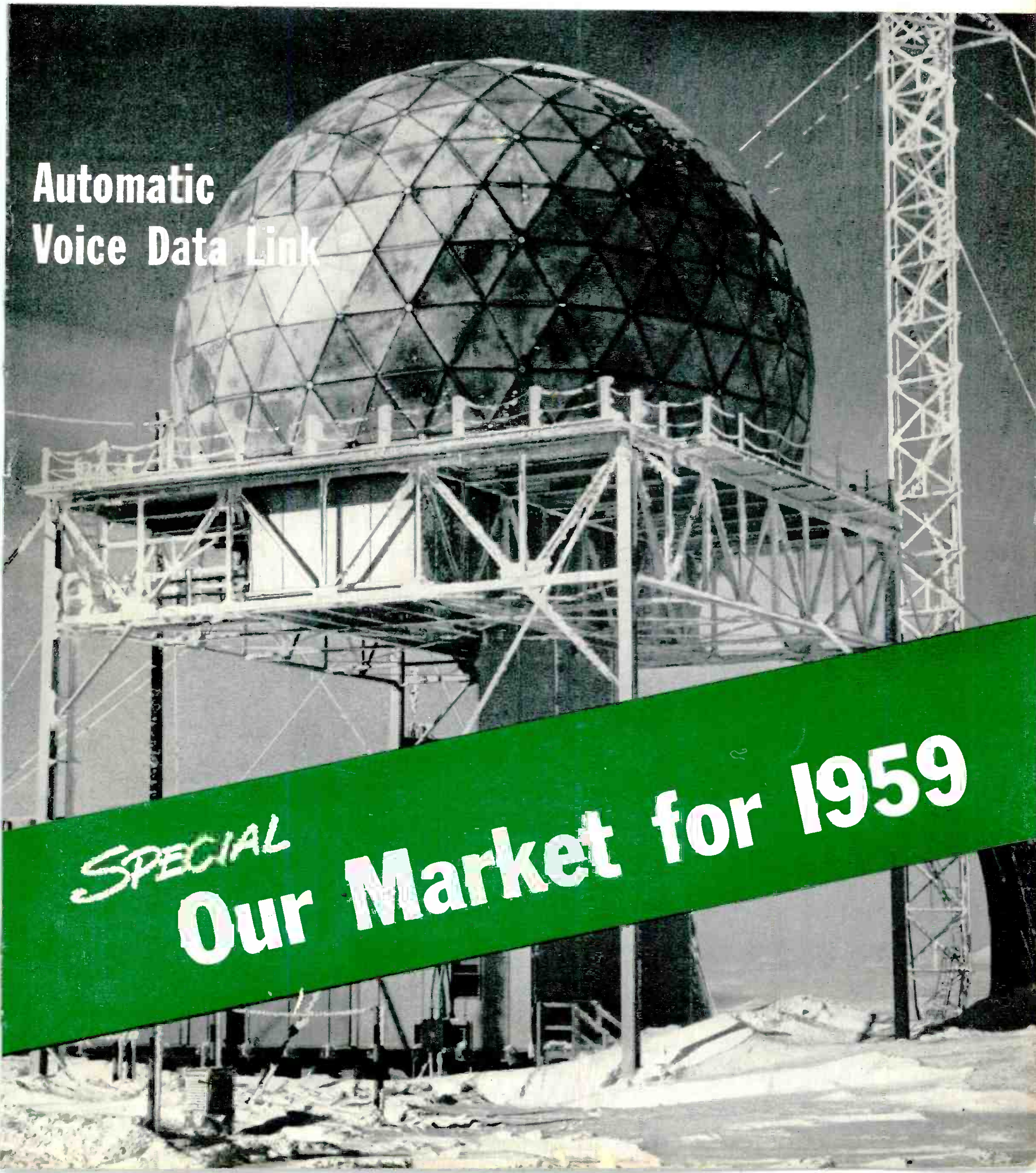
JANUARY 9, 1959

electronics

A McGRAW-HILL PUBLICATION • VOL. 32, No. 2 • PRICE SEVENTY-FIVE CENTS



electronics

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A McGRAW-HILL PUBLICATION
Vol. 32 No. 2

Issue at a Glance

BUSINESS

ENGINEERING

DEPARTMENTS

Dr. Wright takes the  stand for **electronics**

What is your present work in electronics, Dr. Wright?
Vice President In-Charge-of-Operations-and-Engineering at Tung-Sol Electric Inc., a leading manufacturer of electron tubes, semiconductors, tv tubes, lamps, power supplies, flashers, selenium and silicon rectifiers.

How many people are at Tung-Sol?
Approximately 6,000.

Briefly, what is your background in electronics?
Twenty-two years with Tung-Sol.

How many years have you been reading **electronics**?
It goes back over twenty years..

Why have you continued to read it?
After all, this is a very technical and rapidly changing industry. I don't know which is more important, the editorial or advertising. They both help us to keep up with what's going on in the world of electronics.

It has been said that leading publications build a "personality" for themselves. This is a quality that cannot be measured with facts and statistics. How would you characterize the "personality" of **electronics** magazine?
It's not too highbrow, yet it's not a gossip sheet. It's an excellent middle-of-the-road job of reporting technical and business developments. **electronics** *does a down-to-earth reporting job.*

If it's about electronics, read it in **electronics.**

electronics

Published WEEKLY plus the mid-year electronics BUYERS' GUIDE
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ABC ABP

CIRCLE 1 READERS SERVICE CARD→

and now... SOLAR FURNACES!

FROM SUNBEAM TO SUNBOMB: Sunlight is reflected from 355-mirror heliostat ❶, through shuttered attenuator ❷, strikes 180-mirror concentrator ❸. Concentrator focuses a 4" dia. image of approx. 5,000°F within test chamber ❹.

This mighty complex of mirrors can convert a dancing sunbeam into a devastating "sunbomb" — a pulse of concentrated energy hot enough to make tungsten boil.

Such is the new solar furnace of the U. S. Army Quartermaster Research and Development Command just installed at Natick, Mass. It is designed to simulate the intense heat radiation of atom bomb blasts in order to test Army protective materials before actual field trials.

There's more to the furnace than mirrors, of course. The intricate solar tracking mechanisms, capable of following the sun in both elevation and azimuth — as well as the rugged construction which enables the furnace to withstand hurricane winds — these are by Kennedy, a long-time tamer of "out-of-this-world" problems.

CHALLENGING POSITIONS OPEN FOR ENGINEERS IN THIS FAST-GROWING ORGANIZATION

ANTENNA EQUIPMENT

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electronics

Jan. 9, 1959 Vol. 32, No. 2

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

Member ABP and ABC

Shoptalk . . .

CONTINENTAL DEFENSE—Three weeks ago a supersonic Bomarc missile launched from Cape Canaveral brought down a drone flying off the coast of Florida. Intercept data was relayed to the missile by way of a Sage system computer in Kingston, N. Y. Thus ended the testing phase of the Bomarc project. Future firings will be by operational crews training to handle the missile. **On p 26, Associate Editor Mason tells how the radar-to-computer-to-missile triple play of our continental air defense works and who's who in the project.**

Another aspect of continental air defense is vectoring manned interceptors in on hostile bombers. **On p 47, C. W. Poppe of Fairchild Camera and Instrument describes an automatic voice data link that helps reduce human error in passing the word.**

Rounding out the picture, the cover photograph of this issue shows one of our DEW line stations operated by Federal Electric Corp. These long-range radars are the far-seeing eye of continental air defenders.

OUR MARKET FOR 1959—**Next year will be a good one for the electronics industry. Government spending for electronics is big and getting bigger both by actual volume and percentagewise for our industry. Things look good for the home entertainment market and for sales of industrial and commercial electronic equipment.**

These are the conclusions of members of ELECTRONICS research staff, whose statistical look ahead for the electronics business is the subject of a Special Report beginning on p 41. The report is based upon three months of intensive study of the industry, during which our research staff contacted producers and consumers of electronic equipment and components from coast to coast; compared the findings and predictions of all public and private fact-gathering groups.

Coming in Our January 16 Issue . . .

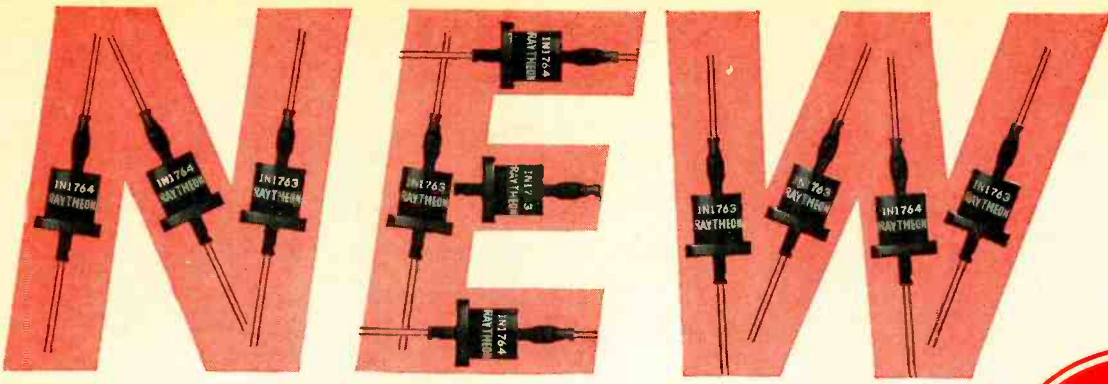
RANGE INSTRUMENTATION—Each time a missile leaves the launching pad at Cape Canaveral, the Caribbean airwaves hum with data as hundreds of millions of dollars worth of electronic gear goes to work. From launch to terminal flight to final impact, precision electronic and optical systems follow the huge birds and relay vital data to scientists on the ground.

Next week Associate Editor Leary brings you the complete story of how range instrumentation has become an extensive new field of applied technology in a few short years. It's a story that has been a year in the gathering. Leary traveled extensively, talked to Air Force people responsible for missile range instrumentation at Patrick AFB and other installations.

You'll learn details of the incredibly complex telemetry, tracking and computing facilities now in existence.

FERROELECTRIC DEVICES—**Electric tuning techniques using the nonlinear characteristics of dielectric materials such as barium strontium titanates are finding increasing use in electronic circuit design.**

According to T. W. Butler of the University of Michigan's Electronic Defense Group, voltage tunable ferroelectric capacitors are being applied to a variety of practical circuits such as f-m oscillators, panoramic receivers and afc systems. Butler's article describes how these new devices are made and what problems are involved in using them as circuit elements.



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1N1763 and 1N1764 DIFFUSED JUNCTION

SILICON RECTIFIERS

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FEATURES:

Economical—now, silicon rectifiers at entertainment field prices.

Uniform — the Raytheon Solid State Diffusion Process permits flat junctions and assures uniform characteristics and uniformly high quality.

Hermetically Sealed — Welded

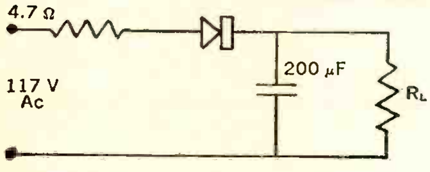
Reliable

SPECIFICATIONS:

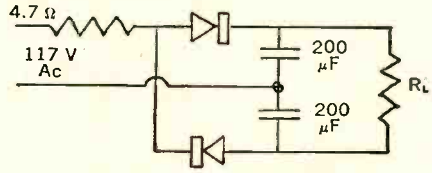
PARAMETER (25°C)	TYPE 1N1763*	TYPE 1N1764†	UNITS
PIV	400	500	V
RMS Voltage	140	175	V
DC Load Current	500	500	mA
Surge Current for 0.1 sec	15	15	A
Max. Reverse Current at PIV	100	100	μA

*for operation direct from power line
†for operation from step-up transformer

TYPICAL CIRCUIT APPLICATIONS



Half wave rectifier, capacitive load



Full wave doubler circuit

RAYTHEON SEMICONDUCTOR DIVISION
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GENERAL PLATE

Copper Cored Glass Sealing Wire Features a Sound Metallurgical Bond

...And Gives You These Advantages...

- **Leakproof Seal between Alloy and Core**
- **High Electrical Conductivity**
- **Increased Thermal Conductivity**
- **Coefficient of Expansion Matches Glass**
- **Facilitates Miniaturization**
- **Cuts Costs**

General Plate Copper Cored Alloy Wire (33% copper clad core, 67% glass sealing alloy) gives you three times greater electrical conductivity than solid #52 alloy wire of equal diameter.

This means you can substantially increase the current carrying capacity of your solid sealed leads without going to larger diameters — or, if you have a miniaturization problem, you can reduce sealing wire diameters correspondingly. The sound metallurgical bond between the copper core and outer shell eliminates any air or gas leaks in the wire.

General Plate Copper Cored Glass Sealing Wires are used for better performance in glass-to-metal seals in hermetically sealed devices such as switches, relays, coils, controls, vacuum tubes and semiconductors.

They are available in #52 alloy, Type 446 stainless, low carbon steel, Kovar* and other glass sealing alloys. Write for Bulletin IND-15.

For details on the complete line of General Plate Clad Metals, ask for a free copy of GP-1 Catalog.

*T.M. Registered Carborundum Co.

You Can Profit by using General Plate Clad Metals

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CIRCLE 3 READERS SERVICE CARD

INTERNATIONAL RECTIFIER CORPORATION

A WORLD OF DIFFERENCE THROUGH RESEARCH

RECTIFIER NEWS

Military Type High Temperature Silicon Power Diodes Operate to 165° C

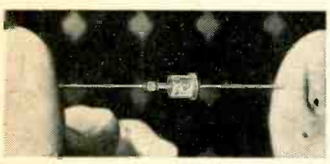
For military or industrial applications where high temperature operation is a must, International Rectifier offers two series of axial lead, hermetically sealed power diodes. Both supply full rated power under convection cooling without a heat sink.

JETEC series 1N536-1N540 and 1N1095-96 operates at −65°C to +165°C with output currents to 750ma. PIV ratings from 50 to 600v. Bulletin SR-202A describes them.

For power supply or magnetic amplifier use, 16 JETEC types are listed in Bulletin SR-132E. Ratings: 50 to 600v PIV at 300ma. Temperature range: −65°C to +150°C.

The high forward conductance and extremely low leakage of these diodes permits rectification efficiencies to 99% at power frequencies; up to 70% at 50kc.

CIRCLE READER SERVICE CARD NO. 115



Ratings: 100 to 600 PIV, up to 500ma

Miniaturized Silicon Diodes For Military and Commercial Use.

Write for Bulletin SR-205

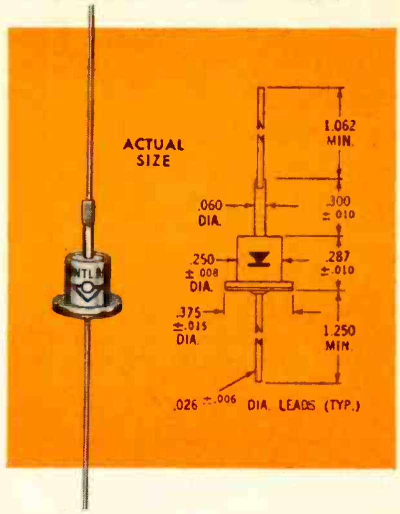
Hermetically Sealed Industrial Silicon Diodes Provide 750ma Output Without Heat Sink

Diodes in this series have been designed to provide optimum reliability and efficiency to your industrial or commercial equipment circuits. By eliminating the space consuming heat sink, you can also realize economies in equipment size as well as assembly time and costs.

Rectified dc output current ratings to 750ma at 50°C can be obtained with PIV voltages ranging from 100 to 500v.

The diode junction is hermetically sealed in an all-welded, shock-proof housing . . . a mechanical construction assuring physical strength and a positive safeguard against contaminants. This adds up to the really important feature — long term reliability! For complete specifications . . .

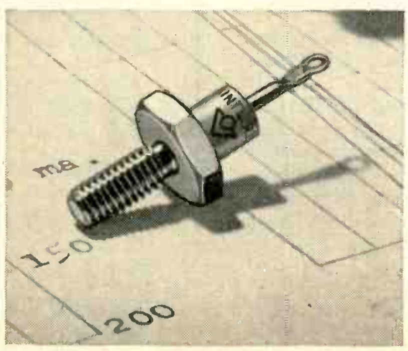
CIRCLE READER SERVICE CARD NO. 116



Absolute Maximum Ratings (at 60 cps. Resistive or Inductive Load)

DIODE TYPES	SD-91	SD-92	SD-93	SD-94	SD-95	SD-91A	SD-92A	SD-93A	SD-94A	SD-95A
Peak Inverse Voltage, Volts	100	200	300	400	500	100	200	300	400	500
RMS Input Voltage, Volts	70	140	210	280	350	70	140	210	280	350
Continuous D.C. Voltage, Volts	100	200	300	400	500	100	200	300	400	500
Rectified D.C. Output Current, ma. at 50° C Ambient	550	550	550	550	550	750	750	750	750	750
at 100° C Ambient	300	300	300	300	300	500	500	500	500	400
Max. Surge Current (1 cycle), Amps.	10	10	10	10	10	15	15	15	15	15
Max. Operating Frequency, Kilocycles	50	50	50	50	50	50	50	50	50	50
Ambient Operating Temperature, °C	−65°C to +125°C					−65°C to +125°C				
ELECTRICAL CHARACTERISTICS										
Max. D.C. Forward Voltage Drop at 25°C	1.5 volts @ 550 ma dc (all types)					1.3 volts @ 750 ma dc (all types)				
Min. Series Resistance (Capacitive Load) (ohms)	6.8	6.8	6.8	6.8	6.8	4.7	4.7	4.7	4.7	4.7
Max. Leakage Current (mA.) at Rated Continuous D.C. Voltage at 100°C	1.0	1.0	1.0	.80	.65	0.5	0.5	0.5	0.4	0.3

High Temperature Stud Mounted Silicon Diode Series Includes Nineteen JETEC and JAN Types.



These silicon power rectifiers are designed for conduction cooling by mounting directly onto the chassis. Ratings from 400ma to one amp. are possible at PIV ratings of from 50 to 600 volts.

Power supply types 1N607 thru 1N614 and magnetic amplifier types featuring low leakage current and high forward conductance are included in Bulletin SR-135C.

JAN types 1N253, 1N254, 1N255 for the military are in full production.

CIRCLE READER SERVICE CARD NO. 117

FOR SAME DAY SERVICE ON PRODUCT INFORMATION DESCRIBED ABOVE, SEND REQUEST ON YOUR COMPANY'S LETTERHEAD

EXECUTIVE OFFICES: EL SEGUNDO, CALIFORNIA · PHONE OREGON 8-6281 · CABLE RECTUSA

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ELECTRONICS NEWSLETTER

ATLAS RADIO COMMAND GUIDANCE is getting new push. GE announces assignment of 150 engineers and technicians to Warren AFB, Cheyenne, Wyo., in connection with installation and checkout of Atlas radio command guidance system. GE expects personnel buildup there will reach peak in 1960.

CANADA may embark on a Bomarc missile program as part of the overall North American air defense scheme. This was reported in Montreal following announcement that Boeing had awarded a contract to Canadair Ltd. for engineering services. Canadian firm is sending 150 missile experts to the U.S. for 12 months to take part in engineering of the Bomarc weapon system.

SNARK, USAF's 6,000-mi-range supersonic missile, gets a $50-million contract boost that will extend production through Dec. 1960. Prime contractor Northrop also produces Snark's stellar-inertial guidance system and airframe.

AIRBORNE TV SURVEILLANCE system called "Alpha" is being evaluated by the Navy, says Temco Aircraft Corp., the developer. Firm says system was designed under Navy contract as a means of terminal guidance for missiles, but is also being evaluated for reconnaissance use.

TRANSISTORIZED DATA-PROCESSING system is announced by RCA. 501 system uses transistorized auxiliary input and output gear, fits into a 15 by 20-ft room. Basic unit costs $675,000, or is leased at rate of $13,000 for a 40-hour week.

JAMES B. FISK this month moved up to the presidency of Bell Telephone Laboratories, while president Mervin J. Kelly became chairman of the board of directors. Fisk last summer was chairman of the Western delegation at Geneva which studied ways of detecting nuclear tests in the event an agreement on their suspension could be reached.

Atlas computer components are plated with 24-karat gold, assembled in building blocks and soldered automatically in an infrared induction furnace at Burroughs Corp. Detroit-area plant.

RUSSIANS are making production use of numerically controlled machine tools operating from punched tape or magnetic tape. So says Harry W. Mergler, assistant professor of mechanical engineering at Case Institute of Technology, who recently visited Soviet factories. Mergler also noted that in the automatic controls field the Soviets have a tendency to put a system into full-scale production line use as soon as it's in reasonably good working state.

SWALLOW, Republic's surveillance drone system, (ELECTRONICS, p 14, May 30, 1958), has been given a $25-million contract boost by Army Signal Corps. The small SD-4 jet pilotless aircraft will be equipped with radar, infrared and photographic cameras. Guidance is accomplished by preprogrammed automatic guidance or by ground or air control.

DOPPLER RADAR tornado warning system has been proved practical. That's the report from Cornell Aeronautical Laboratory which developed the system for the U. S. Weather Bureau. CAL says development brings "hope for mitigating some of the severe damage caused by tornadoes."

Infrared pyrometer that detects overheating of airplane engines between 300 and 700 C was recently unveiled by the Nippon Electric Co. in Tokyo.

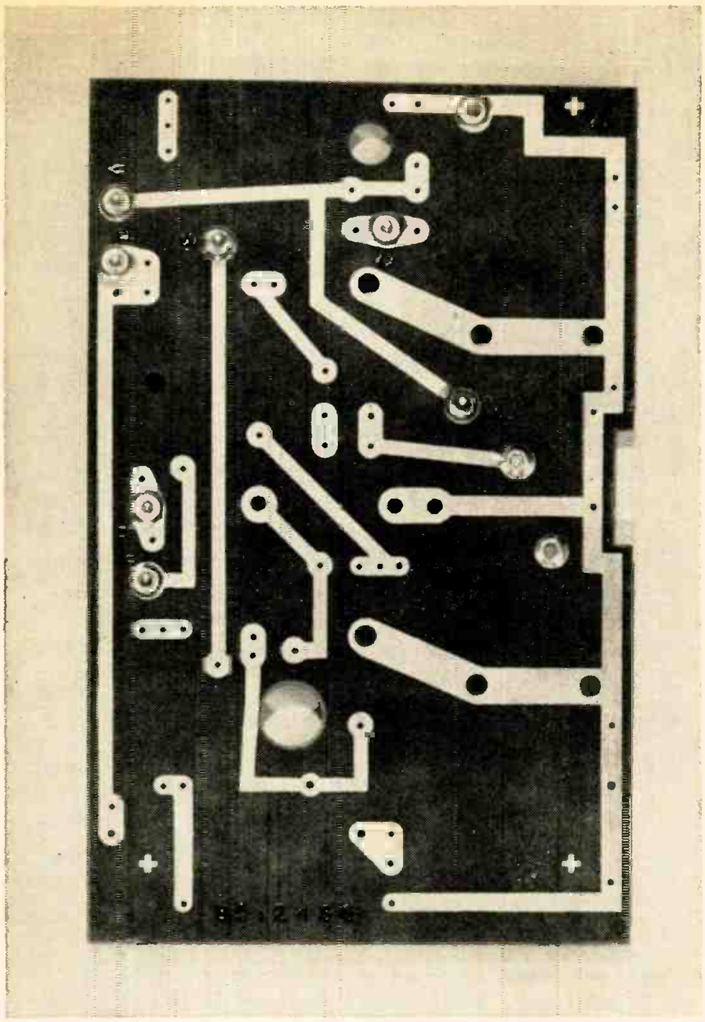
NAVY CONTRACT of about $2 million has been awarded to Collins Radio Co. for a high-density microwave system for the Pacific missile range. System will connect Point Mugu control center and subsidiary centers at San Nicholas Island and Point Arguello, distance of about 150 mi.

ATLAS MISSILE SATELLITE and its communications relay system may have economic implications for the future. Army missile scientist Wernher von Braun envisioned a satellite receiving the texts of letters or telegrams by radio, storing them on tape and transmitting them on command to ground stations at their destination. That might go far towards defraying the cost of space research and exploration.

SPECIAL ADVISORY COMMITTEE headed by Mervin J. Kelly, new board chairman of Bell Labs, will study the scientific programs of the Department of Commerce. Kelly told ELECTRONICS his group would recommend to Secretary Lewis L. Strauss next June steps that would gear the department to the changing needs of science and industry. Kelly's personal area of study is the possibility of mechanizing the Patent Office. Other agencies to be studied: Bureau of Public Roads, Maritime Administration, Weather Bureau, Coast and Geodetic Service, National Bureau of Standards and Office of Technical Services.

NAVY's Oakland, Calif. supply center, which provides 90 percent of the supply and logistic support to ships and shore stations in the Pacific area, is installing Philco's transistorized digital data-processing system, Transac S-2000.

ALL-TRANSISTOR WIREPHOTO TRANSMITTER is announced by Japanese firm Toho Electronics. due out next spring. Factory price: $1,250.



How CDF Di-Clad® can solve your printed-circuit problems

The CDF line of copper-clad laminates in all grades is now known by a new name—Di-Clad. Di-Clad grades meet the varying needs of design, production, and operation of electronic equipment. Grades other than those described are also available.

Di-Clad 28E. For high mechanical strength, low moisture-absorption, and good insulation resistance, CDF Di-Clad laminates of epoxy resin laminated with glass fabric offer the designer a strong, reliable combination.

Di-Clad 112T. A Teflon* glass-fabric laminate offering the best dielectric properties over a wide temperature and frequency range.

Send us your requirements and let our engineers help you select the right grade for your application.

*Du Pont trademark for its tetrafluoroethylene resin.

Di-Clad 2350. An economy paper-base phenolic grade having good tensile, flexural, compressive, and impact strength. Adequate for most non-critical printed-circuit applications. Can be cold punched and sheared up to 5/64 of an inch in thickness.

CONTINENTAL-DIAMOND FIBRE

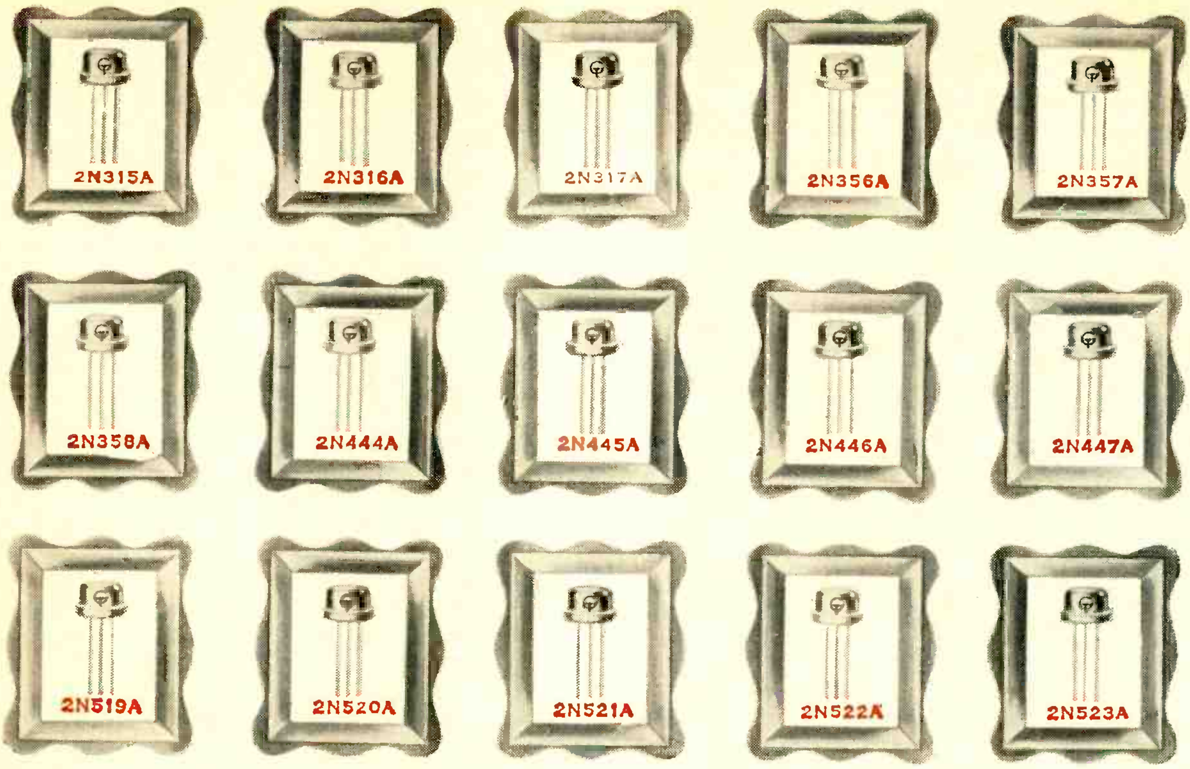
A SUBSIDIARY OF THE Budd COMPANY • NEWARK 16, DEL.

TYPICAL Di-Clad PROPERTY VALUES

	Di-Clad 2350	Di-Clad 26 (NEMA XXXP)	Di-Clad 28 (NEMA XXXP)	Di-Clad 28E (NEMA G-10)	Di-Clad 112T Teflon*
BOND STRENGTH—0.0014" foil (lbs. reqd. to separate 1" width of foil from laminate)	6 to 10	6 to 10	6 to 10	8 to 12	4 to 8
MAXIMUM CONTINUOUS OPERATING TEMPERATURE (Deg. C.)	120	120	120	150	200
DIELECTRIC STRENGTH (Maximum voltage per mil for 1/16" thickness)	800	900	850	650	700
INSULATION RESISTANCE (Megohms) 96 hrs. at 35°C. & 90% RH (ASTM D257, Fig. 3)	500	150,000	600,000	100,000	75,000
DIELECTRIC CONSTANT 10^6 Cycles	4.5	4.0	3.6	4.9	2.6
DISSIPATION FACTOR 10^6 Cycles	0.040	0.026	0.027	0.019	0.0015
ARC-RESISTANCE (Seconds)	5	10	10	130	180
TENSILE STRENGTH (psi.)	18,000	16,000	12,000	48,000	23,000
FLEXURAL STRENGTH (psi.)	27,000	21,000	18,000	70,000	13,000
IZOD IMPACT STRENGTH edgewise (ft. lbs. per inch of notch)	0.80	0.45	0.42	12.0	6.0
COMPRESSIVE STRENGTH flatwise (psi.)	32,000	28,000	25,000	62,000	20,000
BASE MATERIAL OF LAMINATE	Paper	Paper	Paper	Medium-weave, medium-weight glass cloth	Fine-weave, medium-weight glass cloth
COLOR OF UNCLAD LAMINATE	Natural	Natural greenish	Natural	Natural	Natural

All these standard grades are available with 0.0014" and 0.0028" or thicker electrolytic or rolled copper foil on one or both surfaces. Other metal foils and other resin-and-base combinations can be supplied on special order.

*Du Pont Trademark



New "Custom Quality" Family By GENERAL TRANSISTOR

RESEARCH ACTIVITIES APPROACH IDEALIZED TRANSISTOR RELIABILITY

A bright new chapter in transistor history is being recorded at GT's research laboratories, resulting in progressive transistor design of unprecedented reliability, performance and stability. Advanced production control techniques have made possible the New "A-Types" with specification refinements providing . . .

TIGHTER PARAMETER CONTROL
HIGHER OPERATING VOLTAGES
HIGHER SWITCHING SPEEDS
WIDER APPLICATION RANGES

New process controls highlighted by high sensitivity hermetic seal testing, pre-tinning of internal parts, automatic welding of the hermetic seal case and individual handling of units in process insure **improved reliability, uniformity of electrical properties, high mechanical strength and superior hermetic seal.** All transistors are pre-aged for 100 hours at 100°C.

SPECIFICATIONS: POWER DISSIPATION: 150MW @ 25°C STORAGE TEMPERATURE: —65°C TO —100°C

TRANSISTOR TYPE (EIA)	POLARITY	CUT-OFF STATE		CONDUCTING STATE (SATURATED)		TYPICAL SWITCHING CHARACTERISTICS WITH CIRCUIT GAIN OF 20 AT I_C LISTED UNDER CURRENT GAIN		ALPHA CUT-OFF
		Collector-Base Rating BVCBO	Oper. Volt V_{CER} min. $I_{CMAX} = 10\mu a$ $V_{BB} = 1.5V$ $R_{BB} = 62K$	D.C. Current Gain h_{FE}	Conditions	Delay + Rise Time $t_d + t_r$ μSEC	Storage + Fall Time $t_s + t_f$ μSEC	f_{ab} MC Typical
2N317A	PNP	25V	12V	20 — 60	I_C = 400ma, V_{CE} = .25V	0.3	0.7	20
2N316A	PNP	30V	18V	20 — 50	I_C = 200ma, V_{CE} = .2V	0.4	0.9	12
2N358A	NPN	30V	20V	25 — 75	I_C = 300ma, V_{CE} = .25V	0.4	0.9	9
2N357A	NPN	30V	25V	25 — 75	I_C = 200ma, V_{CE} = .25V	0.5	0.9	6
								Minimum
2N523A	PNP	20V	10V	100 — 400	I_C = 20ma, V_{CE} = .25V	0.2	0.6	21
2N522A	PNP	25V	12V	80 — 300	I_C = 20ma, V_{CE} = .25V	0.3	0.8	15
2N521A	PNP	25V	15V	60 — 250	I_C = 20ma, V_{CE} = .25V	0.4	0.9	8
2N447A	NPN	30V	15V	80 — 300	I_C = 20ma, V_{CE} = .25V	0.4	0.7	9
2N446A	NPN	30V	18V	60 — 250	I_C = 20ma, V_{CE} = .25V	0.7	1.0	5
2N445A	NPN	30V	20V	40 — 150	I_C = 20ma, V_{CE} = .25V	1.0	1.3	2

WRITE FOR BROCHURES G-140A AND G-150A

Popular computer types 2N311, 2N312, 2N404, 2N426, 2N427, 2N428, 2N439 and 2N440 are also available.

You grow fastest with the products that serve you best. Prove it to yourself **today** with GT.

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WASHINGTON OUTLOOK

ELECTRONICS PRODUCTION in 1959 will reach "a new all-time high," according to the government's official outlook report on the new calendar year. The report, prepared by the Commerce Dept.'s Business & Defense Services Administration, estimates factory output of electronic equipment and components valued at about $7.9 billion. This is about 14 percent more than last year's volume of slightly under $7 billion.

The BDSA forecast excludes research and development expenditures, thus falls short of the Electronic Industries Assn.'s $8.3 billion estimate of industry sales in 1959. (For ELECTRONICS' views, see p 41.)

On the consumer product side, the government outlook anticipates a boost of some 10 percent over 1958 output—to a total of $1.5 billion.

This is based on a hike in black-and-white tv receiver production from about 5 million sets to about 6 million; also, an increase in radio receiver output from about 12 million sets last year to about 13.5 million in 1959. Government forecasters see no "substantial permanent increase in the size of the consumer market" until color tv sales reach annual rates of at least 500,000 units.

The forcast is for a hike of some 16 percent in military electronic output —not counting R&D spending. But the government warns against possible cancellations, cutbacks, contract revisions and reductions in size of the military establishment.

The outlook is for a continued rise in shipments. One big factor: The increasing numbers of long lead-time missiles becoming operational during 1959. In addition to missiles, BDSA stresses that defense electronic output will be pushed by communications modernization, including the increased use of single sideband and scatter techniques, and the growing electronic content of just about all other weapon systems.

BDSA predicts an 18-percent hike in output of commercial and industrial electronic equipment.

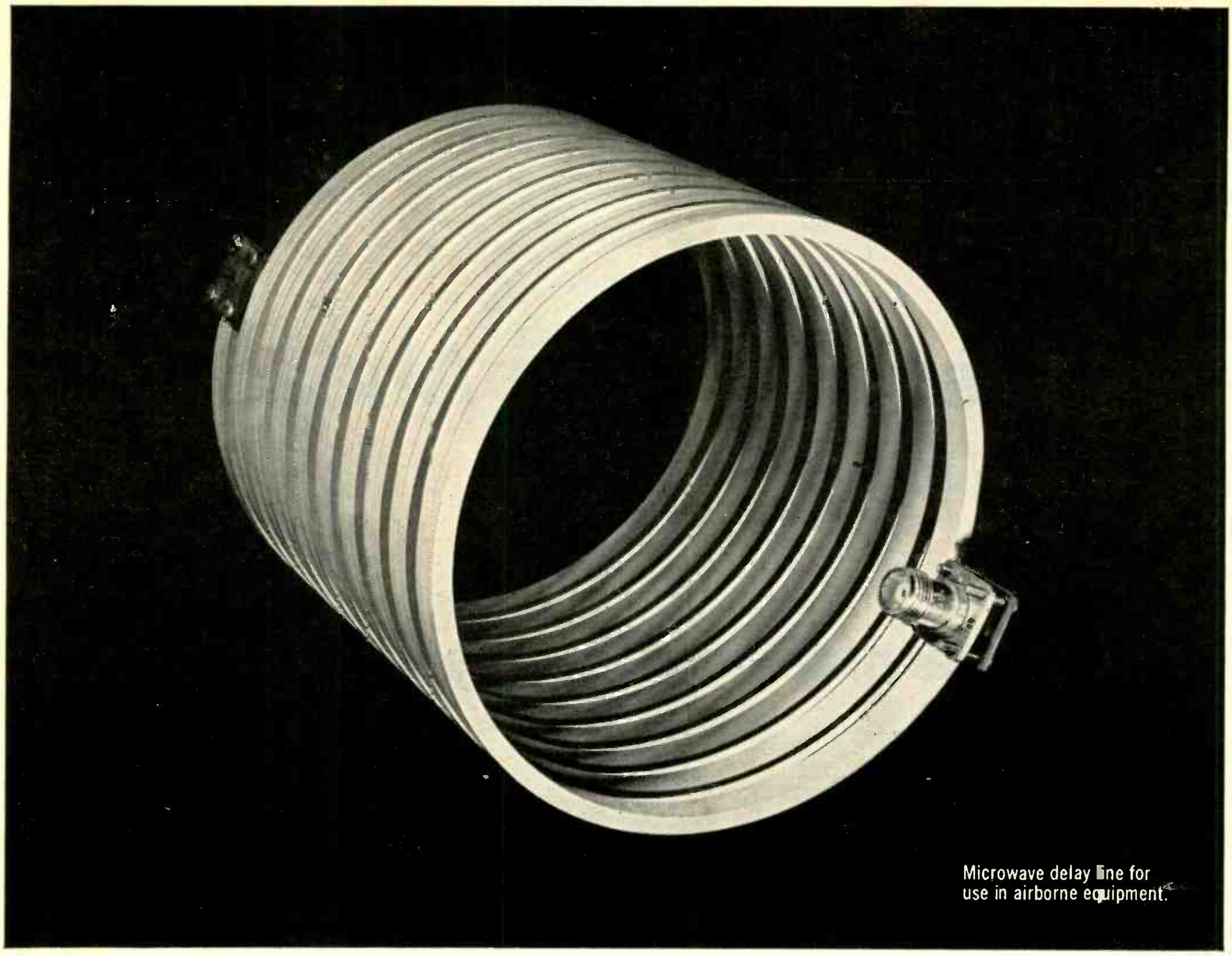
- **In components**, BDSA estimates a 12-percent increase in electron tube production. The forecast comes in the face of admittedly increasing substitution of semiconductors for tubes. The increase is predicted across the board for transmitting and special-purpose tubes, tv picture tubes, receiving tubes, and rebuilt tubes.

  A 25-percent increase is forecast in production of semiconductor devices. Total volume this year of transistors and crystal diodes is estimated at $250 million. Production of electronic components other than tubes and semiconductors will rise about 12 percent over 1958 levels.

- **Uhf tv spectrum** is slated for close scrutiny during 1959 if FCC commissioners Craven and Ford keep at projects now in the talking stage. The Craven plan, outlined last summer, calls for a study to determine whether a block of 25 continuous channels can be set up at the upper end of the present vhf spectrum.

  Then, in a pre-Christmas talk, Commissioner Ford warned that the future looks shaky for uhf stations if things follow their present course. Like Craven, Ford stressed the need to move slowly in order to minimize risk of loss by tv manufacturers and stations.

  Electronics industry is keeping an eye open for space that may become available if the tv spectrum is changed. Officials of the Bell System, for example, hope for the day when the uhf spectrum may be used in part to supply telephone service on a nationwide basis for automobiles, busses and airplanes.



Microwave delay line for use in airborne equipment.

MICROWAVE RESEARCH

The expanding role of electronic equipment in modern military operations has given high priority to microwave research. No field today offers greater challenge to the scientist and engineer.

In support of current electronic countermeasures programs and in anticipation of future systems requirements, Ramo-Wooldridge Division is engaged in microwave research to develop new techniques and to refine conventional components.

Research is under way at Ramo-Wooldridge for new methods and new designs to reduce substantially the over-all size, weight and complexity of electronic equipment for both airborne and ground-based uses.

For example, the low-loss delay line in the photograph above was designed, developed and manufactured by Ramo-Wooldridge for use in airborne equipment. Packaged for use in the system for which it was designed, this miniature ceramic unit weighs less than two pounds. It replaces a component which weighed more than twenty pounds and occupied more than five times as much volume.

Special opportunities exist for those with qualified experience in microwave research—in technique evaluation, component development, and design of such systems equipment—at Ramo-Wooldridge.

Engineers and scientists are invited to explore openings at Ramo-Wooldridge in:

- Electronic Reconnaissance and Countermeasure Systems
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Industry Moves Ahead with Plan '59...

To modernize now for growth and profits

The most expensive task to be performed in America, in this new year of 1959, is the modernization of our industrial plant and equipment. This is true despite the huge expenditures on new facilities made in the past decade.

Contrary to popular opinion, and even to much learned opinion, our industrial facilities are not up to date. In a special survey conducted in August 1958, and supplemented by further interviews since that time, the McGraw-Hill Department of Economics found that it would take $95 billion to bring all our plant and equipment up to the best modern standards. This is over $15 billion more than the record budget of the U.S. government for the coming year.

How did we get so far behind? It is true that business has made record capital expenditures in recent years, but most of this investment has been to expand capacity. And in concentrating on new capacity, industry has fallen behind on the modernization of older facilities. Meanwhile, the $8 billion a year surge of research and development has brought forth new machines and new processes, at a rate that makes prewar and even early postwar equipment badly obsolete.

The lag between what research has promised —especially in more efficient tools of production —and what has actually been accomplished up to now shows clearly in the AMERICAN MACHINIST inventory of metalworking equipment for 1958. This new study, covering 167 types of equipment in 5,800 metalworking plants, shows that three out of five metalworking machines are over ten years old. This is a startling indication of how obsolete many plants have become. A 1958 machine tool is 54% more productive than one purchased in 1948. Many of the tools industry now uses are actually of 1939, or earlier, design.

Investment Starts Up

Now industry's plans for 1959 show a new awareness of the need to modernize. In its surveys, conducted during the last part of 1958, the McGraw-Hill Department of Economics discovered these facts:

(1) Companies generally believe that a larger investment in modernization will

mean more profits—soon. Most of the manufacturing companies in the surveys expect their current modernization expenditures to pay off in less than five years. With labor costs rising steadily, it is only with better, more modern equipment that most companies can hope to make these profit gains.

(2) Industry's plans for modernization have been revised upward. Total plans for 1959 investment, in new plant and equipment, now come to $33 billion—compared with $31 billion reported earlier. And most of these new plans are directed toward modernization—installing new processes or making ready for new products, developed out of the most recent scientific advances.

It therefore seems clear that modernization expenditures in 1959 will rise enough to make an impressive start on the job of updating our plant and equipment. But it will be no more than a start. Research also is moving ahead with giant strides. Plant expenditures must increase rapidly, from 1958's low level, to win the battle against obsolescence.

How Can We Modernize Faster?

What can we do to accelerate industry's new drive for more modern plant and equipment? One aid will be an improved flow of technical information on how, and where, to modernize. With this purpose, the McGraw-Hill Publishing Company several months ago inaugurated PLAN '59, a joint effort by all its magazines to spotlight the best opportunities for modernization. During 1959, McGraw-Hill publications will continue this effort by putting special emphasis on new developments in plant and equipment.

On the key problem of financing modernization—the question "Where's the money coming from?"—the McGraw-Hill Department of Economics plans several new studies in the months ahead. The first of these will deal with the number one problem in financing: the need for adequate depreciation allowances. Such studies are a small, but we hope a helpful, part of the total effort that is needed to modernize American industry.

An Individual Effort

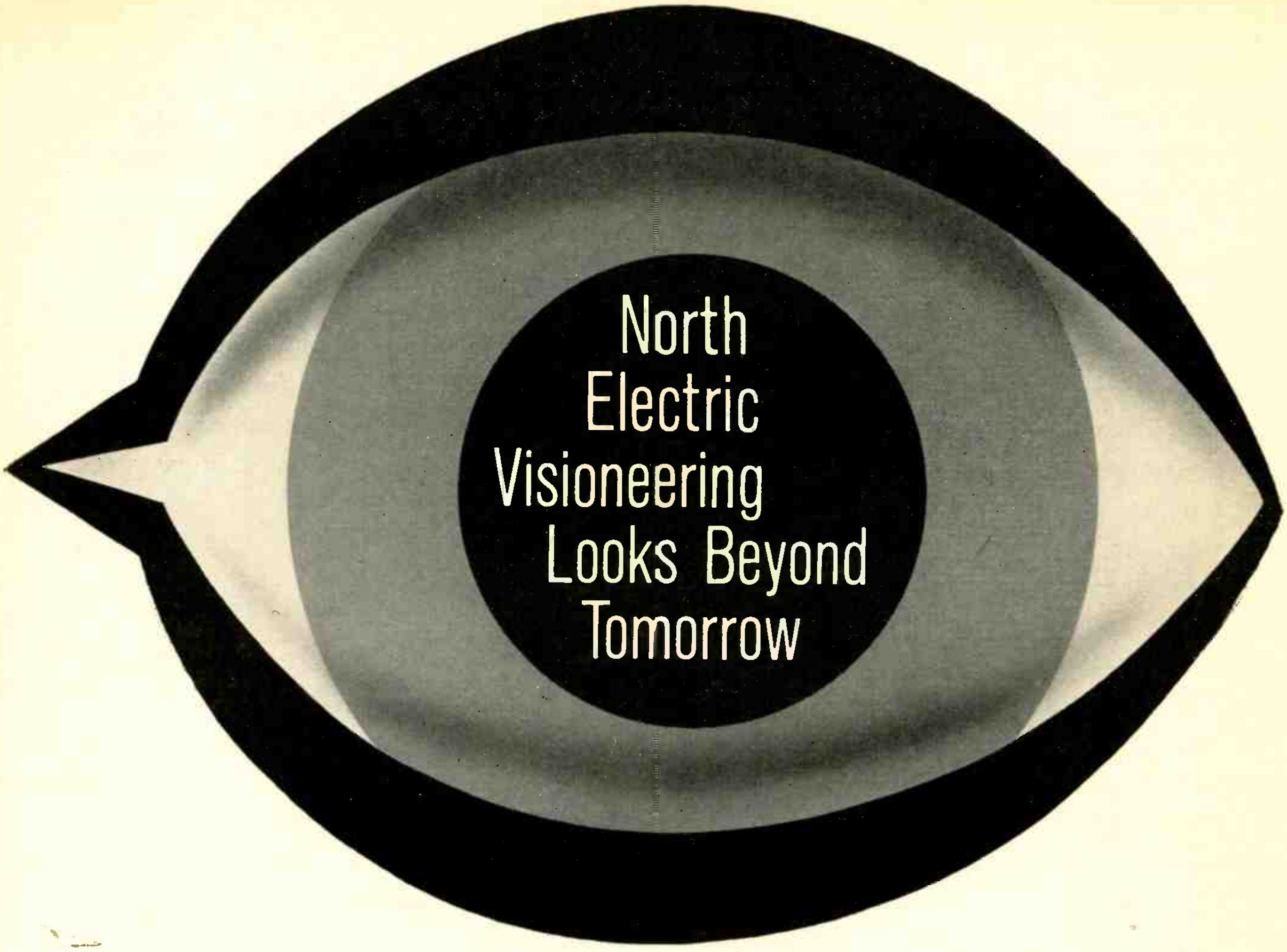
The really vital steps in modernizing must be taken by individual companies. The backlog of obsolete plant and equipment is widely dispersed, among firms of all sizes and in all areas. It cannot be wiped out by dynamic equipment policies on the part of a few leading firms. Not just a few, but thousands of industrial companies must take inventory of their respective equipment and compare it, case by case, with the best new machines available.

Finally, there is need for increased public recognition of the modernization problem, and for federal tax policies appropriate to a period of rapid technical change in business.

The most important point is that the modernization drive has begun. This start can accelerate, with intelligent business and public policies, to give us truly modern industrial facilities. Plant and equipment expenditures are finally beginning to reflect the stepped-up pace of research and development. This can be a major factor in renewed economic growth and prosperity as we move into 1959.

This message was prepared by the McGraw-Hill Department of Economics as part of our company-wide effort to report on opportunities for modernization in industry. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or part of the text.

Donald C McGraw
PRESIDENT
McGRAW-HILL PUBLISHING COMPANY, INC.



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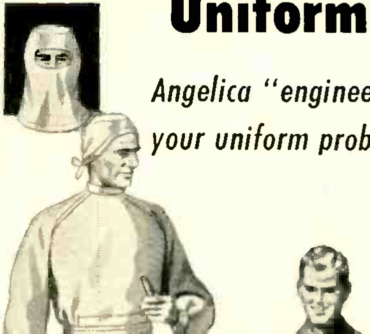
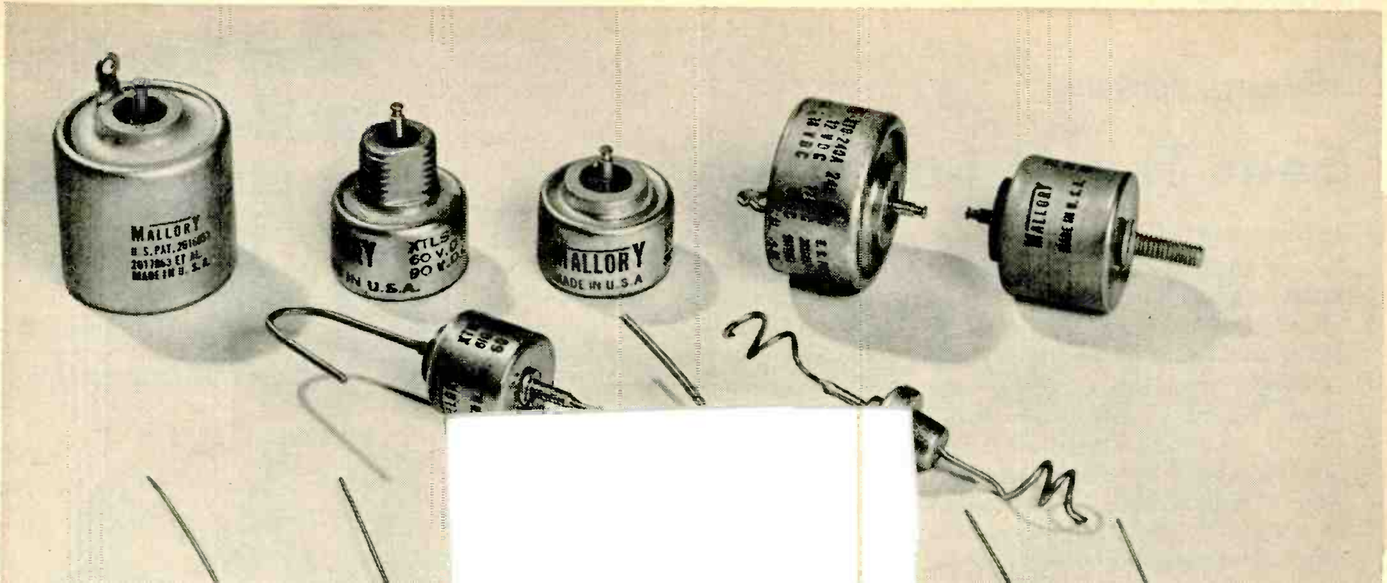
CIRCLE 12 READERS SERVICE CARD

Sees Tax Aid on Way

INCOME TAX DEDUCTION on a portion of earnings reinvested in new plant and equipment has good chance to pass in Congress in 1960, says Senator John Sparkman (D-Ala.), chairman of Senate Small Business Committee. Problem of financing electronics firm growth would be eased if bigger slice of profits before taxes could be retained. As legislators are thinking of allowing deductions up

market facilities available for Tele-Signal products. T-S will retain design and engineering responsibilities for its equipment and will continue present sales and pilot manufacturing efforts.

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Mallory offers a complete range of Tantalum Capacitors. Mallory pioneered the sintered-pellet anode which made possible the first 200°C capacitors to meet critical military vibration requirements. Ratings range from the newest type HAT—the smallest tantalum capacitor ever made—to the XTV high capacity units . . . with a broad selection in between.

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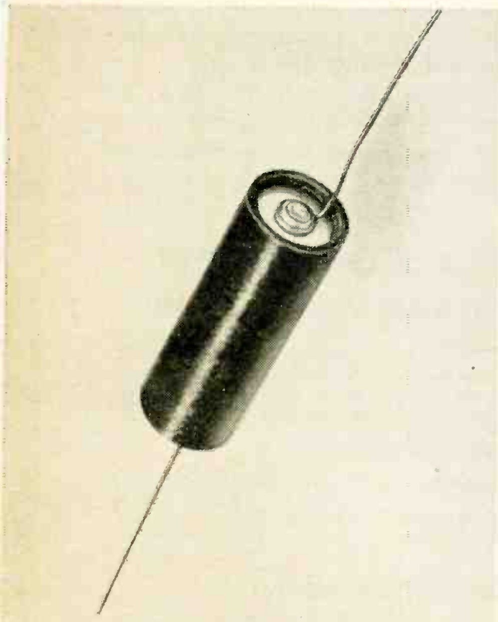
Mallory FP and WP Capacitors have been accepted industry standards for many years. This original 85°C electrolytic is stable and dependable, even at high temperatures. These capacitors feature the famous fabricated plate anode and etched cathode construction, or etched anodes for lower voltages. New spring-clip mounting of the capacitor element within the can means lighter weight—improved resistance to shock and vibration—assurance against electrolyte leakage.

Mallory Cardboard-cased Capacitors offer maximum service at low initial cost. Built to rigid quality control standards, these popular priced components meet a wide variety of initial equipment and service needs.



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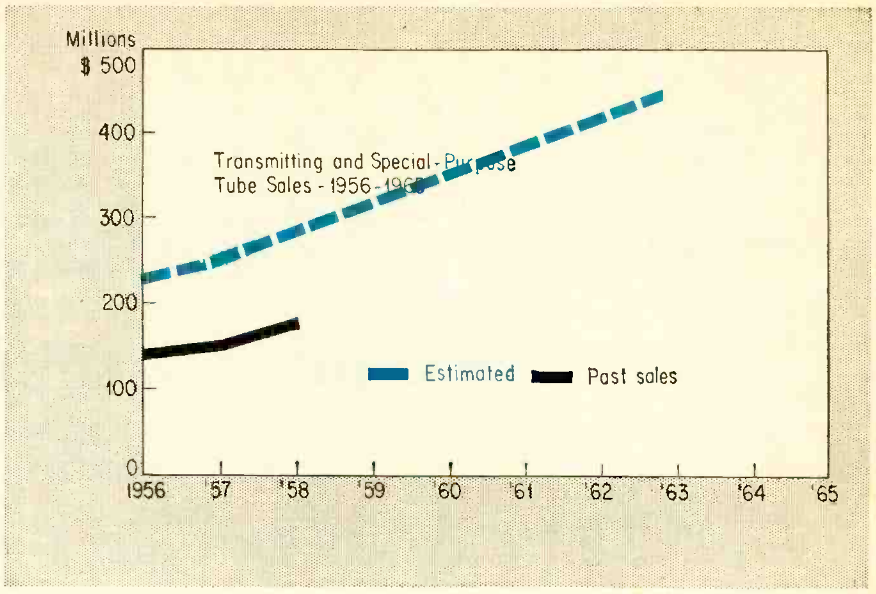


Special-Tube Sales Rising

FACTORY SALES of transmitting, microwave, power and other special-purpose nonreceiving tubes were about $180 million at factory prices in 1958. The market for 1959 looks like about $210 million. At present rate of expansion this should pass the $300-million mark about 1962, nearing $400 million around 1965.

Uses of power tubes in industry, and military increases in microwave applications of magnetrons, switching tubes, klystrons and traveling wave tubes will account for much of the rise.

In addition to the steadily growing total sales volume of these tubes, the variety of types is increasing rapidly as technological advances cross new frontiers.

The breakdowns shown here are a composite of industry estimates, since reporting groups prefer to keep their official figures confidential. One difficulty the groups face is that precise categories are complicated by growing number of small specialist manufacturers who are not members of reporting associations. Problems arise also where one or two makers do most of the business in one category. In these cases production figures are reflected only in totals, not for specific categories.

The overall picture is one of steady growth, with some types fluctuating, others climbing rapidly. In the latter group are storage tubes. They now have annual volume of well over a million dollars; cost $1,000 to $1,500 per unit. X-ray tube market appears relatively stable but growing slowly. Sales in 1958 were around $8 million.

There are a few relatively soft spots, such as ignitrons, which sold over $3 million in 1956, were down to $2.6 million in 1957 and even lower in 1958. Harold Vance, chairman of NEMA-RETMA joint committee on these tubes, and presently manager—sales engineering, RCA Electron Tube Div., points out this is a direct result of last year's poor automobile business. The car industry, which buys ignitrons to weld chassis together, has been the largest market for these tubes.

FIGURES OF THE WEEK

LATEST WEEKLY PRODUCTION FIGURES

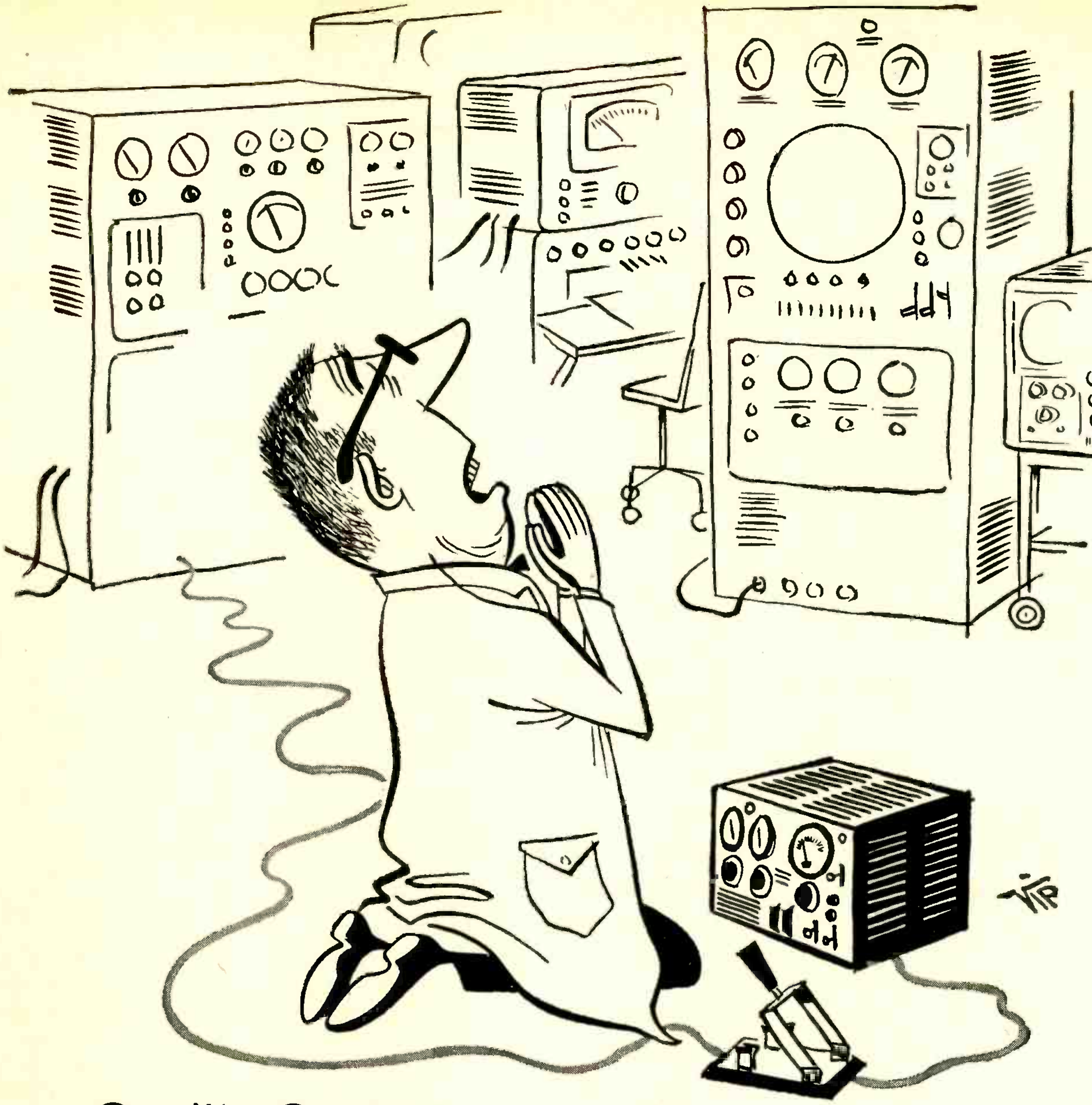
(Source: EIA)	Dec. 19, 1958	Nov. 21, 1958	Change From One Year Ago
Television sets	110,021	116,530	+13.8%
Radio sets (ex. auto)	319,478	390,019	+ 3.4%
Auto sets	124,976	137,678	+28.7%

STOCK PRICE AVERAGES

(Standard & Poor's)	Dec. 23, 1958	Nov. 26, 1958	Change From One Year Ago
Electronics mfrs.	72.24	64.90	+44.0%
Radio & tv mfrs.	76.19	68.96	+86.7%
Broadcasters	78.07	73.77	+52.4%

LATEST MONTHLY SALES TOTALS

(Add 000)	Oct. 1958	Sept. 1958	Change From One Year Ago
Transistors, value	$13,462	$10,811	+90.3%
Transistors, units	5,595	5,076	+57.9%
Rec. tubes, value	$34,362	$33,951	—10.6%
Rec. tubes, units	41,540	40,061	—11.8%
Pic. tubes, value	$19,352	$17,704	— 0.7%
Pic. tubes, units	957	892	— 3.9%



Quality Control: *state of the art*

It has been rumored that some engineers rely upon supernatural means to insure proper quality control. When all else fails, there is something to be said for this method. At Hughes Products, however, we try to take a more scientific approach to quality control. That's why Hughes Products systems and components have established such an outstanding record of reliability.

On the following three pages are specific examples of reliable Hughes components—Quick Recovery Diodes, TONOTRON* Storage Tubes, and MEMO-SCOPE® Oscilloscopes.

In addition to these, other Hughes Products devices with this "built-in" reliability include: Precision Crystal Filters for selective tuning...Rotary Switches...Thermal Relays...MEMOTRON® and TYPOTRON® storage tubes...Diodes, Transistors and Rectifiers with uniform performance...and Industrial Systems which automate a complete and integrated line of machine tools.

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For additional information regarding any component or system please write: Hughes Products, Marketing Dept., International Airport Station, Los Angeles 45, California.

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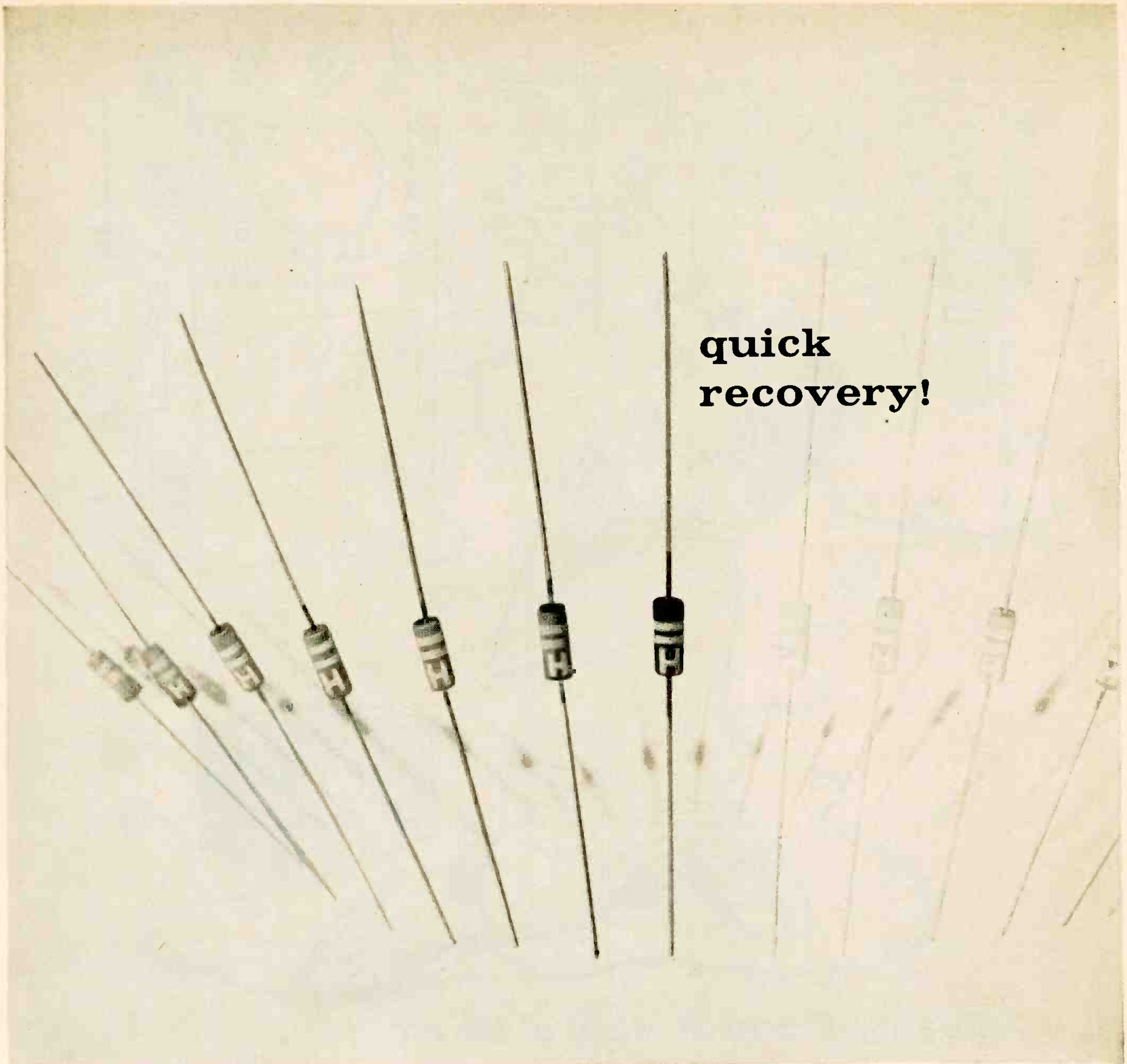

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Reverse current—as low as 1 μA at —175 volts and 25°C

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Special high conductance types in the quick recovery series are available in all voltage classes. No matter what your problem, chances are that there is a Hughes diode to meet your need. Write today for a complete data sheet on the Hughes quick recovery silicon diode —or any other Hughes semiconductor device.

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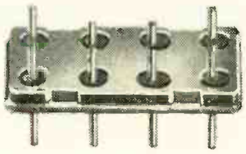

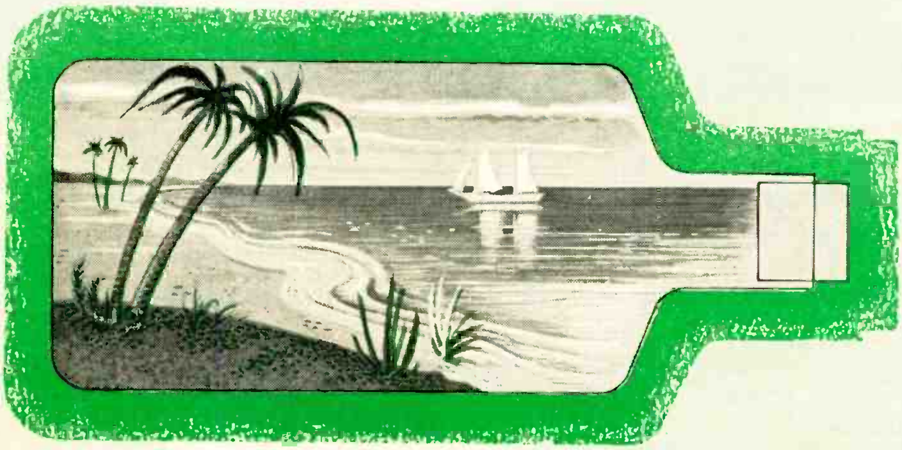

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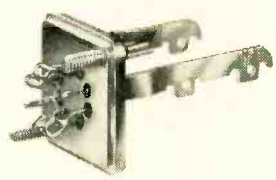

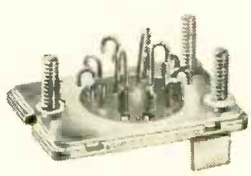

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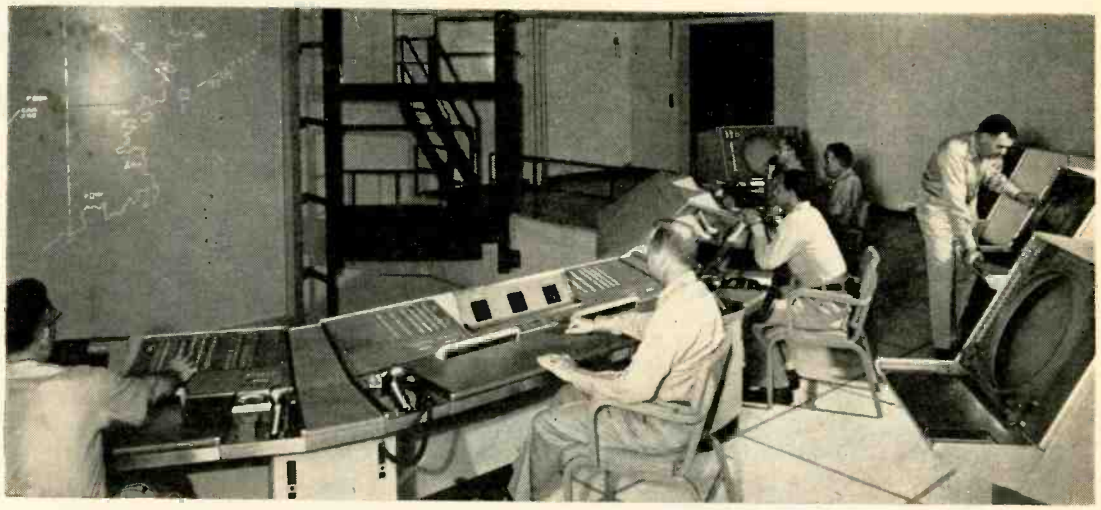
Remote Computers Guide



Monitored and directed in Kingston, N. Y.'s IBM Sage Center, Bomarc knocks down a drone near Canaveral, Fla.

While controversy continues over relative merits of Army's Nike-Hercules and USAF's Bomarc for air defense, both surface-to-air interceptors are successfully speeding toward operational readiness

DESPITE CURRENT controversy over actual need in our air defense system for both Army's Nike-Hercules and USAF's Bomarc ground-to-air missiles, today both interceptor weapon systems are moving ahead toward operational readiness with good speed.

Proponents of economy cuts on missiles with similar missions are countered by strategists who point out that Army's Nike-Hercules is a 100-mi-range point defense weapon, while USAF's Bomarc A and the super Bomarc B are area defense interceptors going out to about 200 and 400 miles respectively.

Both Nike-Hercules and Bomarc A have been test fired successfully a number of times. Bomarc's final launch from Cape Canaveral, controlled via leased lines by IBM's Kingston, N. Y., Sage facilities, took place three weeks ago (photo above), thus ending Kingston's experimental Bomarc launchings.

New Site Opens

Future Bomarc firings will be for training operational crews at Santa Rosa Island, just off the northwest Florida coast. First operational testing and training site for Bomarc crews was activated last month at nearby Eglin AFB, Florida's Auxiliary Field No. 9.

First of the four operational Bomarc launching sites now under construction will be ready before the end of this year. Work on the remaining 10 scheduled sites has not yet begun.

Nike-Hercules is now moving into ready-made Nike-Ajax launching sites where, after some modification, both missiles can be operated with the same equipment.

Construction appropriations for Nike and Bomarc sites, written into Public Law 85-685, on Aug. 20, 1958, include $173,678,000 for the Army and $269,100,000 for USAF. Prior to utilization of the funds, however, the Defense Secretary must determine, with respect to each defended area, which missile or combination of missiles will be used. He has authority to transfer these funds between services.

Both Nikes and Bomarc are controlled by automatic ground guidance radio command systems: Nike-Ajax and Nike-Hercules by Martin's Missile Master system and Bomarc directly by the continental network of IBM Sage centers. Bomarc's terminal guidance system is active radar homing, produced by Westinghouse. Firm's total for this gear to date is $60 million.

Nike sites, located in areas covered by Sage operations, are an integral part of the North American Air Defense system. The Sage Direction Center computer automatically provides each Army Air Defense Command post with information concerning approaching aircraft and identification.

Assigns Targets

Army defenses correlate this data furnished by Sage with their own local radar displays. Target assignments are made by the NORAD commander in the Sage Direction Center for engagements by the Army's defenses.

The Sage/Bomarc firing sequence begins when an AN/FPS-20 long-range search radar, produced by Bendix, detects a flying object. This return is passed along to an AN/FST-2 coordinate data transmitter (Burroughs) located on the radar site. The data transmitter converts the radar return to polar coordinates—range and azimuth—for transmission in digital form over leased lines to an AN/FSQ-7 computer (IBM) in the Sage Direction Center (each center uses two

Missiles

of these $27-million computers).

Digital information on the object's range and azimuth is stored in "Long Range Input" magnetic drums of the computer, compared with programmed data and converted into Cartesian coordinates, referenced to the appropriate Bomarc launch pad.

Missile Gets Orders

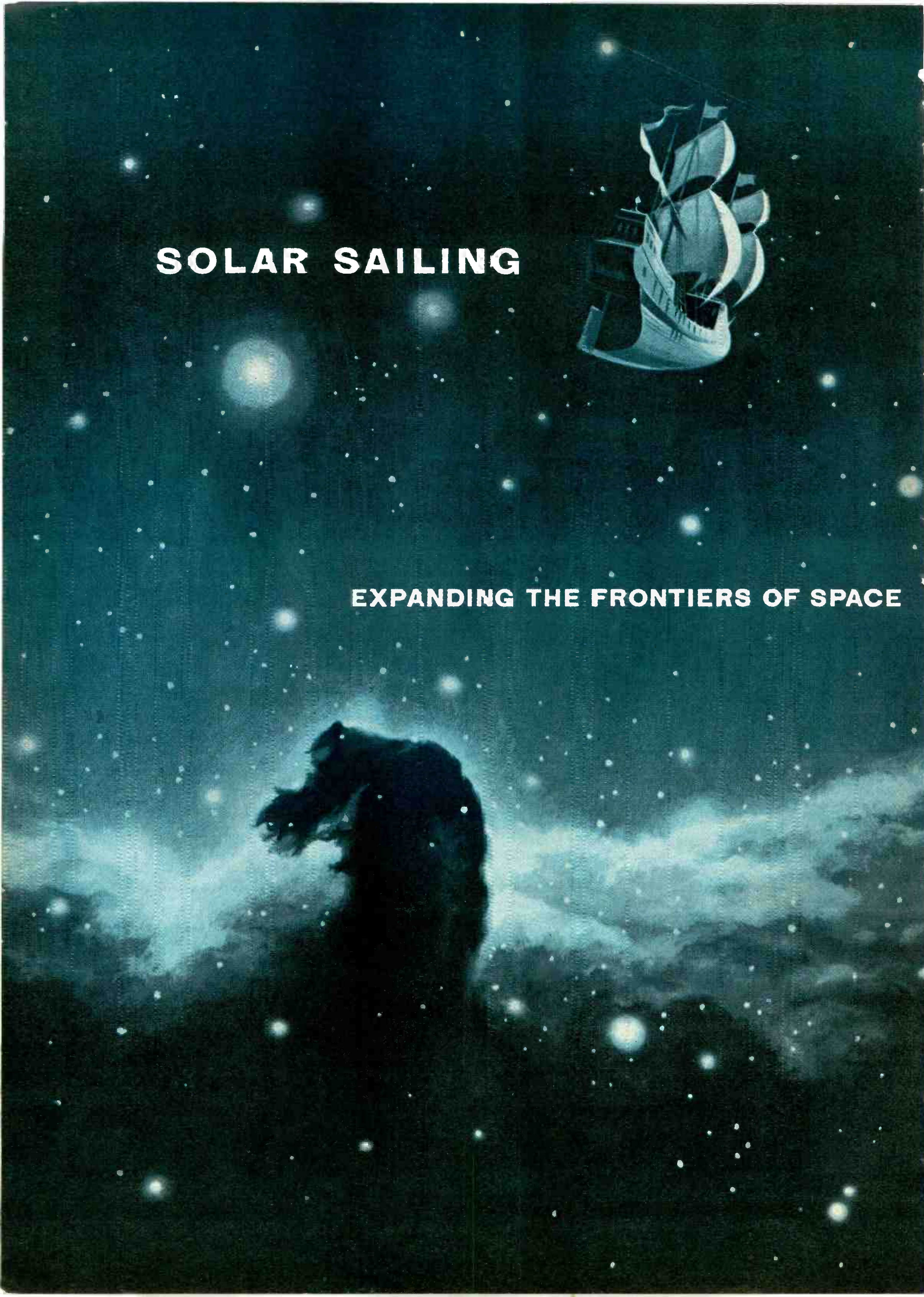
At the instant the fire button is pressed at the weapons console in the Sage center, prelaunch computations are initiated and transmitted to the guidance unit in the Bomarc. These commands are fed directly to the missile during the brief period between flight initiation and take-off. After launch, they go by land-line to the transmitter at the launch site and from there by radio to the missile.

Midcourse commands are calculated and transmitted as required to maintain an intercept course.

Tracks made by the target and by Bomarc are distinguishable on the ground radar scope by turning on a beacon in the missile. Flight path of the target appears on the scope as a line of tiny crosses; the missile appears as slants or slashes.

When the missile is guided to within striking distance of the target, the computer tips missile into a steep dive. The computer cuts off, the missile's active radar homing transmitter goes on, following its echo returns to the kill.

Up to 100,000 instructions per second go from this IBM computer to guide missile in flight to interception. Scope and FIRE button adjacent to it are parts of computer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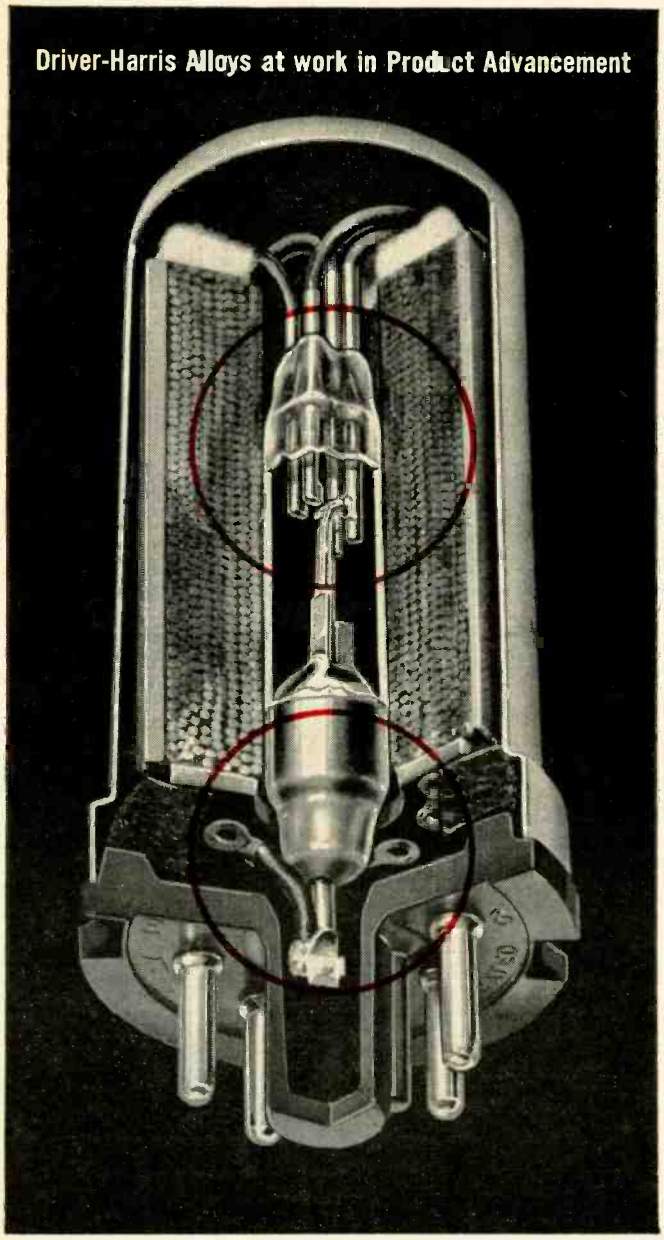

For all kinds of high-speed switching machines and devices which demand accuracy and dependability of the highest order, this new Clare Type HG Relay offers a combination of high speed, high current-and-voltage capacity with remarkably uniform long-life performance. It has a conservative life expectancy of more than a *billion operations* when operated within its ratings and can be driven at speeds up to *100 operations per second.*

In this cutaway view (2¾ x) a magnetic switch, hermetically sealed in a high-pressure hydrogen filled glass capsule, and a coil, are enclosed in a steel vacuum tube type envelope. The switch forms the core of the coil which provides the magnetomotive force for operating it.

The glass enclosed switch is very compact and small (5/16″ diameter x 2″ long) yet its handling capacities of 5 amperes and 500 volts maximum are truly remarkable.

These features of its construction make this possible. In the switch segment, the platinum contact surfaces are wetted and protected from electrical and mechanical erosion with mercury by means of a capillary connection to a mercury reservoir below the contacts. In addition, the high hydrogen pressure enables the contact gap to withstand a high voltage gradient without breakdown.

Keeping the gas from leaking posed a production problem. The specifications for the lead wires at the top of the switch and the tubular vacuum stem at the bottom were stiff. 1. Gas-tight seal against hydrogen at 250 PSI. This was difficult. 2. Perfect match to thermal expansion characteristics of the glass. 3. Good ferromagnetic properties. 4. Exceptional surface bonding properties since the permissible maximum 5 ampere 500 volt limits are dictated rather by factors relating to heating of the metal-to-glass seal than the current handling capacities of the contacts.

Driver-Harris was called upon to produce such an alloy and succeeded in developing a special gas-free nickel-iron alloy No. 152 which meets all these requirements to the complete satisfaction of Clare Engineers.

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USSR: Plan for Electronics

Soviets pin much hope for success of new seven-year economic plan on electronics developments. Though expecting control devices to flow quickly from lab to plant, Reds continue to stress basic research

SOVIET electronics development is slated to play an important role in the success or failure of the new seven-year economic plan.

In recent months Soviet leaders have emphasized the importance of electronic control devices in achieving automation. Since announcement of the new economic plan, there have been more signs that Communist hopes for eventually surpassing the United States economically lie in industrial instrumentation and scientific advances.

Aleksander Nesmeyanov, president of the USSR Academy of Sciences, in a recent article in Pravda discussing the role of science in the seven-year economic plan, singled out these fields of investigation:

- Basic research in nuclear physics in general, and studies of controlled thermonuclear reactions in particular.
- Astronomy, by means of powerful optical and radio instruments and also rockets and earth satellites carrying electronic instruments.
- Solid-state physics, tabbed for "a leading place in the scientific development program."

"Great tasks of technical progress face the country in creating a material-technical basis of communism," wrote Nesmeyanov.

"This includes work on the foundations of computing technique and the development of new, more rapid electronic computing machines which, in the next seven years, will find wide application in the most diverse spheres."

Setting Up Model Plants

Nesmeyanov sees "integrated mechanization" and automatic production controls as "the key factors assuring continued technical progress." To this end, and apparently because of the urgency imposed on the scientists by the seven-year plan, research institutes will bear the responsibility for setting up the model plants from which later automatic factories will evolve.

Development of artificial materials with special properties also "opens vast prospects," declared the Academy of Sciences president. Specifically mentioned: superhard alloys, synthetic fibers, organic and nonorganic synthetic polymers and rare elements.

Program in Gear

To lay the groundwork for Soviet Communism's dream of eventual economic domination of the world, a tremendous program of research expansion is already underway (ELECTRONICS, p 21, Dec. 12, 1958).

Much of the building of laboratories and institutes is going on outside of European Russia. So-called "scientific towns" are springing up in widely scattered places, often with a specialty such as physics-electronics.

Apparently this idea of technical specialization ties in with the role of a research institute as a fountain of new manufacturing processes. And with the spread of electrification in the central and eastern parts of the USSR, more plants will be needed.

Accelerated development and modernization of existing research institutes, maintained by the separate science academies in all of the Soviet republics, was also called for by Nesmeyanov.

What Nesmeyanov wrote in Pravda underscores the "crash" nature of the Soviet production-oriented research and development program. As chairman of the Academy of Sciences, he reports directly to the USSR Council of Ministers. His voice is the dominant one in Soviet scientific circles. It surely will remain so only if he successfully implements Khrushchev's ambitious plan by advancing electronic technology from the laboratory to the automatic factory.

However, outside the domain of the Academy of Sciences other electronic work goes on in the Ministry of the Radio Industry (largely responsible for production of radio and tv sets and components) and the Ministry of Communications (largely responsible for construction of transmission facilities).

Each of these ministries has its own quotas for production and installation of electronic equipment.

Last month a three-day conference on tv was held in Moscow which included research scientists, representatives of plants manufacturing tv gear and heads of stores that sell sets. A Soviet report said it discussed the outlook for tv in the light of the new economic plan.

Soviet Growth

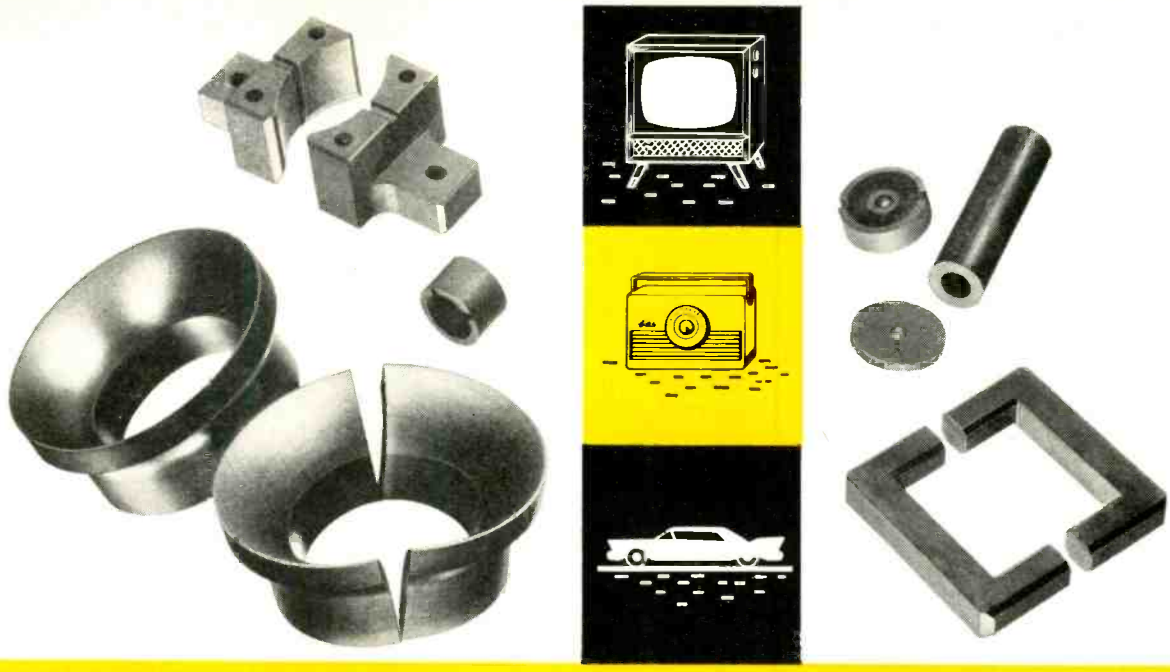
One official said that about 100 new tv transmitting centers and stations are to be built during the next seven years.

He reported that there are now some 60 transmitters operating in the Soviet Union, along with about 70 relay stations. Area reached, he said, is inhabited by more than 50 million people.

Next year alone, 26 tv stations are slated to begin broadcasting. As relay lines are extended, the official stated, it will be possible to "rebroadcast programs from tv stations abroad."

Meanwhile, Boris Stepanov, deputy chairman of the radio and tv committee attached to the USSR Council of Ministers, said:

- By 1965, tv "will embrace all densely populated areas."
- Number of tv sets will increase during the period by 12.5 million and radio receivers by 17 to 18 million. (He said the USSR now had 15 to 18 million radio sets and 2.6 million tv sets.)



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Washington Forecast

Capital observers predict: more military and civilian government spending for electronics, hassle over procurement policies

THE ROLE of Washington in the electronics industry will grow even larger in 1959 than it has been in the past.

The Federal government will become an even bigger market for electronics industry output. The increase will be both in dollar volume and in proportionate share of the industry's factory output.

While the lion's share of government buying in electronics will be by the military services, civilian agencies will also step up their procurement of electronic products. Some factors are: more civilian-directed scientific space exploration, modernization of the nation's civil airways system and the growing use of electronic data-processing machines.

Military spending for research, development and production of electronic hard goods will increase despite the administration's firm intent to pull the reins on overall government outlays.

A top-level Defense Dept. official estimates that about 28 percent of the military hard-goods dollar goes for electronic equipment. He forecasts that electronics' share will increase to one-third of the defense procurement dollar within two or three years.

Defense Budget

Overall military spending in fiscal 1960, starting July 1, 1959, is expected to run to $42 billion—about $1.2 billion over the current rate of expenditure. Missile production expenditures will rise by at least $1 billion over the current $3.4 billion rate—with at least 40 percent spent on electronic gear. The electronics slice of the missile dollar will probably remain stable.

Aircraft production expenditures will dip well under $7 billion in fiscal 1960 for the first time in eight years. Current rate of expenditure is $7.2 billion; next year's volume is likely to show a reduction of some $1 billion, reflecting a rapid transition to missiles. But the electronic slice of the aircraft production dollar, now averaging 25 percent, will increase with the growing stress on automatic fire control, guidance and navigation.

Military research and development spending, estimated at $2.4 billion this year, will rise slightly. Electronic projects take up at least one-quarter of the defense R&D dollar now, are certain to comprise an even larger slice next year.

Defense Strategy

The new defense budget reflects the Administration's intent to stress strategic bomber and missile forces as a deterrent to aggression. The official view is that we have sufficient tactical forces to fight a limited war.

Contract Renegotiation

The Renegotiation Act, under which so-called excessive profits are recaptured from defense contractors, will be extended—probably for two more years. The law expires June 30, 1959. No major changes are likely.

Defense Procurement

Congress is pushing in opposite directions on military buying regulations. Sen. Saltonstall, ranking Republican on the Senate Armed Services Committee, plans to introduce a bill to step up the use of weapon-system management—with increased powers for the prime contractor.

But Rep. Herbert's House Armed Services Investigations Subcommittee, however, plans to probe the increasing use of the weapon-system procurement method. Herbert thinks this buying scheme hurts small business, wants to reduce the volume of contracts now being

for 1959

awarded in this manner.

The Pentagon, meantime, is putting finishing touches on a new set of procurement rules spelling out the types of costs the government will allow on defense contracts.

Minimum Wage Rates

The Labor Dept. will take action this year on the aircraft industry's petition that electronics companies in missile work be required to pay the same Walsh-Healey minimum wage rates as aircraft firms do. In general, there's now a wage differential of some 20 percent.

Electronic companies are opposing the aircraft industry's petition, warn of an across-the-board boost in defense costs.

The Labor Dept. has proposed putting electronics firms with end-item prime missile contracts under aircraft industry rate while exempting subsystem producers.

Taxes

The tax outlook for 1959 is tougher. Tax rates are not likely to be raised. Chairman Wilbur Mills of the House Ways and Means Committee says revenue can be increased by closing loopholes and taxing income that now is exempt.

Corporate income tax rates will be extended beyond their June 30, 1959, expiration date at present 52 percent rate. There are plans to cut back on kinds of income entitled to the 25-percent capital-gains tax rate.

Radome Tests

Electrical characteristics of high-strength radome walls are being determined by Stanford Research Institute engineers. Equipment permits use of a narrow strip of the radome to simulate a large, flat radome panel

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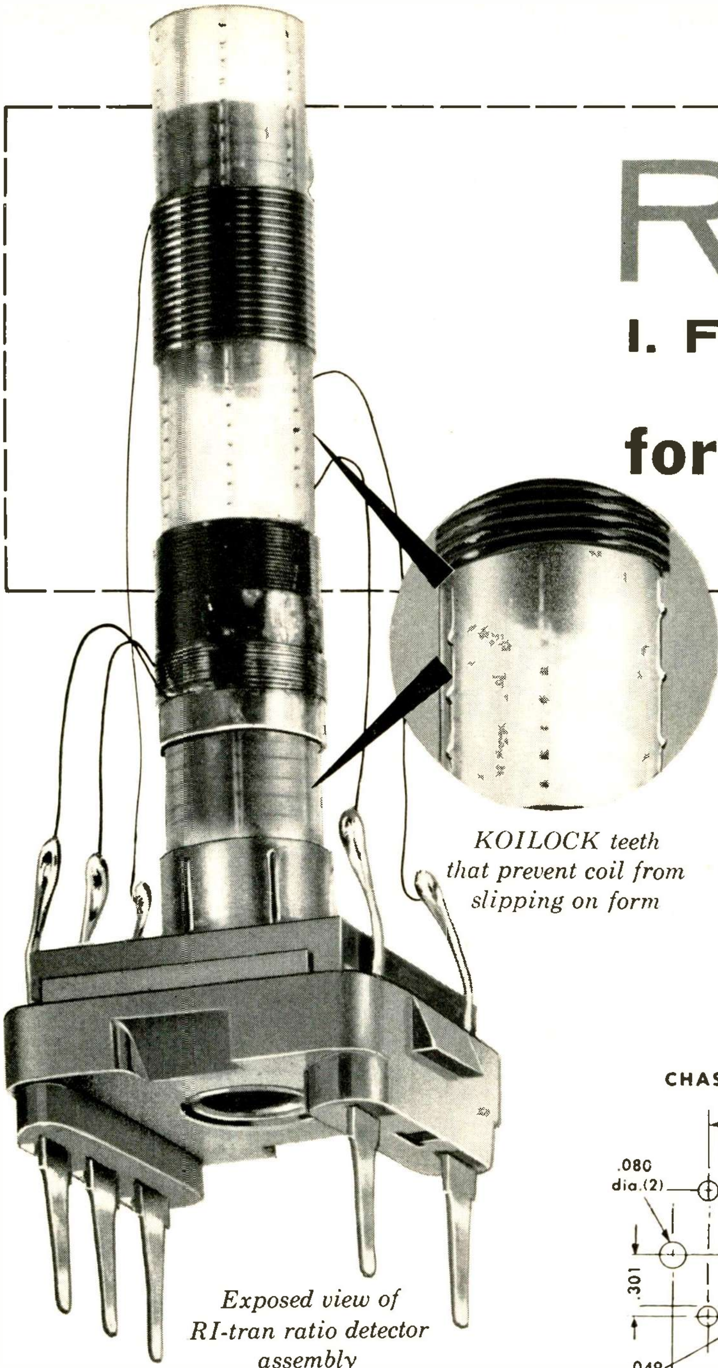
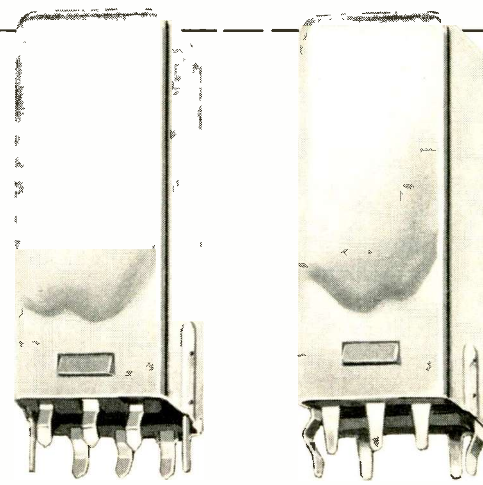


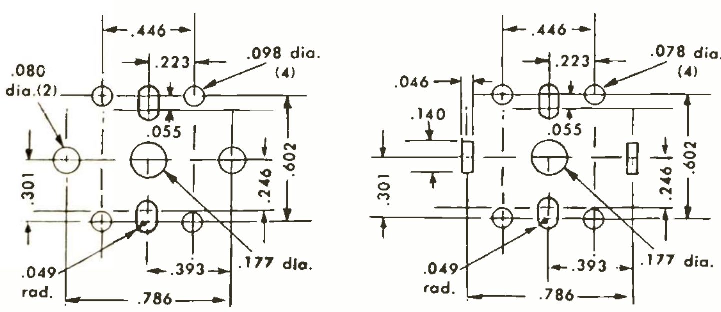
KOILOCK teeth that prevent coil from slipping on form

Exposed view of RI-tran ratio detector assembly



CHASSIS DETAIL

CHASSIS DETAIL



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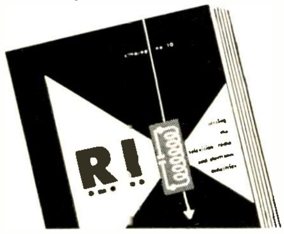

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What's Inside the Atlas

Electronics firms are playing major roles in this nation's history-making space feats

ORBITING last month of the Atlas missile satellite represents two milestones for the U. S. electronics industry:

- Use of a radio-inertial system to guide the 4$\frac{1}{2}$ ton, 185-ft Atlas hull into orbit.
- Operation of a satellite communications system which received transmissions from the ground and later relayed them to earth directly or from storage on command.

Guidance used to put Atlas in orbit was GE-Burroughs' radio-inertial system. GE reports that it has received $83 million worth of contracts so far for the same kind of equipment that took care of the Atlas' tracking, measuring and ground-to-missile data transmission. Atlas is built by Convair-Astronautics.

Burroughs is responsible for the ground-based computer which figures missile trajectory and determines guidance commands for steering the vehicle into orbit. Last month two contracts totaling almost $22.5 million brought Burroughs' total for Atlas ground equipment to about $68 million.

American Bosch Arma's pure inertial system, originally designed for Titan, will be tested in Atlas some time this year.

Developed Secretly

Communications system, which relayed teletypewriter and voice messages of President Eisenhower around the world, was developed secretly by the U. S. Army Signal Research and Development Laboratory, Ft. Monmouth, N. J. RCA's Astroelectronics division and Convair-Astronautics division reportedly contributed to the development.

One voice or seven teletypewriter messages can be transmitted with a power of 8 watts on 132.435 and 132.905 mc. Two beacon transmitters on 107.938 and 107.97 mc are used for tracking.

Communications payload weighs about 150 pounds. This includes two separate 35-pound communications packages, each of which contains: 1$\frac{3}{8}$ by 5-in beacon transmitter; 4$\frac{5}{8}$ by 3$\frac{7}{8}$ by 1$\frac{3}{4}$-in control unit; 6$\frac{1}{4}$ by 4$\frac{1}{4}$ by 4$\frac{1}{2}$-in communications transmitter; 3$\frac{1}{2}$ by 4$\frac{1}{2}$ by 1-in receiver; 4$\frac{1}{8}$ by 9$\frac{3}{4}$ by 2-in d-c to d-c converter and an irregular-shaped zinc-silver battery approximately 13 by 6 by 5$\frac{1}{4}$-in. Each 35-pound unit is about 24 by 10 by 10-in.

Army Signal engineers say the remaining 80 pounds of gear consists largely of coaxial cables, the antenna system, duplexers, r-f cables and other system components. System uses printed circuitry and more than 50 transistors, and a few tubes. Control unit provides circuitry for various switching functions.

Secret Atlas firing had code name Score—for signal, communications, orbit, relay experiment. Accuracy of the guidance and success of the communications system open up possibilities for other electronics-carrying satellites, such as for tv relay, tv reconnaissance and upper atmosphere studies in preparation for putting a man into space.

Jamming Problem

Though enemy jamming is a possibility in radio command guidance systems, GE says: "In all tests to date we have been unable to jam our own radio-inertial guidance system. Jamming requirements can be made so difficult that the enemy finds it a most ineffective and undependable mode of defense." (ELECTRONICS, p 14, Apr. 24, 1958.)

Major subcontractors for the Atlas system, according to government sources, include: Aircraft Armaments Inc., simulator cabinet; Ampex, tape recorders: Dalmo-Victor, antennas; Electronic Engineering, recorders; General Bronze, antenna; Goodyear Aircraft, radomes, antenna assemblies; Machlett Laboratories, tubes; National Co., measuring sets; Nuclear Products, ACF Industries Erco div., training, simulation equipment; Riverside Plastics; radomes; Stromberg-Carlson, test equipment; and Varian Associates, klystron tubes.

MEETINGS AHEAD

Jan. 12: Medical Electronics Meeting, Detecting Unseen Cancer Cells, PGME of IRE, Inst. for Cancer Research, Philadelphia.

Jan. 12-14: Reliability and Quality Control, Nat. Symp., PGRQC of IRE, ASQC, EIA, Bellevue-Stratford Hotel, Philadelphia.

Jan. 13-14: Cathode Ray Tube Recording, Systems Development Corp., Engineers Club, Dayton, O.

Jan. 14: Computers and Medical Diagnosis, Rockefeller Institute, N. Y. C.

Jan. 21-23: Southwest Electronic Exhibit, Arizona State Fairgrounds, Phoenix, Ariz.

Jan. 29-30: Long Distance Transmission by Waveguides, Institution of Electrical Engineers, London, England.

Feb. 1-6: American Institute of Electrical Engineers, Winter General Meeting, Statler Hotel, N. Y. C.

Feb. 12-13: Transistor & Solid-State Circuit Conf., AIEE, PGCT of IRE, Univ. of Penn., Philadelphia.

Feb. 12-13: Electronics Conference AIEE, IRE, ISA, CPS, Eng. Soc. Bldg., Cleveland.

Feb. 17-20: Western Audio Convention, Audio Eng. Soc., Biltmore Hotel, Los Angeles.

Mar. 3-5: Western Joint Computer Conf., AIEE, ACM, IRE, Fairmont Hotel, Los Angeles.

Mar. 5-7: Western Space Age Conf. and Exhibit, L. A. Chamber of Commerce, Great Western Exhibit Center, Los Angeles.

Mar. 15-18: National Assoc. of Broadcasters, Annual Convention, Conrad Hilton Hotel, Chicago.

Mar. 23-26: Institute of Radio Engineers, IRE National Convention, Coliseum & Waldorf-Astoria Hotel, New York City.

Mar. 31-Apr. 2: Millimeter Waves, Symposium, Polytechnic Inst. of Brooklyn, USAF, ONR, IRE, USA Signal Research, Engineering Societies Bldg., N. Y. C.

Apr. 5-10: Nuclear Congress, sponsored by over 25 major engineering and scientific societies, Public Auditorium, Cleveland.

Apr. 13-15: Protective Relay Conf., A & M College of Texas, College Station, Texas.

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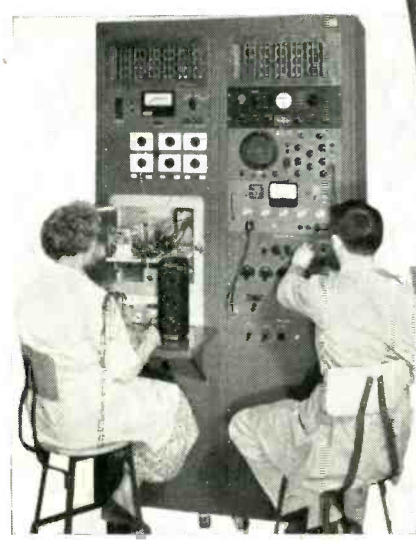

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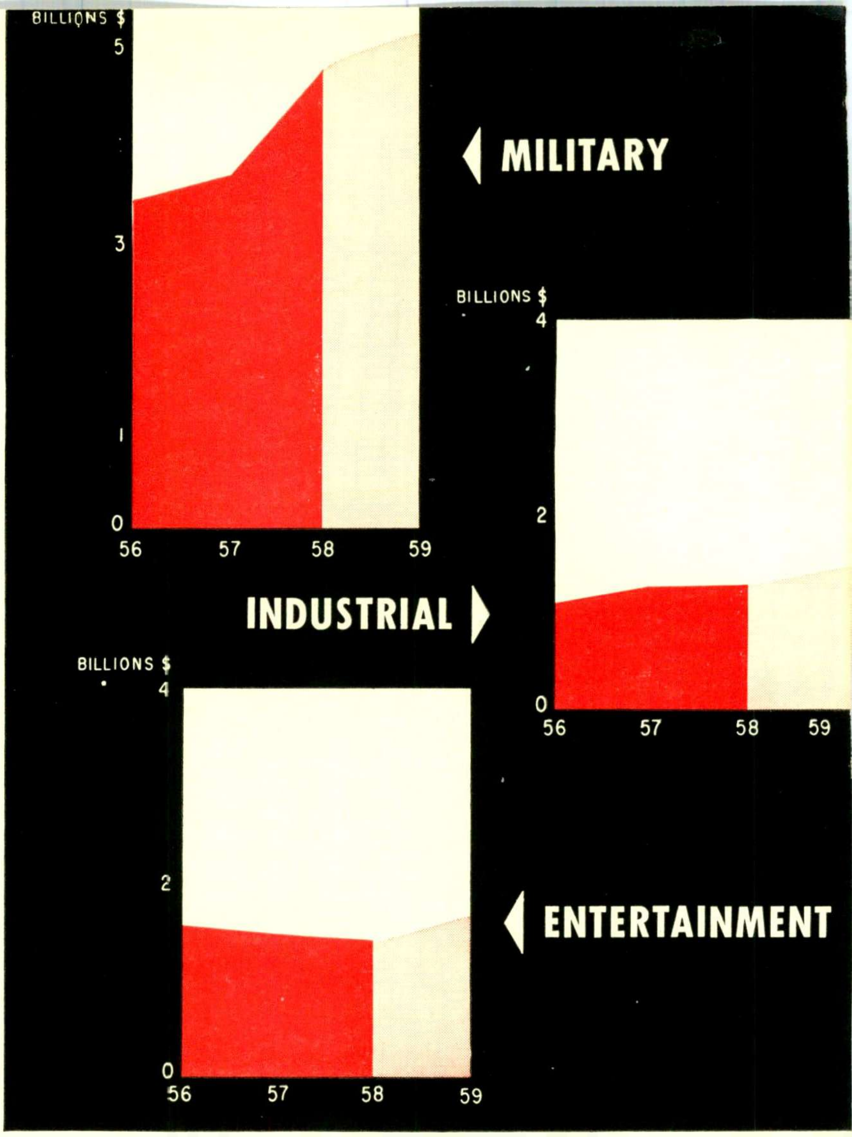


Increased military spending and renewed confidence of both consumers and businessmen foretell a substantial rise in factory sales of electronic equipment and replacement parts

ANOTHER RECORD YEAR for the electronics industry is indicated. Factory sales of electronic equipment and replacement parts in 1959 will total over $9 billion, may go even higher.

Total revenue from all electronics sales and services reached $13.2 billion in 1958, up slightly from 1957's $13 billion. Comparable figure for 1959 is $14.6 billion.

Despite lingering effects of last year's military cutbacks and the recession, industry sales last year reached $8.2 billion, topping 1957's high of $8 billion at the factory.

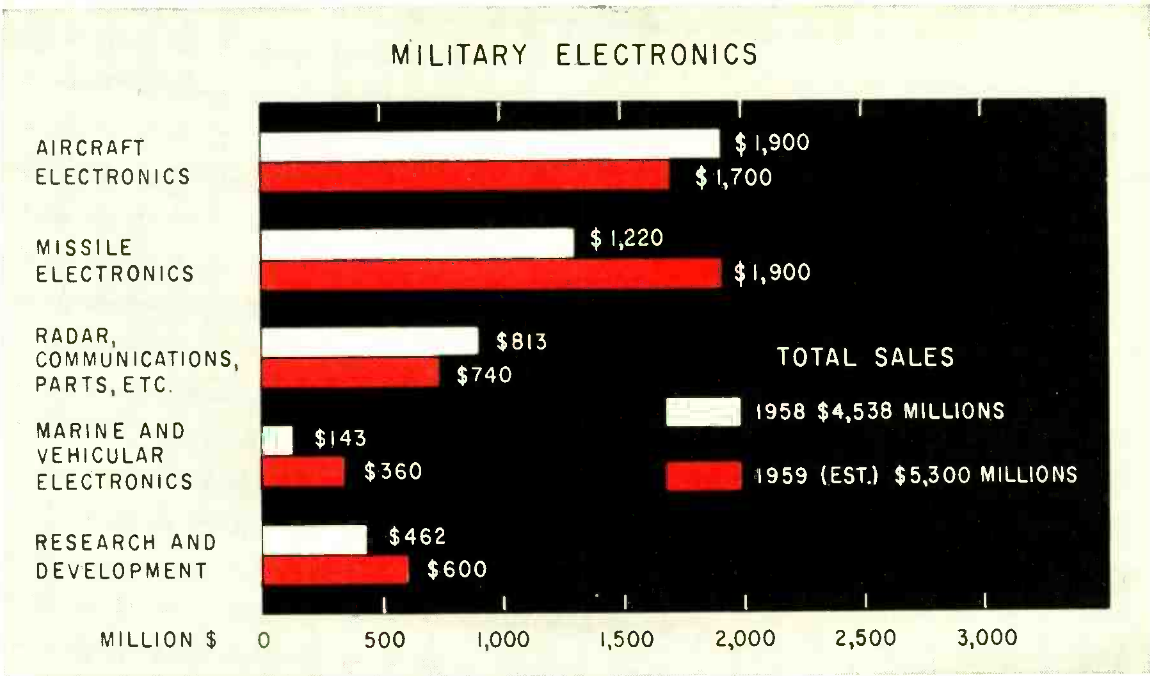
The year ahead will be a good one for our industry, with sales rising once again more than those of industry at large. (See "Electronics' Growth Tops Nation's Pace," p 14, Oct. 7, 1958.) Signposts are to be found both in our industry and elsewhere pointing to a steadily improving general economic picture. Some of the basic trends and indicators are:

Big backlog of military orders; no letup visible ahead.

Industrial bank loans to business starting back up.

Consumers' time payment obligation at new low, while real income and disposable income are rising rapidly.

MILITARY ELECTRONICS—The U. S. Government, our industry's biggest customer, will take more than $5 billion worth of electronics in 1959. This compares with $4.5 in 1958 and $4.3 in 1957. This year, likely to be the best for sales to the military, will see increase largely due to the substantially increased production of many missiles, combined with continued high sales of manned aircraft. This year's



business will be up despite some cutbacks in some missile and aircraft contracts.

Conservative estimates point to a missile tab of about $4.7 billion for 1959. Of this, at least $1.9 billion will go for missile electronics. Although many missiles will be in production in 1959, the full impact of the missile increase won't be translated into production until 1960 or later. Increased allotments for research and development in 1959 for guidance and control will also lead to more production in the years ahead.

Recent information from the Department of Defense and investigation by ELECTRONICS editors (See "The Missile Market," p 13, Nov. 28, 1958) has raised estimates of electronics' share of missile funds. Previously electronics' dollar share of average missile contract was estimated at 35 percent. Revised estimate is 40 percent.

Military aircraft will have a good production year, with about $6.8 billion total expenditures. Of this, electronics' slice will amount to $1.7 billion or more. The aircraft-missile dollar ratio was three to one in 1957, is less than two to one now, and may be down to 50-50 or 40-60 in 1960. But while defense armament

A QUICK LOOK AT THE ELECTRONICS BUSINESS

	1958		1959	
GOVERNMENT ELECTRONICS		$4.54 Billion		$5.3 Billion
Aircraft	1.9		1.7	
Missiles	1.22		1.9	
All Other	1.42		1.7	
ENTERTAINMENT		1.343		1.555
TV Sets	.682		.750	
Radio Sets	.273		.345	
Other	.388		.460	
INDUSTRIAL—COMMERCIAL		1.378		1.572
REPLACEMENT PARTS		.960		1.0
BROADCAST, DISTRIBUTION, SERVICE		5.0		5.2
TOTAL, ELECTRONICS SALES & SERVICE		$13.221 Billions		$14.627 Billions

FACTORY SALES OF INDUSTRIAL ELECTRONIC EQUIPMENT

	1958	1959
Broadcast	$53 Million	$55 Million
Mobile Radio	85	95
Microwave	35	40
Marine	14	15
Aviation	70	150
Other Communications	37	42
Data Processing	258	310
Test Instruments	220	235
Industrial Control	160	170
X-Ray	90	95
Atomic Instrumentation	42	50
Electronic Heating	25	30
Industrial Television	7	8
Commercial Sound	125	135
Theater Equipment	40	42
Miscellaneous	90	100
TOTALS	**$1,378 Millions**	**$1,572 Millions**

shifts and guided missiles take on more and more of the job previously handled by piloted aircraft, jet aircraft will become increasingly a part of everyday life. Shrinking military aircraft electronics needs, therefore, will be offset in part by increased requirements for nonmilitary air navigation, communication and traffic control.

Spending on military communications, radar and associated hardware will amount to about $740 million in 1959. Military R&D will take at least $600 million. This figure will be upped if some prototype and tooling money now in missile and aircraft allotments is subtracted from them and reflected directly in defense figures for R&D. Other smaller military categories will push the final figure over $5.0 billion.

INDUSTRIAL ELECTRONICS — Industrial and commercial electronics is on the brink of a new growth period. Total sales of this equipment during the coming year should pass the $1.5-billion mark, could go as high as $1.6 billion, exclusive of distribution and maintenance. Last year's figure was $1.37 billion, up from 1957's $1.24 billion. Gains will come in part from modernization programs in all industries, including our own.

McGraw-Hill's Economics Department finds in its late 1958 survey that plans for 1959 capital spending in certain industries are already higher than expenditures for 1958. These plans involve more money for modernization and replacement of obsolete facilities than for expansion. With one exception, the industries planning most capital spending are also the ones who make most use of industrial electronics.

These industries include the railroads, which spent only half as much for capital expenditures in 1958 as in 1957. They also include other transportation and communications companies such as airlines, trucking and shipping companies. Electric and gas utilities plan slight cuts for 1959 in this capital spending. But they were the only industries to spend more in 1958 than in 1957, so their expenditures will remain high. The petroleum industry also plans to spend more for capital goods this year than in 1958.

Businessmen will spend more money on electronics than ever before. Much of it will go for mobile radio communications.

There is the possibility of a good-sized market opening up in the increased use of electronics in automobiles for other than radio applications. (See "Autos Enter Electronics Era," p 73, Nov. 21, 1958.) If these uses start in 1960 cars, there will be heavier buying of components in 1959.

ENTERTAINMENT ELECTRONICS — Consumers are expected to purchase over $1.6 billion (factory value) worth of electronic gear for home entertainment. This contrasts with the $1.38 billion bought last year and 1957's mark of $1.53 billion.

Television receiver sales will reach nearly $750 million, about six million units, compared to 1958's 5.3 million receivers, worth about $682 million. Color tv is still not slated for a major breakthrough. Set sales will probably be about 150,000 units as compared with 1958's 125,000 sets. The boom in record playing equipment will continue, with packaged phonographs and high fidelity components getting an extra push from stereo. Tape recorders will sell well over 600,000 units.

Radio receivers will enjoy increased sales, with a

FACTORY SALES OF ELECTRONIC ENTERTAINMENT EQUIPMENT

	1958		1959	
TELEVISION RECEIVERS (B&W).....		$682 Million		**$750 Million**
TELEVISION RECEIVERS, (COLOR)...		37		**50**
Home Radios..................	64		**73**	
Clock Radios..................	45		**52**	
Portables....................	63		**70**	
Auto Radios...................	101		**150**	
RADIO RECEIVERS, ALL TYPES.....		273		**345**
PHONOGRAPHS................		143		**155**
HIGH FIDELITY................		95		**130**
TAPE RECORDERS...............		150		**175**
TOTAL FACTORY SALES.....		**$1,380 Millions**		**$1,605 Millions**

big increase in sales of auto radios. New automobile sales were down 30 percent to only 4.3 million in 1958, but will increase greatly in 1959. Automobile radios in 1957 accounted for more than 35 percent of all radio receiver production. Conservative estimates for this year run from 5.5 million autos to beyond seven million. Estimate of at least 6.3 million comes from Prof. Hans Brems, who predicted the car boom of '55. The anticipated increase of 30-40 percent in next year's automobile sales will mean increased sales of auto radios.

McGraw-Hill's Economics Department has compiled information on consumer spending potential for the months ahead. Durables purchases are seen increasing because: (1) Consumers now have more money than during the past year, except for Christmas debts that will be largely paid off in 2-3 months. (2) Disposable income which has shown little increase since early 1956 is now going up rapidly. Disposable income is measured after taxes and adjustment for increased cost of food, rent and other basics. (3) There is evidence of increased buyer confidence. (4) There are more average radio and tv receivers in use than ever before. (5) More households will be formed next year than ever before. More than two million tv sets will be bought by these new householders alone.

There are now tv receivers in 84 percent of all homes in this country.

Enough of the ingredients exist to suggest that the year 1959 will be a good one for entertainment electronics.

COMPONENTS—Replacement parts for 1958 are estimated to have reached $960 million sales and will near the billion dollar mark in 1959.

Counting both intraindustry sales and sales of replacement parts, semiconductors had their best year, selling about $240 million. They should reach $310-million worth at the factory in '59. Electron tubes are expected to reach about $950 million in 1959, after sales totaling $910 million in 1958. Cathode-ray tubes brought in $170 million last year and should sell about $185-million worth in 1959. Other circuit components: resistors, capacitors, transformers and chokes and miscellaneous totaled about $2.3 billion in 1958, are expected to reach about $2.5 this year.

The tube industry will see slightly increased sales of replacement tubes while crt's for tv sets will rise. Greatest growth areas in electron tubes will be in sales of power and transmitting and other special-purpose tubes.

While sales of conventional components for replacement are continuing at an increasing rate, there is much growth in specialized components for missiles, data-processing equipment and other gear requiring reliability and precision. High sales levels are expected in all types of components as equipment manufacturers build up inventories that were seriously depleted during last year's extra-cautious buying.

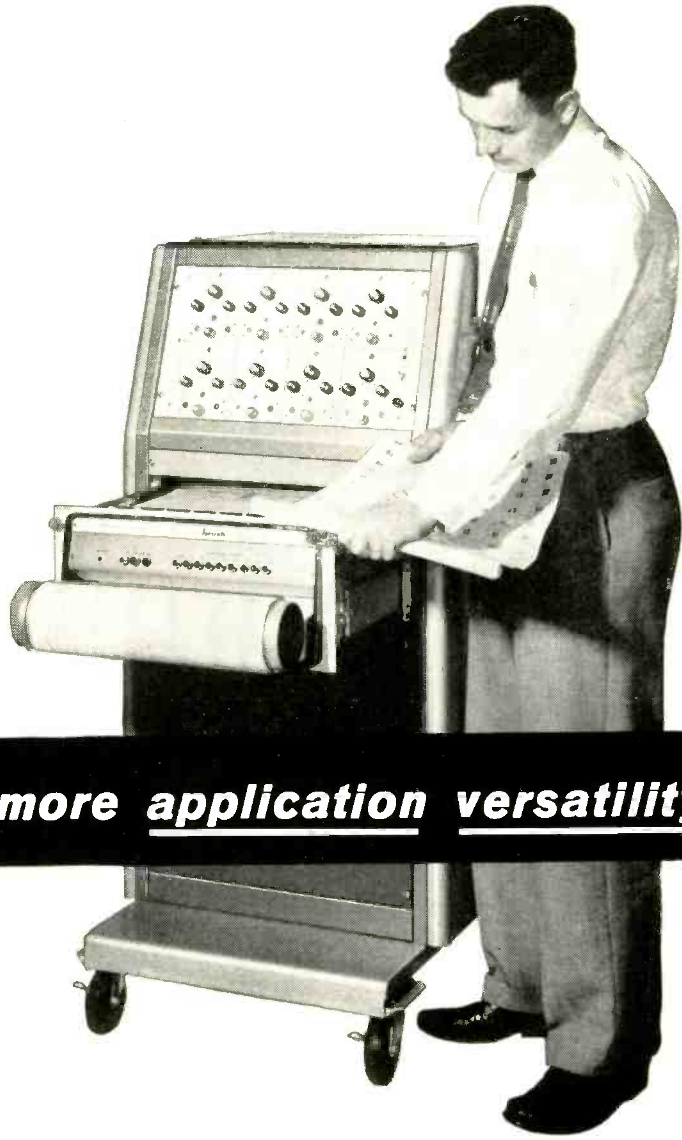
NONMANUFACTURING INCOME—Broadcast revenue has remained fairly constant around $2 billion and is not expected to rise greatly this year. Distribution of consumer and commercial electronics totals another $2 billion. Maintenance and service will reach about $1 billion in 1959, rising gradually with the amount of electronic equipment in use.

FOREIGN TRADE—Moderate increases in electronics foreign trade are expected as part of a general increase in world trade. Among reasons for this is the expectation of higher and long-term spending for consumer goods in Europe. Also contributing will be the settling of raw materials prices on the world market and a record flow of intragovernment development capital to both expanding market areas and underdeveloped countries.

One example of a growing market: according to a U. S. Information Agency official, sales of tv sets overseas will grow from the present 21 million to 50 million by 1962. How much of this market U. S. manufacturers take will depend on whether they will adapt production to foreign systems and on how well they can compete in price.

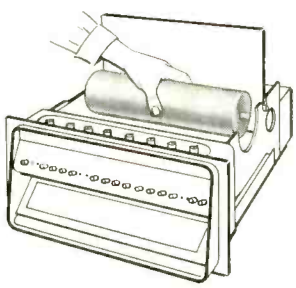
These features of

new Brush ultralinear recording systems...

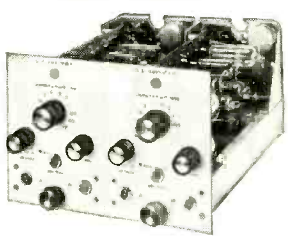


. . . give you more application versatility!

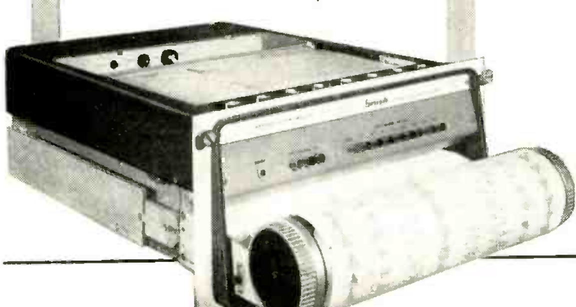
Simplified Chart Re-loading.



Interchangeable, plug-in signal conditioners.



Positive Chart Take-up Drive.



In the fields of telemetry, ground support systems, analog computing and laboratory testing, Brush recording systems have incorporated features which have consistently kept ahead of engineering requirements. Here are a few that show why—

INTERCHANGEABLE PLUG-IN SIGNAL CONDITIONERS. You get your *choice of sensitivities*—you get high input impedance—zero suppression.

SIMPLIFIED FAST CHART RE-LOADING. Loaded from the top—features automatic alignment and tracking.

ACCURATE, EASILY REPRODUCIBLE RECORDINGS. Your choice of rectilinear or curvilinear charts—rugged "throw-proof" pens.

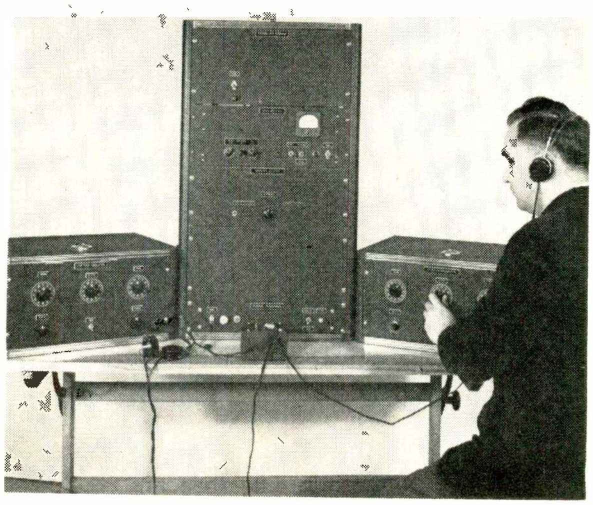
Illustrated above is a Brush RD-1684 rectilinear, 8 channel recording system. Sensitivity of 10 millivolts per chart line—input impedance, 10 megs balanced or 5 megs grounded. Complete system includes mobile cabinet, oscillograph and 8 signal conditioners. No additional preamplifiers required. Available from stock.

brush INSTRUMENTS

DIVISION OF

37th & PERKINS **CLEVITE** CORPORATION CLEVELAND 14, OHIO

electronics
JANUARY 9, 1959



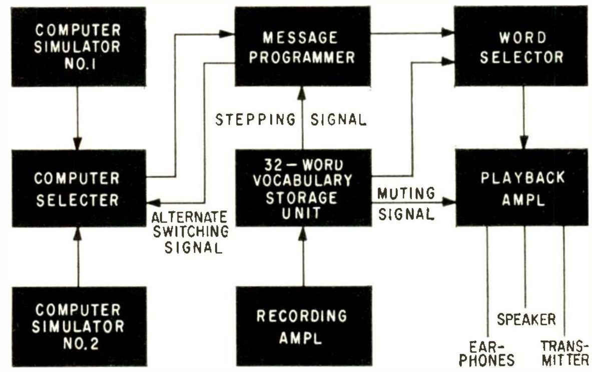


FIG. 1—Automatic voice link handles multiple intercept operations by sequentially transmitting data from several computers

Errors resulting from operator fatigue and poor annunciation are eliminated by automatic voice link

How Robot Voices Vector Fighter Pilots

Experimental automatic voice link converts data describing position of enemy aircraft into verbal instructions for transmission to fighter-interceptors. Words are represented by a five-bit code and are arranged according to desired message format. Binary bits select prerecorded spoken words

By C. W. POPPE and P. J. SUHR*,
Defense Products Division, Fairchild Camera and Instrument Co., Syossett, New York

MODERN FIGHTER-INTERCEPTOR operations require automatic processing of radar information defining positions of enemy and interceptor aircraft. The voice link described here is capable of accepting outputs from several data processing equipments and automatically converting these electrical signals into a verbal message for radio transmission to intercept aircraft.

MESSAGE STRUCTURE—A typical message sent to an interceptor pilot might be: TONE BAKER 2 STEER 185 DEGREES ENEMY ALTITUDE 32 THOUSAND FEET DISTANCE TO CONTACT 19 MILES. Variable address words BAKER 2 and the seven variable numerical words are continuously generated by intercept computers to provide up-to-minute flight-path data for various interceptor aircraft. The alerting signal, represented by the word TONE, and command words STEER, DEGREES, ENEMY, ALTITUDE, THOUSAND, FEET, DISTANCE, TO, CONTACT and MILES are selected on the automatic voice link equipment and arranged into a predetermined message structure by the operator of the station.

Each word is assigned a unique binary code made up of five bits. The state of each bit is determined by grounding or opening the associated circuit.

EXPERIMENTAL SYSTEM — A working laboratory model of the automatic voice link using two computer simulators in place of intercept computers has been built. A block diagram of the system is shown in Fig. 1.

Binary information required to select the two ad-

* Now with Marine Div., Sperry Gyroscope Co., New York.

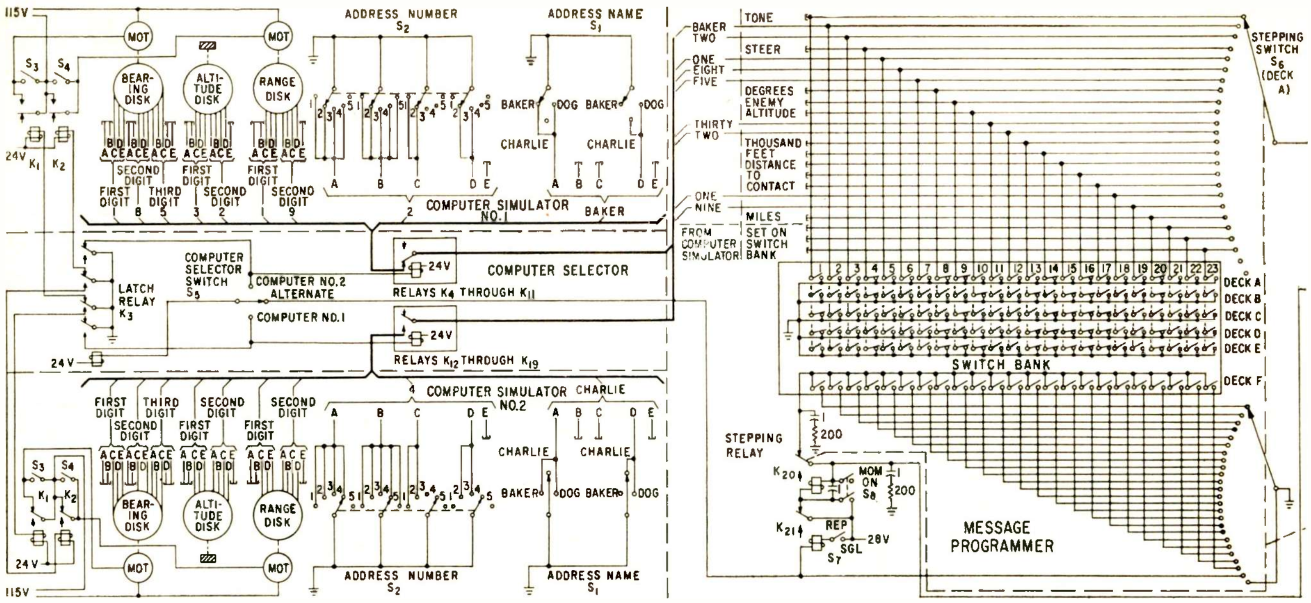


FIG. 2—Each word transmitted by automatic voice link takes ½ sec to generate. Muting microswitch S_8 closes 25 millisec after start of next

dresses and seven numerical words of the example message are generated in each computer simulator. Either simulator can be switched in manually on the computer selector, or the simulators can be selected alternately by a signal sent to the computer selector by the message programmer at the end of each message. The message programmer arranges the message into a preselected format and applies each word sequentially to the word selector. The binary code selects the magnetically prerecorded spoken word from the vocabulary storage unit. The selected audio signal is then fed through the word selector and playback amplifier to a monitoring speaker or earphones, or to a radio transmitter. A recording amplifier is provided to erase words and record new ones as desired.

Stepping signals necessary to advance from word to word are generated by the vocabulary storage unit. This unit also supplies a muting signal to the playback amplifier during the transient-producing switching periods. A schematic diagram of the automatic voice data link model is shown in Fig. 2.

COMPUTER SIMULATOR—Two selector switches in the simulator provide means for setting in address information. Switch S_1 generates the two controllable bits of binary information used to select any one of three address names. Switch S_2 generates the four controllable bits of binary information used to select any one of five address numbers.

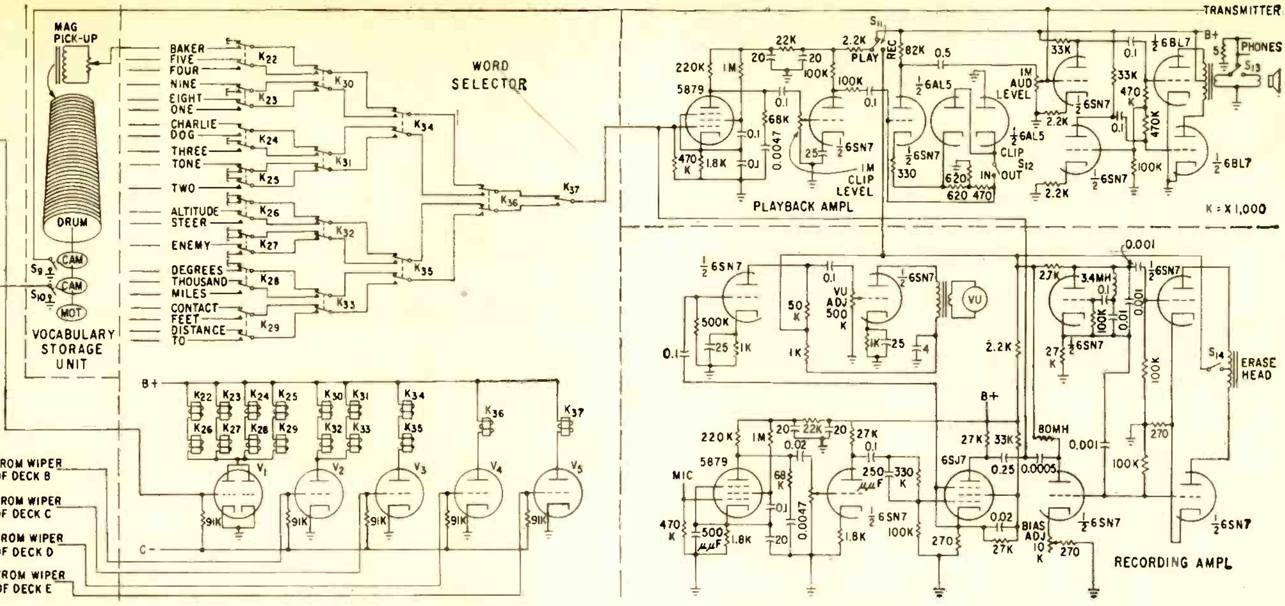
Three coded disk assemblies generate the variable numerical words. Both bearing and range disks are normally motor driven, but can be positioned manually when necessary. The altitude disk can only be positioned manually. The bearing disk produces steering commands from 5 to 360 deg in 5-deg increments; the altitude disk produces altitudes from 1,000 to 36,000 ft in 1,000-ft increments; and the range disk produces distances-to-target from 1 to 36 miles in 1-mile increments.

Correct information is obtained from bearing and range disks only when they have stopped rotating. A circuit consisting of switches S_3 and S_4 and relays K_1 and K_2 is used to stop the driving motors. The switches are actuated by 72 indentations spaced evenly around the circumference of the bearing and range disks.

If a computer simulator is feeding information to the rest of the system, relays K_1 and K_2 are energized and one leg of the parallel power circuit supplying the motors is opened. When the switch contact arms fall into a detent, the other leg of the motor power circuit is opened and the disks stop rotating.

SIMULATOR SELECTOR — Computer selector switch S_5 controls application of the outputs from the computer simulators to the message programmer. If S_5 is used to select one of the computers and the contacts of latch relay K_3 are already properly positioned, nothing happens. However, if the contacts of K_3 are oppositely positioned, the ground return for the coil of K_3 is made energizing the relay and flipping its contacts to the proper position. This action also energizes relays K_1 and K_2 in the computer simulator and the simulator output feedthrough relays K_4 through K_{11} or K_{12} through K_{19} depending on the computer simulator selected. If S_5 is in the ALTERNATE position as shown in Fig. 2, the arms of latch relay K_3 change position each time a message completion signal is received from the message programmer.

MESSAGE PROGRAMMER—Six-deck, twenty-five position stepping switch S_6 selects each word of the message sequentially and applies its five-bit binary code to the word selector. The binary code is applied to corresponding positions of decks A through E by one of two means. Variable address and numerical words are supplied by the computer simulator; the warning tone and the command words are supplied by the switch bank. Deck F is used to advance S_6 rapidly to the starting position at the end of a mes-



word interval. Stepping microswitch S_{10} closes 5 millisec after and opens 5 millisec before S_9

sage less than 23 words long, to stop the rotation of S_6 at the end of a message sent only once and to provide the message completion signal necessary to switch computer simulators alternately.

Each of the first 23 positions on decks *A* through *F* is connected to a single-pole toggle switch. Switches associated with decks *A* through *E* are used to set in the binary codes corresponding to the words in the message. The setting of these switches determines which word on the magnetic drum in the vocabulary unit will be chosen by the word selector as S_6 moves to each position.

All toggle switches associated with input lines from the computer simulator are left in the open position; those associated with tone or command words are closed or open depending on the five-digit binary code; and those associated with lines not used for the message are left open.

The switches associated with deck *F* are used to establish a rapid advance mode after the last word in a message. If a 23-word message is set in, all deck *F* toggle switches are left open. If a repeated message of less than 23 words is set in, however, all switches associated with positions following the message are closed thereby causing stepping relay K_{20} to actuate with each step of S_6.

Switch S_7 actuates relay K_{21} which sets in singular or repetitive modes of message transmission. Momentary ON pushbutton switch S_8 starts the message transmission for a single cycle if S_7 is at SINGLE.

WORD SELECTOR—The word selector consists of a relay pyramid and five associated electron tube controllers. The five binary digits used to select a particular word in the message format are applied to tubes V_1 through V_5 which are normally biased to cutoff by negative voltages. Bits representing ungrounded conditions have no effect on the tubes. Grounded bits, however, raise the grid potential of the tubes causing them to conduct and to pull in the associated relays. The audio signal for each chosen word is fed from one of the 32 pickup heads in the vocabulary storage unit through relay contacts to the playback amplifier.

VOCABULARY STORAGE UNIT—A magnetic recording drum 2⅜-in. in diameter and 7-in. long is used to store the 32-word vocabulary. The drum surface is coated with a layer of red oxide 0.0008-in. thick having a coercivity of 200 oersteads and a remanence of 750 gauss.

Each word is recorded on a track 0.04-in. wide and is spaced $\frac{7}{32}$ in. from adjacent tracks to minimize crosstalk. The 32 playback heads are arranged in 4 groups of 8 heads. Each group is located at a different point around the drum. The drum rotates at 120 rpm and has a surface speed of 15 in./sec. Frequency response is ± 2 db over 100-4,000 cps.

Each word recorded on the drum begins 25 millisec after the start of drum rotation and is completed within 450 millisec. The overlap of 50 millisec is the dead time required for the word selector to choose the next word in the message. During the deadtime, microswitches S_9 and S_{10} are actuated by cams coupled to the shaft of the drum. Switch S_{10} advances the stepping switch in the message programmer to the next word. Switch S_{11} grounds the audio signal to the output stages in the playback amplifier thereby suppressing switching transients.

Automatic voice links can be used in air traffic control applications where voice communication is necessary and where transmission must originate at a remote site. Since commands transmitted digitally from a command center could be converted to verbal messages after reaching a remote transmitter site, fewer land lines and voice channels would be required.

In areas where several languages are used in air traffic control, the vocabulary could be made up in each language and stored on separate drums. The operator could then select the desired transmission language by positioning a selector switch.

Detector Pin-Points

Transistor oscillator provides test tone. High-speed polarized relay follows transients as tape plays back. Machine stops when deviation in recorded and reproduced level indicates a flaw which would make the tape unsuitable for broadcast use

By **N. J. THOMPSON,** Supervisor of Radio and Tv Studio Maintenance, Wisconsin State Broadcasting Service, Madison, Wisconsin

CHECKING OUT recorded magnetic tape is made easy by using this tape-flaw detector. The tester automatically stops tape-transport motion whenever a splice, bad warp or void in magnetic coating cause transient changes in the reproduced level of a tone.

The block diagram, Fig. 1, shows how the unit works. A reel of tape is threaded into the transport mechanism. Switching to TAPE-TEST position removes power from the transport motors, allowing the transport forward switch to be operated without reaction. When a test is started, the start button, pushed and held, supplies 110 v a-c to the transport motors and to the 28-v supply. This starts the transistor oscillator, which records a tone on the tape. The operator adjusts playback gain at a desired level within limits of the sensitive relay. The relay is adjusted with magnetic bias, and closes one contact when the level is 2 db above reference, and closes its other contact when the level is 2 db below reference.

Within this four db range, neither contact is closed, both time-storage capacitors drop, and the power relay is energized. The operator notes the extinguishing of the LOW and HIGH indicator lights and may release the start button. Tape transport continues until the recorded and reproduced level deviates momentarily, at which time the machine stops.

The operator then checks the tape in the vicinity of the heads for flaws. Splices are inspected and remade if necessary, or the reel is discarded if excessive splices are noted.

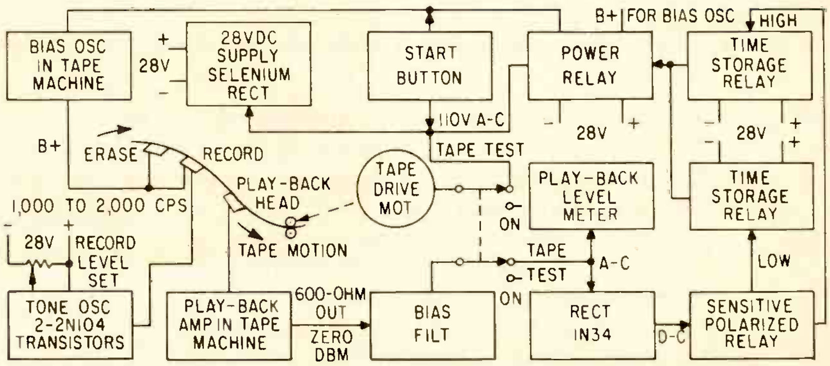


FIG. 1—Block diagram of tape tester. Outlet connection to a clock permits timing of tapes as they are checked in spite of stops and starts

Response To Transients

A transient due to a perpendicular splice may last only a few milliseconds at tape speeds of fifteen inches per second or more. The detector uses a high-speed polarized relay to follow such transients. Tone from the playback head is amplified through the original tape playback amplifier. Output at zero dbm is rectified, filtered and fed to the coil of the polarized relay. To insure fast response, a short-time-constant filter is used on this rectifier.

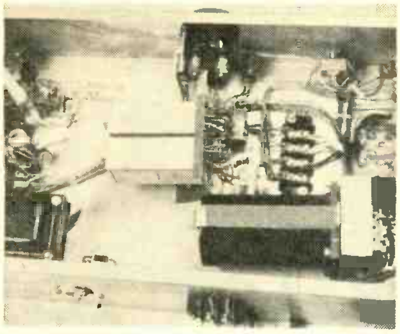
To prevent limiting response time by slower relays following the polarized relay, the polarized relay charges a memory capacitor as it responds to a transient. This capacitor discharges into the coil of a slower relay, which in turn stops the transport. The polarized relay used will follow as much as 200 cps.

The two heads of the commercial tape recorder used were replaced with a three-head assembly. The transistor tone oscillator drives the record head directly so a second amplifier is not required for the record channel. Erase and bias are supplied by the bias oscillator on the transport mechanism with no changes. Plate voltage is removed from the bias oscillator by a relay contact in the tester chassis, to prevent the bias oscillator from running during periods when the transport is in the forward position and the motors are stopped by the tester. Running the oscillator without the cooling effect of moving tape heats the heads.

An outlet is provided on the tape tester for connection to a clock. This permits timing of tapes as they are checked in spite of stops and starts.

No internal connections are made in the tape transport or amplifier. All connections are made by intercepting Jones plugs between amplifier and transport with a pair of

Magnetic Tape Flaws



Top view of chassis shows transistor oscillator at upper left, above the 28-v power supply. Polarized relay is located in cam, lower right. Telephone-type up and down relays are mounted horizontally at center

Author demonstrates one-finger operation of automatic tape-flow detector. Sensitivity of limit settings may require a stop for each splice

cable-type Jones plugs. Wires not intercepted are jumped from plug to plug.

The oscillator frequency, 1 to 2 kc, is chosen high enough to be easily filtered in the playback rectifier, and low enough to be unaffected by minor head misalignment or by head response problems.

Refering to the schematic of Fig. 2, C_1 removes recording bias from the reproduced signal. Capacitor C_2 should not be too large, to maintain adequate speed of response. The memory capacitors are C_3 and C_4. The primary of T_3 is tuned to frequency by C_5 which is chosen experimentally. The relay contacts are protected from arcing into their capacitive load by R_1. Resistor R_2 is chosen to bleed the power supply to the same voltage in the operating position as is available at the starting- but-not-at-the-correct-level condition. This is necessary because the oscillator is sensitive to supply variations, and it was deemed cheaper to use this method rather than incorporate a well-regulated supply. Variable resistor R_3, once set for proper recording level, is never changed. Surprisingly small output, about 0.1 volt at the 3-ohm tap, is required of this oscillator.

The unit may be altered for 6-v relays by changing C_3 and C_4 to 200 μf, R_1 to 10 ohms, the output tap on T_3 to 8 ohms and T_2 to a 6-v, 1-amp filament transformer. The selenium rectifier must also be changed to a 500-ma unit.

Cooperation of A. F. Puariea in the design is acknowledged.

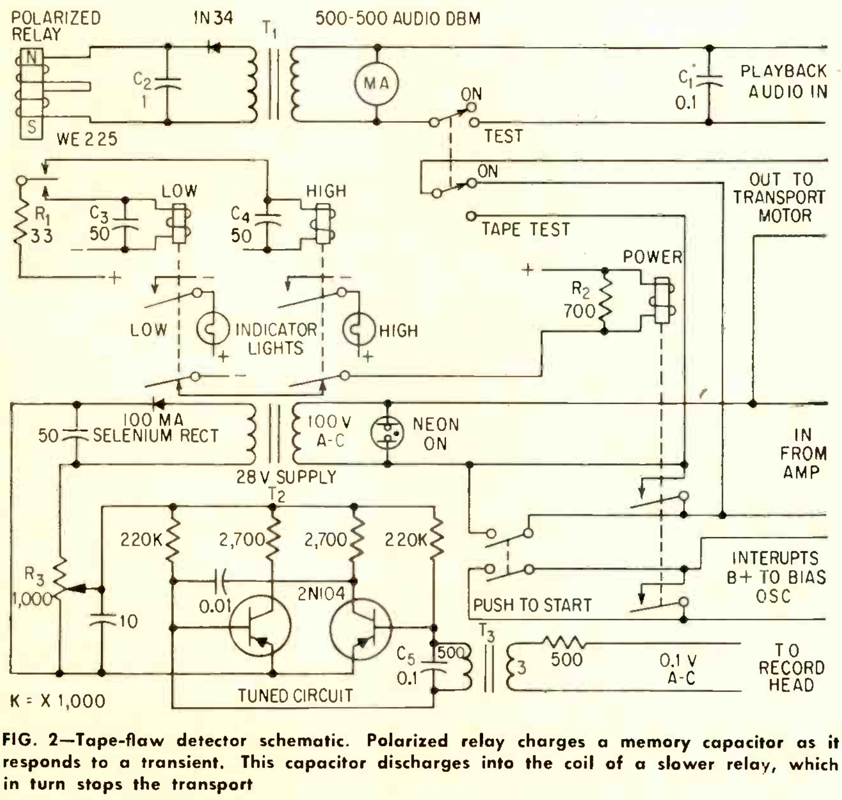


FIG. 2—Tape-flaw detector schematic. Polarized relay charges a memory capacitor as it responds to a transient. This capacitor discharges into the coil of a slower relay, which in turn stops the transport

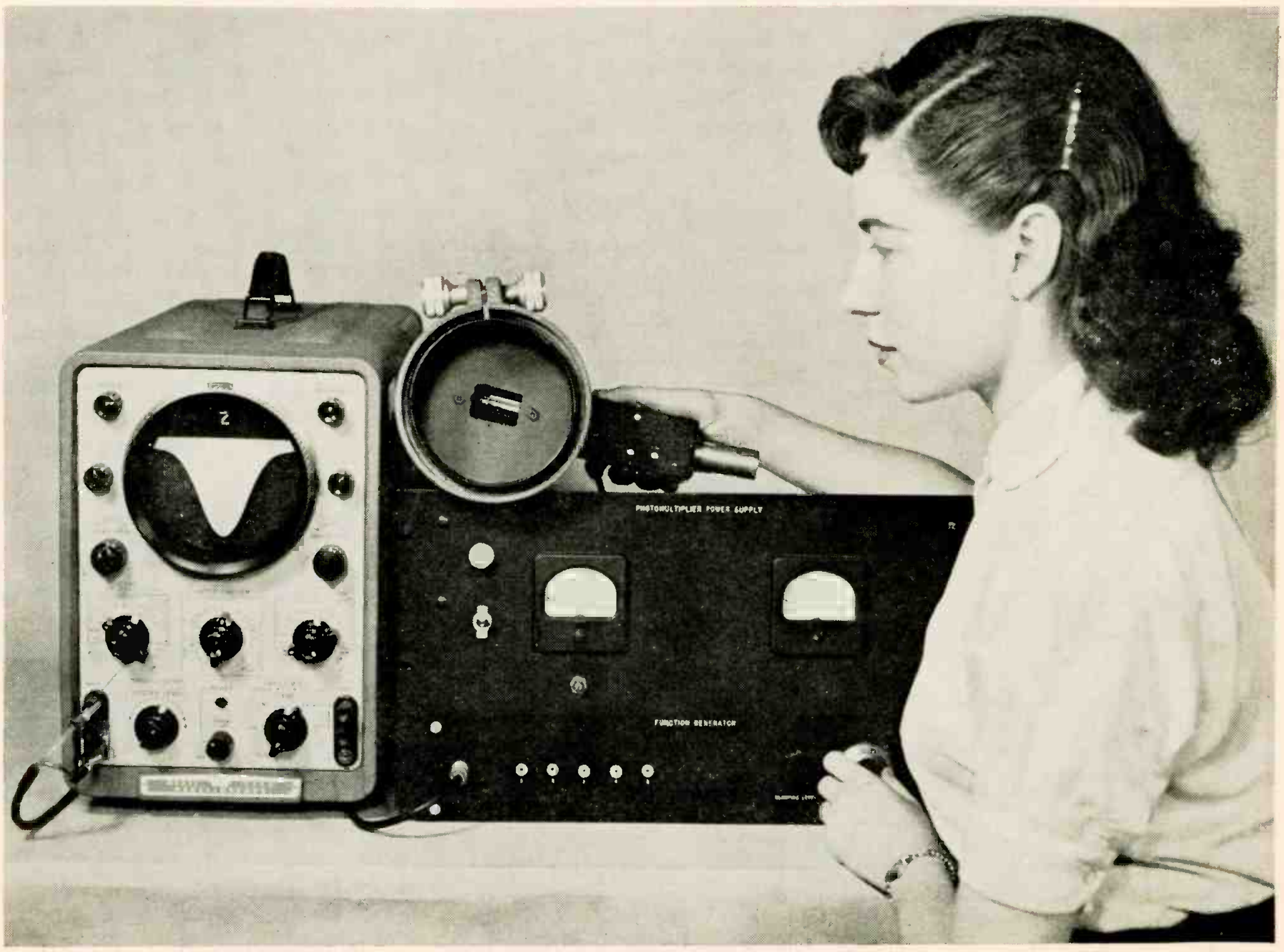
Open-loop photoelectric function generator can generate any single-valued function with an accuracy of better than one percent. Functions of a function can be produced with slight operating modifications. Many of the problems common to closed-loop operation have been eliminated

By BARBARA SILVERBERG, Columbia University, Electronics Research Laboratory, N. Y., N. Y.

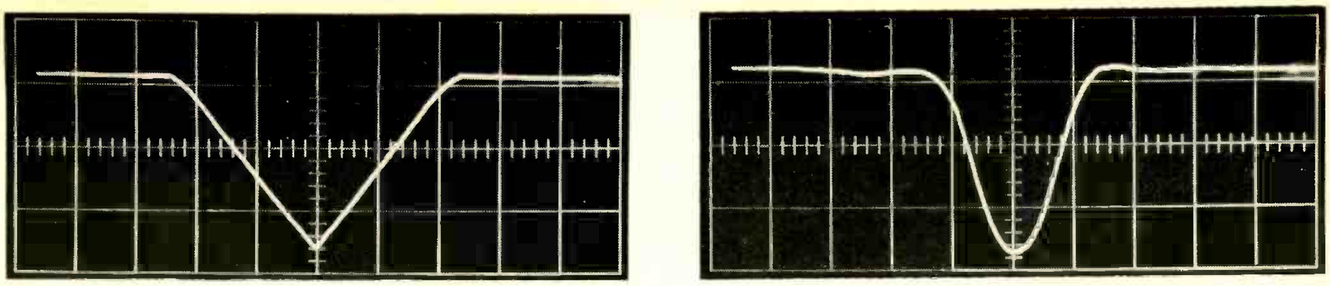
Function Generator for

AN INTEGRAL PART of a radar simulator is a function generator to produce the antenna beam pattern. A closed-loop MacNee type function generator used for this purpose was inadequate in its accuracy and frequency response, susceptible to drift, and plagued by parallax errors, halo effect of the screen and changes in spot size and intensity of the cathode-ray beam.

The general-purpose photoelectric function generator discussed in this article permits the generation of any single-valued function with an accuracy of better than 1 percent, and in addition, allows the generation of a function of function if it should be desired. With proper choice of vertical scan rate, up to 100 kc, the device has a flat frequency response up to 150 cps for the independent variable, and can reproduce functions with frequency



Bench setup illustrates use of component parts that make up photoelectric function generator



Signals were generated with open-loop photoelectric function generator

Radar Simulator

components in the kilocycle range. The interval of time in which the function is to be generated, as well as its repetition frequency, may be chosen arbitrarily.

Open-loop Operation

Unlike earlier methods of function generation, this photoelectric function generator uses an open-loop method of operation. A mask is prepared which is opaque except for the area between the dependent function and an arbitrary reference line, as shown in Fig. 1A. The mask is placed against the face of a flat-faced crt, with the reference line uppermost, and the electron beam is quiescently positioned along a line which is below the lowest point of transparency on the mask. A raster made up of a low-frequency horizontal sweep and a high-frequency vertical sweep is applied to the deflection plates of the crt, and the beam scans the mask at the high sweep rate, as shown in Fig. 1B. Each time the beam moves into the transparent area the phototube viewing the mask saturates and remains saturated until the beam moves across the reference line and back into the opaque area.

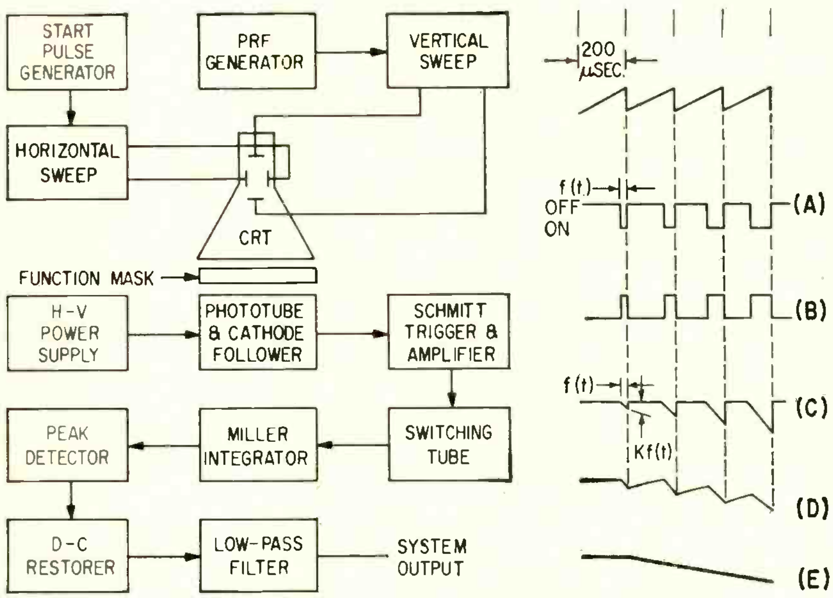


FIG. 2—System block diagram with waveforms for each stage.

Thus for each vertical sweep of the beam, the phototube produces a square wave of duration proportional to the ordinate between the function line and the reference line at the particular horizontal position being scanned.

The amplitude of the square waves is constant, and their fundamental frequency is the repetition rate of the vertical sweep.

The resultant series of duration modulated square waves is amplified, integrated and filtered to produce a varying d-c voltage proportional to the height of the function plus the pedestal between the base of the function and the reference line at the point being scanned. If

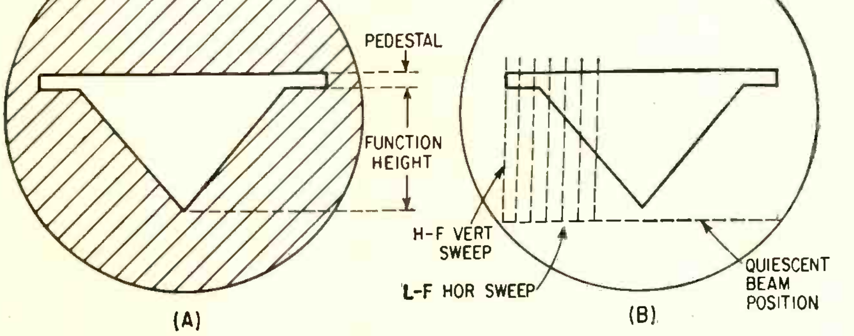


FIG. 1—Opaque mask (left) placed against the cathode-ray-tube face produces the desired function. Raster made up of a low-frequency horizontal sweep and a high-frequency vertical sweep is applied to the crt deflection plates (right)

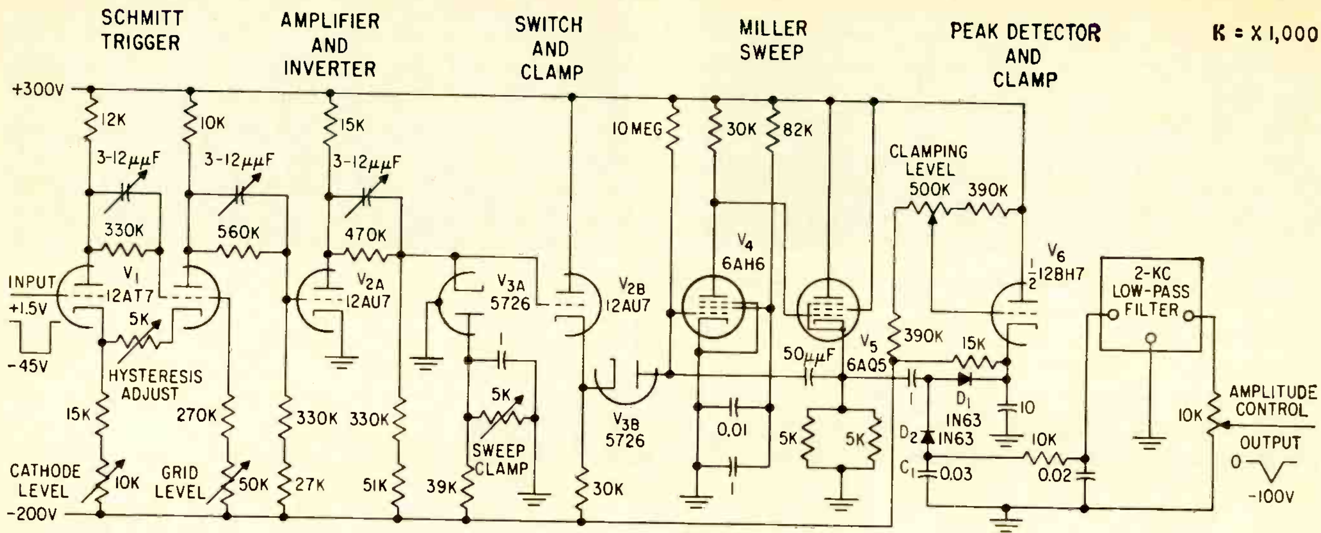


FIG. 3—Function generator which uses a horizontal sweep of ten milliseconds or 100 cps and a vertical sweep of 5 kc

the horizontal position of the beam is a linear function of time, the voltage produced at the output is an electrical replica of the function mask.

The slant of the high-frequency sweeps relative to the vertical causes a small error, which can be eliminated by positioning the cathode-ray tube at a slight angle relative to the reference line on the function mask. This will make the high-frequency sweeps vertical with respect to the function, without affecting the operation of the system in any way.

Time Interval

For a function to be generated accurately, it is necessary that the time interval between the completion of the integration of successive duration modulated square waves be constant. This is accomplished by placing the function mask with the reference line uppermost. Consequently the beam enters the transparent area at an arbitrary time depending on the height of the function at the horizontal position being scanned, but crosses back into the opaque region of the mask at a constant repetition rate. This action causes the square waves at the output of the phototube to commence at arbitrary time intervals, but to terminate at a constant repetition rate, and the above requirement is satisfied.

If a sampled output rather than a continuous output is desired, the vertical sweep trigger pulse can be delayed in time and used to sample the output of either the integrator or the filter.

As an interesting extension of this system, a function of a function can be generated either by varying the vertical sweep speed in a nonlinear manner, or by varying some parameter in the integrator circuit, for instance, the time constant or the integrator voltage.

Placing the function on a small pedestal, as shown in Fig. 1A, removes certain inaccuracies from the system. The most basic inaccuracy is due to the time it takes the phototube to saturate, about five μsec. Without the pedestal, any portion of the function which could be traversed by the beam in less than five μsec would not be reproduced linearly. The pedestal absorbs this nonlinearity and also the nonlinear portion which commonly occurs at the beginning of each integration cycle. The time it takes for the response of the phosphor and the phototube to decay effectively adds a small but constant amount to the height of the pedestal. This composite pedestal can be removed easily just prior to filtering the signal at the output of the system, without otherwise altering the function.

System Description

A block diagram of the function generator together with its waveforms, is shown in Fig. 2. The choice of the horizontal sweep time is arbitrary, depending on the requirements of the system in which the function generator is used. Once this has been established, a Fourier analysis of the function will determine the lowest repetition rate for the vertical sweep which will allow the function to be generated to the accuracy required by the system.

Any increase either in the repetition rate of the vertical sweep or in the horizontal sweep time will serve to further improve the accuracy of the generated function. A schematic diagram of a system using a horizontal sweep time of ten milliseconds and a vertical sweep repetition rate of five kc, is shown in Fig. 3.

The deflection system of the Hewlett-Packard 130 A oscilloscope is used with a 5AQP15 cathode-ray tube; the P15 phosphor has an S-4 response (blue-violet portion of the spectrum) of short persistence. The photosensitive device is a Dumont 931-A multiplier-phototube with high gain and an S-4 response, operated from a $-1{,}000$-v supply.

The sweep circuit provided in the oscilloscope is used as the horizontal sweep for the system. The 5-kc vertical sweep is supplied externally by a bootstrap sweep circuit which, when the clock pulses come in, first discharges and then allows the sweep to form. This permits these same clock pulses to be applied to the Z input of the scope to blank the vertical sweep retrace. The scope provides its own blanking signal for the retrace of the horizontal sweeps.

Circuit Operation

Duration modulated square waves produced by the phototube are fed through a Schmitt trigger which amplifies the signal and eliminates any noise resulting from variations in light intensity. The square waves are further amplified and fed to a cathode follower which opens and closes a diode switch to control integration time of a Miller sweep tube. The most negative excursion of the input to the cathode follower is limited by another diode such that, when the switching diode conducts, it holds the grid of the Miller sweep tube at a fixed low level in its grid base. Only when the switching diode is nonconducting, that is, when the phototube is in its saturated state, is the sweep able to form. To maintain the best possible rise time for the square waves it is advisable to use d-c coupling in this first section of the system.

Because the Miller sweep tube integrates only when the phototube conducts, the amplitude of each sweep is directly proportional to the duration of the corresponding square wave. The square wave in turn is proportional to the height of the function at the abscissa being scanned.

The cathode follower interposed between the feedback capacitor and the output of the Miller sweep tube reduces the recovery time of the integrator to 4 μsec. In addition, this cathode follower drives a d-c restorer and peak detector. Any pedestal present on the function is removed at this point in the circuit by restoring the base of the pedestal to whatever positive voltage is necessary to position the baseline of the function exactly at the zero level. Since the peak detector which follows is designed to pass only that portion of the signal below ground, the pedestal will not come through to the output. The setting of the d-c restorer is the only adjustment in this system which must be checked daily, since drift at this point will determine the amount of the function that appears at the output of the system.

The charge and discharge time constants of the peak detector are chosen to allow the amplitude of the voltage at its output to follow the maximum positive and negative slopes of the function being generated. Following detection, the function is passed through a low-pass filter which has sufficient bandwidth to pass all those frequency components Fourier analysis has proved necessary for accurate reproduction of the function. The filter also cuts off sharply enough to remove the high-frequency ripple.

Synchronization

For the function to be generated with the best possible accuracy, it is necessary for the horizontal sweep to be synchronized with the vertical sweep each time the raster scans the crt. In many cases, the trigger pulse which establishes the horizontal repetition rate is generated elsewhere in the system, competely independent of the vertical prf. From this pulse, a trigger pulse is derived that is synchronized to the vertical prf. One method of accomplishing this is shown in the block diagram of Fig. 4. The independently generated trigger pulse (waveform *A*) switches a bistable multivibrator from the ZERO to the ONE state. The output of the multivibrator, together with the vertical prf clock pulses, is fed to an AND gate; this gate passes the clock pulses only when the multivibrator is in the ONE state (waveform *D*). Thus the AND gate passes the first clock pulse which occurs after the independent trigger pulse comes in. It is this pulse which is used to trigger the horizontal sweep of the scope. In addition, it switches the multivibrator back to the zero state (waveform *B*) so that no further clock pulses are passed by the AND gate until the next independent trigger pulse comes in.

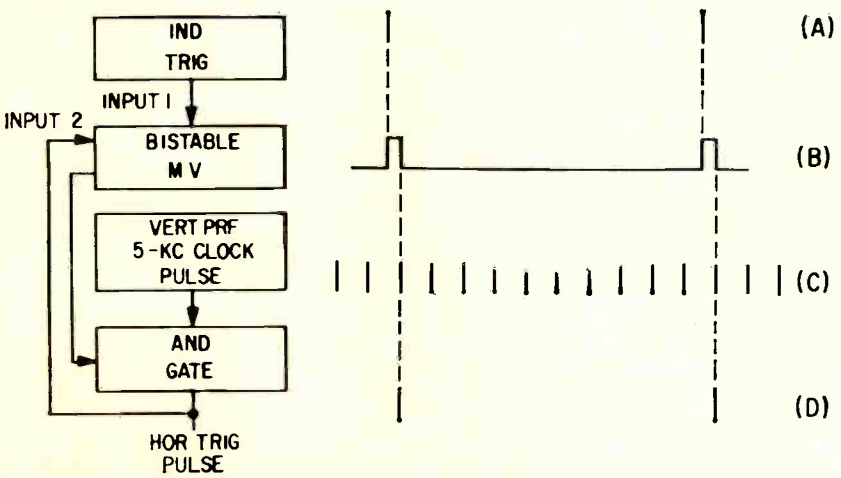


FIG. 4—Synchronization of horizontal and vertical sweep when each signal is generated independently

Performance

The function generator is able to generate any single-valued function to an accuracy of better than 1 percent of full scale. The main sources of error which prevail in other function generators of a similar type, such as persistence of the phosphor, delay time of the phototube and amplifier, variation of deflection sensitivity, changes in spot size and intensity, inaccuracies in some optical system which may be used, have, to a large extent, been eliminated. Of the errors which remain, the greatest is due to the small drift in most oscilloscopes.

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BIBLIOGRAPHY

W. H. Bliss and C. J. Young, Facsimile Scanning by CRT, *RCA Rev*, Sept. 1954.

D. S. Bond and V. J. Duke, Ultrafax, *RCA Rev*, March, 1949.

A. A. Gerlach, C. N. Pederson and R. E. Zenner, A Precise Electronic Function Generator, *Proc NEC*, 8.

E. J. Hancock, Photoformer Design and Performance, *Proc NEC*, 7, p 228, 1951.

L. G. Polimerou, A New Method of Generating Functions, *Trans IRE*, EC-3, Sept. 1954.

D. E. Sunstein, Photoelectric Waveform Generator, ELECTRONICS, 22, Feb. 1949.

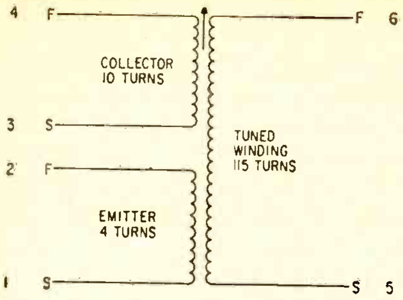

FIG. 1—Typical oscillator coil designed for emitter injection. Single pie gives less variation in coupling than double pie

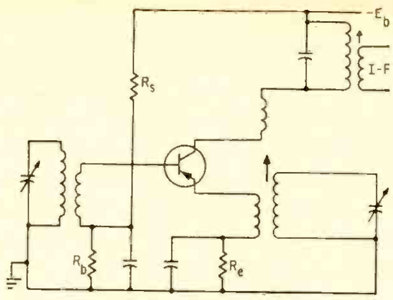

FIG. 2—Emitter-driven converter. Optimum injection voltage for direct emitter current of 0.5 ma is 0.1 to 0.15 v

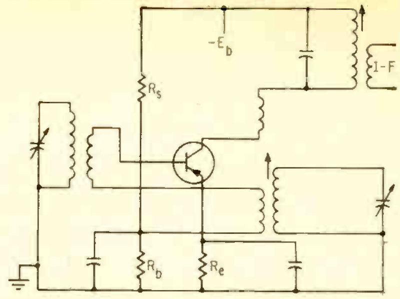

FIG. 3—Base-driven converter. Optimum injection voltage for direct emitter current of 0.5 ma is 0.2 to 0.3 v

Special Circuits for

Four portable transistor receiver circuits—autodyne converter, reflex circuit, avc overload diode and untuned r-f stage—are summarized in tabular form. Introductory text covers general design precedures for the entire receiver

By **WILLIAM E. SHEEHAN** and **WILLIAM H. RYER,**
Transistor Applications Laboratory, Semiconductor Div., Raytheon Manufacturing Co., Newton, Mass.

Circuit	Description and Design Hints	Problems and Solutions
Autodyne Converter (See Figs. 1, 2 and 3)	Used rather than separate mixer and oscillator. Basically an oscillator with special design considerations. Amplitude of oscillations must be limited by nonlinearity of emitter-base diode and not by any other form of nonlinearity such as collector bottoming. Impedance in collector circuit to oscillator frequency must be small enough so that peak-to-peak oscillator voltage does not approach battery supply voltage closely. Cost is about one-half that of separate mixer-oscillator circuit. Gain is about 30 db. Characteristics of transistor types generally used: input impedance to signal frequency, 500-1,500 ohms; conversion gain, 25-32 db; output impedance at 455 kc, 50,000-100,000 ohms. General design procedure: 1. Select oscillator coil design 2. Determine tuned-circuit parameters (oscillator and signal). Usually determined by convenient gang capacitor size 3. Select bias resistor values to give proper operating point and good temperature stability 4. Make necessary corrections to oscillator coil to give proper injection voltage across band. For more injection, increase number of turns on collector feedback winding by 10 to 20 percent and decrease turns similarly to lower injection voltage 5. Adjust number of turns on secondary of antenna to give fairly even sensitivity across band. Make set track by individual capacitor adjustments at each frequency 6. Adjust oscillator-coil and antenna inductances to make set track evenly across band	Greatest improvement in signal-to-noise ratio can be made by increasing size of antenna. Audio rate squegging may be eliminated by redesigning oscillator feedback circuit or changing values of coupling and/or blocking capacitors. Oscillation at i-f or some multiple may be corrected by relocating parts or revising tuned circuit to remove parasitic resonances. Spurious oscillation, apparent mistracking or oscillator pulling and worsened signal-to-noise ratio may be eliminated by removing oscillator feed-through in gang capacitor. Shield r-f section from oscillation section or reverse antenna secondary connections.

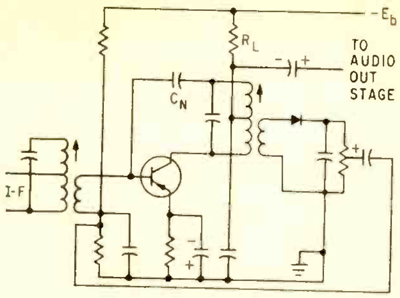

FIG. 4—Typical reflex circuit as used in portable transistor receivers. Transistor is used both as an i-f and audio amplifier

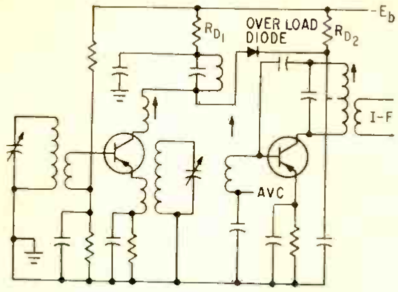

FIG. 5—Avc overload diode circuitry. Operates in conjunction with normal avc applied to the first i-f stage

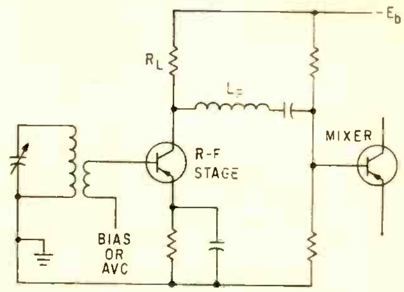

FIG. 6—Untuned r-f stage generally works into a mixer but could also work into a converter stage

Transistor Receivers

OUTPUT STAGE gains of transistor superheterodyne receivers are about 25 to 40 db depending upon power level, supply voltage and circuitry.

The audio driver stage may be expected to contribute about 40 db of power gain. Overall gain should be about 60 to 80 db. For low distortion, negative feedback (3 to 7 db) may be added, reducing overall gain correspondingly. Knowing overall audio-system gain and input impedance, the second detector may be designed for optimum performance at its level. Diode detector losses are about 12 to 18 db. The avc circuits are usually designed after the i-f stages and make some adjustments in the detector necessary at a later time.

Preliminary design of the converter circuit is made to determine its output impedance. This, together with input impedance of the detector, is necessary for proper i-f system design. Generally, one or two i-f stages will be used. Selectivity requirements will determine whether single- or double-tuned i-f transformers must be used. The transistor type must be determined. Then, knowing transistor parameters and performance requirements, the i-f transformers can be designed by use of proper design equations If there is to be avc on the first i-f stage only, bias and avc circuits for the i-f stages can be designed and the second detector circuit optimized. Final step is design of the autodyne converter.

Circuit	Description and Design Hints	Problems and Solutions
Reflex (See Fig. 4	Transistor is used as both an i-f amplifier and as an audio amplifier concurrently. Audio may be capacitance-coupled into next stage as shown or, if audio portion of circuit is used as driver for a class-B output stage, transformer coupling is used. Circuit can contribute 25-30 db i-f gain and 25-35 db audio gain. Its use enables elimination of an audio driver stage from overall circuit without decreasing performance.	Close attention must be paid to avc to prevent overload in the reflexed stage. Reflexed stage itself must be designed carefully to minimize overloading and cross-coupling. Special care must be taken to insure that operation is always in the linear region.
Avc Overload Diode (See Fig. 5)	Overload diode circuit operates in conjunction with normal avc applied to the first i-f stage. Its operation depends upon change in d-c conditions in this stage with changes in bias due to avc. Normally, an avc figure of merit of 30-35 db is obtainable in a set with two i-f stages with avc applied to the first i-f stage only. Addition of overload diode increases this to about 60 db and raises overload from 50,000 to 500,000 μv/m. Similar improvement can be noted in a set with only one i-f stage. Here, typical figure of merit without diode is 20-25 db; with diode, 50 db. Overload point is raised to about one v/m; without diode, about 200,000 μv/m. These figures are for 30-percent modulation.	Diode is connected for a-c across the converter to i-f transformer tuned circuit. D-c circuit is arranged so that diode is reverse-biased under weak signal conditions presenting a high impedance to i-f. Under these conditions, there is negligible shunting effect across the tuned circuit. Under strong signal conditions, d-c bias across the diode becomes a low impedance to i-f, loading down the converter to i-f transformer.
Untuned-R-f Stage (See Fig. 6)	Generally works into a mixer but probably could work into a converter as well. Inexpensive way of adding gain. Does not improve selectivity or image-rejection characteristics. Only makes slight improvement in noise characteristics. Adds 10-14 db more gain. Since circuit can use avc, avc figure of merit and overload point are improved considerably. Using untuned r-f stage, typical set with 300 μv/m sensitivity for 50-mw output can be improved to 50 μv/m at a 10-db signal-to-noise ratio with an avc figure of merit of 70 db.	Largest problem is to obtain a flat gain characteristic across the band. A small peaking coil may be added to the collector circuit to peak up at the high end of the band. Oscillator voltage must be prevented from feeding into the r-f stage by having a grounded shield plate between the oscillator and antenna sections of gang capacitor.

Multiplying Circuit Uses

High-speed magnetic-amplifier square-law circuits containing nickel-iron tape cores, silicon diodes and resistors replace slow-response thermal converters in four-quadrant analog multiplying device. Reversible-polarity output operates common ink oscillographs

W. A. GEYER, U. S. Naval Ordnance Laboratory, Silver Spring, Maryland

FOUR-QUADRANT MULTIPLICATION of signal voltages or signal currents may be achieved by applying a multiplication method which corresponds to the fundamental principle of thermal wattmeters: $(A + B)^2 - (A - B)^2 = 4\,AB$.[1] Two thermocouples or thermoconverters usually provide the square terms; one is heated by the algebraic sum of two derived currents and the other, by their difference.

Recently, the two thermal converters have been replaced with a special form of magnetic-amplifier multiplyling circuit, which acts as square-law device; when employed in two channels it provides the required sum and difference terms.[2]

Given two independent polarity-reversible d-c input voltages, $\pm E_1$ and $\pm E_2$, these voltages are multiplied and a product obtained in the form of a polarity-reversible d-c output voltage that operates a standard ink oscillograph.

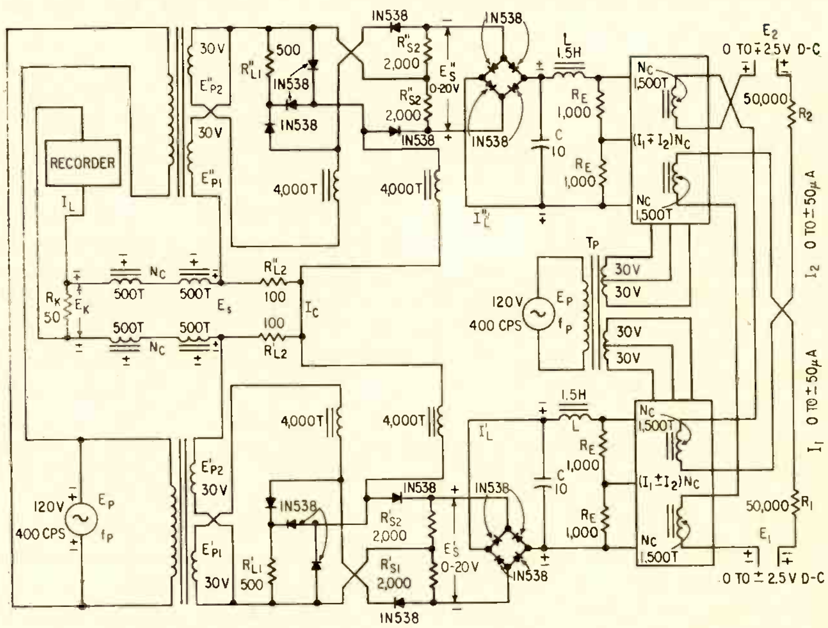

FIG. 2—Polarity-reversible signal currents I_1 and I_2 are multiplied with two square-law and two push-pull magnetic amplifier circuits

Basic Multiplying Circuit

The basic circuit shown in Fig. 1A is a two-stage arrangement that contains the converter (input stage controlled by the first signal voltage E_{S1}) and the multiplier (output stage controlled by the second signal voltage E_{S2}).[3] Resistors R_{S1} and R_{S2} provide the necessary path for the presetting magnetizing currents flowing against the signal voltages.

Circuit operation is described by $E_L = I_{L2}R_{L2} =$ (constant) $(E_{S1}\,E_{S2}/E_{P1})$ where E_{S1} and E_{S2} represent average values and E_{P1} is the rms value of supply voltage E_{P1} derived from power-supply transformer T_P with two separate secondary windings. With E_{P1} equal to a constant, the simplified relationship $E_L =$ (constant) $(E_{S1}\,E_{S2})$ results.

In each stage, the gate voltage (E_{P1} and E_{P2}, respectively) must satisfy the condition $E_{Pmax} < 2\pi\, f_P\, N\, \Phi_{sat}$, where f_P is the power-supply frequency, N is the number of turns of the cores and Φ_{sat} is the saturation flux density of the rectangular-hysteresis-loop core.

Certain limitations with regard

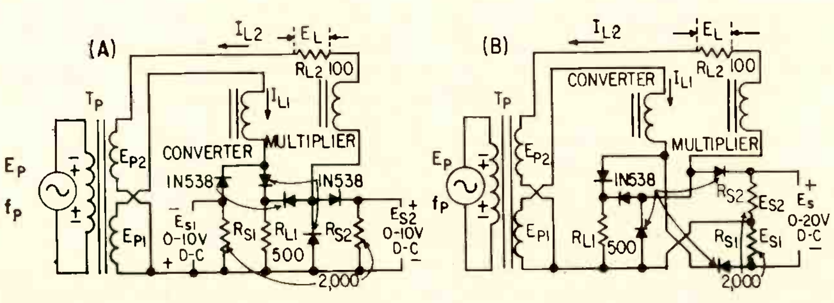

FIG. 1—Basic circuit (A) multiplies d-c voltages E_{S1} and E_{S2}; modified circuit (B) multiplies components, $E_{S1} = E_{S2} = 0.5E_S$, of d-c voltage E_S and provides square terms of signal voltages and currents

Magnetic Amplifiers

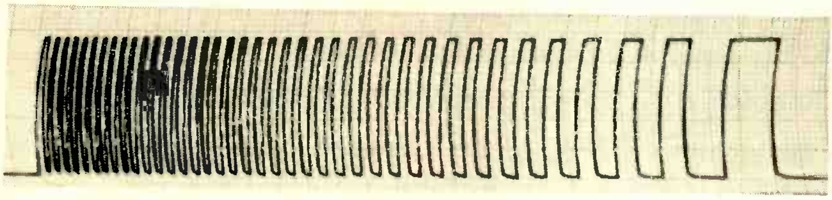

FIG. 3—Output of circuit of Fig. 2 with square-wave input varying from 30 to 0 cps. Frequency variation was obtained by deenergizing a motor-driven switch to obtain the continuously decreasing signal frequency

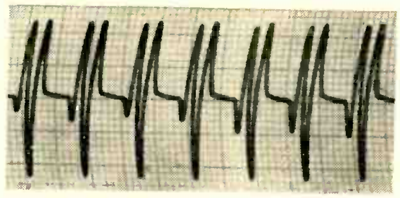

FIG. 4—Output with 60-cps sinusoidal carrier synchronously modulated with 30-cps square wave as the input signal

to the relationship between the instantaneous values of signal voltages E_{S1}, E_{S2} and gate voltages E_{P1}, E_{P2} require that E_{P1} and E_{P2} must be square waves symmetrical about zero if E_{S1} and E_{S2} are pure d-c signal voltages as derived from a battery or a filter circuit.

In both stages, the magnetizing currents must be minimized by proper design of the high-permeability cores.

Square-Law Circuit

Each of the two d-c signal voltages, E_{S1} and E_{S2} has a certain unchanging polarity with regard to the half-wave rectifier elements series-connected with R_{S1} and R_{S2}. One of the basic requirements in many problems concerning multiplication of d-c signals, however, is that each signal may change its polarity.

To fulfill this requirement, the basic circuit is modified as shown in Fig. 1B by supplying the two signal circuits from a center-tapped input resistor $(R_{S1} + R_{S2})$ so that $E_{S1} = E_{S2} = 0.5\ E_S$. In this case the signal voltage E_S must also have a certain polarity, as indicated in Fig. 1B.

This circuit provides the unidirectional output voltage $E_L =$ (constant) $(E_S)^2$.

Complete Circuit

Two square-law circuits have been employed in a four-quadrant analog multiplying device in Fig. 2, using only magnetic cores, silicon diodes and resistors.

Two magnetic-amplifier square-law circuits, similar to that in Fig. 1B, provide the first square term of the algebraic sum of the currents $I_1 = E_1/R_1$, $I_2 = E_2/R_2$ and the second square term of difference of these currents $E_L' =$ (constant) $(I_L')^2 =$ (constant) $(I_1 \pm I_2)^2$, $E_L'' =$ (constant) $(I_L'')^2 =$ (constant) $(I_1 \mp I_2)^2$.

Filter circuits (L, C), and full-wave rectifiers across mixing resistors R_E convert the polarity-reversible output currents $I_L' =$ (constant) $(I_1 \pm I_2)$ and $I_L'' =$ (constant) $(I_1 \mp I_2)$ of the two magnetic-amplifier push-pull circuits into substantially pure d-c which does not change in polarity.

The resulting d-c signal voltage E_S across series-mixing resistors R_{L2}' and R_{L2}'' is balanced by voltage drop $E_K = I_L R_K$ across negative-feedback resistor R_K of the self-balancing magnetic-amplifier push-pull circuit.[2] There is a linear relationship between $E_S = E_K$ and the average value of the polarity-reversible load current I_L flowing through the ink recorder; it can be expressed by $I_L =$ (constant) $I_1 I_2 =$ (constant) $(E_1 E_2)$.

Practical Application

The arrangement of Fig. 2 has been used in conjunction with a Brush recorder to make a permanent record of the product of currents $I_1 = 0$ to $\pm 50\ \mu a$ and $I_2 = 0$ to $\pm 50\ \mu a$ $(R_1 = R_2 = 50{,}000$ ohms). When supplying the two square-law circuits of Fig. 1B from a ferroresonant magnetic-switch circuit with rectangular-hysteresis-loop core material, the gate voltages (E_P) are square waves symmetrical about zero; pure d-c signal voltages, E_{S1} and E_{S2}, can be applied in this case without disturbing proper operation of these circuits.

Supermalloy 2-mil tape cores, with 1-in. inside dia, 1¼-in. outside dia and ⅛-in. tape width, minimize the magnetizing currents.

Accuracy of measurements obtained with this arrangement is about ±2 to 3 percent of full-scale deflection of the ink oscillograph. The response time is about 5 millisec, about two cycles of the power-supply frequency.

Figure 3 illustrates the dynamic performance of the circuit of Fig. 2. A 60-cps synchronous motor driven switch provided a 30-cps square-wave input at full rotational speed. The motor was then deenergized and permitted to slow down to a stop to obtain a continuously decreasing signal frequency.

Figure 4 shows the output with a 60-cps sinusoidal input periodically interrupted with the motor-operated switch in such a way that the input was turned on and off during alternating cycles. The resultant input was a 60-cps carrier synchronously modulated with a 30-cps square wave. The phase relationship between the 60-cps carrier and the 30-cps modulation was continually changed by varying the angular position between the switch and the motor shaft.

REFERENCES

(1) J. H. Miller, A New High-Speed Thermal Wattmeter, *AIEE Trans*, 60, p 37.

(2) W. A. Geyger, Magnetic-Amplifier-Operated Ink Recorders, *AIEE Trans* Paper No. 58-541, *AIEE* Middle Eastern District Meeting, Wash., D. C., April 1958.

(3) L. A. Finzi and R. A. Mathias, An Application of Magnetic Amplifier Circuits to Perform Multiplication and Other Analytical Operations, *AIEE Trans*, 72, Part I, p 455.

Portable Multiplexer for

Stabilized transistor circuits enable four-channel ppm multiplex unit to operate from −54 to +65C. Amplitude modulation of a microwave radio system is pulse position modulated by the multiplexer. Circuit operation of the modulator sweep generator, video pulse shaper, demultiplexer synchronizer and the demodulator flip-flop are described

By **PAUL W. KIESLING, JR.,**
Communications Department, Raytheon Manufacturing Company, Wayland, Massachusetts

INVESTIGATION of the applicability of transistors to pulse-position communications equipment for military use resulted in the development of a portable four-channel all-transistor multiplexer. The equipment has circuits for four channels of modulation and demodulation, the multiplexing and demultiplexing of these channels, line terminal facilities for both two and four-wire operation, and low-frequency signaling facilities. It is packaged in a watertight aluminum case that can be carried on a packboard, and weighs 55 pounds.

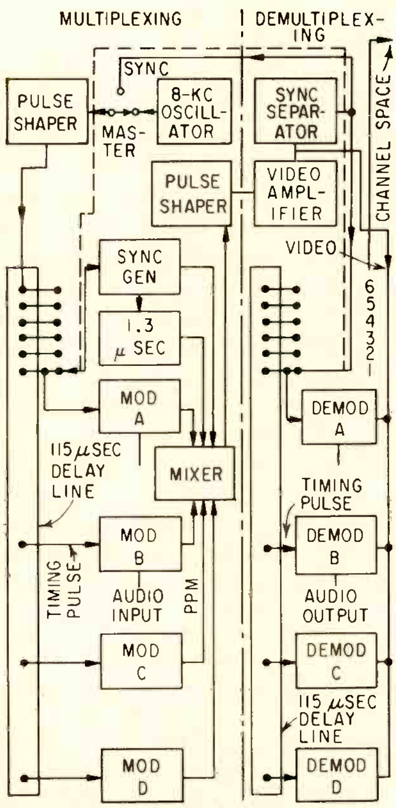

FIG. 1—Terminal equipment block diagram of multiplexer

Operation

The audio or ringing signal to a modulator is sampled at an 8-kc rate or every 125 μsec. Amplitude of the signal at the instant of sampling alters the position of the channel pulse from its normal position by an amount proportional to the amplitude, or a maximum of ±1 μsec which is 100-percent modulation. The sampling signal originates at an 8-kc oscillator but passes through a pulse shaper to a large delay line before sampling each channel. The delay line provides timing pulses for the four voice channels and the synchronizing channel.

After transmission by a microwave radio link, the video signal, consisting of pulses which have a rise and fall time of 0.1 μsec and a width of 0.5 μsec, is sliced of noise at the top and bottom, amplified and each channel individually demodulated. Synchronization of the receiving circuits to the video signal is provided by the output of a circuit that detects the presence of the closely spaced pair of synchronizing pulses. A large delay line similar to that used in the multiplexing circuits provides the timing pulse to gate the proper video pulse to each channel and to convert the pulse-position modulation

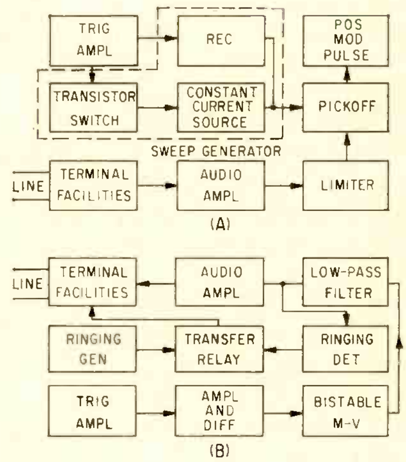

FIG. 2—Basic functions of the modulator (A) and demodulator (B)

to pulse-width modulation. Complete demodulation is obtained by passing the pwm signal to a low-pass, 3.5-kc filter and amplifying the signal output.

Additional circuits convert the four-wire unbalanced circuits to

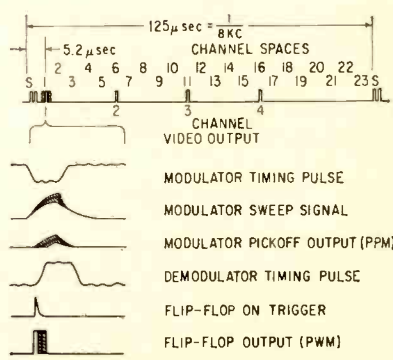

FIG. 3—Video output and modulator and demodulator waveforms for channel one

Telephone Communications

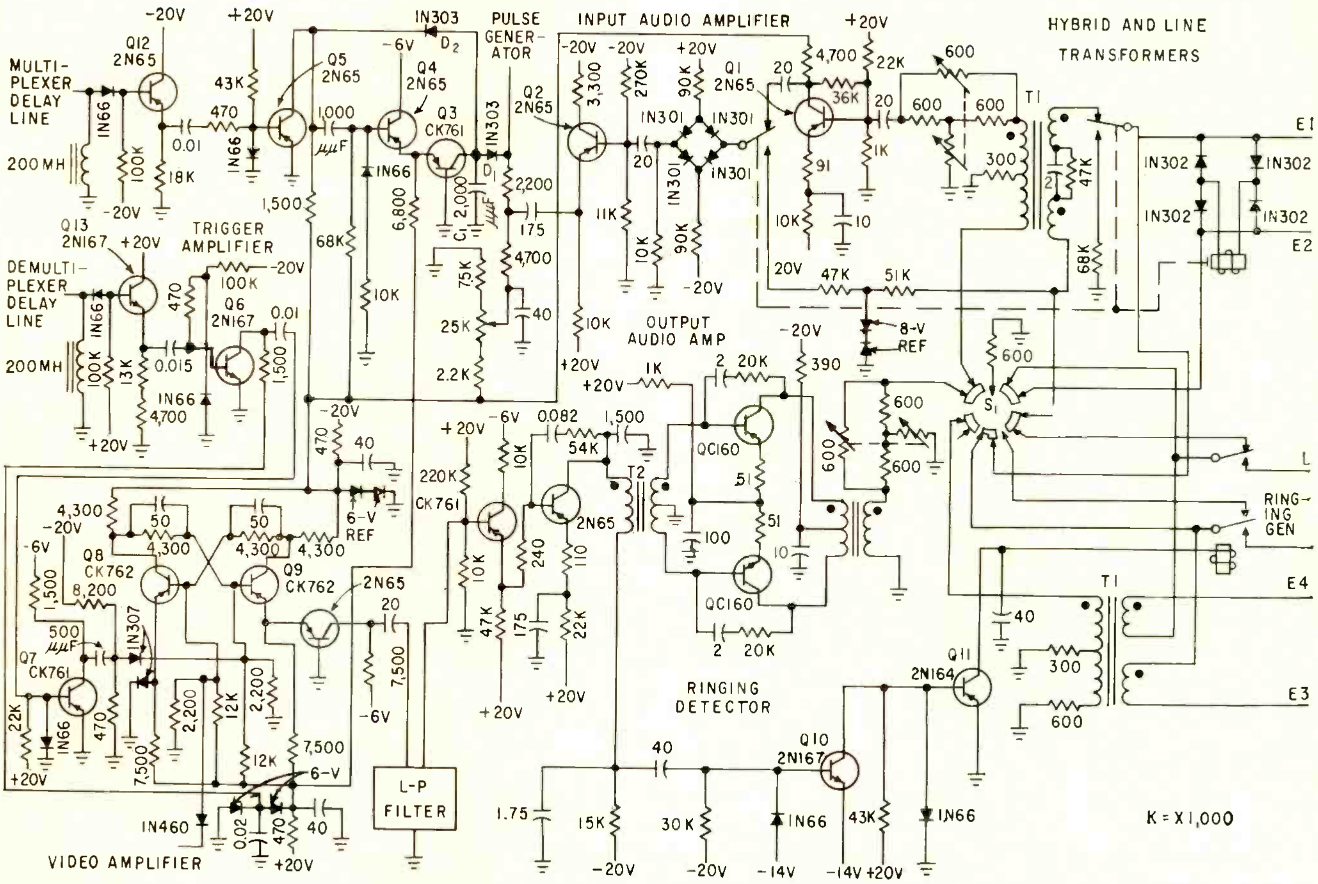

FIG. 4—Modulator-demodulator circuit handles 300 to 3,500-cps voice signals with amplitudes from −20 to +10 dbm

either two- or four-wire balanced circuits and detect low-frequency modulation for signaling. The block diagram of Fig. 1 shows the basic multiplexing and demultiplexing functions and the diagram of Fig. 2 shows the basic functions of a modulator-demodulator. The waveforms of Fig. 3 illustrate the video output and the more important modulator and demodulator waveforms for channel one.

Modulator

The modulator - demodulator shown in Fig. 4 handles 300- to 3,500-cps voice signals with amplitudes from − 20 to +10 dbm and provides output audio signals with the same range of level. In addition, a two-position rotary switch makes it possible to instantly convert from two- to four-wire operation. Additional circuits limit and transfer a high-voltage 20- to 30-cps ringing signal to the modulator and detect the same frequency signal in the demodulator to transfer the output of a common ringing generator to the line terminals.

The upper half of the schematic is the modulator which uses six transistors: two are used to isolate the sweep circuit from the delay line and to trigger the sweep; two are used in the sweep circuit; and two are used in the audio circuits to terminate the bridge-T attenuator, provide gain and isolate the bridge limiter from the pickoff.

Delay-line isolation is provided by transistor Q_{12} which is normally cut off. The R-C components in the emitter circuit were chosen to cause Q_{12} to conduct and Q_5 to conduct and saturate when the negative delay-line trigger reached 50-percent amplitude.

The 10- to 15-μsec pulse at the collector of Q_5 cuts off sweep recovery diode D_2 and emitter follower Q_4. Grounded-base sweep transistor Q_3 acts as a constant-current source of 2 ma to charge capacitor C_1 at 1 v/μsec. The normal pickoff voltage at the cathode of diode D_1 is about 5 v so the normal unmodulated position of the channel pulse is about 5μsec after the sweep is triggered. Precise adjustment of the pulse position is made by a centering control that adjusts the d-c pickoff voltage. An audio signal of 1-v peak at the pickoff gives 100-percent modulation of $\pm$1 μsec.

Amplifier Q_1 drives the limiter and terminates the bridge-T attenuator in 600 ohms. Proper operation of the limiter depends on the high back impedance of the four diodes. High-voltage ringing signals bypass the attenuator, are injected into a limiter and fed into the audio limiter. The ppm output of the modulator has poor rise time and large audio content.

The pulse shaper removes the

audio component from the modulator output to prevent crosstalk and shapes the pulse to the required rise and fall time and width. A typical pulse shaper is shown in Fig. 5. The first stage acts as a high-pass filter and second stage Q_{14} saturates providing a fast rise time pulse 5-μsec wide. This pulse is differentiated and triggers amplifier Q_{15}. The output of this stage triggers a blocking oscillator.

A shorted delay line of 0.5-μsec round-trip length in the base of the 6-0 transistor gives an inverted pulse to turn the oscillator off. This determines the pulse width. The oscillator transformer is wound on a ferrite core. Changes in permeability with temperature do not affect the pulse width since the natural width of the oscillator is always greater than that determined by the delay line. A third winding on the transformer provides drive for output transistor Q_{16}. The collector of this and similar transistors in the other four shaper circuits in a multiplexer are tied together and act as mixers to provide the video train shown in Fig. 3.

Synchronizer Detector

After slicing and amplification, the video pulses in the demultiplexer go to the synchronizer or sync separator shown in Fig. 6. The open-circuited 0.65-μsec delay line in the collector of Q_{17} causes a reinforcement of the second synchronizing pulse which is 1.3 μsec from the first synchronizing pulse. A slicing circuit in the base of the second stage, Q_{19}, is adjusted to permit only the reinforced pulse to fire this stage. This action provides a pulse every 125 μsec that is synchronized to the incoming video signal.

Transistor Q_{18} keeps the slicing voltage constant by compensating for the saturation current of transistor Q_{19}. This enabled the sync separator to operate from -60 to $+70$ degrees centigrade. The output of Q_{19} drives a blocking oscillator that provides the drive for the demultiplexing delay line. This delay line is tapped at appropriate points to provide the demodulator with timing signals that gate the individual video pulses to each demodulator and convert to pulse-width modulation.

Demodulator

The demodulator (Fig. 4) uses 12 transistors: six in the demodulating circuits and six in the audio amplifier and ringing detector circuits. Flip-flop Q_8 and Q_9 converts the pulse-position signal to pulse-width modulation. The flip-flop is turned on by the delay-line timing trigger and turned off by the video pulse following the delay-line trigger. The delay line is isolated from the flip-flop by emitter follower Q_{13} which operates similarly to stage Q_{12} in the modulator. Transistor Q_6 provides gain and Q_7 provides a pulse with a sharp rise time that is differentiated before turning the flip-flop on.

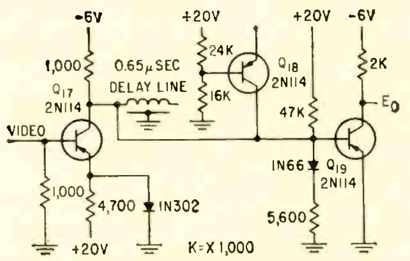

FIG. 6—Pulse synchronized to the incoming video is provided every 125 μsec. Transistor ppm equipment operates over a wide temperature range

The output of the nonsaturating flip-flop is width modulated on the trailing edge and has an unmodulated width of 2.5 μsec. When transistor Q_8 is turned on, its base is slightly negative, thus holding off the diode on its emitter. The collector is not quite at saturation voltage and the base of transistor Q_9 is positive by about 1 v. The diode in the emitter of Q_9 is conducting, clamping the emitter slightly above 0 v.

In operation, this second emitter diode was replaced by a grounded-base transistor stage to drive the low-pass filter. The collector voltage of an ON transistor is determined by its emitter bias circuit and by the voltage divider to the base of the OFF transistor. The voltage divider to the base of the OFF transistor is adjusted to keep that base more positive than the conducting diode in the emitter.

Filter

The low-pass filter, in addition to demodulating the pwm, has an 8-kc notch so that the sampling frequency level is at least 50 db below the audio level in the output. The audio amplifier consists of an emitter follower to properly terminate the filter, one single-ended amplifier and a class-A push-pull amplifier capable of delivering 30 mw of audio power with less than 3-percent harmonic distortion to 600 ohms. The first stage of amplification amplifies a ringing signal of 20 to 30 cps as well as audio. The coupling transformer acts as part of a low-pass filter to pass the ringing signal to ringing detector Q_{10} and Q_{11}. Transistor Q_{11} operates a double-pole double-throw relay to transfer the output of a local ringing generator to the line terminals.

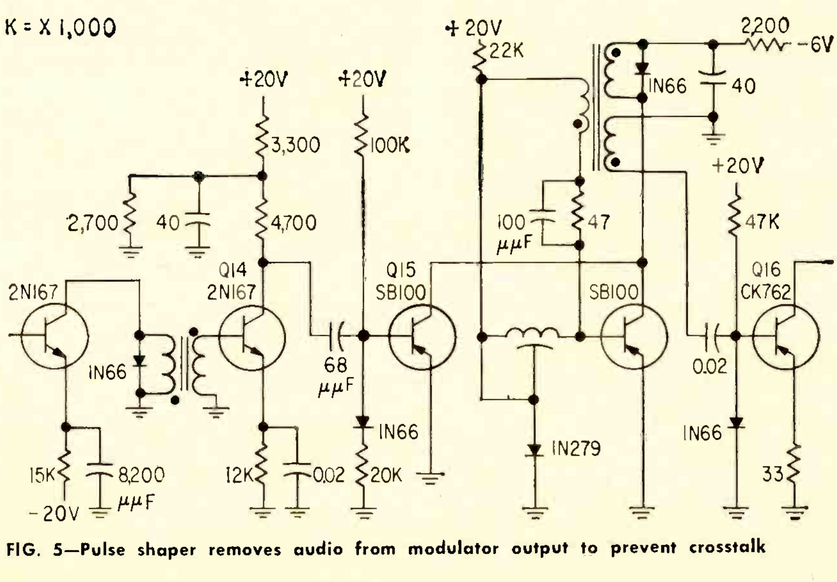

FIG. 5—Pulse shaper removes audio from modulator output to prevent crosstalk

Table I—Properties of 12 Permanent Magnet Materials

Alloy	Residual Flux Density (Gauss)	Coercive Force Oersteds	Max. Energy Product $(BH)_{max}$	Gauss at $(BH)_{max}$	Curie Temp. (°C)	Permanent Change (°C)	Magnetic Losses at 500 C
Alnico I	7,100	400	1,300,000	4,000	870	535	Retain 75% (Alnico I) to 90% (Alnico V) of magnetization
Alnico II	7,500	560	1,600,000	4,600	800	535	
Alnico III	7,000	470	1,350,000	4,500	725	480	
Alnico IV	5,500	730	1,250,000	3,100	880	535	$(BH)_{max}$ and coercive force decrease 10–20%
Alnico V	12,700	650	5,500,000	10,400	880	535	
Alnico VI	10,100	750	3,800,000	7,000	880	535	
Alnico VII	7,000	1,050	2,500,000	3,700	870	535	Alnico V and VI usable to 700 C with 20% loss
Alnico XII	6,100	1,000	1,650,000	3,200	...	480	
Indalloy	9,000	240	9,000,000	......	...	...	Degrades, but usable
Remalloy	10,000	230	1,100,000	6,900	900	...	10–20% loss of remanence
Carbon steel	10,000	50	200,000	6,200	770	...	
Tungsten steel	10,300	70	300,000	6,800	760	...	May be used, but loses remanence

Hard Magnets for 500 C

Magnetic materials with high Curie points and satisfactory metallurgical properties retain enough magnetization for use at high temperatures

By **GEORGE SIDERIS,** Associate Editor

PERMANENT MAGNETS able to retain a substantial portion of their magnetic properties at 500 C are needed in electronic components expected to operate in a nuclear environment. Within 5 to 10 years, new military aircraft and missiles will have temperatures over 500 C throughout most of the aircraft.

Components which require permanent magnets and which are likely to feel the effects of this advance in operating temperature include transducers, traveling-wave tubes, magnetrons plus servo components and other small motors.

Investigations by Armour Research Foundation and Stanford Research Institute on temperature effects on typical permanent magnet materials are summarized in Table I and Fig. 1. The data is also useful in designing below and above 500 C.

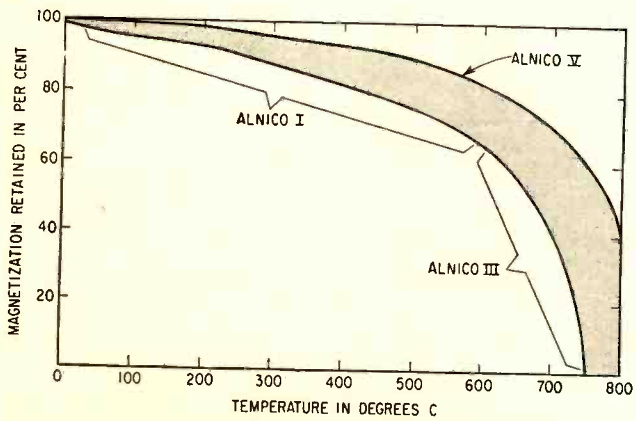

FIG. 1—Magnetic remanence plotted against temperature for Alnico IV

DESIGN CONSIDERATIONS—The Alnicos produced by several manufacturers are generally considered usable at 500 C. Except for Alnico III and the steels, however, the materials contain cobalt. The fact that cobalt will become radioactive in a nuclear environment should be considered in overall system design.

Loss of remanence may be compensated or by overdesign or by preaging the material at the operating temperature to offset irreversible magnetic changes due to temperature rise. Coefficients of thermal expansion for these materials are similar. The Alnicos being hard and brittle, are cast and finished by such methods as grinding, while the steels are ductile and machinable.

Dynamic Trap Captures

In conventional f-m reception, the weaker of two signals is normally suppressed, while the stronger signal is demodulated. In some instances the weaker signal may be the desired one and by using a high-Q trap in a reactance tube circuit, the undesired signal is tracked and attenuated

By ELIE J. BAGHDADY, Asst. Professor of Electrical Engineering,
and GEORGE J. RUBISSOW, Staff Engineer, Instrumentation Laboratory,
Massachusetts Institute of Technology, Cambridge, Mass.

WELL-DESIGNED conventional f-m receivers process the sum of two cochannel signals in such a way as to suppress the effect of the weaker signal and deliver a substantially undistorted replica of the message carried by the stronger signal. This channel-capture effect is a well-known characteristic of wide-band f-m systems. It is a boon to high-fidelity transmission when there is some assurance that the desired signal is the stronger of the two competing signals.

But in many important applications such an assurance cannot be made and the desired signal is likely to be the weaker of the two. In applications such as police, military and telemetering systems, the desired signal may be suppressed irretrievably by a stronger undesired signal. Systems that can capture the weaker of two cochannel f-m signals, when desired, not only facilitate reliable communication, but also hold promise for more efficient use of the spectrum.

The system to be described in this article makes use of a trap that tracks and attenuates the stronger of two signals. Because this signal is frequency modulated, a knowledge of its frequency behavior is needed to guide the trap. This knowledge can be derived with a conventional f-m demodulator such as a limiter-discriminator from the sum of the two input signals.

After appropriate filtering, the output voltage of the demodulator varies essentially with the frequency of the stronger of two input signals.

If this voltage is impressed upon the control grid of a reactance-tube circuit that forms a part of a high-Q tuned trap, the tuning of the trap is varied so that its center frequency follows the instantaneous frequency of the stronger signal. In this way, the trap attenuates the undesired signal below the level of the desired but initially weaker signal. A second conventional f-m demodulator that follows the trap extracts the desired message.

Variable Trap

A possible embodiment of the variable-trap technique is illustrated in Fig. 1. The i-f amplifier provides the usual i-f selectivity and gain in the f-m receiver. If two signal carriers are passed simultaneously by this amplifier, the average output voltage of f-m demodulator No. 1 is made to vary directly with the instantaneous frequency of the stronger signal. After appropriate low-frequency filtering the output is impressed directly upon the input of a reactance tube to vary the tuning of a high-Q trap.

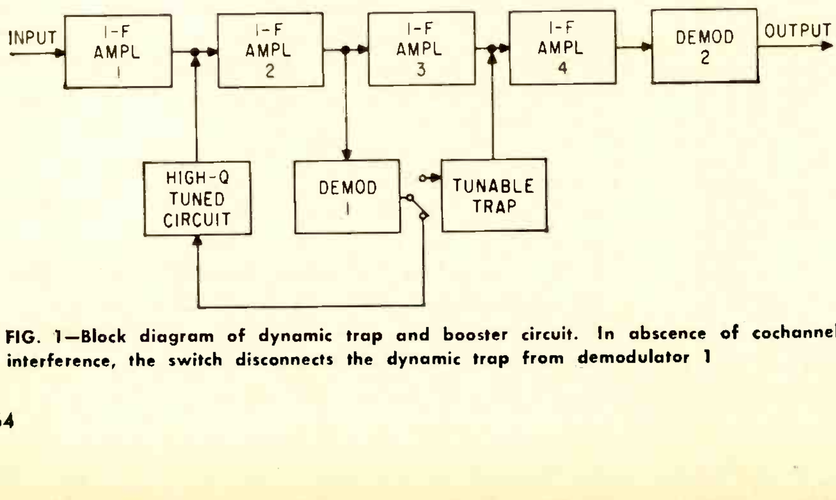

FIG. 1—Block diagram of dynamic trap and booster circuit. In abscence of cochannel interference, the switch disconnects the dynamic trap from demodulator 1

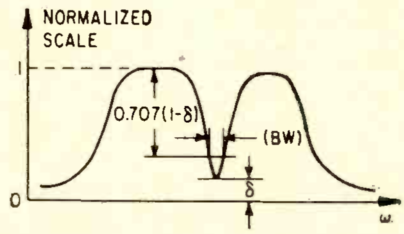

FIG. 2—Graphic illustration of the trap parameters

The trap introduces a depression in the frequency response characteristic of i-f amplifier No. 3 which is centered approximately about the frequency of the stronger signal. The resulting attenuation decreases the amplitude of the stronger signal by a sufficient amount to enable the initially weaker signal to predominate. The average voltage at the output of the second demodulator then varies directly with the instantaneous frequency of the weaker signal, except when the frequencies of both signals fall within the heavy-attenuation band of the trap.

In this case, if the undesired signal is not cancelled out completely by the trap, the signal amplitudes go through equality at least twice as the weaker signal sweeps across the trap attenuation band. The resulting transitions in capture from

Weak F-M Signals

Authors adjust dynamic trap. Device has applications in police, military communications and telemetering

one signal to the other are accompanied by corresponding bursts of distortion in the detected output waveform. The duration of these distortion bursts can be decreased by designing the demodulator to handle weaker-to-stronger signal amplitude ratios close to unity.

If the Q of the trap is sufficiently high, the attenuated band covers a small fraction of the i-f bandwidth. Thus, when the two signals fall simultaneously within the trap attenuation band, their frequency difference is small and the deviation of the instantaneous frequency of the resultant signal from the frequency of either signal is small.

A high-Q trap can cause noticeable f-m transients when swept by an f-m signal. Fortunately, investigation shows that weaker-signal capture performance of the system is not materially affected by trap bandwidth if the second f-m demodulator is sufficiently well designed.

If the stronger signal is the signal that is wanted, its amplitude may be boosted by introducing a high-Q variable-tuned circuit whose center frequency is controlled by a reactance tube. This dynamic-selector arrangement helps decrease the random-noise bandwidth and improves the predominance of the stronger signal over interference.

Trap Techniques

A trap may be characterized by the bandwidth and the depth of the depression it introduces in the steady-state frequency response characteristic of the i-f amplifier. Figure 2 graphically defines these parameters. The trap attenuation factor, δ, is by definition the minimum normalized gain within the passband—the normalization being made with respect to the maximum amplitude response in the passband. The trap bandwidth, BW, is by definition the difference between the frequencies at which the gain within the passband is decreased (by the action of the trap) 0.707 $(1-\delta)$ of its maximum value.

A schematic of the trap system is shown in Fig. 3. The trap circuit was designed on the basis of flexi-

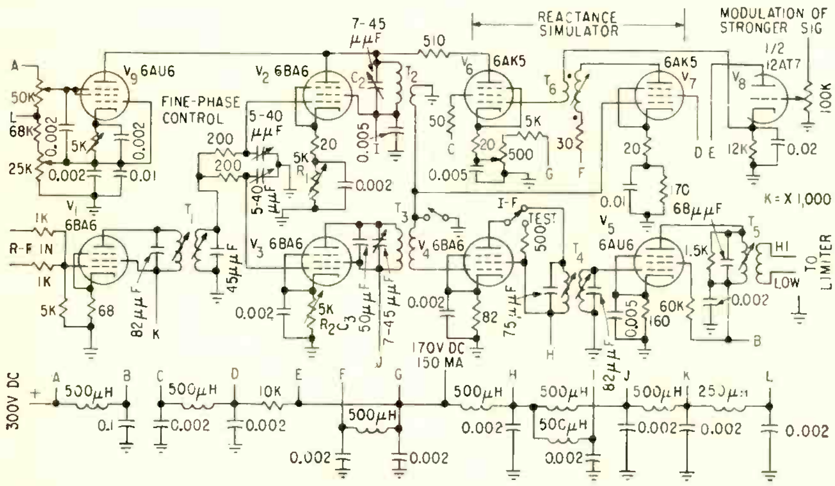

FIG. 3—Schematic diagram of the dynamic trap system. Reactive component of admittance presented at plate of V_6 is varied as a function of stronger signal

bility and ease of variation of the important trap parameters.

The trap circuit consists of two voltage amplifiers V_2 and V_3 with single-tuned plate loads whose circuit Q's have widely different values.

The low-Q circuit consisting of C_3 and the primary of T_3 is fixed-tuned. The higher-Q circuit consisting of C_2 and the primary of T_2 has its center frequency dictated in part by the controllable reactance circuit of V_6, V_7 and V_8, and its bandwidth varied by the value of dynamic negative resistance that is injected by dynatron circuit V_9. Each resonant circuit is closely coupled to an untuned secondary, and the secondaries are connected with opposite polarities. The choice of low Q for the fixed-tuned circuit enables the signal at the center of the trap response to be superimposed upon the corresponding signal across the secondary of T_3 essentially in phase opposition over the entire range of expected trap center frequencies.

Potentiometers R_1 and R_2 provide direct control over the value of the trap attenuation factor δ. Fine adjustment of the phasing between the secondary voltages is provided by a phase-shifting network in the secondary of T_1.

Reactance Simulator

The center frequency of the dynamic trap is determined by the resonant frequency of the tuned primary of T_2. The position of the trap attenuation band can therefore be changed by varying one of the tuning elements. The circuit shown in Fig. 3 was developed especially to provide the desired variable reactance without any attendant variation in the resistive component that the circuit imposes across the tank of the high-Q trap.

In this circuit tube V_7 is driven through step-down transformer T_2 to avoid overdriving its grid. The output of V_7 undergoes a 90-deg phase shift in the low-loss inductive load T_6. The voltage across the secondary of T_6 drives amplifier V_6, this stage acts as a current source feeding the high-Q tank circuit of the trap. It can be shown that the susceptive component of the admittance formed by the plate circuit of V_6 across the tank circuit of the trap can be varied by varying the g_m of tubes V_6 and V_7.

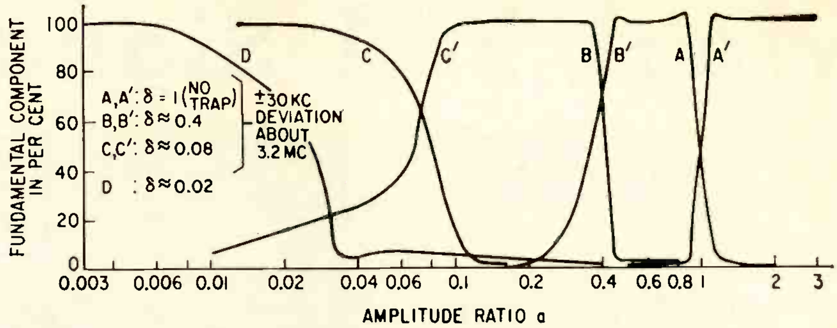

FIG. 4—Effect of trap attenuation factor δ on capture performance. Curves *A*, *B*, *C* and *D* show output from stronger (400-cps) signal

In this circuit the modulation of the stronger signal varies the g_m of V_6. This modulation is applied in series with the secondary of T_6, and its proper phasing is vitally important to the successful tracking of the stronger-signal frequency by the resonance frequency of the trap.

Limiter-Discriminator

In an f-m receiver, the limiter section plays two important roles: it renders the output of the f-m demodulator independent of the amplitude variations of the resultant signal at the input and, with appropriate design, it minimizes the f-m disturbance that the weaker of the two signals at its input causes in the message of the stronger signal at the receiver output.[2]

The limited-discriminator circuit used here has a low output time constant and a detection characteristic that is linear over twice the i-f bandwidth. Three stages of narrow-band limiting precede the discriminator. To avoid time-constant problems, 6BN6 limiters are used. Since no grid-leak bias is required for this tube, sharp changes of amplitude can be well handled.

Performance

The capture performance of an f-m receiver is brought out in a test procedure that simulates cochannel interference by the superposition of two carriers whose modulations can be easily identified and separated. A suitable choice of modulation for easy measurements is a sinusoidal message of known frequency. The receiver performance is then evaluated quantitatively in terms of an amplitude plot of the fundamental component of stronger-(or weaker-) signal modulation frequency as a function of the weaker-to-stronger signal amplitude ratio, a. Generally, a more complete presentation involves both weaker- and stronger-signal characteristics plotted on the same coordinates, as well as a plot of the total distortion as a function of a.

The capture characteristics of the dynamic-trap receiver are determined largely by the two parameters that are defined in Fig 2. The more important of the two is the trap attenuation factor δ. In essence, δ represents the factor by which the amplitude of the undesired (but initially stronger) signal is ideally multiplied.

In Fig. 4, curve A shows the measured capture characteristics of the receiver without the trap. The weaker- and stronger-signal curves are symmetric about the $a = 1$ line. The capture-transition region is relatively narrow and is centered at $a = 1$. Curves B, C and D demonstrate the effect of introducing a dynamic trap of fixed 15-kc bandwidth but with δ given the three values indicated on the plots.

These curves show that the introduction of a trap with some assigned value of δ shifts the capture-transition region from the neighborhood of $a = 1$ to the neighborhood of $a = \delta$. The weaker signal is thus captured for all values of a that are slightly greater than δ on the one hand and less than or equal to the capture ratio of the f-m demodulator that guides the trap on the other. Curve D represents the best measured performance.

REFERENCES

(1) E. J. Baghdady, Capture of the Weaker of Two Cochannel F-M Signals, (to be published). Also. Quarterly Progress Reports, p 52, Oct. 15, 1957, Research Laboratory of Electronics, MIT.

(2) E. J. Baghdady, Theory of Stronger-Signal Capture in F-M Reception, *Proc IRE*, 46, p 728, Apr. 1958.

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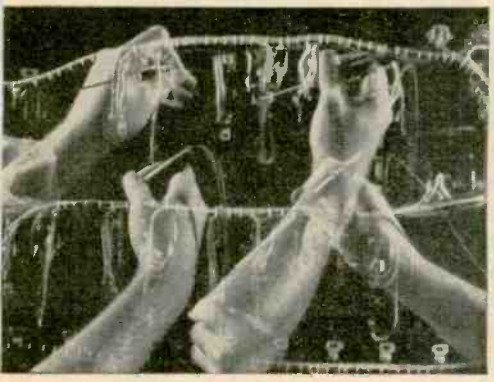

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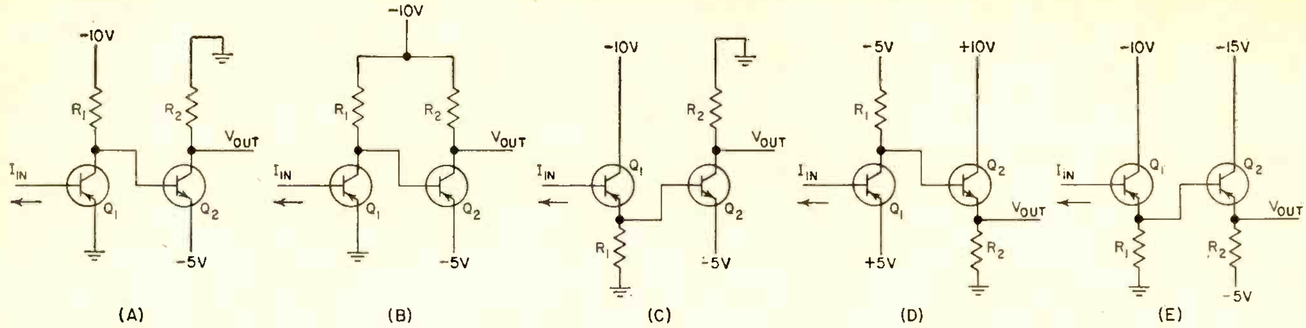

FIG. 1—Typical d-c transistor amplifiers. In (A), large values of I_{in} can burn out Q_2. Other circuits effectively limit current

Easing Transistor Loads

Direct-coupled transistor amplifiers are often driven to overload during normal operation. Some simple design rules presented here limit the current and power dissipation to safe limits when the input stage is overloaded

By **WILLIAM F. SAUNDERS, III** General Engineer, Link Aviation, Inc., Hillcrest, N. Y.

DESIGN OF DIRECT-COUPLED transistor amplifiers must include a means for limiting power dissipation in the transistors during amplifier overloads when every stage may be cut off or saturated with large currents. Considering current and power dissipation of each transitor, with the preceding stage in both extreme conditions, produces a direct-coupled amplifier that will always operate within the ratings of the transistors.

Figure 1A shows a possible two-stage, direct-coupled transistor amplifier. Assume that Q_1 can be driven either to cutoff or to saturation by I_{in} and examine the base current of Q_2 under these conditions. When I_{in} is so small that Q_1 is cut off, then Q_2 is also cut off and the ratings of Q_2 are not exceeded. For normal operation with V_{out} between 0 and -5 volts, the collector voltage of Q_1 is fixed at approximately -5 volts and the collector current divides between R_1 and the base of Q_2. Any increase in I_{in} appears in the collector of Q_1 multiplied by the current gain of Q_1. This increase in current flows directly into the base of Q_2 since the current through R_1 remains constant. Thus, the base current and power dissipation of Q_2 can reach large values which may cause the destruction of Q_2. This configuration would be satisfactory only if I_{in} were limited.

Other Methods

Another two-stage transistor amplifier is considered in Fig. 1B. If I_{in} is large, the increased collector current of Q_1 flows through R_1 making the collector voltage of Q_1 more positive, cutting off Q_2. For an I_{in} so small that Q_1 is cut off, the base current of Q_2 is limited by the current through R_1. This current is approximately equal to the normal collector current of Q_1, and usually other design requirements such as amplification and normal operating currents result in an R_1 large enough so the maximum ratings of Q_2 are not exceeded when Q_1 is cut off, even though Q_2 is saturated. Thus, the maximum current in Q_2 is independent of the maximum I_{in} and Q_2 is protected from the effects of extremely large input signals. A common-collector circuit shown in Fig. 1C, has no excessive current or power dissipation in Q_2 when Q_1 is overloaded, provided R_1 is large.

The criteria for either configuration can be written as two rules relating the configuration and transistor type (*pnp*, *npn*). First, a common-emitter stage must be followed by a similar transistor.

Second, a common-collector stage must be followed by a transistor of the complementary type. These two rules are completely general and always provide protection provided R_1 is large.

The low current gain of common-base stages will usually eliminate any saturation problems. For the same reason, it is not normally advantageous to use common-base stages in direct-coupled amplifiers.

Another design procedure restricts the operation of a critical stage to only one of the overloaded conditions. This may be accomplished in an operational amplifier by limiting the input signal to only one polarity. In Fig. 1D and 1E the maximum available base voltage of Q_2 is insufficient to cause large currents in Q_2 even when Q_1 is overloaded. This is not true if the $+5$ and $+10$ volt supplies are interchanged in Fig. 1D or if the -10 and -15 volt supplies are interchanged in Fig. 1E.

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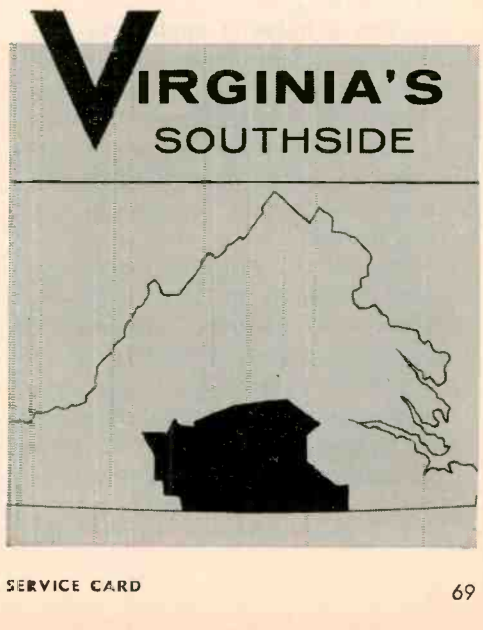

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Square-Loop Cores for Logic-Circuits

By A. L. FREEDMAN, Stevenouge, Herts, England

CURRENT WEIGHTING is often used to perform logical operations with square hysteresis-loop magnetic cores. For example, the AND gating operation is performed by applying to a core a current pulse equal in magnitude to the input current pulse but opposite in direction. The current pulse is applied simultaneously with the inputs.

Assuming that the direction of the input current pulse is such as to change the state of the core, the change will occur only if both input signals are present. This arrangement suffers from two drawbacks. All inputs must be available during the same input phase. Also, there is the difficulty that the inputs (including the counterbalancing or dummy inputs) have to be precisely standardized, and their durations must coincide exactly.

These drawbacks can be eliminated by using a separate core for each input. Input cores are used for both storage and standardization of the input pulses. An AND gate using this method is shown in Fig. 1.

Inputs X_1 and X_2 and dummy input X_3 (which is always ONE) may be applied at any time. The output winding is wound on cores C_1 and C_2 in one direction and on core C_3 in the opposite direction. The same number of turns are used on all the cores.

Operation

When a pulse is applied to this winding, simultaneous outputs of the same magnitude are produced. The output from C_3 opposes the outputs from the other two cores. An output of appropriate polarity will result only when X_1 and X_2 are both present.

Most of the common logical operations such as OR (but not the exclusive (OR), INHIBIT, combined OR and INHIBIT, and at least n out of m' can be carried out in one step.

The method obviously relies on the uniformity of the cores. In a particular application, circuits employing up to four cores were required and with the cores used

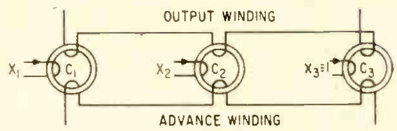


FIG. 1—Output winding on C_1 and C_2 is wound in one direction and in the opposite direction on C_3

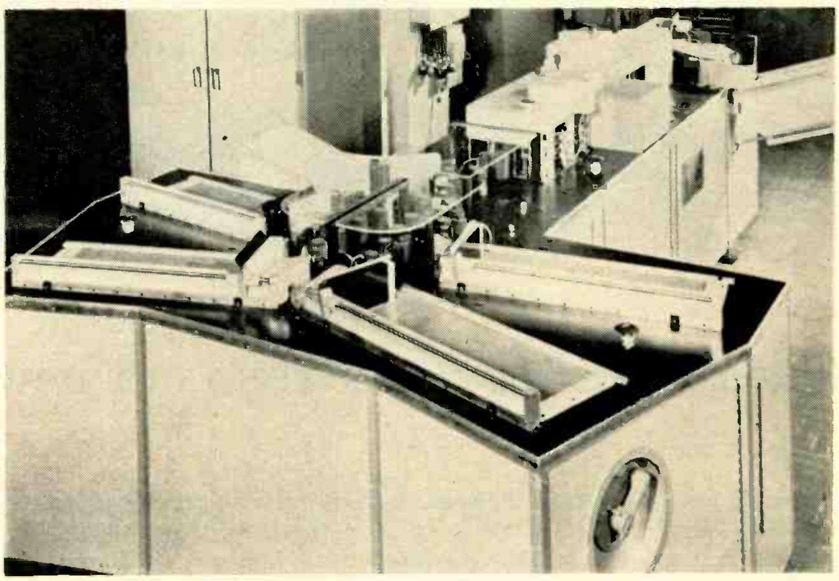
(Mullard 3mm D3) proved entirely satisfactory.

The proposed method requires more cores than does balancing currents applied to one core during the input phase. This is to some extent offset, since all cores are identically wound, and logical circuits can be built up from one standard element.

The method described is not suitable for use in shift-register type logic when diodes are used to prevent cores from loading preceding ones. This is because the output winding is wound on cores in opposing directions. Thus, for instance, when core C_3 in Fig. 1 is set, a voltage will appear on the output winding. Assume that a diode is on the output winding directed so that it will allow current to flow to the next stage when cores C_1 and C_2 are reset, but not when these cores are set. It will not prevent the following stage from loading core C_3 when C_3 is set.

The author is indebted to the directors of Ericsson Telephones Ltd. for permission to publish this article.

Electronic System Cancels Stamps



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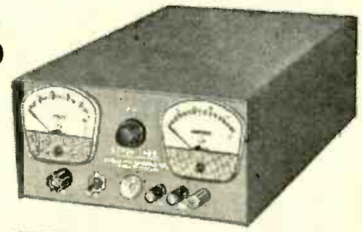

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SC-18-1	0-18	0-1	.02	.2	8¼″	4 5/32″	13⅝″
SC-18-2	0-18	0-2	.01	.1	8¼″	4 5/32″	13⅝″
SC-18-4	0-18	0-4	.005	.05	19″	3½″	13″
SC-36-0.5	0-36	0-0.5	.08	.8	8¼″	4 5/32″	13⅝″
SC-36-1	0-36	0-1	.04	.4	8¼″	4 5/32″	13⅝″
SC-36-2	0-36	0-2	.02	.2	19″	3½″	13″
SC-3672-0.5	36-72	0-0.5	.15	1.0	8¼″	4 5/32″	13⅝″
SC-3672-1	36-72	0-1	.08	.8	19″	3½″	13″

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- **POWER REQUIREMENTS:** 105-125 volts, 50-65 cycles. 400 cycle units available.
- **OUTPUT TERMINATIONS:** DC terminals are clearly marked on the front panel. All terminals are isolated from the chassis. Either positive or negative terminal of each DC output may be grounded. A terminal is provided for connecting to the chassis. The DC terminals, the remote programming terminals and the remote error signal sensing terminals are brought out at the rear of the unit.
- **CONTROLS:** Power-on-off switch, one turn voltage control, on front panel. Over-current control on rear of unit. Ten turn voltage control available on special order.
- Continuously Variable Output Voltage. No voltage switching.
- Suitable for square wave pulsed loading.
- Either positive or negative can be grounded.
- Units can be series connected.
- High efficiency
- Low heat dissipation.
- Compact, light weight
- For bench or rack use.
- Color: Gray hammertone. (Special finishes available).

ORDERING INFORMATION:

Units without meters use model numbers indicated in table. To include meters add M to the Model No. (e.g. SC-18-1-M).

*Rack adapter for mounting any two 8¼″ x 4 5/32″ units is available. Model No. RA2 is 5¼″ high 19″ wide.

*Rack adapter for mounting any one 8¼″ x 4 5/32″ unit is available. Model No. RA3 is 5¼″ high 19″ wide.

AN 0.01% SERIES IS AVAILABLE IN 13 NEW MODELS

KEPCO OFFERS MORE THAN 120 STANDARD VOLTAGE REGULATED POWER SUPPLIES COVERING A WIDE RANGE OF MAGNETIC, TUBE AND TRANSISTOR TYPES. MOST MODELS AVAILABLE FROM STOCK. SEND FOR BROCHURE B-587

KEPCO LABORATORIES, INC.
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INDEPENDENCE 1-7000

orienting device. This device directs the letter to one of four terminal letter collection stackers. All letters are uniformly faced so that stamps—and therefore addresses—are oriented in the same manner.

The machine's special scanning and sensing devices can almost instantaneously make positive identification of a postage stamp. It can differentiate a stamp from envelope windows, trade marks, advertising, Christmas and Easter seals, and other markings on envelopes.

The machine, developed by the Government Electronics division of Emerson Radio & Phonograph Corp., will be installed with Emerson's culling machine. The culling machine is undergoing evaluation tests in the Main Post Office in Washington, D. C. It separates letters from other objects, such as packages, keys, large envelopes.

More Sound from Transistor Amplifier

By E. F. KEIRNAN, Los Angeles, Calif.

TRANSISTORIZED broadcast receivers with six transistors often use three of the transistors as audio amplifiers. Vacuum-tube receivers having about the same performance capabilities generally have not more than two tubes acting as audio amplifiers. One of these is usually a detector as well.

Theoretically, efficiency of the class A amplifier is 50 percent. In practice, class A vacuum-tube amplifiers range in efficiency from 20 to 25 percent. Transistor class A efficiencies range from 35 to 49 percent.

With these efficiencies, it does not seem necessary to use half again as many transistors for audio amplification.

Experimental Receiver

The writer assembled an experimental four-transistor superheterodyne receiver. The usual arrangements for coupling the audio output amplifier directly to a hearing-aid unit were used.

Sensitivity and selectivity of the receiver were completely satisfactory. However, audio output was not. Various changes were made with little improvement. Finally, each of two old vibrating-armature loudspeakers were substituted. Acceptable quality sound output was greatly increased. However, a 2½-in. dynamic speaker and matching transformer produced negligible output.

The dynamic speaker is not a very efficient converter of electrical to acoustic energy. At 400 cycles, when mounted on a large baffle, efficiency falls between 2 and 10 percent, with 3 percent a nominal average. However, this low figure did not account for the almost complete lack of output in the present case, since the vibrating-armature speakers use cone radiators similar to those used in dynamic types.

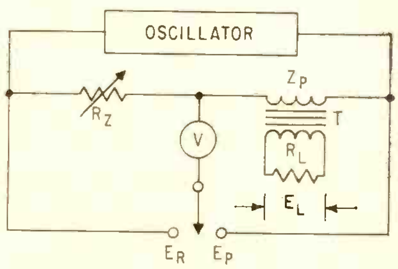


FIG. 1—Simple test setup permits determination of efficiences of audio transformers for transistor receivers

However, a dynamic speaker requires a matching transformer, while the vibrating-armature speaker does not. To determine the influence of the transformer, tests of a collection of inexpensive miniature and subminiature output transformers were made. For reference purposes, a larger transformer was also tested.

The test setup is shown in Fig. 1. Variable resistor R_z was connected in series with the primary of transformer T. Resistor R_L, equal to the nominal load impedance, was connected across the secondary.

The oscillator was adjusted to 400 cycles and the value of resistor R_z adjusted until E_R equalled E_P. Voltage E_L across the load resistor was then measured.

Primary watts $W_P = E_P^2/R_z$. Secondary watts $W_L = E_L^2/R_L$. Transfer efficiency is $W_L/W_P \times 100$.

Transfer efficiencies of the small transformers varied between 13 and 17 percent. Efficiency of the larger transformer was 85 percent.

Flexible Conductor Operates to 250 C

By CHARLES J. BERAN, Chief Project Engineer, Tensolite Insulated Wire Co., Inc., Tarrytown, N. Y.

AS THE TREND towards miniaturization in electronic equipment continues, the need for obtaining the greatest possible mechanical strength in any particular wire size used becomes more and more important. The conductor to be described was developed with this need in mind. It has better tensile strength and flex life than copper and is suitable for use in Teflon-insulated hookup wire for operation to 250 C. Table I shows approximate breaking strengths of some strandings used in fine hookup wires.

Other Considerations

Another important consideration for a conductor of the type developed is its performance when subjected to repeated stresses of a magnitude less than its ultimate strength. The highest unit stress at which a material can be subjected to a large number of repetitions of loading and still show no evidence of failure is called the endurance limit.

Finally, the selected conductor material must perform as an electrical conductor and its resistance must not be appreciably higher than that of copper.

Material Selected

The material selected to give the most favorable combination of conductivity, flex life and mechanical strength is a chrome-copper alloy. Its composition is: copper, 99.05 percent; chromium, 0.85 percent and silicon, 0.05 percent. The alloy is treated to be oxygen-free. It takes nickel and silver plate with the same ease as copper. The plated, annealed alloy has a tensile strength of 49,000 to 52,000 psi as compared to about 35,000 to 40,000 psi for annealed, silver-plated copper. Conductivity of the new conductor is 90- to 93-percent that of annealed copper. The new conductor meets or exceeds conductor requirements of Type E and EE of Mil-W-16878.

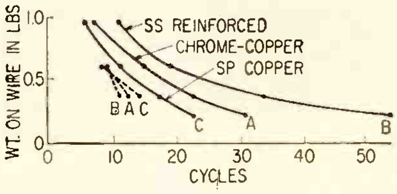


FIG. 1—Comparative flex-life values with bar flex test A. Dotted lines are cycles for first strand to break.

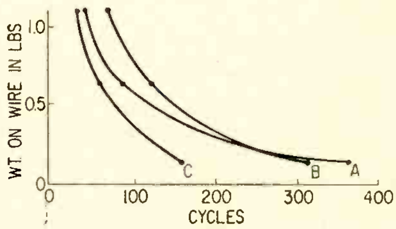


FIG. 2—Comparative flex lives for bar flex test B

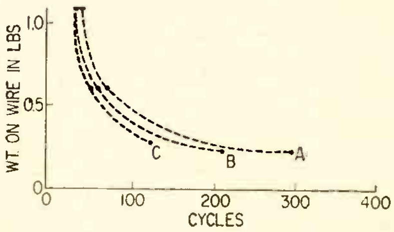


FIG. 3—Flexing for first-strand break for bar flex test B

The previous approach to the problem of higher strength conductors has been substitution of a high-strength member for one or more of the silver-plated copper strands. This approach has the following disadvantages: First, increased resistance is brought about generally at the upper limit of or outside the requirements of the appropriate military and commercial specifications. Second, the difference in tensile and elongation between the copper and steel can result in premature failure of the copper strands when flexed. Third, in most flex life testing, the copper conductors fail first, leaving only the reinforcing member or members.

Table II shows a comparison of the physical and electrical properties of chrome-copper alloy, copper and reinforced construction. All wires used for the table were AWG 26, 7/34 concentric. All strands, with the exception of the

Table I—Breaking Strength of Silver-Plated Annealed-Copper Conductors

Wire Size	Stranding	Approximate breaking strength in lb
AWG 24	7/32	15.5
AWG 26	7/34	10.2
AWG 28	7/36	6.6
AWG 30	7/38	4.7
AWG 32	7/40	2.8

Table II—Comparison of Physical and Electrical Properties

	Chrome-Copper Alloy	Copper	Reinforced Strands
Elongation in percent	19	17	18
Tensile strength in psi	50,800	38,000	51,000
Resistance in ohms/M ft	37.0	35.9	42.3

"We grew too fast for our bank"

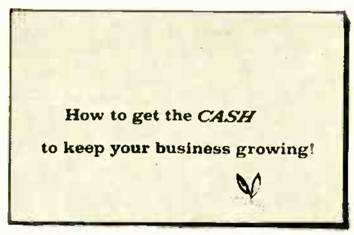
When he was fourteen years old, Jim McClain earned pocket money by rewinding motors and transformers. Thirteen years later James Ernest McClain, with very little capital but lots of know-how and drive, started his own business, specializing in the repair of distribution transformers.

In its first year, ESCO Manufacturing Company, of Greenville, Texas, consisting of 27 years old McClain and a hired mechanic, grossed $35,000, netted $7,000. Last year, gross was several millions, and net profit, correspondingly substantial.

In the early years the local bank was able and willing to supply all the credit that Esco needed. But the growth was so rapid and the matching need for working capital so great, the local bank wasn't quite able to go along. So Mr. James Ernest McClain, then head of a company grossing better than a half million dollars, and not willing to dilute his equity or surrender any voice in management, turned to Textile Banking Company for financing cooperation and advice.

Mr. McClain says: "In addition to the advantages we enjoy in using TBC's funds as equity capital, and the savings we effect in eliminating credit losses and the cost of a credit department, there is perhaps an even greater advantage. Though we are far away from the industrial and financial centers, we have the privilege of being able to call on TBC's experienced executives for advice in solving many problems, financial and otherwise. Their experience, their contacts, their ability to supply us with nation-wide credit information usually give us the right solution."

At TBC, we don't work miracles. We help growing companies, whose sales exceed $500,000 annually, meet all the capital needs of rapid expansion, without surrendering any management control, or without any dilution of profits. If you want to know more about how we do it, write for a free copy of our new booklet, "How to get the *cash* to keep your business growing."



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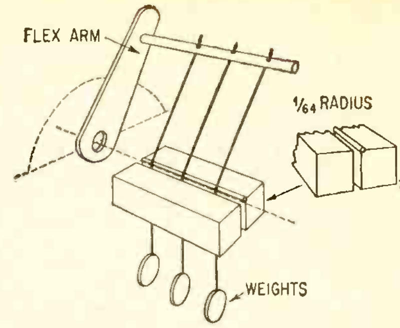


FIG. 4—Bar flex test A with flex cycles of 24/min

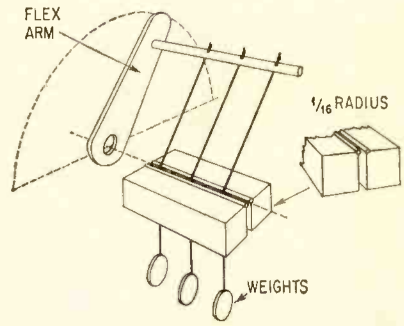


FIG. 5—Bar flex test B with flex cycles of 12/min

reinforcing member, had 40 micro-in. silver plate. Insulation was removed before the conductors were tested. Resistance values can vary slightly from lot to lot of wire because of the tolerance on individual strands.

Figures 1, 2 and 3 show comparative flex-life values for the different conductors. All wires were AWG 26, seven-strand concentric. Figures 4 and 5 show the two different test setups used.

Shift Register Uses Single-Wire Memory

UNDER DEVELOPMENT at Bell Telephone Laboratories is a reversible, diodeless shift register using a single magnetic wire as the memory element. The wire is twisted and is magnetized most easily in a spiral direction. When a suitable magnetic field is applied, the wire can store pulses. Amount of twist regulates the magnetic interactions between magnetized zones.

Information bits are written in and slid along by means of tiny eight-turn solenoids wound on a ceramic tube. The 0.002-in. diam Permalloy wire is stretched through the center of the tube.

To insert a magnetized zone into the register, simultaneous pulsing of three adjacent coils is necessary. Two coils must be pulsed to slide this zone along the wire. For example, if a bit is stored by pulsing coils 1, 2 and 3, it can be moved along one space by proper pulsing of coils 1 and 4. After a bit has been advanced, the wire can be cleared by pulsing the erase coil with about 240 ma.

For readout at the end of the register, a 170-ma pulse is passed through three special readout coils. A voltage pulse appears across the magnetic wire if a bit is present. (See ELECTRONICS, p 7, Dec. 57.)

Transducer Package Includes Demodulator

BOTH A DIFFERENTIAL transformer and a phase-sensitive demodulator are combined in a single lightweight package known as the Dirpot and manufactured by Pneuma-Serve Ltd., Toronto.

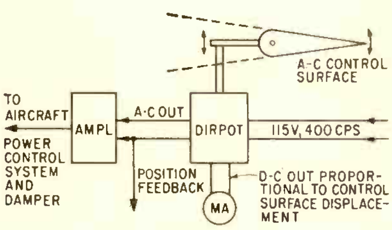


FIG. 1—Dual-output unit used in an aircraft control surface position indicator

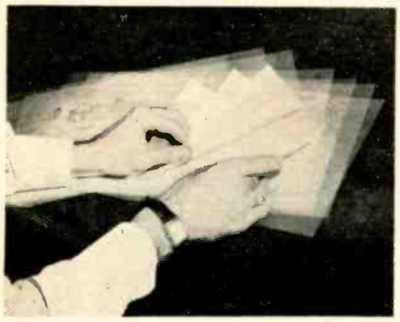
Displacement of the armature modifies the flux paths in an E core. The alternating voltage output from the differential transformer is demodulated by the phase-sensitive demodulator. Polarity of the output voltage determines on which side of neutral the armature is positioned.

Outputs

The 115-v, 400-cps unit has an output of up to ±3 ma into a 2,000-ohm load for an armature displacement of ±0.030 in. It can also be supplied with an a-c/d-c output for use in such applications as the aircraft control surface position indicator shown in Fig. 1.

Photos Assist Drafting, Assembly

By J. C. ISBISTER, R. T. HARDING, S. GANGI and F. J. KIRCH Arma Div., American Bosch Arma Corp., Garden City, N. Y.



Overlays of translucent detail drawings are built up and photographed to produce drawings with desired amount of detail

First step is preparing vellum pasteup of repetitious detail cut from an expanded drawing

UNUSUAL PROCEDURE for preparing detailed drawings from design layouts has been developed by Arma. Photographic techniques replace hand detailing. "Fotogram" is the word coined to describe it.

It is estimated that Fotogram will eventually relieve the draftsman of 50 per cent of uninteresting and uncreative details. Cost reductions are in proportion and time will be available for more useful, rewarding work.

The Fotogram process will also reduce the need for preparation of assembly drawings by manual methods. For example, the "exploded" layout can be used for assembly of prototype equipments.

As assembly progresses on the initial products, photographs are made corresponding to the views of a conventional subassembly drawing. When the photos are reproduced by Fotogram techniques with notes and identifying nomenclature, they become assembly "drawings", eliminating need for manually-prepared drawings. Aside from cost savings, assembly Fotograms facilitate manufacture.

An exploded or expanded method of layout represents unassembled components in their proper spatial relationship and coded to permit assembly. Principal dimensions only are shown. To prepare details, views of the elements to be detailed are cut from a copy of the original layout and are mounted on a standard drawing format or a transparent reusable format, depending on the reproduction method to be used. Additional dimensions and notes are added. The pasteup is reproduced on vellum and can be reproduced by any desired method.

Overlays Prepared

An overlay method produces the design layout by building up a series of component elements on translucent material. As the layout progresses, the elements are tiered one on the other until all the elements have been assembled to complete the layout. To detail it, it is necessary only to remove the elements in succession, treating each in the manner described to produce the original Fotogram for normal use.

Variations may be introduced to meet specific requirements by an additive method. A layout produced by conventional or Fotogram methods is detailed by placing a special photographic film over the area desired. Areas required are roughly delineated by tracing over the film with a stylus or brush containing developing solution. The film is exposed to controlled light, to burn out undeveloped areas. The film is exposed with a transparent format overlay to make the master.

In a subtractive method, a paper photo positive of the layout is prepared. Areas to be eliminated from the detail are brushed out with a reducing solution or white paint,

Fixture Simplifies Fluxing

Shaped parts rotate between brushes loaded with flux

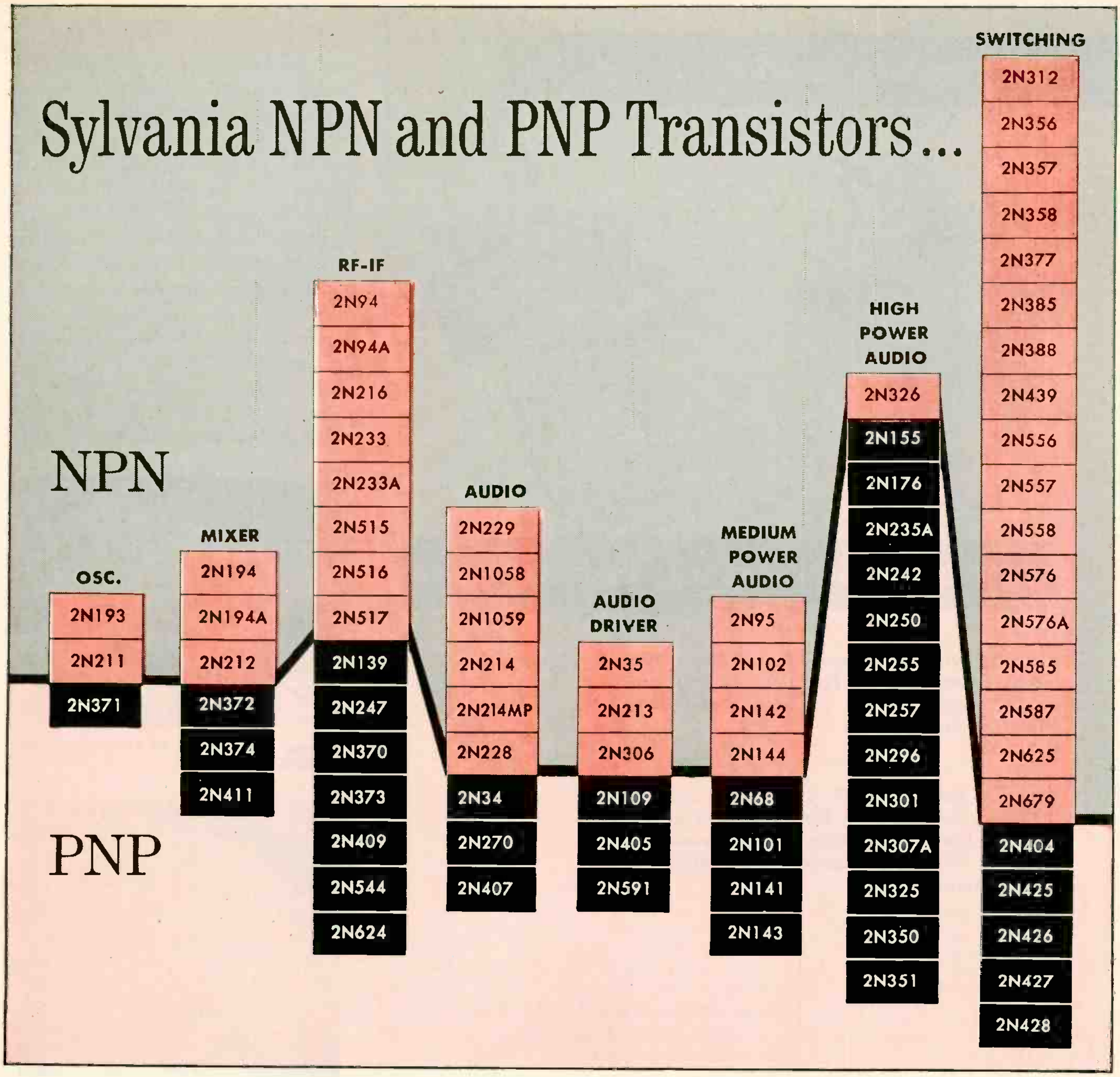
FLUXING OF PARTS with awkward contours is speeded up at Fenwal, Inc., Ashland, Mass., with a motorized fixture. The fixture holds the part and rotates it between a pair of flux brushes.

The part shown is a stainless steel aircraft fire detector, which has a triangular flange mounted on a cylindrical shell. Dipping was impractical because the assembly has an open end and hand brushing proved tedious.

In the fixture, the part is held horizontally in a collet mounted on the shaft of a fractional horsepower motor. The collet inside diameter is about $\frac{1}{8}$ inch oversize to permit the shells to be slipped in and out freely. The collet holds about $\frac{2}{3}$ the length of the shell.

Rotation is kept slow, about 45 rpm, to prevent the flux from spraying off. Fluxing brushes are held in the ends of a $\frac{1}{4}$ inch tube bent to straddle the flange. The holder pivots on an axle and is heavier at the brush ends so that it dips into a flux trough when the operator releases the holder. This action also clears the way for loading the fixture.

Fluxing rate of the setup is about 8 seconds per piece. The flange and shell are subsequently torch brazed.



A planning chart for designers who need both

From high-power audio types to high-stability switching types, both NPN and PNP germanium transistors are now available from Sylvania. With this wide range of types, electronic design engineers can take full advantage of the complementary aspects of NPN and PNP in every major circuit application.

Sylvania NPN and PNP transistors for switching applications exhibit the high Beta stability and fast rise time so important for data processing. NPN and PNP types for RF-IF applications feature high output resistance for increased gain. For your audio needs Sylvania offers one of the industry's most complete lines.

The entire Sylvania line of NPN and PNP types incorporates hermetic seal construction for maximum protection against humidity and other environmental conditions that can affect performance. For complete information on NPN and PNP transistors, contact your Sylvania representative or write Sylvania directly.

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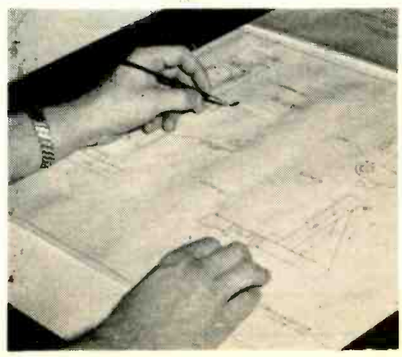
notes and dimensions are added as required. The Fotogram is then prepared using a reproduction method.

An overlay method of detailing consists of placing a transparent drawing format over the area to be detailed. Notes and additional information are added as required and the combination is reproduced to form the Fotogram.

As part of the program, the preparation of schematic diagrams by the Fotosetter process (ELECTRONICS, p 122, Dec. 5) was evaluated. Studies of its application to military projects indicates that wiring diagrams may be produced in half the time required by manual methods.

Pasteup is reproduced by Xerography and Multilith



Areas to be eliminated from drawing are bleached out or hidden with white paint

Ultrasonics Cleans Delicate Stampings

METAL STAMPINGS too delicate for mechanical or manual washing may be ultrasonically cleaned in large batches. Such a process is used by Sergeant & Wilbur Heat Treating Corp., Powtucket, R. I., before and after heat treating mu-metal laminations.

The laminations, supplied by Allegheny Ludlum Steel Corp., are

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0.004 inch thick. As received from cold stamping, they require degreasing. This is done by immersing them for 5 minutes in a chlorinated solvent bath in an ultrasonic cleaner.

The parts are then covered with

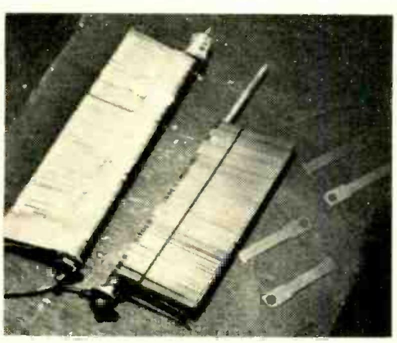
Operator removes 1,000 laminations from cleaner

an aluminum oxide powder, Alundum, made by the Norton Co. The powder prevents them from sticking on jigs which hold 1,000 laminations during heat treating and final cleaning.

They are heat treated in a protective atmosphere of cracked city gas an anhydrous ammonia. The parts emerge from the furnace free of scale or discoloration, but are covered with powder partly cooked onto the jigged pieces.

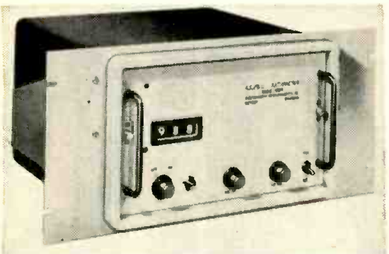
The powder is removed by 20 minutes immersion in an ultrasonically agitated bath of detergent and warm water. The cleaning unit used is a 1 gallon model, Series 600-3, manufactured by Nard Ultrasonics Corp., Westbury, N. Y.

The tank will hold 4 jigs at once, yielding a rate of 12,000 laminations an hour if necessary. S & W reports rejects are virtually nil. The assembled stacks of laminations must meet tolerances of a few ten-thousandths of an inch.



Jig at right shows how stack of laminations has shrunk after removal of powder required in heat treating

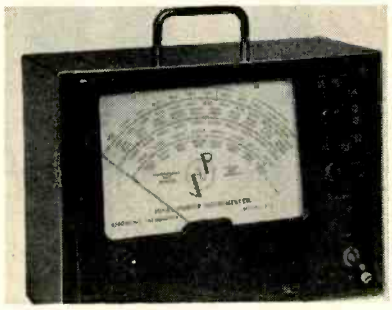
ON THE MARKET



Digital Ratiometer for a-c, d-c input

PERFORMANCE MEASUREMENTS Co., 15301 W. McNichols, Detroit 35, Mich., announces model 1594 a-c/d-c digital ratiometer for computers and control system applications. Range of ratios that can be measured directly in numerical values is 0 to 1,000. Input voltages range from 0 to 6.3 v a-c and 0 to 6 v d-c. With a high impedance input, this instrument measures a-c and d-c voltage ratios with a rated accuracy of ±0.10 percent full scale. **Circle 200 on Reader Service Card.**

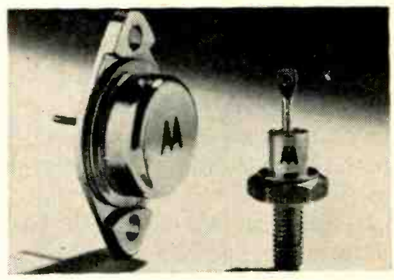
Frequency Meter high accuracy



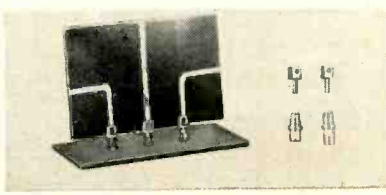
JONES-PORTER INSTRUMENT Co., Box 302, Millburn, N. J. Featuring 14 ranges through 80 kc and 7 ranges through 80,000 rpm, all direct reading, the model T-2 frequency meter achieves extreme readability, accuracy, and freedom from drift through the use of saturable core circuitry throughout. An internal calibration standard permits the use of any power supply frequency, since it is not related to the 60 cps system. It will accept any input voltage from 10 mv to 300 v and give equal accuracy on any repetitive function. **Circle 201 on Reader Service Card.**

Silicon Zener Diodes two new types

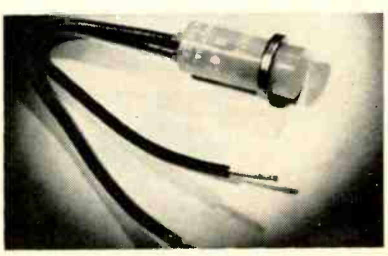
MOTOROLA INC., 4545 W. Augusta Blvd., Chicago 51, Ill., announces silicon zener regulator diodes with voltage ranges up to 200 v. The 10 MZ series, rated for 10 w at 55 C, is housed in the Jetec, standard 10-32 stud package; while the 50 MZ (50 w) series uses the TO-3 package with either plug-in or solder-in features as well as series interlock construction for protection against overvoltage on load. Both are available with either anode or cathode connected to case. **Circle 202 on Reader Service Card.**



Plug and Jack for p-c boards



CAMBRIDGE THERMIONIC CORP., 445 Concord Ave., Cambridge 38, Mass., announces a plug and jack, designed for mounting one printed circuit form perpendicular to another. Using this combination, any number of p-c boards may be plugged to the master boards. The new plug, designated 2319, has a 0.0635 in. bore running through the rectangular shank. The end of the shank is slotted to a depth of 0.125 in. to accommodate boards 1/32 in. thick. The plug has a 0.062 in. pin diameter. Its corresponding jack, designated 2320, is available in four different shank lengths for use with circuit boards from 1/16 in. to 3/16 in. thick. **Circle 203 on Reader Service Card.**



Pilot Light miniaturized

INDUSTRIAL DEVICES, INC., 982 River Road, Edgewater, N. J., announces a new type miniaturized neon pilot light, the Omni-Glow. Completely assembled by the manufacturer and ready for installation and operation, this unit extends for less than ⅞ in. behind the panel. It mounts in a single ½ in. hole and attaches with a push-on nut that is supplied. The unit is U/L and CSA approved. **Circle 204 on Reader Service Card.**

Power Supply all-transistor

DRESSEN-BARNES CORP., 250 No. Vinedo Ave., Pasadena, Calif.

Model 62-124 all-transistor power supply is free from line transients and overshoot in the output. Unit provides full 2-ampere current over

(Continued on p 86)

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Six rugged new capacitor types designed SPECIFICALLY to SAVE SPACE in compact, transistorized assemblies. Two temperature ranges to choose from. All types rated for 500-hours accelerated life testing.

Full Rated to 85°C

Types **626G - 627G** (Extended foil)
Types **628G - 629G** (Inserted tab)

Temperature Range—Full rating at 85°C — to 125°C with 50% derating.

Life Test—500 hours at 85°C and 125% of rated voltage.

Capacity Tolerance—All tolerances to ± 1%.

Insulation Resistance—40,000 meg. × mfd. at 25°C but need not exceed 70,000 megohms.

Case Styles—Available in all case style variations in MIL-C-25A.

Full rated to 125°C

Type **616G** (Extended foil)
Type **617G** (Extended foil)

Temperature Range—Full rating to 125°C - to 150°C with 50% derating.

Life Test—500 hours at 125°C and 125% of rated voltage.

Capacity Tolerance—All tolerances to ± 1%.

Insulation Resistance—50,000 meg. × mfd. at 25°C but need not exceed 100,000 megohms.

Case Styles—Available in all case style variations in MIL-C-25A.

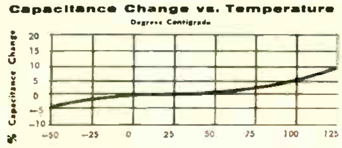
50-VOLT DIMENSIONS

Capacitance in Mfds.	626G* D	626G* L	627G D	627G L	628G* D	628G* L	629G D	629G L	616G*† D	616G*† L	617G† D	617G† L
.001	.173 ×	21/32	.173 ×	23/32	.173 ×	1/2	.173 ×	9/16	.173 ×	11/16	.173 ×	3/4
.0022	.173 ×	21/32	.173 ×	23/32	.173 ×	1/2	.173 ×	9/16	.173 ×	11/16	.173 ×	3/4
.0047	.173 ×	21/32	.173 ×	23/32	.173 ×	1/2	.173 ×	9/16	.193 ×	11/32	.193 ×	3/4
.01	.173 ×	21/32	.173 ×	23/32	.173 ×	1/2	.173 ×	9/16	.193 ×	11/32	.193 ×	3/4
.022	.233 ×	21/32	.233 ×	23/32	.193 ×	21/32	.193 ×	23/32	.233 ×	7/8	.233 ×	15/16
.047	.312 ×	21/32	.312 ×	23/32	.233 ×	21/32	.233 ×	23/32	.312 ×	11/16	.312 ×	3/4
.1	.312 ×	25/32	.312 ×	27/32	.312 ×	21/32	.312 ×	23/32	.400 ×	3/4	.400 ×	7/8
.22	.400 ×	1	.400 ×	1 1/16	.400 ×	7/8	.400 ×	15/16	.500 ×	1	.500 ×	1 1/8
.47	.500 ×	1 1/8	.500 ×	1 3/16	.500 ×	1	.500 ×	1 1/16	.562 ×	1 1/8	.562 ×	1 1/4
1.0	.560 ×	1 7/16	.560 ×	1 13/32	.560 ×	1 13/32	.560 ×	1 13/32	—		—	

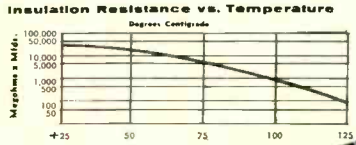
*These types have one lead grounded to the case. Others have both leads insulated.

†Also available in 150V, 400V & 600V ranges.

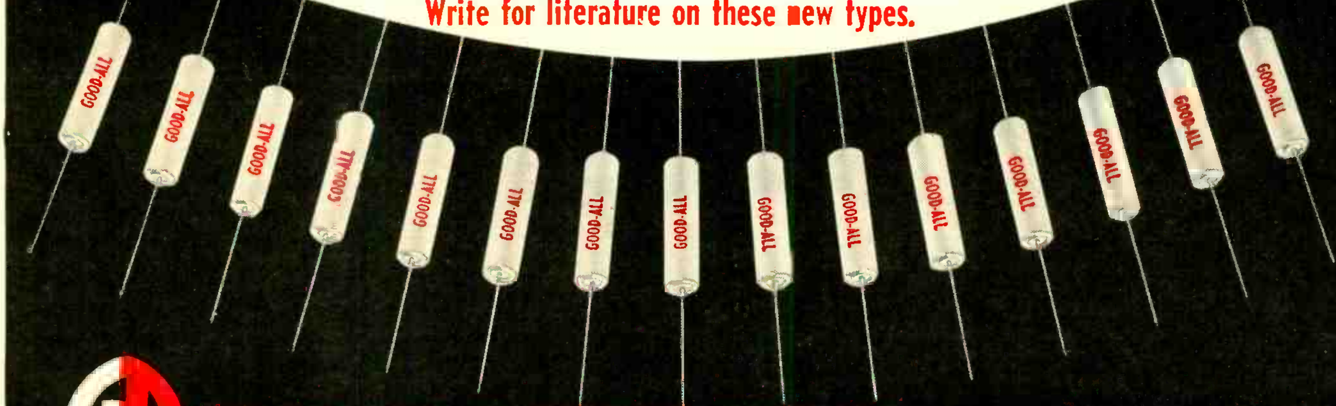
Capacitance Change vs. Temperature



Insulation Resistance vs. Temperature



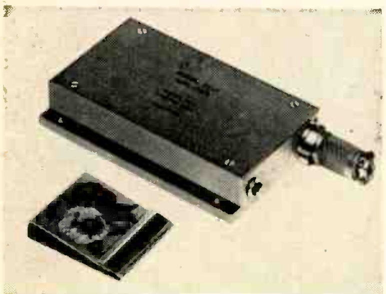
Write for literature on these new types.



GOOD-ALL ELECTRIC MFG. CO. • OGALLALA, NEBRASKA

GOOD-ALL CAPACITORS NOW AVAILABLE AT YOUR LOCAL DISTRIBUTOR

A LEADING MANUFACTURER OF TUBULAR, SUBMINIATURE ELECTROLYTIC AND CERAMIC DISC CAPACITORS voltage range of 0.5 to 36 v d-c. There is no derating for continuous operation. Regulation is 0.05 percent for a line voltage change from 105 to 125 v; and 0.05 percent from no load to full load. The supply maintains regulation despite rapid switching of full output current. Unit is short-circuit proof, and has special fusing to prevent damage to transistors. Price is $640. **Circle 205 on Reader Service Card.**

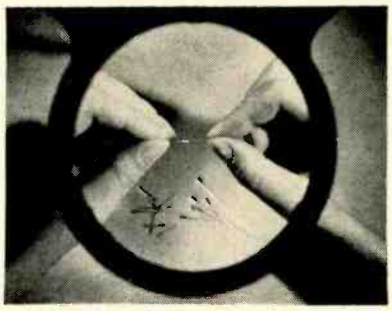


Telemetry Amplifier subminiature

ENDEVCO CORP., 161 E. California St., Pasadena, Calif., offers a new airborne subminiature amplifier, model 2617, to be used with high impedance transducers such as piezoelectric and capacitive devices. It is protected against humidity (potted). Subminiature MIL type output connectors are supplied. A selectable fixed gain of 10, 30 or 100 is preset at the factory. Unit offers 1,000 megohm input impedance with less than 50 mv residual noise (shorted input), broad range of 2 cps to 20 kc and low current requirement (5.0 ma). **Circle 206 on Reader Service Card.**

Tantalum Capacitor sintered anode

P. R. MALLORY & CO. INC., 3029 E. Washington St., Indianapolis 6, Ind. The new type HAT sintered anode electrolytic capacitor has a case size less than 1/16 in. in diameter and only slightly longer than 1/8 in. in length, with d-c leakage current



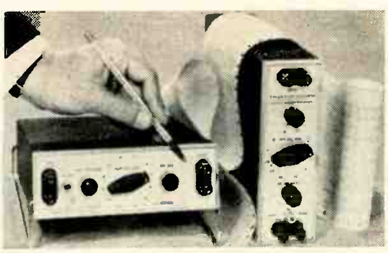
less than 1 μa. It was designed to replace tantalum wire anode capacitors of comparable ratings. Units are ideally suited for by-pass coupling and filter applications requiring relatively high capacitance in a minimum of space. They are available in ratings of 1 to 10 μf and ratings of 1 to 10 v. **Circle 207 on Reader Service Card.**

Transistor Tester for lab, production

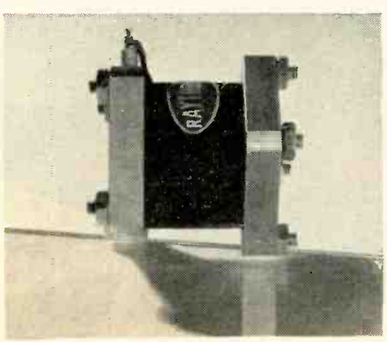
BAIRD-ATOMIC, INC., 33 University Rd., Cambridge 38, Mass. The KP-2 series of transistor test sets feature extended testing ranges for analyzing transistors at frequencies from 100 cps to 200 kc. They offer ranges up to 2 amperes, 200 v with two regulated semiconductor power supplies for bias voltages and currents. The direct measurements obtained on the test sets are based on "h" parameters using basic simple and straight forward circuitry for optimum dependability. **Circle 208 on Reader Service Card.**

D-C Amplifier recorder accessory

TEXAS INSTRUMENTS INC., 3609 Buffalo Speedway, Houston 6, Texas. Model 301 d-c amplifier converts d-c voltages to 1 ma d-c recorder signals with minimum burden.



It gives d-c amplification with a-c stability. Unit covers range from 10 mv d-c full scale to 100 v d-c full scale in 12-step selection. At the lower limit, indicating sensitivity is 2.22 mv/in. when used on the "recti-/riter" recorder. **Circle 209 on Reader Service Card.**

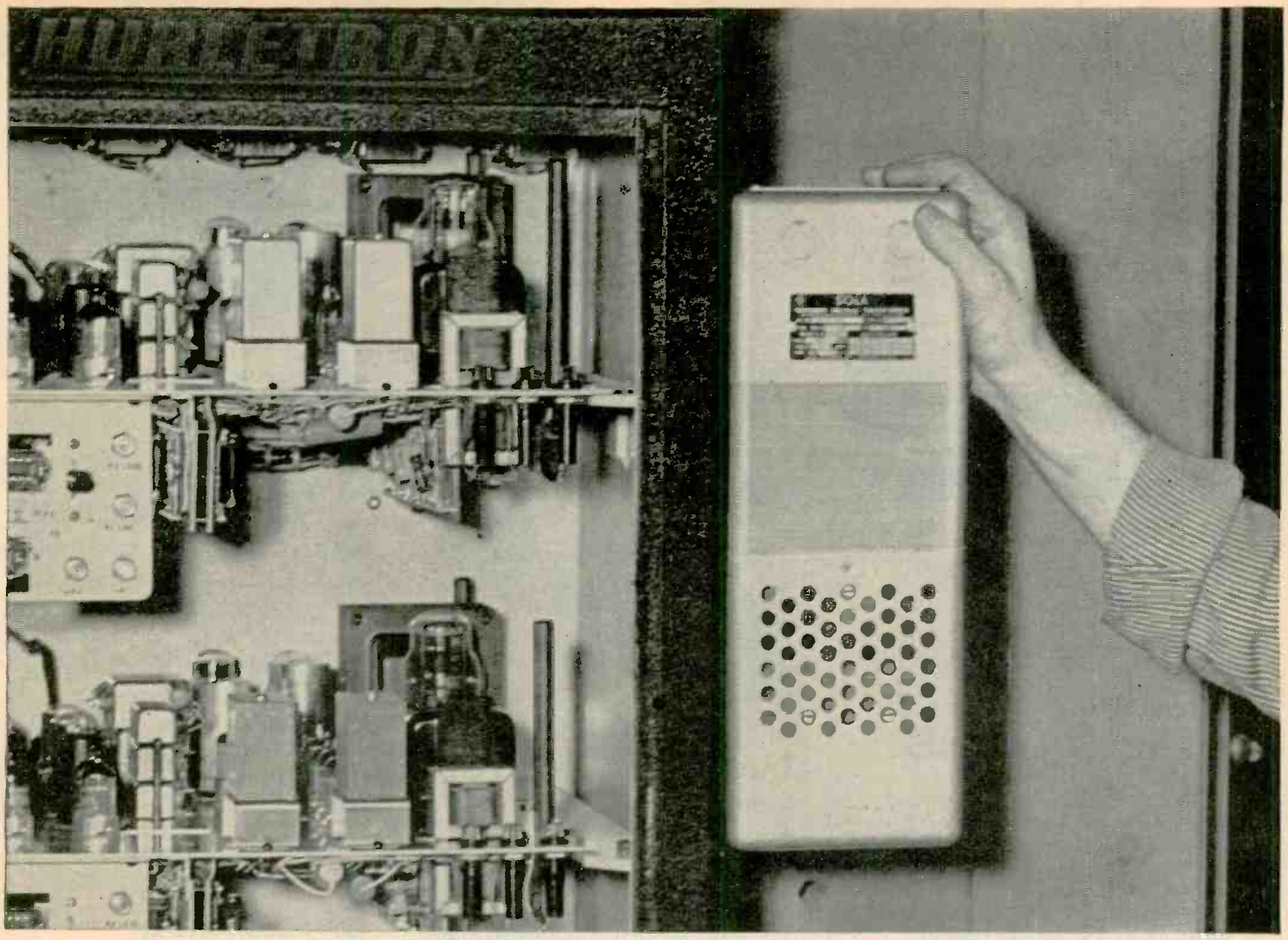


Ferrite Switch low-power, X-band

RAYTHEON MFG. CO., Waltham 54, Mass., has introduced a low-power X-band ferrite switch for on-off applications. Model SXL1 provides a minimum isolation of 25 db with an insertion loss of 0.5 db (maximum). Multiples of this isolation can be obtained by connecting several SXL1's in series. Weight is only 15 oz; overall length, 1.7 in. **Circle 210 on Reader Service Card.**

Power Supply metallic rectifier

OPAD ELECTRIC CO., 69 Murray St., New York 7, N. Y. Model KM87B aircraft battery substitute



Sola's Standard-type Constant Voltage Transformer, mounted at right of control cabinet, supplies regulated input voltage for dependable operation of Hurletron printing register control.

Equipment delivers full-efficiency performance with input voltage Sola-regulated within ±1%

Built in or added as an accessory, Sola Constant Voltage Transformers permit voltage-sensitive equipment to operate at full efficiency. Variations in line voltage as great as ±15% are stabilized to within ±1% of equipment nameplate voltage. This eliminates performance variations and failures caused by irregular voltage—highs, lows, or most transients. Sola-regulated input voltage also gives tubes and other components the correct electrical environment for full life.

The Sola Constant Voltage Transformer is a static-magnetic regulator whose action is automatic and virtually instantaneous—it responds to variations in input voltage within 1.5 cycles. It has no tubes or moving parts and requires no manual adjustments or maintenance.

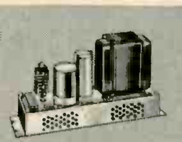
The Standard-type CV illustrated is only one of a complete line of Sola voltage regulators having wide application in electrical and electronic devices. Such special types as harmonic-free, filament, plate-filament, and adjustable harmonic-free transformers all provide the benefits of regulated input voltage. More than 40 models of these economical, compact regulators are available from stock. Sola also manufacturers custom-designed units (in production quantities) to meet special needs.

For complete data write for Bulletin CV-170.

Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill., Bishop 2-1414 • Offices in principal cities • In Canada, Sola Electric (Canada) Ltd., 24 Canmotor Ave., Toronto 18, Ont.

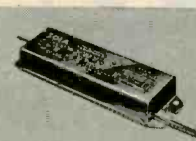
SOLA

CONSTANT VOLTAGE TRANSFORMERS



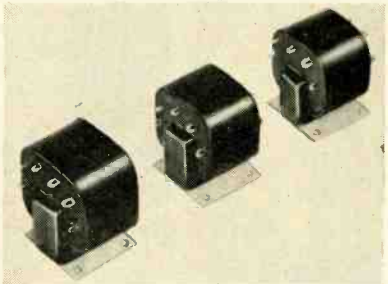
REGULATED DC POWER SUPPLIES

MERCURY LAMP TRANSFORMERS



FLUORESCENT LAMP BALLASTS

A DIVISION OF BASIC PRODUCTS CORPORATION is a metallic rectifier type power supply which provides a stepless controllable output of from zero to 32 v d-c with a continuous duty load current rating of 20 amperes. Ripple is held to within ½ of 1 percent throughout the range of the equipment. Cooling is by convection. Voltage regulation from 1/10 load to full load does not exceed 12 percent at 32 v output. **Circle 211 on Reader Service Card.**

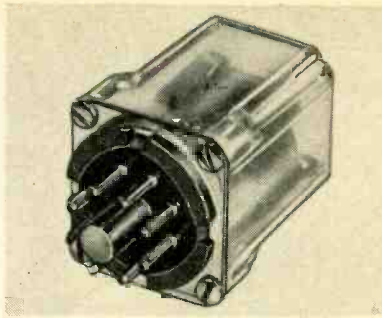


Transformers filament type

UNITED TRANSFORMER CORP., 150 Varick St., New York 13, N. Y., announces a new stock series of 400 cycle filament transformers designed to provide maximum reliability with small size and weight. They are suited to ground or airborne applications. **Circle 212 on Reader Service Card.**

Junction Transistor *pnp* type

RADIO CORP. OF AMERICA, Somerville, N. J. The 2N331 is a new, germanium alloy-junction transistor of the *pnp* type especially designed for use as a low-power a-f amplifier in critical industrial and military applications. It has a current transfer ratio characteristic which is essentially constant over the useful operating current range of the device. The transistor features low collector and emitter cutoff currents, low base resistance, a typical power gain of 44 db, and a typical noise factor of 9 db. **Circle 213 on Reader Service Card.**

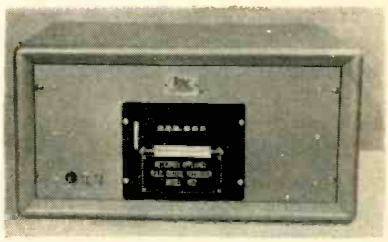


Midget Relay dust-protected

KURMAN ELECTRIC CO., 191 Newel St., Brooklyn 22, N. Y., offers the series 23D dust-protected, midget sensitive relay. The light weight relay is ideal for all plate circuit, photoelectric, and remote control applications, where space economy and current drain are chief design features. Series 23D has a sensitivity as low as 6 mw, spdt, with a maximum coil dissipation of 2¼ w. **Circle 214 on Reader Service Card.**

F-M Transmitter for telemetering

DORSETT LABORATORIES, INC., 401 E. Boyd St., Norman, Oklahoma. Model TR-12 telemetering transmitter features true f-m operation and is crystal stabilized. Frequency tuning range is from 225 to 260 mc. Power output is up to 4 w with a plate supply of 250 v. Filament supply is 28 v a-c/d-c at 400 ma. The true f-m design permits a full 125-kc deviation over a modulation range of from 300 cps to 80 kc with only 1-percent distortion. **Circle 215 on Reader Service Card.**



Digital Recorder versatile unit

RESEARCH APPLIANCE CO., Route 8 at Craighead Rd., Allison Park, Pa. Model 457 digital recorder is a ver-

satile instrument suitable for analog to digital conversion, indication, recording, and controlling. It is available with provisions for connecting to, and controlling a card punch machine for subsequent use in computing and data processing equipment. Printing cycle is 3 sec and longer. Accuracy is $\pm\frac{1}{2}$ percent. **Circle 216 on Reader Service Card.**

Vibration Exciter simple to operate

Electrodynamics Division, L. C. Miller Co., 5005 E. Slauson Ave., Los Angeles 22, Calif. The LCM-100 is a new type of vibration exciter which features a horizontal, air supported, push-pull driven table. Although primarily designed for the production testing of components and small subassemblies, the unit's wide frequency range (5 to 15,000 cps) and high force output will make it an ideal research tool for the product design engineer. **Circle 217 on Reader Service Card.**

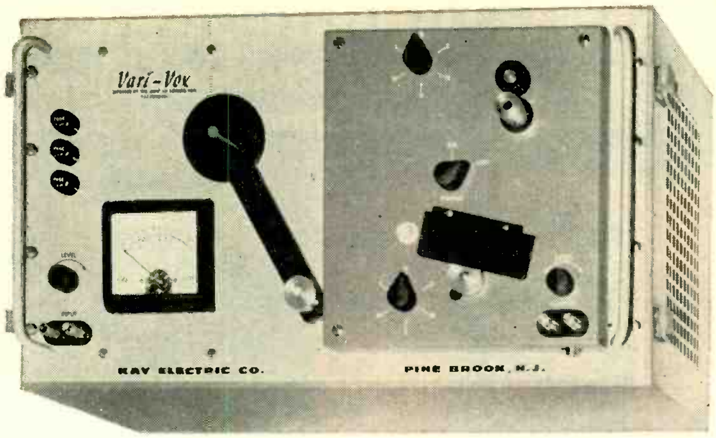
Pulse Tube fast warm-up

CBS-Hytron, Parker St., Newburyport, Mass. The high pulse-emission 7318, a new reliable miniature twin-triode, provides two amperes of peak current in 10-μsec pulses. The compact tube features fast operational warm-up. Its major uses include industrial, computer, missile and airborne applications. It is ideally suited for blocking oscillators, square wave modulators and multivibrators. It will operate in

NEW!

KAY *Vari-Vox*

CATALOG NO. 615-A



SPEEDS SPEECH TO TWICE NORMAL RATE . . . or SLOWS SPEECH TO ONE-THIRD NORMAL RATE

and Still Retains Intelligibility

DOUBLES INFORMATION TRANSMITTED FOR SAME TIME AND BANDWIDTH

The Kay *Vari-Vox* is a speech-time compressor and expander. During expansion or compression, it repeats or discards parts of audio signals—such as vowels, consonants, pauses in speech—and retransmits the complex signal so that complete intelligibility is retained.

Intelligence fed into the *Vari-Vox* may be speeded up and then compressed, or slowed down and then expanded by a known factor to restore the original meaning. Information fed into the *Vari-Vox* may be transmitted at 18 different speeds between twice the original rate down to one-third the original rate. The degree of compression or expansion versus the speed of the input recording determines intelligibility.

SPECIFICATIONS

Frequency Response: 500-8,000 cps ± 2.0 db (max).
Input Impedance: 600 ohms.
Input Signal Recommended: 0.2 V rms.
Sensitivity: 0.10 V rms for full-scale operation.
Output Impedance: 600 ohms.
Output Signal: 0.20 V rms.
Information Rate: Compression up to 2 times normal rate in 9 steps.
Expansion down to one-third normal rate in 9 steps.
Recording Indicator: Standard V. U. Meter.
Power Supply: Self-contained.
Power Requirements: 100 watts, 117 V (± 10%, 50-60 cps ac.
Dimensions: 10½″ x 19″ x 9″ rack panel.
Weight: 45 lbs.
Price: $1,495.00, f.o.b. factory. (Add 10% for export.)

Vari-Vox APPLICATIONS (Partial List)

Compression

• Speed up Data Read-out • Cut Monitoring Time and Tape Storage • Faster Analysis of Complex Signals • Reduce Time, Material and Storage in Talking Books or Speech Records • Increase Information Rate for Signal Monitoring • Frequency Multiplication of Read-out Signal

Expansion

• Better Interpretation of Foreign Language Monitoring • Stenographic Transcription of "Difficult" Subject Matter • Phonetics and Voice Studies • Foreign Language Studies • Greater Intelligibility in the Presence of Noise • Frequency Division of Read-out Signal

Write for New Kay Catalog

KAY ELECTRIC COMPANY

Dept. E-1 Maple Avenue Pine Brook, N. J. CApital 6-4000 an ambient temperature range of −62 to +100 C. **Circle 218 on Reader Service Card.**

Accelerometer hermetically sealed

Lind Corp., Research Park, Princeton, N. J. Type TA2 linear accelerometer is a seismic mass system which possesses low cross sensitivity by virtue of the high transverse stiffness of the self-compensating E springs. It is totally immersed in a silicone fluid with a viscosity selected to provide a damping ratio of 0.65. Volumetric changes in the oil with temperature rise are compensated by incorporating expansion chambers in the case. This allows an operating temperature range from −40 C to +100 C. Dual pots are provided for high level, redundant output. **Circle 219 on Reader Service Card.**

Instrument Housings corrosion-proof

Warminster Fiberglass Co., Box 254, Warminster and County Line Roads, Hatboro, Pa., has introduced new fiber glass reinforced instrument housings which are light,

Actual Size

TI 2N559 ULTRA-HIGH SPEED GERMANIUM SWITCHING TRANSISTORS

Now TI 2N559 diffused-base germanium transistors give you ultra-high frequency/high temperature operation. Precision manufacture makes possible . . . switching times of 275 millimicroseconds and lower in saturating circuitry . . . minimum of 150 mW at 25°C . . . operation to 100°C . . . meets or exceeds MIL-T-19500A specifications. All units stabilized at well over rated temperatures for utmost reliability.

CHARACTERISTICS‡	Conditions	Sym	Min	Max	Units
Emitter Breakdown Voltage	$I_E = -100\ \mu$Adc, $I_C = 0$	BV_{EBO}	−3.5	—	Vdc
Collector Breakdown Voltage	$I_C = -100\ \mu$Adc, $I_E = 0$	BV_{CBO}	−15.0	—	Vdc
Static Forward—Current Transfer Ratio	$I_C = -10$ mAdc, $V_{CE} = -0.3$ Vdc	h_{FE}	25	—	—
Base Voltage	$I_C = -10$ mAdc, $I_B = -0.4$ mAdc	V_{BE}	0.34	0.44	Vdc
Collector Cut-Off Current	$V_{CB} = -4.5$ Vdc, T ambient = 65°C	I_{CBO}	—	−50	μAdc
Delay and Rise Time	$V_{BE}(0) = -0.5$ Vdc, $I_B(1) = -1.0$ mAdc, $V_{CC} = -3.5$ Vdc, $R_L = 300$ ohms	(t_d+t_r)	—	75	mμsec
Storage Time	$I_B(1)$ −1mAdc, $I_B(2) = -0.25$ mAdc, $V_{CC} = -3.5$ Vdc, $R_L = 300$ ohms	t_s	—	100	mμsec
Fall Time	$I_B(1) = -1$ mAdc, $I_B(2) = -0.25$ mAdc, $V_{CC} = -3.5$ Vdc, $R_L = 300$ ohms	t_f	—	100	mμsec

MAXIMUM RATINGS

V_{CB}*	V_{EB}*	V_{CE}*	T_{STG}	I_E	I_C	T_j†
Vdc	Vdc	Vdc	°C	mAdc	mAdc	°C
−15	−3.5	−15	−65 to +100	50	−50	100

* These voltages may be exceeded (without permanently impairing the transistor) provided the current is limited to 100 μa.

† Derate at 0.5°C/mw. This is equivalent to a maximum power rating of 150 mw at 25°C ambient.

‡ This specification covers the detail requirements for a transistor having the following characteristics at a case temperature of 25±3°C, unless otherwise specified.

WORLD'S LARGEST SEMICONDUCTOR PLANT

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

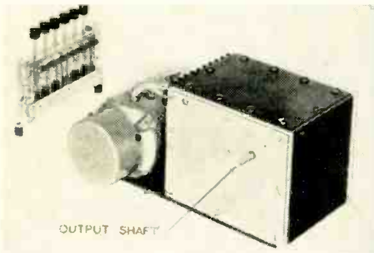
strong, and corrosion-proof. They are ideal for use in the chemical and allied industries where corrosion is a problem. Housings can be any color desired with color an integral part of the housing itself. Circle 220 on Reader Service Card.

Simulation Table single-axis

GENISCO, INC., 2233 Federal Ave., Los Angeles 64, Calif., has available the highly versatile and accurate A916 single-axis flight simulation table for testing airborne components under simulated pitch, yaw and roll maneuvers. It may be used with an analog computer, function generator, tape recorder, and digital-to-analog converter to evaluate autopilot systems and to determine the dynamic characteristics of high performance gyros and accelerometers. Circle 221 on Reader Service Card.

D-C Power Supplies intermediate range

UNIVERSAL ELECTRONICS CO., 1720 Twenty-Second St., Santa Monica, Calif., announces a new line of intermediate range transistorized regulated d-c power supplies, designated as the Q series. They provide output voltages ranging from 5-8 v to from 26-30 v, at currents of 1, 2, 4, 6, 10, 15 and 25 amperes. Regulation of 0.05 v, 0 to full load and 0.05 v per 10-percent line change is provided. Circle 222 on Reader Service Card.



Transmission Unit
multipurpose

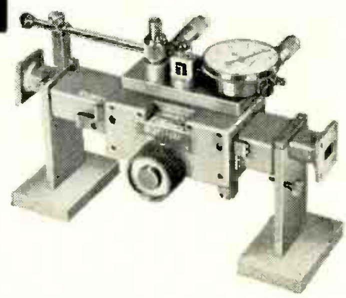
HATHAWAY DIVISION, The Hamilton Watch Co., 5800 E. Jewell Ave., Denver 22, Col. A new multipurpose, Class 3 commercial type transmission unit is announced. The $6\frac{1}{2}$-lb package containing five gear sections, is designed for speed, variability and smooth operation. Instantaneous speed changing requires no gear change. Circle 223 on Reader Service Card.

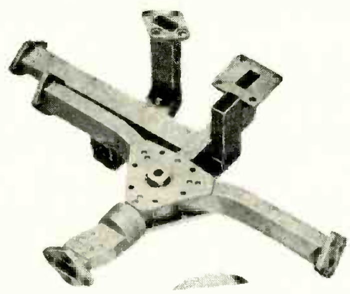
Gyro Drift Recorder
highly accurate

METROLOG CORP., 169 N. Halstead St., Pasadena, Calif., announces a sensitive instrument with better than 1 percent accuracy for measuring and recording drift and random disturbances of gyroscopes, platforms and similar devices. A unique pen makes it impossible for trace to go off-scale, and it will operate unattended for extended periods. It ignores periodic vibration and cyclic inputs which recur at rates in excess of 1 cpm regardless of amplitude of these inputs. It provides a permanent, accurate record which may be attached to the device under test. It has a chart width of 2 in. and a speed of 12 in. per hr. Circle 224 on Reader Service Card.

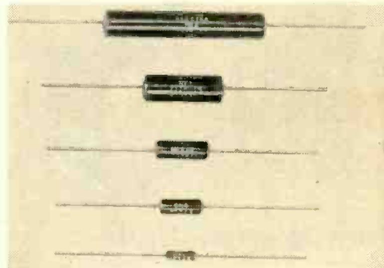
Transformers
voltage stabilizing

CHICAGO STANDARD TRANSFORMER CORP., 3501 Addison St., Chicago, Ill., has available transformers for use with any type of equipment



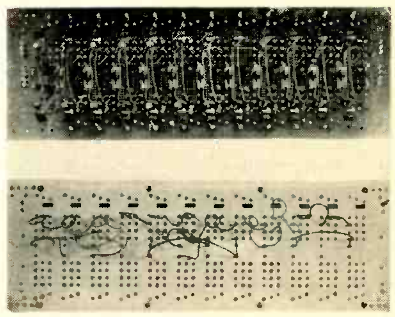


that requires continuous, automatic voltage regulation. They can be built into the equipment, or can operate as a separate device. Circle 225 on Reader Service Card.



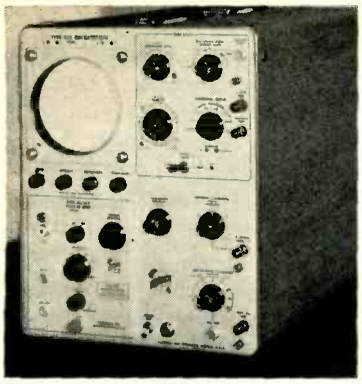
Metal Film Resistor small, low in cost

ELECTRA MFG. CO., 4051 Broadway, Kansas City, Mo., announces a new molded precision metal film resistor featuring low controlled temperature coefficient, low noise level and high stability under severe humidity conditions. It is claimed to equal or surpass a precision wire wound resistor, yet is smaller, lower in cost, also gives better r-f performance, plus uniformity in size over wide resistance ranges. Circle 226 on Reader Service Card.



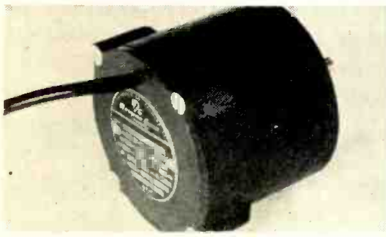
Logic Unit Board versatile array

GENERAL MILLS, INC., 1620 Central Ave., Minneapolis 13, Minn. This logic unit board is a transistorized digital component from which computers and data handling systems can be assembled simply and at low cost. It is a highly versatile array of basic computer elements which can be rapidly connected to serve complete logic and control functions of complex digital computers. Circle 227 on Reader Service Card.



Oscilloscope
d-c to 30 mc

TEKTRONIX, INC., P. O. Box 831, Portland 7, Ore. Type 543 is a fast rise oscilloscope with the plug-in feature. Nine plug-in preamplifiers are available for signal-handling versatility. Sweep range is 0.02 μsec/cm to 15 sec/cm, accelerating potential is 10 kv, built-in voltage calibrator has 18 outputs from 0.2 mv to 100 v peak-to-peak. **Circle 228 on Reader Service Card.**



A-C Motor
miniature device

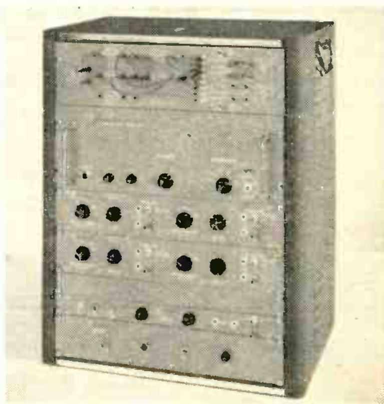
WESTERN GEAR CORP., P. O. Box 182, Lynwood, Calif., announces a new 200 v, 400 cycle, miniature 3 phase a-c motor, model 35YH37. It develops 1/20 hp at 6,500 rpm. Unit was originally designed as a fan motor to circulate air in an aircraft deep freeze compartment. It develops 1/20 hp at 6,500 rpm. 2½ in. in diameter and 2½ in. in length. **Circle 229 on Reader Service Card.**

Test Oscillator
for 3,950-11,000 mc

FXR, INC., 26-12 Borough Place, Woodside 77, N. Y. The C772A and X772A test oscillators provide self-contained, versatile power sources for the 3,950-11,000 mc frequency range. Maximum output of 10-100 mw provides considerably more power than signal generators operating in the same frequency range. Features include an integral power supply and modulator, single knob direct-reading frequency control, automatic reflector voltage tracking and an r-f attenuator. Internal pulse, square wave, and provision for external pulse or frequency modulation are available. **Circle 230 on Reader Service Card.**

Laminated Tape Head for four-track use

THE NORTRONICS CO., INC., 1015 S. Sixth St., Minneapolis 4, Minn., announces the new model TLD-L laminated stereophonic in-line record/playback magnetic tape head. The laminated pole-piece construction reduces core losses, and, as a result, model TLD-L will record and reproduce frequencies between 30 and 15,000 cps at a tape speed of 3¾ ips. The gap thickness is less than 100-millionths of an in. and its depth is unusually large to promote long life. Track width of each section is 0.043 in. Center-to-center spacing between sections is 0.136 in. **Circle 231 on Reader Service Card.**



Pulse Generator module construction

RUTHERFORD ELECTRONICS CO., 8944 Lindblade St., Culver City, Calif. Model B3-2A is a high repetition rate multiple pulse generator. Unit consists of a generator providing repetition rates from 10 cps to 1 mc, 4 variable delay circuits with delay from 0 to 10,000 μsec for

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controlling pulse position or pulse width, and 2 pulse forming units producing pulses of positive or negative polarity with rise and fall times of 0.02 μsec and amplitude of 25 v. Circle 232 on Reader Service Card.

Snap-Action Switch with mounting ears

GENERAL CONTROLS AUTOMATION DIVISION, 8070D McCormick Blvd., Skokie, Ill. Convenient rigid mounting back of panel or other surface in fixed relation to actuating mechanisms is provided by integrally molded ears on basic Klikswitches. Side mounting holes also permit use of the mounting ears for attaching various forms of actuating mechanisms. The snap-action switch mechanism is encased in molded phenolic. Switches are available with spdt or spst normally closed contacts rated 8 amperes at 115 v a-c, non-inductive load. Circle 233 on Reader Service Card.

Servo Pots high precision

CIRCUIT INSTRUMENTS INC., 2801 Anvil St., North, St. Petersburg 33, Fla. A new series of servo-potentiometers combine high precision and electrical characteristics in various combinations of materials. Featuring low torque operation, linear or nonlinear windings and multiple taps, the line is available with diameters of $\frac{7}{8}$ in., $1\frac{1}{16}$ in., $1\frac{7}{16}$ in., $1\frac{3}{4}$ in., 2 in. and 3 in. and ganged to requirement. Standard units employ all precision machined parts and precision ball bearings resulting in high mechanical accuracy, and are supplied with turret terminals which are gold plated for ease of soldering. Circle 234 on Reader Service Card.

Distortion Meter covers a-f spectrum

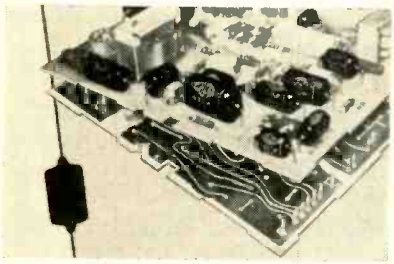
Barker & Williamson, Inc., Bristol, Pa. For accurate measurements of residual noise and harmonic content in the audio frequency ranges, as in FCC proof-of-performance tests, a reliable distortion meter is invaluable. A new distortion meter now available requires only 0.3 v for noise and distortion measurements, and measures fundamentals from 30 to 15,000 cps and harmonics to 45,000 cps. For measurements of low level audio voltages in determining noise and harmonic content, full scale readings of 0.3, 0.1, 0.03, 0.01, 0.003 v are provided. Circle 235 on Reader Service Card.

Silicon Rectifiers self-protecting

Trans-Sil Corp., 55 Honeck St., Englewood, N. J. The new diffused technique for producing silicon rectifiers makes it possible to protect such units against short circuits, surge currents and sustained overloads, through the use of low-cost standard, commercial fuses. Rectifier stacks are available in half-wave or full-wave configurations from 1.0 ampere to several thousand, with peak inverse ratings in 50 v multiples to thousands of volts. Circle 236 on Reader Service Card.

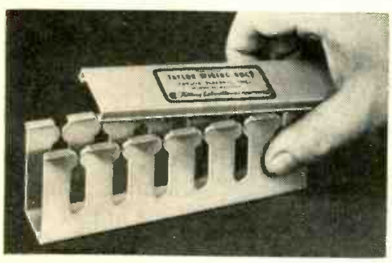
Controller and contact meter

Waters Mfg., Inc., Wayland, Mass. C-Trol, a new contact-meter-controller, continuously controls or limits any electrical variable. The self-contained, transistorized unit uses no locking coils or magnetic contacts. Reset is automatic. Modular design permits separation of control unit and contact meter. Circle 237 on Reader Service Card.



Molded Capacitors
bifilar winding

Rhombic Associates, 60 West 45th St., New York, N. Y., has available Wima Tropidur molded capacitors. Their particular advantages are maximum safety with a minimum of size and negligible damping because of the bifilar winding. Also, they have a perfect seal between element and terminal wires due to an exclusive hot-dip fusing process. Circle 238 on Reader Service Card.



Wiring Duct
rigid vinyl

Taylor Electric, 15400 Dale, Detroit 23, Mich. A new wiring duct features slots instead of holes to speed installation of large lugged wires on control panels, switch gear and electronic consoles. Type 0 duct eliminates harness lacing or lug attachment after assembly. It holds all wires in place with snap-on cover. The duct is extruded from high impact rigid vinyl plastic, which is oil and acid resistant and self-extinguishing. Circle 239 on Reader Service Card.

Literature of

MATERIALS

Magnetic Shielding. Magnetic Shield Division, Perfection Mica Co., 1322 No. Elston Ave., Chicago 22, Ill. Newly issued 31-page manual No. 101-122 is a comprehensive summation describing design and fabricating techniques for non-shock sensitive, non-retentive Netic and Co-Netic magnetic shielding. **Circle 255 on Reader Service Card.**

Acetate Tapes. Minnesota Mining and Mfg. Co., 900 Bush St., St. Paul 6, Minn. A four-page booklet lists physical and electrical properties of Scotch brand acetate tapes, as well as the military specifications met by the tapes. **Circle 256 on Reader Service Card.**

COMPONENTS

Servo Amplifiers. Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y. Bulletin S-893 describes the new line of miniaturized transistor-magnetic servo amplifiers with power ratings to 16 w. **Circle 257 on Reader Service Card.**

Low Level D-C Measurements. Microdyne, 300 W. Washington, Chicago 6, Ill. Low d-c potentials in the microvolt ranges can now be read easily by means of a new precision chopper inverter described in a recent 9-page brochure. **Circle 258 on Reader Service Card.**

Solder Terminals. Alpine Electronic Components, Inc., Waterbury, Conn. Catalog 158, section 1, contains information on a line of solder terminals, and introduces three new terminals specifically designed for molding into plastic headers for use with printed circuits or with miniature tube sockets. **Circle 259 on Reader Service Card.**

Servo Motors. Ketay Department, Norden Division, United Aircraft Corp., Commack, Long Island, N. Y. A recent bulletin contains applications data for stand-

the Week

ard and custom servo motors, including schematics of units operating direct plate to plate, with transistorized amplifiers and with magnetic amplifiers. Circle 260 on Reader Service Card.

EQUIPMENT

Synchro and Resolver Testing. Theta Instrument Corp., 48 Pine St., East Paterson, N. J. A bound catalog describes in detail the theory and method of resolver testing. It attempts to remove the mystery of these complex tests through complete coverage of both the measurements and the test equipment. Circle 261 on Reader Service Card.

Radio Interference Meters. Stoddart Aircraft Radio Co., Inc., 6644 Santa Monica Blvd., Hollywood 38, Calif. Five new 4-page bulletins give specifications, military approval data and applications of radio interference and field intensity measuring equipments covering a frequency range of 30 cps to 1,000 mc. Circle 262 on Reader Service Card.

Recorder Controller Assembly. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa. Complete information about the model S Speedomax G multiple-point recorder controller assembly for two-position control on many processes involving multi-zone control is found in data sheet ND46-33(6). Circle 263 on Reader Service Card.

FACILITIES

Plug/Harness Systems. Cannon Electric Co., 3208 Humboldt St., Los Angeles 31, Calif. A description of the company's plug/harness systems facilities is contained in the illustrated catalog HC-1. The systems described are used in missile circuitry and other applications where more than usual ruggedness and reliability are required. Circle 264 on Reader Service Card.

CEC Opens New Plant

CONTROL ELECTRONICS CO., INC., recently moved into its new plant in Huntington Station, N. Y. This building, embodying the latest in production and engineering facilities, comprises 11,000 sq ft of space.

Company manufactures precision delay lines and test equipment, such as phase angle meters, vhf/uhf frequency calibrators and radar range calibrators. Its engineering department, in addition to developing the company's products, does research and development for the government on complex electronic and electromechanical devices.

In keeping with its growth pattern set over the past few years, CEC has added more engineers and supporting personnel. It expects to be in full production shortly on new product lines consisting of band pass filters, precision frequency standards, and magnetostrictive delay lines.

According to Gene Wendolkowski, vice president, the new plant is laid out for efficient and rapid servicing of customers' needs. The plant layout allots 5,500 sq ft for production and assembly, 4,000 sq ft for engineering, and 1,500 sq ft for administrative functions. The engineering laboratories are equipped with the latest, highly accurate, electronic measuring equipment and standards. Additional R&D facilities include a separate r-f screen room and environmental chambers for temperature and life tests.

ASCOP Names Technical V-P

NEWLY appointed technical vice-president of the Applied Science Corp. of Princeton is Erwin Donath.

In his new post he will report directly to ASCOP president Thomas C. Roberts and will participate in all top management actions. He will supervise the operation of the Instrumentation Division, the company's largest operating unit which develops and produces airborne and ground based telemetering equipment. In addition, he will be directly responsible for the full scope of the company's technical operations, from advanced research and development through final product design and marketing.

Donath joined the company in 1948 as senior engineer and became chief engineer in 1953. For the last two years he has been responsible for the direction of the company's long-range R&D programs, and the company's entry into commercial markets with new industrial telemetering and supervisory control equipment.

Philco Appoints Four Managers

KEY APPOINTMENTS to handle Philco Corporation's increasing activities in the semiconductor field were recently announced by William H. Forster, director of research for the Solid State Electronics Research Department.

Charles H. Sutcliffe has been named manager of component development; James B. Angell, manager of circuit research; Marvin E. Lasser, manager of applied physics research; and Edmundo Gonzalez-Correa as manager of research planning.

TMC Chooses Chief Engineer

TECHNICAL MEASUREMENT CORP., North Haven, Conn., manufacturer of nuclear radiation measurement equipment, appoints Donald S. Davidson as chief engineer.

Prior to joining TMC, Davidson was associated with Knolls Atomic Laboratory in Schenectady, N. Y. He is known for his work in the field of transistorized instrumentation, particularly multichannel pulse analysis systems, reactor con-

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for computer applications

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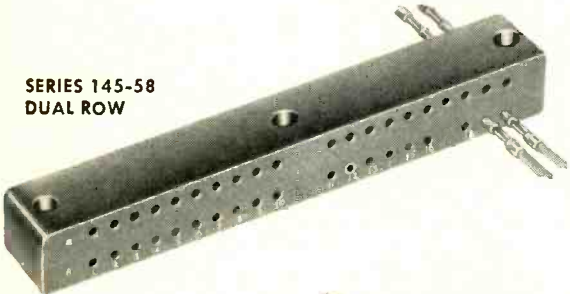

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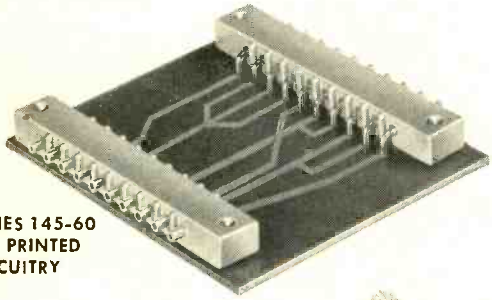
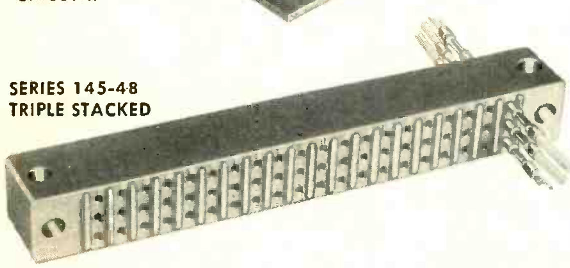
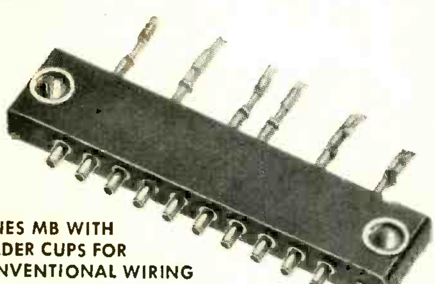


SERIES 145-60
FOR PRINTED
CIRCUITRY

SERIES 145-48
TRIPLE STACKED





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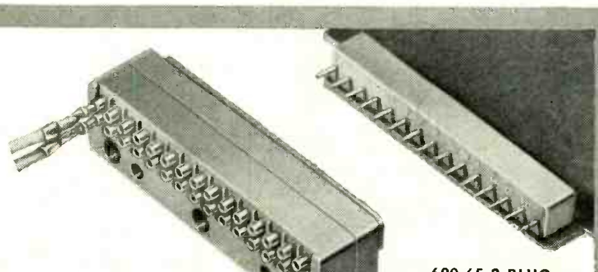
Continental Connector can supply all types of taper pin blocks and connectors for conventional wiring and printed circuitry in any combination of feed-through shorting or non-shorting terminals. Our engineering department is prepared to cooperate in solving your connector application problems. Write today for technical information.



DUAL TERMINAL SOCKET 600-65-1

600-65-2 PLUG DIP SOLDERED TO PC BOARD . . . MATES WITH 600-65-1 SOCKET

DUAL TERMINAL CONNECTOR FOR SOLDERLESS WIRING 15 contact . . . series 600-65

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trol and safety instruments.

In addition to other duties at Technical Measurement Corp., Davidson will be responsible for the completion of a new line of transistorized instruments.

California Gets New Company

FORMATION of Continental Device Corp. in Hawthorne, Calif., was recently announced by Joseph S. O'Flaherty who will serve as the new company's president. O'Flaherty was formerly manager of the Semiconductor Division of Hughes Aircraft Co.

Continental Device Corp. will specialize in the research, development, and production of semiconductor devices.

Oldfield Joins Raytheon

HOMER R. OLDFIELD, JR. has been appointed assistant manager of the

Government Equipment Division for Raytheon Mfg. Co., Waltham, Mass.

A member of the General Electric firm for the past 13 years, Oldfield has resigned his position as general manager of the firm's computer department at Phoenix, Ariz., which he had held since 1955.

Sprague Advances James LeGette

APPOINTMENT of James LeGette as manager of the Interference Control Laboratory located in Los Angeles, Calif., is announced by Fred Scarborough, manager of the Sprague Electric Company's Interference Control Field Service Department. He moves up from the post of assistant manager.

LeGette was previously with Chance-Vought Aircraft, having worked on such projects as the F8U Fighter and the Regulus missile.

News of Reps

Donner Scientific Co., San Francisco Bay Area manufacturer of analog computers, linear servo accelerometers, and electronic test instruments, has named **Hawthorne Electronics** as engineering sales rep for Oregon, Washington and Idaho.

Four new reps were recently appointed by Scientific-Atlanta, Inc., Atlanta, Ga.

George G. Gostenhofer & Associates with offices in Waltham, Mass., will cover the New England states; **D. B. Associates** with offices in Syracuse and Buffalo, N. Y., will handle upstate New York; and the **Gawler-Knoop Company** with offices in Roseland, N. J., Wyncote, Pa., and Silver Spring, Md., will cover the rest of the territory formerly covered by the H. L. Hoffman Company. **Phillips Electronics Industries, Ltd.**, of Toronto, Canada, will cover the Canadian territory which has been handled on a direct basis until this time.

COMMENT

Kudo

We are quite favorably impressed with the editorial job done on our manuscript ("Tracking Man-Made Moons," p 33, Jan. 2). The meat of the article has been retained while the overall length is much reduced.

C. H. LOONEY
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D. C.

Terminology

As part of our continuing process of keeping the terms in our Buyers' Guide directory issue up to date, we recently asked several score manufacturers what they thought about the proper way to classify various electronic products. One of our friends in Syracuse, N. Y., sent us this answer to our questions on printed circuits:

. . . In regard to terminology for printed circuits, the present situation is a highly confused one and general agreement is completely lacking.

Historically, the use of the term *printed circuits* started with the makers of resistor-capacitor circuit assemblies based on a barium titanate high-K baseplate and encapsulated in a phenolic cover coat. Some years later the makers of etched and plated wiring boards appropriated the term to describe their products.

This is obviously a technical misuse of the term, since you can't have a circuit unless some circuit elements—such as resistors, capacitors or inductors—are included. Such products should be called *printed wiring boards*, with a descriptive adjective such as *etched*, *plated*, *stamped*, etc., to describe the process.

Since the term *printed circuits* has become so misused, the makers of true printed circuits have inclined to the use of *printed electronic components*, *printed packaged assemblies*, etc., to get away from the confusion with printed wiring boards. Obviously the Institute of Radio Engineers should have straightened out the mess a long time ago, but to date has shown no interest in the matter. Neither has the Electronic Industries Association, who have indeed added to the confusion by setting up a "Printed Circuits" Committee which covers both printed wiring boards and printed electronic assemblies.

My best wishes to you in your attempt to clarify the mess.

C. A. PRIEST
ELECTRONICS DIVISION
ONONDAGA POTTERY CO.
SYRACUSE, N. Y.

Reader Priest's firm, incidentally, calls its printed circuits printed electronic assemblies.

Department of Science?

It seems to me that the publications serving the various technologies should take a definite stand for the creation of a cabinet Department of Science. But strangely enough, I have never seen such a stand taken.

When you consider all the wasted effort that goes into duplicated research and pursuits down blind alleys, it becomes plain that a coordinating body is needed. Who could fulfill this function better than the federal government? Further, the expense of many research programs today cannot be sustained by private industry.

I can't understand the objections that prevent the establishment of such a department. The measure goes before Congress periodically, but is always shelved.

E. R. HINCHMAN
WORCESTER, MASS.

We're not so sure that a cabinet department is needed, unless reader Hinchman means a department that would aid the flow of information among the sciences and create a favorable atmosphere for the growth of scientific understanding. The Department proposed in S. 3126, the Science & Technology Act that was shelved in the last session, was much more than that, and the Senate was naturally leery of it.

If industry can't carry its own water, the nation is in pretty bad shape. We feel that it can.

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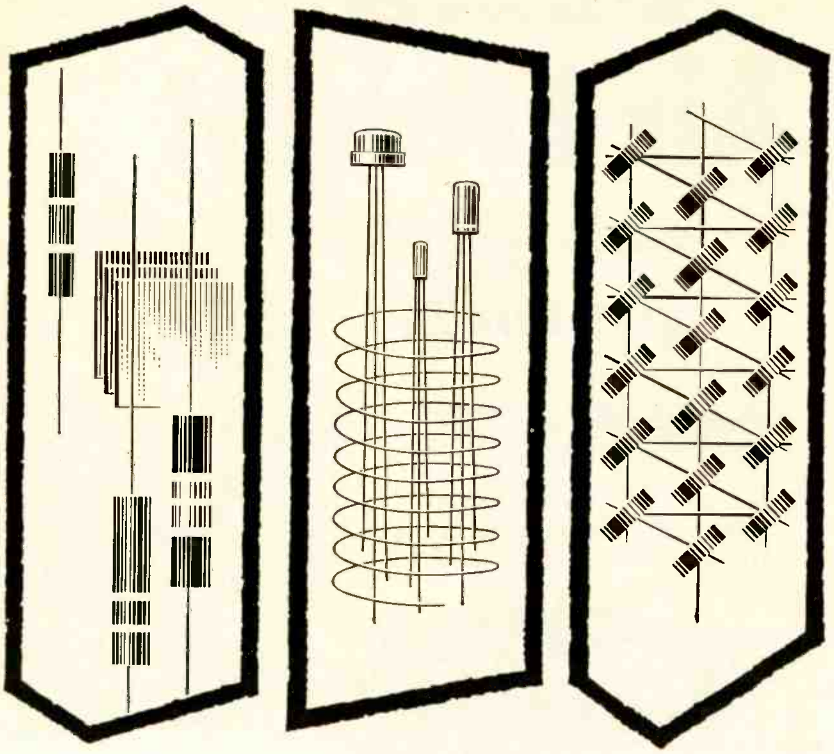

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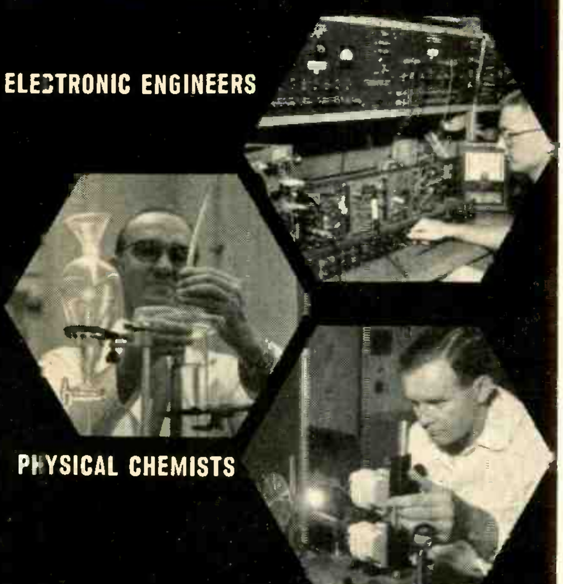
ON SEMICONDUCTOR FRONTIERS

YOU can help 'beat the heat' at 200°C

ELECTRONIC ENGINEERS



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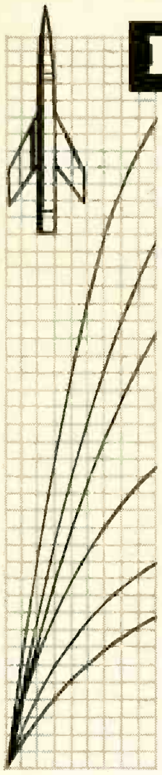

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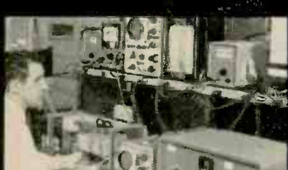
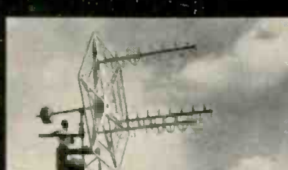


Measuring phase stability vs. temperature during prototype equipment development



Developmental helical antenna, part of sophisticated new direction-finder system

Pattern measurements—vital to development of microwave dish antennas

60′ parabolic receiving antenna for missile telemetry and tracking

INDEX TO ADVERTISERS

■

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

ADVERTISERS INDEX

* See advertisement in the June, 1958 Mid-Month ELECTRONICS BUYERS' GUIDE for complete line of products or services.

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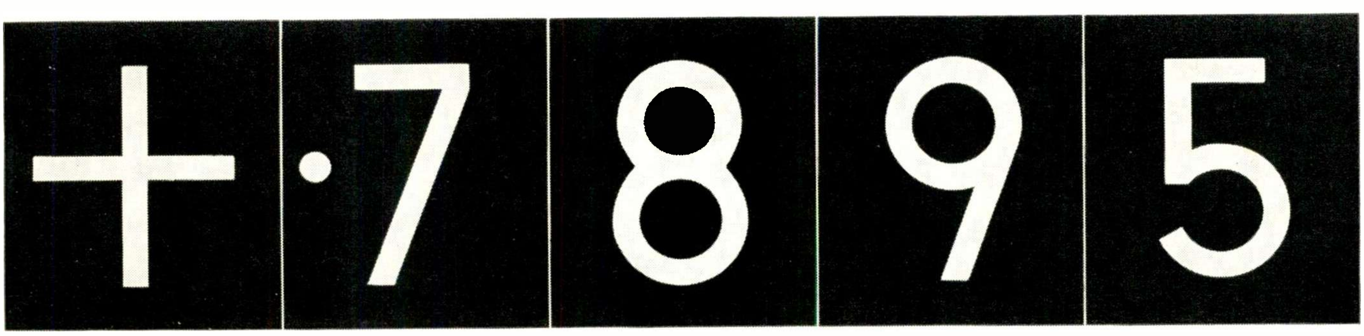
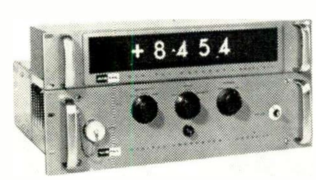
5. DESIDERATE SPECIFICATIONS (MODEL 401B DC DIGITAL VOLTMETER): *Display*...4 digit with automatic polarity indication and decimal placement. Total display area 2″ high x 7½″ long, internally illuminated. Each digit 1⅛″ high. *Automatic Ranges*... .0001 to 999.9 volts covered in 4 automatic ranges. Sensitivity control provides gain ÷10 setting and least digit sensitivities of .1, 1, and 10 mv. *Accuracy*... 0.01% ±1 digit. *Counting Rate*...20 counts per sec., providing average balance (reading) time of 1 sec. *Reference Voltage*...Chopper-stabilized supply, referenced to an unsaturated mercury-cadmium standard cell. *Input Impedance*...10 megohms, on all ranges. *Output*...Visual display, plus print control. Automatic print impulse when the meter assumes balance. No accessories required to drive parallel input printers. *Input*...115 volt, 60 cycle, single phase, approx. 75VA. *Dimensions*...Control unit, 5¼″ high x 19″ wide x 18″ deep. Readout display, 3½″ high x 19″ wide x 9″ deep. *Weight*...Approx. 40 lb. *Price*...$2,450.



Model 402B AC/DC 4-digit



Model 401B DC 4-digit

Model 501 DC 5-digit

6. WIDE RANGE OF MODELS—ACCESSORIES—SPECIAL SYSTEMS: Versatile "digital building blocks" permit measurement of AC, ohms, ratios of AC and DC, automatic scanning of multiple inputs...4- or 5-digit models. Preamplifiers increase digital voltmeter sensitivity to 1 microvolt DC, 10 microvolts AC. Buffers permit driving typewriters, tape punches and printers. KIN TEL's Special Products Department can design and manufacture digital instruments to meet special requirements...complete digital systems for data logging, missile checkout and automatic production line testing.

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