A McGraw-Hill Publication 75 Cents January 19, 1962

electronics

EVAPORATING FILM CIRCUITS

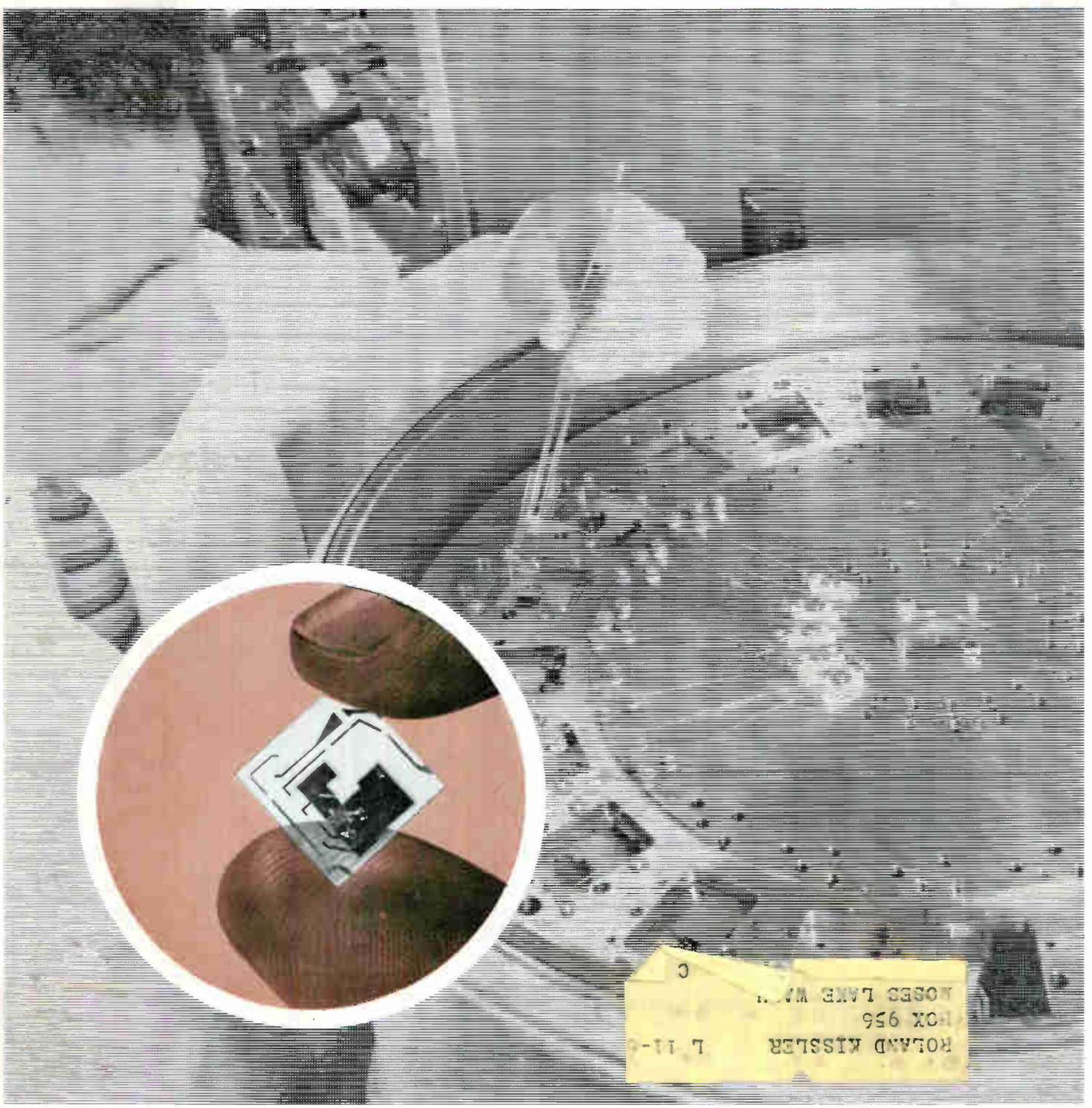
Turntable does 20 at once, p 70
(Photo below)

STEREO TEST GENERATOR

For f-m multiplex receivers, p 37

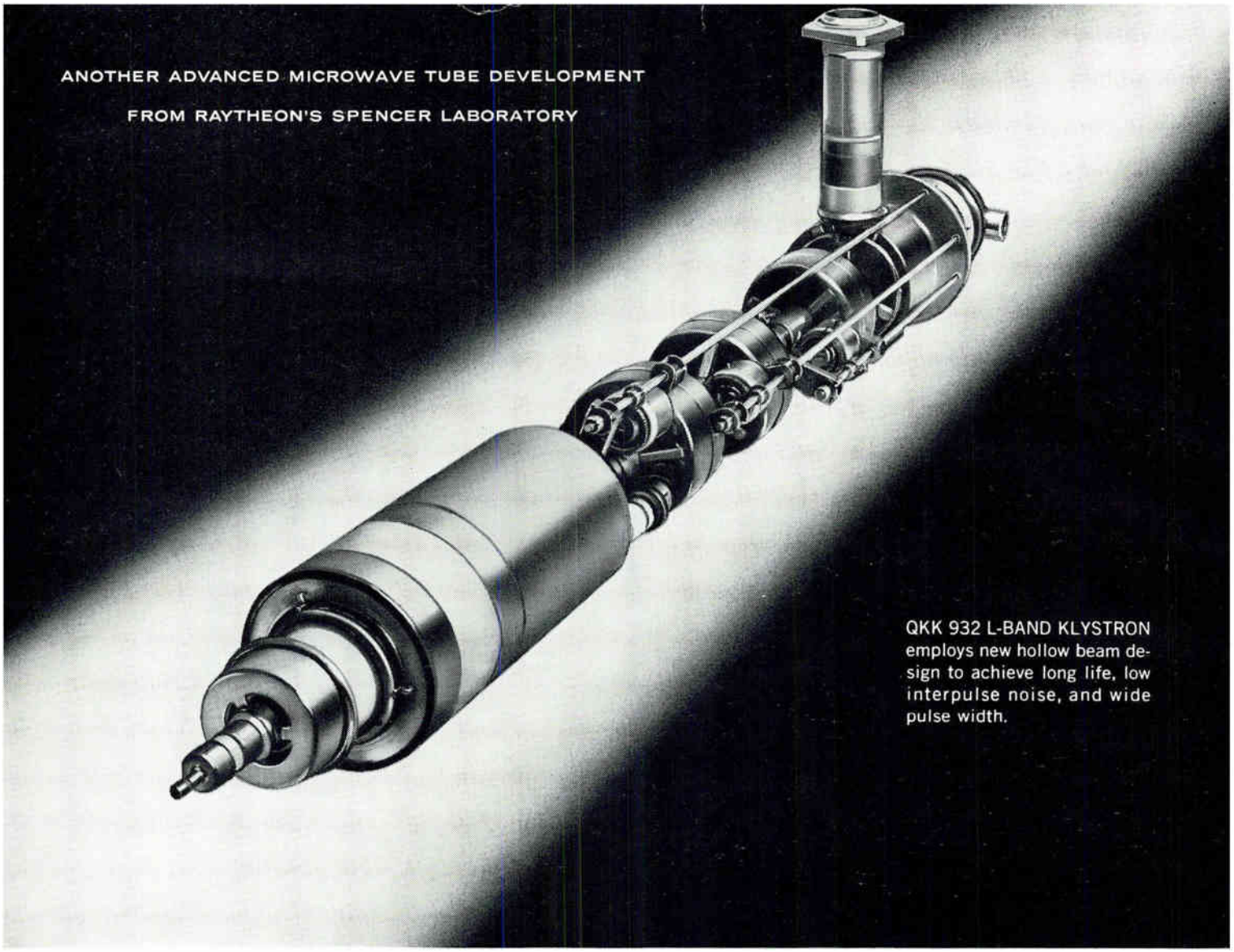
SQUELCH SYSTEM

Uses double superhet, p 44



ANOTHER ADVANCED MICROWAVE TUBE DEVELOPMENT

FROM RAYTHEON'S SPENCER LABORATORY



QKK 932 L-BAND KLYSTRON employs new hollow beam design to achieve long life, low interpulse noise, and wide pulse width.

SOMETHING NEW IN KLYSTRONS

Raytheon's QKK 932, first to use magnetron injection gun and modulating anode, offers the advantages of:

- Longer tube life.
- Modulating Anode mu of 3.
- Extremely low interpulse noise.
- Long pulse operation (up to 1000μs or longer).

The QKK 932 is a 4-cavity, solenoid focused klystron with a peak power output of 35 kw. The tube is mechanically tunable from 1250-1350 Mc, and has 40 db minimum gain with a minimum efficiency of 35%.

A series of hollow beam injection gun klystrons, from 8 watts CW to 2 Mw peak, are in advanced stages of development. Write today to Raytheon Company, Microwave & Power Tube Division, Waltham 54, Massachusetts.

QKK 932—GENERAL CHARACTERISTICS	
Peak Power Output	35 kw min.
Frequency (tunable)	1250-1350 Mc.
Gain	40 db min.
Efficiency	35% min.
Cathode Voltage	25 kVdc
Modulating Anode Voltage	+7.85 kv (peak), —2 kV bias
Input Connection	Type N
Output Connection	1⅝" coax.

RAYTHEON COMPANY

RAYTHEON

MICROWAVE AND POWER TUBE DIVISION

CIRCLE 251 ON READER SERVICE CARD

January 19, 1962

electronics

A McGraw-Hill Publication *75 Cents*

W. W. MacDONALD, Editor

Contents continued

electronics

January 19, 1962 Volume 35 No. 3

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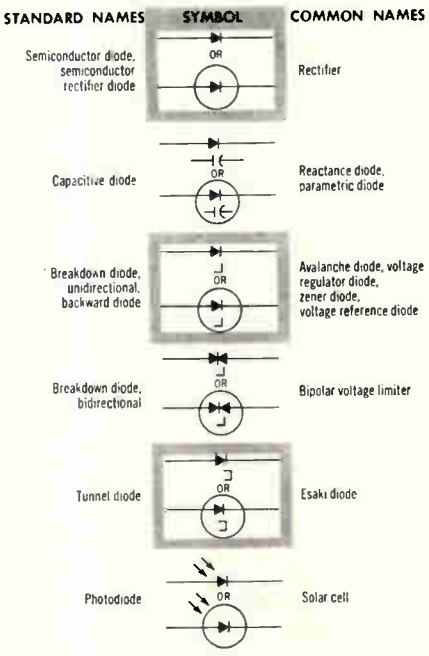
CONTENTS Continued

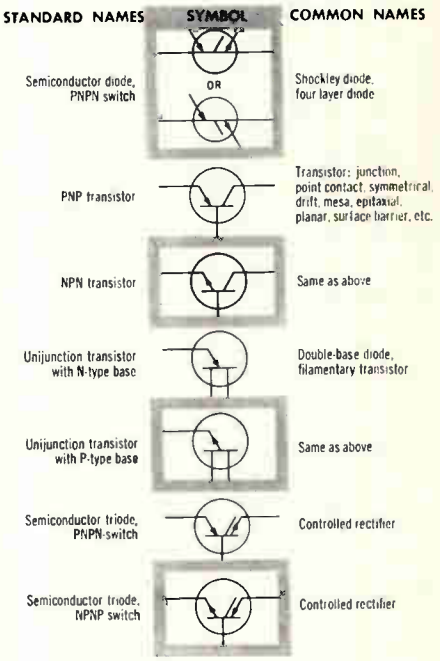
DEPARTMENTS

Symbols and Standards

ONE OF THE MOST frustrating situations currently confronting the designer of semiconductor circuits is the wide range of terminology and symbology used for some of the newer devices.

There is, even now, a way out of this maze of confusion: use the terms and symbols developed by the various technical committees of the IRE and AIEE. They have already been adopted by the American Standards Association as part of a proposed revision of Y32.2, "Graphical Symbols for Electrical and Electronic Diagrams." They have been adopted by the Armed Forces as part of MIL-STD 15.1, dated October 30, 1961. And they have been submitted to the International Electrotechnical Commission by the U. S. delegation.





Shown here are semiconductor symbols about which there has been considerable controversy. There are many more. We will publish a chart showing 364 symbols and 127 letter combinations for all commonly used electronic devices, including semiconductors, in our issue March 23. Meanwhile, let's start standardizing on these.

DIAGNOSIS. One physician, a specialist in children's heart ailments, is turning his practice over to his associates for a year so he can freshen his techniques at one of the nation's leading medical centers. He especially wants to become more familiar with the most recent advances in electronic diagnostic equipment.

He knows about much of the diagnostic equipment ELECTRONICS has reported during the past year and is interested in an article on electrocardiogram transmission by phone which we are publishing this week (p 20). However, in his office, he uses only a handful of tried and proven types of equipment—x-ray, fluoroscopes, ecg, and the like.

Physicians, he says, would welcome many of the newer systems if they could be sure of their reliability and if maintenance were no problem. Too often, the most interesting of the new systems are expensive, cranky and one-of-a-kind. What every physician really wants from electronics, he says, is a really reliable, low-cost ($100 or less) electronic stethoscope. Right now, he puts his faith in good quality acoustic stethoscopes and his practiced ear.

Coming In Our January 26 Issue

BANANA TUBE. Although it sounds a bit Rube Goldbergish, an approach to color television described by P. Schagen, of Mullard, is less expensive than using conventional color picture tubes. His tube has three separate bands of color phosphors across the face. The colors are mixed by a rotating drum and are displayed with the aid of special optical devices.

H. J. Galbraith, of Motorola, tells about a completely self-contained ultrasonic doppler navigation aid. Its purpose is to guide soldiers to their destination, even if they have to push the set through mud. Other developments reported include clutter reduction methods for air route surveillance radar, by W. W. Shrader, of Raytheon; how to use neon bulbs in precision oscillator control circuits, by J. M. Tewksbury, of Bendix; a low-duty-cycle tunnel-diode tester, by L. M. Zappulla, of RCA, and energy detectors for satellites, by J. W. Freeman, of Iowa State University.

COMMENT

Proprietary Piracy

In the Dec. 22 issue (p 4), I particularly noted the *Crosstalk* editorial entitled Proprietary Piracy. I am in a position to have observed closely a recent spinoff in which the parent views are closely and substantially those of your editorial. The child's view, with much justification, is quite different.

I encourage you to continue the exploration of this general field. It needs much clarification and light. For example, I know of spinoffs that were not primarily motivated by a feeling that "working for wages is holding him back." I suspect that management myopia is responsible for more spinoffs than is generally recognized. This is particularly true of the management of one of our major eastern manufacturers. As in political divisions, whenever leadership fails, not necessarily in providing for sales growth or profits, but in providing an atmosphere suitable for growth of the individual, a revolution (spinoff) results.

And in another area involving piracy, have you noticed how frequent it is that mountains of government monies are spent to develop an R&D mouse? Whereupon, after a discrete interval, the expenditure of a few dollars of company money suddenly yields significant "proprietary" breakthroughs in the same area of research. Here is another topic for you: What is proprietary information? I notice that many complaints of proprietary piracy are in reality complaints by the pirate that he was hijacked.

KENNETH A. YOUNG
Kenneth A. Young
Associates, Inc.
Groton, Mass.

Radar Meteorology

One of our most critical problems in the Weather Bureau is the extraction of information and transmission to remote locations. The radar operator, with the observing aids we have given him, is an extremely efficient filter, and relatively little information is passed on by him.

It is pretty well agreed among radar meteorologists that data transmission to remote locations (fifty-plus miles) is best accomplished by conversion of radar information to digital form for transmission over standard telephone lines. The difficulty lies in developing a system capable of producing the information desired at a reasonable price. We have had several contacts with engineering firms who have developed rather exotic data processors, but these companies have very little, and in some cases no appreciation of our meteorological requirements. Usually, equipment designed and built for other purposes is not suited to us, and these companies could save considerable time and effort if they consulted competent meteorologists first.

An inexpensive device is needed for extracting doppler information from standard pulsed weather radars. The Weather Bureau has been operating a c-w doppler for some time for experimental purposes, but purchase of a number of units seems to be not feasible at this time. A simple modification to our existing pulsed radars appears to us to be the most economical and has the best chance for funding in future years.

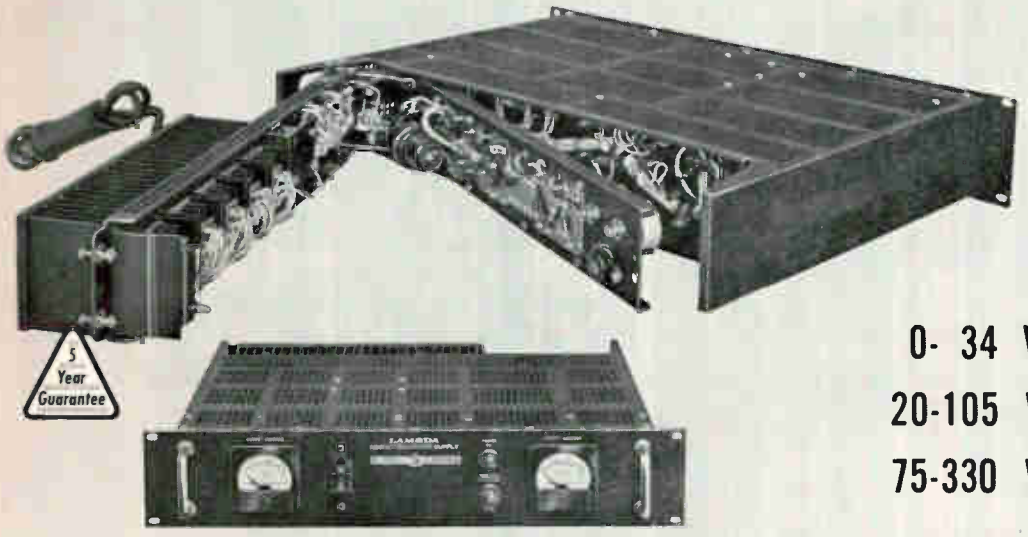
Radar meteorology is beginning to show signs of some maturity after years of growing. We have begun to develop operational techniques that are objective in nature rather than subjective. We are rapidly moving toward use of quantitative data, chiefly in terms of measuring echo density. However, present methods of radar calibration are very subjective; for instance, determining minimum detectible signal using a signal generator, and we find it very difficult to develop calibration procedures that ensure standardized performance in a network of thirty or more radars. We would like to achieve an overall accuracy of about 2 db, using personnel who are not engineers, meaning our radar operators, who are meteorologists and who understand very little about metrology. Once the data have been properly quantized, the large amount produced lends itself very nicely to automatic processing.

S. G. BIGLER
Weather Bureau
U.S. Department of Commerce
Washington, D. C.

LAMBDA

Convection Cooled Transistorized Regulated Power Supplies

AVAILABLE FROM STOCK



LA SERIES

0- 34 VDC 5, 10, 20 AMP
20-105 VDC 2, 4, 8 AMP
75-330 VDC 0.8, 1.5, 3 AMP

SPECIAL FEATURES

- Convection Cooled—No internal blowers or filters—maintenance free
- Ambient 50°C
- No Voltage Spikes or overshoot on "turn on, turn off," or power failure
- Guaranteed 5 years
- Remote programming over Vernier band
- Hermetically-sealed transformer designed to MIL-T-27A
- Easy Service Access
- Short Circuit Proof
- Constant Current Operation—Consult Factory

ALL MODELS 105-140 VAC INPUT

CONDENSED DATA—LA SERIES

DC OUTPUT (Regulated for line and load)

Model	Voltage Range (1)	Vernier Band (2)	Current Range (3)	Price (4)
LA 50-03B	0- 34 VDC	4 V	0- 5 AMP	$ 395
LA100-03B	0- 34 VDC	4 V	0-10 AMP	510
LA200-03B	0- 34 VDC	4 V	0-20 AMP	795
LA 20-05B	20-105 VDC	10 V	0- 2 AMP	350
LA 40-05B	20-105 VDC	10 V	0- 4 AMP	495
LA 80-05B	20-105 VDC	10 V	0- 8 AMP	780
LA 8-08B	75-330 VDC	30 V	0- 0.8 AMP	395
LA 15-08B	75-330 VDC	30 V	0- 1.5 AMP	560
LA 30-08B	75-330 VDC	30 V	0- 3 AMP	860

Regulation (line) ..... Less than 0.05 per cent or 8 millivolts (whichever is greater). For input variations from 105-140 VAC.

Regulation (load) ..... Less than 0.10 per cent or 15 millivolts (whichever is greater). For load variations from 0 to full load.

Ripple and Noise ..... Less than 1 millivolt rms with either terminal grounded.

Temperature Coefficient ..... Less than 0.025%/°C.

(1) The DC output voltage for each model is completely covered by four selector switches plus vernier range.

(2) Center of vernier band may be set at any of 16 points throughout voltage range.

(3) Current rating applies over entire voltage range.

(4) Prices are for unmetered models. For metered models add the suffix "M" and add $30.00 to the price.

AC INPUT 105-140 VAC, 60 ± 0.3 cycle(5)

(5) This frequency band amply covers standard commercial power line tolerances in the United States and Canada. For operation over wider frequency band, consult factory.

Size

LA 50-03B, LA20-05B, LA 8-08B	3½" H x 19" W x 14⅜" D
LA100-03B, LA40-05B, LA15-08B	7" H x 19" W x 14⅜" D
LA200-03B, LA80-05B, LA30-08B	10½" H x 19" W x 16½" D

SEND FOR COMPLETE LAMBDA CATALOG.

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LA 124

CIRCLE 5 ON READER SERVICE CARD

Versatile programming

plug-in programming for each individual column, code options with plug-in column cards

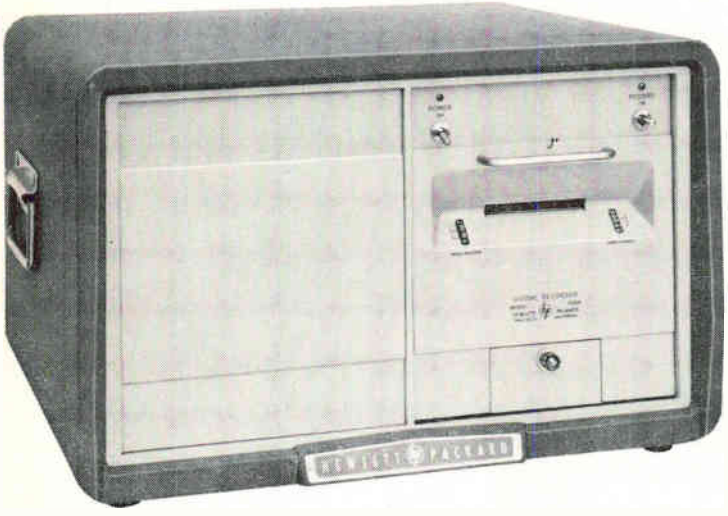
Fast data transfer

takes just 2 msec; prints up to 5 lines per second

Flexible BCD input

1-2-2-4 BCD input is standard; dual input available

all yours with this new hp 562A SOLID STATE DIGITAL RECORDER



SPECIFICATIONS

Printing Rate: 5 lines/sec. maximum

Column Capacity: To 11 columns (12 available on special order)

Print Wheels: 12-position, 0 through 9, a minus and a blank (Many special character wheels available from stock)

Driving Source: Parallel-entry 4-line BCD, 1-2-2-4. Other codes available on plug-in cards. Source reference voltages establish "0" and "1" states, which may be as much as 100 v above or below ground. "1" state 4 to 75 v above "0" reference. Driving power approx. 30 μa into 270,000 ohms.

Print Command: ± pulse, 20 μsec or greater in width, 6 to 20 v.

Hold Signal: (Available for each data source) —7 v to + 15 v and + 15 v to —7 v.

Transfer Time: 2 msec

Paper Required: Standard 3" roll or folded

Line Spacing: Single or double, adjustable

Size: Cabinet, 20¾" x 12½" x 18½"; Rack, 19" x 10½" x 16⅞" deep behind panel.

Price: hp 562A (cabinet) or hp 562AR (rack mount) $1,600.00 to $2,200.00 depending on options. hp 580A Digital-Analog Converter, price on request.

New, solid state hp 562A Digital Recorder prints digital data on 3" paper as fast as 5 lines per second, each line containing up to 12 digits. The instrument incorporates a unique data storage unit for each digit column that allows the data source to transfer data to the recorder in just 2 milliseconds, after which the source is free to collect new data.

Besides the standard parallel-entry 4-line BCD code (1-2-2-4), you can easily use other 4-line codes just by substituting plug-in column cards. Ten-line code operation (without data storage feature) is also available with plug-in cards.

Further, hp 562A accepts dual input (optional) and prints data simultaneously from two unsynchronized sources. A "patch panel" permits programming these two separate, unsynchronous inputs (even if coded differently) in any manner. Combinations of plug-in column code cards and "patch panel" column programming give complete flexibility in both dual-source data acquisition and data print positioning.

Analog output for high-resolution strip chart and X-Y recording is available as an extra-cost built-in feature of the 562A or through the new hp 580A Digital-Analog Converter, a separate solid state, high-precision instrument.

Designed for use with solid state and vacuum tube counters, Model 562A is ideal for a wide variety of individual and system applications. Call your hp representative today.

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7087

ELECTRONICS NEWSLETTER

Too Many Incompetent Electronics Firms?

WASHINGTON—"Many industrial firms who bid on military contracts have less than a desirable degree of competence," said Finn J. Larsen, Army's assistant secretary for R&D, during his controversial banquet address to the Eighth National Symposium on Reliability and Quality Control last week.

Larsen said this was especially so in electronics. His point was this: a few engineers with a good idea land a contract, form a company, become engrossed in business side of their venture and let incompetent engineers handle the project and other contracts.

He claimed that while nearly one-third of the thousands of other small businesses started each year fail, "almost none" of the more than 4,000 small electronics firms begun in the past five years have gone out of business.

"This seems to be a clear indication that we are almost certainly carrying too many of these as marginal and submarginal business operations, and that our government is not getting its money's worth from many of them," Larsen said.

Larsen also criticized the "great waste of scientific manpower" in military contractor selection. Proposals made by 10 or more bidders frequently require as much engineering effort "as the successful bidder utilizes to conduct the development project." He also called on engineers to stress functionally simple designs and to "avoid the temptation of unnecessarily upgrading or refining a weapons or communications system"

Transistor Modulators Control Electric Cars

ALLIS-CHALMERS reports it has a static controller for battery driven vehicles that gives smoother operation and less power drain than the sequential shorting of accelerating resistors with contactors. A pulse width modulation technique is used to continuously vary average or d-c voltage delivered to the traction motor.

Transistors are employed in a switching mode. The unit can incorporate silicon controlled rectifiers to handle high voltages. Added feature, says the company, is inherent protection from motor, battery or controller damage from overcurrents caused by stalling or overload.

Satellite Share Sales Are Sought by Senator

WASHINGTON—Plan to solve the problem of ownership of a communication satellite system is proposed by Sen. Robert S. Kerr (D-Okla.), chairman of the Senate Space Committee. He has introduced legislation to set up a $500 million private corporation with membership open to both domestic and international firms.

Under Kerr's plan, 5,000 shares valued at $100,000 each would be sold. The minimum holding by any one company would be five shares. Satellites would be supplied by NASA and rates charged for satellite communications would be controlled by FCC.

The plan is patterned closely to one favored by the administration, but is not administration sponsored. President Kennedy will send Congress an official administration plan for ownership of a system within the next few weeks.

Army Opens Integrated Communications Network

ARMY BEGAN using this month its new communications system, Scan (Switched Circuit Automatic Network). It ties together in a single network more than 180 Army, Navy and Marine Corps installations in the U. S. The system will transmit voice, secure voice, data and facsimile.

Army had been using a variety of manually switched networks and point-to-point private line circuits. The new system, developed by AT&T, lessens the vulnerability of the Army's communications by routing messages through alternative switching centers.

Scan has four switching centers located at Santa Rosa, Calif.; Hillsboro, Mo.; Rockdale, Ga., and Frederick, Md. These locations were selected because they are outside major target areas and make maximum use of trunklines which bypass major population centers.

NASA Checking Up on Down-to-Earth Results

COMMERCIAL BYPRODUCTS of space research and development are being investigated by the University of Denver Research Institute under a $56,745 grant from NASA. The agency wants to know what products, processes, systems and materials are being produced for civilian use and how the results of research can be spread. Some authorities expect commercial byproducts of the space program will exceed those of military developments during World Wars I and II.

1962 Small Boat Sales Estimated $16 Million

NEW YORK—At the opening of the National Motor Boat Show last Friday, J. Leonard Lovett, marine products manager of Raytheon, estimated pleasure boatmen would buy $12 million in electronics gear this year. Sales to small commercial boats would add $4 million, he said.

Predictions are based on advance orders for boats, which tend toward record 1960 levels. Sales slacked off in 1961. Steady growth of electronics sales is expected in the future. In the next five years, marine radiotelephones are expected to double from today's level of 90,000 licensed units.

New equipment at the show caters to the desires of offshore yachtsmen for navigation aids that are easy to operate and draw less

power. At least two lines of Japanese equipment were displayed along with domestic direction finders, radar, loran, depth sounders, radiotelephones and other equipment.

Spaceship Designed Like Accelerator is Proposed

UNIQUE METHOD of loading space ships with enough energy to accelerate them to the speed of light has been proposed by a New Mexico Highlands University professor. A. A. Kraus, Jr., says that a vehicle sent toward the sun could reach the required speed in a month.

The vehicle would have an ionizer at one end and a voltage gradient along its length. As it passes through hydrogen, the gas is ionized and protons are accelerated toward the rear. If there are enough free protons near the sun, Kraus says, no ionizer would be needed and the vehicle would be reduced to a simple voltage generator.

Kraus proposes a three-stage feasibility program. First, send a probe near the sun to measure proton and hydrogen distribution, temperature, magnetic field and other parameters. Next, try a test vehicle. Third, send a returnable vehicle to a nearby star.

Army Medics Consider Remote Signal Device

Development of a lightweight signaling and tracking system is being considered by the Army Medical Equipment Development Laboratory, Fort Totten, N.Y. The transmitter would weigh six ounces or less and would be operated by an involuntary physiological response if the wearer became unconscious. A portable tracking device would monitor signals within a radius of 300 yards. Such a system could be used to locate casualties.

Semiconductor Technology Pushed by East Germans

EAST GERMANS are stepping up research on ultrapurification of materials, particularly semiconductors. Like the West (ELECTRONICS, p 41, July 7, 1961), they are working on techniques to measure impurities of less than one part per million and their goal is impurity detection at the parts per billion level. Researchers are turning toward carbides and III-V compounds.

Robert M. Bakish, research director of Alloyd Electronics, who attended a recent conference at Dresden, reports his impression that the East Germans have high capability in the pure materials field, independently of any Russian backup. Impurity detection limits were defined as 10^{-10} by activation analysis, 10^{-7} by emission spectroscopy and 10^{-5} or 10^{-6} by mass spectroscopy, in a review paper.

Bakish also reported that a multistage electron beam melting furnace has been developed by M. von Ardenne, of Dresden. The beam impinges on work after passing through differentially evacuated stages. Differential pumping allows pressures as high as 10^{-2} mm Hg in working chambers. The gun is refocused at the end of each stage.

Second Echo Balloon Rips and Tears Apart

NASA'S PLANS to further test the feasibility of using large, reflecting balloons as passive communications satellites went awry on Monday when a 135-foot sphere ripped and tore apart as it was being inflated.

The concept was demonstrated by the 100-ft Echo still in orbit after 18 months. That balloon, made of aluminized Mylar, has lost 60 percent of its reflectivity, indicating it has lost its spherical shape.

The new Echo was constructed differently, in an effort to develop balloons that would retain their shape after the inflation gas was lost. It consisted of Mylar laminated on each side with aluminum foil. As a sublimating powder expanded the balloon, the foil was to stretch beyond its elastic limit. This was expected to make the sphere rigid.

The Thor launch vehicle was equipped with a miniature television camera and a recoverable motion picture camera to watch the inflation. The schedule calls for placing a rigidized sphere in a 700-mi-high polar orbit this spring.

In Brief . . .

MISSILE EQUIPMENT contracts announced last week include $33 million to Autonetics for Minuteman guidance control system production; $4 million to Lockheed, for Polaris.

MISSILE SERVICES awards include $2.7 million to Westinghouse Electric for Polaris launch R&D; $1.9 million to Telecomputing Services for reduction of test data; $1 million to Avco-Everett for MHD and reentry studies.

MUNTZ TV is making a 19-in. tv set in the $100 price class. It uses eight tubes, including six Compactrons.

NORWAY and Sweden have ordered long-range air traffic control radars from Selenia SpA, of Italy. The Norwegian installation will be remotely operated by microwave relay.

AIR FORCE says it will locate its new equator-watching space tracking radar in Florida. Contract will be awarded in March.

HALLICRAFTERS is sponsoring a citizens' band radio emergency organization called React, with Chicago headquarters.

MOTOROLA has formed a Solid State Systems division in Phoenix.

LABORATORY FOR ELECTRONICS has acquired 100 percent of Elenik Engineering, a Swedish industrial electronics firm.

IBM ANNOUNCES orders from Britain for 130 type 1401 computers, is shipping three 7070's to Japan.

NATIONAL CASH is installing one of its NCR 315 systems at a Washington, D.C. savings and loan association.

UNITED ARAB REPUBLIC has ordered a 1-Mw, $1.25 million radio transmitter from Continental Electronics.

AIRCRAFT ARMAMENTS has a $13 million Army contract to modify and manufacture Nike missile training devices.

FILMISTOR®

METAL FILM RESISTORS OFFER 5 DISTINCT TEMPERATURE COEFFICIENTS TO MEET ALL CIRCUIT REQUIREMENTS

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EXCEPTIONAL RESISTANCE TO MOISTURE AND MECHANICAL DAMAGE

• • •

SURPASS MIL-R-10509 PERFORMANCE REQUIREMENTS

Providing close accuracy, reliability and stability with low controlled temperature coefficients, these molded case metal-film resistors outperform precision wirewound and carbon film resistors. Prime characteristics include minimum inherent noise level, negligible voltage coefficient of resistance and excellent long-time stability under rated load as well as under severe conditions of humidity.

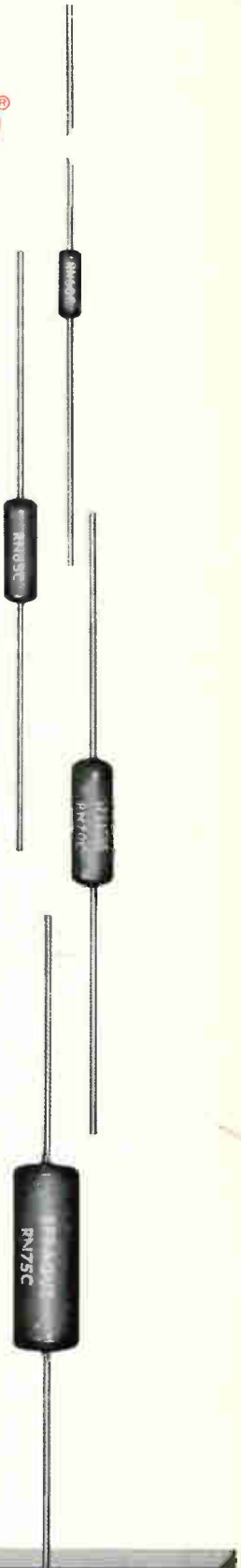
Close tracking of resistance values of 2 or more resistors over a wide temperature range is another key performance characteristic of molded-case Filmistor "Metal Film" Resistors. This is especially important where they are used to make highly accurate ratio dividers.

Filmistor "Metal Film" Resistors are automatically spiralled to desired resistance values by exclusive Sprague equipment. The metallic resistive film, deposited by high vacuum evaporation, bonds firmly to special ceramic cores. Noble metal terminals insure low contact resistance.

The resistance elements, complete with end caps and leads attached are molded in dense, high temperature thermosetting material to form a tough molded shell for maximum protection against mechanical damage, moisture penetration and repeated temperature cycling.

Filmistor "C" Resistors, in ⅛, ¼, ½ and 1 watt ratings, surpass stringent performance requirements of MIL-R-10509D. Characteristics C and E. Write for Engineering Bulletin No. 7025 to: Technical Literature Section, Sprague Electric Co., 35 Marshall Street, North Adams, Mass.

For application engineering assistance write:
Resistor Division, Sprague Electric Co.
Nashua, New Hampshire



SPRAGUE COMPONENTS

RESISTORS	INTERFERENCE FILTERS	HIGH TEMPERATURE MAGNET WIRE
CAPACITORS	PULSE TRANSFORMERS	CERAMIC-BASE PRINTED NETWORKS
MAGNETIC COMPONENTS	PIEZOELECTRIC CERAMICS	PACKAGED COMPONENT ASSEMBLIES
TRANSISTORS	PULSE-FORMING NETWORKS	FUNCTIONAL DIGITAL CIRCUITS

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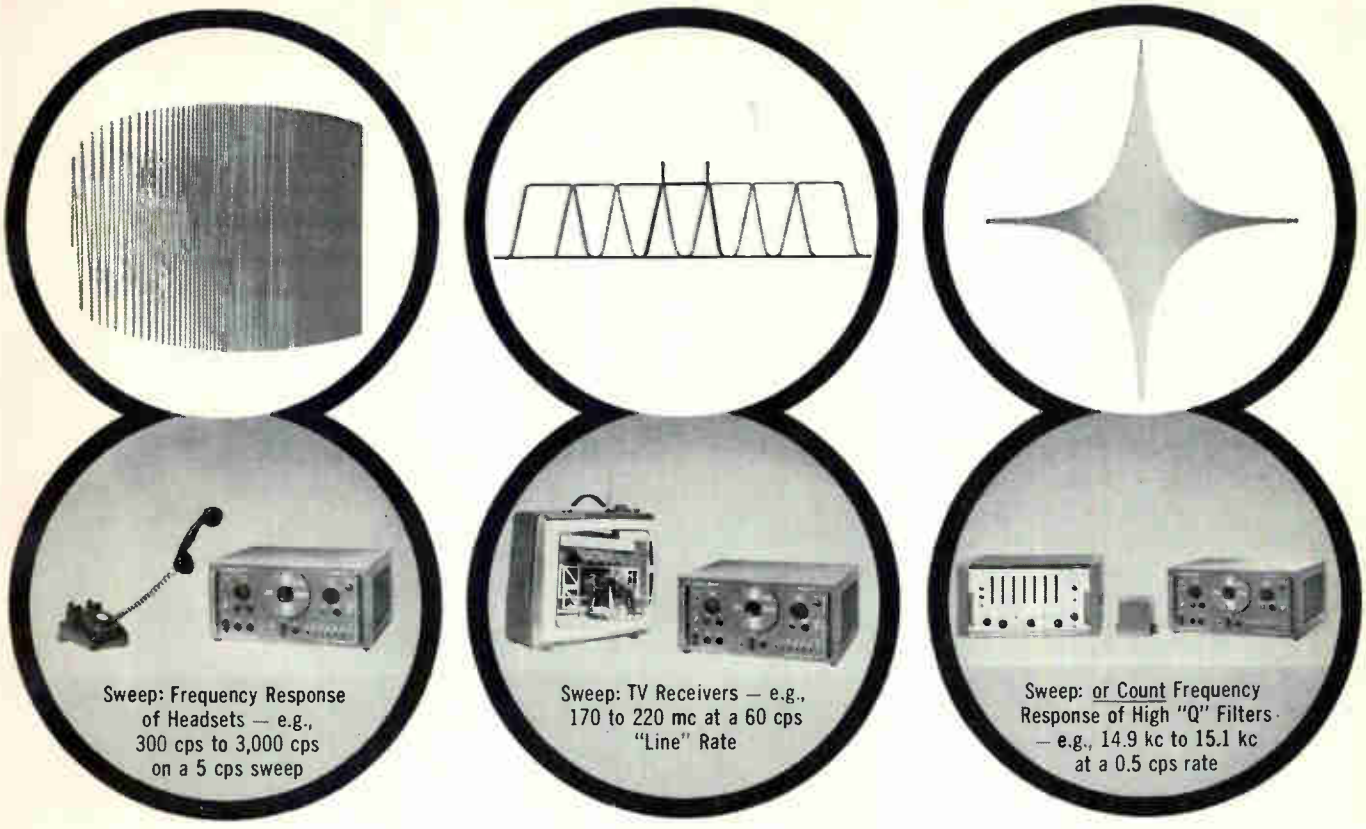

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SWEEPING OSCILLATOR

935-B

50 CPS TO 220 MC IN 12 BANDS • WIDE RANGE OF SWEEP WIDTHS VARIABLE REP RATES • MANUAL AND AUTOMATIC OPERATION

- Single wide-sweep video displays from 10 mc down to 1 kc.
- Linear and logarithmic sweeps of 0.2 cps to 30 cps; or sweep locked to line frequency.
- Audio Sweep of 50 cps to 20,000 cps.
- 8 fixed, narrow-band video frequency sweeps for repetitive operations.
- Fundamental frequency 10 mc to 220 mc (widths to 30 mc plus).
- High-level output of 1 V rms into 70 ohms. AGC'd to ± 0.5 db over widest sweep.
- Manually-operated control for varying oscillator frequency.
- Fixed pulse-type markers or variable marker provision.

Price: $1295.00 F.O.B., Factory ($1425.00 F.A.S., New York).

The wide frequency range, extensive choice of sweep widths and repetition rates make the Kay *Ligna-Sweep* SKV a most useful sweeping oscillator.

For high frequency work, the unit provides 9 sweep bands, operating at fundamental frequencies for wide, stable sweeps from 10 to 220 mc. At the low end of the spectrum, an audio frequency sweep from 50 to 20,000 cps is provided. High order stability permits frequency sweeps to as low as 50 cps.

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Check Video Bandpass — e.g., 1 kc to 10 mc at 1 cps rate


Check Radar IF's — e.g., 25 to 35 mc at 30 cps


Check Audio Bandpass — e.g., 50 cps to 20 kc at 1 cps Log Sweep

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WASHINGTON OUTLOOK

EXPLOSION IN EDUCATIONAL TV demands during the next decade is indicated by a survey conducted by the National Association of Educational Broadcasters, underwritten by the Department of Health, Education and Welfare. The survey covers tv prospects in all levels of education.

Educators say they need at least 1,472 channels. There are now only 2,200 tv stations assigned for both uhf and vhf and both educational and commercial use. There are now 275 channels assigned to education, 187 uhf and 88 vhf. Of these, 60 are in use: 40 vhf and 20 uhf. The need is seen for 825 additional uhf stations and 97 more vhf stations, to meet the goals of a national education network and the desires of numerous communities for two to 12 channels with simultaneous broadcasts.

IF NAB CALCULATIONS are anywhere near accurate, future demand for uhf channels could equal present demand for vhf. This would hinge on success of FCC's drive to get uhf sets in the hands of viewers, through legislation requiring manufacture of all-channel receivers. When many viewers have uhf sets, a collision between educators and commercial interests scrambling for uhf stations is readily imaginable.

There are signs educational tv is beginning to snowball. FCC Chairman Minow is pushing hard, got a vhf educational station for New York City. Purdue's test of airborne transmission is getting high marks. The District of Columbia just got its first station.

SMOLDERING DISPUTE over government contracting with nonprofit organizations may flare on the space front in Congress this year. The House Committee on Science and Astronautics has made a staff study, may hold hearings this session. Industry complaints have centered on the heavy amount of military contracting with nonprofit groups.

Now, inertial guidance firms are disturbed because NASA chose MIT's Instrumentation Laboratory to develop the navigational system for the Apollo spacecraft. NASA says the laboratory pioneered much of the work in this field and has proved its capability. However, companies argue that there should have been competitive bidding, that industry talent may be eroded from lack of work. Complaints have been taken to Republican congressmen.

HIGHWAY RESEARCH BOARD, an arm of the National Academy of Sciences-National Research Council, will spend $400,000 in the coming fiscal year to study feasibility of using electronic controls to automate highways. Bureau of Public Roads already is looking into what is feasible on a theoretical basis.

The eventual goal—roadway electronic controls that would pilot cars at fixed speeds and intervals—is probably many years away. More immediate possibilities are devices that would warn of traffic jams ahead, order shifts of traffic into alternative lanes and routes, signal speed changes and otherwise improve traffic flow.

A number of firms have done considerable research and development work in this field, among them RCA, General Motors, Thompson Ramo Wooldridge, Westinghouse and Bendix. RCA has offered equipment for the Highway Research Board's study.

A now-disbanded planning group of outside experts advising the Kennedy administration on transportation policy concluded last year that full highway automation already is technologically within grasp. It recommended an experiment on a 100-mile stretch of superhighway to be built between two major cities within the next two years. Public Roads officials, however, view the planning group's outlook as overly optimistic.

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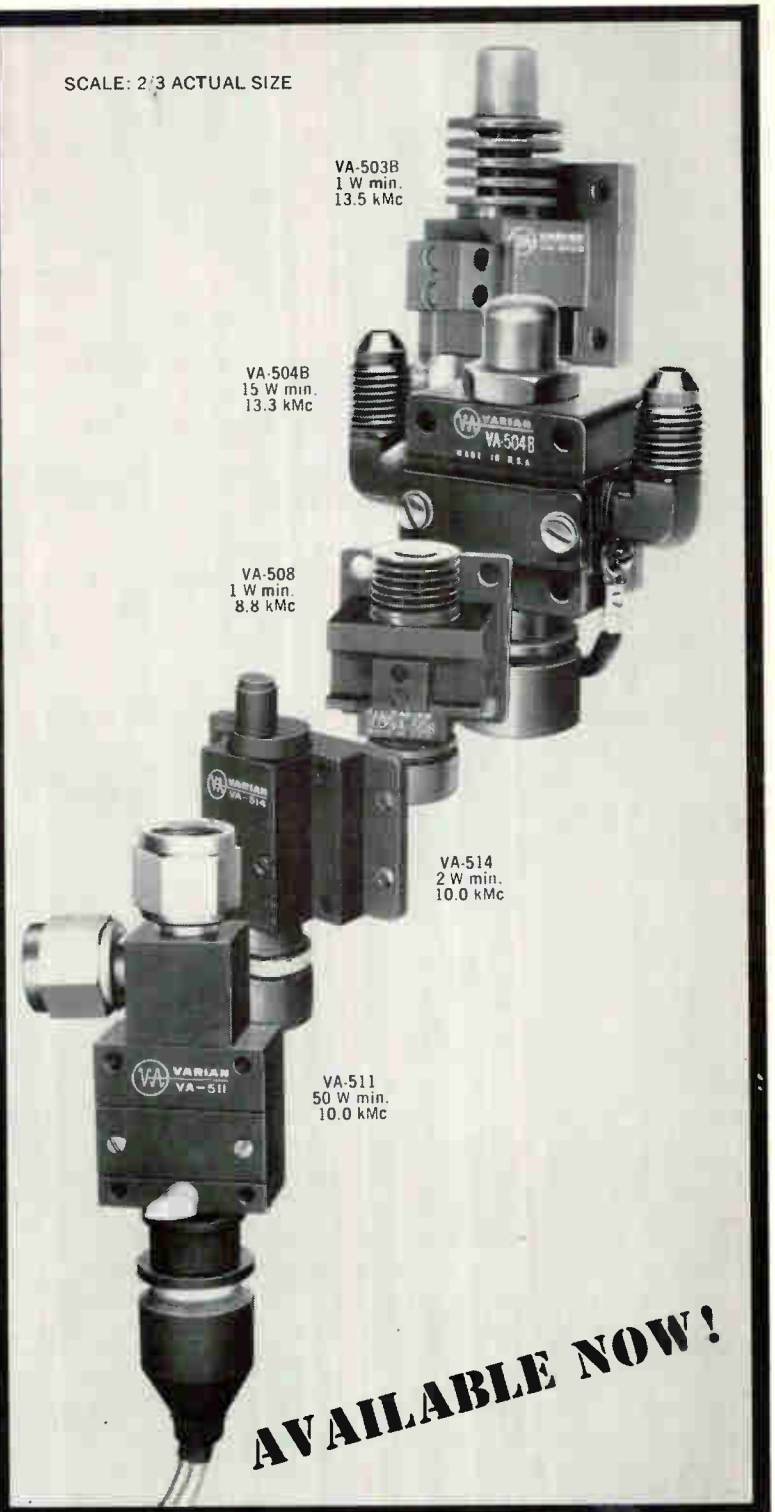
Characteristics of the VA-511 are typical of the oscillators in this group. The VA-511 produces 50W minimum power at 10 kMc, and operates at 10 kV, 60 milliamperes. FM noise is less than 1 cycle. Weight, less than 24 oz.; size: 6¼ in. x 2¼ in. x 1¾ in.

For additional technical information on this fine family of klystron oscillators, address Tube Division.



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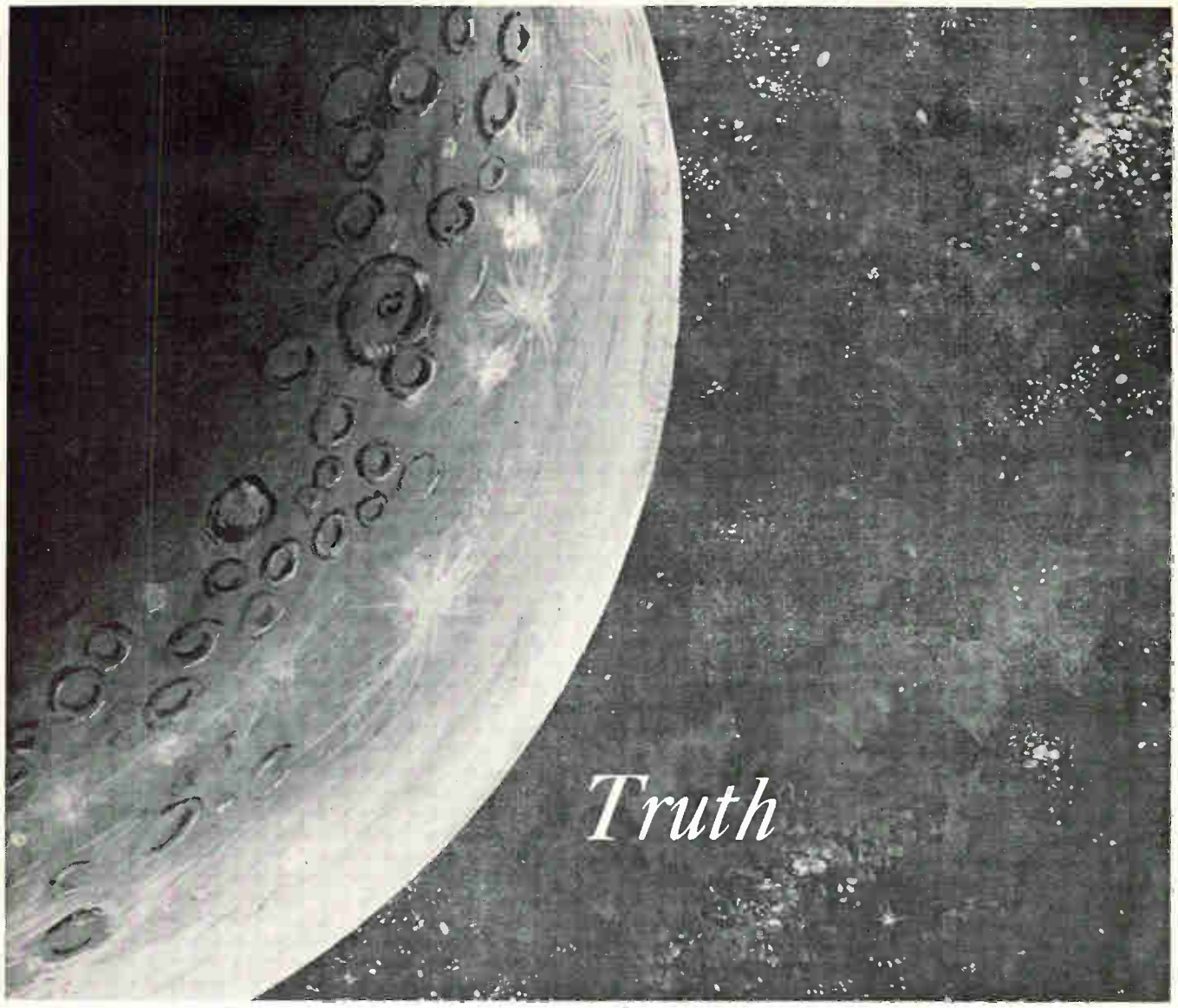

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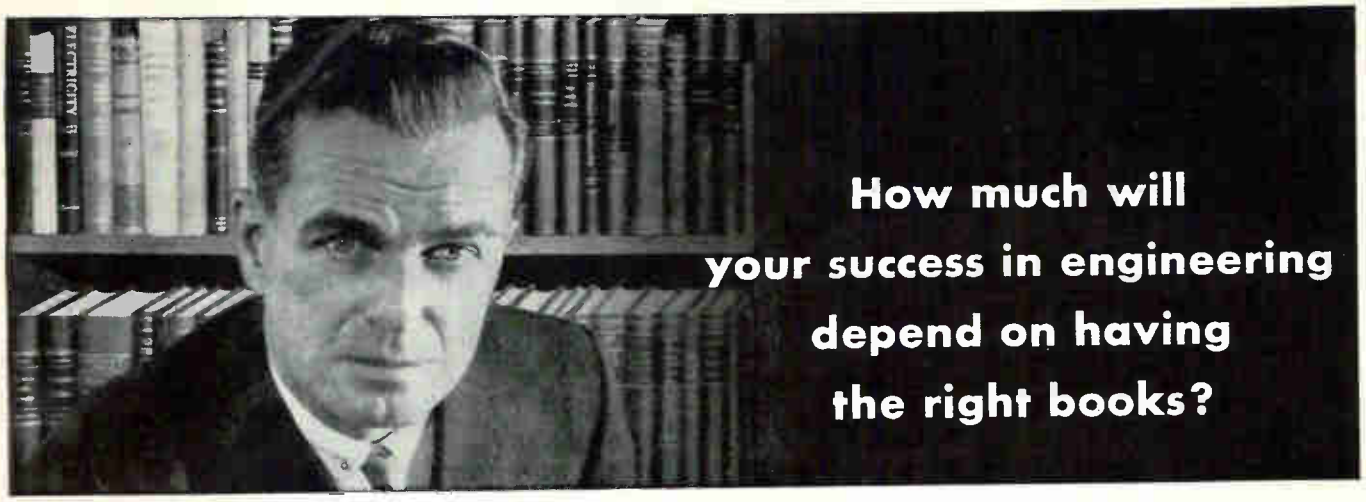

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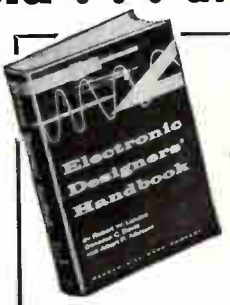

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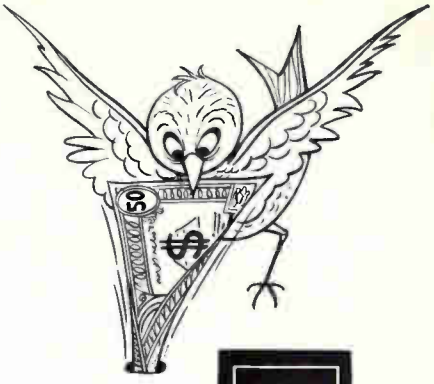

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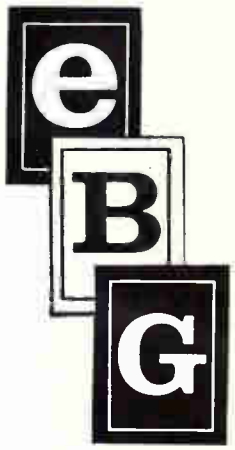

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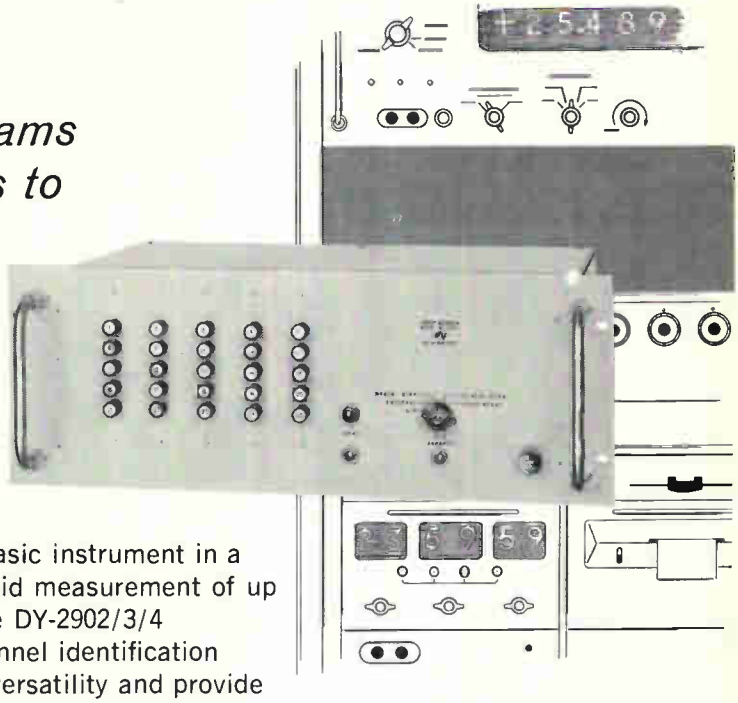

With off-the-shelf Dymec instrumentation it's simple to measure pressure, flow, temperature, velocity, volume—any parameter that can be converted to or related to a voltage, frequency, time interval or period, resistance or current.

Using the DY-2901 Input Scanner as the basic instrument in a system, for example, you can program rapid measurement of up to 25 points—or up to 100 inputs with the DY-2902/3/4 slave scanners. Built-in programming, channel identification and latch-lock input connectors increase versatility and provide money-saving utility. Channels to be measured are selected by front-panel buttons and programmed by an internal pin board which lets you select function and range of the measuring equipment.

With the DY-2901, you can make more effective use of other Dymec instruments such as the DY-2401 Integrating Digital Voltmeter, the DY-2410 Multi-Converter, and the DY-2540 Coupler. Application Note 15 describes complete Dymec Systems capabilities.

Here are some of the inputs you can measure with these systems:

- dc voltage, from a few mv to 1,000 v
- ac voltage, from a fraction of a volt to 750 v rms, 20 cps to 100 KC or more
- frequency, dc to 10 MC or more
- time interval or period, from less than 1 nanosecond to 100 days
- resistance, fractions of an ohm to 100 megohms or more
- current, from 10^{-9} amps to 10 amps or more

And here are some of the features your Dymec system can provide:

- Scaling: Multiplying factors can be pre-set to provide digital readings in desired measuring units (psi, gpm, rpm, etc.)
- Ranging: Measuring equipment can be automatically programmed to desired range for each channel
- Normalizing: Separate multiplying factor can be supplied for each channel to relate all measurements to a par value
- Scale Expansion: Zero offset provides high measurement resolution on each range
- Sequence: Individual channels can be omitted from any measurement cycle

Call your Dymec/Hewlett-Packard representative today or call direct for specifications on the DY-2901 Input Scanner ($1,950), DY-2401 Digital Voltmeter ($3,750), DY-2410 Multi-Converter ($1,975), DY-2540 Coupler (typically $1,200 to $2,400), or other Dymec instruments for versatile systems application.

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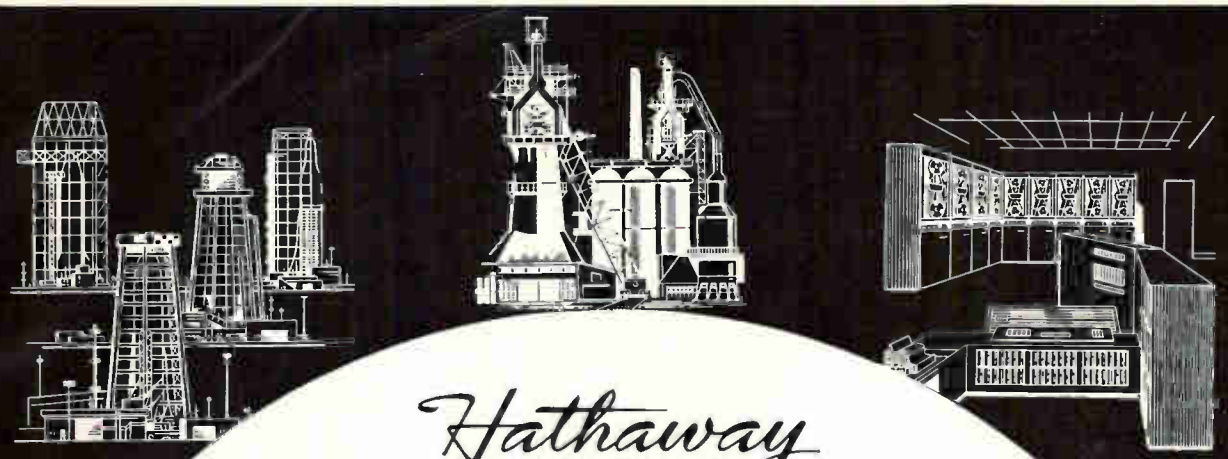

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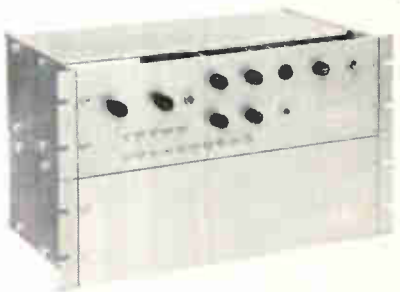

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And design potential is nearly unlimited because of these special features: **Contact rating:** 10,000,000 operations at 100 milliamperes, 115 V 60 cps resistive, 10,000,000 operations at 125 milliamperes, 28 vdc resistive. 1,000,000,000 operations dry circuit. **Natural contact frequency:** 2,700 and 2,800 to 3,200 cps. **Vibration:** 20 G's to 2,000 cps, energized or non-energized with no fault operation. **Noise:** Useable in the low microvolt region. **Isolated dual-ended contacts. Permanent lubrication prior to assembly. Low cost.**

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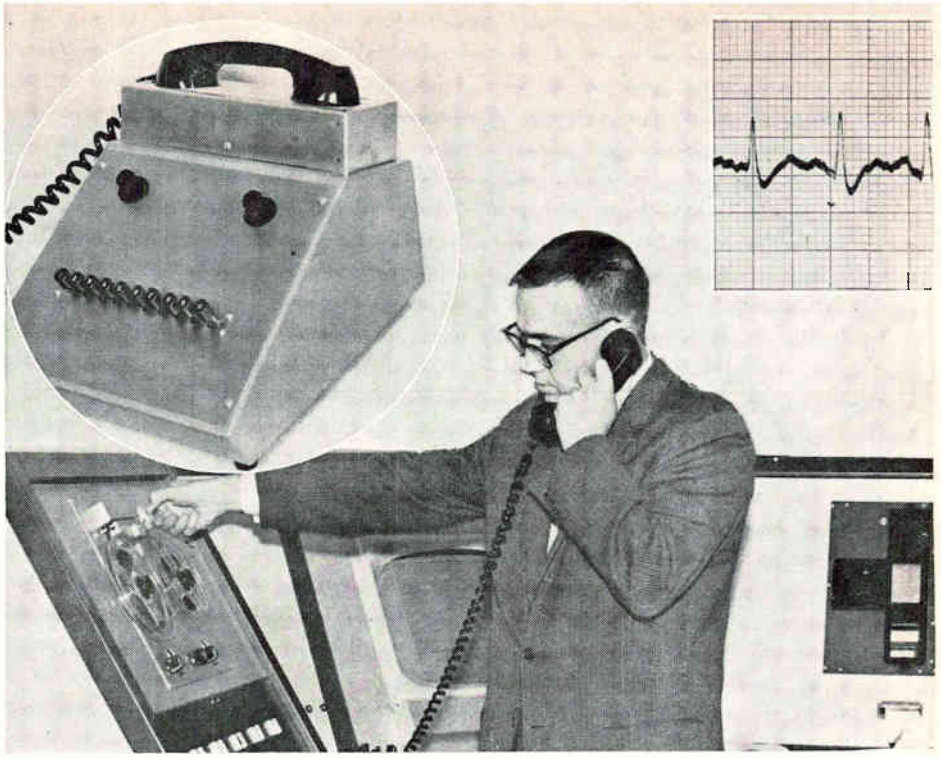
Phone Lines Transmit Data on Heart Beats



Ecg sent by telephone from Atlantic City, N. J., to Electronic Medical Systems' offices in St. Paul, Minn., is monitored, recorded and analyzed at receiving console. Insets show the transmitter and portion of ecg

PHYSICIANS will soon be able to transmit electrocardiograms (ecg) by telephone, for long-distance consultation with cardiologists. The heart specialist can listen to the heartbeats while watching the ecg being traced by a recorder.

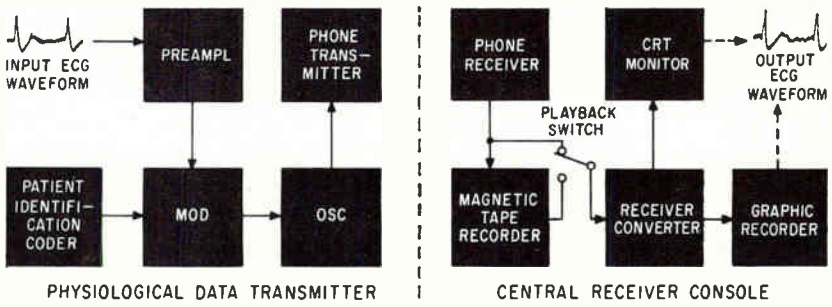
Although several physicians both here and abroad have used the telephone technique experimentally, no wide-scale application exists. However, three such systems now under test are expected to become operational this year. They could be used by physicians in communities without cardiologists, or by physicians on ships equipped with radiotelephones.

The systems developed by Mnemotron Corp. and Electronic Medical Systems use acoustic coupling to a telephone. The other, by Bell Telephone, uses direct electrical coupling. Laws regulating wire tapping generally require acoustic coupling, but Bell can install its system just as it does ordinary phones.

One advantage of the acoustic systems, though, is that physicians can carry the transmitting unit and forward an ecg directly from a patient's home to medical centers for analysis.

Bell's special data-phone sets transmit what is termed "live" ecg information. Prototype models pick up the cardiac signal by electrodes connected to the phone unit. An amplified electrical representation of the ecg is transmitted and is traced at the receiving end by a Minneapolis-Honeywell Visicorder.

Mnemotron's Sonolink has a six-ounce transmitter that clips onto the telephone mouthpiece. It converts ecg signals to pulse frequency modulated sound, audible as a soft, continuous beep of varying pitch. The receiver clips onto the telephone earpiece. It reconverts the data and feeds it to a conventional ecg, tape recorder or oscilloscope.



Data flow of EMS's system. The receiver can service many portable ecg transmitters

Electronic Medical Systems reports it has obtained high-fidelity transmission of 500 miles with a similar system. Data reliability is ascribed primarily to a high signal-to-noise ratio.

The physician uses a portable transmitter to acoustically couple the patient's ecg to the phone. A bandtype chest electrode requires only one lead from the patient to the amplifier. The physician can manually insert codes that identify the physician, patient and time of recording. Records can be played back, so analysis can be made at any time convenient to the specialist and the inquiring physician.

All three of these companies report that systems for transmitting other physiological data, such as electroencephalograms, are underway.

Another recent development in this field is a fetal heartbeat monitor built by Dr. Saul Larks, of Marquette University, working with Magnavox researchers at Fort Wayne, Ind.

Signals picked up by small sensors on the mother's abdomen frequency modulate a small four-tube transmitter which is acoustically coupled to a telephone mouthpiece through a 1.5-inch loudspeaker. Center frequency is 1.75 Kc and output is in the one-watt range. An eight-by-five-inch, seven-tube receiver converts the data for record-

ing and display on a cro.

The device can be used from the 11th week of pregnancy to term. Marquette expects it to help specialists detect congenital heart or metabolic diseases which cause miscarriages.

Lockheed has a radiocardiograph designed to clip onto a patient's clothing. The transmitter, which looks like a fountain pen, is connected to electrodes which are taped to the patient's chest. Output can be fed into phone lines, so physicians can monitor the heartbeat while the patient goes about his normal activities.

The rights to this device were recently given by Lockheed to the Heart Research Foundation, of Los Angeles. The Foundation says it will be made available to cardiologists soon.

Computer and Sensors Form Artificial Hand

MECHANICAL manipulator that can feel and remember shapes and perform simple operations on the "knowledge" acquired has been built by an MIT graduate student to study artificial intelligence.

The system can recognize blocks, pile up the blocks or, if it finds a box, load the blocks into the box. The student, H. W. Ernst, programmed MIT's TX-0 computer to perform the cognitive processes and equipped the manipulator with 30 devices which give it a sense of touch and position.

EIA Parts Section To Study Coil Spec

COIL SECTION has been organized as part of the inductive components subdivision of the Electronic Industries Association's parts division, the division chairman, W. Myron Owen, of Aerovox Corp., has announced. Section chairman will be Harry W. Waddell, of Jeffers Electronics division of Speer Carbon Co. One of the group's first activities will be to determine EIA action to develop a high reliability version of MIL-C-15305 (r-f and i-f coils).

Solid State Nuclear Analyzer

SOLID-STATE multiparameter recorder analyzer developed by Argonne National Laboratory is reported to combine slow record-fast search of magnetic tape with the precision and repeatibility of digital data handling.

Opening of a neutron shutter starts a scaler counting crystal oscillator clock pulses. A neutron's arrival at the target sets the stage for detection of two coincident gamma rays. A coincidence pulse terminates the clock and opens linear gates, starting analog to digital conversions. Binary notation of pulse heights and neutron time of flight across magnetic tape takes about 200 μsec.

The record station's 256-channel core memory monitors and provides for visual display of information transferred to tape from any of three tracks. The memory also permits a check on retrieval of data from tape, since data accumulated in monitors is identical to that played back at search station.

Organization and analysis of recorded events takes place at the search station, where a 1,024-word memory is provided in conjunction with a flexible set of window-like restrictions imposed on gamma ray parameters. Restriction gate is associated with each of four memory quadrants. Operating like a digital single channel analyzer, each window adds one count to the memory when the input's numerical value equals or exceeds the lower boundary, but is less than higher boundary.

Single search pass of 2,500-ft tape containing three million events takes 3½ minutes, providing for linear or semilog display of four 256-channel spectra on a crt. Read out by typewriter, punched tape or x-y recorder takes five minutes.

The system could be adapted to chemical, aerodynamic and other processes as well as nuclear analyses, according to Argonne dexelopers. It uses 2,100 transistors and 3,300 diodes.

Vacuum Chamber Tests Full-Scale Spacecraft

SPACE ENVIRONMENT chamber recently placed in operation at Bendix-Systems division, Ann Arbor, is large enough to test full-scale spacecraft. It measures 20 ft in diameter by 27 feet long. Altitudes up to 250 mi can be simulated in the chamber.

Biomedical Telemetering Belt

Miniature telemetering instruments, developed by Boeing for space medicine research, can be worn on belt, allowing subject to move freely. Arnoux Corp. will make the equipment

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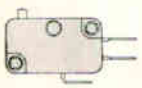
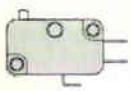
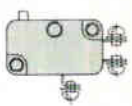


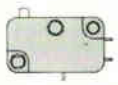
Quick Connect Terminals



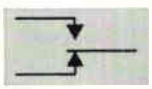
Solder Lug Terminals



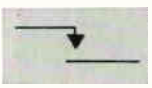
Screw Terminals



Short Solder Lug Terminals



Double-Throw



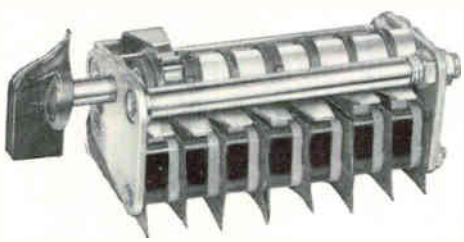
Normally-Open

Normally-Closed

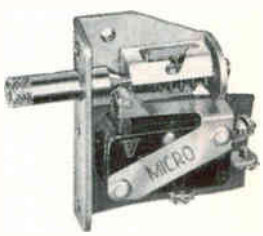
"V3" SWITCH ASSEMBLIES

***Multi-Circuit Toggle Switches** available with 4 to 12 SPDT switches. Above: 8-switch unit. (Catalog 73.)*

***3-Position Toggle Switches** make or break in all three lever positions. (Catalog 73.)*



***Rotary Selector Switches** available with from one to eight switching units and two to eight detent positions. (Data Sheet 86.)*



***Door Interlock Switches** for safeguarding electrical equipment. Wide variety available. (Data Sheet 186.)*

COMPLETE RANGE OF AUXILIARY ACTUATORS

Leaf Actuator

Roller Leaf Actuator

Low Force Lever Actuator

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MICRO SWITCH, FREEPORT, ILLINOIS
A Division of Honeywell
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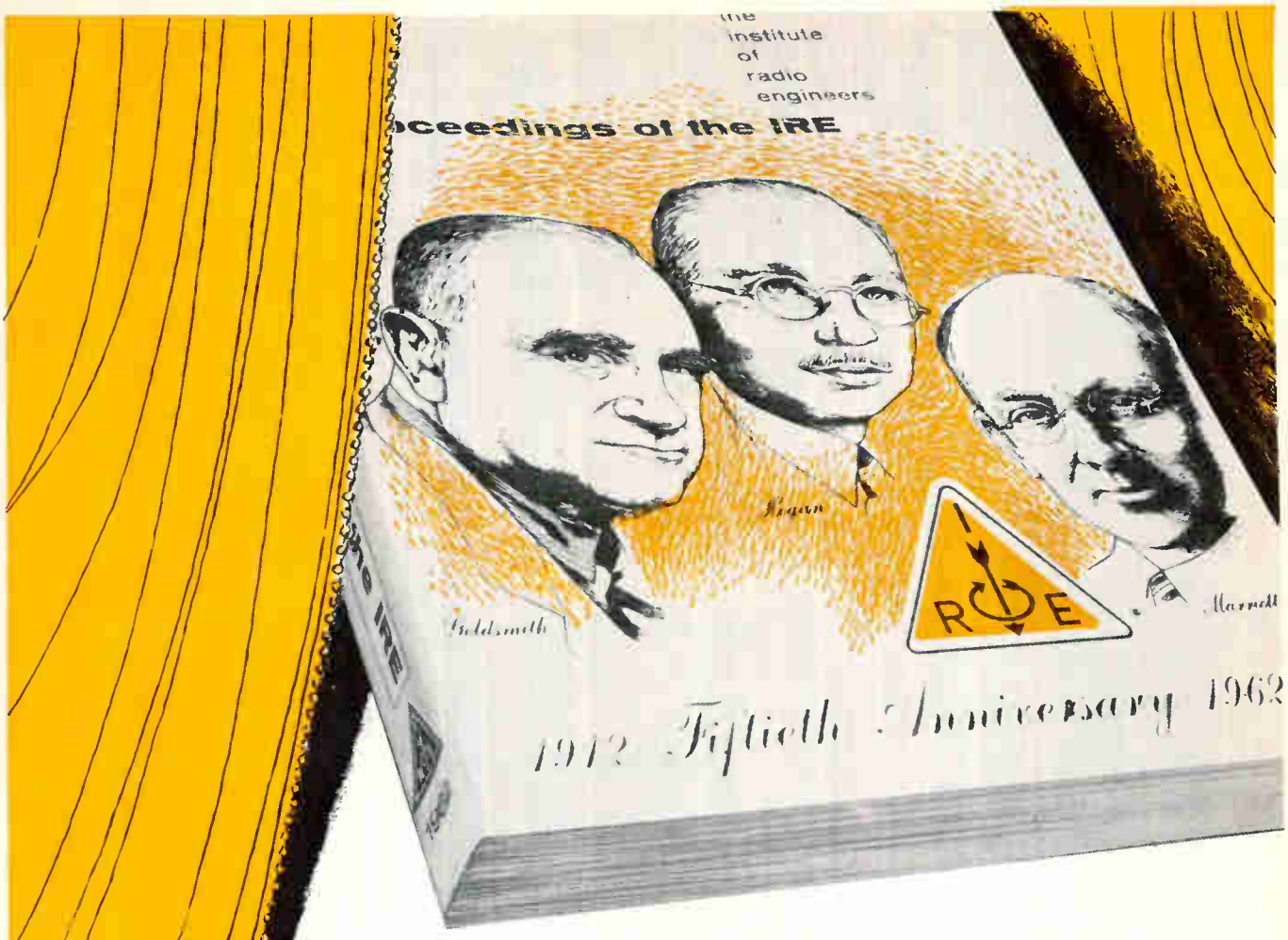
Honeywell
MICRO SWITCH Precision Switches



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ISSUE OF **Proceedings**

In honor of the IRE's 50th anniversary, the May 1962 issue of *Proceedings of the IRE* will survey the progress of electronics from 1912 to 1962. It will forecast the future of electronics for the next 50 years. And this special issue of *Proceedings* will have more than 600 pages of additional editorial text, discussing developments in

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Industrial Electronics
Bio-Medical Electronics
Ultrasonics Engineering
Military Electronics
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Electronics experts from all over the world contribute to make this anniversary issue concise yet all-inclusive. 100,000 copies will be printed. Only members of the IRE, in good standing in May 1962, and subscribers will receive a copy. We regret that unlike special issues of the past, no copies can be made available to non-members, or for single copy sales. As a member of the IRE you will find the May anniversary issue of *Proceedings* the master reference work you will treasure always.

The Institute of Radio Engineers • 1 East 79th St., New York 21, LE 5-5100

Low-Altitude

By HAROLD C. HOOD
Pacific Coast Editor

LOS ANGELES—A sensitive low-altitude altimeter based on radioisotope backscatter techniques is reported under development at Giannini Controls Corp. It gives promise of easing landing problems of spacecraft as well as aircraft.

Early tests of the lightweight, all-weather height-above-terrain indicator point to accuracies greater than one inch at the critical eight-to-10-ft "flare out" height for fast-landing jet aircraft. Its developers claim that, unlike conventional pressure and radar altimeters, accuracy of the new device improves as the gap between ground and instrument is closed.

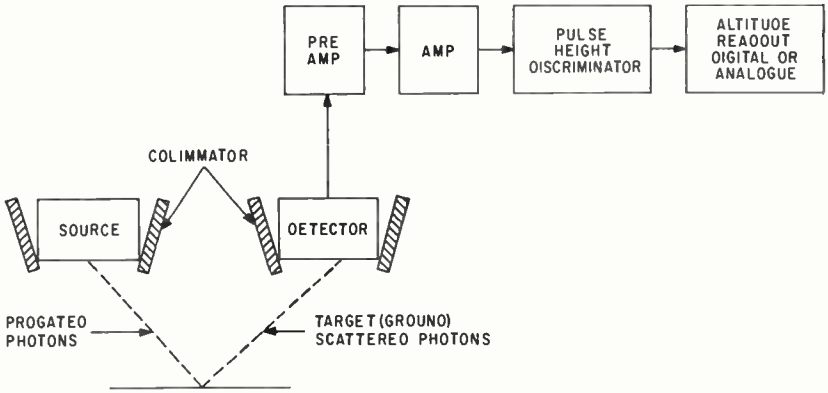
Basically, the system consists of a radioisotope source, such as Cobalt^{60}, from which photons are propagated, and a solid-state or scintillator detector which picks up the reflected particles returning to the vehicle. Giannini envisions a 100-millicurie source for most applications, appropriately backshielded from the detector and from vehicle passengers or crew.

Maximum weight of the detector is 10 pounds, dimensions are eight in. high by three in. diameter. With a solid-state detector, it would measure two in. square and three in. long.

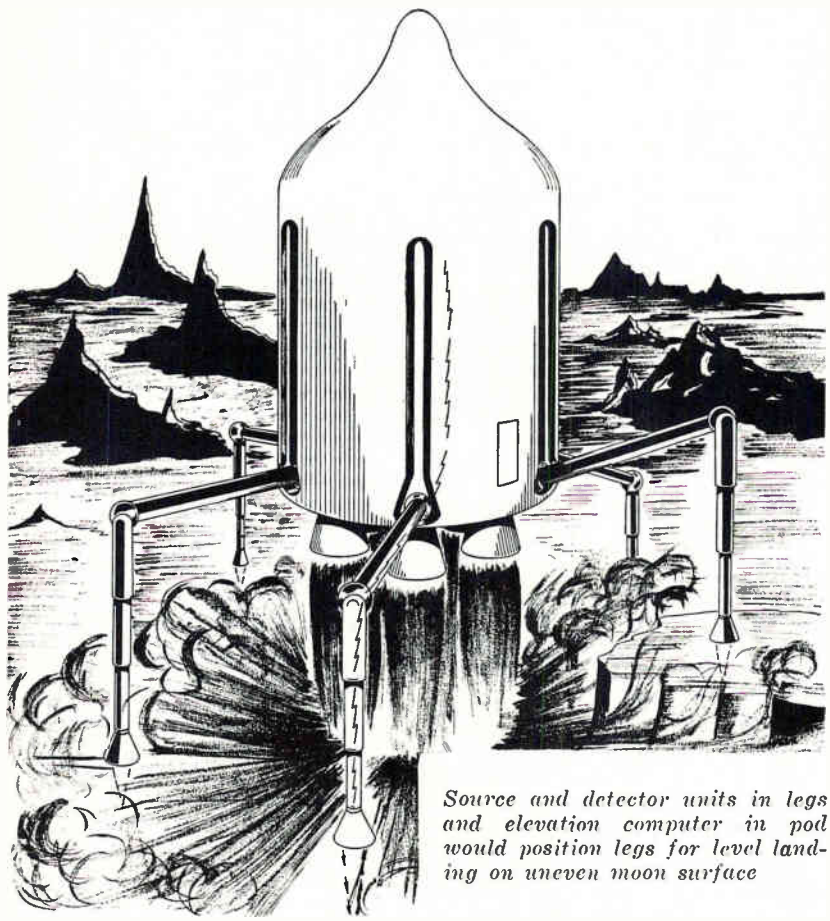
No power is required for the gamma radioisotope source and the detector needs less than 2 watts. Giannini points out that this is much less than power that 30 Gc or higher-frequency doppler radar packages need to attain comparable accuracies.

Simple digital electronics are used throughout. Altitude readout is a digital counter calibrated in feet or an analog scale, as desired. Cost of the entire system when in production will be about $3,000.

The block diagram shows the basic system used for either the scintillator or the solid-state configuration. In the former, a sodium

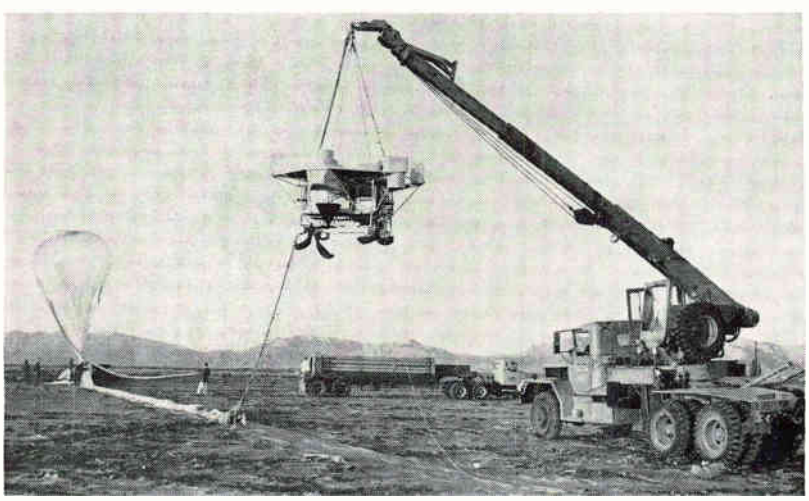


Reflections are sensed by multiplier phototube in scintillator system or by p-n junction in solid-state version



Source and detector units in legs and elevation computer in pod would position legs for level landing on uneven moon surface

Recent tests in the New Mexico desert measured cosmic ray background for calibration of radioisotope distance measuring devices



Altimeter Uses Radioisotope Backscatter

iodide crystal or plastic scintillator at the face of a photomultiplier tube receives the reflected photons. The signal is amplified and fed through a pulse height discriminator.

In the solid-state version, energy levels of reflected particles are sensed by a back-biased silicon PN junction and the signal is fed to the preamplifier.

Since the gamma source is not a coherent one, reflected photons are received in a Poisson distribution which is passed through scalers in the pulse height discriminator. The distribution sequentially becomes Gaussian and then regular, making accurate, consistent read-outs possible.

Lunar landing is another application anticipated by Giannini. When lunar vehicles soft-land on the moon, it will be of utmost importance to determine their proximity to the surface just before impact, and to achieve level landings. These must be made on unfamiliar terrain and on ground whose profile and supporting ability are unkonwn. In the case of round-trip vehicles, once the craft topples the possibility of a return voyage to earth is highly unlikely.

Developers propose the use of a combination altimeter-densitometer system in each landing leg of the space vehicle. Intelligence received would be fed through two pulse height discriminators and commutated to determine positioning of each leg. Leg positions are adjusted so that one leg does not sink too far into a quicksand-like substance or another land on a higher ledge of ground.

For the densitometer function, a low-energy photon source would be required. The regular 100-millicurie source would be used for sensing distance above ground.

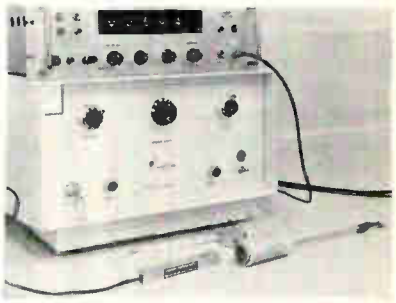
The following formula for the count rate indicates why excellent short distance resolution is possible, since count rate varies inversely with the square of the distance. The count rate, I, received at a detector of area A_D, at a distance R from the ground (or other scattering medium), and a source strength I_o is given by:

$$I = \frac{I_o A_D \eta f}{4 \pi R^2} e^{-(\mu_a/\rho_a)(\rho R)}$$

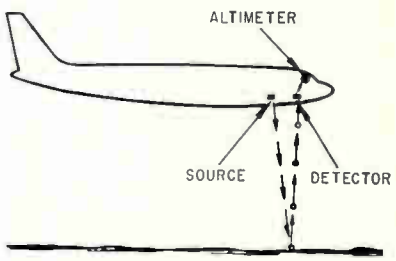
where η is detector efficiency, f is backscatter factor ($\simeq$ 10 percent for Co^{60}), μ_a/ρ_a is absorption coefficient (0.06 cm^2/gm for Co^{60}) and ρ is air density (1.293×10^{-3} gm/cm^3 at sea level).

The company says that maximum practical range of the instrument in its present configuration is 200 feet. Accuracy of the indicator when used for airliner landing approach would not be appreciably effected by slush on the runway, or by a course over water immediately before contacting the runway, the company adds.

There reportedly is no safety hazard to personnel involved because of the radioactive source. Giannini points out, for example, that in a nonrepeating emergency situation, a person could hold the 100-millicurie source in his hand one foot from his body for 40 hours without injury.



Test for measuring radiation scattering in air. Source is in the cylinder; the solid-state detector and preamplifier drive the scaler



In airplane, altimeter indicates height detected by photon backscatter

Industry to Get AEC Data on Space Power

CLASSIFIED nuclear space power and propulsion system data will be made available to private industry under the Atomic Energy Commission's access permit program for development of peaceful uses of atomic energy. The regulations were amended recently.

Companies meeting security qualifications can obtain restricted data for private business and research uses. Applicants must show that they will contribute to R&D in this field, or are engaged in or preparing a study program for AEC, or are furnishing an access permittee with professional services.

Four new categories of classified information come under the regulation: C-90, nuclear reactors for ramjet propulsion; C-91, reactors for rocket propulsion; C-92, systems for nuclear auxiliary power (Snap), and C-93, advanced concepts for future application.

AEC has been stepping up its research in space power and propulsion (ELECTRONICS, p 107, Nov. 17). Figures for the last two fiscal years are:

	1961 ($ millions)	1960 ($ millions)
POWER SYSTEMS		
radioisotope	2.9	3.1
reactor	14.3	8.4
PROPULSION SYSTEMS		
rocket (Rover-space)	25.1	15.5
ramjet (Pluto-missile)	23.1	16.3

Parts Supply Center Gets Set to Open

DEFENSE ELECTRONICS Supply Center (DESC) will become an operating element of the new Defense Supply Agency on July 1. Location for the center will be Gentile Air Force Station, Ohio. Facilities and resources of nearby Dayton Air Force Depot which already manages much of USAF's electronic supply will also become part of the center.

The Air Force is now installing a new automatic high-speed communications system, known as Comlognet, at the Dayton depot. The system, which will be operational Oct. 1, will interchange traffic with other military teletypewriter and data networks. A transceiver connection to Columbus, Ohio, will link the Air Force facility with Army and Navy communications systems which can thus be tied in with the world-wide USAF transceiver network.

General and special office equipment is on hand or due to be installed to support the center's requirements. Automatic data processing gear includes the Sperry Rand 1105, IBM 650B and Univac 1. Related punch card equipment to support the computers is in place.

DESC is scheduled to employ 3,476 military and civilian personnel by September, 1964. Dayton Air Force Depot will employ 1,999 in support of DESC operations and a Facility Support Unit will require 321 employees. Less than 10 percent will be military.

USAF will assign 414,000 line items to DESC. By Sept., 1964, when it is in full operation, the center will have reviewed 1,020,000 items for management including anticipated item growth. This total will be reduced to approximately 680,000 net items by simplification, standardization and commonality actions.

DOD estimates that DESC will manage an inventory worth about $400 million in fiscal year 1963. This will increase to $500 million in 1964. Annual procurement is expected to reach $143 million in the first year of operations and $198 million the second year. Sales to the military services are estimated at $165 million in 1963 and $220 million in 1964. Receipt and issue transactions at the wholesale level are expected to attain a volume of 5 million the first year and 7 million the second year of operation.

The study made by Maj. Gen. C. B. Root, USAF, with a joint staff participation, that resulted in these actions, noted that requirements for new parts increase 20 percent annually, far outstripping the retirement of "old" components. U. S. Reserve Forces and Military Assistance Program countries continue to generate requirements for "old" parts even when U. S. Forces can retire items from their inventories.

The military services are managing and distributing electronic parts in the U. S. as follows:

Army—The Army Signal Supply Agency, Philadelphia, Pa., and depots at Tobyhanna, Pa.; Sacramento, Calif.; Lexington, Ky.; and off-site warehouses at Fort Worth, Texas, and Atlanta, Ga.

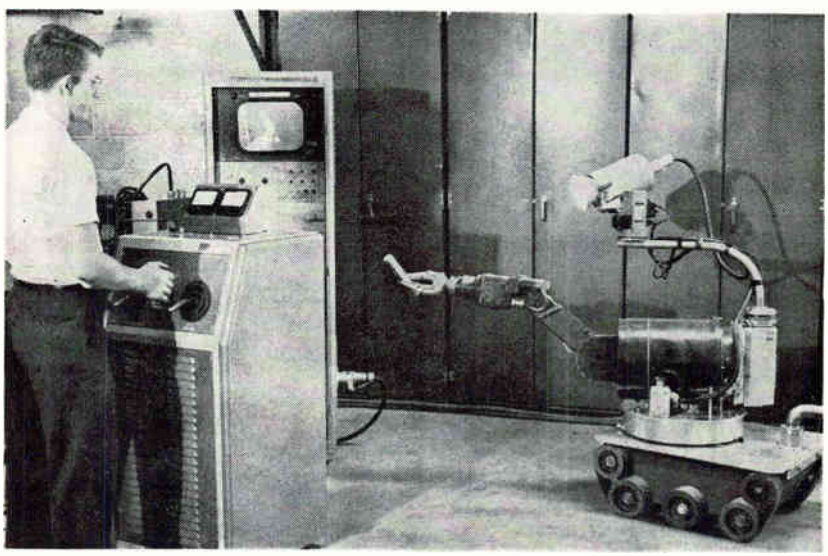
Navy—Electronics Supply Office, Great Lakes, Ill., with depots at Oakland, Calif.; Norfolk, Va., and Bayonne, N. J.

USAF—Gentile Air Force Station, Ohio, and Rome, N. Y.

The military services will jointly establish item management coding for the assignment of items to DESC and the retention of other items for their own management.

The first category of parts scheduled for integration is electron tubes. DESC will manage Federal Stock Group 59 items (electrical and electronic components) and Class 6145 items (wire and cable).

Mechanical Hands—and Feet and Eyes



Remotely-controlled mechanical manipulator with tv camera picks up nuclear fuel element at AEC's Hanford Works. System was set up by General Electric, which manages the facility, to handle chores in hazardous areas

France Will Increase Applied R&D Budget

PARIS—The French government is planning further boosts in applied research expenditures, which have already been doubled in the past three years. Although firm plans have not been announced, it is expected that equipment outlays for nonmilitary research will total some $300 million over the next four years.

For nonmilitary research in

EDP Time Clock

Completion of an installation on a F-104 at Lockheed is reported by supervisor who inserts his badge and punched card in a remote Edge (Electronic Data Gathering Equipment) system reporter. Lockheed is installing 400 of these, plus central computers, to automate production management. RCA designed the system

1962, $91.5 million has been allocated for operating expenses and $31.5 million for new equipment. Energy conversion and oceanography will get major shares.

France's space effort is tagged at $17 million for 1962. About half the money will be used to contribute to a program aimed at getting a French satellite aloft by 1964 or 1965. An American-built launch vehicle would be used. Remaining funds will finance France's share of the European cooperative space project.

Continuing the practice established over the past three years, a single director aided by a 12-man scientific cabinet will direct the research efforts of more than a dozen ministries. The cabinet will be made up of men from government and industry.

To spur private research, the government is planning additional tax inducements. Benefits will include stepped up depreciation write-offs for research equipment and facilities, tax offset for financial participation in government-approved research centers, and exemptions from income taxes on profits for contract research organizations, in some special cases.

Compares Cards and Tape

INFORMATION HANDLING system recently developed for F. W. Dodge Corp. simultaneously compares punched cards and magnetic tape to identify subscribers slated to receive construction reports. The machine sorts through subscriber lists at rates over 5,000 addresses a minute—a job formerly done by hand.

Customers' requirements and report material are categorized into over 1,200 definitive units in three major fields of interest. Tape frames identify the subscriber by number and the types of reports he wants. Corresponding holes in a punched card identify the type of report being distributed.

The card is scanned photoelectrically on a drum driven coaxially with the tape reader. When signals from a tape frame and the card match in memory units, the matching signal passes through gates and a pulse amplifier to a counter.

The counter passes the signal on to an indicator lamp at a numbered subscriber box. The counter has two functions: keeping track of which tape frame is being read and switching the signals to the proper lamps. After the tape file has been compared with a report card, clerks distribute copies of the report to the indicated boxes and reset the system.

The same equipment prepares the tape files. Subscriber preferences are punched on a card similar to the report card, the card is scanned and the signals are recorded. The memory is bypassed, but the frame number appearing on the counter is used to identify the subscriber.

The system was developed and built for F. W. Dodge by Shepard Laboratories, Inc., of Summit, N.J., under direction of the inventor, Allen L. Grammer, of Newark, N.J. F. W. Dodge is a subsidiary of McGraw-Hill Publishing Co.

Bar Chart Recorder

Remote recorder made by Electronic Associates, Inc., provides cost and production control information for up to 40 production or data processing machines. Machines can be monitored continuously

Monitors in Eight Cities Will Check Auto Exhausts

SAN FRANCISCO—The second of a proposed eight-link chain of air contaminant monitoring stations was opened here late last month by the U. S. Public Health Service.

Sponsored by the San Francisco Bay Area Air Pollution Control District and USPHS, the monitoring station will automatically sample and analyze the downtown San Francisco atmosphere as part of a Public Health survey to determine effects of auto exhausts on human health in urban areas. Gases to be sampled and studied include sulfur dioxide, nitric oxide, nitrogen dioxide, carbon monoxide, hydrocarbons, ozone, and oxidants.

The instrumentation system is comprised of scintillation counters provided with strip chart recorders and analog-to-digital converters which will automatically tape-punch all data for computer analysis. Instruments were provided by Beckman Instruments.

The San Francisco sampling station will eventually be time standard-calibrated with seven similar stations to be set up in other metropolitan areas. These are Los Angeles, Detroit, Washington, D. C., New Orleans, Philadelphia, Chicago, and Cincinnati. The latter has been operating since November.

just compiled: Selecting The Correct Delay Line

For the Specifying Engineer, selection of the correct delay line is now simplified. A new manual from Shallcross concisely covers: Characteristics, Specifications, Applications and Special Features of all delay lines in both the Electromagnetic and Sonic Groups. Also included: Testing Procedures, Determination of Size, Reducing Delay Line Costs, and new Standard Definitions and Terminology. This new booklet is the product of Shallcross' long experience in the design, engineering and manufacture of custom-built delay lines for critical applications. If you're a Specifying Engineer, you'll want your own personal copy. It's yours for the asking. Just check the reader service card or write: Shallcross Manufacturing Company, Selma, North Carolina.

INSTRUMENTS • RESISTORS • SWITCHES • ATTENUATORS • DELAY LINES

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MEETINGS AHEAD

ELECTRICAL ENGINEERING Exposition for Electrical-Electronics Industry, AIEE; N.Y. Coliseum, N.Y.C., **Jan. 29-Feb. 2.**

REDUNDANCY TECHNIQUES FOR COMPUTING SYSTEMS, Office of Naval Research; Dept. of Interior Aud., Wash., D. C., **Feb. 6-7.**

MILITARY ELECTRONICS, PGMIL of IRE; Ambassador Hotel, Los Angeles, **Feb. 7-9.**

SOLID STATE CIRCUITS, Internat. Conf., PGCT of IRE, AIEE; Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa., **Feb. 14-16.**

APPLICATION OF SWITCHING THEORY TO SPACE TECHNOLOGY Symp., USAF, Lockheed Missiles and Space; at Lockheed, Sunnyvale, Calif., **Feb. 27-Mar. 1.**

SCINTILLATION AND SEMICONDUCTOR Counter Symp., PGNS of IRE, AIEE, AEC, NBS; Shoreham Hotel, Washington, D. C., **Mar. 1-3.**

MISSILES & ROCKET TESTING Symp., Armed Forces Communications & Electronics Association; Coca Beach, Fla., **Mar. 6-8.**

EXTRA-HIGH VOLTAGE COMMUNICATION, CONTROL & RELAYING, AIEE; Baker Hotel, Dallas, Tex., **Mar. 14-16.**

IRE INTERNATIONAL CONVENTION, Coliseum & Waldorf Astoria Hotel, New York City, **Mar. 26-29.**

QUALITY CONTROL Clinic, Rochester Soc of Q.C.; U. of Rochester, Rochester, N. Y., **Mar. 27.**

ENGINEERING ASPECTS OF MAGNETO-HYDRODYNAMICS, AIEE, IAS, IRE, University of Rochester, Rochester, N. Y., **Mar. 28-29.**

SOUTHWEST IRE CONFERENCE AND SHOW; Rice Hotel, Houston, Texas, **April 11-13.**

JOINT COMPUTER CONFERENCE, PGEC of IRE, AIEE, ACM; Fairmont Hotel, San Francisco, Calif., **May 1-3.**

HUMAN FACTORS in Electronics, PGHFE of IRE; Los Angeles, Calif., **May 3-4.**

ELECTRONIC COMPONENTS Conference, PGCF of IRE, AIEE, EIA; Marriott Twin Bridges Hotel, Washington, D. C., **May 8-10.**

NATIONAL AEROSPACE Electronics Conference, PGANE of IRE; Biltmore Hotel, Dayton, Ohio, **May 14-16.**

ADVANCE REPORT

BROADCAST & TELEVISION RECEIVERS *Spring Conf., PGBTR of IRE: at O'Hare Inn, Chicago, June 18-19. Papers particularly sought on new products and new concepts of component and circuit design. Deadline for papers is February 15, but authors should submit 50-100 word summaries at their earliest convenience to: Mr. Al Cotsworth, Zenith Radio Corporation, 6001 W. Dickens Ave, Chicago 39, Illinois.*

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You will find more information on the back of this page and a convenient, confidential Professional Placement Inquiry. A prompt reply to your inquiry will be forthcoming from Mr. R. M. Smith, Manager of Industrial Relations Administration-Engineering, Dept. 130-90, General Dynamics|Astronautics, 5720 Kearny Villa Road, San Diego, California.

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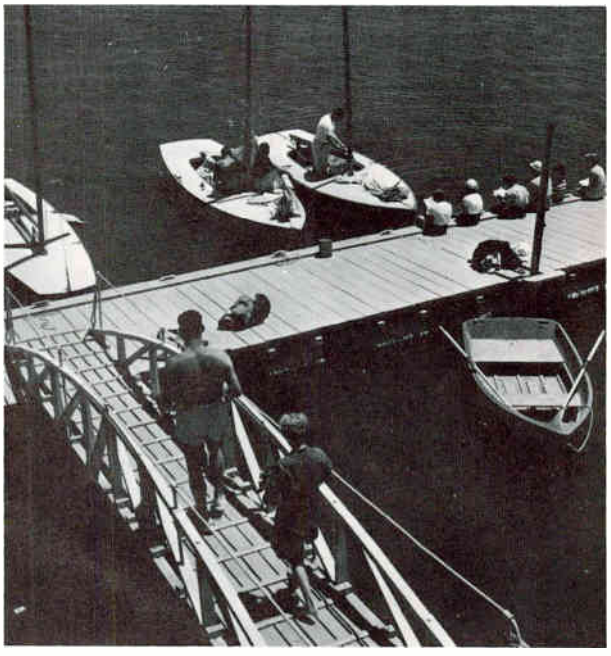

In addition to the positions described on the other side, openings also exist in these and other specialties:

Technical Writing • Field Engineering • R. F. Systems • Technical Instruction • Human Factors • Landlines • Launch Control Systems • Closed Loop TV Systems • Telemetering • Ground Support Equipment • Autopilot • Guidance • Systems Checkout.

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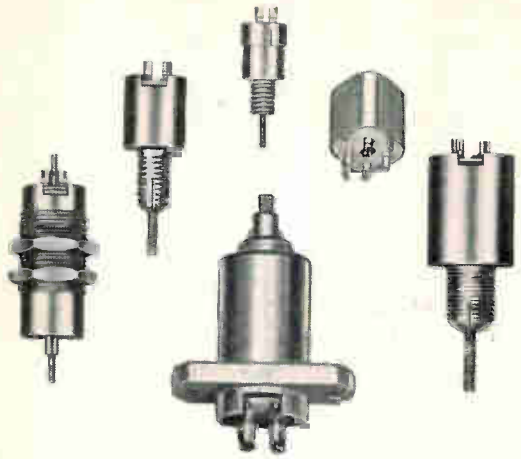

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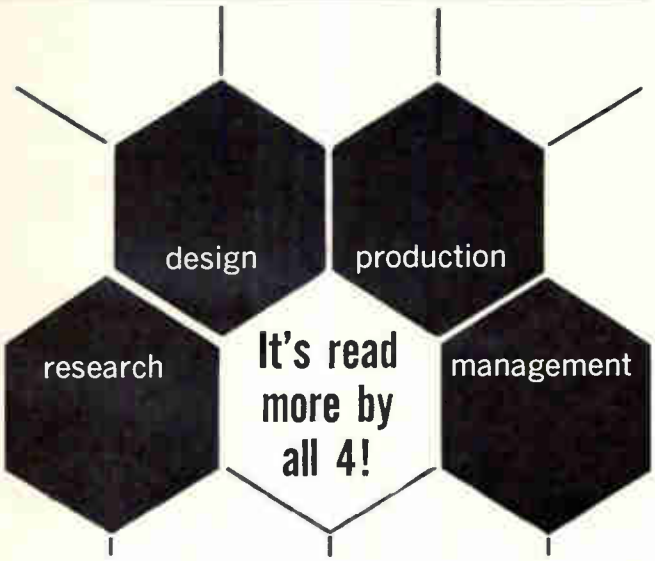

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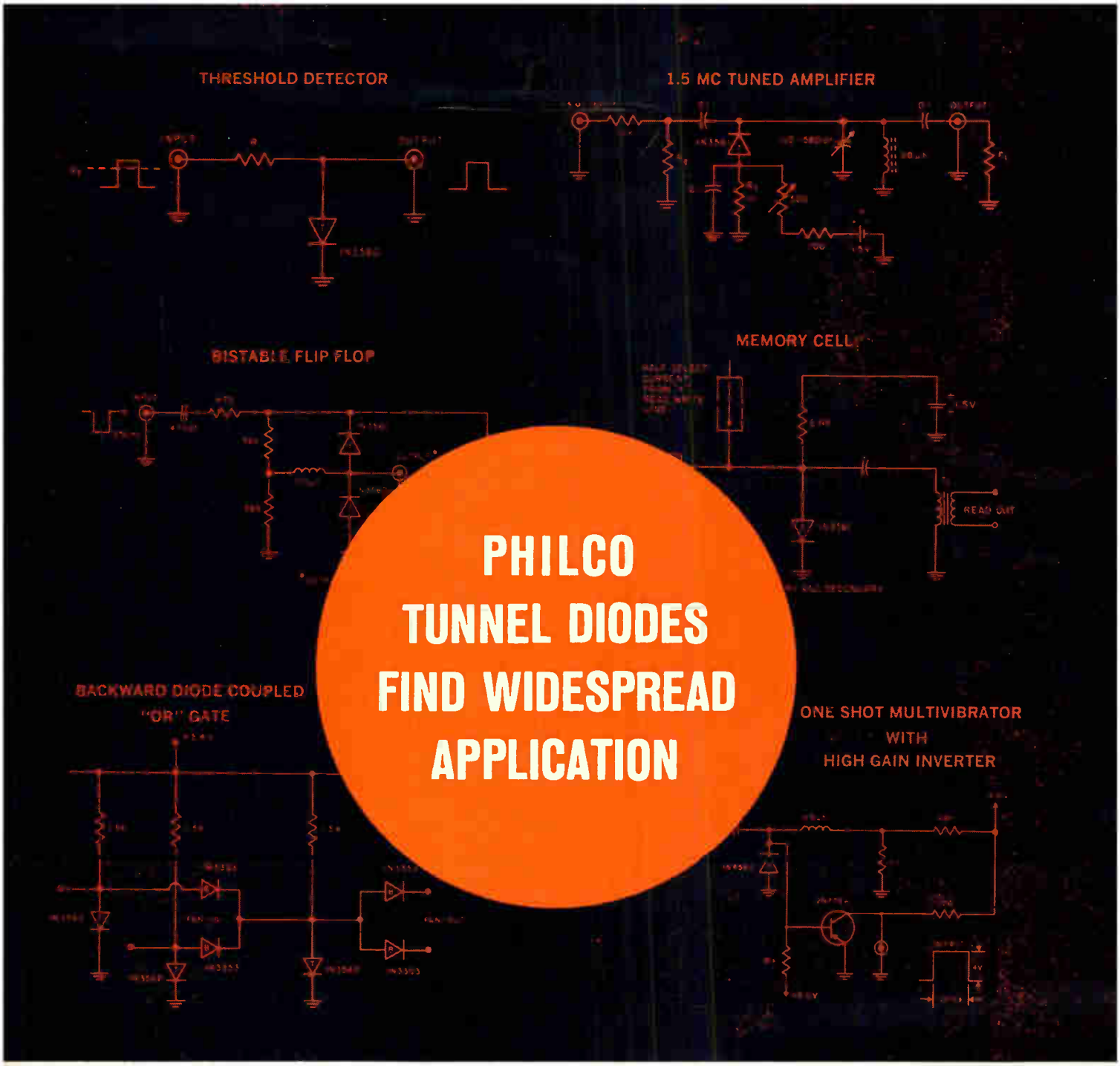

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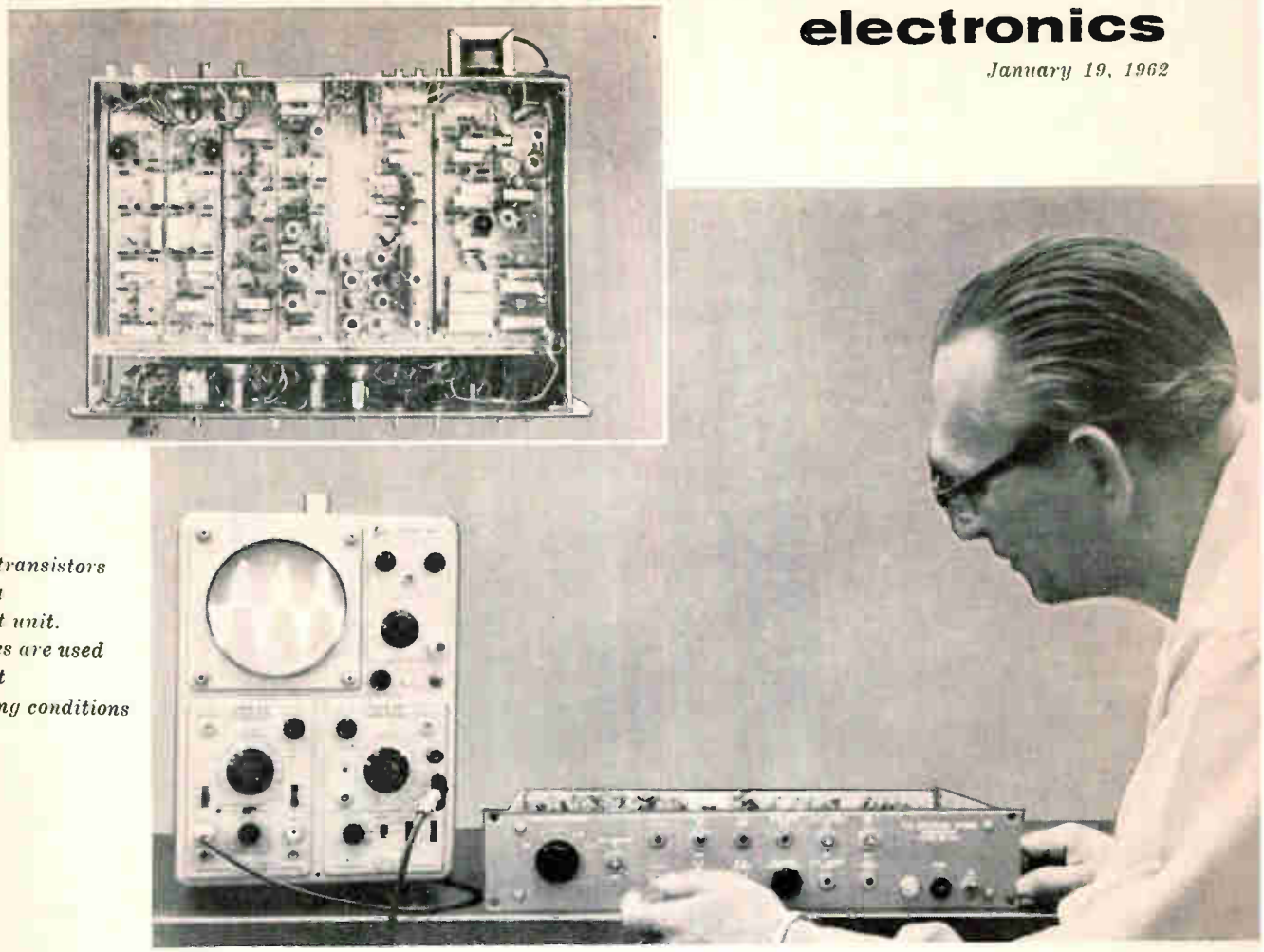


Use of transistors makes a compact unit. Switches are used to select operating conditions

STEREO F-M MULTIPLEX Alignment Signal Generator

Transistor unit generates complete FCC approved stereophonic multiplex signal for receiver and stereo adapter design, testing and alignment

By STANLEY FELDMAN, Test Equipment Engineering, Consumer Products, Motorola, Inc., Chicago, Illinois

STEREOPHONIC MULTIPLEX SIGNAL as finally accepted by the FCC can be written $(E_L + E_R) + (E_L - E_R) \sin \omega t + K_1 \sin (\omega t/2) + e_{sc}$ where $(E_L + E_R)$ represents the sum of the left and right input audio signals; $(E_L - E_R) \sin \omega t$ is a suppressed-carrier double-sideband signal, or the product of the difference of the left and right signal and a 38 Kc carrier; $K_1 \sin (\omega t/2)$ is a reference 19 Kc subcarrier used in the receiver to synchronize the local oscillator for separation of the left and right information; and e_{sc} is a background f-m signal whose carrier is approximately 67 Kc. According to FCC specifications, it should be possible to transmit this background signal simultaneously with the stereo multiplex signal with the minimum of crosstalk, and is included in this generator primarily for making this check in testing receivers and adapters.

The system used in the multiplex generator is shown in Fig. 1. The right channel input feeds a phase inverter to obtain $+R$ and $-R$ signals for matrixing. The left channel input feeds an emitter follower which supplies $+L$ to the matrix. Both $(L + R)$ and $(L - R)$ can be obtained from matrix

by resistor adding.

The $(L + R)$ signal feeds a feedback amplifier whose gain is determined principally by the ratio of feedback resistor and input R-C network. Adjustment of C in the input makes it possible to precisely set the preemphasis characteristics. The output of the $(L + R)$ amplifier feeds an L-C network which delays the $(L + R)$ signal to compensate for the envelope delay in the suppressed-carrier signal.

The $(L - R)$ signal goes through an identical amplifier and feeds the suppressed-carrier modulator section. The $(L + R)$ signal, the suppressed carrier signal, and the 19 Kc reference carrier are resistively added and passed through a low-pass filter, which is flat to 53 Kc. Frequency components of the suppressed-carrier signal above 53 Kc are undesirable and attenuated by this filter. The output of the filter is resistively added to the SCA background f-m signal and fed into the output amplifier.

The technique used for generating the suppressed-carrier signal is shown in Fig. 2. The 38 Kc signal is fed to Schmitt trigger Q_1 and Q_2 which furnishes 38 Kc square waves of 0 and 180 degrees phase. These square waves gate transistors Q_3 and Q_4 ON and OFF. The collector supply voltages for Q_3 and Q_4 are emitter followers Q_2 and Q_5, which furnish d-c voltages with superimposed $(L - R)$ audio signal. The $(L - R)$ signal out of Q_2 can be considered + phase and the $(L - R)$ signal out of Q_5 is 180 degrees out of phase with Q_2. The output of the two gates is summed at the input to Q_4 and results in a suppressed square-wave carrier signal. Using Fourier series to describe the circuit, the output of Q_3 can be written:

$$e_3 = [E_{dc2} + (L - R)]\left[\tfrac{1}{2} + \frac{2}{\pi}\sin \omega t + \frac{2}{3\pi}\sin 3\,\omega t \ldots\right]$$

The output of Q_4 would be:

$$e_5 = [E_{dc1} - (L - R)]\left[\tfrac{1}{2} - \frac{2}{\pi}\sin \omega t - \frac{2}{3\pi}\sin 3\,\omega t \ldots\right]$$

Addition of the two collector waveforms give:

$$e_3 + e_5 = \frac{E_{dc2} + E_{dc1}}{2} + 4\frac{(L - R)}{\pi}\sin \omega t + \frac{4}{3\pi}(L - R)\sin 3\,\omega t$$

$$+ [E_{dc2} - E_{dc1}]\left[\frac{2}{\pi}\sin \omega t + \frac{2}{3\pi}\sin 3\,\omega t \ldots\right]$$

Making E_{dc2} equal to E_{dc1} by adjustment of the bias of Q_2, and passing the above through a capacitor to eliminate the d-c component results in:

$$(e_3 + e_5) = \frac{4}{\pi}(L - R)\sin \omega t + \frac{4}{3\pi}(L - R)\sin 3\,\omega t \ldots$$

Passing this through a low-pass filter to eliminate the 3rd harmonic and higher-frequency components results in the suppressed carrier signal. $K\ (L - R)\sin \omega t$.

This technique resulted in a highly-stable and linear-suppressed-carrier generator. The 38 Kc carrier can be suppressed approximately 60 db below maximum signal level over short intervals, and will maintain approximately 46 db rejection over days of operation.

Generation of the SCA signal is accomplished by bias modulating a symmetrical stable multivibrator and passing the frequency modulated square wave through a band-pass filter which is flat from 59 to 73 Kc.

Switches are used to select any desired operating conditions. It is possible to generate $L + R$ or $L - R$ separately with or without pre-emphasis, the SCA subcarrier can be inserted or removed and other necessary alignment circuits have variable controls.

The unit is made up of four printed circuit boards which occupy the main area of the chassis. The power supply consists of two simple zener diode regulated supplies +10 v and −10 v, and uses approximately 15 watts of line power.

The author acknowledges Dominick Wisniewski for his assistance.

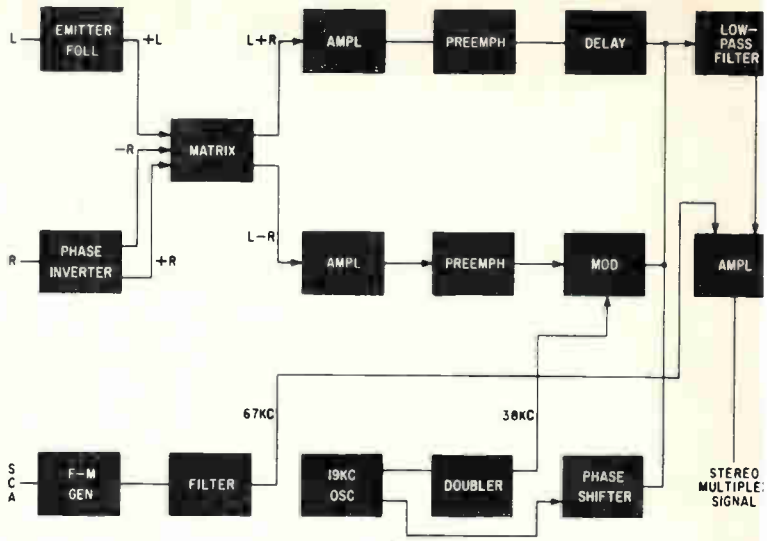


FIG. 1—Low-pass filter in stereo circuit cuts off at 53 Kc; SCA 67-Kc signal is passed through a bandpass filter flat between 59 and 73 Kc

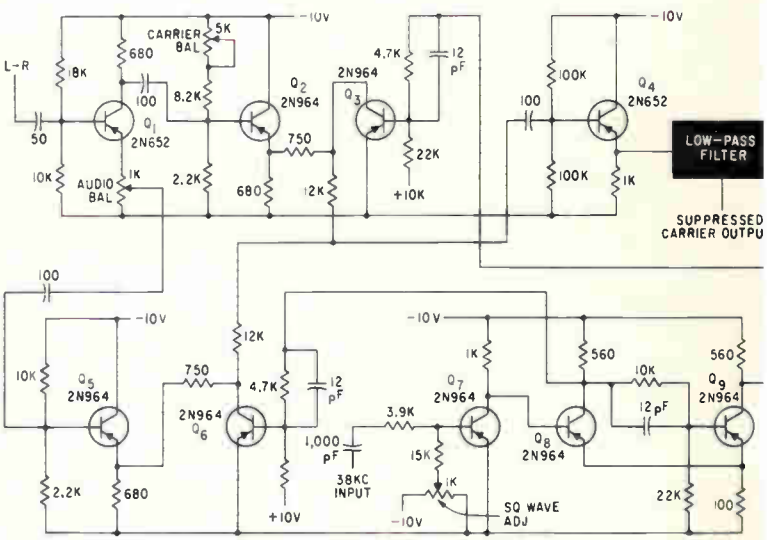
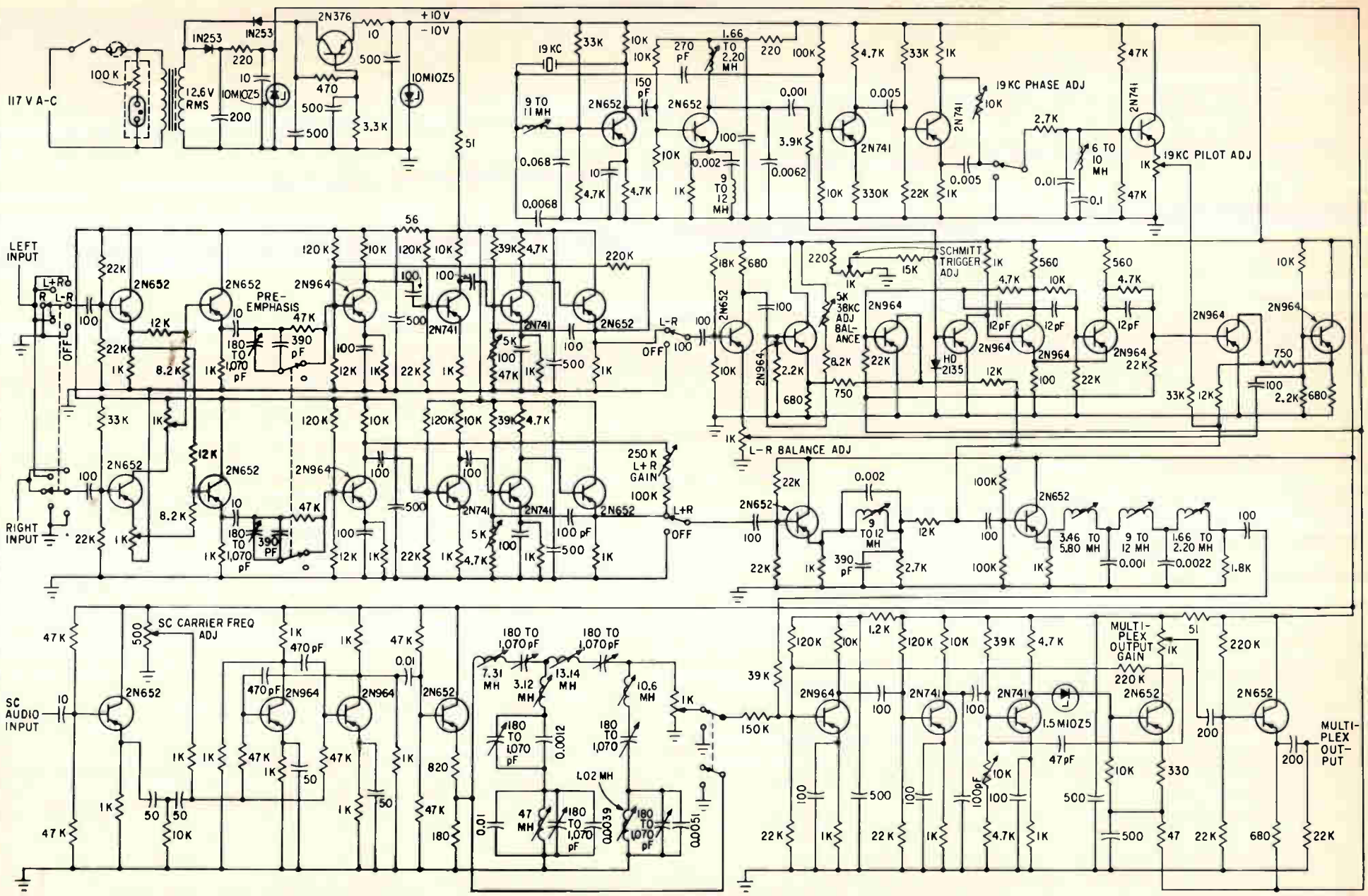


FIG. 2—Suppressed-carrier circuit of stereo signal generator. Output is 38 Kc modulated by L-R signal. Carrier frequency is suppressed



Complete stereo multiplex signal generator used for testing and alignment of receivers and multiplex adapters

MICROWAVE RELAY

Designing With Traveling-Wave Tubes

High-power microwave amplifiers, horn antennas, frequency-shifting plan provide high capacity, reliable communications system

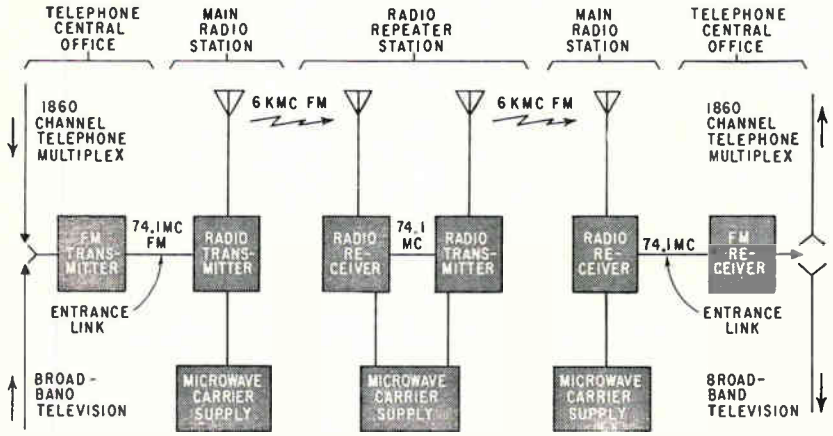


FIG. 1—Terminal stations and a typical repeater station in microwave communications network

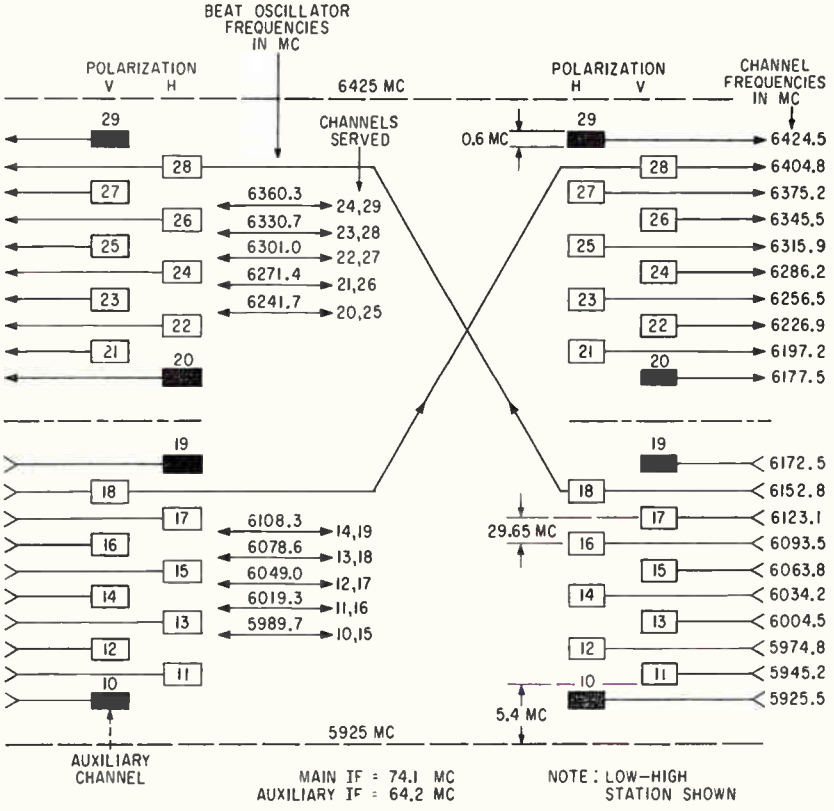


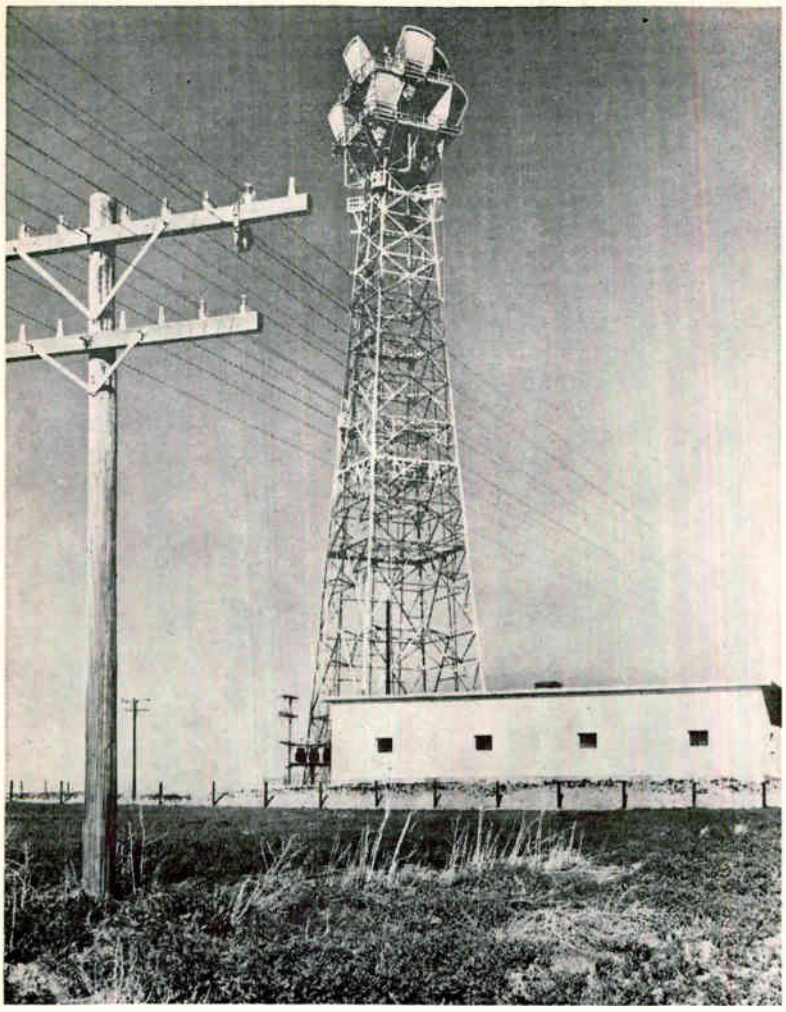
FIG. 2—Frequency plan for the system. Signal received on channel 18 (6,152.8 Mc) is retransmitted on channel 28 (6,404.8 Mc)

NEW LONG-HAUL microwave system combines a number of advances in communications system design developed at Bell Laboratories in recent years. The TH system has been developed to provide eight 10-Mc wide-band and two 0.6-Mc narrow-band channels for telephone and television transmission.

Designed to supplement the present transcontinental TD-2 system which operates in the 4-Gc band, the TH system operates in the 5,925 to 6,425 Mc band. Six of the eight wide-band channels are in use at all times. The other two are kept as standby. Each wideband channel can handle up to 1,860 telephone circuits or one television channel plus 420 voice circuits. The two narrow-band channels are in the guard band between the broadband transmitters and receivers and also at the edge of the band. These two channels provide circuits for transmission of alarm signals from unattended stations, switching signals in case of failure of a regular circuit and for voice circuits between station operators.

Figure 1 shows the entire system. Each circuit consists of a broadband f-m transmitter using a traveling-wave tube with an output of 5 watts over the operating range. Receiving equipment consists of a low-noise f-m receiver at each of the eight broadband channels that converts the signal to a 74.1-Mc intermediate frequency. At each repeater station, the signal is not demodulated, but converted into a preassigned transmission frequency that differs from the received frequency by 252 Mc.

The system frequency plan minimizes crosstalk, Fig. 2. The 5,925



Typical relay station in Bell System's TH cross-country microwave network

to 6,425-Mc band is divided in equal parts. At each repeater station, transmitters operating in both directions use one portion of the band, while receivers operating in both directions use the other portion. Frequency assignments are reversed at the next repeater station. When a signal is received, it is converted to the 74.1 Mc i-f, passed to the transmitter and converted to a microwave frequency that is the received frequency plus or minus 252 Mc. If the signal is received on the lower portion of the 6-Gc band, the transmitted signal will leave the repeater at that frequency plus 252 Mc. A shift to the lower portion of the band is performed if the signal is received in the top half. This 252-Mc shift is common to all signals, and minimizes coupling between antennas pointed in the same direction.

The system has been improved over the TD-2 system only where an improvement was indicated by past experience.[1] Where the TD-2 approach was best, the design was not changed.

Among the first of the design improvements was the development of the horn reflector antenna, Fig. 3. The most important consideration was the possibility of simultaneous use of the antenna for the TD-2 system and the TH system as well as a proposed TJ (11 Gc) system. This antenna uses a circular waveguide feed that permits it to transmit cross-polarized signals in all these bands. Antennas with vertically polarized channels are placed next to antennas carrying horizontally polarized channels. Tests show that an adjacent channel signal is attenuated about 25 db in the entire system.

Three types of repeater systems are available to the communications system designer. In the first, the r-f signal is demodulated and amplified, and this baseband signal modulates the transmitter for retransmission. A second system is the r-f to r-f repeater in which the signal frequency is not changed except to switch channels. Bell Laboratories' engineers chose a third system for use in the TH links. Here the signal is converted to an i-f frequency at the receiver and passed on to the transmitter modulator. Use of this frequency permits a common interconnection between parts of the system. There is also greater ease in separating and switching channels.

Past experience with other microwave systems has indicated that an i-f of about 70 Mc is a good compromise in the amplifier design between the vacuum-tube input conductance and broadband coupling network design.[1] The frequency chosen, 74.1 Mc, is an odd multiple of channel spacing.

Type of modulation was the subject of wide study.[1] Pulse modulation systems give excellent noise and distortion performance through a series of repeaters, but require large bandwidths. High-index frequency modulation is unsuitable for the same reason because it trades bandwidth for noise performance.

Single-sideband suppressed-carrier transmission, on the other hand, makes efficient use of the spectrum, but requires a high degree of linearity to reduce distortion. Power amplifiers at 6 Gc with the required linearity probably could not be built at the present state of the art.

A compromise was chosen for the TH system. Low-deviation frequency modulation was chosen because it requires a relatively narrow band and will tolerate compression in the amplifiers. Optimum frequency deviation was found to be ±4 Mc peak based on

FIG. 3—Horn antenna handles signals in the 4, 6 and 11 Gc bands simultaneously

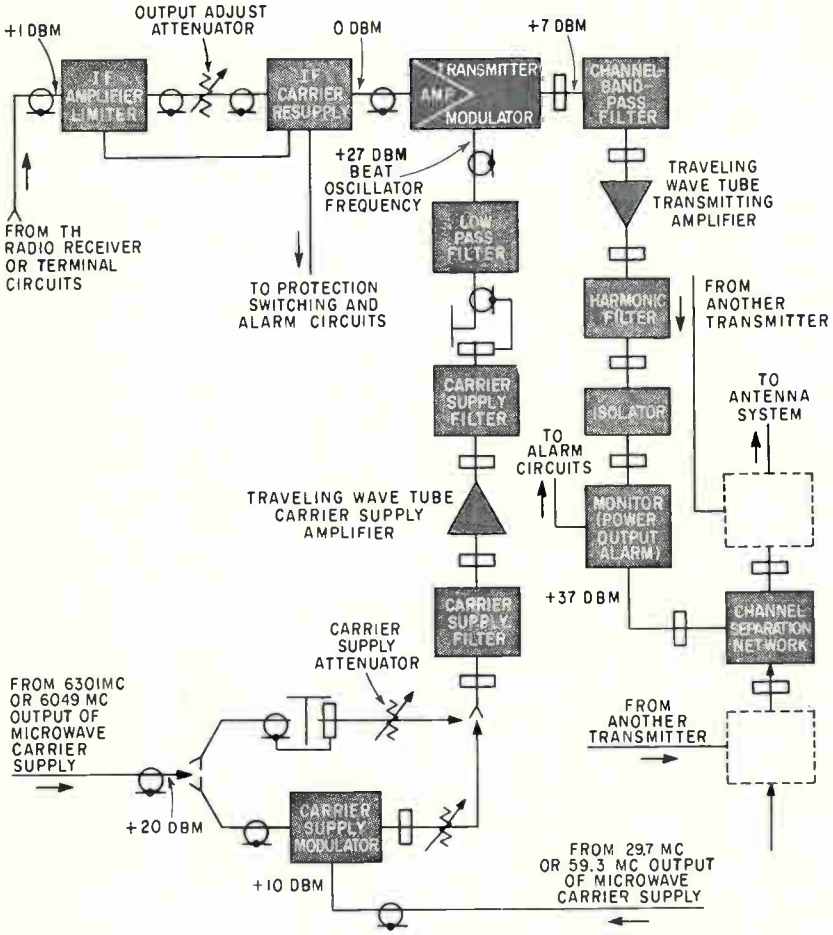


FIG. 4—Two twt amplifiers are used in transmitter. Carrier resupply prevents noise interference caused by carrier loss

the availability of a high-power transmitter tube, the receiver noise figure and system distortion.

To achieve reasonable output, the Western Electric Type 444A traveling-wave tube was adopted for use. This twt has an output of 5 watts in the 6-Gc band. The twt amplifier has a gain of about 32 db. A filter follows the amplifier to attenuate the second harmonic an additional 25 db.

Two twt amplifiers are in each transmitter, Fig. 4. One twt amplifier is in the signal path as an amplifier, and another as a carrier supply amplifier.[2] As an amplifier, the gain and frequency response is flat over the entire band. To minimize the noise contribution of the twt amplifier to the system, the amplifier gain is held to between 30 and 35 db. Tube gain is reduced by lowering the helix voltage.

Carrier supply amplifier output is about 0.5 watt. Allowable gain is determined by noise. The carrier supply and carrier supply amplifier provide the beat-oscillator frequency for the transmitter modulator. A second twt amplifier at a single frequency seems inefficient, but it saved introducing a second type of microwave amplifier into the system and allowed the use of a common power supply for both.

The power required to focus the tube and for its cooling is held to a minimum to increase reliability of the equipment at unattended locations. The amplifier package allows replacement of the twt with a minimum of down time and adjustment.

Conversion of the 74.1-Mc i-f to microwave frequency is done by a parametric amplifier up-converter used as the transmitter modulator. A Western Electric 427A varactor diode is matched to WR159 waveguide by a diode mount. By displacing the coaxial cable off center in the waveguide, the resistive component of the diode impedance can be matched to the characteristic impedance of the waveguide. This distance is adjustable to compensate for differences in diodes.

Reactance is partially cancelled by a fixed short in the waveguide behind the coaxial extension. Remainder of the reactance can be cancelled by an adjustable short in the coaxial line.

If sufficient negative bias is applied to it, the 427A diode is capable of giving conversion gain. But because the diode's impedance becomes more frequency sensitive as gain is increased, the diode is operated at low conversion gain. Bias is set at about −1 volt for 0-db gain.

Another design feature is the common microwave carrier supply, Fig. 5. In a fully equipped repeater station, 40 beat oscillator signals are required. To reduce the number of components and increase the reliability of the system, a common beat oscillator supply was designed. Oscillator frequency is 14.82593 Mc which makes channel spacing 29.65 Mc. Since beat oscillator frequencies are to be symmetrical about the center of the band (6,175 Mc), the i-f was chosen to be 74.13 Mc. The frequencies generated in the carrier supply are obtained from the crystal oscillator by multiplication chains and shift modulators. Harmonics are the second, fourth, 408th and 425th. Two vhf signals are provided at 29.65 Mc and 59.30 Mc. Two microwave signals at 6,049 Mc and 6,301 Mc are also provided.

With separate beat oscillator supplies, a failure of one supply would put one channel out of commission. With the common supply, a failure would put the system out of commission. However, a second complete supply is provided with automatic switching.

Should a carrier be lost by fading, the gain of the limiter reaches maximum in a few millimicroseconds, and the gain of the main i-f amplifier reaches maximum in a few microseconds. This action causes saturation of the twt amplifiers with resultant noise spread over a wide band.

To avoid noise interference from carrier loss, a carrier resupply unit is designed into the system. It replaces a lost carrier within 0.1 millisecond. This prevents other repeaters from going to full gain and reduces the limiter gain to attenuate incoming noise.

High-frequency transistors having an h_{fe} cutoff of 750 Mc are used in the oscillator and amplifier stages of the carrier resupply. In the equivalent circuit, Fig. 6, these

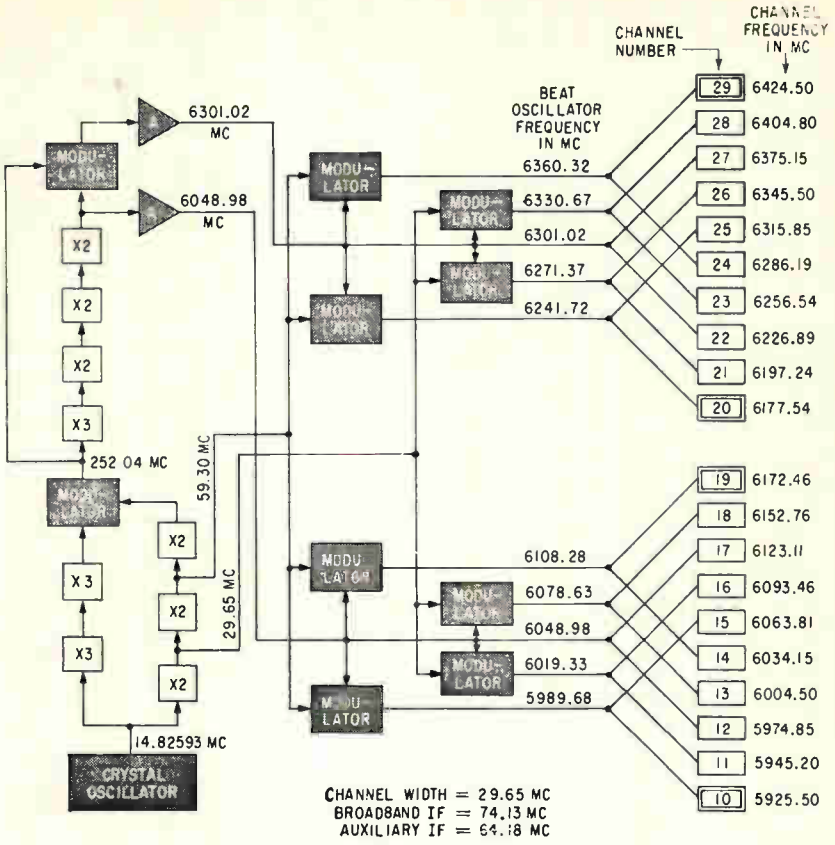


FIG. 5—Beat oscillator frequencies in each station are generated by the single crystal oscillator, lower left

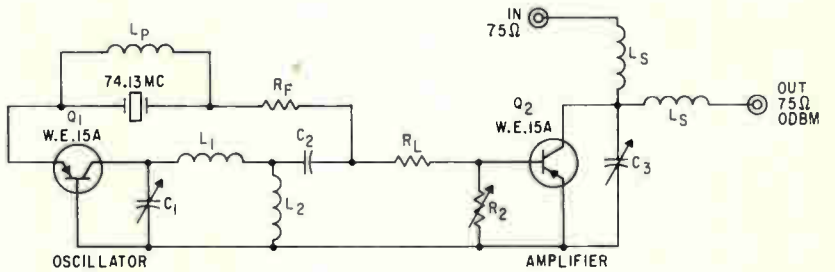


FIG. 6—Carrier resupply i-f oscillator and amplifier replace lost carrier within 0.1 millisecond

transistors, Q_1 and Q_2 are switched from cutoff to their operating point when a carrier is to be supplied. Rapid starting of the crystal oscillator is assured by providing resistor R_F in series with the crystal to lower its Q. The crystal operates in the series resonant mode at 74.1 Mc. Inductor L_P tunes out parallel crystal capacitance.

Circuit C_1, L_1, C_2, L_2 acts as a transformer at 74.1 Mc and provides current gain to maintain oscillation and feed load R_L. The crystal is in the feedback loop of grounded-base transistor Q_1. Transistor Q_2 is a grounded-emitter amplifier with a current gain of about 15 db. A wide-band, low-pass filter, consisting of L_S, C_3, L_S, bridges the collector of Q_2 across a 75-ohm coaxial line. Carrier power output is adjusted by R_2.

An automatic switching system in the system protects against signal loss from fading and equipment failure.[3] Monitor circuits are also supplied.—L.D.S.

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(3) A. J. Giger and F. K. Low, The Automatic Switching System of TH Radio, *The Bell System Technical Journal*, November 1961.

Receiver Squelch Control Uses Double Superheterodyne

Squelch level in a receiver usually has to be set at a compromise value to cover all operating circumstances. Here squelch level is automatically adjusted to suit incoming signals

By J. M. TEWKSBURY, Bendix Radio Division, Baltimore 4, Md.

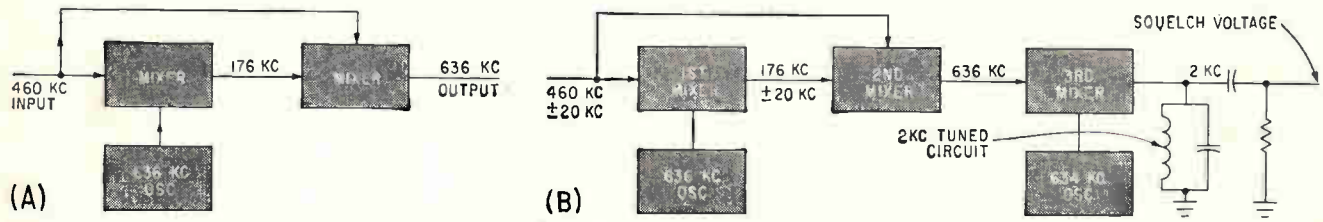


FIG. 1—Double superheterodyne process delivers a 636-Kc output (A); block diagram of actual circuit (B) shows how the 2-Kc squelch-control voltage is developed

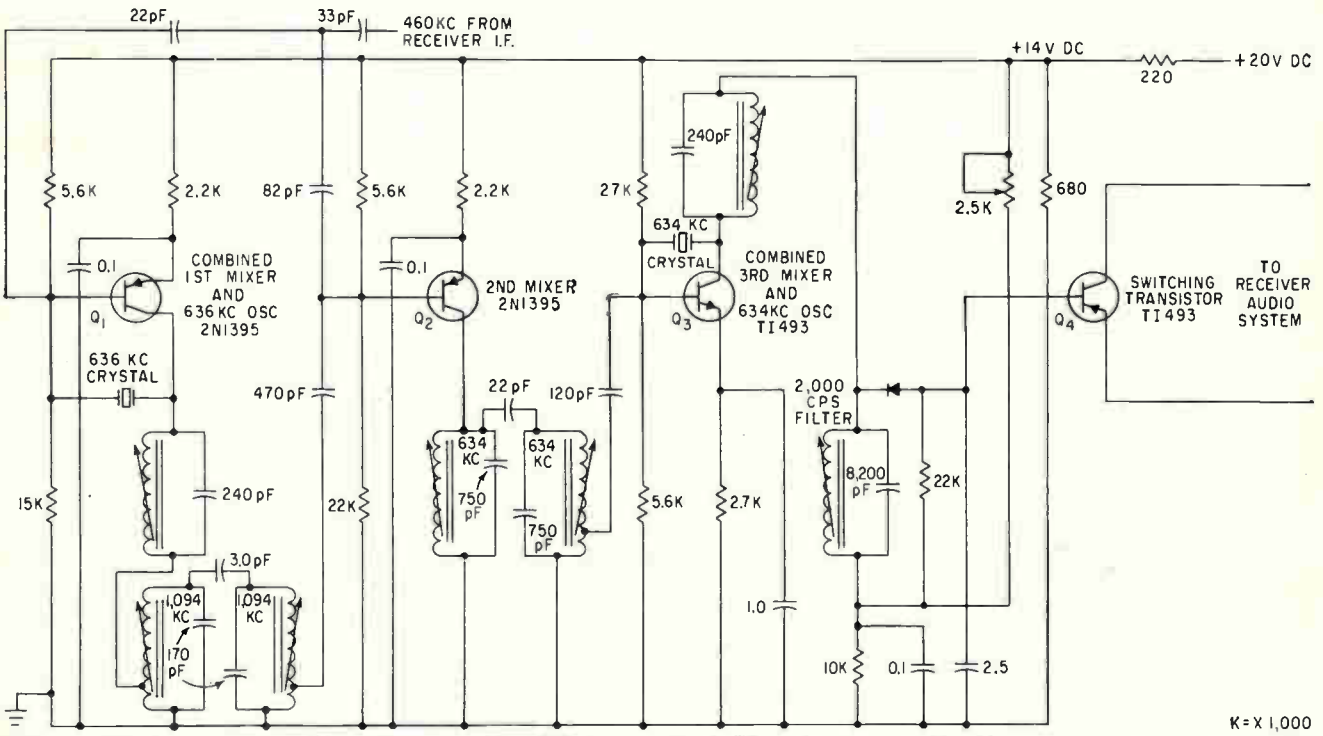
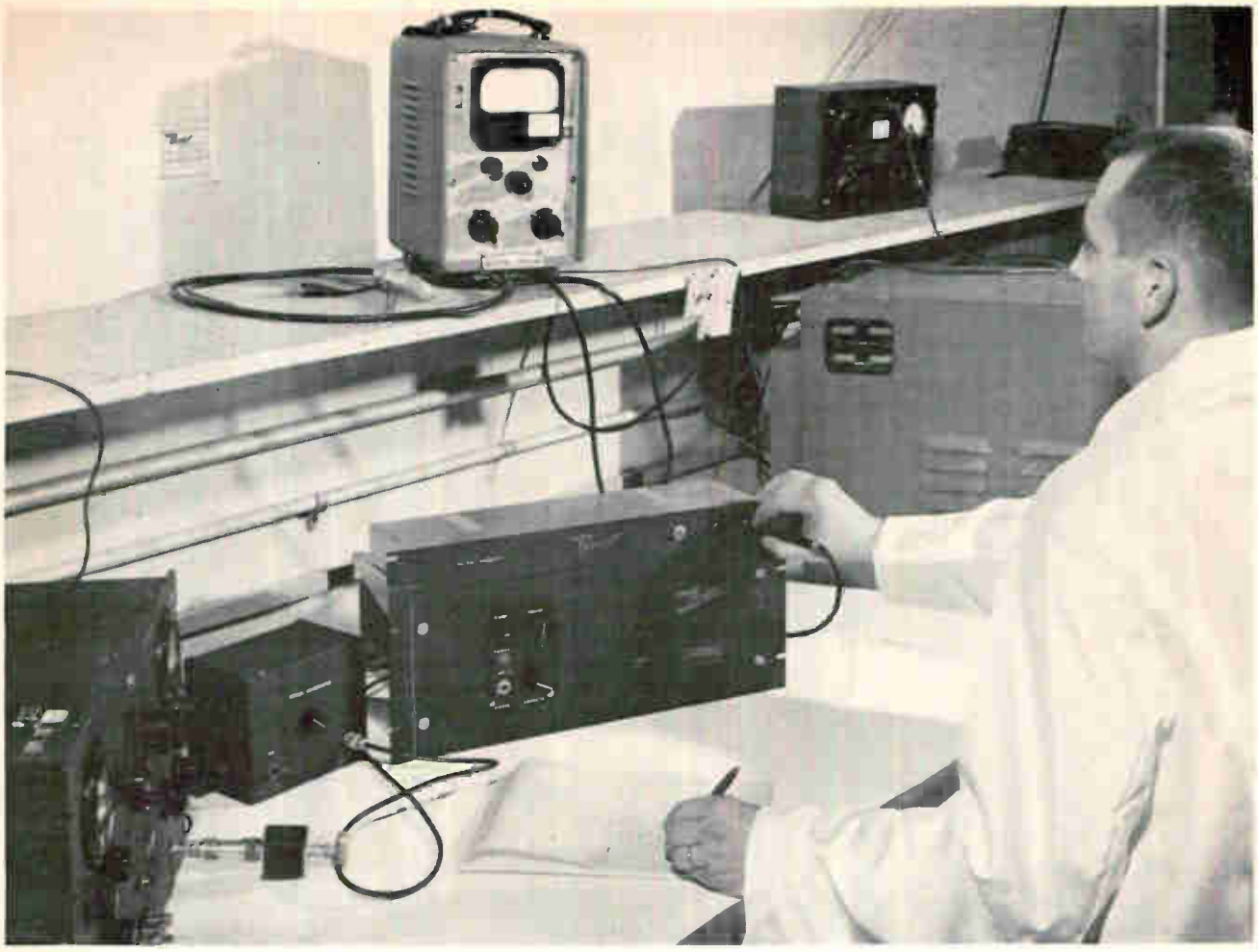


FIG. 2—Mixer stages Q_1 and Q_2 use one transistor for both mixing and generating the local oscillator signal. The final 2-Kc output is rectified for switching the squelch transistor Q_4



Technician Bob Coburn injects noise spikes from a d-c motor directly into receiver antenna to check squelch unit signal-to-noise ratio. Squelch unit (immediately beneath Coburn's hand atop receiver) mutes receiver until carrier signals are received

THE IDEAL SQUELCH CIRCUIT prevents audio output from a receiver during periods when intelligible signals are not being received and thereby relieves the operator of annoyance from atmospherics or man-made static.

Often a number of receivers are operated simultaneously in control towers and communication centers. Malfunction of squelch systems adds to the room ambient noise level at the operating position and impairs operation.

A reliability survey of aircraft electronic equipment indicated that a large percentage of the unscheduled removals of communications receivers were due to squelch problems. Since a plane flies over areas that have varying noise levels, it is difficult to arrive at an optimum squelch setting. When an airborne receiver unsquelches in a noisy area, it is subject to removal at the next stop with the notation: noisy receiver. On the other hand, if the squelch is set at a higher level, there is a chance that the pilot will be unable to hear a weak station. In this case, the receiver may be removed with the complaint: low sensitivity.

This squelch system is carrier operated and detects the presence of the carrier by the double superheterodyne reflex principle.

Because of transmitter frequency tolerances and receiver drift, vhf receivers for network use have a passband that is usually much wider than required to pass the signal.

The double superheterodyne reflex circuit operates so that any signal in the passband will be converted to a single crystal-controlled frequency. This signal frequency is subjected to carrier detection that develops the voltage to unsquelch the receiver.

Figure 1A illustrates the operation of the double superheterodyne reflex circuit. Frequencies are suitable for use with the receivers to which this squelch system was adapted.

A 460-Kc input is mixed with a 636-Kc crystal-controlled oscillator voltage and the difference frequency of 176 Kc is selected and applied to a second mixer. In the second mixer, the 176-Kc signal is combined with the original 460-Kc input to produce an output of 636 Kc.

To illustrate a property of this circuit, assume an input signal of 440 Kc. The first conversion produces 196 Kc, which, when mixed with the input gives an output of 636 Kc.

Likewise, a 480-Kc input signal is first converted to 156 Kc, and this combination will also produce a 636-Kc output. This circuit is connected to the last i-f stage of a communications receiver in which the i-f passband extend from 440 Kc to 480 Kc; any signal in this passband then would be converted

to 636 Kc. The 176-Kc channel must have a bandwidth of at least 40 Kc.

The output of the double superheterodyne reflex circuit is confined to a specific frequency. Since it is known beforehand that the carrier will be at a specific frequency, it is possible to use a stable oscillator for carrier detection.

The block diagram in Fig. 1B illustrates the complete circuit. The 636-Kc output is heterodyned with the voltage delivered by a 634-Kc crystal-controlled oscillator. The 2,000-cycle beat note is filtered and rectified, developing a d-c voltage that activates the audio stages and unsquelches the receiver.

The first experimental version of this squelch system was designed for use with the RG-9C receiver. Equipped with low-noise first stages, this receiver is intended for weak signal areas. Having a noise figure of 4.5 db, the RG-9C shows a signal-to-noise ratio of 6 db at an input of 0.45 microvolt. Consistent squelch openings at carrier levels as low as 0.08 microvolt are possible with the squelch arrangement, and the system is completely impervious to noise.

When extremely high level noise inputs are applied to the receiver, the receiver's avc system tends to maintain a nearly constant level in its last i-f stage. The noise input to the squelch system is thus limited and this prevents the squelch from becoming blocked or saturated, or otherwise inoperative.

The receiver's avc action has a further desirable effect since noise develops an avc voltage that reduces the signal in the last i-f. Consequently, a higher level of signal is then required to open the squelch. Tests with this unit showed that if it were adjusted to open at a given signal-to-noise ratio, this ratio would remain constant in the presence of high noise levels. This is advantageous in voice communications because it insures that squelch openings will occur at a constant level of intelligibility.

An all-transistor version of the squelch circuit is shown in Fig. 2. This device was similar to the all-tube version except that the first conversion was to the sum frequency of 1,096 Kc. The complete unit was mounted on the front panel of the receiver.

The first mixer-oscillator, Q_1 of Fig 2, receives the signal from the last i-f stage of the receiver at an amplitude of about one-half volt. This signal, when mixed with the self-generated 636-Kc signal produces the first conversion frequency that is selected by the tuned circuit in the collector. Output of the first mixer-oscillator is about one volt.

In the second mixer Q_2 the i-f voltage is combined with the signal from the first mixer-oscillator. The second mixer delivers an output of approximately one volt at 636 Kc.

The mixer-oscillator circuit Q_3 beats the incoming 636 Kc from Q_2 with its own internally generated 634-Kc signal to produce a 2,000 cps beat note. A high-Q tuned circuit improves the signal-to-noise ratio and the filtered 2,000 cps tone is then fed to the squelch switching transistor Q_4 that controls the receiver audio system.

In the experiments, the all-transistor squelch unit gave consistent squelch openings at five tenths microvolt input, while the associated receiver had a 6 db signal-to-noise ratio at an input of 2.5 microvolts.

Noise tests were made in the laboratory using a noise generator as shown in Fig. 3A with the d-c motor connected capacitively to the antenna terminal of the receiver. As measured on the avc bus, this noise source produced the equivalent of a 40-microvolt continuous carrier. It is representative of the type of noise in most installations.

All of the squelch units can be adjusted to open on 0.5 microvolt or less, but they still remain closed when subjected to the full output of the noise generator.

In converter circuits of this type there must be a minimum of r-f leakage between stages. Any leakage from the 636-Kc oscillator voltage to the third mixer can cause a continuous 2,000-cycle output even when no input signal is applied. The voltage thus developed can be detrimental to the operation, especially if it happens to be out of phase with the normal 2,000-cycle signal. In applications some residual voltage can be tolerated but it reduces the dynamic range of the squelch system.

An alternate saving of components can be made if the d-c output voltage is derived from a phase detector. The sketch shown in Fig. 3B illustrates the operating principle. The carrier voltage at the output of the second mixer is of the same frequency as the first crystal oscillator. When these two signals are applied to a phase detector, a d-c voltage is developed providing the proper phase relationship has been maintained. This voltage can be integrated over a long period to produce an effective bandwidth that is narrower than the bandwidth obtained by a tuned circuit. The phase detector circuit also has an advantage in that it requires only one crystal.

Using the phase detector the frequency stability of the oscillator is not critical since both channels of the phase detector originate from the same source. A self-excited oscillator can be used. However, the first conversion channel must have a wider bandpass to accommodate the frequency drift of the oscillator.

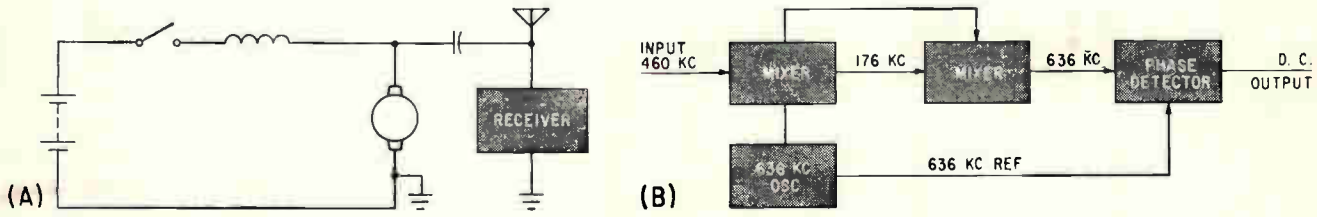


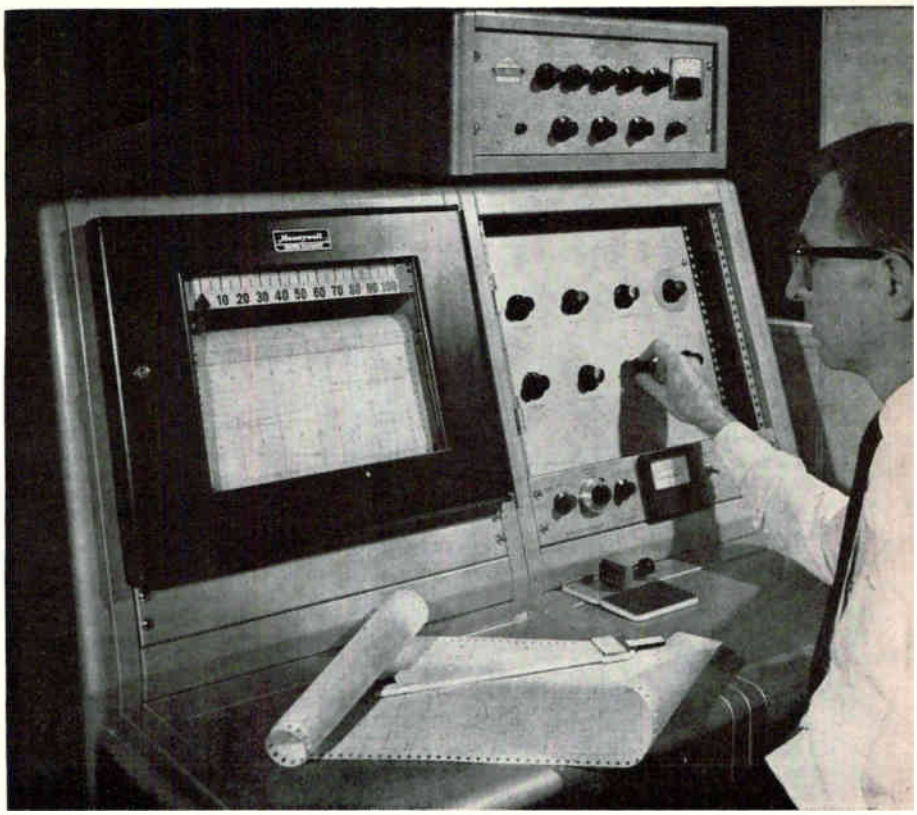
FIG. 3—Direct-current motor generates noise signal for testing receiver (A). Phase detector system (B) saves components in producing the d-c squelch control voltage

MEDICAL ELECTRONICS

PART VII *(Last of a Series)*

Studying Life Processes

Contributions of spectroscopy, radiography and photometry in identifying and measuring characteristics of living matter



Research chemist investigates moisture content of living tissue using Schlumberger's model 106 nuclear magnetic resonance analyzer

By WILLIAM E. BUSHOR,
Senior Associate Editor

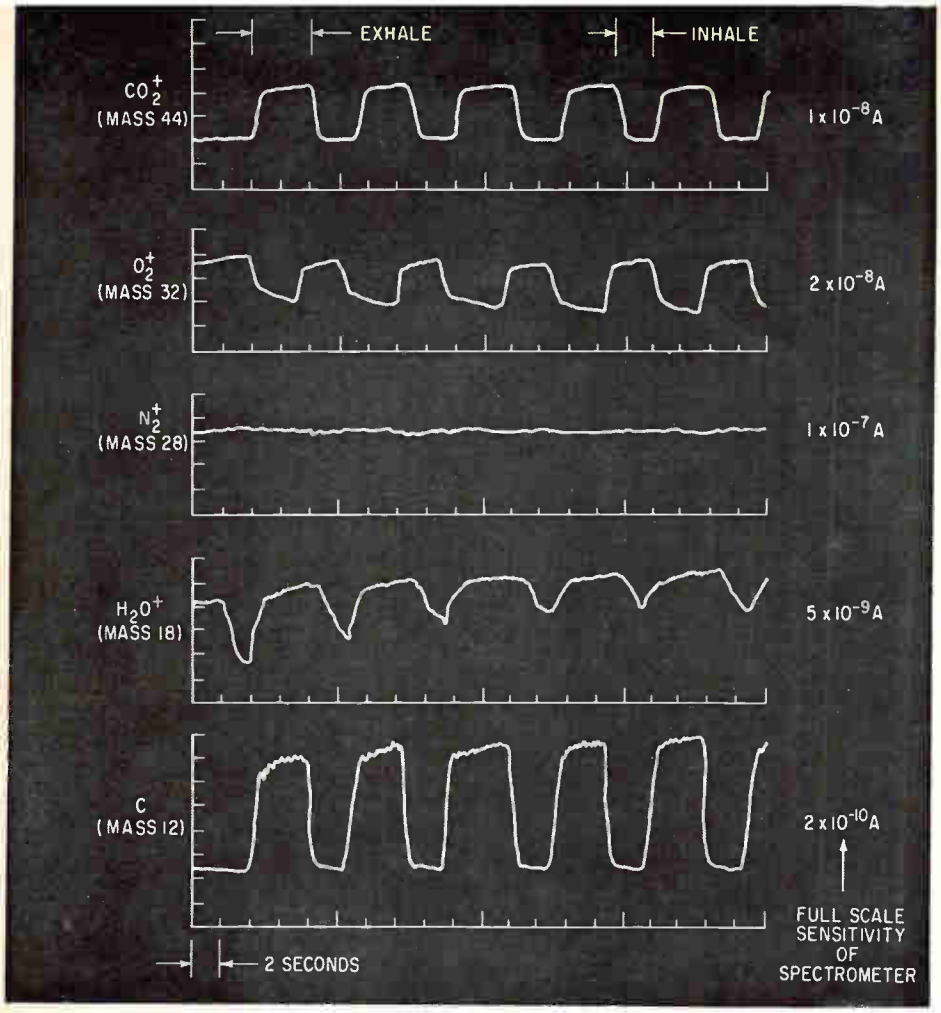
POWERFUL as microscopic techniques are in visualizing life processes (see Part VI), they cannot provide the quantitative identification and evaluation often required. This article will discuss some of the measuring instruments involving electronics which are now at the disposal of medical researchers.

Ultraviolet Spectroscopy—A microspectroscope is a combination of a microscope and a spectroscope on whose screen spectrum lines can be observed. Television augments this conventional measuring instrument through employment of extremely sensitive pickup tubes that operate with minimum amounts of light, and exceed the sensitivity of the eye and photographic film. Using uv light, measurements of the fluorescence from living cells stained with acridine dyes in concentrations considerably less than previously used are possible.[1]

Microspectral fluorescence emission from single cells stained with acridine orange have been recorded on a high-sensitivity tv pickup tube at Western Reserve U.[2] An image orthicon and an intensifier-image orthicon tv camera are used with a high-power monochromator whose exit slit has been removed. The light source is a high-pressure mercury-vapor concentrated arc lamp with colored glass filter. Light passing through the microscope is dispersed by the monochromator and the spectrum focused on the tv pickup tube. Intensity variations with wavelength of the received light are displayed on a line selector and photographed. These images are used to generate curves of the fluorescence emission spectrum. This instrument will permit study of fluorescent carcinogens in living tissue and autofluorescence of living cytoplasm.

Infrared Spectroscopy—Each molecule has a unique ir absorption spectrum that consists of many individual absorption lines. In organic material containing complicated multicompounds, the complete ir spectrum is nearly equivalent to the sum of the spectra of the individual compounds. Thus by recording and cataloging the spectra for the individual pure compounds in various substances, an unknown specimen can be identified and analyzed rapidly using comparative techniques.[3] Ir spectroscopy has been used in medical research to perform analytical research in the structural determination and synthesis of penicillin and cortisone. Studies of naturally occurring biological samples extracted and handled as chemical mixtures such as cholestral in blood and barbiturates, and research on the role of steroids in metabolism also have been done with ir spectroscopic techniques.

Applications of ir microspectroscopy, wherein an achromatic reflecting microscope is combined with an ir monochromator or spectrometer, include determination of the spectra of tissue, living muscle



Breath-by-breath analysis of respiratory gases made with Bendix Research's model 17-210 time-of-flight mass spectrometer. Ionizing electron energy used was 60 volts

fibers, bacteria colonies, antibiotics, vitamins, hormones and serums. Also, microanalysis using this equipment has become a powerful weapon in cancer research.

Mass Spectrometers—These instruments for analysis of gases, liquids and solids can handle a wide range of concentrations accurately and with fast response. They analyze a substance by measuring the mass-to-charge ratio of its components. Different ions are deflected by combined electric and magnetic fields, which then focus each type in a beam on a detecting electrode for measurement (see figure).

A time-of-flight mass spectrometer that provides the rapid response characteristics for pulmonary research has been constructed by Bendix' Research Laboratories.[4] The instrument has a double-grid source that will focus all peaks, regardless of mass, with one setting of instrument operating parameters. Since the time interval during which a mass peak is detected is much shorter than that during which the original ionization took place, the signal-to-noise ratio and resolving power are substantially increased over those previously obtainable. Also featured is a magnetic multiplier ion detector with unusually high gain and wide bandpass characteristics that uses crossed magnetic and electric fields to control ion trajectories.

R-F Spectroscopy—Nuclear magnetic resonance (nmr) and electron paramagnetic resonance (epr) spectrometers provide researchers with accurate and nondestructive analytical tools for studying living matter.

Researchers predict future applications of nmr and epr will include hydration/dehydration studies, measurement of blood flow without opening the vessel, study of free radical formation and destruction in physiological and neurological processes, and detection of certain pathological conditions for diagnostic purposes.[5]

Basis of the nmr approach is that isotopes of elements can be separately identified according to their differing nuclear gyromagnetic constants. All isotopes having an associated spin, or angular momentum, also possess a magnetic moment that acts like a tiny magnet with a well-defined, unique magnetic strength. The gyromagnetic ratio (spin value/magnetic moment value) for a particular atomic nucleus is a constant. Because this ratio differs from one isotope to the next, the nuclei can be separated and identified by studying their nmr spectra.

One of the most important applications of nmr is in the study of the complex chemical substances obtained from plants. Many of these are ultimately used as drugs. Also, high-resolution nmr spectrometers are being used to study chemical groups involved in binding penicillin and stretomycin to serum albumen.[6]

Varian Associates has recently introduced a high-resolution (1 part in 10^8) nmr spectrometer that will produce a permanent, repeatable record of the location and character of hydrogen atoms within a molecule. (ELECTRONICS, p 54, Mar. 24, 1961). This instrument has given nmr spectra data on antibiotics, enzymes, vitamins and insecticides.

Schlumberger reports that their wide-line nmr equipment (see photo) is being used to investigate moisture content of tissues (living and dead), diffusion of moisture in tissue, fat content of animal tissues, structure of proteins with absorbed moisture (living and dead), and enzymatic degradation of meats.

The epr spectrometer uses the magnetic properties of electrons to reveal chemical structure and bonding characteristics. Gyromagnetic ratio or spectroscopic splitting factor (total magnetic moment/spin value) for a particular electron is constant for a given atom and environment. This relationship permits detection of free radicals and the study of their complete kinetics. A number of free radical reactions suggested by chemical experiments has been substantiated including enzymatic oxidation reduction and biological photosynthesis.[7]

Epr's have also been used at

the U. of California to indirectly determine why bacteria that have survived freeze drying retain regenerative capacity after prolonged storage in a vacuum, but lose this capacity when stored in air.[8]

Announcement by Melpar of their epr spectrometer that uses a zero-field maser as an amplifier might give a significant increase in sensitivity of measurement—an achievement that could make it possible for the first time to analyze certain reactions in cancer growth. Called the x-band epr spectrometer, the instrument uses a klystron or maser oscillator as a source of microwave energy. Absorption signals created by the microwave beam passing through the specimen are amplified by a maser amplifier before being fed to a narrow-band phase sensitive lock-in crystal detector. From this point conventional spectrometer equipment is used.

Double resonance techniques in which both nmr and epr are employed have also been used to measure reactions of electrons and atomic nuclei simultaneously.[9]

Neutron Research Activities—Electronics is also helping to study the relationship of magnesium content of blood to the viability of blood in storage. From this experimentation, being conducted at General Dynamics' General Atomic division, may come improved methods for storing blood plasma over longer periods of time than presently possible. Also, it may tell if there is a relationship between magnesium content and the blood's condition.

The process, called neutron activation analysis, begins by exposuring whole blood in the Trica research reactor for a prescribed time. When the radioactive sample is taken from the reactor, its emitted radiations are analyzed electronically according to their energies and the results recorded graphically. This technique can also be used to study diseased cells and tissue such as is present in leukemia and cancer.

Neutron spectroscopy may also be of aid to medical or biological research workers.[10] Of interest is the use of threshold radio activants developed to cover the 1.3 to 9,000 ev energy range. The technique is based on the interaction of either steady state or pulsed neutron beams and nuclei having thresholds below which reactions do not occur. All that is required is measurement of radioactivity.

Autoradiography—Another powerful research tool of comparatively recent vintage is autoradiography—a technique by which investigators make laboratory specimens take pictures of themselves. The procedure is simply to inject a radioisotope into a cell or tissue, place the specimen against a photographic emulsion and develop the film to observe the image created by the radioactivity. Applications of autoradiography abound, including studies of metabolism in individual cells, of malignant lesions, of immunity, and of membrane permeability as well as to localize elements in the biological system. Lifetime activities of living cells can be traced showing details on how much of various substances they take up, to what portion of the cell the substance goes and what happens after the cell divides or dies. Scientists at Brookhaven National Laboratory have traced the life cycles of blood cells to determine how long the various types of cells live in the body.

Photometry—Photometers not only can measure the intensity of light sources, but also the amount of illumination reflected from or passing through a biological specimen. Many of microscopy and spectroscopy techinques employ this type measurement. If a photometer is used with a magnifying system such as an optical microscope, a device capable of giving extremely accurate illumination measurement is evolved called a microphotometer or microdensitometer.

A recording microspectrophotometer for uv absorption measurements of cells has been built by the Karolinska Institute in Sweden.[11] A multiplier-phototube amplifier system together with dynode feedback and measuring circuits detect and record small photocurrents at high signal-to-noise ratios. This instrument permits studies of the kinetics of enzyme reactions within a small part of a single, living cell.

A new uv photometer, built by the Starling Corp., was recently developed by the California Corporation for Biochemical Research (Calbiochem). This instrument, essentially a uv densitometer, lets investigators get a quick reading of optical density changes in blood caused by a rise in enzyme content. Such changes often indicate heart damage, hepatitis and other body disorders, and can be detected by this technique before other symptoms can be observed.

An electronic device for automatically measuring rate of enzyme reaction of a sample in optical density changes has been designed by Astra's Medical Engineering division. The instrument can store one hundred samples, add a reagent to and measure rate of optical density change of each, record this measurement and the sample identifying number on a paper tape, and shut itself off when done.

Studies of oxygen uptake of the lungs are being made by the Dartmouth Medical School with a double-beam photometer.[12] Instead of analyzing this uptake in a man or animal as is most often done, a thin layer of hemoglobin-containing solution is exposed to diffusion of gases and the changes in light transmission recorded.

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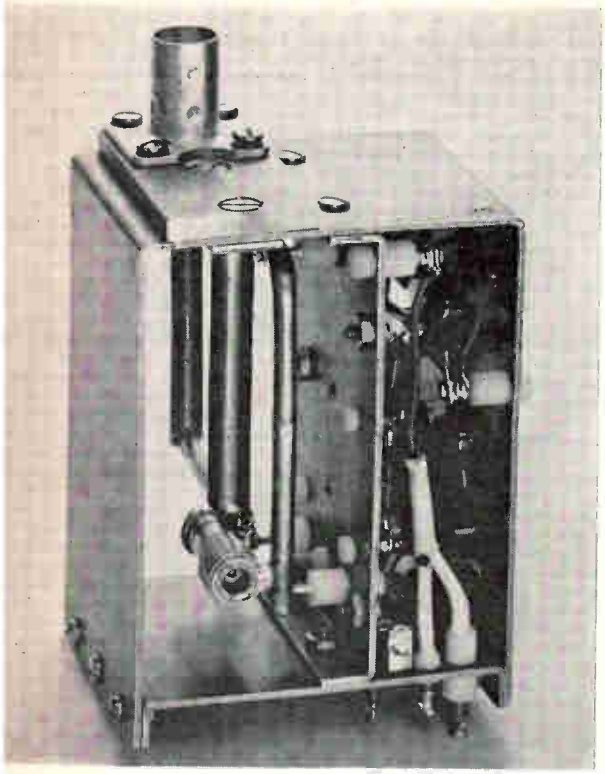
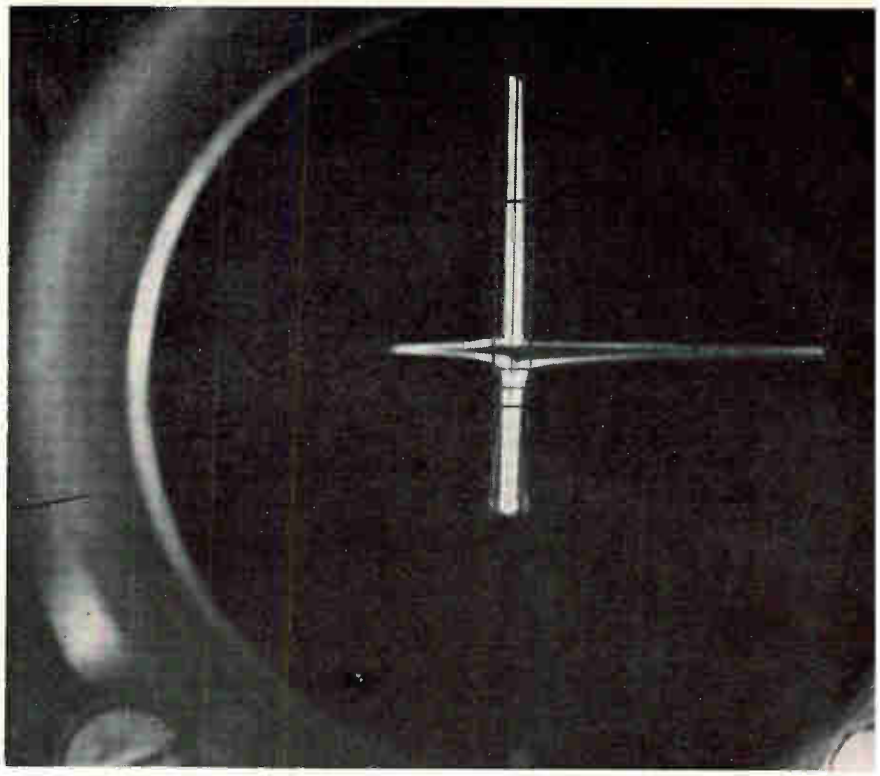


Transmitter was designed to meet missile environmental requirements



Deflection to the right resulting from stronger signal of starboard antenna is corrected by changing aircraft heading

REDESIGNING

Project Mercury Beacons

Rescue beacon provides visual display of encoded pulses that eliminates ambiguity in identification and furnishes directional information. Both recovery time and number of search craft are reduced

By J. G. RICHTER

Manager, Space Communications Dept.
Simonds Precision Products, Inc.,
Tarrytown, N. Y.

RECOVERY beacon system designed for the Mercury space capsule provides positive visual identification and directional information to each search craft. The beacon transmitter successfully used to recover U.S. astronauts provides encoded signals that eliminate confusion even in the presence of other signals at the same frequency.

The Sarah (Search-and-Rescue-and-Homing) equipment has been credited with saving the lives of many aircraft and ship survivors during World War II. Value of the system has continued into the space age, but more demanding requirements have resulted in develop-

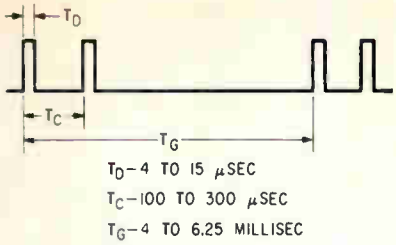


FIG. 1—Duration, pulse spacing and pulse-group spacing are all adjustable to encode beacon transmissions

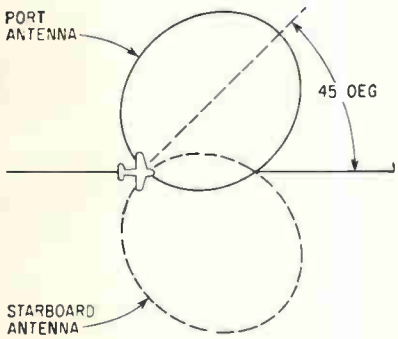


FIG. 2—Lobe switching of two antennas with overlapping patterns provides directional information

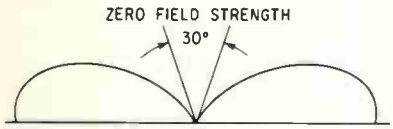


FIG. 3—Absence of display over region of zero field strength enables aircraft to pinpoint beacon

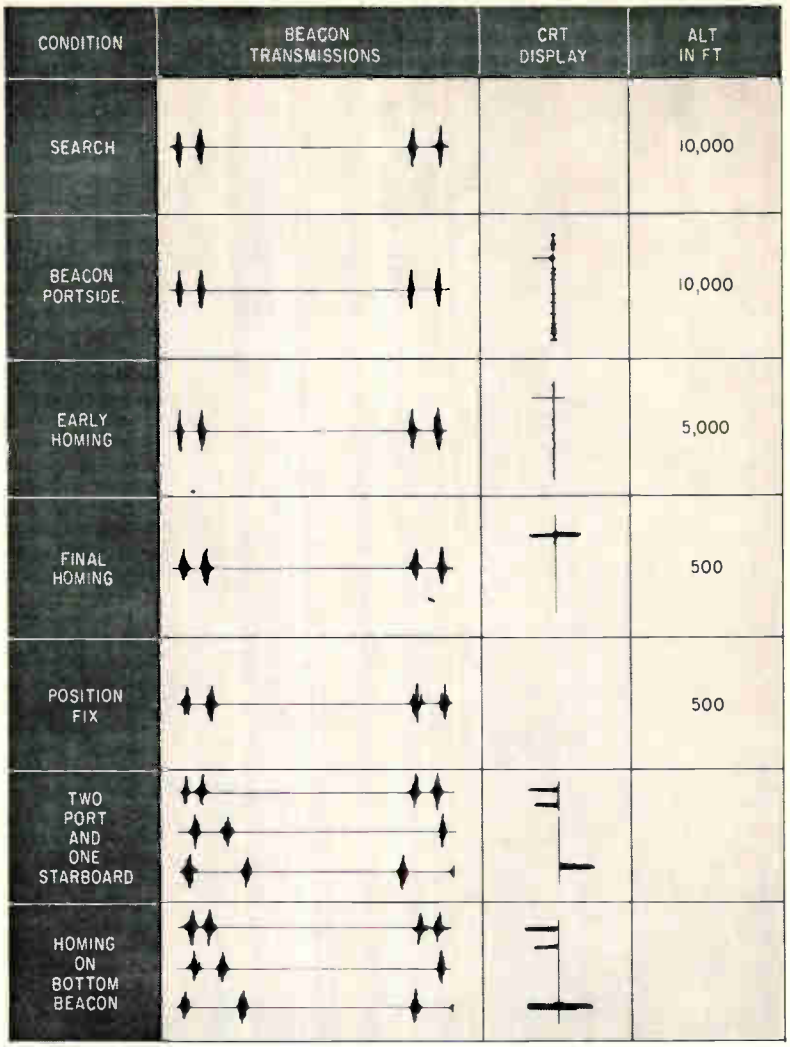


FIG. 4—Beacon receiver displays for typical search and homing conditions including presence of other beacons

ment of a super Sarah with increased capabilities.

The objective in redesigning the system was to increase its effectiveness; fewer search craft now take less time to pinpoint a beacon-equipped target. The improved performance results from transmitting encoded signals from a more powerful transmitter and providing an unambiguous visual display of received signals that eliminates confusion in identifying aural signals. The receiving system in each search vehicle also provides directional information that enables target location to be established within a matter of feet.

The beacon automatically and continuously transmits groups of pulses at low repetition frequency. In the typical modulation pattern of Fig. 1, pulse duration, pulse spacing and pulse-group spacing, identified at T_D, T_C and T_G, can be adjusted within the limits shown.

Two directional antennas are mounted in each search craft so that their patterns just overlap in front of the craft as in Fig. 2. Automatic lobe switching of the antennas is accomplished in the superhetrodyne receiver. When beacon pulses are received, a vertical trace appears on the crt screen with horizontal deflections, as shown in the photograph. Signals received by the port antenna cause deflection to the left, while signals received by the starboard antenna cause deflection to the right.

The vertical whip antenna normally used with the beacon is omnidirectional in the horizontal plane. As shown in Fig. 3, field strength immediately above the antenna is zero throughout an inverted cone having an apex angle of about 30 degrees.

When an aircraft receives the beacon signal, its heading is changed to make the horizontal deflections equal on each side of the vertical trace. As the target is approached, receiver gain is reduced manually because the stronger received signals produce wider deflections. As the aircraft enters the region where beacon transmitter field strength is zero, the trace abruptly disappears from the crt, which indicates that the target is immediately below the aircraft. An accurate fix of beacon location can be established with this display even under the most adverse conditions. Typical search and homing conditions are shown in Fig. 4.

The transmitter provides 100-

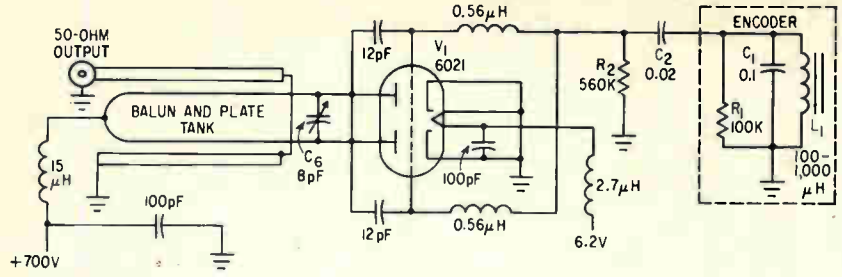


FIG. 5—Dual triode can provide 100-watt pulses because of small duty cycle

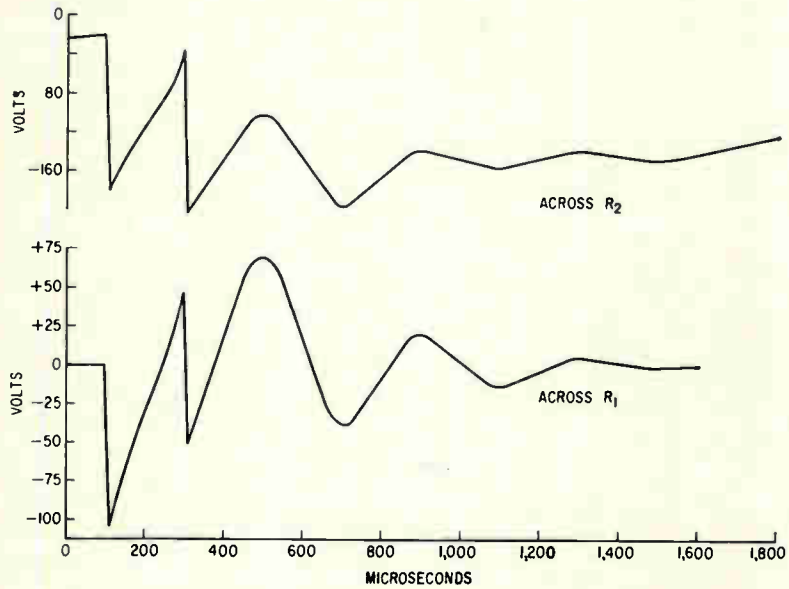


FIG. 6—Low-frequency voltages developed across resistors as a function of time are typical

watt pulse output. In range tests, it demonstrated that 150-mile line-of-sight transmissions to an aircraft at 15,000 feet altitude are obtainable. The transmitter in the photograph was designed to meet the environmental and other conditions of missile flight followed by unattended operation. This service requires small size, light weight, stable operation and high power output with limited power consumption. The transmitter module is 3 by $1\frac{5}{8}$ by $2\frac{1}{8}$ inches and the unit weighs 4 ounces excluding the power supply.

The transmitter circuit in Fig. 5 includes a highly efficient push-pull power oscillator and pulse encoder. Good frequency stability is obtained from 220 to 260 Mc using a transmission-line plate tank and a balun output circuit. Besides providing optimum coupling into a 50-ohm load, the balun limits frequency changes caused by objects near the antenna. Frequency is set by the plunger-type variable capacitor, C_6.

Subminiature dual-triode V_1 operates at a plate potential of 700 volts, which greatly exceeds maximum plate voltage rating of the tube. However plate power dissipation is within the recommended level because of the low duty cycle. In extended life tests conducted for more than 5,000 hours, no signal deterioration was experienced.

The operating cycle that produces the modulation shown in Fig. 1 begins with V_1 conducting. Voltage across C_1 and C_2 in series becomes increasingly negative, eventually cutting off V_1 after time T_D. The negative voltage across C_1 discharges through choke L_1 at a frequency determined by $\frac{1}{2}/\pi(L_1C_1)^{\frac{1}{2}}$. The voltage across C_1 changes polarity because of the inductive reactance of L_1. When the sum of the voltages across C_1 and C_2 again permit V_1 to conduct, a second pulse is produced at time T_G after the first pulse.

At the end of the second pulse, the tube is held cut off by the negative voltage that has developed across C_2 during the pulses. The slow discharge of C_2 through R_2 requires about 5 milliseconds, after which the tube is permitted to conduct again. A pulse is initiated at time T_G after the first pulse, beginning the cycle again. Typical low-frequency voltages developed across resistors R_1 and R_2 are shown in Fig. 6.

Constant heater and plate voltages determine stability of frequency, pulse and pulse-group spacings, pulse duration and power output. Although stability of frequency, pulse spacing and pulse-group spacing are relatively independent of plate-voltage variations, most circuit parameters are affected by heater-voltage variations.

Mercury batteries are used for beacon power because of their high power capacity. However, voltage of a typical mercury battery when it is first put into service is 6.7 volts, while the end-of-life level is 5.7 volts. Frequency variations resulting from changes in heater voltage, as well as from other causes, are handled by an automatic swept-frequency tuner in the search receiver. Receiver frequency is swept 2 Mc above and below 243 Mc. When a trace appears on the crt, receiver frequency is locked manually.

Plate voltage for the beacon transmitter is provided by a d-c to d-c converter operating from an input of 6.2 volts d-c. This simplifies original and replacement battery requirements since a single 6.2-volt battery provides all power. A converter for the beacon weighs 5 ounces and is $2\frac{3}{4}$ by $2\frac{1}{8}$ by $1\frac{3}{8}$ inches.

The transmitter module is potted in polyurethane foam to increase its shock resistance. In addition to rigid quality control, temperature cycling of selected critical components contributes to overall reliability. The transmitter has successfully withstood shock impact tests of 500 g for 15 milliseconds using a waveshape approximating a half sine wave.

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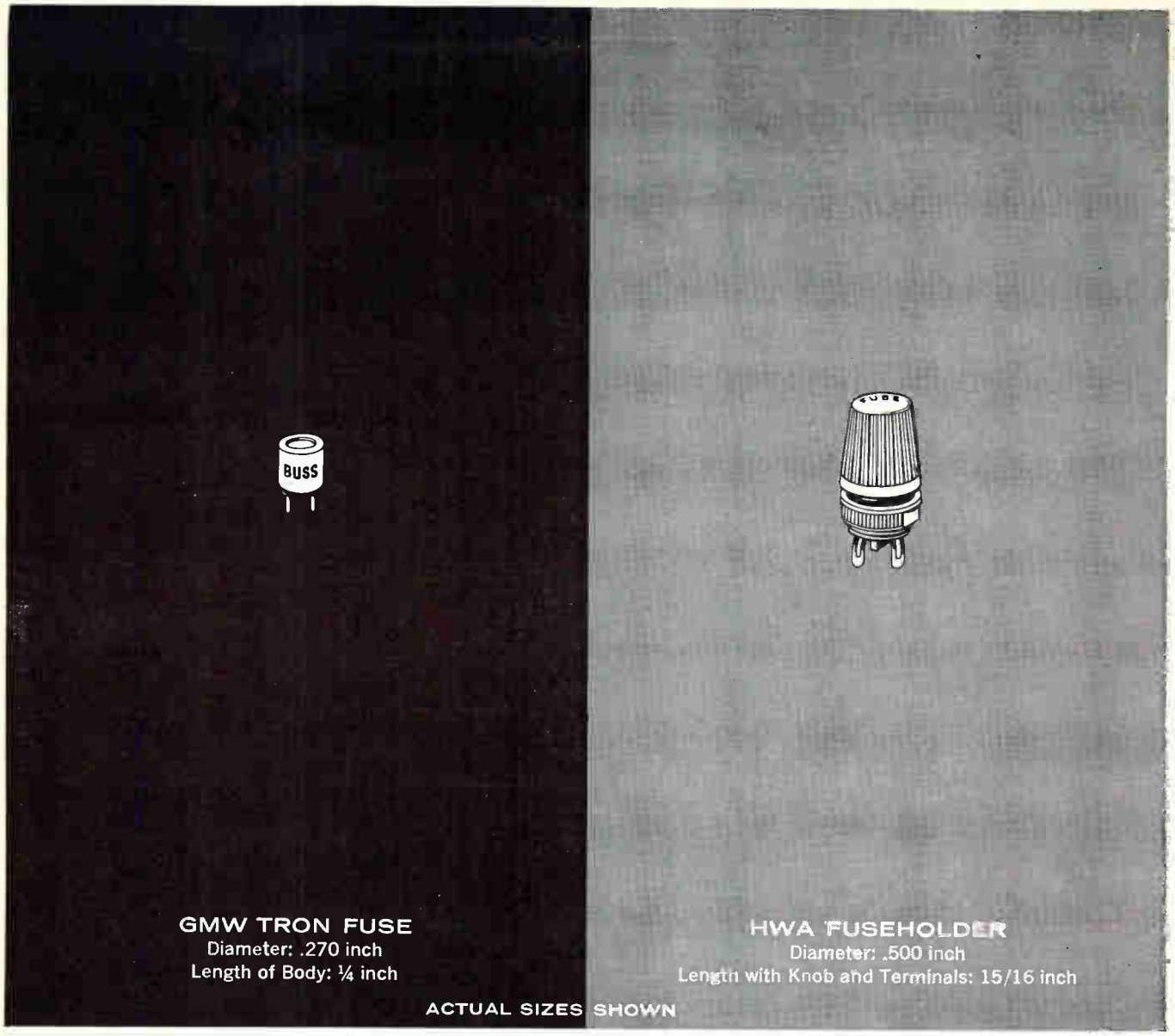

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Rigid construction of fuse and holder assures extraordinary reliability under high shock and vibration conditions. Fully insulated ceramic body isolates fusible element from effect of dust, corrosion, moisture and vapors.

DESIGNED FOR SPACE-TIGHT APPLICATIONS

Panel Mounted. Holder can be mounted on panel by hand. No special tool required to run down holding nut.

Prong type contacts on fuse make it easy to install or replace.

A knob for the holder may be used to make holder water proof from front of panel.

HOLDER CAN BE MOUNTED IN PRINTED CIRCUITS

Terminals of holder can be inserted into holes and soldered on printed circuit board without additional forming.

If desired, GMW fuse may be used without holder and mounted directly into printed circuit boards.

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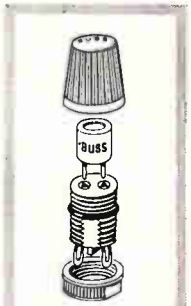

Exploded view of GMW-HWA fuse & holder combination.

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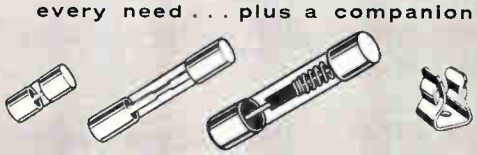

FUSETRON BUSS — TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION — McGRAW EDISON

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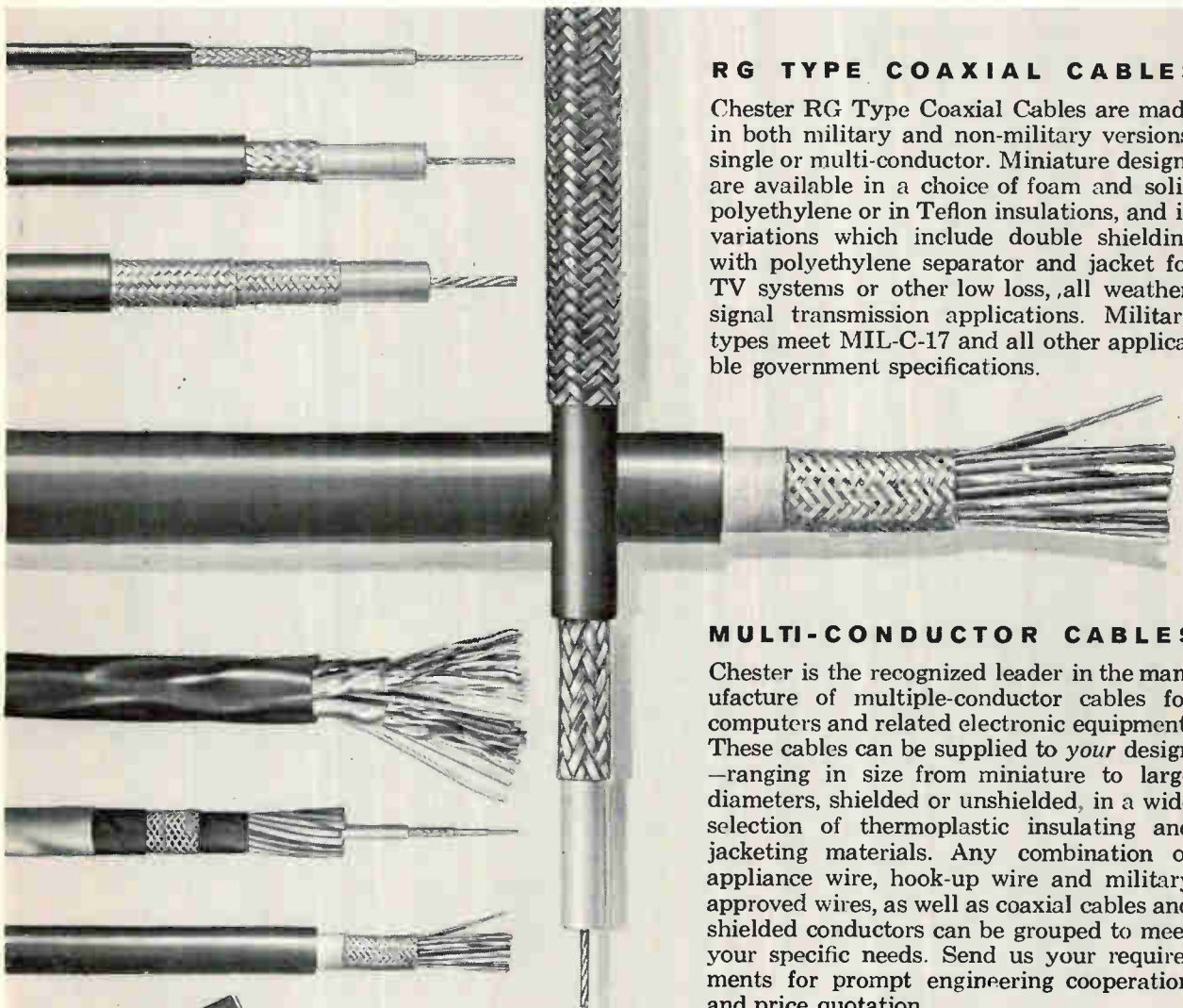

RG TYPE COAXIAL CABLES

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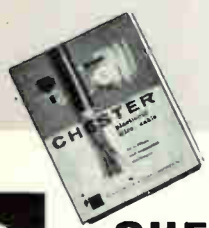

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Horn Patterns Are Recorded to Tenth Harmonic

By O. M. SALATI
D. J. LEWIS
The Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, Pa.

PATTERN measurements were made for an L-band horn antenna over a 10:1 frequency range. Tests include both horizontal and vertical polarization and were made from well into the Fresnel to the far field.

Available antenna performance data in the near field at other than design frequency and polarization is generally limited to simple aperture shapes and illumination. Although patterns can be estimated or calculated in the design band, it is difficult at other frequencies. The antenna and its transmission line may support higher order modes that affect aperture distribution and thus radiation pattern and impedance. Determining patterns from the calculated pattern of each mode is also difficult but effort would be considerably reduced if the modes present were known.

Cutoff frequencies for all modes that can propagate in the waveguide feed for the L-band horn are listed in table 1. No attempt was made to analyze mode generation and conversion in the horn. Many modes in the table will not be found. Mode selectivity in the transition between generating tube and transmission line reduces the number of measurements, and frequencies were chosen to avoid coincidence with cutoff frequency of any mode.

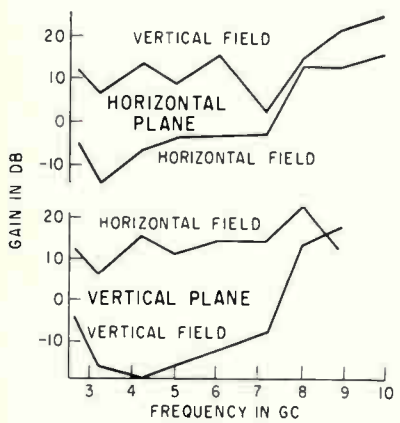

FIG. 1—Gain was measured as a function of frequency at 1 meter distance

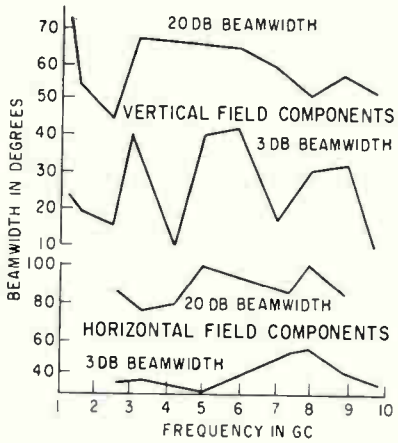

FIG. 2—Beamwidth of horizontal radiation pattern is plotted as a function of frequency

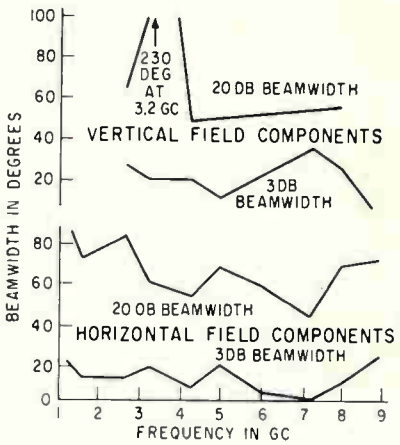

FIG. 3—Beamwidth of vertical radiation pattern is plotted as a function of frequency

TABLE I. TE_{mn} AND TM_{mn} MODE WAVEGUIDE CUTOFF FREQUENCIES

m \ n	0	1	2	3	4	5	6
0	—	1.82	3.63	5.45	7.26	9.08	10.9
1	0.908	2.05	3.71	5.52	7.71	9.12	
2	1.82	2.57	4.06	5.75	7.9	9.25	
3	2.72	3.27	4.56	6.08	8.17	9.16	
4	3.27	4.06	5.13	6.53	8.5	9.76	
5	4.56	4.87	5.81	7.08	8.93	10.13	
6	5.45	5.75	6.53	7.68	9.13		
7	6.35	6.6	7.3	8.35	9.63		
8	7.26	7.47	7.58	9.08			
9	8.17	8.35	8.93	9.81			
10	9.08	9.25	9.76				
11	10						

For the tests, the horn antenna is mounted with its axis 2.78 meters above a roof in an area where reflections are negligible. The horn is mounted on a radar antenna rotator, which is installed on a track-mounted movable tower. The tower permits 15 meters variation in the spacing to a receiving antenna mounted on a stationery wooden tower. Standard-gain exponential horns used to probe and record the radiation field were available in pairs with their gain accurately standardized. No serious ground reflections were found except at the maximum 15-meter range.

Aperture of the L-band exponential horn is 41 by 54 cm and taper length is 93 cm. The vswr measurements in table 2 were made at the horn input waveguide (WR-650) using a coaxial slotted line with a UG-953/U waveguide-to-coaxial adaptor and with a standard L-band waveguide slotted line. Performance was satisfactory in the operating band for both feeds. Measurements at 1 Gc were not made using the waveguide because a stretching section was not available and above 2 Gc because of higher modes in the slotted section. Vswr could be measured to 4 Gc with a coaxial slotted section before higher modes appeared. These results indicate the need for impedance measurements.

Patterns in the vertical and horizontal planes were recorded at 1.2, 1.6, 2.6, 3.2, 4.2, 5, 6, 7.2, 8, 8.9, and 9.9 Gc. Some far field measurements were included at every frequency. The test horn was replaced once in each measurement series with the standard-gain horn used as a field probe. This gave a reference for the entire set of recorded patterns since recorder gain was constant during each series.

To describe results, major lobe is defined as any lobe within 20 db

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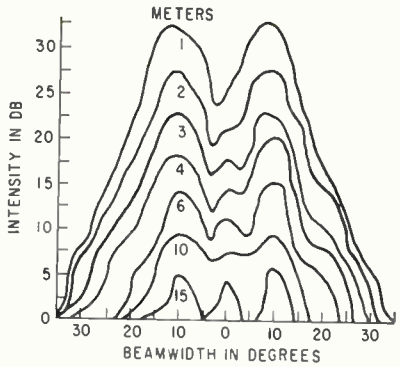

FIG. 4—Vertical field component of horizontal radiation pattern is shown at 8 Gc for various distances

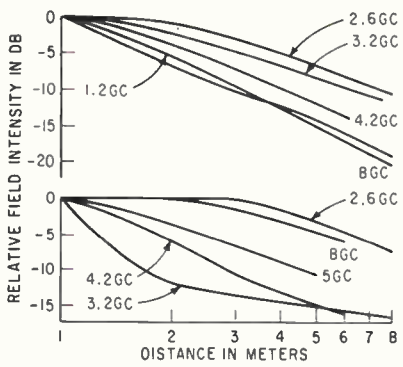

FIG. 5—Vertical (top) and horizontal components of horizontal pattern as a function of distance

of the strongest part of the pattern and separated by at least 3 db from the rest. Beamwidth is angle between pattern extremes above a specified level and may contain several major lobes. Gain, measured relative to a standard-gain horn, is ratio of an isotropic radiator field to maximum horn field in a given plane for a given polarization. Receiving antenna polarization defines the received field component.

Gain is plotted as a function of frequency for vertical and horizontal field components in Fig. 1. Antenna spacing was 1 meter, always within the near field. Contrary to expectations, gain is nearly constant at all frequencies. Theoretically vertical component gain of the horizontal pattern should equal horizontal component gain of the vertical pattern. The difference indicates lack of symmetry in the horn, track uneveness or incorrect horn positioning when polarization planes are shifted.

The 3- and 20-db beamwidths for all field components in both patterns are plotted in Fig. 2 and 3. Although gain curves indicate constant beamwidths, it should not be assumed that no points exist where beamwidth and gain change markedly.

Typical patterns in Fig. 4 show behavior outside the operating band. At higher frequencies, the forward beam is generally broken into smaller beams and considerable cross polarization is evident. Beam breakup almost certainly results from multimode aperture excitation. No explanation is offered for the two- to three-lobe at 8 Gc.

Patterns usually change little beyond 2 or 3 meters separation, suggesting that far field conditions may occur at relatively close range. This idea is supported by the plots of field intensity as a function of frequency in Fig. 5. The data show maximum field strength for each separation with field strength at 1 meter used as a reference. Slope of most curves within about 3 meters approaches 10 db per decade, suggesting that the horn far field is within this range.

Results suggest that gain is relatively constant to the 7th or 8th harmonic and then increases. Design and cross polarization gains become comparable near the 7th harmonic. Beamwidth is nearly constant to about the 7th harmonic, and the number of major lobes changes with distance. The near field-far field criterion that distance is greater than D^2/λ does not apply when other modes are present.

This work was supported by Rome Air Development Center.

TABLE II. L-BAND HORN VSWR

Freq in Gc	VSWR waveguide	VSWR coax-waveguide
1	—	1.7
1.2	1.1	1.1
1.3	1.07	1.1
1.5	—	1.12
1.9	1.05	1.1
2	1.1	2.1
2.2		2.6
2.5		1.8
2.8	mode	6.3
3	conversion	3.3
3.1	present	2.7
3.3		8.9
3.9		3.8
4		4.4

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Rome Electronics, Inc.
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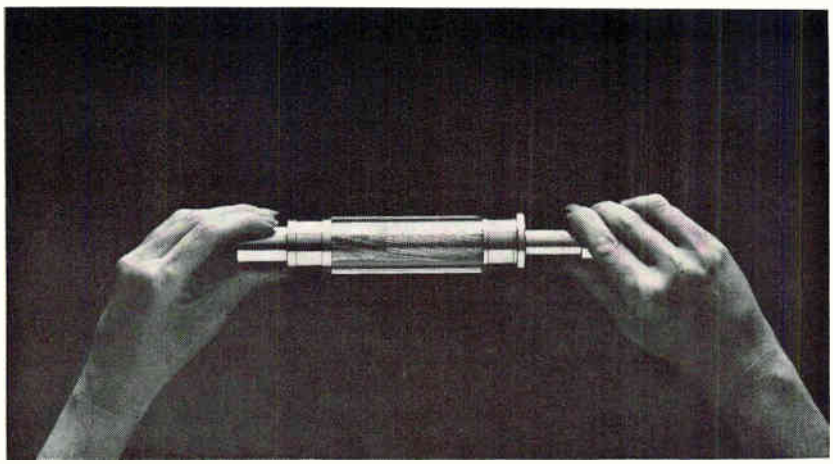

Hyperboloid twist in female receptacle, center of connector, assures reliable contact pressure for pins inserted in socket

TWIST CONNECTORS, developed under a French patent, have their male pins contact a female receptacle that has a basket-weave design, see photo. When the pins are inserted in the socket, the wire contact members are under tension and the arrangement assures a low spring rate with adequate wear allowance. The male plug slides into a smooth surface and grips firmly, there are no sharp discontinuities in slope on the sliding surface, and the insertion and withdrawal forces are even and smooth. Each floating pin receptacle allows enough lateral and angular freedom to compensate for misaligned pins during insertion.

This design concept is known as hyperboloid contact. Used in conjunction with solid pin entry, this socket design is said to result in positive linear electric contact through the elastic wrapping of the pin by each line wire contact.

The wire contact members are made of beryllium copper, silver and gold plated. The solid-entry pin insertion has a burnishing or polishing action which results in improvement of the connector through repeated use.

Because of the flurry of interest shown by engineers in this connector concept at the Wescon show last fall, a complete line of these Curtac connectors are now being developed for racks and panels, and other applications in the coaxial field.

Connector Applications

Electronic Fittings Corporation, of Bethel, Conn., a subsidiary of the Curtiss-Wright Corporation, is now promoting the twist connectors as a major project. According to company, this connector concept can be applied to any connector application that uses one or more wires. And a big market for these connectors is projected in the r-f field, for airborne and missile applications, ground support equipment, and in printed circuits.

Company claims that their new connectors obtain improvement in voltage loss, are able to handle high currents, and can get excellent wear.

Standard military life tests showed that after 500 insertions and withdrawals, contact resistance of the Curtec connectors averaged four to five times better than required by the specification. The test was extended through 100,000 insertions, with the connector still functioning satisfactorily. The units tested showed an average 13.2 my loss before testing, well within the specification. After use, the connectors showed an average 4.9 mv loss.

The twist connectors eliminate chatter and physical damage caused by vibration. In the vibration test, the contacts were monitored for discontinuity by a chatter monitor capable of detecting chatter of 10 microseconds or greater with no evidence of chatter or physical damage. A shock force of 50 G's, with a time duration of 11 milliseconds, also failed to show evidence of physical damage or contact chatter.

Among the Curtac advantages given by Electronic Fittings Corp. are: numerous linear contacts, reliability of the socket due to smooth mating of the contact pins, minimum wear and friction, rugged construction with closed entry, uniformity of production for electromechanical end use, manual extraction of multiple pin and socket arrangements, and high electrical performance.

Company is producing a complete line of standard Curtac connectors, with particular emphasis on applications which call for extreme reliability. Miniaturized components include a three-amp rated connector utilizing an 0.025 male pin with 0.10 centers. With no obvious limitations as to size, the company has already made three-quarter inch pins capable of carrying 600 amps or more. Custom made connectors are also being produced for special requirements.

Power Breakthrough Achieved in K_u Band

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range than any other TWT's now commercially available, according to company report.

The highest powered, Z-5184, has a peak saturated power output of more than 1 kilowatt. The other two, both for continuous-wave operation, are the Z-5183, with a CW output of 10 watts and the Z-5182 with a minimum CW output of 150 milliwatts.

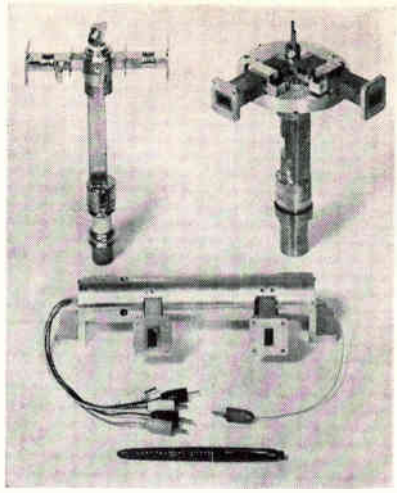
The tubes can be used individually or in tandem sequence, according to engineers at the GE Power Tube Department's Traveling Wave Tube Products Section, Palo Alto, Calif., where the tubes were designed and built.

The broad bandwidth and high gain of the new tubes make them useful in radar, electronic countermeasure equipment, microwave relay systems, and radiometry.

The high-power Z-5184, designed as the final amplifier tube in a pulsed chain, has a small signal gain of 30 db and a minimum saturated gain of 25 db. It is 11-in. long and 5.37-in. in diameter. The tube weighs about 20 pounds, including solenoid.

In mechanical tests, the Z-5184 withstood shock of 50 g for 11 millisecs and vibration of 15 g up to 3,000 cps. The tube is liquid cooled and operates in ambients of −65 C to 100 C. In typical operation, the tube has a 0.01 duty cycle and pulse length of 10 microsecs.

The medium power Z-5183 is a packaged assembly including the focusing solenoid, tube, and housing with a total weight of about 34 pounds. The tube has a small signal gain of 34 db and a minimum saturation gain of 30 db. The Z-5183 is 9-inches long and 7.4-inches in diameter. Periodic permanent magnet focusing will be available in a very short time.

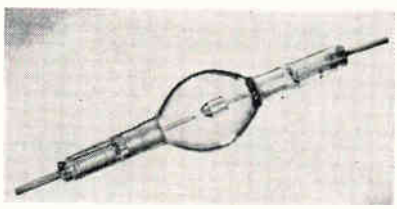


High-powered Z-5184, top left, shown with medium-power Z-5183, top right, and low-power Z-5182, bottom

The low-power Z-5182 has a minimum saturated gain of 30 db and a small signal gain of 35 db. It is periodic permanent magnet focused. The tube is 11.2-in. long, 4-in. high, and 2-in. wide, weighing 3 pounds.

All three tubes are of metal and ceramic construction and may be installed in any position.

Arc Lamp Used For Solar Simulation



FIVE KILOWATT mercury-xenon arc lamp, developed by Engelhard Hanovia, Inc. Lamp operates at 50 volts and 100 amperes, emits a spectrum similar to sunlight in outer space, particularly in the ultraviolet and infrared ranges. It produces 230,000 lumens.

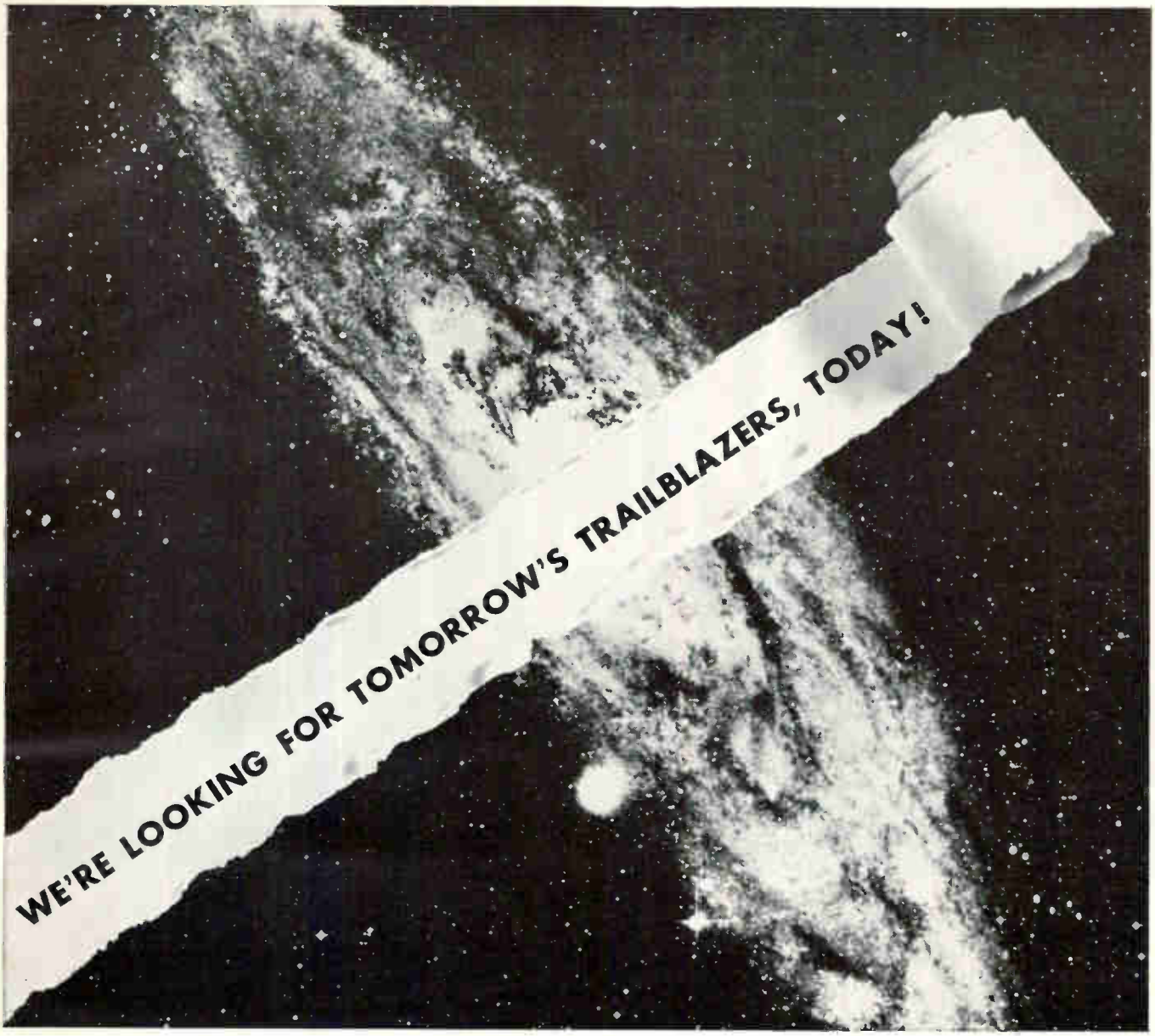
The lamp's bulb, custom-made from quartz and containing tungsten electrodes, is filled with xenon and mercury. In operation, the lamp begins as a xenon lamp, with the xenon activated by radio frequency. The xenon is ionized and starts the arc discharge, which in turn vaporizes the mercury and increases the internal pressure.

Special Purpose Crt's

QUANTITIES of special cathode-ray tubes for B-52 bombers have been supplied by Raytheon.

The 10-in tubes have one side window to accommodate superimposed video-mapping information, and another for a camera readout.

Work is being performed under a contract from Warner-Robbins Air Force Base, Macon, Georgia.



AC, The Electronics Division of General Motors, is now seeking *creative* engineers, physicists and mathematicians to fill important and challenging positions in the Advanced Navigation Field. The positions:

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(Advanced Inertial Guidance Systems and Airborne Digital Computers)

Digital Computer Development Engineers
Research and Development Engineers
Transistor Circuit Design Engineers
Systems Engineers

Milwaukee

Military Defense Systems, Program and Project Engineers
Radar Design and Development Engineers
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Reliability Program Engineers
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If you are experienced and interested in any one of these positions, please send your resumé to Mr. G. F. Raasch, Director of Scientific and Professional Employment, Dept. 5753, 7929 S. Howell, Milwaukee 1, Wisconsin. We are an Equal Opportunity Employer.

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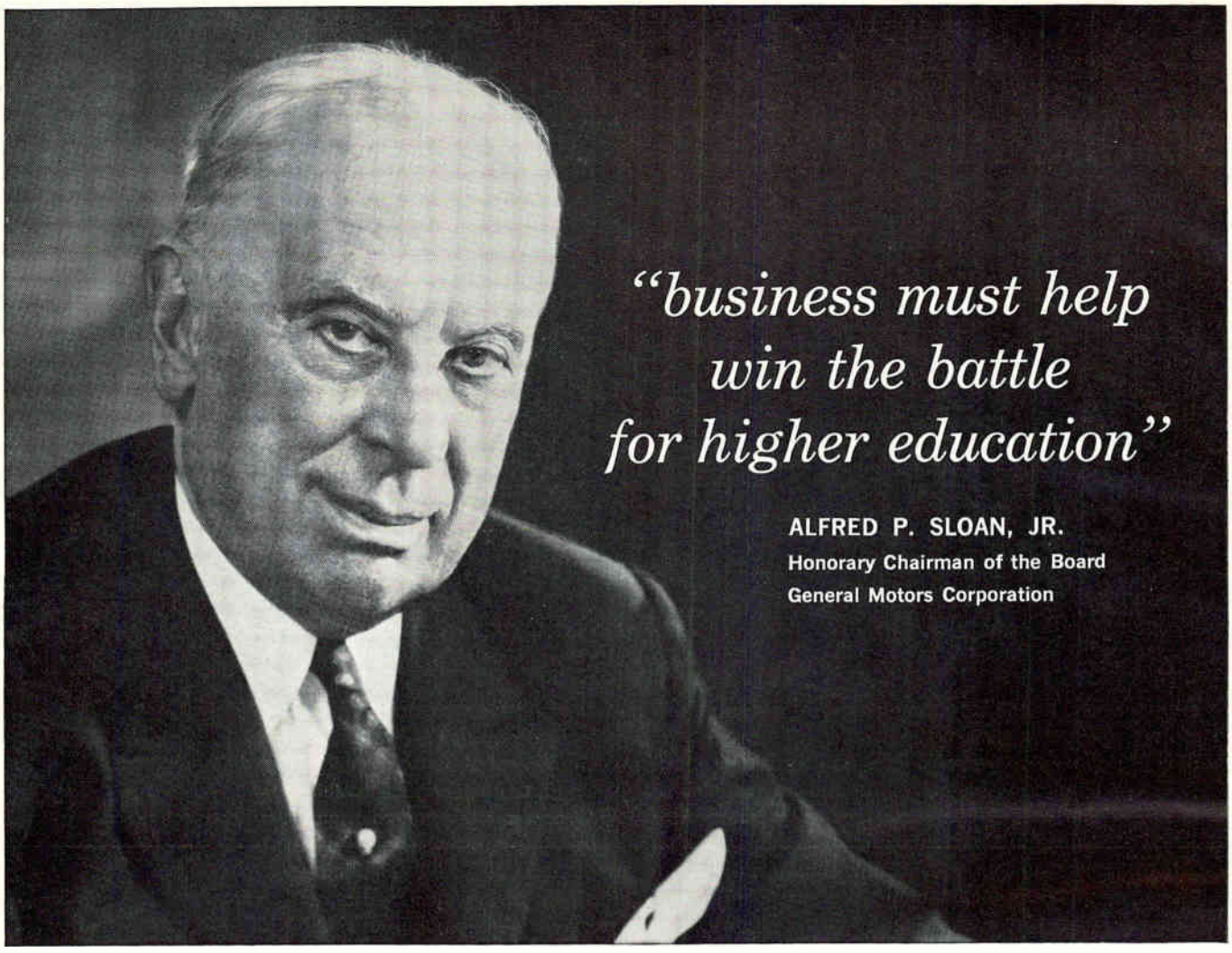

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For additional information on the crisis faced by higher education write to: Higher Education, Box 36, Times Square Station, New York 36, N. Y.

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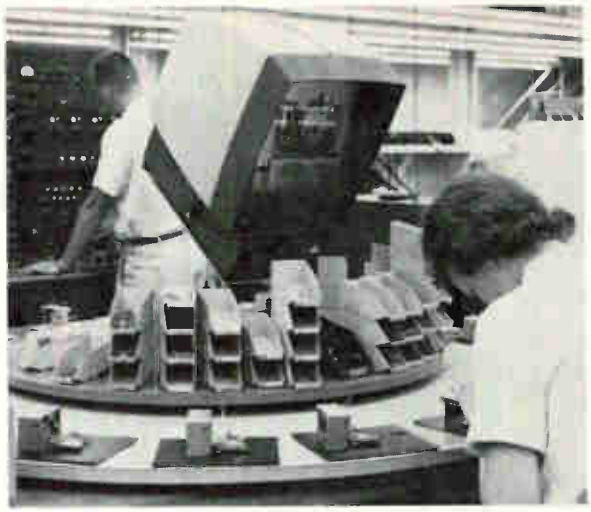

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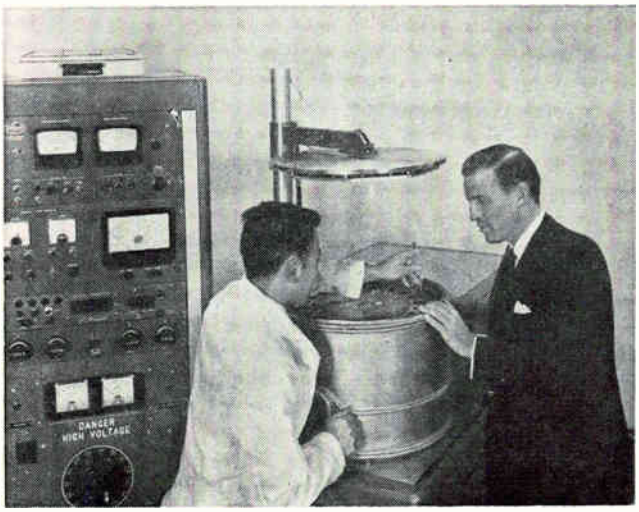
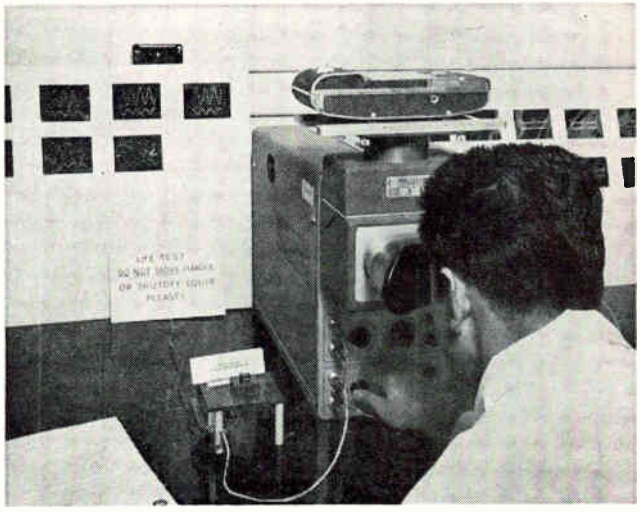


Resistors and capacitors are deposited on 20 substrates at a time in high-vacuum chamber



Three-stage deposited circuit servo amplifier undergoes life test, is one of first circuits made on the machine

Evaporator Makes Deposited Microcircuits

A PRODUCTION machine for high-vacuum deposition of integrated microcircuitry, capable of depositing 20 circuits during one pump-down cycle and reportedly able to produce accuracies at least as high as obtainable in the laboratory, has been introduced by the Solid State Physics group of Lear, Inc. Designed on the premise that the prime economic stumbling block of current evaporative processes is the time consumed in evacuating the deposition chamber, heating the substrates and associated jigs to required temperatures, and reverting to atmospheric conditions, the machine can precisely deposit complex resistor, capacitor and conductor patterns on a score of substrates during a single operating cycle.

Operating Principles

A production cycle for the new machine is approximately two hours, with actual fabrication time per circuit less than two minutes. Lear estimates that time savings per batch over previous methods ranges from 20 to 50 hours, and the cost of an average circuit with passive elements only will be reduced to less than a dollar, or considerably below the present cost using conventional printed circuit technique.

Evacuating the chamber to operating atmosphere of 10^{-6} mm to 10^{-7} mm of mercury requires ten minutes. Heating the substrates sufficiently (about 350 C) so that the mobility of the deposited film permits rapid crystallization takes another 25 minutes. An additional 25 minutes is required to cool down to 100 C, during which time inert gases such as helium or argon are bled into the chamber.

Induction heating of the work area is accomplished by a unit mounted in the cover of the chamber; a thermocouple in contact with the substrate mount permits temperature control of ±2 C.

To date, most of the circuits produced by the machine have been deposited on ½ by ½-in. soft glass substrates with fired-on solder tabs, but the machine can handle any size up to one inch square. A rotating horizontal steel disc, turned manually by a lever mounted on the operator's console, has twenty stations in which the substrates and masks are mounted flat and parallel to each other.

Materials used in the prototype machine are chrome gold alloy or beryllium copper for conductor patterns, nuchrome for resistors, and silicon monoxide for dielectric layers. Two electron bombardment towers, located 12 inches below the turntable, vaporize and direct the flow of the metals used for conductors and resistances.

Resistor Deposition

Six 0.057-inch nichrome wires are fed through holes in a water-cooled copper anode and heated to 1,400 C. Molten metal is bombarded by a hot tungsten emitter and is directed upward toward the masked substrate to produce a resistive pattern. Conductor material is fed into its tower in shot form, evaporated, and similarly deposited onto the substrates.

Dielectric material is vaporized in an oven surrounding a perforated ceramic chimney. One or two ounces of silicon monoxide is packed around the outside of the chimney and sublimates through the perforations and up toward the substrate. The chimney arrangement and its 12-inch distance from the turntable largely eliminates unwanted pinholes.

Solenoid-operated shutters control the flow of vapor to the substrates, and consequently, the thick-

Philco Single-Position Automatic Tester, shown in photo, enables you to plug-in 10 different parameter tests. Can be programmed to test 10 different transistor types, too.

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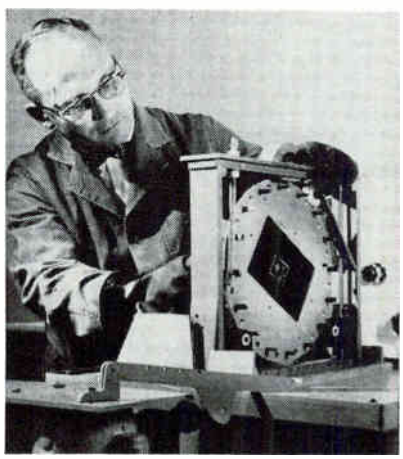
ness of films deposited. These may be manually operated or automatically controlled. For conductor films, an electric timer controls the time the shutters are open. For resistor films, a digital ohmeter with an automatic cut-off in the fourth decimal place is used. This ohmeter reads the resistance of a monitor strip which is deposited adjacent to and simultaneously with the desired pattern. Patterns of 20 to 30 resistors having a combined resistance of up to 200,000 ohms and within a tolerance of 5 percent reportedly are practical. Relatively low-ohm-per-square films are used because of the stability obtainable. A nichrome film of 100 ohms per square when deposited upon a substrate at 350 deg C will be completely crystalline upon removal

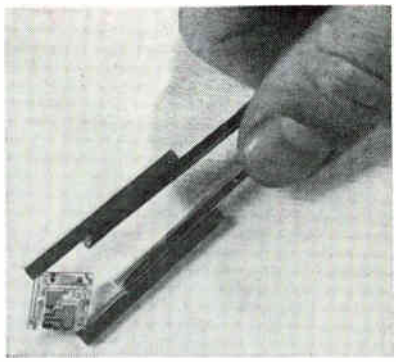


Stainless steel masks are developed from oversize artwork

from the evaporator, and will change less than one percent in total resistance due to subsequent surface oxidation. A film of several thousand ohms per square, on the other hand, can change in resistance from later surface oxidation by 50 percent or more.

Thickness of dielectric deposition is controlled by observing, through a system of lenses and mirrors, the shift in color fringes due to light interference as the material builds up on a monitoring ring of stainless steel. For example, the dielectric shutter may be closed when the operator notices the third green fringe, or the fifth red fringe, and so on. Capacitors to within ±5 percent are possible.

To date, capacitors have all been three-layer devices. Great care has been taken to prevent foreign particles and spattering from causing minute pinholes in the dielectric layer—the prime problem in thin-film capacitor fabrication. Typical capacitors have values as high as 0.03 μf per square cm, with breakdown of 60 to 100 volts and Qs from 100 to 2,000.



Typical microcircuit produced by the machine

A critical problem in thin film deposition is masking. Masks for the deposition process are etched from type 300 series stainless steel 0.005 to 0.008 inch thick, and frequently have openings less than 0.005 inch in width. Original circuit layout is made 25 times the size of the actual circuit and is reduced photographically in two stages.

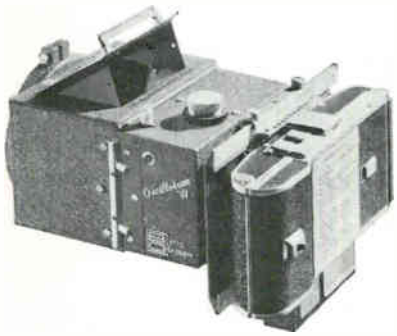
Uncased transistors and diodes are presently inserted manually but high priority is being given to the problem of evaporating active elements. One approach is evaporation or electro-deposition of single crystal semiconductor films onto the dielectric substrate.

Another approach is use of the tunnelling phenomena in extremely thin films. Cal Tech has been active in this field and indications are that such films between 10 and 70 angstroms thick will obviate the need for depositing single crystal materials for semiconductor functions.

At present the evaporator produces 20 $\frac{1}{2}\times\frac{1}{2}$ inch circuits per cycle. In its next stage of development it will produce 320 $\frac{1}{4}\times\frac{1}{4}$ inch circuits at an estimated cost of about one cent each. Eventually, 2,000 circuits 0.1×0.1 inch, with active elements of gallium arsenide, will be produced at one time, with costs estimated at less than one cent each.

The machine will be used to make circuits for the company, to make circuits to specs for other companies, and will also be available on lease.

Use the POLAROID® 10,000 SPEED Land Film



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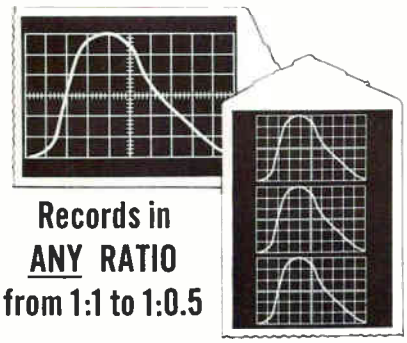
BEATTIE-COLEMAN MARK II OSCILLOTRON



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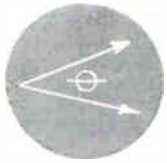
January 19, 1962

Gertsch announces:



the CRB line of complex ratio bridges

Ideal for voltage and phase comparison.

Measures complex voltage ratios – both in-phase and quadrature – with high accuracy.

These Gertsch CRB instruments are designed for testing 3- or 4-terminal networks, including transformers, synchros, resolvers, gyros, and transducers. The Gertsch line includes:

SOLID STATE BRIDGE—Model CRB-4. Instrument is fully transistorized . . . highly accurate. A self-contained, phase-sensitive null indicator permits rapid measurements. $R_x + R_y$ voltage ratios are read from concentric switch dials. *Battery or line* operation . . . case or rack mounting. Operating frequency range: 380-420 cps. Weight 20 pounds.

COMPLEX RATIO BRIDGE—Models CRB-1B and CRB-2B. In these units, quadrature component reading is indicated either as rectangular coordinate, tan θ, or θ directly in degrees. Useful for measuring angles as small as .001°. Six-place resolution, with high accuracy. Cabinet or rack mounting.

CRB-1B	30-1,000 cps	2.5 f or 200 V max.
CRB-2B	50-3,000 cps	.35 f or 200 V max.

AUTOMATIC COMPLEX RATIO BRIDGE—Model CRB-3. A self-nulling AC bridge with digital readout of both in-phase and quadrature voltage ratios. Excellent for production testing.

Accuracy of bridge is .002% max. Five-place resolution, with automatic quadrant indication. Unit is self-contained, requiring no external calibration sources, and is equipped for external printer readout.

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IMPEDANCE COMPARATORS

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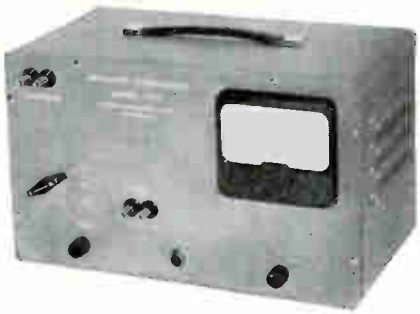
- Percentage deviation from standard read on large meter
- Rapid response — no buttons to push
- High accuracy and stability
- Self calibrating — requires no recalibration when changing ranges



SPECIFICATIONS	MODEL 60	MODEL 1010
BRIDGE SUPPLY	6 Volts	2 Volts
FREQUENCY	60 CPS	Either 1 KC or 10 KC
FULL SCALE RANGES	±1%, ±5%, ±10, ±20%	±5%, ±10%, ±20%
IMPEDANCE LIMITS:		
Resistance	5 ohms to 5 megohms	5 ohms to 5 megohms
Capacitance	500 mmfd. to 500 mfd.	50 mmfd. to 10 mfd.
Inductance	15 millihy. to 10,000 hy.	100 microhy. to 100 hy.
PRICE	$199.00	$329.00

OTHER MODELS AVAILABLE

MODEL	BRIDGE VOLTS	FULL SCALE RANGES
1000	2.5V-1000 CPS	±1, 5, 10%
1025	2V-1 KC, 25 KC	±5, 10, 20%
400	2.5V-400 CPS	±1, 10, 20%
60-S	.2V-60 CPS	±1, 2, 10, 20%
60-L	.6V-60 CPS	±1, 5, 10, 20%

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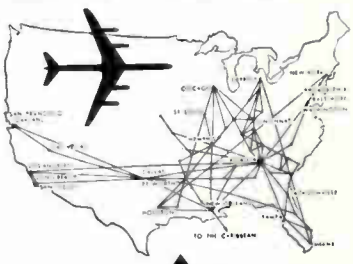

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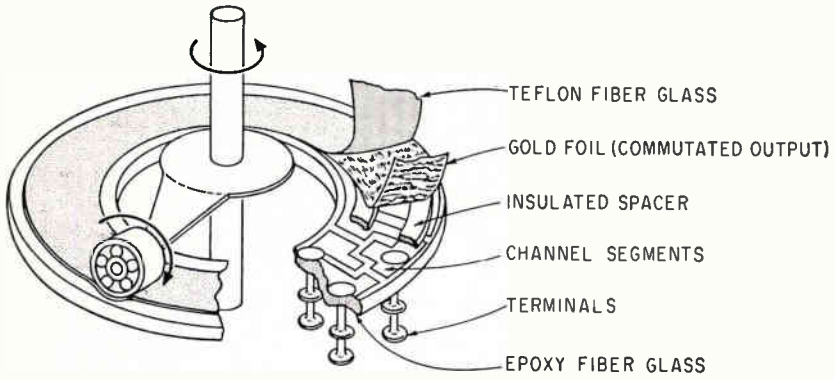
DESIGN AND APPLICATION

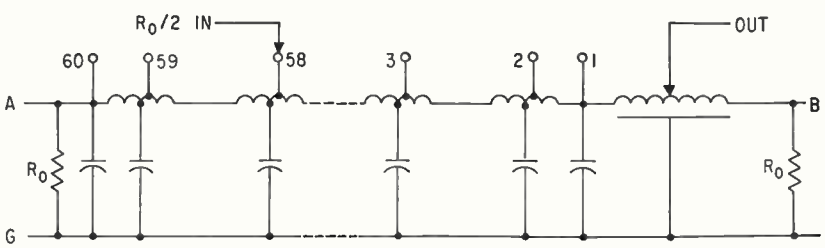


Mechanical Sampling Switch

HAS NO SLIP RINGS

A NEW TYPE of sampling switch produced by Datametrics Inc., 87 Beaver Street, Waltham 54, Massachusetts, has a unique electrical contact method that dispenses with sliding friction and slip rings. Called DATACEL, the principle of operation is shown in the sketch. The channel segments are arranged in a circle with the gold foil (commutated output) contact supported away from the channel segments by insulated spacers 0.002-in. thick making an hermetically-sealed enclosure. The upper side of the gold foil (in contact with the miniature ball-bearing depressor), is laminated to a thin layer of Teflon impregnated fiberglass to provide a running surface for the depressor. As the foil is depressed, contact is made from each successive switch segment to the gold foil. The depressor does not carry any current or participate in any electrical activity. Foil displacement is slight and well within elastic limits. Wear tests indicate up to 90×10^6 rotations at speeds of 1,000 rpm. Electrical contact resistance between channel segments and the gold foil is less than 0.01 ohm.

CIRCLE 301 ON READER SERVICE CARD

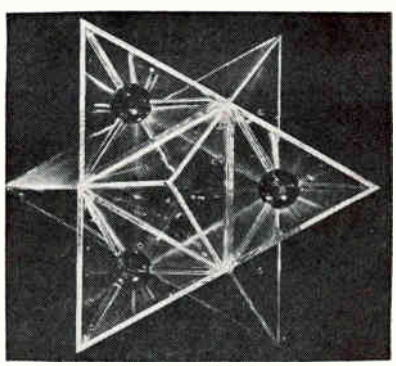


Continuously Variable Delay Line

LESS THAN 8×10^{-11} SECOND RESOLUTION TIME

RECENTLY announced by Ad-Yu Electronics Lab., Inc., 249 Terhune Avenue, Passaic, New Jersey, is a continuously variable delay line with less than 8×10^{-11} second resolution time and a maximum delay over 30 microseconds. The device consists of two parts; a continuously variable delay line which is essentially a condensed r-f cable and a step-variable delay line consisting of 60 sections of LC m-derived networks switched with a 1-pole, 60-position rotary switch. The basic circuit is shown in the sketch. The step-variable delay line is used as the coarse adjustment and the continuously-variable section is used for fine adjustment. To minimize reflection, the source impedance must equal one-half the characteristic impedance of the delay line $R_o/2$, terminals A and B terminated by the characteristic impedance of the line R_o and the output line connected to a high-impedance load such as the grid of a vacuum tube amplifier or cathode follower. Applications include radar ranging and tracking or precision synchronization of gating circuits.

CIRCLE 302 ON READER SERVICE CARD



Crystal Model Building Block

EASES VISUALIZATION

DEVELOPED at M.I.T., and produced by Therodyne Corp., 239 Massachusetts Avenue, Cambridge, Massachusetts, these crystal model building blocks transfer the frame of reference from close-packed spheres, as in the traditional ball-and-rod crystal models, to the interstices between them which take the octahedral and tetrahedral shapes. Using this system, crystal planes are visual where they must be imagined with conventional ball-and-rod models, they produce coordinated concepts in that chemical formulas of crystal material can be determined very easily, they can

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. . A full range of instrumentation for non-destructive dielectric tests, is offered. Very High Voltage D-C HYPOT® models have output to 250 kv at 25 ma. A-C HYPOT® models are available with output to 150 kv at 25 kva. Features may include: automatic rate of voltage rise control, memory circuit to record voltage at time of breakdown, and many others described in a special catalog.

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Mobile high voltage test sets determine insulation breakdown in cables, bushings, transformers, motors and similar equipment. They are readily transportable, have advanced safety features and meet applicable specifications for testing elements of electronic, missile and ground support systems. Widely used by electric utilities and for industrial maintenance. Descriptive bulletin available.

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The VIBROTEST® megohmmeter is direct reading with an electronic power supply that eliminates cranking and leveling. Multi-range models combine megohm, d-c and a-c voltage measurement in compact instruments with welded steel portable case.

Model 250 VIBROTEST® Megohmmeter with 4½" scale, has ranges: 1 to 50, 10 to 500, 100 to 5,000 and 1,000 to 50,000 megohms. Price, $279.50. Catalog describes many additional models.

Portable HYPOTS® . . to 10 kv

Compact instruments for measurement of insulation breakdown voltage and leakage current. Outputs to 10 kv, a-c. Also, with d-c output voltage. New bulletin describes many available models.

Model 412 Portable HYPOT® has output adjutsable 0 to 1500 v, a-c. Leakage current readout light adjustable from 0.3 to 3.0 ma. Price $137.50.

Bench HYPOTS® . . to 45 kv

Semi-portable instruments measure insulation leakage current and breakdown voltage. Available with d-c output voltage to 45 kv at 25 ma, and with a-c output to 35 kv at 2 kva. Bench type welded steel cabinets have carrying handles.

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VIBROGROUND® Ohmmeters measure resistance to ground from electrical and electronic equipment. They are direct reading, self-powered from long life battery. Bulletin available, lists all models as well as instruments for measuring soil resistivity and conductance.

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Instruments for automated testing of voltage breakdown, insulation resistance, leakage current, continuity . . at unlimited test points, with full random access.

Illustrated at left, is multi-circuit analyzer for cables, components and circuits . . with printed tape readout of rejections.

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Direct reading resistance measurements are made with an accuracy of up to ½ of 1% . . from 0.05 ohm to 100,000 ohms. Have compenastion for battery and lead resistance, self-contained battery. Model 244 has ranges of 0-50/500/5,000/50,000 ohms. Price, $128.00 . . Model 246, ranges to 100,000 ohms, $148.00.

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Designed to your needs . . embodying these and related measurements: Continuity, Insulation Resistance, High Voltage Breakdown, Leakage Current, Capacitance and Inductance Bridge. Also, modification of standard instruments will be made as required to meet your applications. When writing, give complete details of your requirement.

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Available as general purpose units or with facilities for specific applications. HYPOT® D-C power supplies are widely used in test and development of capacitors, cables, klystrons and other high voltage devices. Output voltages to 250 kv with full load ratings to 50 ma, are offered. Our engineering department will supply full data on models suitable for your requirements.

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- Earth Resistivity . . the VIBROGROUND®
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ASSOCIATED RESEARCH, INC.

3781 W. Belmont Ave. · Chicago 18, Illinois

be used to demonstrate silicate structures and can also be used to demonstrate geometry and orderliness of three-dimensional lattices. The building blocks are available as preassembled models of germanium, silicon and rare earth metals. The photo on p 74 shows configuration of a diamond crystal.

CIRCLE 303 ON READER SERVICE CARD

L-F Time Base
MINIATURIZED

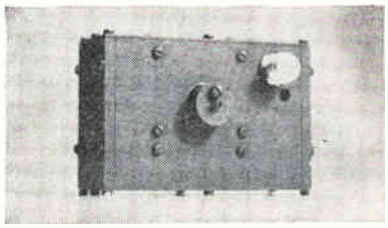
FORK STANDARDS, INC., 1915 N. Harlem Ave., Chicago 35, Ill., has developed a miniaturized 1-sec time base. Claiming high frequency accuracy to 0.002 percent, the unit is built around a precision type tuning fork oscillator operating near 1,000 cps. Signal output of the time base oscillator is reduced, using miniaturized circuitry, to any desired frequency from 60 cps down to 1 cps. Frequency accuracy is maintained over a temperature range of 0 to 65 C. Input power is 12 v d-c with output a square wave, 8 v peak-to-peak into 10,000 ohms.

CIRCLE 304 ON READER SERVICE CARD

D-C Power Amplifier
2 IN. BY 2 IN. BY 1 IN.

INERTRONICS, INC., P. O. Box 462, Westbury, L. I., N. Y. For use in driving d-c torquemotors of 3 w to 100 w capacity from 28 v d-c line, this class B silicon transistor amplifier may be connected for either voltage or current feedback for optimum servo response, and is completely protected against normal causes of failure. Full output is achieved with 2 v signal into 100,000 ohm input. Drift is under 10 percent over rated temperature range of −55 C to 125 C.

CIRCLE 305 ON READER SERVICE CARD



Miniature Amplifier
WIDE BAND

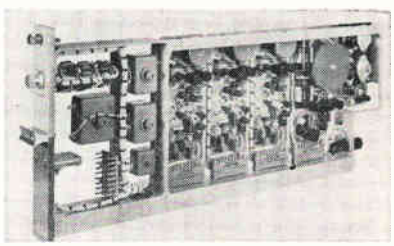
SPACE COMMUNICATIONS CORP., 4 Spring Ave., Bergenfield, N. J. Employing advanced multipole techniques, bandwidth obtained for the model 12L13 uhf amplifier is 100 Mc at 10 db gain. Response shape is maximally flat and center frequency at 1,000 Mc. Applicable for pulse and c-w techniques for use as transmitters, signal generators and low-noise receivers. Price is $250.

CIRCLE 306 ON READER SERVICE CARD

Pulse Generator

ALFRED ELECTRONICS, 3176 Porter Drive, Stanford Industrial Park, Palo Alto, Calif. Pulse generator providing 300 to 450 v for loads up to 250 ma peak is designed for modulating microwave amplifiers.

CIRCLE 307 ON READER SERVICE CARD



Active Filter
LOW PASS

REDCOR DEVELOPMENT CORP., 7760 Deering Ave., Canoga Park, Calif. Model 440A low pass filter is useful in data gathering systems for signal conditioning. The accuracy of the 3 db point, attenuation characteristic, and insertion loss is controlled within ±0.05 percent of a true Butterworth. Frequency re-

sponse extends to d-c and d-c stability is controlled by high gain chopper stabilization amplifiers. Input impedance is 1,000 megohms and source impedance can vary within 0-5,000 ohms without degradation of accuracy. Prices from $1,300.

CIRCLE 308 ON READER SERVICE CARD

Microvoltmeter

VERSATILE UNIT

PHYSICAL SCIENCES CORP., 389 N. Fair Oaks Ave., Pasadena, Calif. Model 1101 d-c microvoltmeter is a precision instrument having ±0.1 percent accuracy in all ranges for measuring outputs of bonded or unbonded strain gages, thermocouples, resistance thermocouples, and low level d-c voltages. Resolution is 1 μv on the 1 mv full scale range. Ranges are: ±1,000 μv; ±10, ±50, ±100 mv.

CIRCLE 309 ON READER SERVICE CARD

Rotary Pot

DAYSTROM, INC., Archbald, Pa. Weighing only 7 grams max, and with a total overall case length of only $\frac{3}{4}$ in., model 304 is a single-turn unit which emphasizes high linearity.

CIRCLE 310 ON READER SERVICE CARD

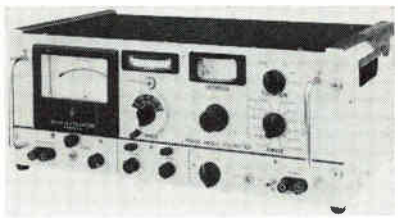
Circulator

FOUR-PORT

RANTEC CORP., Calabasas, Calif., has developed a 4-port waveguide circulator for communication link applications. Model CXB-205 covers

the band 5.925 to 6.425 Gc with 20 db minimum isolation, insertion loss less than 0.25 db, vswr 1.15:1 max. Power handling capability is 300 w average and operates over a temperature range of −55 C to +71 C. The low swr prevents interchannel modulation distortion.

CIRCLE 311 ON READER SERVICE CARD



Voltmeter

PHASE ANGLE

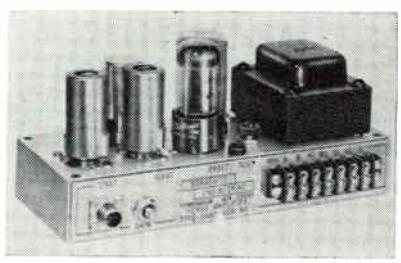
NORTH ATLANTIC INDUSTRIES, INC., Terminal Drive, Plainview, N. Y. Model VM-301 broadband phase angle voltmeter combines in one instrument the ability to measure both phase angle and magnitude of complex a-c signals and their vector components with respect to a reference voltage over a frequency range of 10 cps to 100 Kc. It is applicable to amplifier and network design, vibration and telemetry analysis, bio-medical research, phase sensitive null detection in production and laboratory.

CIRCLE 312 ON READER SERVICE CARD

L-F Noise Generator

ELGENCO INC., 1555 Fourteenth St., Santa Monica, Calif. Model 301A noise generator employs a grid-controlled gas thyratron in a transverse magnetic field as the primary noise source.

CIRCLE 313 ON READER SERVICE CARD



Servo Amplifier

LOW-COST, HIGH-GAIN

SCHAEVITZ ENGINEERING, P. O. Box 505, Camden 1, N. J. The SA-62

may be used for all measurement and control applications in which minute 60-cps signals from a transducer must be amplified to produce up to 5.6 w of controlled undistorted a-c power. It provides reversible power to the control phase of two-phase servomotors with 2,000-6,000 ohms impedance across the control windings. Price is $125.

CIRCLE 314 ON READER SERVICE CARD

Digital Modules

12 CIRCUITS AVAILABLE

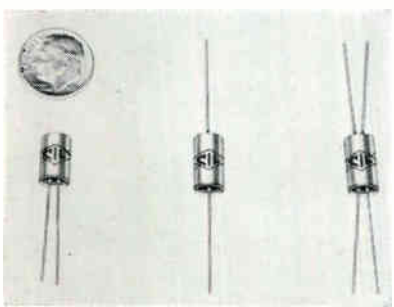
DELCO RADIO DIVISION, General Motors Corp., Kokomo, Ind. Series of silicon digital modules in 12 different circuits operate at a delay-per-stage of less than 25 nsec. It includes digital plug in cards and block modules which operate conservatively at 10 Mc over the complete temperature spectrum of −50 C to + 100 C.

CIRCLE 315 ON READER SERVICE CARD

Power Supply

KEPCO, INC., 131-38 Sanford Ave., Flushing 52, N. Y. Model ABC 40-0.5M has continuously variable output of 0-40 v d-c at 500 ma; line/load voltage regulation, 0.05 percent.

CIRCLE 316 ON READER SERVICE CARD



Microinductors

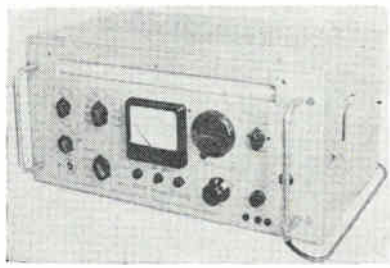
HIGH RELIABILITY

CLIPPARD INSTRUMENT LABORATORY, INC., 7390 Colerain Road, Cincinnati 39, O. Ultra fine wire winding techniques, and a new concept in design and construction, enable

NEWER

these microinductors to withstand more than 10,000 g. Designed for relatively low current circuitry in rockets, missiles and space-age miniature equipment, the ferrite-cored inductors are supplied in three styles: with double leads at one end, with single leads at both ends, and with double leads at both ends.

CIRCLE 317 ON READER SERVICE CARD



Microvoltmeter

SELECTIVE TYPE

ROHDE & SCHWARZ, 111 Lexington Ave., Passaic, N. J. Type USVH is a highly sensitive receiver with output voltage indicated by a diode voltmeter. Switch selects six input impedances from 50 ohms to 500,000 ohms. Meter is calibrated in volts and db and has an added expanded scale with calibration from 0.7 to 1. Single frequency changing for input frequencies from 10 to 1,000 Kc, double frequency changing for 1 to 30 Mc.

CIRCLE 318 ON READER SERVICE CARD

Power Inverter

AIRBORNE UNIT

AMERICAN ELECTRONICS, INC., 1598 E. Ross Ave., Fullerton, Calif., announces an airborne d-c to a-c, 400 cps, three-phase power inverter for space applications. Model 121-103-501 is capable of delivering a continuous output of 500 or 750 v-a, depending on the cooling process utilized. It maintains its output frequency regulated at ±0.5 percent. Use of scr's increases overall reliability.

CIRCLE 319 ON READER SERVICE CARD

PRODUCT BRIEFS

CONVERTER-REGULATOR for space application. Lockheed Electronics Co., 6201 E. Randolph St., Los Angeles 22, Calif. (320)

UHF PREAMPLIFIERS ultra-low-noise. Community Engineering Corp., State College, Pa. (321)

DIPPING COMPOUNDS high temperature. Isochem Resins Co., 221 Oak St., Providence 9, R.I. (322)

TELEMETERING COMMUTATOR subminiature unit. Instrument Development Laboratories, Inc., Attleboro, Mass. (323)

BLOCKING OSCILLATOR TRANSFORMER high powered. PCA Electronics, Inc., 16799 Schoenborn St., Sepulveda, Calif. (324)

MICROWAVE ABSORBERS cones and spears. Electronautics Corp., Maynard, Mass. (325)

WIRE WOUND RESISTORS in 10 and 25 w. Dale Electronics, Inc., Columbus, Neb. (326)

LIQUID P-C COATING cures at low temperatures. Sonap Inc., 184 E. Union St., Allegany, N.Y. (327)

SELENIUM RECTIFIER COLUMNS rated to 1 million volts. International Rectifier Corp., 233 Kansas St., El Segundo, Calif. (328)

P-C CONNECTORS crimp-type contacts. U.S. Components Inc., 1320 Zerega Ave., N.Y. 62, N.Y. (329)

EPOXY MOLDING COMPOUNDS for electronic encapsulation. Mitchell-Rand Mfg. Corp., 51 Murray St., New York 7, N.Y. (330)

SEALED TRIMMER POTENTIOMETER ½ in. diameter. Maurey Instrument Corp., 4555 W. 60th St., Chicago 29, Ill. (331)

STROBOSCOPE-TACHOMETER auto-synchronizing. Power Instruments Inc. 7352 No. Lawndale Ave., Skokie, Ill. (332)

DIGITAL LOGIC CIRCUITS half-adder, buffer, counter adapter. Fairchild Semiconductor, 545 Whisman Rd., Mountain View, Calif. (333)

MONITOR-DETECTOR regulates r-f signal levels. Telonic Industries, Inc., Beech Grove, Ind. (334)

Literature of

GOLD-ANTIMONY CEMENT E. I. du Pont de Nemours & Co. (Inc.), Wilmington 98, Del. Ceramic data sheet No. 2 describes No. 7944 gold-antimony cement designed to replace gold-antimony solder preforms used in the manufacture of diodes and transistors. (335)

DECADES & STANDARDS General Radio Co., West Concord, Mass. Resistance, capacitance and inductance decades and standards are described in a 6-page folder. (336)

MAGNETOSTRICTIVE DEVICES Spectran Electronics Corp., 146 Main St., Maynard, Mass. An 8-page brochure, intended as a facilities resumé, contains much state-of-the-art technical information on magnetostrictive devices. (337)

MATCHED PAIRS & QUADS General Electric Co., Syracuse, N.Y. Specification sheets 70.90 and 70.91 deal with four matched diode assemblies made from ultra high speed and controlled conductance planar epitaxial passivated silicon switching diodes. (338)

SILICON TRANSISTOR OSCILLATOR Solid State Electronics Co., 15321 Raven St., Sepulveda, Calif. Bulletin covers the model C-110 crystal and heater controlled silicon transistor oscillator. (339)

LOW-NOISE TRANSISTORS Sperry Semiconductor, Norwalk, Conn. A specification sheet describes *pnp* silicon alloy transistors. (340)

TERMINAL BLOCKS DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N.Y. Brochure covers an expanded line of solderless terminal blocks with taper pin wiring terminations. (341)

FLEXIBLE PRINTED CIRCUITRY Garlock Electronic Products, Camden, N.J., offers an engineering manual entitled "Flexible Printed Circuitry With Teflon FEP." (342)

HARMONIC FILTER Caswell Electronics Corp., 414 Queens Lane, San Jose 12, Calif. Loose-leaf perforated sheet illustrates and describes a new harmonic filter. (343)

ENVIRONMENTAL EQUIPMENT Temperature Engineering Corp., 1 Tempcor Blvd., Riverton, N.J., has

prepared a 56-page catalog of temperature processing and environmental equipment. (344)

GROUND SUPPORT UNITS Tenney Engineering, Inc., 1080 Springfield Road, Union, N.J., has issued a 44-page illustrated brochure detailing the products and capabilities of its Ground Support and Systems division. (345)

VULCANIZED FIBRE Taylor Fibre Co., Norristown, Pa. Taylorite 113, a flame resistant vulcanized fibre with high dielectric strength and good mechanical properties is described in bulletin 2.11. (346)

INDICATOR SWITCH Industrial Electronic Engineers, Inc., 5528 Vineland Ave., N. Hollywood, Calif. Two-page catalog provides technical information on a multi-label Cue indicator switch. (347)

LINEAR DISPLACEMENT TRANSDUCER Sanborn Co., 175 Wyman St., Waltham 54, Mass. Bulletin covers a d-c differential transformer with built-in carrier system. (348)

MAGNETIC MODULATORS Transmagnetics, Inc., 40-66 Lawrence St., Flushing 54, N.Y. Performance, theory and applications of magnetic modulators are detailed in 10-page bulletin 200-1. (349)

POWER PACKS Electronic Research Associates, Inc., 67 Factory Place, Cedar Grove, N.J. Catalog sheet covers additions to the Transpac line of solid-state miniaturized high current power packs. (350)

ROLLED CERAMIC CAPACITORS Hi-Q Division, Aerovox Corp., Olean, N.Y. High-capacity, high-reliability rolled ceramic capacitors are the subject of a 2-page technical bulletin. (351)

MODULAR HOUSINGS Stantron, Division of Wyco Metal Products, 6914 Beck Ave., N. Hollywood, Calif. A catalog describes and illustrates a large variety of modular electronic housings. (352)

EPOXY RESIN ADHESIVES Bacon Industries, Inc., 192 Pleasant St., Watertown 72, Mass., offers three data sheets on epoxy resin adhesives compounded for hermetic sealing applications. (353)

Beck: Analyze . . . then choose

SOME WEEKS after he became president of Philco Corporation, Charles Beck was leaving his office to address the Philadelphia Chamber of Commerce. Word came that Philco distributors in the Atlanta, Ga., region wanted to hear from their new boss that same evening. Rather than put off either engagement, Charles E. Beck flew to Atlanta practically from the Chamber speaker's rostrum and was back at work in his Philadelphia offices the next day.

Actions like this typify Philco's dynamic young president—recently described by a Ford Motor Co. vice president as the man within Ford who knows most about Philco. Well before the two companies merged, Beck had made a thorough study of Philco and was directly in charge of merger negotiations.

Unworried about learning the intricacies of the electronics industry, Beck says any problem is one of analysis. "Based on analysis, the next step is to choose the right alternative. Do this and the problem is solved."

Long involved in the ins and outs of foreign trade through his Ford affiliations, Beck has some firm feelings on the subject as applied to electronics. He acknowledges the tough challenge imposed by Europe and Japan but insists that the answer is not for America to put up its guard defensively. "We must be more aggressive than ever," he says. "We must fight back. The answer lies in emphasizing efficiency, not in crying for help."

Ask one of Beck's associates what the new executive likes to do by way of relaxation and the answer is usually "Work!". He is a man of few hobbies, lots of drive and countless cigars. He once quipped to a member of his staff that he smokes so many cigars to keep things going for his tobacco-growing friends and neighbors in his home town of Stanford, Ky.

Beck was born on a farm forty years ago, the third of four children. Except for a five-year period he lived and worked on the farm until he left in 1939 to go to Berea College on a scholarship. His excellent high school record included winning the state public speaking championship.

Although he first studied agricultural sciences, he transferred his interests in 1943 to business and moved to Detroit. He worked for Murray Corp., an auto body manufacturer, and went to the University of Detroit at night.

During the war, Beck served as a B-29 pilot with the 20th Air Force. Most of his duty was in the Pacific. He returned to the Murray Corp., earned BA and BS degrees at Wayne State University and taught night classes in management technology at Wayne for five years.

From Murray, Beck moved to Ford where his talent in management led him eventually to the position at Philco.

Among the many extra tasks that Beck now has is finding a home in the Philadelphia area for his wife Ruth and three children: Bobby, 10; Susan, six; and David, four. The family is living in Dearborn, Mich., for the time being.

D'Onofrio Takes New Sperry Post

APPOINTMENT of Carmine D. D'Onofrio as manager of the Sperry Gyroscope Company's Marine Division, Syosset, L.I., N.Y., is announced.

D'Onofrio returns to Sperry's Long Island industrial complex after a year-and-a-half assignment as assistant manager and then acting manager of the Sperry Utah Co. in Salt Lake City.

Sperry's Marine Division is primarily responsible for development and production of inertial navigation systems, computers and control equipment for the Navy's Polaris submarines.

DuPont Opens Research Laboratory

THE CERAMIC DIVISION of DuPont's Electrochemicals Dept., has moved its research team from the Perth

Amboy, N.J., plant to Chestnut Run Laboratories, near Wilmington, Del. This research center is primarily concerned with technical assistance to customers and with research related to the development of new products and the application of present products to meet customer requirements.

Products for electronic components to be researched here include silver compositions for conductive coatings; gold, platinum and palladium for transistors, diodes and capacitors; and screenable resistor compositions.

Northeastern Names Production Manager

NORTHEASTERN ENGINEERING, INC., Manchester, N. H., has appointed James P. McGuire as production manager. He was last employed with General Electric as a production administrator on the Polaris fire control system.

Northeastern specializes in production of electronic systems and instrumentation.

Sprague Electric Hires Van Hassel

HERBERT J. VAN HASSEL, JR. has joined the Sprague Electric Co., North Adams, Mass., as product specialist for a-c capacitors. He

comes to Sprague from the Gibson Refrigerator division, Hupp Corp.

Research-Cottrell Forms New Division

RESEARCH-COTTRELL, INC., Bound Brook, N.J., has set up an electronics division to market custom designed high-voltage equipment to the electronics industry. The division will offer power supplies, transformers, control systems, and other special electronic equipment, initially in the range of 5,000 to 150,000 v with power outputs to 500 Kw, for specialized uses.

The recently-expanded laboratory and testing facilities will be utilized by the new division.

PEOPLE IN BRIEF

Gen. Graves B. Erskine, USMC (Ret.), has joined the Systems Div. of Beckman Instruments, Inc., as an executive consultant. **Sherrod E. Skinner**, retired from General Motors Corp., is elected chairman of the board of trustees of Aerospace Corp. **Archie P. Kelley** is promoted to director of advanced research at AiResearch Mfg. Div. of The Garrett Corp. **Amir H. Sepahban**, formerly with Philco Corp., named principal staff engineer at Martin Marietta Electronic Systems & Products Div. **John R. Thorne**, ex-Litton Systems, Inc., now president of the newly formed The Scionics Corp. in Canoga Park, Calif. **Leon S. Nergaard** advances to director of the microwave research laboratory at RCA's David Sarnoff Research Center. **Don Sweet** moves up at Electronic Engineering Co. of California to the post of senior group engineer. Kane Engineering Laboratories elevates **Max P. Forrer** to manager, applied physics group. **Seymour Schwartz** of Transistor Applications, Inc., elected chairman of the board of its subsidiary, New England Transformer Co. Carad Corp. ups **David Simmons** to director of engineering. **Paul B. Wishart**, president of Minneapolis-Honeywell Regulator Co. is elected chairman of the board and chief executive officer. **James H. Binger**, v-p and director, succeeds him as president.

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electronics

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2. Select those for which you qualify.
3. Notice the key numbers.
4. Circle the corresponding key number below the Qualification Form.
5. Fill out the form completely. *Please print clearly.*
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ATOMIC PERSONNEL INC. Philadelphia, Pennsylvania	126*	3
BOONTON RADIO CORP. Boonton, New Jersey	128*	4
DALMO VICTOR CO. Div. of Textron, Inc. Belmont, California	92	5
ERIE ELECTRONICS DIV. Erie Resistor Corp. Erie, Pennsylvania	126*	6
ESQUIRE PERSONNEL SERVICE INC. Chicago, Illinois	126*	7
GENERAL DYNAMICS/ASTRONAUTICS San Diego, California	33, 34	8
GRUMMAN AIRCRAFT ENGINEERING CORP. Bethpage, L. I., New York	89	9
HARVARD UNIVERSITY Cambridge, Massachusetts	92	10
INTERNATIONAL ELECTRIC CORP. Paramus, New Jersey	120*	11
I T T KELLOGG Communications Systems Division Chicago, Illinois	93	12
JET PROPULSION LABORATORY California Institute of Technology Pasadena, California	125*	13
LOCKHEED MISSILES & SPACE CO. Group Div. of Lockheed Aircraft Corp. Sunnyvale, California	74*	14
MICROWAVE SERVICES INTERNATIONAL, INC. Duarte, California	126*	15
MINNEAPOLIS HONEYWELL CO. Denville, New Jersey	127*	16

CONTINUED ON PAGE 92

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electronics WEEKLY QUALIFICATION FORM FOR POSITIONS AVAILABLE

Personal Background

NAME .....

HOME ADDRESS .....

CITY .....ZONE.....STATE.....

HOME TELEPHONE .....

Education

PROFESSIONAL DEGREE(S) .....

MAJOR(S) .....

UNIVERSITY .....

DATE(S) .....

FIELDS OF EXPERIENCE (Please Check)

11962

- ☐ Aerospace
- ☐ Antennas
- ☐ ASW
- ☐ Circuits
- ☐ Communications
- ☐ Components
- ☐ Computers
- ☐ ECM
- ☐ Electron Tubes
- ☐ Engineering Writing
- ☐ Fire Control
- ☐ Human Factors
- ☐ Infrared
- ☐ Instrumentation
- ☐ Medicine
- ☐ Microwave
- ☐ Navigation
- ☐ Operations Research
- ☐ Optics
- ☐ Packaging
- ☐ Radar
- ☐ Radio—TV
- ☐ Simulators
- ☐ Solid State
- ☐ Telemetry
- ☐ Transformers
- ☐ Other .....
- ☐ .....
- ☐ .....
- ☐ .....

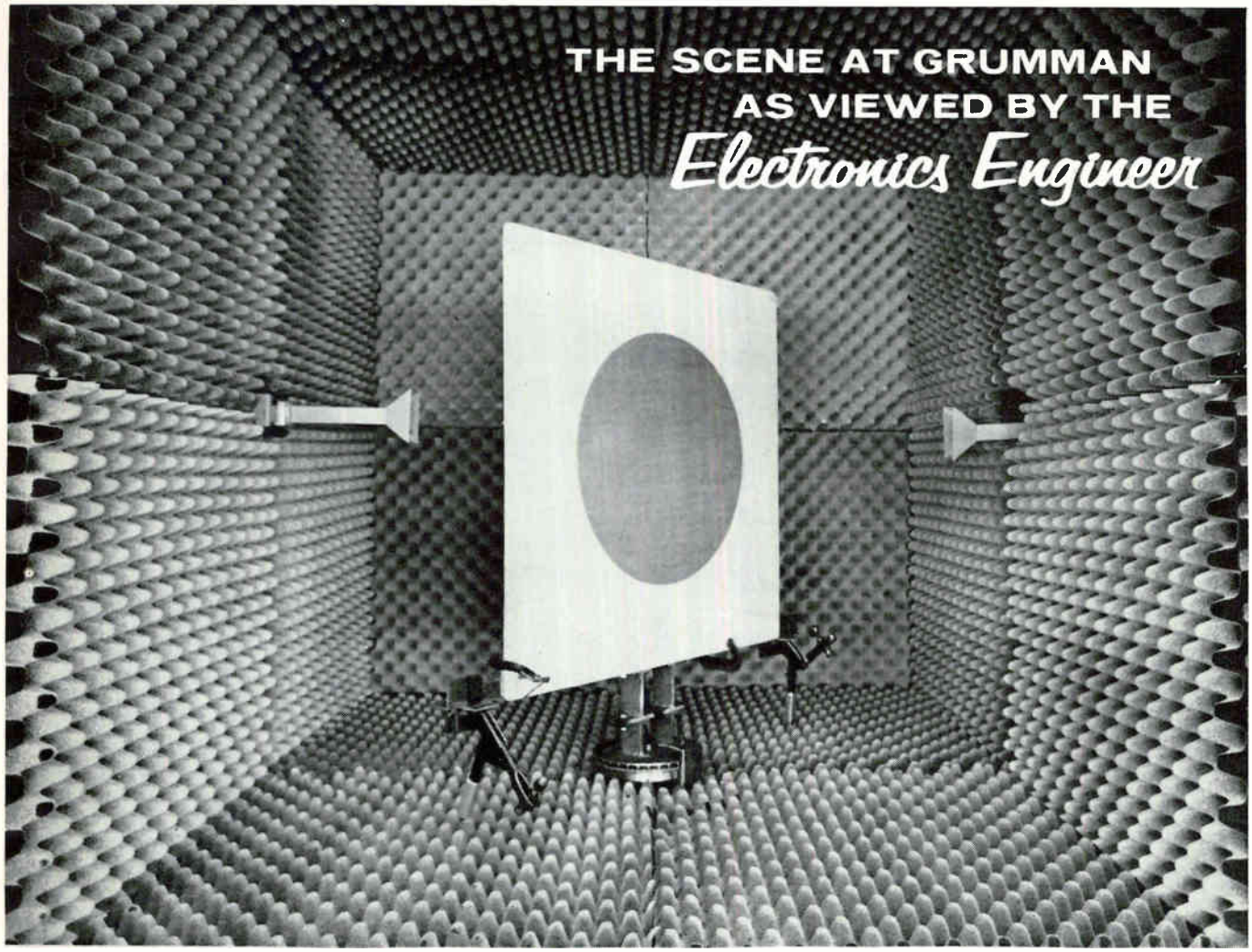
CATEGORY OF SPECIALIZATION

Please indicate number of months experience on proper lines.

	Technical Experience (Months)	Supervisory Experience (Months)
RESEARCH (pure, fundamental, basic)	.....	.....
RESEARCH (Applied)	.....	.....
SYSTEMS (New Concepts)	.....	.....
DEVELOPMENT (Model)	.....	.....
DESIGN (Product)	.....	.....
MANUFACTURING (Product)	.....	.....
FIELD (Service)	.....	.....
SALES (Proposals & Products)	.....	.....

CIRCLE KEY NUMBERS OF ABOVE COMPANIES' POSITIONS THAT INTEREST YOU

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25



...Dark Room

To obtain the electrical properties of various dielectric materials in the microwave frequency spectrum, Grumman engineers designed this miniature microwave "dark room" (Anechoic Chamber) about a two-horn interferometer. This unique device can accurately determine the "electrical" thickness or effective dielectric constant of flat panel samples of exotic materials which are used in Grumman's continuing advances into "Space" environment. A good example of these advances is the Orbiting Astronomical Observatory (OAO) Grumman is building for the NASA. The OAO is but one of the many programs at Grumman deeply involved with electronics. Electronics engineers who can add to this capability are urged to consider the following positions:

Radome/Antenna Design Engineer—BS in EE or Physics with a minimum of 3 years experience in radome and antenna design. Background in classical electromagnetic theory and advanced math essential. Work consists of analysis and synthesis of radomes, or antennas on current and advanced designs including the use of the IBM computer facilities to develop design techniques.

Digital Computer Systems Engineer—BSEE with a minimum of 4 years experience in the analysis design and development of digital computers. Will participate in the integration of digital computer into a complex weapons system. A significant part of the effort will be devoted to extensive laboratory and flight development programs.

Radar Development Engineers—BSEE with a minimum of 4 years experience in the analysis, design and development of airborne radar systems. Should be capable of analyzing the radar system with the end view of integrating the equipment into a complex weapons system. Will fully participate in laboratory and flight development programs conducted in the finest facilities available in a professional atmosphere.

Data Processing Engineers—Background in digital data processing, logic circuit design, memory devices, R-F modulation techniques and related digital techniques required. Opportunity to participate in advanced design of systems concepts and hardware development. BSEE or BS in Physics with a minimum of 3 years' applicable experience is required.

To arrange an immediate interview, send your resume to Mr. W. Brown, Manager Engineering Employment, Dept. GR-76
(U. S. citizenship required)

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Bethpage · Long Island · New York

All qualified applicants considered regardless of race, creed, color or national origin.

Philco WDL has immediate and challenging engineering positions open in Discoverer, Midas and Advent programs in these categories:

Data systems engineering

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Systems test planning

Systems reliability analysis

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Tracking and control systems design

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And others

U. S. citizenship or current transferable Department of Defense clearance required.

if your future is for growing...

People at Philco's Western Development Laboratories are proud of their achievements, secure in the steady growth of their company, enthusiastic about their future.

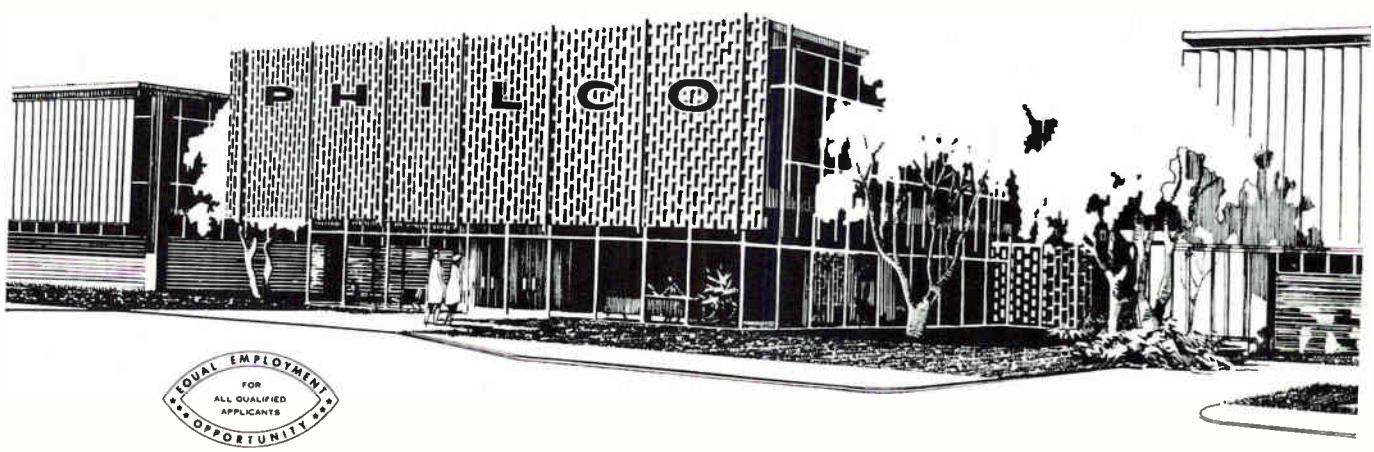
In just four years, Philco WDL has expanded from a staff of 18 to more than 2,000. At the end of this year WDL will open a new 250,000-square-foot facility which will accommodate a continually expanding complement of engineers, scientists and supporting staff members.

Philco WDL, the space organization which designed and built the Courier satellite, conducts an ever-growing development program in tracking, satellite instrumentation, communications, data processing and command—moving hand in hand with the federal government in space exploration and space age defense.

Your growth with a growing company, ideal living on the Northern California Peninsula, professional and monetary advancement commensurate with your own ability—these are some of the advantages and satisfactions of working at Philco Western Development Laboratories.

If yours is one of the fields listed at the left, write today to Mr. W. E. Daly, in confidence, of course, Department E-12.

This new 250,000-square-foot addition to Philco Western Development Labs is further indicative of your future there.



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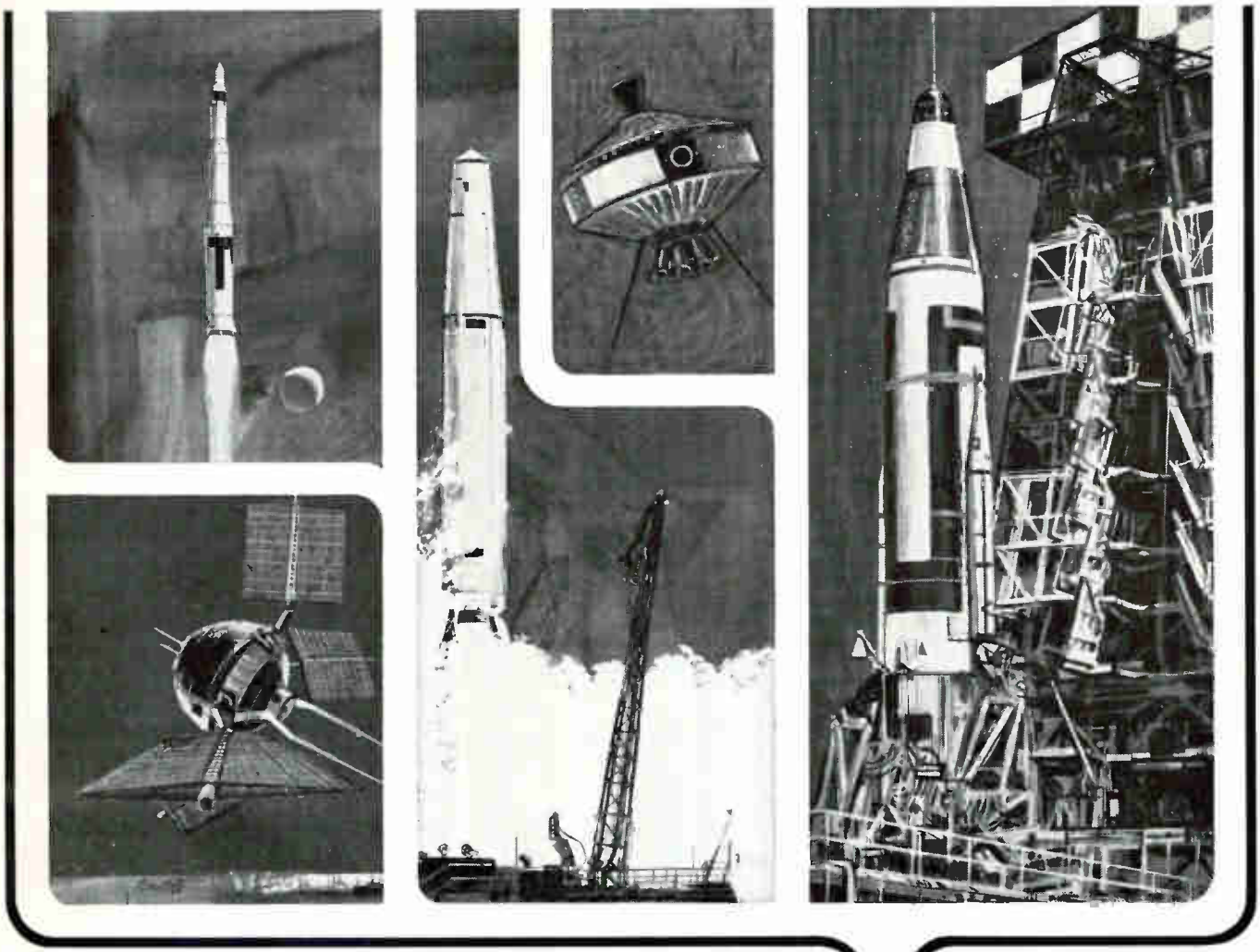
WESTERN DEVELOPMENT LABORATORIES

3875 Fabian Way, Palo Alto, California

CAREERS IN SPACE TECHNOLOGY LEADERSHIP



Of particular interest to engineers and scientists is the continuing growth and diversification of Space Technology Laboratories, Inc. What is now STL was founded as the Guided Missile Research Division of the Ramo-Wooldridge Corporation in 1954, when the Ballistic Missile Program was given highest national priority. ■ Assigned contractual responsibility for the program's systems engineering and technical direction, STL has grown in parallel with the need for its capabilities – from a small group of engineers, scientists and administrators to an industrial organization with a professional staff numbering more than 2,000 with 2,500 supporting personnel – from its initial headquarters in a suburban Los Angeles schoolhouse to the ultra-modern STL Space Technology Center nearing completion on a 110-acre site at One Space Park, Redondo Beach, California, close to Los Angeles International Airport. ■ During its years of Space Technology Leadership, STL has contributed importantly to the management of a program that, in a successful race against time, has given this nation the Thor, Atlas, Titan and Minuteman ballistic missile systems. At the same time, STL has been called upon to design, fabricate, instrument and successfully launch Pioneer I, Explorer VI and Pioneer V – all of which were tracked and commanded by STL's world-wide space communication network (SPAN) – and to contribute to the management of the Transit 1B, Transit 2A, Transit 3B, Courier 1B and Tiros programs. ■ Today, STL in addition to its continuing role in the USAF Atlas, Titan and Minuteman programs, is performing research, development, design and construction for three Orbiting Geophysical Observatories (OGO), as well as project coordination and systems planning for Project Relay, both for NASA; and participating in the Army Advent communication satellite project. STL's continuing program of original and applied research covers a broad spectrum of technical disciplines including particle physics, solid state theory, guidance space physics, communication theory, propulsion and power, and electromagnetic systems in the infrared, ultraviolet and microwave regions. ■ The expanding activities of STL create immediate career opportunities in Southern California and at Cape Canaveral for engineers and scientists of talent and vision. All qualified applicants are invited to communicate with Dr. R. C. Potter, Manager of Professional Placement and Development. STL is an equal opportunity employer.

Career opportunities exist at STL for qualified engineers and scientists in support of these programs:

ATLAS
TITAN
MINUTEMAN
OGO
ADVENT
RELAY

SPACE TECHNOLOGY LABORATORIES, INC.

P.O. BOX 95005-J LOS ANGELES 45, CALIFORNIA
P.O. BOX 4277, PATRICK AFB, FLORIDA

a subsidiary of Thompson Ramo Wooldridge Inc.

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405A

electronics

WEEKLY QUALIFICATIONS FORM FOR POSITIONS AVAILABLE

(Continued from page 88)

COMPANY	SEE PAGE	KEY #
MITRE CORPORATION Bedford, Massachusetts	95*	17
PAN AMERICAN WORLD AIRWAYS INC. Guided Missiles Range Div. Patrick AFB, Florida	14	18
PHILCO WESTERN DEVELOPMENT LABS. Palo Alto, California	90	19
REMINGTON RAND Office Machines Div. of Sperry Rand Corp. South Norwalk, Connecticut	126*	20
SANDERS ASSOCIATES INC. Nashua, New Hampshire	125*	21
SPACE TECHNOLOGY LABS., INC. Sub. of Tompson-Ramo-Wooldridge Los Angeles, California	91	22
UNION CARBIDE NUCLEAR CO. Oak Ridge, Tennessee	93	23
UNIVERSITY OF MICHIGAN Ann Arbor, Michigan	92	24
P-7950	92	25

* These advertisements appeared in the 1/12/62 issue.

SEARCHLIGHT SECTION

(Classified Advertising)

BUSINESS OPPORTUNITIES
EQUIPMENT — USED or RESALE

●

DISPLAYED RATE

The advertising rate is $27.25 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request. AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page. EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

UNDISPLAYED RATE

$2.70 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

PROPOSALS, $2.70 a line an insertion. BOX NUMBERS count as one line additional in undisplayed ads.

DISCOUNT OF 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

NEW INDUSTRY WANTED

INDEX TO ADVERTISERS

Audited Paid Circulation

• See advertisement in the July 20, 1961 issue of Electronics Buyers' Guide for complete line of products or services.

■

• See advertisement in the July 20, 1961 issue of Electronics Buyers' Guide for complete line of products or services.

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R. S. QUINT:
Assistant Publisher Buyers' Guide and Business Manager
FRED STEWART:
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Marketing Service Manager

RICHARD J. TOMLINSON:
Production Manager
GEORGE E. POMEROY:
Classified Manager
HUGH J. QUINN:
Circulation Manager

ADVERTISING REPRESENTATIVES

NEW YORK (36):
Donald H. Miller, Henry M. Shaw, George F. Werner
500 Fifth Avenue, OXford 5-5959
BOSTON (16):
William S. Hodgkinson, Donald R. Furth
McGraw-Hill Building, Copley Square, Congress 2-1160
PITTSBURGH (22):
David M. Watson
Four Gateway Center, Express 1-1314
PHILADELPHIA (3):
Warren H. Gardner, William J. Boyle
6 Penn Center Plaza, LOcust 8-4330
CHICAGO (11):
Harvey W. Wernecke, Robert M. Denmead
645 North Michigan Avenue, Mohawk 4-5800
CLEVELAND (13):
Paul T. Fegley
55 Public Square, Superior 1-7000
SAN FRANCISCO (11):
R. C. Alcorn
255 California Street, Douglas 2-4600
LOS ANGELES (17):
Peter S. Carberry, Ashley P. Hartman
1125 W. 6th St., Huntley 2-5450

DENVER (2):
J. W. Patten
Tower Bldg., 1700 Broadway, Alpine 5-2981
ATLANTA (9):
Michael H. Miller
1375 Peachtree St. N.E., Trinity 5-0523
HOUSTON (25):
Joseph C. Page, Jr.
Prudential Bldg., Holcomb Blvd., Jackson 6-1281
DALLAS (1):
Frank Le Beau
The Vaughn Bldg., 1712 Commerce St.
Riverside 7-9721
LONDON W1:
Dennis McDonald
34 Dover St.
FRANKFURT/Main:
Stanley R. Kimes
85 Westendstrasse
GENEVA:
Michael R. Zeynel
2 Place du Port

"Headquarters for Business Information"

McGraw-Hill Technical and Business Publications

American Machinist/Metalworking Manufacturing
Aviation Week and Space Technology
Business Week
Chemical Engineering
Chemical Week
Coal Age
Construction Methods and Equipment
Construction Daily
Control Engineering
Electrical Construction and Maintenance
Electrical Merchandising Week
Electrical Newsletter
Electrical West
Electrical Wholesaling
Electrical World
Electronics
Engineering Digest
Engineering and Mining Journal
E & MJ Metal and Mineral Markets
Engineering News-Record
Factory
Fleet Owner
Industrial Distribution
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Nucleonics
Nucleonics Week
Platt's Oilgram News
Platt's Oilgram Price Service
Power
Product Engineering
Purchasing Week
Science Week
Textile World

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Ingenieria Internacional Construccion
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Metalworking Production (Great Britain)

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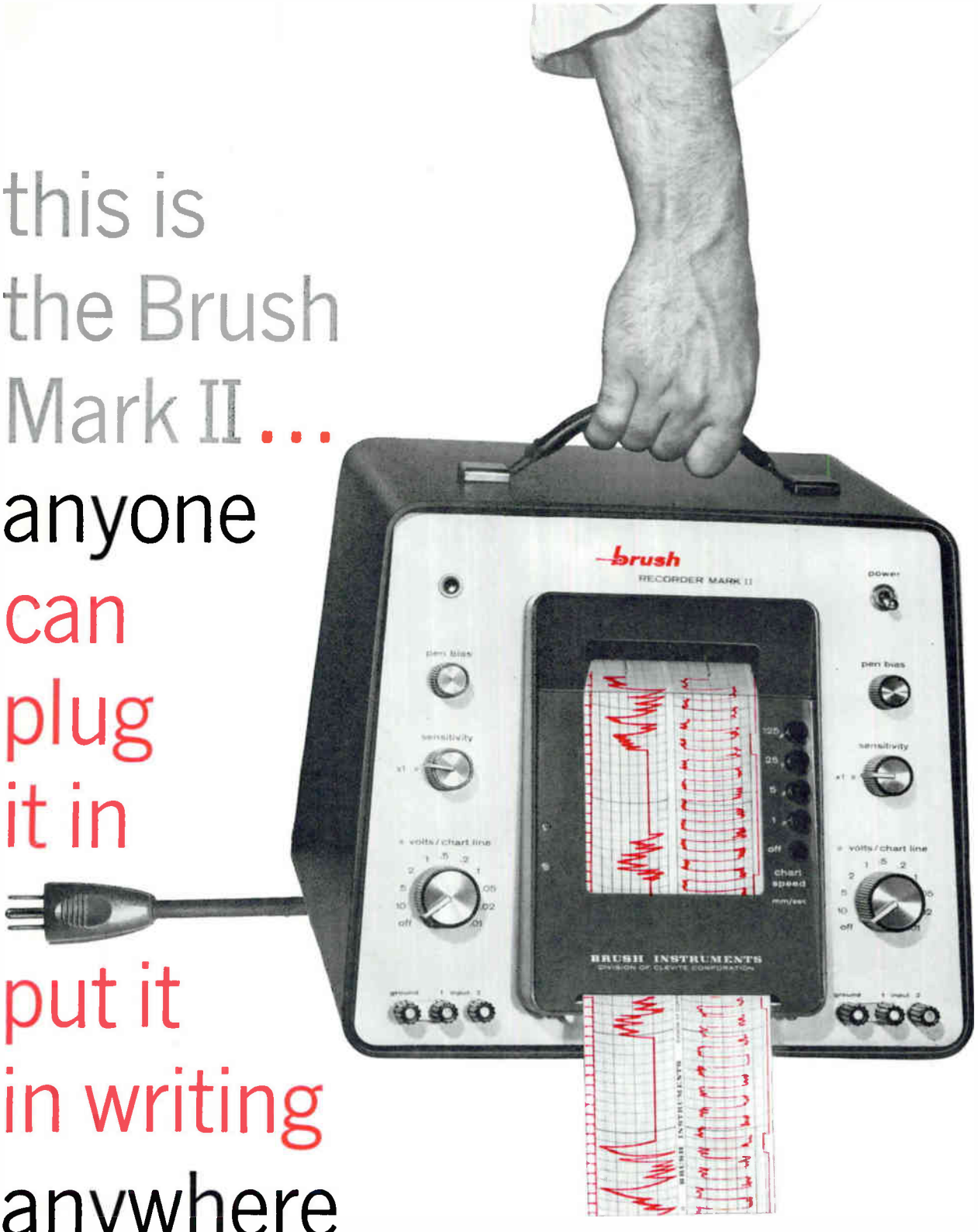
this is the Brush Mark II...

anyone can plug it in put it in writing anywhere



There is no direct writing recorder on the market that approaches the compact Mark II in sheer usefulness. It is a completely integrated engineering tool that can be operated by anyone . . . in the shop or in the field . . . for countless research or design requirements. Every function necessary for uniform, crisp, easily reproduced readouts is "built-in". The Mark II gives you two analog channels plus two event markers; 4 chart speeds; DC to 100 cps response with 40 mm amplitude; 10 mv/mm sensitivity; high input impedance. Ink or electric writing models. Immediate shipment from stock.

brush INSTRUMENTS
DIVISION OF
37TH AND PERKINS **CLEVITE** CORPORATION CLEVELAND 14, OHIO

For use in electronic equipment that must perform dependably in strong nuclear radiation fields

Among conventional active electronic circuit components, the RCA nuvistor electron tube is in the class of components *least susceptible to catastrophic failure from nuclear radiation.* In addition nuvistors are commercially available and offer extremely small size, light weight, and exceptionally low power drain.

These facts are of utmost importance to you if you are designing communications or navigational equipment which must provide dependable performance in an environment of strong nuclear radiation. In such an environment, even momentary failure of equipment can disastrously curtail our vital communications or navigation operations.

Recent tests have shown that the RCA-7586 nuvistor triode and the RCA-7587 nuvistor tetrode have given dependable performance after being subjected to a nuclear radiation pulse of extremely high intensity as specified in the Neutron Radiation Damage Test, Military Standard MIL-STD-446A, November 25, 1960.

In these critical equipment design areas, one cannot afford to risk component failure. Specify RCA nuvistor for airborne communications, airborne controls, missile avionic systems, radar networks, telemetering equipment, and ground support equipment.

For additional information, see the RCA Field Representative at our office nearest you.

RCA

The Most Trusted Name in Electronics

RCA ELECTRON TUBE DIVISION—FIELD OFFICES

EAST: 744 Broad Street, Newark 2, New Jersey, HUmboldt 5-3900 • MIDWEST: Suite 1154, Merchandise mart Plaza, Chicago 54, Illinois, WHitehall 4-2900 WEST: 6801 E. Washington Blvd., Los Angeles 22, Calif., RAymond 3-8361 • 1838 El Camino Real, Burlingame, Calif., OXford 7-1620