner

The diversity combiner uses a novel means of obtaining effective diversity action over a wide dynamic operating range. Signal amplification is combined with semilogarithmic compression to provide a control voltage effective over a 60-db range of input signal level variation. Furthermore, the control voltage variation is approximately the same for a given db difference in signal levels, without regard to their actual strength. As a result, the diversity action is as good at low signal levels, where it is needed, as at normally high signal levels.

Transmitter and Receivers

The receivers are the same as government equipment presently being used in the Army's global communications system and have the stability necessary for single-sideband operation. The single-sideband converter has a motor-operated afc system which zeroes in on the partially suppressed carrier. Dual-diversity receivers are used to overcome fading, with antennas a minimum of 600 feet apart.

The single-sideband transmitter is continuously tunable from 4 to 28 mc, with bandswitching, and provides 10 kw peak-effective-power output. The transmitter has built-in monitoring facilities for single-sideband operation.

The transmitter can be placed in immediate operation by using a simple terminated folded dipole while the more elaborate rhombic antenna is being erected. Similarly, two double-doublets can be erected immediately at the receiver-communications center van for the diversity receivers. Both the transmitter and receiver sites have a mast with two uhf parabolic antennas for the receiver-transmitter link.

New Standards for

Table I—Effect of High Temperatures on Laminated Plastics

Grade	100% Strength at 23C			Temp C	Percent of Original Strength at 23 C								
					1 Hour Aging Time			168 Hours Aging Time			1,000 Hours Aging Time		
	Dielectric‖ v/mil	Dielectric⊥ v/mil	Flexure psi		Dielectric‖	Dielectric⊥	Flexure	Dielectric‖	Dielectric⊥	Flexure	Dielectric‖	Dielectric⊥	Flexure
XX	495	545	18,800	105	20	30	55	50	90	80	65	120	70
				155	30	25	40	75	80	60	50	85	50
				180	25	*a*	30	*a*	*a*	45	35	*a*	30
XXXP	560	575	16,800	105	35	45	45	65	105	65	65	105	60
				155	35	30	25	75	105	45	65	95	40
				200	35	20	20	40	*a*	15	10	*a*	15
LE	310	400	18,700	105	45	30	55	85	105	80	80	105	65
				155	65	25	40	85	100	50	*b*	100	15
				180	60	30	40	80	95	30	*b*	100	*b*
AA	40	60	18,700	120	135	55	80	145	170	95	250	165	105
				180	140	60	65	190	145	70	195	100	35
				220	240	75	55	150	95	45	160	80	25
GPO-1	355	515	23,900	120	60	70	60	60	75	65	50	80	80
				180	60	70	25	35	25	30	35	15	30
				220	40	65	25	25	10	20	15	10	5
G5	195	595	44,800	120	65	20	70	70	30	75	70	25	75
				180	55	20	65	80	25	45	75	20	40
				220	60	20	60	60	20	40	65	15	15
G7	355	290	29,700	155	50	105	50	90	90	70	60	95	70
				200	70	170	40	70	125	60	70	125	60
				250	80	180	30	*b*	120	50	*b*	*b*	40
G10	310	445	63,200	105	*c*	*c*	15	*c*	*c*	20	*c*	*c*	25
				155	40	30	5	55	50	5	60	45	5
				200	30	25	5	55	35	5	45	25	5
				250	35	25	*c*	45	20	*c*	30	25	*c*

(*a*)—Blistered (*b*)—Delaminated (*c*)—Insufficient Material

INCREASED APPLICATION of laminated plastics in electrical circuits has led to a revision of National Electrical Manufacturers Association standards. These plastics, frequently used under severe operating conditions, are being studied for an accurate determination of their properties and their variation with temperature.

CLASSIFICATION SYSTEM—Earlier standards for thermal classification of electrical insulating materials have been based solely upon composition. This system designated unimpregnated silk, cotton and paper as Class O, capable of operating at 90 C. A number of other materials with higher endurance temperatures such as mica, porcelain, glass and quartz were placed in the highest class (C) with permissible operating temperatures exceeding 220 C. This classification system has proven inadequate for present high-temperature requirements, where insulator operation may vary from 15 to 20 years use in motors to a few minutes use in certain missiles.

While new material uses have made a change in classification necessary, material design has played a significant part in bringing about this revision. New types of electrical insulation often use common materials but are still capable of operation under widely varying temperature conditions.

Because of the magnitude of the testing task, NEMA has limited recent studies to one flexural strength test, and two dielectric strength tests. The results are presented in Table I where one of the dielectric strength tests was performed with voltage applied parallel to the laminations, and the second with voltage applied perpendicular to them. The test specimens were ¼ in. thick and were exposed to the standard laboratory atmosphere (23 C and 50 percent relative humidity) for at least one week before being subjected to the experimental conditions.

Laminated Plastics

TEST RESULTS—The test results show that flexural strength falls off after one hour but appears to recover at the 168-hour period after which it again decreases. In the case of dielectric strength, this effect is also apparent. In some specimens the values for 168 hours are greater than their 100 percent dielectric strength.

Although the effect of temperature on these three properties of laminated plastics is important, other properties must be considered before choosing a particular grade. Some of these are presented in Table II. The values in Table II were obtained at 23 C, and further testing is necessary before they can be interpolated to higher temperatures. Table III shows the standard NEMA grade classification for laminated plastics.—A. S. R.

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(2) "Industrial Laminated Thermosetting Products," National Electrical Manufacturers Association, New York, 1959.

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Table II—Laminated Plastics' Characteristics at 23 C

Grade	Maximum dissipation factor[a]	Maximum water absorption[b] (percent)	Minimum bonding strength (lbs)	Maximum dielectric constant[a]
XX	0.05	1.3	800	6
XXXP	0.035	0.75	.....	4.8
LE	0.07	1.3	1,600	6
AA	.....	2.5	1,800	...
G-5	0.08	2	1,570	8
G-7	0.022	0.35	650	4.2
G-10	0.035	0.2	2,000	5.4
N-1	0.039	0.4	1,000	3.9

(*a*) at 1 mc; specimen ⅛ in. thick (*b*) specimen ⅛ in. thick

Table III—NEMA Grade Classification

NEMA Grade	Description	Properties	Applications	Finishes Available	Colors
XX	Paper base; phenolic laminate	High dielectric strength; excellent moisture resistance	Panels; subpanels; coil forms; brush holder bushings	Semigloss; polished	Natural; black
XXXP	Paper base; phenolic resin	High insulation resistance; low moisture absorption	Bases for printed circuits; radio and TV panels; terminal blocks	Semigloss; dull	Natural
LE	Fine weave cotton fabric base; phenolic resin	High moisture resistance; good flexural strength; good acid resistance	Terminal blocks; strips	Semigloss; polished	Natural; black
AA	Asbestos fabric base; phenolic resin	Heat resistant; dimensionally stable	Electrical appliance insulation; slot wedges	Semigloss	Natural
GPO-1	Glass mat base; polyester resin	Good arc resistance; high impact strength	Panels; subpanels; slot wedges; armature; plates	——	——
G-5	Glass fabric base; malamine resin	Excellent flame and heat resistance	Switchboard panels; arc barriers; switch and circuit breaker insulation	Semigloss	Natural
G-7	Glass fabric base; silicone resin	High heat and arc resistance; low dielectric losses	Slot wedges; slot liners for high temperature motors; high frequency uses	Semigloss	Natural
G-10	Glass fabric base; epoxy resin	Low moisture absorption; dimensionally stable	Base for printed circuits requiring high hot solder temperatures	Semigloss	Natural
N-1	Nylon fabric; phenolic laminate	High insulation resistance; low loss factor	Wave change switch bases; radar and instrument parts subjected to fungi	Semigloss	Natural

Monitoring Multiple

Multichannel interrogator and signal separator scheme uses vacuum tubes and semiconductor diodes to detect the presence of a signal from a large number of possible sources. It can also detect absence of a signal. The circuit has applications in automatic and digital systems

By **R. KRONLAGE,** Air Arm Division, Westinghouse Electric Corp., Baltimore, Maryland

SIGNAL DETECTORS are important and widely used devices. Usually, they are conventional rectifying devices. As equipment increases in complexity and the number of duties of the equipment increases, the functions of detectors become more complex.

A particularly difficult function required in the field of automatic equipment is the detection of a single signal from a large number of separate sources. It is important that such a detection process determine the particular source of the signal quickly and accurately. For instance, doppler radar sets must search a bank of sharp filters placed side-by-side for a target. This must be done quickly while the antenna scans a field of search.

Build-up time in such filters prevents scanning with a variable-frequency oscillator because of the quick response necessary. Solid-state devices of various types, and mechanical and magnetic switches have been used. These devices have the serious disadvantages of low impedance, the requirement of holding off all but one channel, or short life and low reliability. The number of components increases steadily as the number of channels increases.

Mechanical Switch

When a motor-driven mechanical switch is used as a detecting device a synchronized companion switch is needed. This second switch scans a reference indicator so that the signal source will be determined correctly. This requirement is also true of similary operated devices.

Time coincidence of the reference switch and the channel output switch indicates the correct channel. Additional circuitry is required to quickly disconnect and memorize the reference switch output.

Signal Monitoring

The vacuum-tube circuit of Fig. 1 has been successfully applied for detecting a signal from one of many channels. This novel and efficient means of electronic detecting is used to replace a motor-driven mechanical switch.

Operation of the circuit is such that when there is no signal on any of the channels, nothing happens and all the channels are simultaneously monitored for signals. The channels are electrically decoupled from each other by the diodes to the detector input and the circuit is built to operate on a positive signal from any channel. Many more channels can be handled, but for convenience only five are shown.

Circuit Description

When a positive signal appears at one of the inputs, it passes through diode D_3 to the input of the detector circuit. The input circuit is cathode follower V_{3A} whose output signal is adjusted by potentiometer R_1 to obtain the desired sensitivity.

After amplification by V_{3B} and V_{4A}, the signal drives cathode follower V_{4B}. The output of V_{4B} is sufficiently positive to drive Miller inte-

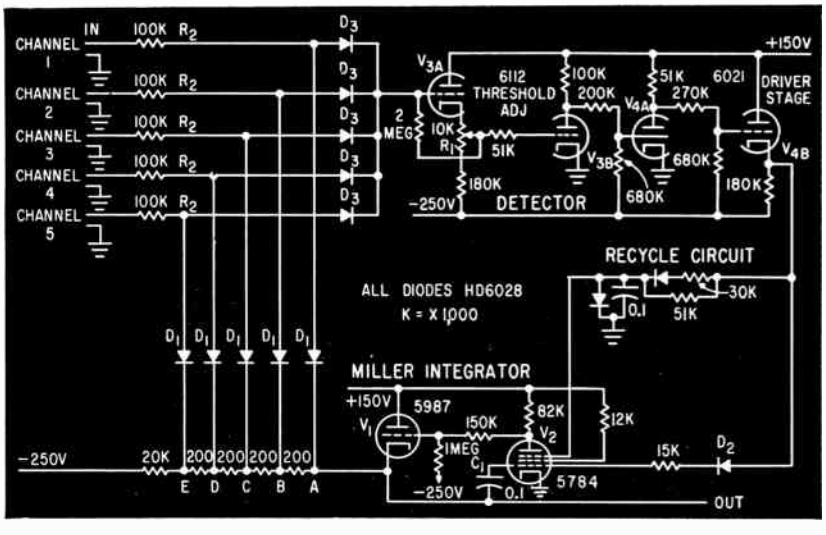

FIG. 1—Detector unit uses recycle circuit to provide output presentation for oscilloscope

Inputs Simultaneously

grator V_1 and V_2. The output of cathode follower V_1 is driven linearly negative as shown in Fig. 2.

As V_1 goes negative, it disconnects one channel at a time from the detector until the live channel is reached. A channel is disconnected when its disconnecting diode, D_1 of Fig. 1, goes below zero volts, thus loading the signal source.

Series resistors R_2 increase the output impedance of the signal source, permitting easy loading to zero volts by the disconnect diodes. When the live channel, the channel with a signal on it, is reached and disconnected, the detector output is cutoff. Cathode follower V_1 is no longer driven negative and diode D_2 prevents discharge of capacitor C_1, thus storing or memorizing the level at which disconnect has occurred.

The output of V_1 is an analog representation of which channel has a signal on it. This output voltage is available for d-c level change, attenuation, amplification or whatever is necessary to meet specific equipment requirements.

Recycling Circuit

To obtain recycling, the suppressor grid of pentode V_2 is coupled to the output of the driver stage through the recycle circuit shown in Fig. 1. When the suppressor of V_2 goes negative, all the plate current of V_2 is channelled to the screen of V_2, and V_1 recharges C_1 through the control grid of V_2 to ground.

With this coupling, cathode follower V_1 goes to the correct output voltage and recycles to provide a more convenient presentation for an oscilloscope.

The recycling circuit can be changed drastically for different modes of operation. Without the recycling circuit, the integrator output will store a voltage to within 0.1 volt for 2 min. This storage time can be changed by changing C_1.

In the event there is more than one input to the detector, the circuit will proceed until the last input is disconnected and will indicate this channel as the live channel. This may or may not be a disadvantage. In normal usage this is not a disadvantage, and is similar in operation to other types of devices performing the same function.

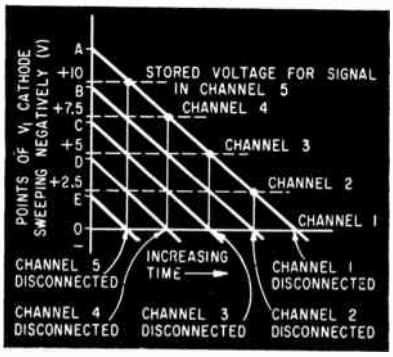

FIG. 2—Negatively sweeping cathode sequentially disconnects channels until the active one is found

Should the absence of a signal be the detecting objective, two possibilities are present. When the signals of the channels to be monitored are negative voltages, no changes are necessary. The absence of a signal is then positive going and is equivalent to the appearance of a positive signal.

Positive Signals

Where it is impossible to obtain negative signals the entire operation must be reversed. All diodes must be reversed, the detector output driving the integrator must go negative in the presence of a signal and other means must be used to recycle the unit. Under these conditions, the integrator will be swept in a positive-going ramp.

When only changes in signals are to be detected, an a-c connection, or capacitive coupling of signals to the detector, may be used. The signals in such a connection could originate at any d-c level.

A number of these devices can be used simultaneously to handle hundreds of channels when necessary. They may search from both ends of the signal channels simultaneously, or can be built in other configurations to fit a particular application.

Applications

The circuit can be put to use in such fields as automation and digital equipment. If any similar quantities, such as current, voltage, resistance, liquid and solid levels, light intensities and temperatures, need monitoring or regulation, the application is valid as long as the quantities can be converted to voltages.

Incoming inspection of resistors in an electrical manufacturing plant would be a typical application for this circuit.

Practical advantages of these units are low cost, simplicity of operation and component economy. For each additional channel only two diodes and two resistors need be added.

Electrical advantages include high-speed operation, no electrical operation when there is no signal present, no wasted time since there is continuous monitoring of all channels, high impedance of the disconnect method over similar devices and a direct analog output.

Unit Performance

An experimental unit now in operation handles 50 channels. The cathode follower is set at 70 v and 1 v per channel sensitivity is used. Channel 50, the first to be disconnected, is represented by an output of 50 v and channel one by 0 v. Over many operations on all channels the maximum deviation from perfect accuracy is 0.1 v. Impedance levels used are shown in Fig. 1.

Power-supply voltages become a problem when the number of channels to be investigated by a single circuit exceeds 70. In such a case, two devices are used, adding relatively little to the cost.

Balloon-Borne Circuits Sort

Transistorized circuits operate effectively over wide temperature and pressure range for high-altitude study of cosmic rays. Telemeter coding system is designed for reception through noise

By **DONALD ENEMARK**, Physics Department, State University of Iowa, Iowa City, Iowa

BALLOON-BORNE APPARATUS has proven to be invaluable in the measurement of cosmic ray phenomena. This high-altitude observation technique opens many new areas of study to the geophysicist, but it presents a serious problem to the electronics engineer. Any circuits designed for such use must be able to withstand wide ranges of temperature and pressure.

The system shown in Fig. 1 has been tested for temperature stability from 38 C to -45 C. Using inexpensive germanium transistors, the circuit measures cosmic ray energy and intensity. It has already been used successfully at altitudes of 130,000 ft.

General Description

The system uses a sodium iodide scintillation crystal optically coupled to a multiplier phototube. Radiation falling on the crystal produces light scintillations that excite the multiplier phototube to produce electrical output pulses. The amplitude of each pulse is proportional to the radiation energy. The pulse sizes are separated into increments by the discriminator and sent to scalers for counting. The outputs of the four scaling channels are coded and applied to the telemetry system.

An automatic integrating ion chamber acts as a second detector. It triggers a scaler at a rate dependent on the ionizing power of the radiation. The output of the scaler is applied to the telemetry. The plastic scintillators act as a third detector. They are attached to multiplier phototubes, and the axes of the tubes are lined up vertically. The two amplifier-discriminator channels are connected in a coincidence circuit. Whenever a coincident pulse occurs, it is gated through to a height-to-time converter, and the output of the converter is applied to a subcarrier oscillator in the telemetry system. The Olland barometric altimeter provides the pressure information used to determine balloon altitude.

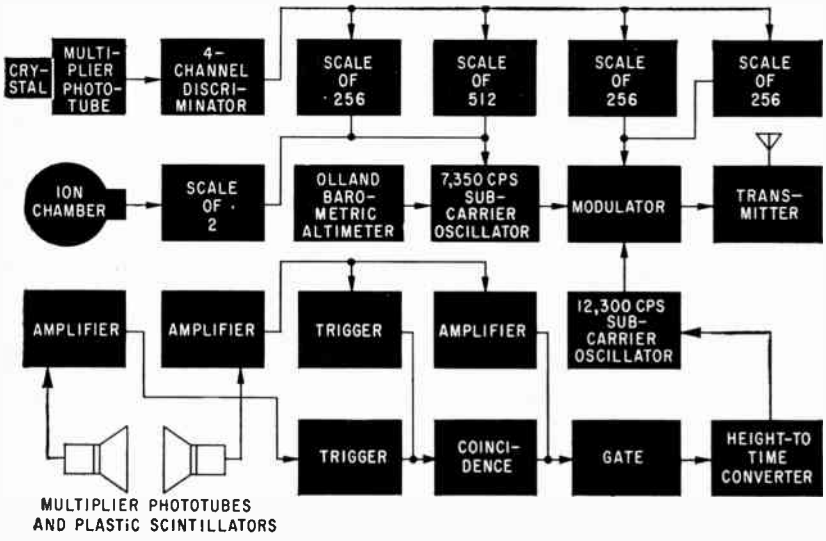

FIG. 1—Block diagram of cosmic ray measuring system is designed for high temperature and pressure stability

Scalers

The transistorized scalers used for counting are shown in Fig. 2. The input trigger circuit requires about .5-v negative pulse to operate the scaler.

The simplest detector channel in the instrument is the one using the ion chamber. Each time the electrometer in the chamber recharges, it produces a negative output pulse of several volts. The signal is connected to the input of a scaler, and the scaler output is used to modulate the telemetry system.

Four-Channel Discriminator

The four-channel discriminator is composed of a common amplifier and four individual amplifiers which drive four trigger circuits. The four trigger outputs are used to drive four channels of scalers. The individual channels require either 256 or 512 counts to produce one output to the telemetry system.

The detector that operates with this circuit is the sodium iodide scintillator-multiplier phototube combination. The plate supply for the multiplier phototube is 900 v. The individual dynodes are supplied from taps to various points within the batteries. The output appears as negative pulses of various amplitudes across R_1 in Fig. 3. The gain of the 6199 multiplier phototube is in the order of one million, but there are rather large differences between the gains of individ-

High-Altitude Cosmic Rays

ual tubes. The input network of R_1, R_2 and R_3 is used for attenuation, and in practice the value of R_2 is selected to provide the required pulse size at the base of Q_1.

The first two stages of the common amplifier operate together to supply a high input impedance, a gain of one, and a low output impedance. The first stage Q_1 is an emitter follower with some output across R_7 to drive Q_2. Transistor Q_2 amplifies this signal and feeds it back across the emitter load R_5 in the proper phase to insure a gain of one. The output of the first two stages, which act as an impedance transformer, is fed to Q_3 where it is amplified and applied to the bus which feeds the four individual discriminator channels. Resistor R_6 and d-c feedback through R_7 improve gain stability. The voltage gain from the input of Q_1 to the output of Q_3 is about four. The β of Q_3 is chosen to be about 30 thus allowing a maximum signal of about 7 v on the common bus.

The bus supplies the signal to four potentiometers, the settings of which determine the discrimination point of that particular channel. The four channels are identical, and only one is shown in the diagram. The input amplifier Q_4 is similar to the preceding stage and has a voltage gain of about four. The trigger circuit is a Schmitt type adapted to transistors. Feedback for regenerative action is applied across R_8 in the emitter circuit. The output pulse is about 10 μsec long. Accelerating capacitor C_1 has a small effect on the output pulse width. The thermistor network is necessary to keep the discrimination point constant with temperature changes. It has some shunting effect on the feedback resistor R_8, and, as a result, the triggering point is not as distinct as with the vacuum tube version.

The gain of the amplifier decreases slightly as the temperature decreases, but the thermistor network overcompensates slightly making the circuit insensitive to temperature.

Balloon is made ready for launching of cosmic ray measuring apparatus

Energy-Loss Telescope

The multiplier phototubes for the scintillation detectors in the energy-loss telescope receive their plate and dynode potentials from the same 900-v battery as the single scintillation detector. The output of each multiplier phototube is fed through an impedance transformer, an amplifier, and a discriminator, and finally the outputs of the two channels are compared for coincidence. The signal in one channel is also sent through another amplifier, a gate circuit, and finally to a height-to-time converter.

The gate is an AND gate which only allows the pulse through to the converter if there is a pulse from the coincidence circuit. In order to get an output from the height-to-time converter there must be a signal in each channel large enough to pass through its discriminator, and the signals in the two channels must be coincident.

The amplifiers in all three channels are almost the same as the one in the four-channel discriminator. The trigger circuit is also similar, except that the transistors are replaced by *npn* types to get positive input and output pulses, and some component values are changed. The most significant change is the replacement of the thermistor network and emitter resistor with a single Sensistor as shown in Fig. 4. There is no longer a shunting effect on the feedback, and the regenerative triggering circuit compares well with the vacuum tube version. The trigger output pulse has a minimum length of about 3 μsec.

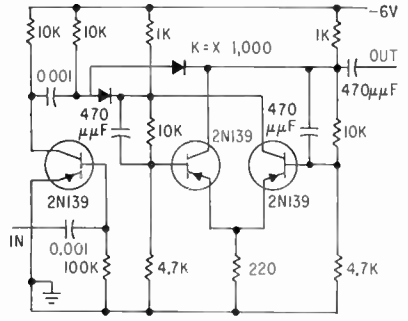

FIG. 2—Each scaler stage is a bistable circuit with trigger amplifiers between each two stages

The coincidence circuit is a transistorized version of a common

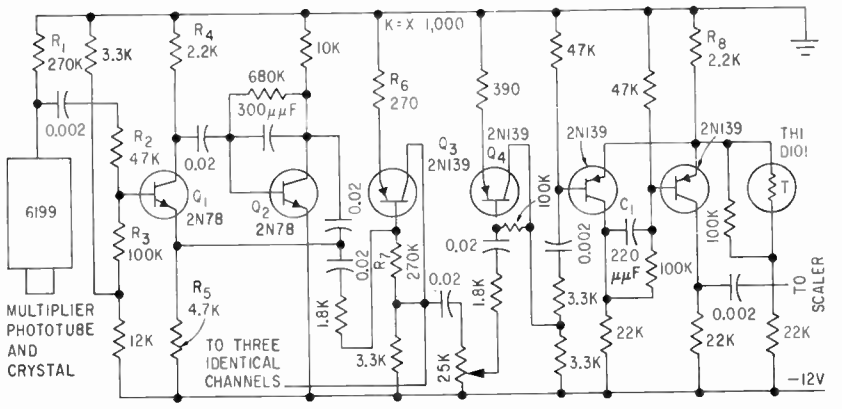

FIG. 3—In this four-channel discriminator, the first two stages make up the impedance transformer

tube circuit. In the quiescent state the base resistors of both Q_6 and Q_7 keep the transistors conducting heavily, and the potential across R_1 is nearly the full supply voltage. When a positive pulse appears at the base of Q_6, it is cut off momentarily, but Q_7 remains in conduction, and thus the potential across R_1 changes only slightly. If a pulse appears at Q_7, but not at Q_6, the condition is the same as before; however, if a pulse appears at both Q_6 and Q_7 at the same time, then a negative output pulse is sent as a gate pulse to Q_2.

Gate Circuit

The height-to-time channel gets its signal from the divider R_1, R_5. The pulse is delayed slightly by R_2 and C_1 to get it in time with the gate pulse which must go through several stages and thus is delayed. The delayed signal goes through the impedance transformer, is amplified, and is applied to the gate circuit. In the gate circuit the base of Q_2 is returned to 1.25 v, and thus it is in a condition to conduct heavily if a potential is applied to the collector.

As long as there is no gate pulse at the base of Q_2, the positive pulses from Q_3 are developed across R_6 by the shunting action of Q_2. If a negative gate pulse is applied to the base of Q_2 at the same time as a positive signal pulse appears at the collector, the signal will not be attenuated. When this condition is satisfied, the positive pulse charges C_2 through D_1.

The time constant of C_2, R_6, the resistance of the diode and the resistance of Q_3 in conduction is approximately 1 μsec. since the rise time of the pulse at this point is about 1 μsec, the charging capacitor C_2 is charged nearly to the peak pulse voltage. The capacitor is allowed to discharge through R_7, and the exponential voltage is used to cut off V_1. This amplifier is saturated by the large input voltage, and its output is nearly square. The voltage to which C_2 is charged is a function of the energy lost in the scintillator.

The time at which V_1 is cut off is a function of the voltage on C_2; hence the width of the output pulse of Q_1 is a function of the energy loss and can be calibrated to measure that energy. At the time of calibration the ratios of the divider circuits in the emitters of Q_1 and Q_8 are adjusted to compensate for the variation in the gain of the multiplier phototubes.

Subcarrier Oscillators

To complete the instrumentation, a stable subcarrier oscillator is needed. A Colpitts oscillator designed for 7,350 cps and 12,300 cps is used with the frequency modulation by the reactance method.[1]

Transistor Q_3 as shown in Fig. 5 is connected in a Colpitts configuration with C_3 and C_4 in parallel with C_5 acting as the feedback divider. Capacitor C_5 is also used for tuning. The output is taken from the emitter circuit because it has a rather low impedance and also has a waveform which is quite simple to filter to a near sine wave.

The signal from the other oscillator comes in through another RC filter, and the mixed output is taken across R_1. The emitter current of Q_2 is a combination of d-c from the first stage and the a-c fed back and shifted in phase by C_2. The collector current drawn through L_1 by Q_2 is not exactly in quadrature with the current drawn by the oscillator. The result is a change in the apparent inductance in the circuit, which causes a change in the oscillator frequency. The frequency is determined by the emitter cur-

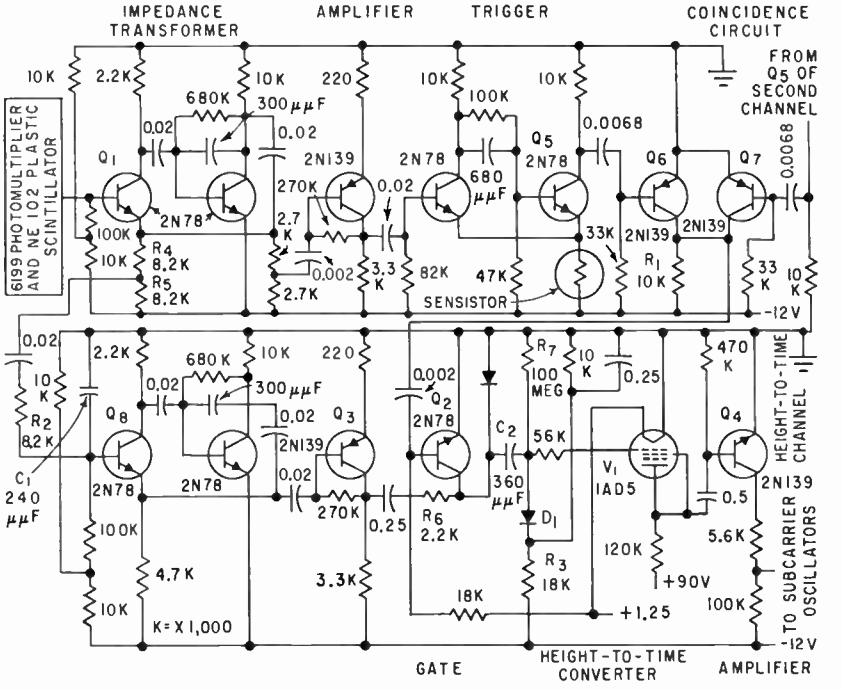

FIG. 4—Energy-loss telescope uses Sensistors to help compensate for temperature effects. Circuit normally employs two identical channels for the two phototubes

rent of Q_2. The input impedance of Q_2 is very low, and the first stage is added to make it easier to modulate the oscillator. To avoid temperature stability problems, Q_1 and Q_2 are connected in different configurations so that the drift of one tends to nullify the drift in the other, but the compensation is not complete. The d-c feedback gives the additional stability required.

In this instrumentation only pulse, not analog, information is fed to the sub carriers, so there is no need for either absolute frequency stability or absolute deviation linearity.

The input pulse to the 12,300-cps oscillator is a square wave from the height-to-time converter of the telescope, and it is allowed to modulate the oscillator directly. The pulses from the scalers going to the 7,350-cps oscillator, however, must be modified in some way so that they can be identified later. The input networks differentiate and rectify the square waves from the scaler. The diodes are connected in opposite directions to allow pulses of opposite polarity in the two channels.

Capacitors C_1 and C_6 are necessary across the diodes to prevent rectification and resultant biasing from the r-f carrier.

The input to the subcarrier from the ion chamber is through a large capacitor and no diode, so the square wave is converted to a very wide, differentiated pulse of both polarities. The input from the barometer-altimeter is through resistor R_2. As the drum in the Olland cycle rotates, it grounds one end of R_2 at keyed intervals. For any pressure there is a unique arrangement of pulses.

Modulator and Transmitter

The modulator and transmitter used in this instrumentation is described in detail in ELECTRONICS.[2] The transmitter is a quarter-watt, 92-mc, transistorized, f-m unit. The modulating signals are mixed at the input to the modulator, and the composite signal is applied to the f-m transmitter. Two scaler channels are sent to the subcarrier oscillator, and the other two are differentiated and clipped by networks similar to the ones used with the subcarrier and applied directly to the transmitter modulator.

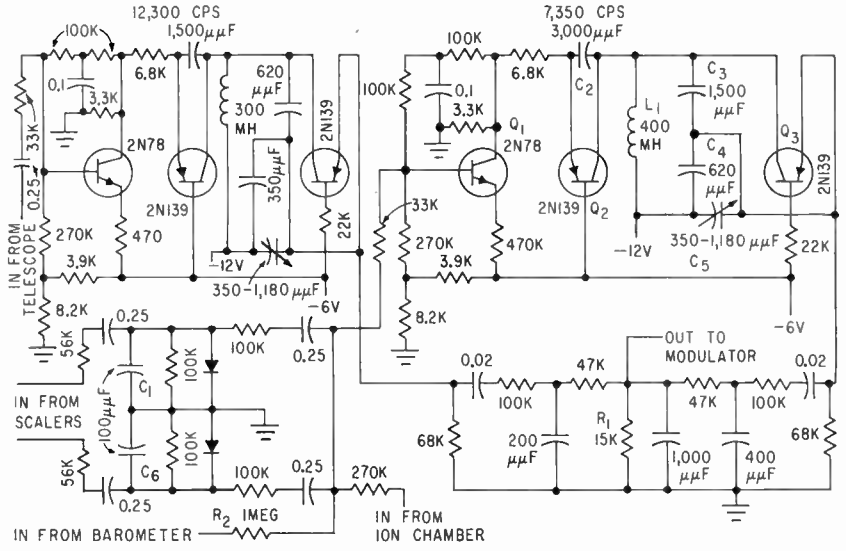

FIG. 5—Stabilization of the input stage of the subcarrier oscillators against temperature effects is obtained with d-c feedback

Coding of Modulation

With seven channels of information to be telemetered with one carrier and two subcarriers, some type of coding is necessary for channel identification. The 7,350-cps subcarrier has four channels of information impressed on it. One scaler channel registers as a positive spike, another scaler channel as a negative spike, the ion chamber scaler as a very wide pulse of both polarities, and the Olland cycle information appears as a shift in the base line.

Since the information from the energy-loss telescope may come at high rates, and the measurement is carried in the pulse width, it is the only channel on the 12,300-cps subcarrier. The pulse widths are measured directly by a time-interval meter, and they are recorded immediately by an automatic digital printer. The last two scaler channels appear as positive and negative spikes directly on the r-f carrier.

The information from the scaled channels is all transmitted with uniformly shaped pulses, and can be received through considerable noise. The height-to-time channel, however, must have a high signal to noise ratio if the pulse width is to be measured accurately; consequently, a large part of the bandwidth is assigned to that channel. The modulation of each channel is adjusted by varying the size of the mixing resistors at the input to the modulator.

In actual operation nickel-cadmium storage batteries have been used for power. They are capable of operating through the cold night hours without any appreciable lowering of performance.

Many of the individual circuits such as the subcarrier oscillator or the trigger circuit may be applied profitably to uses other than ballooning.

This project was done under the direction of Kinsey A. Anderson, Physics Department, State University of Iowa. The work was supported by funds from the Office of Naval Research.

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(1) F. M. Riddle, California Institute of Technology, Patent No. 2,728,049.
(2) Donald Enemark, Transistors Improve Telemeter Transmitter, ELECTRONICS, Mar. 13, 1959.

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D. C. Enemark, Transistors Improve Telemeter Transmitter, ELECTRONICS, p 136, Mar. 13, 1959.
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Design of High-Frequency

Computer clock pulse generators provide multiphase outputs that can operate into loads ranging from high-speed computing systems to small circuits. D-c level of clock signal is easily adjusted in reliable and efficient circuit

By **GERALD O. OLSON,** Staff Research Engineer, University of Denver, Denver, Colorado.

VERSATILE MULTIPHASE clock pulse generators have been designed that operate in the range of 10 to 30 mc. The clocks were required for development of synchronized high-speed computing systems.

Clock pulse generators for this purpose should possess low output impedance, since they are generally used to drive nonlinear diode gates. Power output of the driving stages must be sufficient to drive the clocked stages of a system and should be variable to drive small subassemblies.

Waveform

A sine wave was chosen for the clock pulse generator rather than a square wave because of circuit simplicity and the less stringent bandwidth requirements. Crosstalk in the system may be greater, since peak-to-peak amplitude will be greater, but with the low-impedance lines usually involved, crosstalk does not become bothersome.

Amplitude must be sufficient to provide satisfactory rise and fall times.

Oscilloscope Synchronization

To synchronize oscilloscopes with a high-frequency signal, a synchronizing generator is included in the clock pulse generator. It supplies a signal that is an exact submultiple of the operating frequency to the oscilloscope sync input. A synchronized gating generator with a 5-kc rate was selected.

Two approaches have been used in designing clock pulse generators. The first delivers low-impedance cathode-follower output. However, some difficulty is encountered in maintaining proper d-c level and gain. D-c level is controlled by the d-c bias on the the output tubes.

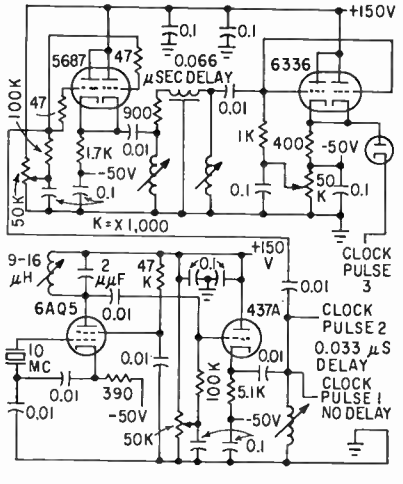


FIG. 1—Clock oscillator output through cathode follower is split into three channels (two not shown) to get clock pulses at three phases

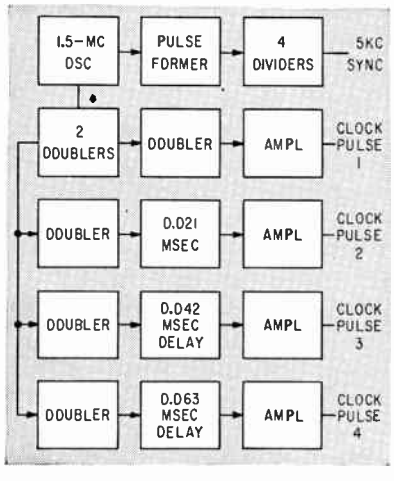


FIG. 2—Four-phase clock pulse generator provides 12-mc output and 5-kc oscilloscope sync signal

Clock pulse generator is being used to evaluate performance of small subassembly but could be used with synchronized high-speed computing system

A 10-mc sine wave is generated by an oscillator and fed to a cathode follower. The signal is split into three channels, one of which is shown in Fig. 1. Another cathode-follower driver is required for each channel to avoid interaction between channels. The delay line used is RG 65/U, with a 0.033-μsec delay in the second channel and no delay in the first channel.

By terminating both sending and receiving ends of the delay line in the characteristic impedance, distortion is avoided and attenuation is negligible. Slug-tuned inductors are inserted to tune out interelectrode and wiring capacitances. This generator can drive many gates with little distortion, depending on the currents to be switched.

The synchronizing generator, not shown, is a specially designed

Clock Pulse Generators

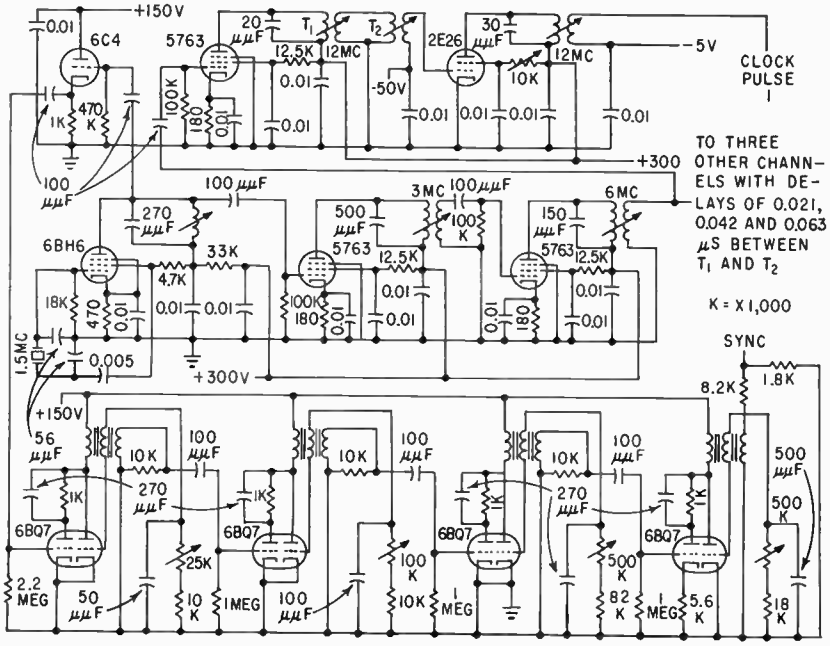


FIG. 3—Transmitter techniques are used in transformer-coupled generator to provide low impedance output at any reasonable power level

blocking-oscillator chain used to divide 10 mc to 5 kc. Since the first stage of this system is not reliable at these frequencies, a different approach has been used in subsequent clock pulse generators.

Transformer-Coupled Amplifier

The second approach uses transformer-coupled amplifiers and standard transmitter tubes. Obtaining low output impedance and desired output voltage requires choosing operating potential and transformer ratios correctly. With available transmitting tubes, almost any power output can be obtained.

The block diagram in Fig. 2 shows a four-phase 12-mc clock. To minimize jitter of synchronizing signals, the fundamental frequency is chosen at one-eighth of the clock rate or 1.5 mc.

The 1.5-mc sine-wave oscillator output in Fig. 3 is fed through two doubler stages and split into three channels. Each channel has an additional doubler followed by the power amplifier. Again RG 65/U delay line is used. No terminations are required since the proper turns ratios of T_1 and T_2 will match plate and grid impedances to the line. By tuning T_1 and/or T_2 slightly off resonance, the signal outputs can be correctly phased. The doubler stages reduce the possibility of parasitic oscillations. The slug in the output transformer with fixed coupling might affect coupling as the primary is tuned. Amplifier plate current should therefore be used as an indication of resonance, rather than output voltage on the link.

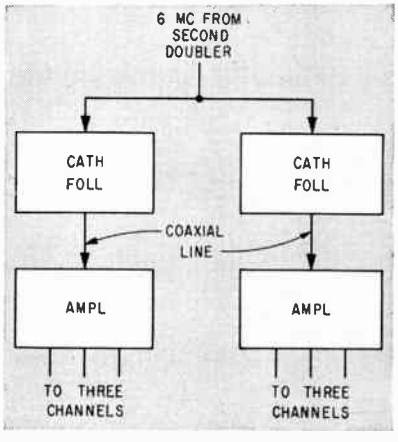


FIG. 4—Additional output power can be obtained from dual unit. Long coaxial lines should be of about the same length to provide equal delays

Output amplitude can be controlled somewhat by the variable series screen resistors. However, current ratings of small size potentiometers are limited. An output transformer with variable coupling could be used, but load must not be completely uncoupled nor tube dissipation ratings exceeded.

In Fig. 2, output from the 1.5-mc oscillator is fed to a cathode-follower pulse former. Pulses are fed to the blocking oscillator chain, which divides 1.5 mc down to 5 kc.

Multiple Output Units

If one set of clock amplifiers cannot provide sufficient power or if signal distribution is simplified, a dual unit such as shown in Fig. 4 can be used. The two clock output units are driven by cathode followers through a 91-ohm coaxial line. The coaxial lines should be of equal length so that their transmission delays will be equal.

Reliability of a dual unit that has been in use has been quite satisfactory. The only component failures were screen potentiometers. These failures indicate that a better method of controlling output voltage must be devised unless loads on each phase are equal.

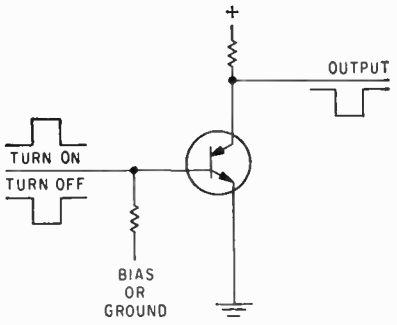
Efficiency and ease of adjusting d-c level of clock signal, plus other advantages, leads to a choice of transformer-coupled amplifiers over cathode followers. Units designed for frequencies from 10 to 30 mc have been constructed and satisfactorily operated. Both three and four-phase systems have been devised, and any reasonable number of phases is possible.

Transmission of clock signal is accomplished with open-wire lines. To avoid serious phase shifts and resonances along the lines, several leads are fanned out from each phase. This method reduces serious inductances and keeps voltage variations within limits.

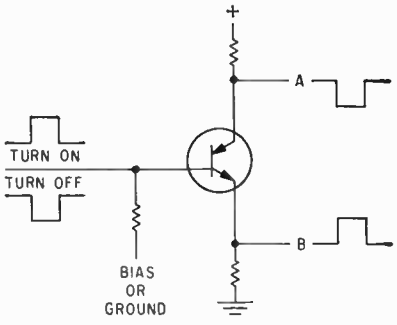
The protoypes in the schematics are not optimized, but the general design method has been successful.

Triggered Bistable Semiconductor Circuits

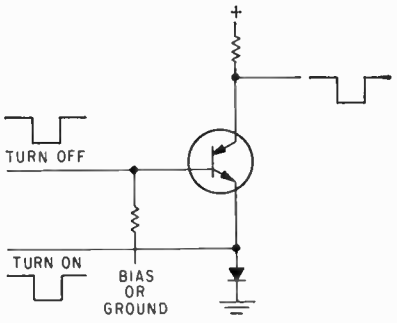
By J. B. HANGSTEFER and L. H. DIXON Jr., Solid State Products, Inc., Salem, Mass.



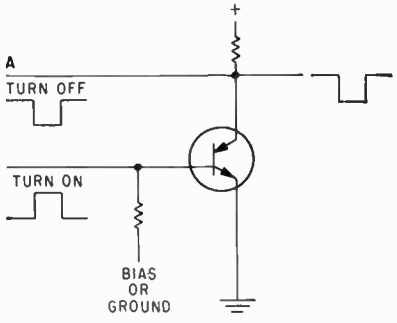
Turn on and off accomplished at base. Output pulse width determined by time between on and off input pulses is independent of pulse widths



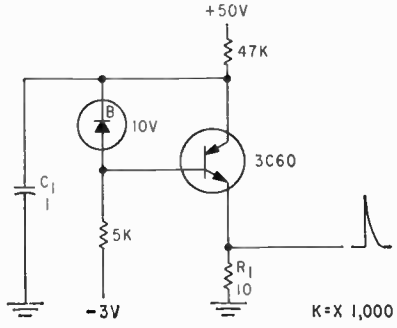
Output taken from both collector and emitter. Input voltage for both on and off increased by amount equal to output voltage at point *B*



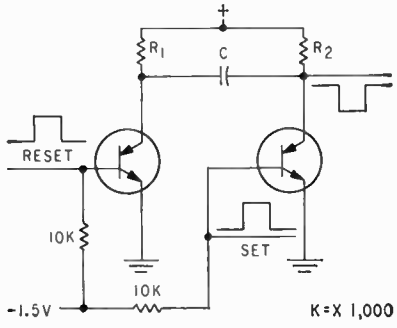
Negative trigger pulses used. Turn-on to emitter across silicon diode. Diode used because impedance is low with device on. Turn-off accomplished at base



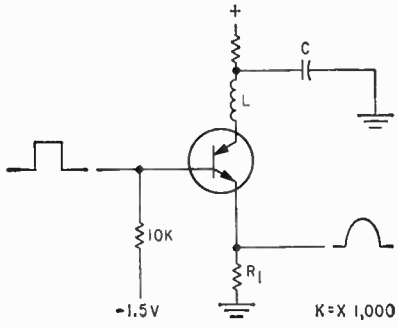
Turn off by driving collector negative. Essentially all collector current must be bypassed to point *A* for turn off to take place



Pulse generator delivers 1 ampere peak output current of 10 μsec duration. Higher outputs possible by reducing R_1 and increasing C_1



Power flip-flop delivers 1 ampere output current. On current determined by B+, R_1 and R_2. $C_{min} = 251/E$ where I is on current, E is B+ voltage



LC pulse generator has half-sinusoid output determined by L and C. R_1 should be less than $X_L/10$ to prevent excessive damping

THIS *PNPN* semiconductor device is triggered on by a low-level positive pulse applied to its base. Once on, it will remain on without need for sustaining base current. A negative pulse applied to the base will turn it off where it will remain until triggered on again.

Present units are designed for operation in the range of 1 to 8 ma collector current. When on, the collector-to-emitter voltage drop is approximately 0.8 v. The dynamic resistance is in the region of 10 ohms. When off, the device has a high impedance with leakage current normally less than one microampere. Turn-on and turn-off times are approximately 0.4 μsec each and circuit repetition rates to 200 kc are possible.

The ohmic value of the collector resistor and the B+ voltage determine the on current level. For most circuits, the current level should be set between 3 and 5 ma to insure the best

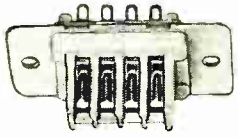
'ISUAL ALIGNMENT UNNECESSARY
RIBBON SPRING CONTACTS
LOATING BUSHINGS

ıe Wedge principle with the strong spring action of the contacts holds e connector in positive contact, and provides ease of insertion and ithdrawal. The protective barriers between ribbon contacts insure ıiform spacing. The entire length of the contacts are supported by ɔality dielectric. Mupltiple mounting makes it possible to make or eak any number of circuits simultaneously. Molded-in mounting plates e of corrosion resistant passivated stainless steel.

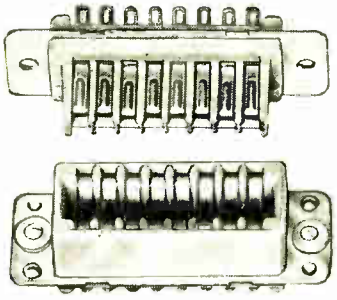
BLUE RIBBON CONNECTORS

The ribbon contact principle, with dielectric guide and support eliminates the ossibilities of damaged or bent contacts and prevents ifficulties of plug-in. No dependence on contact arıngement or visual alignment is necessary.

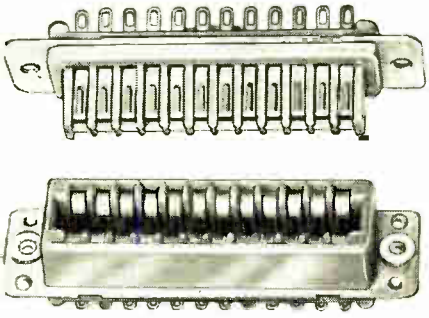
EGULAR TYPE:



8 CONTACT
PLUG AND SOCKET



16 CONTACT
PLUG AND SOCKET



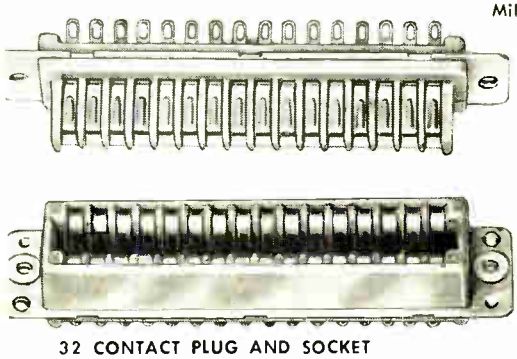
24 CONTACT PLUG AND SOCKET

Commercial plating and contact material. Mineral filled Diallyl body Type MDG per Mil.-M-14E.

36 - 4100 - 8P
36 - 4200 - 8S
36 - 4100 - 16P
36 - 4200 - 16S
36 - 4100 - 24P
36 - 4200 - 24S
36 - 4100 - 32P
36 - 4200 - 32S

Military plating and contact material. Mineral filled Diallyl body Type MDG per Mil.-M-14E.

36 - 4100 - 8P (334)
36 - 4200 - 8S (335)
36 - 4100 - 16P (334)
36 - 4200 - 16S (335)
36 - 4100 - 24P (334)
36 - 4200 - 24S (335)
36 - 4100 - 32P (334)
36 - 4200 - 32S (335)



32 CONTACT PLUG AND SOCKET

Manufactured by agreement with Amphenol Electronics Corporation

24 CONTACT
PLUG AND SOCKET

IMPROVED TYPE

The above illustrations show the improved design of the plug and socket castings which eliminates any possibility of breakage.

Commercial plating and contact material. Black Mica body Type MFE per Mil.-M-14E.

36 - 4100 - 8P (355)
36 - 4200 - 8S (355)
36 - 4100 - 16P (355)
36 - 4200 - 16S (355)
36 - 4100 - 24P (355)
36 - 4200 - 24S (355)
36 - 4100 - 32P (355)
36 - 4200 - 32S (355)

Military plating and contact material. Mineral filled Diallyl body Type MDG per Mil.-M-14E.

36 - 4100 - 8P (340)
36 - 4200 - 8S (340)
36 - 4100 - 16P (340)
36 - 4200 - 16S (340)
36 - 4100 - 24P (340)
36 - 4200 - 24S (340)
36 - 4100 - 32P (340)
36 - 4200 - 32S (340)

Commercial plating and contact material. Mineral filled Diallyl body Type MDG per Mil.-M-14E.

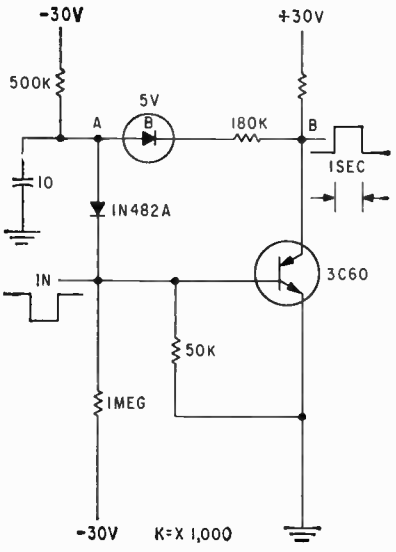
36 - 4100 - 8P (365)
36 - 4200 - 8S (365)
36 - 4100 - 16P (365)
36 - 4200 - 16S (365)
36 - 4100 - 24P (365)
36 - 4200 - 24S (365)
36 - 4100 - 32P (365)
36 - 4200 - 32S (365)

Cinch
ELECTRONIC COMPONENTS

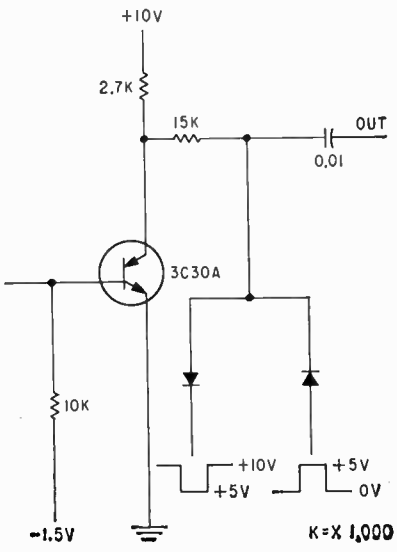
CINCH MANUFACTURING COMPANY

1026 South Homan Ave., Chicago 24, Illinois
Division of United-Carr Fastener Corporation, Boston, Mass.

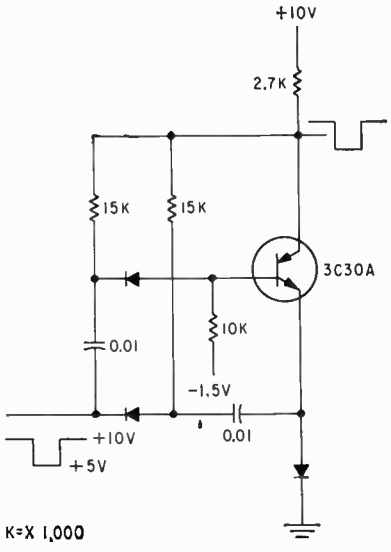
Centrally located plants at Chicago, Illinois; Shelbyville, Indiana; LaPuente, California; St. Louis, Missouri.



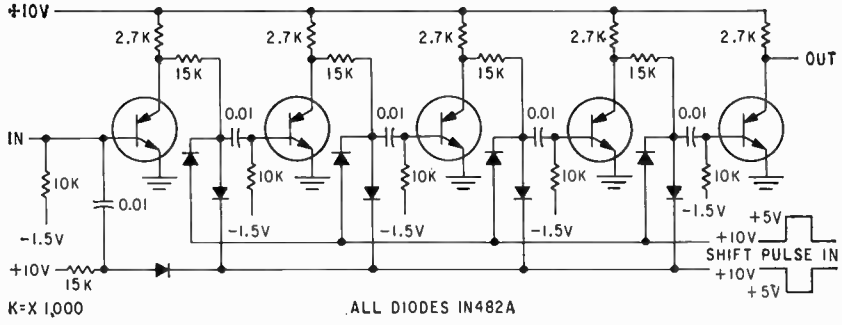
One-shot multivibrator provides up to 10 seconds delay. Circuit normally on. Point *A* at −11 v, point *B* at +1 v. Negative trigger operates circuit



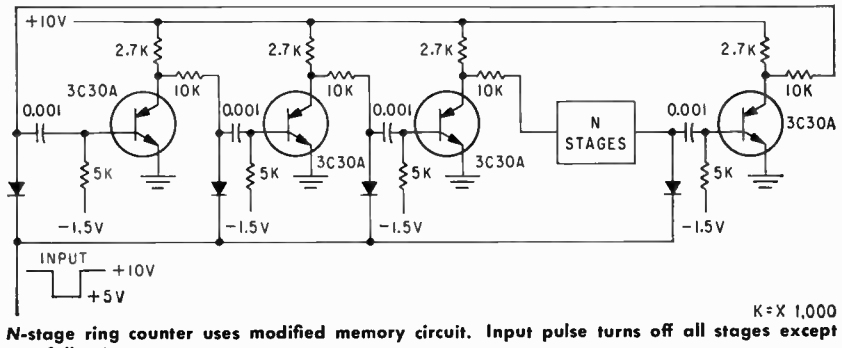
Basic memory circuit delivers either positive or negative pulse output accomplished by coupling diodes and transition memory capacitor



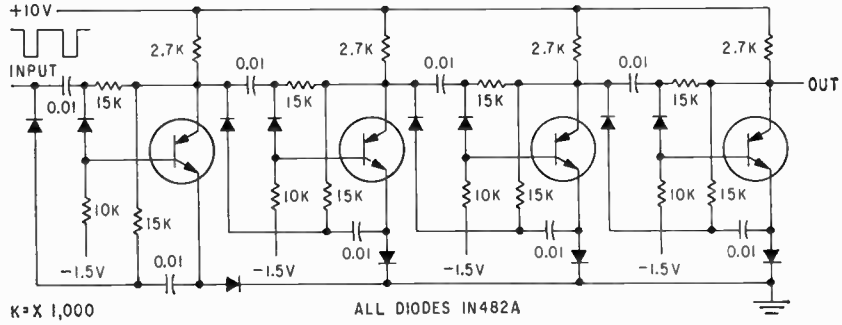
Flip-flop binary counter operates 2:1 by negative trigger pulses. Can be driven from identical flip-flop or from collector of npn silicon transistor



Shift register consists of five one-bit memory elements connected in cascade



N-stage ring counter uses modified memory circuit. Input pulse turns off all stages except one following on stage



Four-stage binary counter has 16:1 division operating on negative trigger pulses

performance throughout the operating temperature range. The B+ voltage should be above +3 v to make the circuits insensitive to small voltage changes.

When the device is off, collector cutoff current can act as a positive gate current signal, tending to turn the device on. A base resistor is used to provide base bias current to insure stable off conditions throughout the operating temperature range. For operation up to 125 C, the base bias current should be a minimum of −150 μa. If a bias voltage of −1.5 v is used, the base resistor should be 10,000 ohms or less.

Smaller values of base resistor can be directly connected to ground or emitter at the expense of increased trigger current requirements and a reduced operating temperature limit. The base-to-emitter voltage must be less than +0.10 v at 100 C. Since collector cutoff current can approach 50μa at 100 C, the maximum value for base resistor at 100 C when directly grounded is 2,000 ohms. More base resistance can be used below 100 C. Above 100 C, negative bias is recommended.

The symbol used indicates the base contact is at the internal *p* region of the *pnpn* device.

FREQUENCY STANDARDS

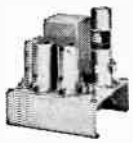
*3⅛" high
400 - 1000 cy.

PRECISION FORK UNIT
TYPE 50

Size 1" dia. x 3¾" H. Wght., 4 oz.*

Frequencies: 240 to 1000 cycles
Accuracies:—
Type 50 (±.02% at —65° to 85°C)
Type R50 (±.002% at 15° to 35°C)
Double triode and 5 pigtail parts required
Input, Tube heater voltage and B voltage
Output, approx. 5V into 200,000 ohms

FREQUENCY STANDARD
TYPE 50L



Size 3¾" x 4½" x 5½" High
Weight, 2 lbs.

Frequencies: 50, 60, 75 or 100 cycles
Accuracies:—
Type 50L (±.02% at —65° to 85°C)
Type R50L (±.002% at 15° to 35°C)
Output, 3V into 200,000 ohms
Input, 150 to 300V, B (6V at .6 amps.)

*3½" high
400 to 500 cy.
optional

PRECISION FORK UNIT
TYPE 2003

Size 1½" dia. x 4½" H. Wght. 8 oz.*

Frequencies: 200 to 4000 cycles
Accuracies:—
Type 2003 (±.02% at —65° to 85°C)
Type R2003 (±.002% at 15° to 35°C)
Type W2003 (±.005% at —65° to 85°C)
Double triode and 5 pigtail parts required
Input and output same as Type 50, above

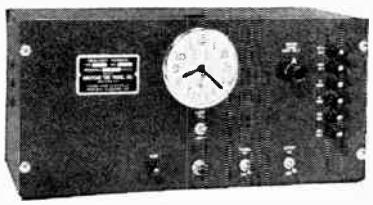
FREQUENCY STANDARD
TYPE 2005

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

Frequencies: 50 to 400 cycles (Specify)
Accuracy: ±.001% from 20° to 30°C
Output, 10 Watts at 115 Volts
Input, 115V. (50 to 400 cycles)

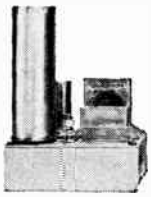
FREQUENCY STANDARD *NEW*
TYPE 2007-6
TRANSISTORIZED, Silicon Type
Size 1½" dia. x 3½" H. Wght. 7 ozs.
Frequencies: 400 — 500 or 1000 cycles
Accuracies:
2007-6 (± .02% at —50° to +85°C)
R2007-6 (±.002% at +15° to +35°C)
W2007-6 (±.005% at —65° to +125°C)
Input: 10 to 30 Volts, D. C., at 6 ma.
Output: Multitap, 75 to 100,000 ohms

FREQUENCY STANDARD
TYPE 2121A



Size
8¾" x 19" panel
Weight, 25 lbs.

Output: 115V
60 cycles, 10 Watt
Accuracy:
±.001% from 20° to 30°C
Input, 115V (50 to 400 cycles)



FREQUENCY STANDARD
TYPE 2001-2

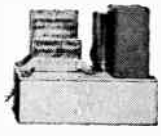
Size 3¾" x 4½" x 6" H., Wght. 26 oz.

Frequencies: 200 to 3000 cycles
Accuracy: ±.001% at 20° to 30°C
Output: 5V. at 250,000 ohms
Input: Heater voltage, 6.3 - 12 - 28
B voltage, 100 to 300 V., at 5 to 10 ma.

FREQUENCY STANDARD
TYPE 211IC

Size, with cover
10" x 17" x 9" H.
Panel model
10" x 19" x 8¾" H.
Weight, 25 lbs.

Frequencies: 50 to 1000 cycles
Accuracy: (±.002% at 15° to 35°C)
Output: 115V, 75W. Input: 115V, 50 to 75 cycles.



ACCESSORY UNITS
for TYPE 2001-2

L—For low frequencies multi-vibrator type, 40-200 cy.
D—For low frequencies counter type, 40-200 cy.
H—For high freqs, up to 20 KC.
M—Power Amplifier, 2W output.
P—Power supply.

This organization makes frequency standards within a range of 30 to 30,000 cycles. They are used extensively by aviation, industry, government departments, armed forces—where maximum accuracy and durability are required.

WHEN REQUESTING INFORMATION
PLEASE SPECIFY TYPE NUMBER

American Time Products, Inc.

Telephone: PLaza 7-1430

Watch Master
Timing Systems

580 Fifth Ave., New York 36, N. Y.

VHF Intrusion Alarm Is Self-Adjusting

By G. A. WHITLOW, Argus Alarm Devices, Baton Rouge, Louisiana

SECURITY protection of an area is often difficult or impossible using electromechanical means. Electronic devices, such as photoelectric cells, capacitance relays, ultrasonic generators and detectors and vhf receivers and/or oscillators, have been used as conditions demand.

The intrusion alarm to be described is a vhf or uhf oscillator and antenna used to detect motion. It provides an aural or visual alarm but can be modified to switch on tv cameras or lights.

Several oscillator circuits function satisfactorily as motion detectors if they are tuned off resonance or loaded by coupling to an antenna with a resonant frequency 25 percent higher or lower than that of the oscillator. Oscillation amplitude is limited so that it is readily affected by environmental changes.

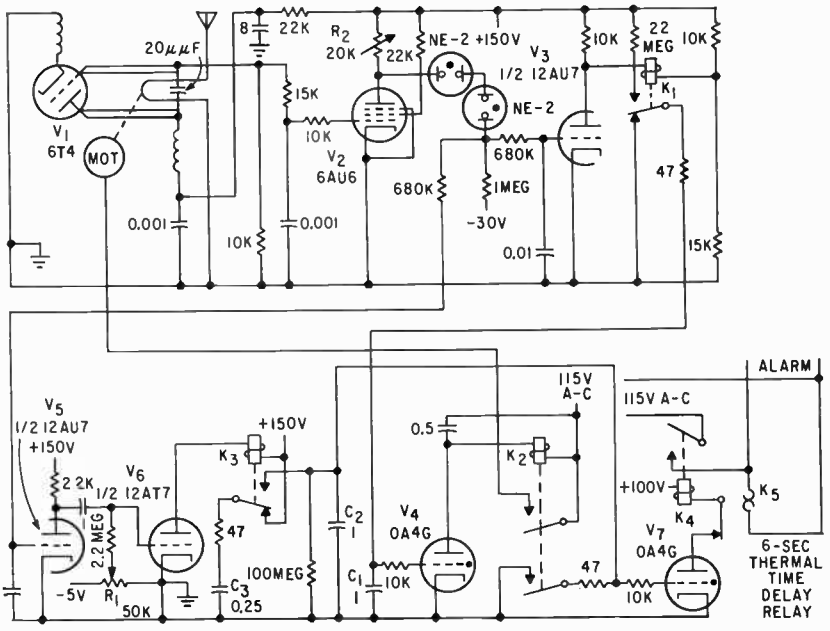


FIG. 1—Drift in oscillator grid voltage activates timing motor which alters degree of coupling between oscillator tank and antenna

If radiation wavelength is one meter, an object moving toward or away from the antenna, or along a reflection path, causes the phase relationship of radiated and reflected waves to shift through 2 π radians at the antenna for each half wavelength of movement. If antenna and oscillator Q's are high, the varying phase of the reflected wave changes oscillation amplitude. It also provides a cyclic signal in which amplitude is a function of distance between oscillator and moving object and frequency is twice velocity of the moving object in meters/sec.

Construction

In Fig. 1, two $\frac{3}{16}$-in. silver-plated copper rods 5 in. long and with centers separated $\frac{5}{8}$ in. compose the tank inductance of the 300-mc oscillator. The high Q of the lines approaches that of a quartz crystal.

The antenna is coupled to the lines with a pick-up loop that is mechanically coupled to a 4-rpm timing motor, so that degree of coupling between oscillator tank and antenna may be varied through a considerable range. The degree of coupling determines oscillation amplitude.

The optimum condition for motion detection is that oscillator grid voltage be between -0.75 and -1.5 volts. As grid voltage nears zero, the motion detector becomes more sensitive and is unstable as grid voltage exceeds -0.5 volt.

Gradual temperature and humidity changes alter grid voltage so that it must be maintained automatically. The adjusting motor sets the degree of coupling to maintain oscillator grid voltage at a preselected level. Oscillator grid voltage is coupled to the grid of amplifier V_2, the plate of which is directly coupled to the grid of V_3 by the constant voltage drop across two neon lamps.

Tube V_3 is one leg of a bridge. A positive or negative shift of 0.1 volt at the grid of the oscillator is sufficient to energize bridge relay K_1.

Normally C_1 is grounded through the contacts of K_1. A slow drift of oscillator grid voltage energizes K_1, and C_1 charges through a high resistance. If K_1 is energized longer than the 20-sec time constant, cold-cathode relay tube V_4 fires, starting the coupling adjustment motor by energizing K_2. When oscillator grid voltage swings through its preselected value, V_4 is extinguished and de-energized K_2 stops the motor. The device thus readjusts itself for maximum performance.

If K_1 were energized intermittently by signals caused by motion, C_1 would not charge sufficiently to fire V_4, preventing a readjustment cycle from starting.

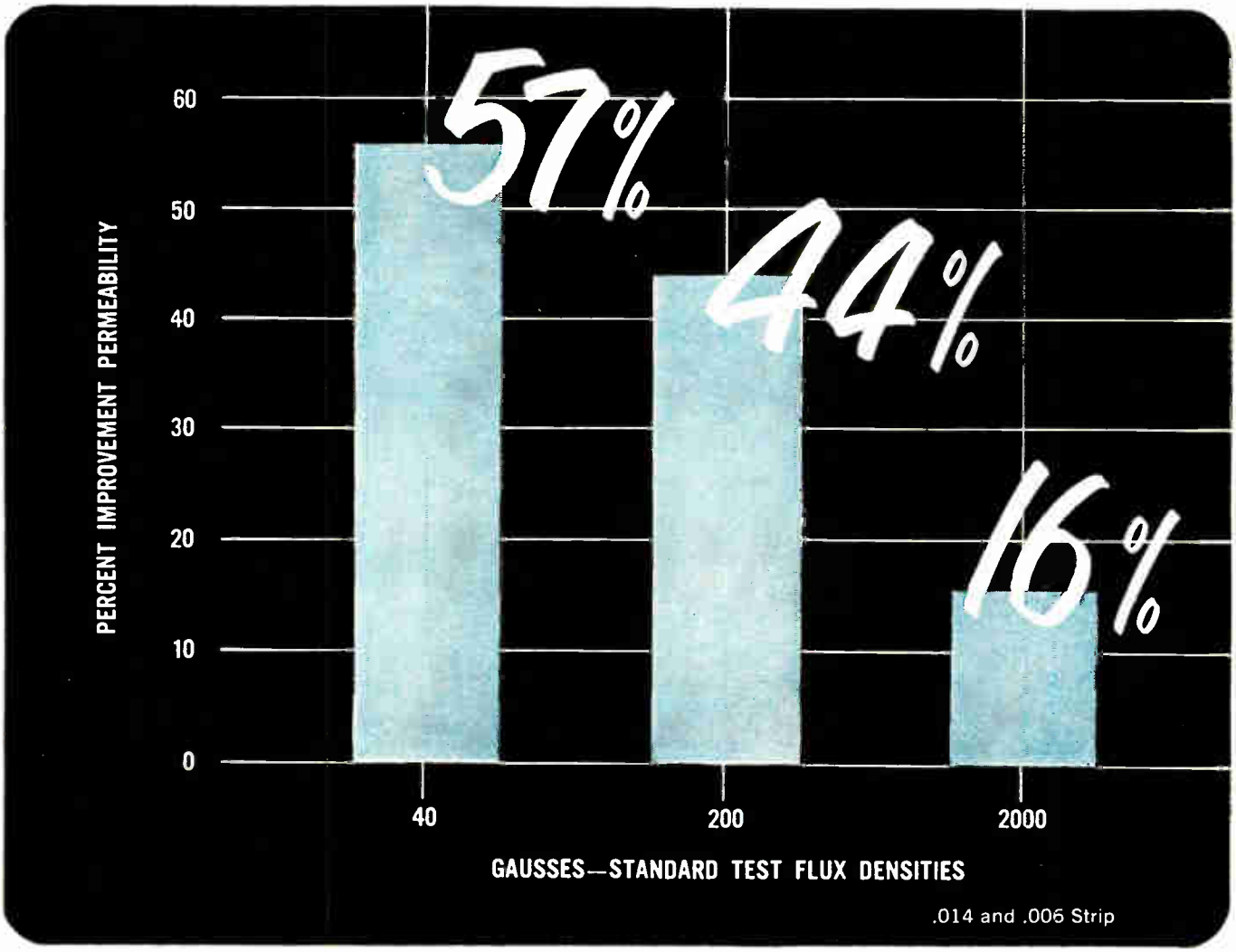
Motion Detection

For alarm signal detection, V_5 is directly coupled to the signal source and output is RC coupled to V_6. Relay K_3 is energized by a change in voltage lasting about one sec. Potentiometer R_1 limits idling current through normally de-energized K_3.

Signals from the motion detector operate K_3 at a rate equal to twice the velocity in meters/sec of the moving person or object using an oscillator frequency of 300 mc.

Incremental charges from K_3 charge C_2. Values of C_2 and C_3 are

Experience**—the added alloy in **A-L Electrical Steels



Greater permeability for Allegheny Ludlum's AL-4750...and it's *guaranteed*

promises more consistency, higher predictability for magnetic cores

AL-4750 nickel-iron strip now has higher *guaranteed* permeability values than ever before. For example, at 40 induction gausses AL-4750 now has 57% higher permeability than in the past, using the standard flux density test.

This greater permeability means better consistency and predictability for magnetic core users . . . and allows careful, high performance design.

This improvement in AL-4750 is the result of Allegheny Ludlum's continuing research on electrical alloys and nickel-bearing steels. Moly Permalloy has been similarly improved in permeability. A-L constantly researches silicon steels, including A-L's well-known grain-oriented silicon, Silectron, and other magnetic alloys.

Complete facilities for the fabrication and heat treatment of laminations are available at Allegheny Ludlum. And A-L's technical know-how guarantees you close gage tolerance, uniformity of gage throughout the coil and minimum spread of gage across the coil-width.

If you have a problem on electrical steels, laminations or magnetic material, call A-L for prompt technical assistance. Write for blue sheet EM-16 for complete data on AL-4750. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa. Address Dept. E-20.*

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selected so that three charges from C_3 transferred to C_2 fire cold-cathode relay tube V_7. An object moving through a distance of one and one-half wavelengths along a direct or reflection path within a few seconds causes an alarm signal.

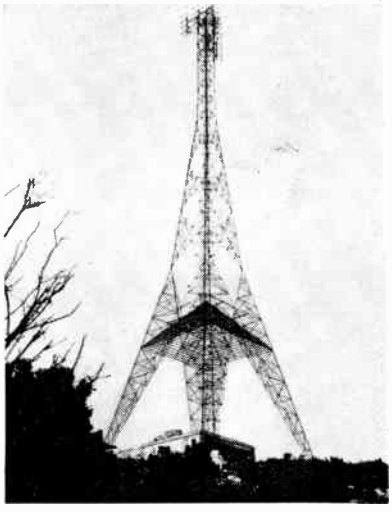
The d-c plate source of V_7 through the coil of K_1 holds K_1 energized until time-delay thermal relay K_5 interrupts plate current of V_7. Thus the aural or visual alarm signal is provided for as long as K_4 is energized, which is determined by the time delay of K_5. Thermal inertia of K_5 prevents another alarm cycle, and all circuits have time to reach a quiescent state before the contacts of K_5 reclose.

Alarm Conditions

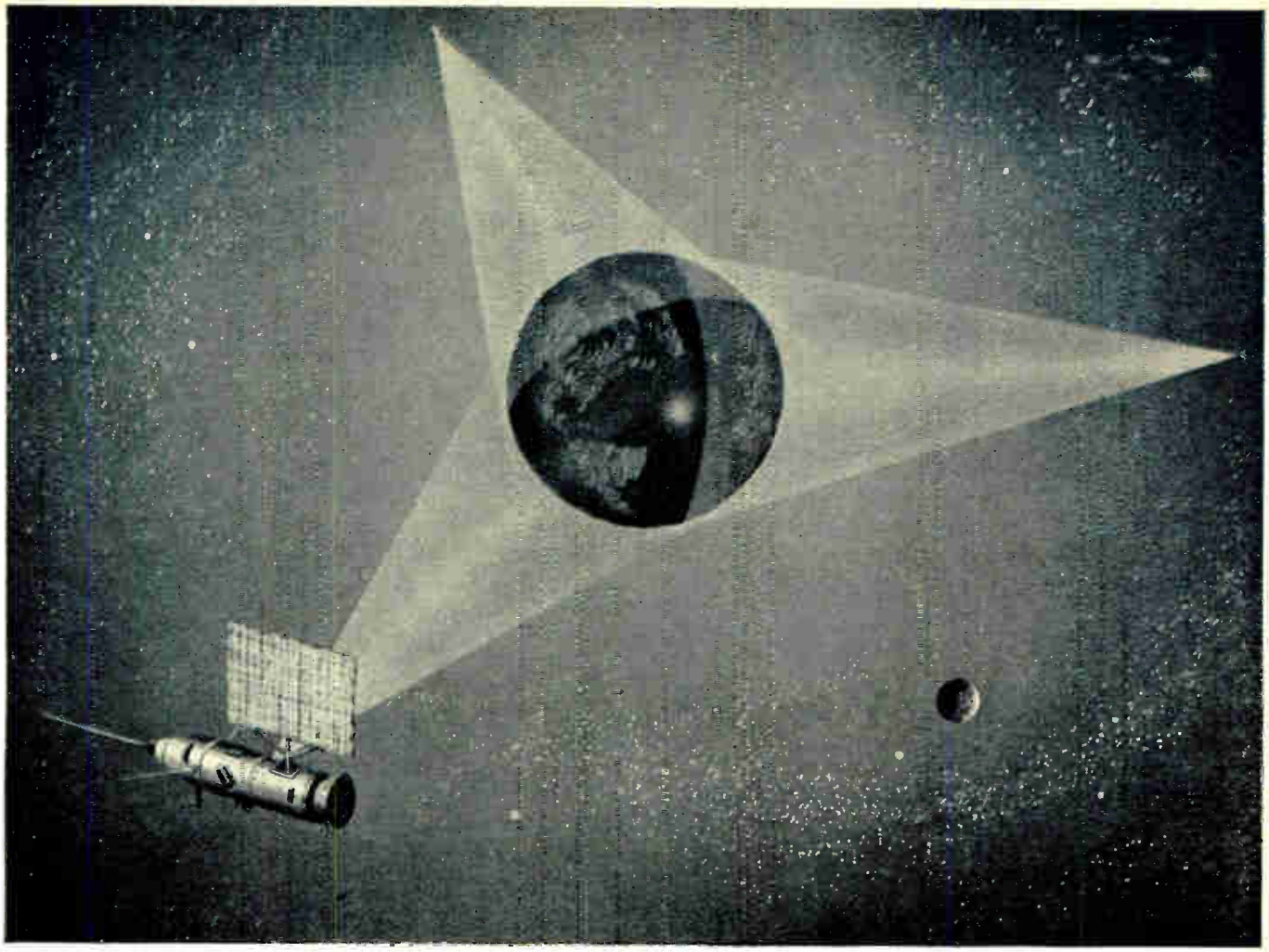
Three signals within a few seconds was selected as a requirement before an alarm signal is triggered to prevent false alarms caused by power-line fluctuations, strong signals passing through the oscillator frequency or other extraneous influences.

Well-regulated power is required for successful operation. Drift in amplifier V_2 changes oscillator grid voltage slightly but does not affect over-all performance. Changing detector location alters radiation resistance enough to shift oscillator

Tv Antenna Provides Unusual Pattern



Yugoslavian tv net uses equipment supplied by Siemens & Halske AG. Radiation pattern from mountain-top site was required to provide energy to two adjacent valleys



THE FAR REACHES OF MAN'S KNOWLEDGE

Over the years ITT Laboratories has made significant contribution to advancing the state of the art in electronics. Today highly evolutionary progress is moving apace in such areas as broadband communications systems, low-noise parametric amplifiers, atomic clocks, inertial navigation systems, high density storage tubes, and space guidance, navigation and flight control. Major achievements are resulting in stored program digital computers and digital communications.

While engineers and scientists at ITT Labs meet the urgencies of today, they are simultaneously exploring the far reaches of man's knowledge, accepting small failures, making small successes, to unlock the doors to revolutionary achievements in electronics.

Communications, as essential to civilization as food and shelter, is an area of unlimited challenge which constantly occupies our efforts. To find more room within the radio spectrum for electronic communications — from direct current to the cosmic rays — is a major goal. Revolutionary ways to extend communications is another. We foresee early success with single satellite systems of the delayed-transponder type, and possibly passive reflector satellites. In only a few years ITT's "Earth Net" communication system may be a reality, providing global communications via three satellites in orbit. Within a generation, world-wide television may be a commonplace.

Positions of responsibility, challenge and reward are open to engineers with minimum B.S. degree and U.S. Citizenship. For information regarding specific positions, write G. T. Wall, Technical Placement Director.

ITT LABORATORIES
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grid voltage, which can be set by R_2.

Effective working range and pattern depends on type of antenna. A 30-ft radius using a vertical antenna to an elongated pattern by a Yagi up to 60 ft from the antenna is average performance.

Instrument Alters Scopes for Fast Pulses

HIGH-SPEED, relatively low cost, transistorized instrument now makes it possible to view repetitive millimicrosecond pulses on conventional oscilloscopes. The Model SU-22, just announced by Lumatron Electronics, Inc., has a rise time of better than 0.6 millimicroseconds and a sensitivity of approximately 30 mv/cm.

Calibrated sweep speeds of 0.5×10^{-9} sec are possible and a companion unit permits its use at repetition rates of several hundred mc. The high-speed operation is made possible by the use of the sampling technique (see ELECTRONICS, p 69, July 31).

The technique eliminates need for traveling-wave tubes, wide-band amplifiers and similar devices. Instead, it uses a circuit that produces and amplifies narrow samples of the waveform, rather than the waveform itself. In the sampling circuit, unamplified, repetitive low-level signal waveforms are sampled (strobed) by a very fast pulse produced by an avalanche transistor. The sample is stretched, amplified and displayed on the screen of the oscilloscope as a dot.

The next pulse is then strobed, but at a slightly later instant, resulting in a new sample corresponding to the instantaneous amplitude of the pulse at the sampling point. The resulting dot is displayed next to the preceding dot, and so on until the entire waveform under investigation has been strobed and displayed as a continuous pattern. The sampling pulse now resets in time and the process is repeated.

The new unit, having slightly slower rise time and lower sensitivity, fills the gap between conventional oscilloscopes and complex ultrahigh speed instruments. It is in production, with deliveries scheduled to begin this month.

Up to 5 megohms in a ½-watt resistor . . .
and better operating
characteristics, too!

Only the WESTON VAMISTOR®

offers performance like this!

Here, at last, is a precision metal film resistor which offers substantial advantages over all other types—wire wound, deposited film, etc. Look at this list of VAMISTOR capabilities and characteristics:

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- VAMISTOR OFFERS HIGHEST RESISTANCE RANGES. For example, 1.5 megohms in ¼-watt size . . . 5 megohms, ½-watt.
- VAMISTOR HAS OUSTANDING THERMAL CHARACTERISTICS. Runs cooler . . . resists thermal shock. Standard temperature coefficient doesn't exceed 50 ppm/°C.—lower than Nichrome wire. Also available with maximum of 25 ppm/°C. Temperature coefficients don't vary over the resistance range.
- VAMISTOR OFFERS UNUSUALLY LONG SHELF LIFE, STABILITY. Exclusive process of fusing element to inside of steatite tube assures long life, improved resistance to all environmental conditions.
- VAMISTOR IS MORE RELIABLE; HAS GREATER MEAN-TIME-TO-FAILURE.
- VAMISTOR PRODUCES NO CORONA; IS AS NOISE-FREE AS BEST WIRE-WOUND RESISTORS.
- VAMISTOR OFFERS EXCEPTIONAL PERFORMANCE UNDER RADIATION.
- VAMISTOR ACCOMMODATES HIGHER MAXIMUM CONTINUOUS WORKING VOLTAGES.
- VAMISTOR IS VIRTUALLY NON-INDUCTIVE. Capacitance characteristics are superior to all other existing resistors.
- VAMISTOR IS SUBJECTED TO STRICTER QUALITY CONTROL THAN ANY OTHER RESISTORS.
- THE VAMISTOR LINE CONFORMS TO MIL-R 10509C CHAR. C. Styles RN-65, RN-70, RN-75 and RN-80.

For full information, contact your local Weston representative . . . or write to Daystrom-Weston Sales Division, Newark 12, N. J. *In Canada: Daystrom Ltd., 840 Caledonia Rd., Toronto 19, Ont. Export: Daystrom Int'l., 100 Empire St., Newark 12, N. J.*

MIL STYLE	WESTON MODEL	WESTON DIMENSIONS	
		LENGTH	DIAMETER
RN-65, RI-92	9855-2	0.650	0.235
RN-70 RI-94	9852	0.866	0.312
RN-75, RI-96	9850-2	1.120	0.411
RN-80	9849-2	2.156	0.411

WESTON Instruments

A DAYSTROM UNIT

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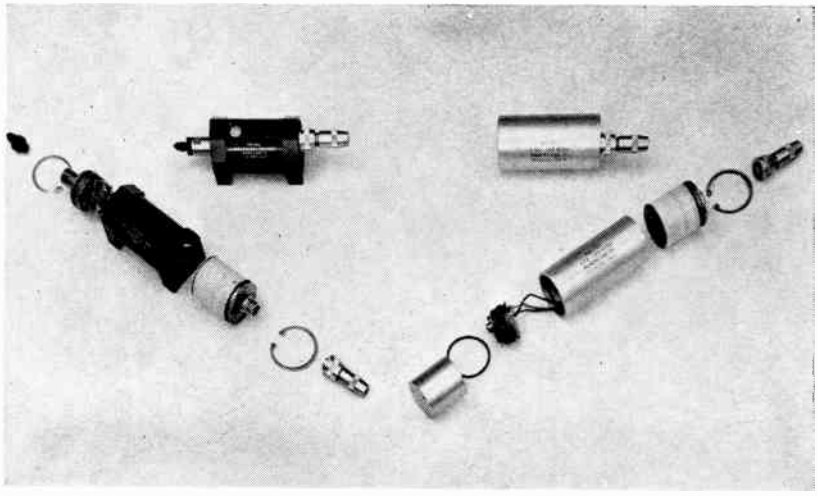
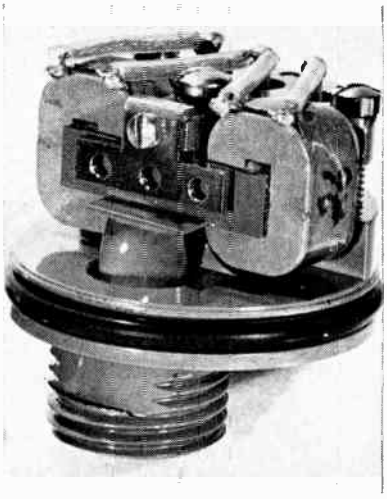


A pressure transducer, left, and an accelerometer, right, are shown completely assembled and disassembled. At the bottom are the variable-reluctance elements and solid state electrical package comprising the synchronous switch, synchronous demodulator and output filter. Two small trimpots have been provided so zero and full-scale values may be standardized to permit interchangeability



Variable reluctance component from the pressure transducer. Units similar to these have been vibration tested from 50 to 2,000 cps at a 35 g level for an extended period without failure

Reliable High-Output Transducer

By O. K. KOWALLIS, Chief Engineer, Wiancko Engineering Co., Pasadena, Calif.

THE NEED for high-output transducers has, in the past, been met primarily by various potentiometer types. These units have limitations in resolution and life expectancy when placed in critical missile instrumentation systems. System components possessing Coulomb friction are generally undesirable from a reliability viewpoint.

The variable-reluctance principle of transduction provides high resolution, ruggedness and reliability. However, ordinarily it must be excited by an a-c source, and secondly it provides a high-level a-c output.

Synchronous Switch

The variable-reluctance d-c transducer, developed by Wiancko Engineering of Pasadena, California, provides a d-c output by the application of solid-state switching techniques. The a-c excitation voltage required of all variable-reluctance transducers, is provided by a solid-state synchronous switch, see Fig. 1, which alternately reverses the polarity of the 28-v d-c power source.

A square wave voltage is produced which is used to excite the variable-reluctance bridge and synchronous demodulator. The duty cycle, frequency and amplitude stability are maintained constant by the synchronous switch. A frequency of 5 kc was chosen.

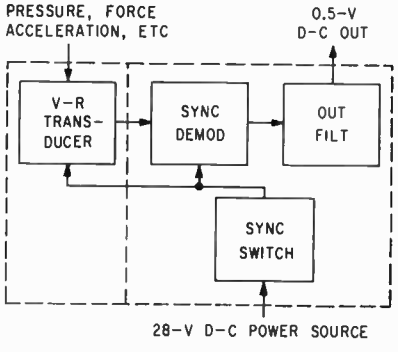


FIG. 1—Block diagram of the variable-reluctance d-c transducer

Demodulator

The synchronous demodulator is a ring type having four diodes. This demodulator has good response far in excess of the 5 kc switching rate encountered. If care is exercised in selecting and matching these diodes, zero drift or sensitivity change due to temperature is less than 0.1 percent of full-scale output.

The low-pass output filter has a cut-off slightly above 1 kc. The frequency response, exclusive of the variable-reluctance transducer, can be as high as 1,000 cycles. Many telemetering applications require only a few cycles dynamic response. In such cases, the output filter can be designed with a cut-off at any desired point below 1,000 cycles.

With proper impedance transformation, the high-power output characteristic of a variable-reluctance transducer makes it possible to provide a 0 to 5-v d-c output without amplification. This capability offers

Table I—Transducer Characteristics

Linearity	<0.5 percent
Hysteresis	<0.1 percent
Resolution	continuous
Excitation	28-v d-c
Output[a]	5-v d-c
Temp. range	−65 F to 165 F[b]
Response to temp	
Zero drift	<0.01 %/F
Sens. drift	<0.02 %/F
Response to accel.	0.001 to 0.05%/g[c]
Response to vibra	<1% error for 25g 50 to 2,000 cycles
Shock	50g without damage

[a] — ±2.5-v available for ± diff press.
[b] — can be designed to operate over range 32 F to 250 F
[c] — depends upon range

utmost in performance

TYPE 33M

MOLDED mylar* CAPACITOR

applications | *computers • instrumentation • test equipment filter networks • transistor circuitry • amplifiers*

Sangamo Type 33M molded mylar* capacitors combine the excellent electrical performance characteristics of mylar* dielectric material with a molded case of high moisture resistant thermosetting plastic.

Temperature Range: "The Type 33M is designed to operate over the temperature range of —55°C. to +85°C. Satisfactory performance at 125°C. can be obtained by derating the voltage to 50% of the 85°C. value."

Dissipation Factor: The dissipation factor of the Type 33M capacitor does not exceed 1% at normal equipment operating temperature over the complete audio frequency range.

Tolerances: Available in capacitance tolerance values of ±5%, ±10%, ±20%.

Life Test: These units will withstand a life test of 250 hours at 125% of rated voltage at 85°C. Life tests at 125°C. should be made at 125% of the derated voltage.

Dielectric Absorption: Dielectric absorption of Type 33M capacitors is less than half that of oil impregnated paper capacitors.

Moisture Resistance: Type 33M capacitors will successfully withstand the moisture resistance tests specified in Spec. MIL-C-91A.

Insulation Resistance: The insulation resistance of these capacitors will exceed 5,000 meg/mfd. over the normal operating temperature range.

• Write for engineering bulletin TSC-206A

*DuPont's trademark for polyester film.

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

SC-59-6

significant size, weight, and economic advantage over low-level transduction methods.

Undoubtedly, one of the greatest values of this development is the contribution to advancing the state of the telemetering art. A tabulation of representative specifications on pressure transducers in the 5 psi to 10,000 psi range is given in Table I.

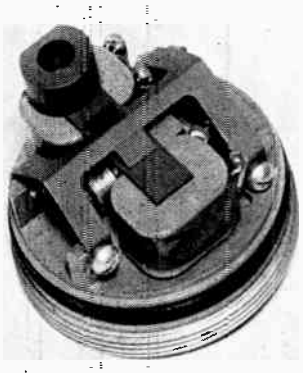
Other Advantages

These units provide a constant output impedance in the range of 2 to 5 kohms depending on output filter. This is an advantage as no non-linearity term is created by a source impedance change as is the case for potentiometer-type transducers when operated into a fixed load impedance.

Another significant advantage is that the entire electrical portion of the transducer output is isolated from ground. It is also electrostatically shielded and isolated from the 28-v power source. Thus a high value of rejection for external noise source is provided. The signal to noise ratio of a transducer in its system environment is most important and these characteristics assure the achievement of the maximum signal-to-noise ratio at the

Long-Lived Tubes

Power tubes at Lisbon Station of Radio Free Europe have logged upwards of 30,000 hours to date. The average life of 40 RCA-9C25 tubes in 20-hour daily service exceeds 25,000 hours and ten of these tubes have given over 30,000 hours of full power service. Three of the 9C25's are approaching the 40,000 hour mark



Variable reluctance component from the accelerometer unit

output of the transducer.

Certain missile applications of this transducer package will require the sensing element be separated from the electronic package. This may be done quite easily for distances in the order of 25 feet. The primary reason for this separation will be temperature, as the sensor will normally operate satisfactorily at temperatures significantly above the limits set for the electronic portion of the package.

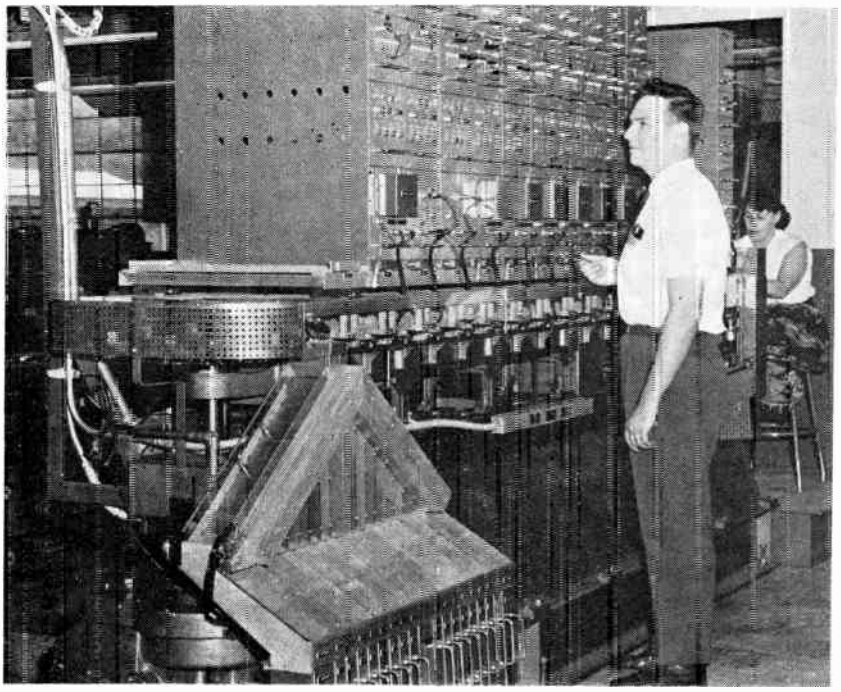
Fluorocarbon Resin

QUANTITY PRODUCTION of a true thermoplastic that can be melted, molded and extruded will begin flowing in the fall from a Du Pont plant in Parkersburg, W. Va.

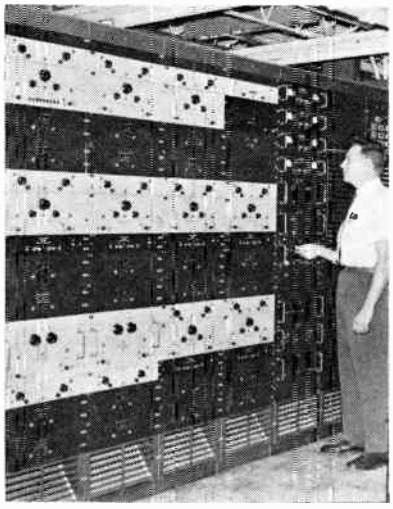
The product is Teflon FEP-fluorocarbon resin (fluorinated ethylene propylene). FEP has about all of the properties of Du Pont's TFE with one exception: TFE can be exposed continuously at 500 F while FEP is limited to about 400 F. However the new thermoplastic will extend the benefits of Teflon to areas once excluded: encapsulated molding of electronic parts.

Three-quarters of the market is expected in wire and wire products and the remainder will go into injection molded parts, tubing, hose and a variety of other uses.

As a primary insulation, FEP can be extruded successfully over tin-plated, aluminum-plated, silver-plated or bare copper conductors. As a jacketing material, it will be applied over shielded and unshielded primaries as well as multiconductor and coaxial cables.



Test circuits are housed in modular units over diode conveyor



Control cabinet. Power supplies for test modules are at left; controls, computer and their power supplies are at right

Digital Techniques Sort Diodes

DIGITAL TECHNIQUES are used in a production line diode sorter which automatically classifies a diode family into as many as 16 categories of d-c characteristics. It performs 16 tests simultaneously on 16 diodes, for an overall rate of 1,500 an hour with an accuracy within 0.3 percent.

The Digital Automatic Tester and Classifier (DATAC) was designed by Sylvania Electric Products Inc., Semiconductor Division, and is in use at its Hillsboro, N. H., plant.

Test modules are located along the top of a conveyor-type mechanical indexing track. The computer and power supplies are in an adjoining cabinet. The physical layout is shown in Fig. 1, a block diagram of the system in Fig. 2 and the master timer in Fig. 3. The scan clock pulse generator is the same as the index clock pulse generator (Fig. 4) except that the flip flops are started by the master timer test pulse.

The present machine is manually loaded. During the dwell time of each index cycle, a diode is placed in the grooved carrier at the load position. It is carried to a polarity checking position and is rotated 180 degrees if polarity is incorrect.

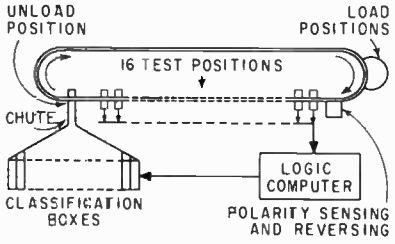


FIG. 1—Physical layout of index conveyor

The diode then passes through each test according to a programmed order. The result of each test is in binary logic form. A binary answer is transmitted to the computer portion where it is stored in a memory register. After the 16th test, the complete register word is read out and sequentially compared with 16 independent sets of requirements or categories.

If the characteristics of a diode match one of the preset categories the gate to one of the classification boxes is opened. The diode drops through a chute into its box. A 17th box accepts unclassified diodes.

Diodes could pass more than one

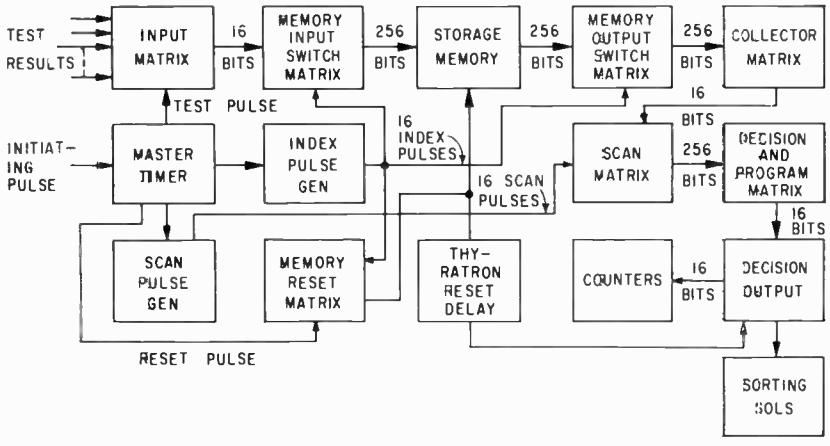
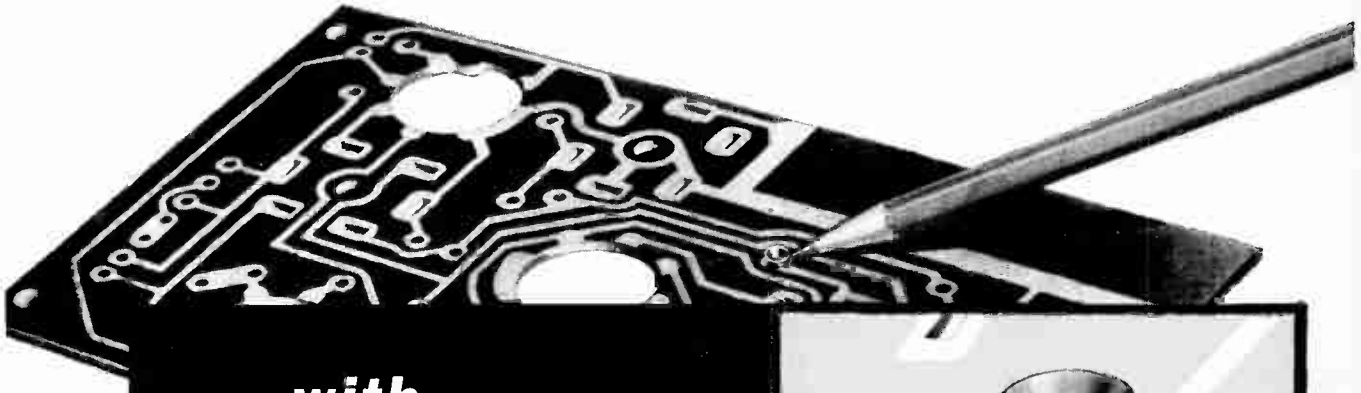
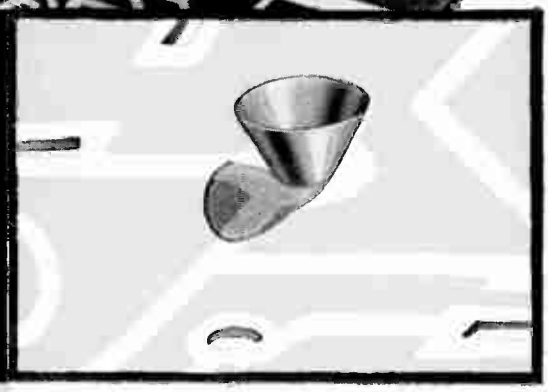


FIG. 2—Functional circuits of the indexing and sorting controls

RELIABLE CONNECTIONS



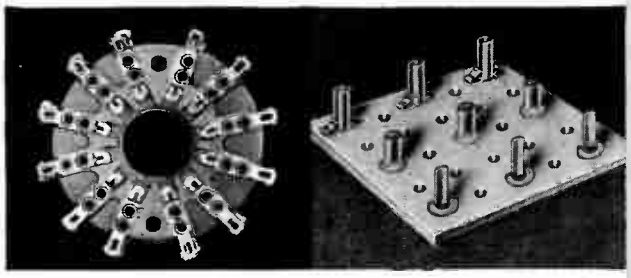
...with LOW COST EYELETS



NEW FUNNEL FLANGE eyelets designed especially as connectors for PW boards. Solves two-sided circuitry and solder problems. Speeds insertion. Are fed and set automatically on United Machines.

Eyelets give you unlimited opportunities for savings as connectors, fasteners, terminals, bushings, contacts for switches and hundreds of similar applications. Only with United Eyelets do you have such a wide choice of standardized sizes, special designs for cutting costs on unusual production problems, combined with a comprehensive line of the most versatile eyelet setting machines available.

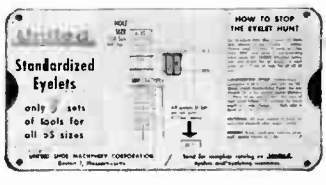
In no other way can you get the flexibility obtainable with eyelets at comparable installed costs. Call or write us today for more information. Our national sales and service organization is ready to help with your most challenging problem.



NEW MINIATURIZED EYELETS as connectors and fasteners for low cost, high speed insertion in components, PW boards, miniature equipment. Designed for high speed automatic feeding with United Machines. Copper or brass.

CUT COSTS WITH SHEARED EYELETS as stand-off terminals. Set as many as 3000 terminals per hour. Cuts soldering time too.

Simultaneous multiple eyeleting from either or both sides of machine. Typical six eyelet application illustrated. 50 years' experience is your assurance of complete dependability.



NEW EYELET SELECTOR — FREE

Simplify design, purchasing, inventory, and production. Decide the hole size and grip, and set the calculator to find the exact eyelet you need. Send for your free copy today!

United

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category. Since it is desirable to classify the diode according to the first or highest group, only the first decision is considered. This is accomplished by a decision output circuit of the form shown in Fig. 5. Sixteen thyratrons are temporary storage units for the final classifying decision.

Each decision output is connected to the input of a particular thyratron. All thyratrons have a common cathode circuit. They are reset by making their anodes more positive than their cathodes. A short pulse on the reset relay handles this after each dwell period begins.

The cathode bias is set to prevent the thyratron from firing as long as the potential on the output of the scan circuits is zero (no signal or a *bad* answer). When a *good* answer occurs, the input potential of that thyratron is increased above the firing point and the thyratron fires. Because of the higher current flow in the common cathode resistor, the bias on all other thyratrons increases so that a second *good* answer will not fire any of the remaining thyratrons.

A single answer for each diode places it in the highest category for which it qualifies. The solenoids for the box gates are actuated by mercury relays in the thyratron anode circuits.

Modular construction facilitates servicing. Test modules are ar-

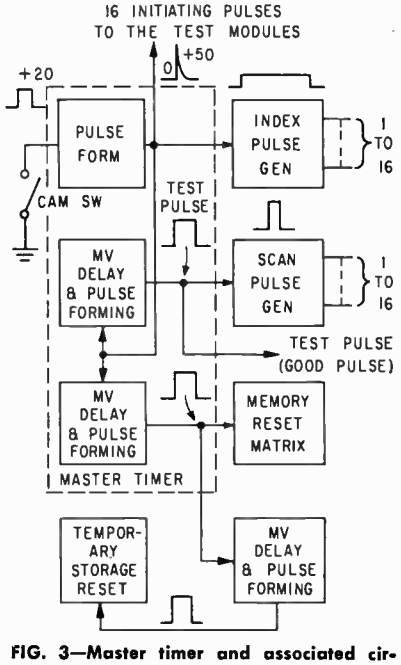


FIG. 3—Master timer and associated circuits. Pulse shapes are shown

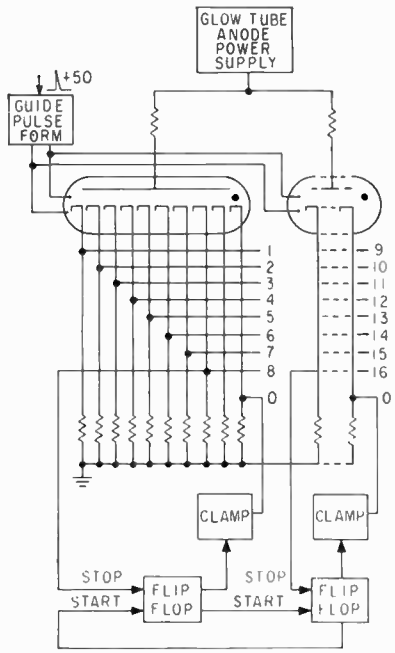


FIG. 4—Index clock pulse generator

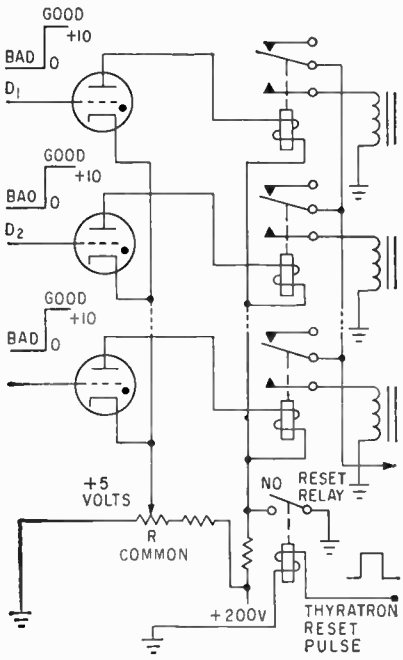


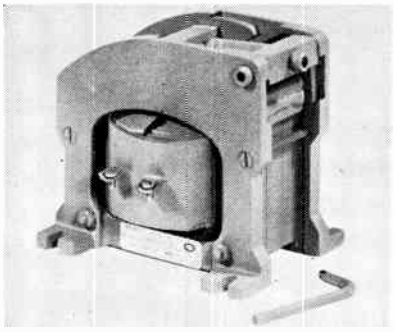
FIG. 5—Decision output circuit limits classification of a diode to a single category

ranged so that tests can be changed from forward to reverse; test limits and test order can also be changed. Category sorting requirements may be programmed. Primary input power of 208 v at 30 amps is provided on a separate line to avoid transient spikes.

A new model, with 32 test stations and automatic loading is expected to be ready this fall. One which tests diode characteristics of transistors is also planned.

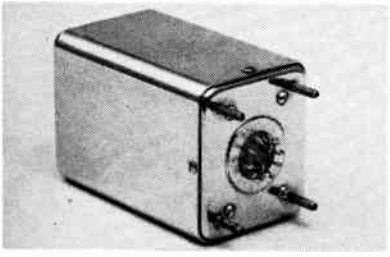
On The Market

Inductances adjustable units



MAGNETIC SPECIALTIES, INC., 10 Albemarle Ave., Trenton 3, N. J. Vari-Henry inductances are of two types: a single-winding type having a ratio of maximum to minimum inductance in excess of 6 to 1; a two-winding type, for series or parallel connection, having a ratio of maximum to minimum inductance in excess of 24 to 1. Vari-Henry employs a core and armature of laminated silicon-iron. The spacing between core and armature determines the inductance and is controlled by an adjusting screw. In 60 cps a-c applications, volt-ampere ratings range from 150 va for the smallest units to 100 va for the largest units now being manufactured.

CIRCLE NO. 200 READER SERVICE CARD

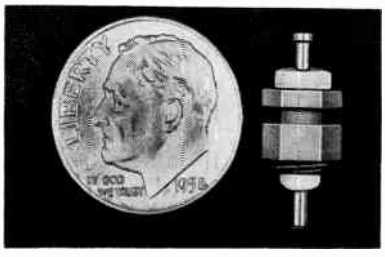


L-F Oscillators transistor type

MONITOR PRODUCTS CO., South Pasadena, Calif., announces the LTO series of l-f transistor oscillators. Frequency range is 400 cps to 500 kc; frequency stability, up to 1 part 10^6; calibration accuracy, ± 0.002 percent; warm-up time, 15 minutes; temperature range, -55 C to $+85$ C; power output, 28 v d-c, 15 mil and 28 v, 15 w or 115v, 15 w. Vibration is up to 20 g's to 2,000 cps depending on frequency. Connections are glass-metal sealed header type.

CIRCLE NO. 201 READER SERVICE CARD

Small Insulator feed-through type



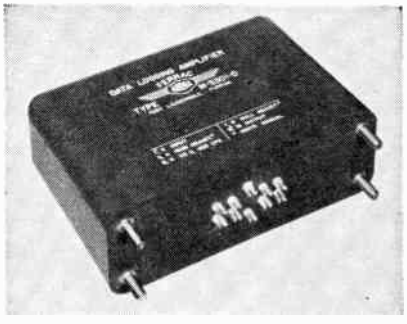
FLUOROCARBON PRODUCTS INC., Camden 1, N. J. Series CF-405 high performance feed-through insulator features a hollow threaded metal body which fits through a bed plate and is secured by a hex nut. The entire insulator unit ranges from 0.690 in. in length and has a rated capacitance of 2.00 $\mu\mu$f. The terminal, which passes through its hollow body, is spaced by a force-fitted Teflon plug. Teflon's insulating properties insure maximum performance in severe applications.

CIRCLE NO. 202 READER SERVICE CARD

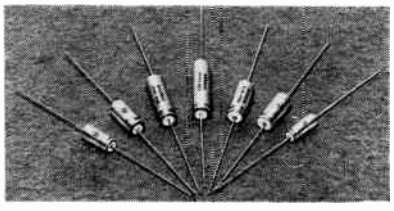
Magnetic Amplifier data logging

AIRPAX ELECTRONICS, INC., Seminole Division, Ft. Lauderdale, Fla. The M-5301-D data logging amplifier is a three-stage, high accuracy, molded magnetic amplifier designed to deliver ± 5 v at a linearity better than 0.1 percent. Performance similar to that of chopper amplifiers is obtained. Input and output are completely isolated, completely floating and free of ground and power line. Voltage gains from 100 to 10,000 can be obtained by use of external resistance. Five watts of power are drawn from a 115 v, 400 cps power line. Hipot test: 500 v, 60 cps for one minute.

CIRCLE NO. 203 READER SERVICE CARD



Capacitors extended-life



SPRAGUE ELECTRIC CO., North Adams, Mass. Type 40D miniature tubular aluminum electrolytic capacitors are designed for more than a 10 year service life under typical operating conditions in actual circuit applications. Mechanical construction is such as to assure freedom from open circuits even after extended periods of operation in the millivolt signal range. A controlled

Tubes are suited to the job—at SPERRY

Sperry electronic tubes are designed to withstand extremes of heat, cold, shock or other environment to suit the application.

TWO NEW BROADBAND, HIGH POWER CW TWT AMPLIFIERS FROM SPERRY

P-BAND 240-510 mc

STP-49

L-BAND 500-1000 mc

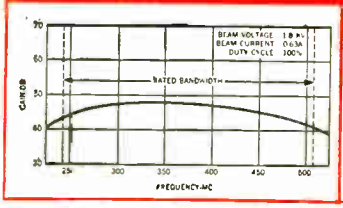
STL-48

SPECIFICATIONS:

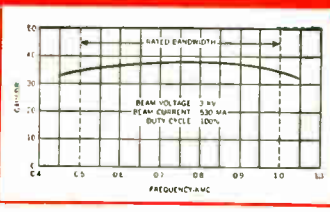
Freq. Ranges	STP-49, 240-510 mc; STL-48, 500-1000 mc
Rated Output Power	200 w (min)
Input Power at Rated Output Power	500 mw (max)
Small-Signal Gain	30 db (min)
Heater Voltage	12.6 v
Gain at Rated Output Power	25 db (min)
Beam Current	625 ma (nom)
Beam Voltage	STP-49, 1600-1900 v; STL-48, 2800-3200 v
Heater Current	STP-49, 2.5 amp; STL-48, 5 amp

Small-Signal Gain vs Frequency

STP-49

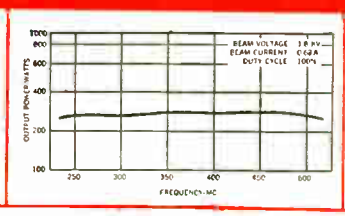


STL-48

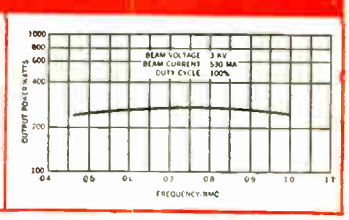


Saturated Power vs Frequency

STP-49



STL-48



In these two new TWT's, Sperry brings you the unique combination of high output power, broad bandwidth, and rugged environmental construction for the P and L bands. They are the only tubes of their kind available. Together they offer a frequency range of 250 to 1000 mc for such cw applications as "over-the-horizon" communications, long-distance TV and radar, tropo-scatter networks, mobile and point-to-point microwave and any other type of amplifier service where high gain, high power and freedom from tuning are desirable. They can be used to transmit narrow-band signals having many channels—or fewer signals requiring wide bandwidth. Both tubes are of all metal-ceramic construction, ruggedized, reliable and stable in both open and short circuits. Sample quantities available now. Write for complete data.

SPERRY

SPERRY ELECTRONIC TUBE DIVISION, *SPERRY RAND CORPORATION, GAINESVILLE, FLORIDA*

Address all inquiries: Gainesville, Florida, or Sperry Offices in Brooklyn, Boston, Philadelphia, Los Angeles and Montreal. Export Dept., Great Neck, New York

spin sealing of the can about a specially-processed resilient rubber bung results in a reliable closure, which will successfully pass immersion tests and extended exposure to high ambient temperatures without leaking.

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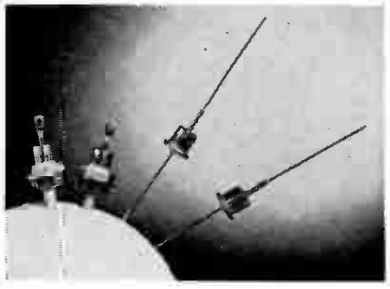
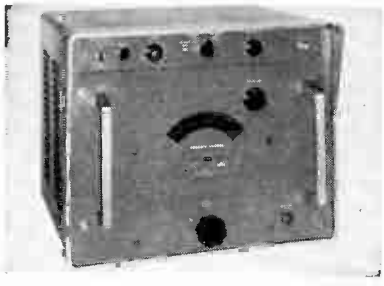


Silicon Rectifiers diffused junction

MOTOROLA INC., 5005 E. McDowell Rd., Phoenix, Ariz., offers a wide variety of diffused junction silicon rectifiers in industry standard top hat and stud-mounted welded packages. All units have very low back currents at high temperatures. Very high surge current handling capacity and excellent stability are other highlights. Rugged construction is designed to meet or exceed military environmental conditions of MIL-T-19500A.

CIRCLE NO. 205 READER SERVICE CARD



Signal Source 1,050 to 11,000 mc

POLARAD ELECTRONICS CORP., 43-20 34th St., Long Island City 1, N. Y., has developed model KSS microwave signal source in a single compact cabinet with interchangeable plug-in microwave tuning units. . It is recommended as a stable, reliable source of microwave energy at relatively high output levels: 80 to 400 mw in the lowest range, 14 to 40 in the

highest. Model KSS generates internal square wave signals variable 10 to 10,000 pps, internal c-w signals—and may be externally modulated. Pulse rise and decay time on external modulation is 0.15 μsec minimum.

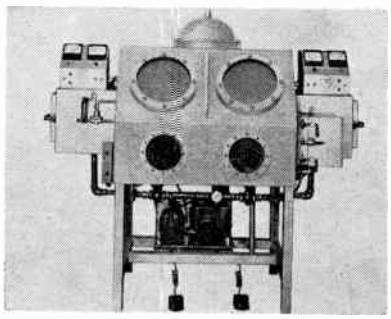
CIRCLE NO. 206 READER SERVICE CARD

Laminated Plastic epoxy-paper base

NATIONAL VULCANIZED FIBRE CO., 1059 Beech St., Wilmington 99, Del. Phenolite grade EP-491 is a premium grade epoxy-paper base laminate. It features excellent flame resistance, exceptionally good cold punching quality, and electrical

properties and dimensional stability superior to regular XXXP types. Developed specifically to meet the stringent p-c requirements of computer manufacturers, it will also have many other uses.

CIRCLE NO. 207 READER SERVICE CARD



Vacuum Oven Dry Box precision lab tool

CONTROLLED ATMOSPHERE ENCLOSURES MFG. CO., INC., 1061 E. 8th St., Jacksonville 6, Fla., announces the inert atmosphere vacuum oven dry box. Designed for high vacuum drying operations, this system is automatically controlled and permits accurate drying temperatures up to 575 F while being subjected to vacuum processes into the low micron range. Unit meets all critical standards.

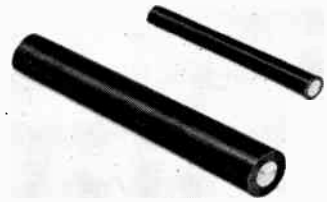
CIRCLE NO. 208 READER SERVICE CARD

Programmers for commercial uses

THE A. W. HAYDON CO., Waterbury, Conn. The 41900 series of programmers is designed for use in industrial and commercial applications where production facilities are required. Flexibility of design of the compact units makes them adaptable to many applications

which cannot be satisfied with other timers. The model illustrated on p 80 has four switches and is typical of the construction used when one to four electrical circuits must be controlled. Switches are spdt, snap-action type with silver contacts nominally rated 15 amperes resistive at 115 v a-c.

CIRCLE NO. 209 READER SERVICE CARD



Insulated Rod for high torque use

THE RICHARDSON CO., 2860 Lake St., Melrose Park, Ill., has a new high strength, paper base Insurok laminated plastic sheathing ideally adapted to the insulation of aluminum or steel rods for use under high torque. The Insurok laminate sheathing solves the torque problem. It will accept multiple set screw mountings of components without chipping or cracking, thus eliminating the potential dangers and equipment maintenance inherent with the use of old style, molded type sheathings.

CIRCLE NO. 210 READER SERVICE CARD

Regulator power-temperature

RESEARCH, INC., 115 N. Buchanan, Hopkins, Minn. Power input to an electrically heated process can be controlled to maintain a precise temperature with a recently developed electronic system. Packaged as a compact unit the SPG5009 power-

temperature regulator includes an electronic controller and ignitron firing circuit. The ignitrons may be either air cooled or water cooled depending on power requirements. By varying the firing angle of the ignitrons the controller proportionally regulates the load power, which is 50 kva for the air cooled or 140 kva for the water cooled version.

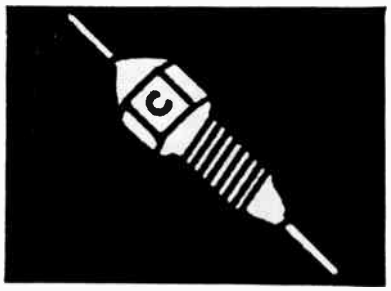
CIRCLE NO. 211 READER SERVICE CARD

Degausser semiautomatic

MAGNASYNC MFG. CO., LTD., 5546 Satsuma Ave., N. Hollywood, Calif. Model A-937 semiautomatic turntable degausser features a predetermined 20-sec timed cycle that completely eliminates guesswork. The pushbutton-controlled motor-driven

turntable insures fast and complete bulk erasure and eliminates noise patterns which are generated by irregular rotational motion. The degausser is designed to accommodate all sizes of instrumentation tapes and magnetic films. Price is $159.50.

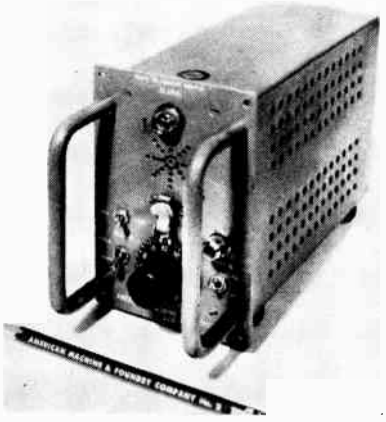
CIRCLE NO. 212 READER SERVICE CARD



Ceramic Capacitor 2.5 cm long

MAIDA DEVELOPMENT CO., 214 Academy St., Hampton, Va., Type 287 ceramic capacitor has been designed to withstand the most rugged environmental requirements of thermal shock, vibration, moisture, etc. It is potted with epoxy in a gold plated brass case. Operating range is −55 C to +125 C. Insulation resistance at +125 C is 20,000 megohms minimum. Rating is up to 1,200 $\mu\mu$f at 350 wvdc.

CIRCLE NO. 213 READER SERVICE CARD

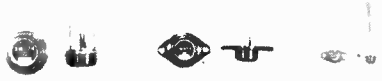


Leakage Monitor for TR tubes

AMERICAN MACHINE & FOUNDRY CO., 11 Bruce Place, Greenwich, Conn. After about 500 hr of operation, radar TR tubes are subject to deterioration in the form of leakage which causes poor response or even blocking of the recurrent echo

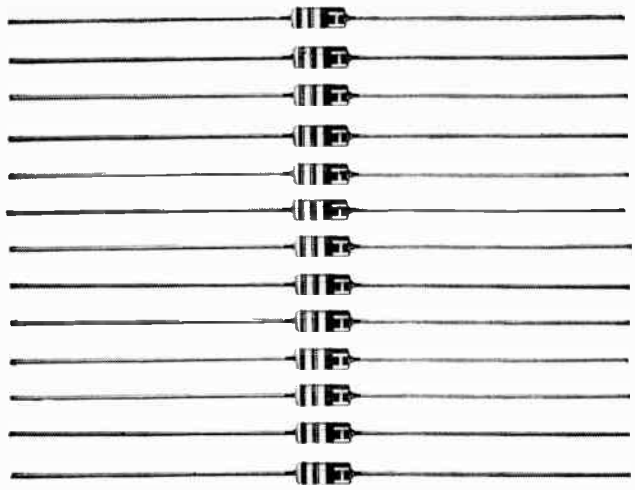
and expensive damage to the system's mixer and input circuits. Thus early detection of any malfunction means higher long-term system efficiencies and increased operational economies. Under conditions of excessive TR tube leakage, the AMF transistorized monitor signals an audible or visible alarm.

CIRCLE NO. 214 READER SERVICE CARD



Power Transistors germanium type

DELCO RADIO DIVISION, General Motors Corp., Kokomo, Ind. Representative samples of a complete line of germanium power transistors are illustrated. Starting at the left, the 2N174 (in the 10 to 15 ampere range) was recently improved with germanium wafer material especially formulated for switching ap-



HIGH VOLTAGE RECTIFIERS

in reliable, subminiaturized packages

You'll find Hughes silicon rectifiers ideally suited to design problems which combine high voltage with small size. In fact, Hughes rectifiers can handle **more** voltage than **any** rectifiers of comparable size.

You also get high reliability. Packaged in the Hughes glass envelope—proven dependable throughout many years of testing and use—this rectifier will stand up under highly adverse operating conditions.

Hughes silicon rectifiers are also packaged in modules in various configurations, such as: ring modulators, matched pairs and quads, etc.

The complete line of Hughes rectifiers ...with 50 to 1000 volt ratings at 50 to 200 mA... is available for immediate delivery—and in large volume quantities. For additional information, you are invited to write or phone the Hughes Semiconductor sales office or distributor nearest you. Or write: Hughes Products, Marketing Department, **SEMICONDUCTOR DIVISION, NEWPORT BEACH, CALIFORNIA.**

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

RATINGS AND SPECIFICATIONS: Absolute Maximum Ratings at 25° C.

JEDEC No.	PIV	RMS Volts	Max. Average Rectified Current mA	Max. Surge Current One Cycle (amp)	JEDEC No.	PIV	RMS Volts	Max. Average Rectified Current mA	Max. Surge Current One Cycle (amp)
1N846	50	35	200	2A	1N868	50	35	100	1.0
1N847	100	70	200	2A	1N869	100	70	100	1.0
1N848	200	140	200	2A	1N870	200	140	100	1.0
1N849	300	210	200	2A	1N871	300	210	100	1.0
1N850	400	280	200	2A	1N872	400	280	100	1.0
1N851	500	350	200	2A	1N873	500	350	100	1.0
1N852	600	420	200	2A	1N874	600	420	100	1.0
1N853	700	490	200	2A	1N875	700	490	100	1.0
1N854	800	560	200	2A	1N876	800	560	100	1.0
1N855	900	630	200	2A	1N877	900	630	100	1.0
1N856	1000	700	200	2A	1N878	1000	700	100	1.0
1N857	50	35	150	1.5	1N879	50	35	50	.5
1N858	100	70	150	1.5	1N880	100	70	50	.5
1N859	200	140	150	1.5	1N881	200	140	50	.5
1N860	300	210	150	1.5	1N882	300	210	50	.5
1N861	400	280	150	1.5	1N883	400	280	50	.5
1N862	500	350	150	1.5	1N884	500	350	50	.5
1N863	600	420	150	1.5	1N885	600	420	50	.5
1N864	700	490	150	1.5	1N886	700	490	50	.5
1N865	800	560	150	1.5	1N887	800	560	50	.5
1N866	900	630	150	1.5	1N888	900	630	50	.5
1N867	1000	700	150	1.5	1N889	1000	700	50	.5

Storage temp. −65° to +200°C.
Max. Leakage current full cycle average 20μA.

Typical Full Load Forward Voltage Drop Full Cycle .6 Volts.

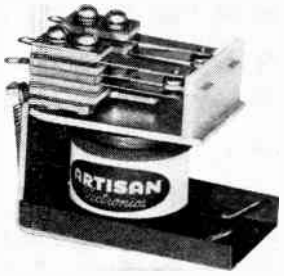
Creating a new world with ELECTRONICS

HUGHES PRODUCTS

SEMICONDUCTOR DEVICES • STORAGE TUBES AND DEVICES • MICROWAVE TUBES • VACUUM TUBES AND COMPONENTS • CRYSTAL FILTERS • MEMO-SCOPE® OSCILLOSCOPES • INDUSTRIAL CONTROL SYSTEMS

plications where high current switching at highly efficient levels is required. The 2N553 series is in the 2 to 3 ampere range with two military versions. The one-half to one ampere transistor (pictured at right on p 85) is the 2N1172. It can serve as a driver unit or for medium power audio output.

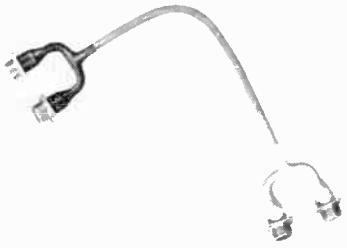
CIRCLE NO. 215 READER SERVICE CARD



All-Purpose Relay
Nylon blade lifter

ARTISAN ELECTRONICS CORP., 171 Ridgedale Ave., Morristown, N. J., announces model RH, a small, light, low-cost all-purpose relay. A Nylon blade lifter is employed to assure extra long life and dependable operation. Relay is constructed to provide a large amount of contact wipe and high contact pressure. Available in all voltages up to 230 v a-c and 110 v d-c, it can be supplied with contact arrangements up to 4 pdt with a choice of 5 or 10 ampere contacts.

CIRCLE NO. 216 READER SERVICE CARD

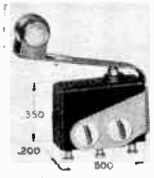


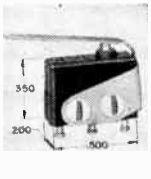
Molded Harness
and cable assembly

REVERE CORP. OF AMERICA, Wallingford, Conn. New molded harnesses and special electric cable assemblies are designed for maximum protection against specific environmental hazards over a broad temperature range, resulting in increased harness and system reliability. Harnesses can be constructed for −120 F to +500 F continuous use, or to

+600 F intermittent use. Constructions are engineered to provide excellent resistance to corona, abrasion, tear, fuel, oil and solvents, and are moisture and fungus proof.

CIRCLE NO. 217 READER SERVICE CARD





Actuators for tiny switches

MICRO SWITCH, Freeport, Ill., announces two new auxiliary actuators for use with sub-subminiature switches. Fabricated of corrosion-resistant steel, they absorb the side thrust which a cam or slide might exert on the switch plunger. Catalog listing JX-40 has a leaf actuator for use with low angle or slow moving cams or slides. The JX-45 has a roller leaf actuator to allow rapid cam or slide operation. Sub-subminiature switches and the actuators are expected to find usage on aircraft relays, computers, miniature recording devices, rocketry equipment, satellite gear and other applications where weight and space are at a premium.

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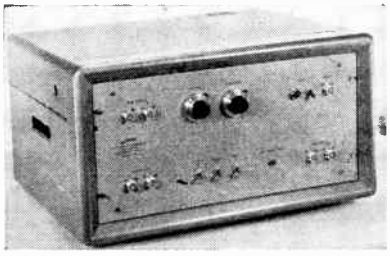


Coincidence Analyzer fast-slow

INTERSTATE ELECTRONICS CORP., 707 E. Vermont Ave., Anaheim, Calif. Model 704 fast-slow coincidence analyzer features 0.01 μsec resolution in fast channel; up to 40,000 coincidence counts per sec; delay line compensation; and 2, 3, or 4 coincidences for counting. It is ideal for counting minute quantities or radioisotopes.

CIRCLE NO. 219 READER SERVICE CARD

Literature of

MATERIALS

Doped Germanium Monocrystals. Semimetals, Inc., 133-20 91st Ave., Richmond Hill 18, N. Y. Bulletin describes zone levelled germanium monocrystals and specifications of material available for use in manufacturing transistors, rectifiers and diodes.

CIRCLE NO. 250 READER SERVICE CARD

COMPONENTS

Breadboard Parts. Helipot Division of Beckman Instruments, Inc., 2500 Fullerton Road, Fullerton, Calif. A 24-page book gives a complete description of all parts necessary for the easy assembly of complicated gear trains and servomechanisms.

CIRCLE NO. 251 READER SERVICE CARD

Diodes & Rectifiers. U. S. Semiconductor Products, Inc., 3540 W. Osborn Road, Phoenix, Ariz. Specifications for most of the company's diodes have been compressed to fit on one folded sheet of paper for ready reference.

CIRCLE NO. 252 READER SERVICE CARD

Multiple Rotary Switch. Couch Ordnance, Inc., 3 Arlington St., North Quincy 71, Mass. Data sheet S-1 deals with the type JR multiple rotary switch which is designed to meet MIL-S-21604 (BuShips).

CIRCLE NO. 253 READER SERVICE CARD

EQUIPMENT

Delay Lines. Deltime Inc., 608 Fayette Ave., Mamaroneck, N. Y. Bulletins 201 and 202 deal with recent advances and refinements in delay-line techniques. Bulletin 203 describes general purpose delay-line equipment.

CIRCLE NO. 254 READER SERVICE CARD

Temperature Control System. Airborne Accessories Corp., 1414 Chestnut Ave., Hillside 5, N. J. An electromechanical system which automatically holds temperature of liquids, air or solids within pre-

scribed limits in aircraft, missile and related applications is described in bulletin PS-4A.

CIRCLE NO. 255 READER SERVICE CARD

Magnetic Shift Register. Magnetics Research Co., Inc., 255 Grove St., White Plains, N. Y. Technical bulletin 359 illustrates and describes a 5-bit 250 kc magnetic shift register with transistor timing and driving circuit.

CIRCLE NO. 256 READER SERVICE CARD

Test Instruments. B&K Instruments, Inc., 3044 W. 106th St., Cleveland 11, Ohio. A 24-page catalog lists a complete line of integrated instruments for automatic measurement of sound, vibration and strain.

CIRCLE NO. 257 READER SERVICE CARD

Temperature Data Recording System. Datex Corp., 1307 S. Myrtle Ave., Monrovia, Calif. Bulletin 350-1 illustrates and describes a 75-point temperature scanning and logging system.

CIRCLE NO. 258 READER SERVICE CARD

Wave Analyzer. Hewlett-Packard Co., 275 Page Mill Road, Palo Alto, Calif. Description, advantages and uses of the model 302A wave analyzer are given in a technical data sheet.

CIRCLE NO. 259 READER SERVICE CARD

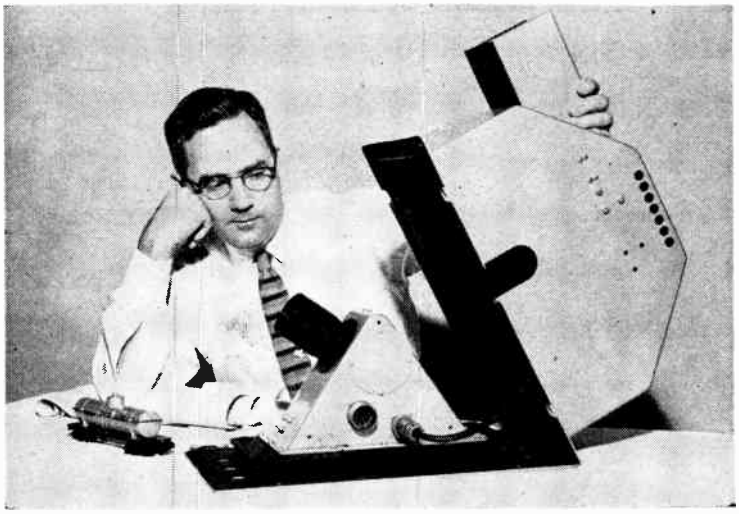
FACILITIES

Services. Canadian Westinghouse Co., 286 Sanford Ave. North, Hamilton, Ontario, Canada. A comprehensive booklet covers the research and service facilities available to the defense and commercial electronics industry.

CIRCLE NO. 260 READER SERVICE CARD

Data Processing. Franklin Electronics, Inc., Communication and Control Division, Van Nuys, Calif. Bulletin CC-220 describes an advanced research, design and development facility for data processing systems and components.

CIRCLE NO. 261 READER SERVICE CARD



Blackstone: touch all bases

LIKE BEN FRANKLIN, who began his career by arriving in Philadelphia with three loaves of bread, Henry Blackstone began his by arriving in California with three oranges and 50 cents.

That was 21 years ago. Today Blackstone is president of Servo Corporation of America, which this month begins moving into a new $1½-million plant in Hicksville, L. I. New plant will consolidate the activities of six plants and more than 350 employees.

Blackstone received his BSEE from MIT in 1938, a bad year for fledgling engineers. After college, where tuition had been covered by a partial scholarship and part-time jobs, he hitched-hiked to California and got a job in a public utilities company just as his money ran out.

A short time later, he and another engineer, Curtis Hillyer, set up in business for themselves as consultants. Studies of antiaircraft techniques during ROTC training had convinced Blackstone that there were better ways to knock down enemy aircraft than visually sighting guns, and he devoted much time to the study of missile-control systems.

Letters from the young consultants drew scant attention from West Coast manufacturers. A reply from industrialist Sherman Fairchild, however, contained $500 and an invitation to come to New York to "talk things over." The two partners headed East that same day.

In 1943, at the age of 25, Blackstone was placed in charge of Fairchild's electromechanical engineering laboratory and appointed to the National Defense Research Council.

At the end of the war, when Fairchild's missile program was discontinued, Blackstone left and with a total capital of $10,000, founded Servo Corporation of America in what had once been a dancehall in Huntington, L. I.

The Idaho-born executive possesses a restless energy which is belied by his soft-spoken ways, and shows itself in a startling capacity for hard work. With a grin he says that he now puts in about a 60-hour work week which at one time ran to 80 hours. He says he hopes some day to whittle this down to 50 hours. Besides following his firm's technical developments, he takes a larger than usual part in advertising and marketing.

A recent trip to Europe to explore potential markets for Servo's products illustrates one Blackstone philosophy: "touch all the bases." This approach to business has resulted in the expanded activities of his company which at one time were confined to military missile guidance systems exclusively. Present activities include infrared detectors, electronic measuring equipment, communications and navigation gear, radio direction-finding systems and computers.

Blackstone and his wife, Barbara, live in Cold Spring Harbor, L. I. Family relaxation includes boating, swimming and landscape gardening.

IRE-PGEWS Plans Symposia

DUAL national symposia of the IRE Professional Group on Engineering Writing and Speech, being held simultaneously in Boston and Los Angeles on Sept. 17-18, are based on the theme "More Effective Communication of Scientific and Technical Information."

Sessions in both cities are expected to serve both the public's need to know more about electronics, and the industry's continuing need to know more about the techniques of communicating intelligence.

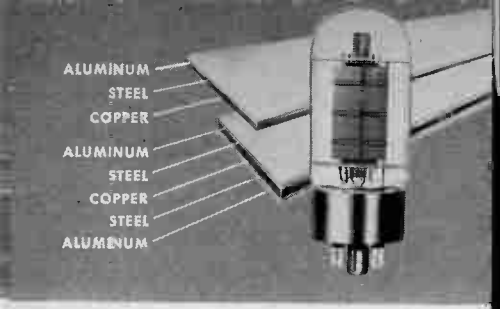
At the Boston symposium, James Girdwood, publisher of ELECTRONICS, will speak on the functions of the business press and its relationship to technical journalism. Other subjects to be covered in the sessions at the Sheraton-Plaza Hotel will include backgrounds and advances in communication, advertising techniques and legal considerations, use of language as an engineering tool in electronics and in the growing field of space technology.

Keynote speaker at the Ambassador Hotel in Los Angeles will be Lester C. Van Atta of Hughes Aircraft. Among topics to be covered there are the state of the technical-information art, defense requirements for better engineering writing and speech, and education and techniques for better engineering writing and speech.

Wins Promotion At Aeronutronic

APPOINTMENT of Joseph K. Slap as manager of product planning for computer operations at Aeronutronic, a division of Ford Motor Co., Newport Beach, Calif., was recently announced. He was previously special assistant to the director of marketing for computer operations.

Prior to joining Aeronutronic last year, Slap was assistant general manager at the ALWAC Computer Division, El-Tronics, Inc., Hawthorne, Calif. He previously was with Northrop Aircraft, Inc.,



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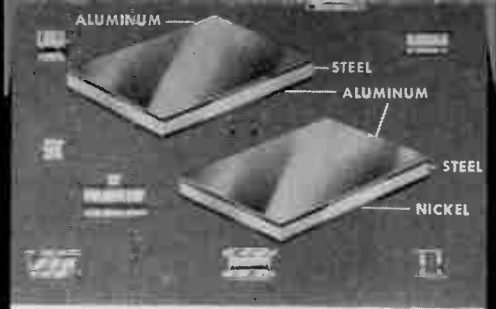
Three-layer and five-layer materials used for anodes in rectifier and amplifier tubes. Provide longer power output life . . . uniform heat dissipation . . . high electrical conductivity . . . improved anode reradiation . . . and reduce costs.



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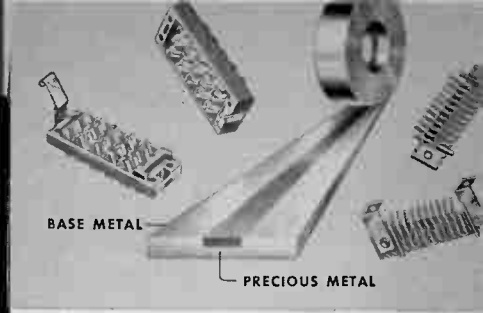
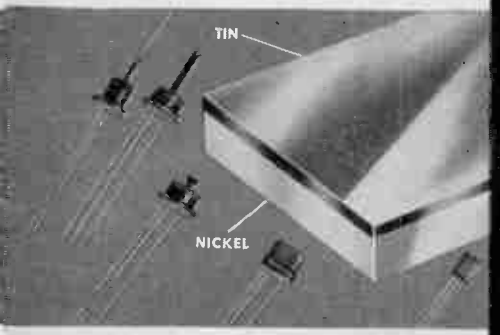
These clad metals are used as alternate materials for solid pure nickel in electron tubes. They conserve critical material . . . reduce costs substantially. Supplied in annealed coils ready for your production.



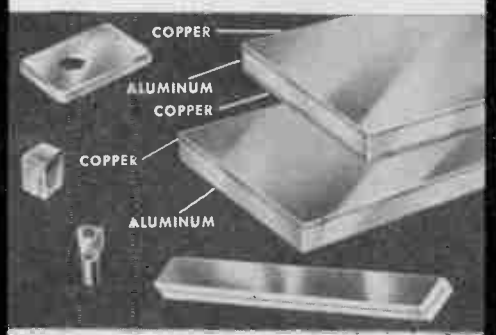
CLAD PRECIOUS METAL CONNECTOR MATERIALS

High reliability of connectors, clips, terminals obtained by using gold and other precious metal alloy stripe materials . . . place high performance materials in the contact areas . . . cost-savings and improved performance over gold electroplated parts.



TIN CLAD METAL STRIP and other Semiconductor Clad Metals

A number of combinations of clad metals are available for use on base tabs, lead wires, whisker wires, base materials and enclosures in silicon and germanium diodes, transistors and germanium power transistors.



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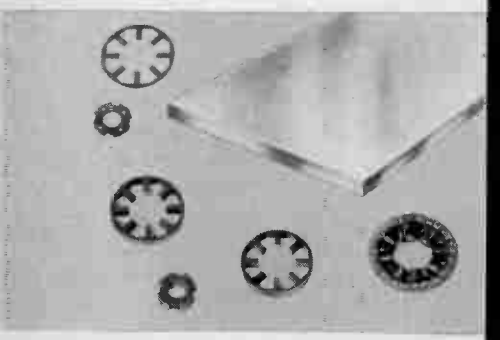
Easily formed, deep drawn or spun. Used for waveguides, component cases, variable condenser blades, chassis and electrical or thermal conductive parts. Light in weight, saves up to 30% over the cost of solid copper.

COPPER-CORED GLASS SEALING WIRES

Featuring a sound metallurgical bond, these wires give three times greater conductivity than solid 52 alloy wire of equal diameter . . . they facilitate miniaturization. Features include: leakproof seal between alloy and core, high electrical and thermal conductivity, lower costs.



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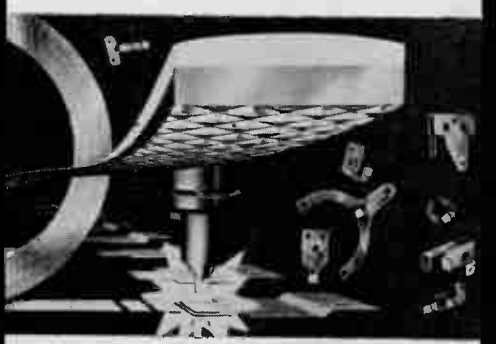
For magnetic applications requiring low core losses and high permeability at low flux densities in current and pulse transformers, relays, gyro mechanisms, servo mechanisms, missile guidance systems, etc.



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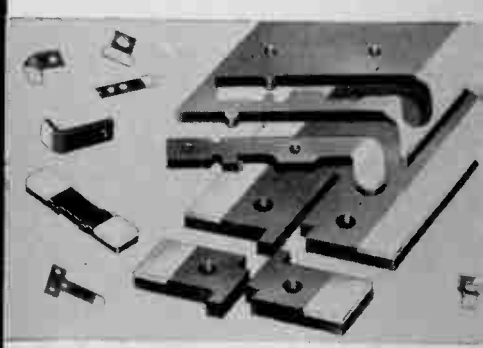
For products you want to automate, this modern contact form permits greater latitude in contact assembly design . . . automatic assembly of two or more parts in a single operation. Tape contacts are easily attached by spot welding . . . are self-aligning . . . and allow broader assembly tolerances. Save up to 40% in contact costs.



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If you are seeking metals with useful characteristics that can't be found in a single metal or alloy, investigate clad metals. If you want stronger or lighter components — or better electrical and mechanical properties — or fewer corrosion problems — or if you are interested in conserving critical metals or reducing parts costs, you can profit by using General Plate Clad Metals.

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GENERAL PLATE PRODUCTS: Clad Metals • Electrical Contacts • Truflex® Thermostat Metal
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in Hawthorne as group engineer in charge of the electronic computing and mathematical analysis section, Fluid Dynamics Department.

Name Fred Lack DuKane Director

PIONEER in the communications industry, Frederick R. Lack, recipient of the 1959 EIA medal of honor, has been elected to the board of directors of DuKane Corp., St. Charles, Ill.

Lack recently retired from his position as vice president of Western Electric Co. after a career of nearly 45 years with Bell Telephone System.

Ellenback Joins Mid-Eastern

DANIEL R. ELLENBACK has joined Mid-Eastern Electronics, Inc., Springfield, N. J., as head of the high resistance calibration laboratory. He was formerly a junior en-

gineer at Weston Electrical Instrument Corporation where he was engaged in development of electronic test equipment, metal film resistor applications, and in Weston's micromodule program.

News of Reps

Beil and Whitaker, Inc., rep firm of Reading and Bethlehem, Pa., will cover eastern Pensylvania for Clarostat Mfg. Co., Inc., Dover, N. H.

Eltron Engineering Sales Co., Newtonville, Mass., is named New England sales rep for Shockley Transistor Corp., Palo Alto, Calif.

Appointment of **Gawler-Knoop Co.** as northeastern Atlantic sales reps for Perkin Engineering Corp. Electronic Division, El Segundo, Calif., is announced.

Howard C. Jappe of Wakefield, Mass., is now sales rep for Phalo Plastics Corp., Shrewsbury, Mass., in the Massachusetts, Rhode Island and northern New England areas.

Isocyanate Products, Inc., Wilmington, Del., appoints **Midwest Technical Service** of Downers Grove, Ill., as its midwestern sales and service office. Isocyanate Products Inc. manufactures prepolymers for foamed in place resins.

Avion Division, ACF Industries, Inc., Paramus, N. J., has appointed the **Grady Duckett Sales Co.** as sales rep for its commercial and military electronic components. The Atlanta firm will cover the states of North and South Carolina, Tennessee, Mississippi, Alabama, Georgia and Florida.

Erie Resistor Corp., Erie, Pa., appoints the following as reps for instrumentation products sales:

John F. Dreier, Abbott-Allison Co., of Meriden, Conn., for the New England area; **John Brogan & Associates** of Westbury, N. Y., for the New York area; and **Scientific Sales Engineering Co.** of Atlanta, Ga., for the southeastern states.

COMMENT

More Nav-Aid In-fighting

Your usually satisfying editorial "retorter" implied, in the July 17 issue (Comment, p 108) that Ted Bonner's argument on the superiority of Decca's navigation aid over VOR-DMET masks an economic point of view. This reaction seems prejudiced, unscientific, and a little surly, like the boy who belts his bright little antagonist when it's become apparent he's losing the battle of words.

Is Mr. Bonner's point correct or not? Is VOR-DMET's azimuth accuracy insufficient for traffic control in dense air traffic areas or isn't it?

Decca might justifiably reply that your attitude unmasks a fear that the American electronics industry may lose a market to a superior foreign approach.

R. D. KRONING
BELL TELEPHONE LABS
NEW YORK

We don't feel competent to judge the merits of the two systems, having never run a test ourselves. Vortac proponents say its azimuth accuracy is sufficient; Decca proponents say not so. FAA says tests here are inadequate for judgment. U. S. has a vested interest in keeping civil distance-measuring gear compatible with Tacan (hence our remark about economic viewpoints). For the time being, we're waiting for more data from the FAA tests now being flown, and will continue to report the results as they arise. We have no fears, one way or the other.

Soviet Equipment

Your article "Soviet Equipment Design" (p 37, July 24) was very nicely presented. I would like to point out, however, that American medical color television is not primarily sequential, as you stated on p 38.

Although there has been a newcomer to the field of medical color television that uses sequential television, a careful check of active medical programing should reveal a significant predominance of NTSC (National Television Standards Committee) color.

The Smith Kline & French Laboratories' medical color television unit, which is incidentally celebrating its tenth anniversary of closed-circuit medical color tv, uses a complete mobile NTSC bus.

The 9-by-12-ft picture is projected by a three-barrel Schmidt system that was built in Eindhoven, Netherlands.

Smith Kline & French has also recently acquired an additional NTSC-type bus that is used in the United Kingdom. This unit was built by Marconi.

I cannot speak for the various hospitals in the U. S., but a check of their facilities should reveal a surprising amount of NTSC programing hours.

JOSEPH GEIGER

SMITH KLINE & FRENCH LABORATORIES
PHILADELPHIA

Project DAMS

Your article about the DAMS project (Washington Outlook, p 14, May 29) was partly in error. The DAMS project has not been cancelled, but rather is very much alive and active at the Crosley division of Avco Corp.

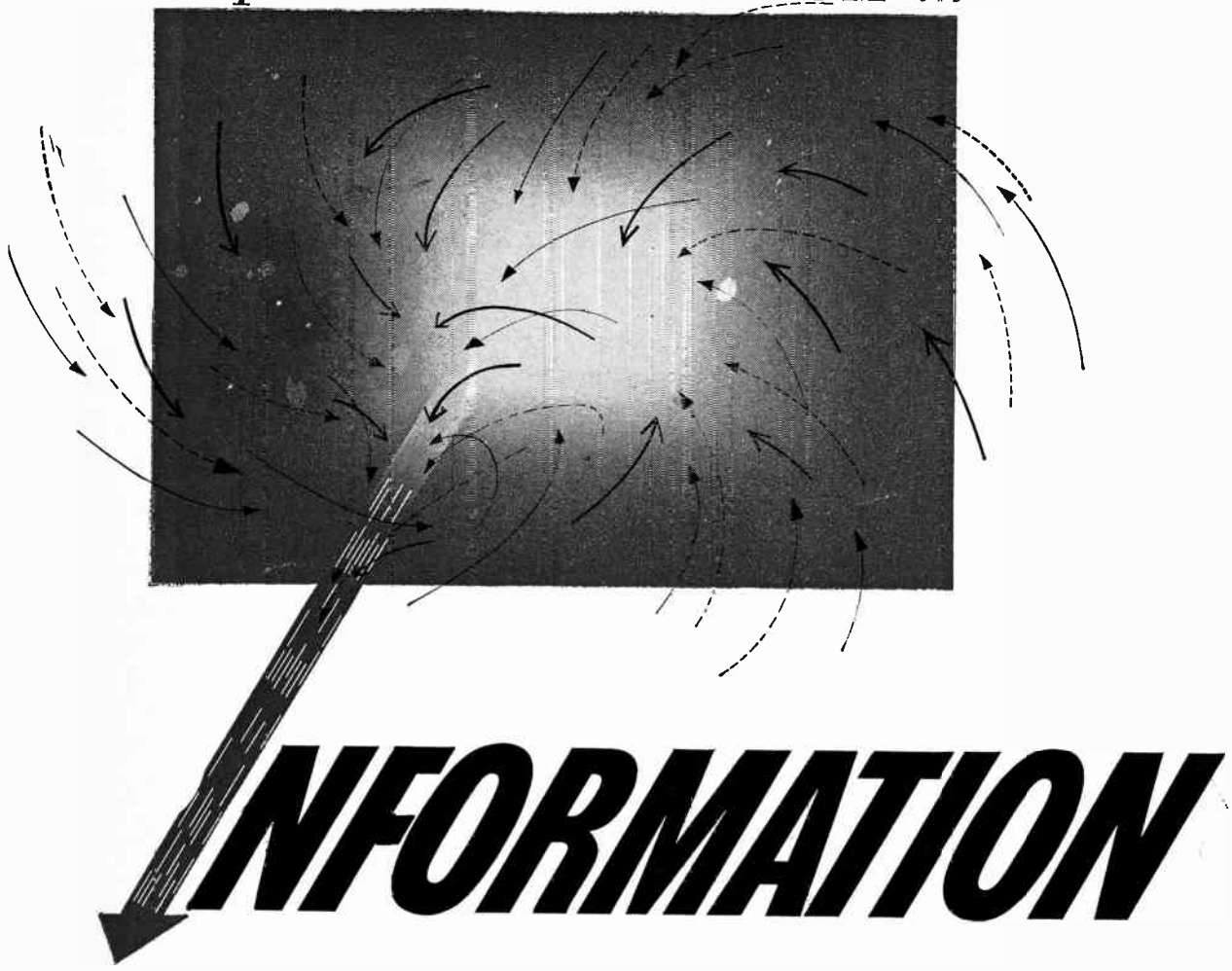
Two years ago, Avco/Crosley and two other contractors were given separate phase I study contracts to investigate antimissile system techniques for bombers. When this work was completed, budget reasons made it necessary for the Air Force to select only one contractor to continue the program. Avco/Crosley's performance under the phase I contract, together with its earlier efforts, led to its selection as the contractor to continue the DAMS project. The project has been funded three times and is being continued . . .

F. C. REITH

AVCO CORP.
CINCINNATI, O.

When one of our contacts in industry told us that DAMS was cancelled, we tried to get the Air Force to confirm or deny. We got no reply. Air Force officers still refuse any comment whatsoever. We were obviously wrong in reporting the cancellation, although we did preface it with "Word has been leaked . . ."

Explore new areas at IBM in



INFORMATION

Information retrieval is a major area of study at IBM. Current investigations may lead toward such benefits as the instant accessibility to knowledge in scientific libraries throughout the country—or toward a system which can translate any of the earth's languages into English in real time.

Problems in information retrieval have defined entirely new concepts for the design of storage, input-output and "memory" units—achieving far greater capacities than any known today. These facilities will provide for the handling of the tremendous amount of updated information needed by business, science and government. With extremely rapid accessibility to vast amounts of information electronically stored by machine, industrial and research efforts can be materially expedited. IBM needs engineers and scientists with the vision and the ability to pave the way to tomorrow.

You will enjoy unusual professional freedom and the support of a wealth of systems knowledge. Comprehensive education programs are available plus the assistance of specialists of many disciplines. Working independently or as a member of a small team, your individual contributions are quickly recognized and rewarded. This is a unique opportunity for a career with a company that has an outstanding growth record.

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SOME TYPICAL ASSIGNMENTS

704 PROGRAMMER ANALYST to study data flow diagrams and write differential equations of a circuit diagram; to investigate analog and digital real-time control systems, using high-speed electronic digital and/or analog computers. Must be familiar with variable length alphabetic data, transforms, numerical analyses.

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COMPUTER OR SYSTEMS ENGINEER, MATHEMATICIAN OR PHYSICIST to design advanced computer, and work on development of new information retrieval program. Must have strong interest in transistor circuit design or in logical or systems applications of solid state circuitry.

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General Electric's Flight Test Center at Schenectady, N. Y. has 4 positions open for graduate Electrical Engineers, with experience in the radar and communications field, for flight testing of advanced electronics systems.

Two (2) of these openings are for engineers flexible enough to permit spending 30-day periods at different USAF bases a few times during year. (Additional allowances for "temporary duty" assignments apply.) The other two are permanent assignments at the Flight Test Center in Schenectady.

Salary open! full G-E benefits

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(a Department of the Defense Electronics Division)

GENERAL ELECTRIC

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Monsanto is engaged in a major effort in the field of new electronic materials. A man well acquainted with the electronics industry and its materials requirements is needed to guide new product development and research programs. He must be capable of discussing research, product evaluation, device applications and markets with top-level scientists, engineers and executives in the industry.

This is a permanent position and represents an unusual opportunity for personal and professional advancement.

Send resume to:

Dr. D. T. Mowry
Director of Development
Research and Engineering Div.

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Openings for experienced component sales engineering organizations interested in the following territories: New England States;—Minnesota, Iowa, Wisconsin;—South Carolina, Georgia, Alabama;—Kansas, Missouri, Arkansas;—Louisiana, Mississippi;—New Mexico, Arizona.
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520 N. Michigan Ave., Chicago 11, Ill.

Systems
Electronic / *Engineers*
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OPEN ON MOST "TALKED ABOUT"

MISSILE OF THEM ALL

POLARIS

...and other diverse and complex weapons projects at General Electric's Ordnance Department in the Berkshires*

When the first operational Polaris missiles are installed in the "George Washington" —first atomic submarine specifically designed as floating platform for the Navy's undersea-launched IRBM s — it will be a day of great moment for the engineers and scientists at General Electric's Ordnance Department, who are now pouring their energies, imagination and technical skills into the development, design and production of Polaris Fire Control and Inertial Guidance Systems.

A day of celebration — but also one that ushers in new and other challenging problems — for the push to develop the next generation of long-range underwater ballistic missiles and kindred advanced weapons and weapon systems will be on.

There are openings now for engineers (*EEs or MEs*) with two to seven years' experience in these areas:

SYSTEMS DEVELOPMENT / SYSTEMS DESIGN OR EVALUATION
FIRE CONTROL ENGINEERING / INERTIAL COMPONENT DESIGN / COMPUTER DEVELOPMENT
ELECTRONIC CIRCUIT DEVELOPMENT / STRUCTURAL DESIGN AND VIBRATIONS
FIELD SERVICE & EVALUATION / QUALITY ASSURANCE & RELIABILITY ENGINEERING
ELECTRO-MECHANICAL DESIGN / ADVANCED PRODUCTION ENGINEERING
ELECTRICAL DISTRIBUTION SYSTEMS ENGINEERING / PLANT FACILITIES ENGINEERING
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Field Test Engineering (Florida, California and several naval stations in continental U.S.)
Also technician openings for graduates with missile experience

Write in strict confidence to: Mr. R. O'Brien, Dept. 69-WH
Ordnance Department of the Defense Electronics Division

GENERAL ELECTRIC

100 Plastics Avenue, Pittsfield, Mass.

* **Additional Projects Under Investigation at the Ordnance Department.** Urgent, vital and engrossing as the Department's share in the Fleet Ballistic Missile Program is, it is just one of the diverse activities here that today offer engineers a progression of challenging assignments on: **Atlas Guidance Equipment • Talos Handling and Launching Equipment • Advanced Torpedo Development • Tartar Fire Control**

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High-temperature Chemistry of Solids and Gases, High-temperature Properties of Materials, Vapor Pressure, Decomposition Species, Radiation Measurements

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Advanced electronic circuits for missile-borne, missile detection, and monitoring instrumentation, including transistorized circuitry development. Ultra-high-speed optical and electronic instrumentation for laboratory and ballistics application. Radiometric measurements in the ultra-violet, visible and infrared.

Energy Conversion and Power Supply Studies

Broad solid-state program for theoretical and experimental research on high-temperature materials involving materials preparation, measurement of electrical and other properties, and device fabrication.

Challenging opportunity to apply unusual high temperature techniques developed in the Division to these areas.

The division's fully equipped laboratory and new suburban location provide an unusually attractive working, and recreational environment. Excellent opportunities exist for independent research .

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Your reply will be accorded absolute confidence and you will receive a prompt answer.

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