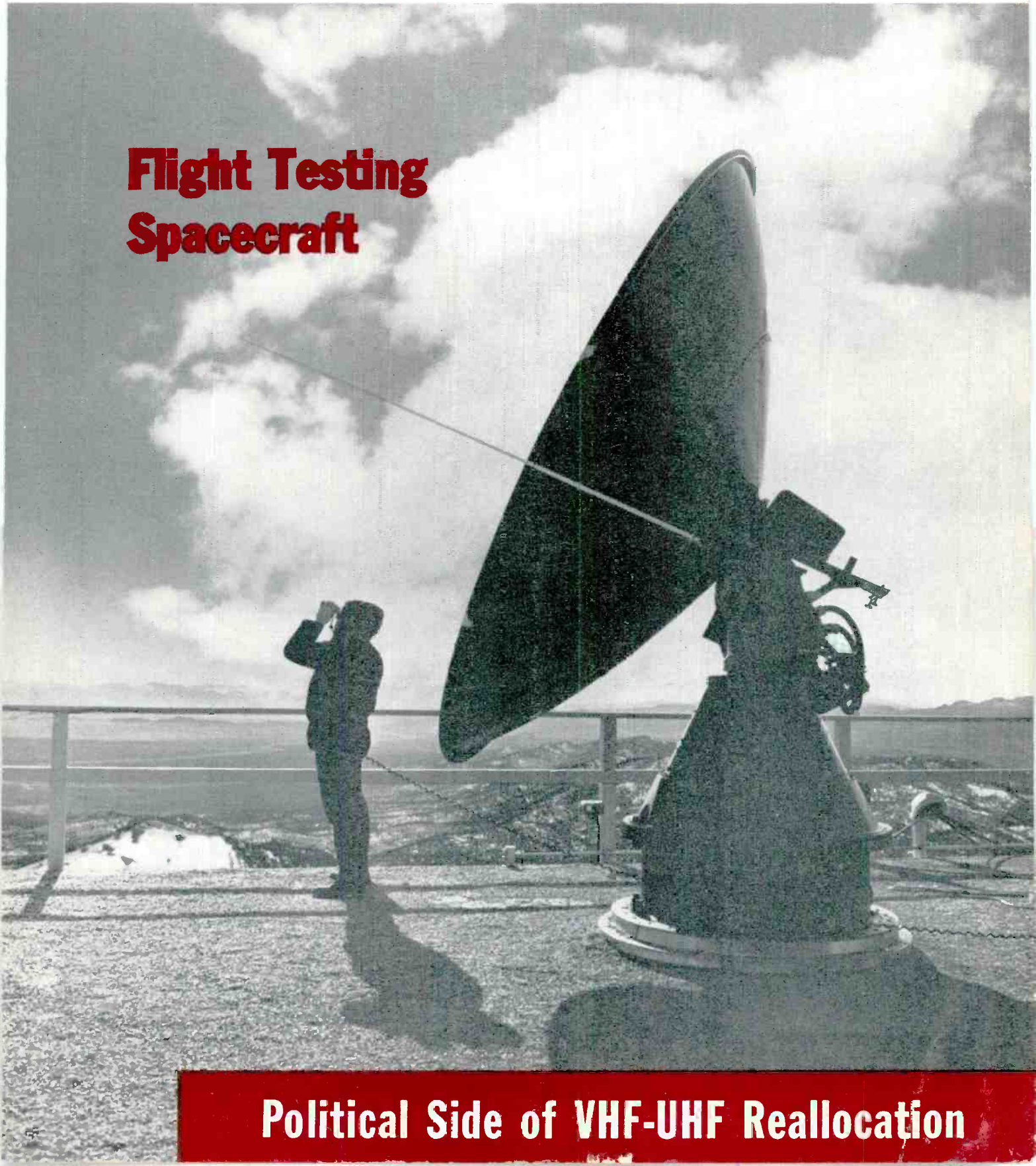
MARCH 27, 1959

electronics

A McGRAW-HILL PUBLICATION VOL. 32, No. 13 PRICE SEVENTY-FIVE CENTS

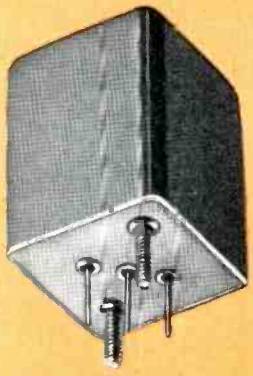


Flight Testing Spacecraft

Political Side of VHF-UHF Reallocation

NEW
MINIATURIZED UNITS
FROM STOCK...

UTC has led the high Q coil and filter fields for over 25 years. Fresh examples of this leadership are represented in the UTC Minifilters and Miniductors described below. Though greatly miniaturized, the designs are conservative and will provide the exceptional reliability associated with all UTC products.



HPM and LPM case (MIL AG)
1 x 1 x 1⅜"
Weight .....2¼ oz.

BPM case (MIL AF)
¾ x ¾ x 1⅛".
Weight .....1 oz.

UTC MINIFILTERS

Hermetically sealed to MIL-T-27A and MIL-F-18327 Specs.

UTC stock interstage filters have been an industry standard for over a decade. The new UTC miniature filters provide almost the same characteristics in an extremely miniaturized package. Attenuation of these minifilters is only slightly less than their larger counterparts, as is operating level. Special minifilters can be supplied for any frequency above the minimum shown for each group. Straight pin terminals are provided for printed or standard circuits.

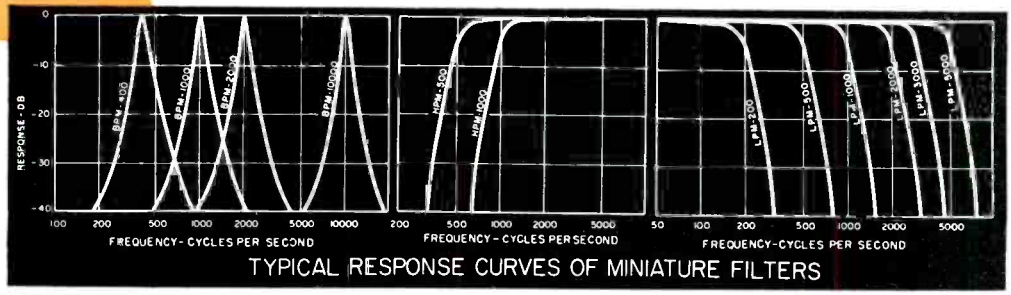
BPM units (band pass) have 2:1 gain. Attenuation is approximately 2 db ± 3% from center frequency, and 35 db per octave as shown. Input 10,000 ohms, output to grid, tapped for 10,000 ohms output to provide flexibility in transistor circuits.

HPM units (high pass) have a loss of less than 6 db at cutoff frequency, and an attenuation of 30 db at .67 cutoff frequency. Input and output 10,000 ohms.

LPM units (low pass) have a loss of less than 6 db at cutoff frequency, and an attenuation of 30 db at 1.5 cutoff frequency. Input and output 10,000 ohms.

STANDARD FILTERS STOCK FREQUENCIES

BPM—400	LPM—200
BPM—1000	LPM—500
BPM—2000	LPM—1000
BPM—10000	LPM—2000
HPM—500	LPM—3000
HPM—1000	LPM—5000

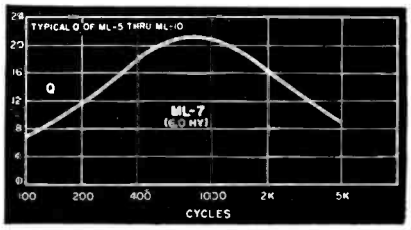


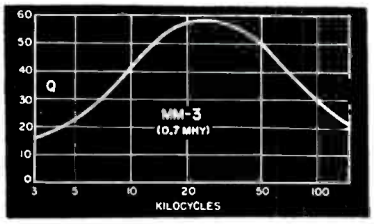
TYPICAL RESPONSE CURVES OF MINIATURE FILTERS

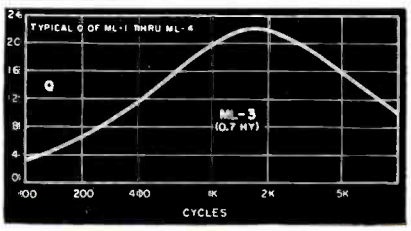
UTC MINIDUCTORS

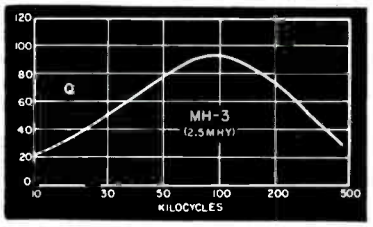
Hermetically sealed to MIL-T-27A Specs., MIL type TF5RX20YY

UTC Miniductors are ideal for transistor and printed circuit applications, providing high Q in miniature form. The ML-1 to 4 units are for medium low frequencies, adjusted to ± 3% at 1 V. 1 KC. The ML-5 thru 10 series are for lower frequencies, adjusted to ± 3% at 1 V. 400 cycles. The MM and MH units are for medium and high frequencies, adjusted to a tolerance of ± 2%. Temperature stability is excellent on all Miniductors, ± 1% from —55° C. to + 100° C. The ML group are in a Hipermalloy shield case . . . The MM and MH coils are symmetrical toroids . . . for high coupling attenuation and low hum pickup. The DCMA MAX. shown is for approximately 5% drop in inductance.









Type No.	Inductance (0 DC)	DC MA Max.
ML-1	.25 Hy.	9
ML-2	.4 Hy.	7
ML-3	.7 Hy.	5
ML-4	1.4 Hy.	3
ML-5	2.5 Hy.	1
ML-6	4.0 Hy.	.7
ML-7	6.0 Hy.	.6
ML-8	10 Hy.	.5
ML-9	25 Hy.	.3
ML-10	60 Hy.	.2
MM-1	3. Mhy.	50
MM-2	5. Mhy.	40
MM-3	8.0 Mhy.	30
MM-4	12.5 Mhy.	25
MH-1	.6 Mhy.	75
MH-2	1.5 Mhy.	37
MH-3	2.5 Mhy.	28
MH-4	6 Mhy.	23

ML CASE
1 3/32 x 1 3/32 x 9/16 high

MM, MH CASE
9/16 Dia. x ¼ high

ACTUAL SIZE

And Special Units to Your Specifications

UNITED TRANSFORMER CORPORATION
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electronics

MARCH 27, 1959

A McGRAW-HILL PUBLICATION
Vol. 32 No. 13

Issue at a Glance

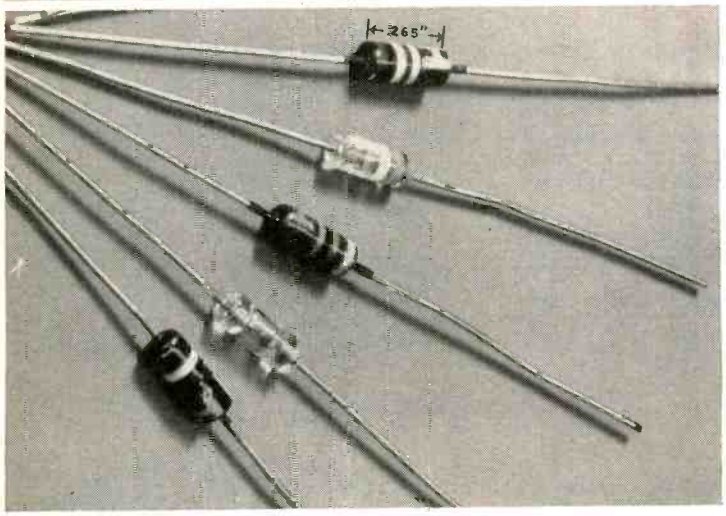
BUSINESS

ENGINEERING

DEPARTMENTS

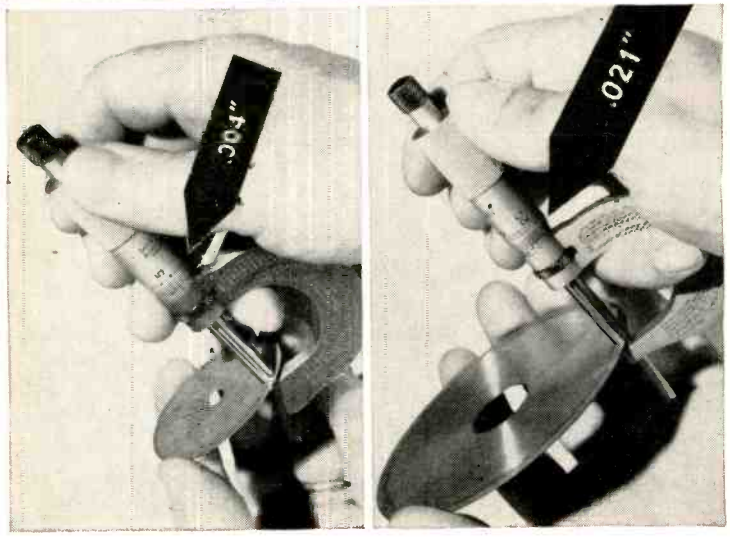
From a single ingot

At left, an ingot of pure silicon cemented to a ceramic block for slicing. At right, a sliced wafer before and after dicing into diode pellets about 1/32" square and .020" thick. Norton diamond wheels were used for both slicing and dicing.



. . . you can cut thousands of "dice" at lowest cost

Tiny silicon diodes, as shown, are used in modern electronic circuits where the operating heat is too high for germanium. Norton diamond wheels are ideal for use on either of these semiconductor materials.



. . . with "tailor-made" Norton diamond wheels

Of these two Norton diamond cut-off wheels, the one miking at .021" thickness has a diameter of 4" — measurements recommended for many slicing applications. The other, showing a thickness of .004", has a diameter of 2" — extra small dimensions that are vital to extra small dicing.

The extreme thinness and close tolerances to which Norton diamond cut-off wheels are held help you cut the loss of germanium, silicon and other costly materials.

Some of these wheels, in fact, are thinner than the cover of this magazine — but whatever their specifications, all of them cut fast, free and straight . . . and minimize chipping. And all are made with the dimensional uniformity that assures precision in gang-dicing.

Remember: Norton was first to introduce all three types of diamond wheels — resinoid, metal and vitrified bonded . . . leads in pioneering with man-made diamonds as well as mined diamonds . . . does its own checking and sizing of diamonds . . . certifies every diamond content . . . duplicates wheel specifications with consistent accuracy . . . brings you a complete line, covering every application.

For prompt service, see your Norton Abrasive Engineer or Distributor. Or write to NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and Distributors around the world.

W-1899

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ABRASIVES

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NORTON PRODUCTS Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals — BEHR-MANNING DIVISION Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

Burnell SUBMINIATURE FILTERS

AS SMALL AS 3/4" x 3/4" x 1 3/8"
AS LIGHT AS 1 1/4 OUNCES

"TOM THUMB" TELEMETERING FILTERS

CHAN. #	FREQ.	IMP. 100K P/N	B. W.	SIZE	WT.
1	400 cps.	S-60001	±7½%	¾ x 1½ x 2¼ H	4 oz.
2	560 cps.	S-60002	±7½%	¾ x 1½ x 2¼ H	4 oz.
3	730 cps.	S-60003	±7½%	¾ x 1½ x 2¼ H	4 oz.
4	960 cps.	S-60004	±7½%	¾ x 1½ x 2¼ H	4 oz.
5	1300 cps.	S-60005	±7½%	¾ x 1½ x 2¼ H	4 oz.
6	1700 cps.	S-60006	±7½%	¾ x 1½ x 2¼ H	4 oz.
7	2300 cps.	S-60007	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
8	3 KC	S-60008	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
9	3.9 KC	S-60009	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
10	5.4 KC	S-60010	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
11	7.35 KC	S-60011	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
12	10.5 KC	S-60012	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
13	14.5 KC	S-60013	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
14	22 KC	S-60014	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
15	30 KC	S-60015	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
16	40 KC	S-60016	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
17	52.5 KC	S-60017	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
18	70 KC	S-60018	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
A	22 KC	S-60019	±15%	¾ x ¾ x 1⅜ H	1¼ oz.
B	30 KC	S-60020	±15%	¾ x ¾ x 1⅜ H	1¼ oz.
C	40 KC	S-60021	±15%	¾ x ¾ x 1⅜ H	1¼ oz.
D	52.5 KC	S-60022	±15%	¾ x ¾ x 1⅜ H	1¼ oz.
E	70 KC	S-60023	±15%	¾ x ¾ x 1⅜ H	1¼ oz.

Designed and tested to specification #MIL-T 26985

Supplied in two principal case sizes:

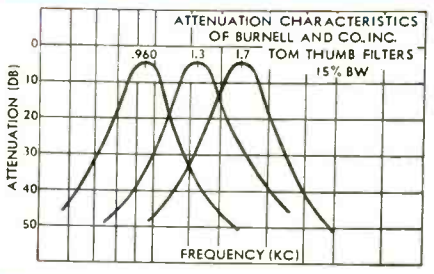
1. For RDB channels 1 through 6, case size is ¾ x 1½ x 2¼ inches high; weight: 4 ounces.
2. For channels 7 and up, case size is ¾ inches square and 1⅜ inches high; weight: 1¼ ounces.

These cases are generally equipped with a 4-pin plug to match the small Winchester socket.

ATTENUATION CHARACTERISTICS

Impedance: 100 K ohms in and out.
Insertion loss: less than 6 db.
At ± 7.5% band width is less than 3 db.
At ± 25% band width is greater than 15 db.
At 1.75 f attenuation is 40 db or more.
At .57 f attenuation is 40 db or more.

Also available in micro-miniature *MICROID*® types. Write for new literature.



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PELHAM 8-5000 • TELETYPE: PELHAM 3633

PACIFIC DIVISION: 720 MISSION STREET, SOUTH PASADENA, CALIFORNIA
RYAN 1-2841 • TELETYPE: PASACAL 7578

electronics

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SHOPTALK . . .

SPELLBINDERS. Last week in a restaurant in the heart of New York City's financial district, a crowd of securities analysts sat spellbound to hear talks by representatives of major electronics firms on what the future holds.

This is just one sign of the increased interest Wall Street is paying to our industry.

This year several firms will need money to grow on. Some will seek public financing for the first time. Happily, the investing public seems keenly interested in the growth potentials of well-managed electronics firms.

Associate Editor Emma has been speaking with security underwriters and officers of firms which have recently made stock offerings, to determine what qualifications the underwriters seek. To find out what it takes for a firm to raise money, see p 39.

YOUR FUTURE. Continuing growth both of our industry and this magazine has resulted in additional openings on our staff for engineering editors. Helping to write and edit ELECTRONICS magazine can be a deeply satisfying and rewarding experience. It can also be a man-killing job. It depends on what kind of a man you are.

Here's what it takes: A degree in electrical engineering with heavy concentration in electronics, a year or so of experience in our industry, a well-developed bump of curiosity about new circuits, components, systems and materials. If you fill this bill and are able to write, edit and report technical developments, Editor MacDonald would like to talk to you about your future on our staff—especially if you live within commuting distance of New York City.

Coming In Our April 3 Issue . . .

STEREO. Anyone who has ever heard high-quality stereo music soon finds himself wanting to hear more. This accounts for the current boom in stereo records and custom audio components . . . a boom which pushed up factory sales by more than $100 million last year.

Now the boom is spreading into the broadcast field. As reported in ELECTRONICS early this year (p 26, Jan. 30), the National Stereophonic Radio Committee was formed within the Electronic Industries Association with a view to establishing firm stereo standards for a-m, f-m and tv broadcasters in 1959. Some 125 stations have scheduled stereo broadcasts on a more-or-less regular basis.

Key to the final form of future stereo broadcast systems is the question of compatibility. It appears that solicitude for the monophonic listener, who receives half the content of broadcasts under the a-m/f-m stereo technique, is one of the prime factors in shaping the stereo standards.

Hence, to preserve compatibility, there have been offered a number of systems and techniques; some are just gimmicks—others soundly engineered and downright ingenious. Next week, ELECTRONICS brings you up to date on stereo broadcasting. Managing Editor Carroll has culled the major proposals and techniques put forth in this exciting and somewhat controversial area. His article tells you what you want to know—as listener and as engineer.

RADAR RELAY. A system capable of sending radar information over ordinary telephone lines must either sacrifice resolution or substitute time for bandwidth, according to H. W. Gates and A. G. Gatfield of ITT Labs in Fort Wayne, Ind.

They describe a system which uses the storage method of bandwidth compression for an air-traffic control system capable of transmitting radar data over narrow-band transmission lines using a scan-conversion storage tube.

TYPE 150D—Solid-Electrolyte Electrolytics for transistor circuitry. (Bulletin No. 3520B)

Prompt delivery on all SPRAGUE

TYPE 109D—Sintered-Anode Electrolytics for −55 C to +125 C operation. (Bulletin No. 3700)

TYPE 110D—Foil Type Electrolytics for −55 C to +85 C operation. (Bulletin No. 3601)

TANTALEX® CAPACITORS

TYPE 160D—Solid-Electrolyte Electrolytics for hearing aid applications. (Bulletin No. 3515)

TYPE 120D—Foil Type Electrolytics for −55 C to +125 C operation. (Bulletin No. 3602)

complete ratings

TYPE 200D—Porous Anode Electrolytics for high capacitance at low voltage. (Bulletin No. 3705)

With the increased availability of tantalum, Sprague can now offer its famous TANTALEX® Capacitor line on *large-quantity, short-delivery schedules* . . . covering complete ratings in all the types illustrated.

TANTALEX Capacitors are backed by thousands of test hours. They're characterized by extremely low leakage current and unusually high capacitance stability even at low temperatures. Sprague's many types cover a temperature range of from −55 C to +125 C; voltage ratings from ½ volt up to 150 volts.

WRITE FOR ENGINEERING BULLETINS on the Sprague TANTALEX Capacitors in which you're interested. Address your letter to Sprague Electric Co., Technical Literature Section, 35 Marshall St., North Adams, Mass.

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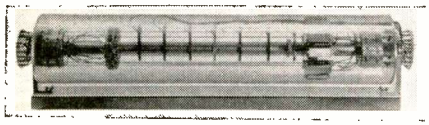
Nickelonic News

VOL. 1 — DEVELOPMENTS IN NICKEL AND NICKEL ALLOYS AND THEIR APPLICATIONS — No. 7

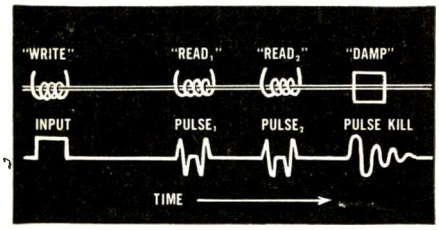


Magnetostriction of Nickel drives Deltime data storage unit. With these units some 15 million bits of data could be handled in a 3x7x7 foot space, engineers estimate.

Shock waves in Nickel "store" 1500 bits of information

MAMARONECK, N. Y.: Magnetostriction produces shock waves in Nickel that travel one foot in about 63 microseconds. Deltime, Inc. uses this property of Nickel to build electronic delay lines. Their latest is a data storage unit that packs eleven 300-microsecond delays in a small space. Ten lines "store" 150 bits of data each, the other "clocks."

Center rod of unit (shown with plastic cover to reveal detail) is structural. Nickel delay lines are concentrically located around rod. Diagram below shows schematic of a single line with associated pulses.



Delay lines are Inco Electronic-Grade "A"* Nickel, drawn fine and stranded to reduce eddy currents. Deltime engineers say Nickel combines large and efficient magnetostrictive response, minimum corrosion, excellent mechanical properties.

Pertinent Literature: Write for Inco Bulletin 127B: "Magnetostriction".

Circle (107, 108, 109) Reader's Service Card.

5 new Inconel-protected instruments retain accuracy at missile speeds, heats

. . . point the way to more reliable high temperature parts design

CHICAGO, ILL.: Streaking through the air on mile-a-second missile nose cones . . . fixed in hot, corrosive fluid streams . . . the five new instruments described below operate reliably at glowing temperatures. Aero Research standardizes on Inconel* nickel-chromium alloy for parts of these instruments that bear the brunt of this demanding service.

(1) Total temperature probe — withstands 1740° F generated by friction during flight on missile nose cones. (See photos below.) For maximum reliability, its Inconel sheathing also withstands oxidation and thermal shock.

(2) Wide-range thermocouple — measures temperatures from as low as — 320° up to + 1900° F in high-velocity fluids. Inconel sheathing effectively resists these severe erosive-corrosive conditions.

(3) High-accuracy, high-temperature probe—measures temperatures between 0° and 1800° F. Again, Inconel sheathing assures reliability, protecting its accuracy in supersonic jet exhausts, high-temperature furnaces.

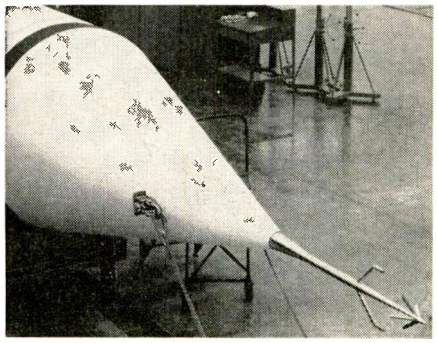
(4) Jet thrust measuring rake, water-cooled — operates in 3500° F jet afterburner gases. Inconel alloy construction provides essential high strength at high temperature, plus corrosion resistance.

(5) Sonic-speed, 4430° F, wind tunnel, water-cooled — Inconel alloy forms all major components, gives tunnel the backbone needed to stand up under terrific velocity and heat.

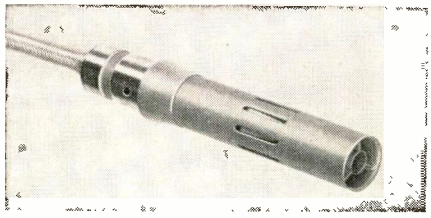
You, too, can give parts high temperature stamina with Inconel alloy. It retains useful strength through 2000° F, and can be easily welded and formed into intricate shapes.

Pertinent Literature: Write for Bulletin T-7: "Engineering Properties of Inconel and Inconel X", and "Inco Nickel Alloys for Electronic Uses".

Circle (107, 108, 109) Reader's Service Card.

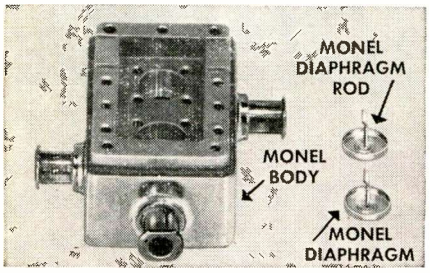


Inconel-sheathed total temperature probe mounted on Redstone missile nose cone — assures high strength at high temperatures and readily withstands oxidation, erosion and thermal shock at extreme velocities. Probe (shown at right) is product of Aero Research Instrument Company, Inc., Chicago, Illinois.



Sensitive transducer measures minute changes of pressure in human body

...Monel fluid chambers withstand corrosion, do not affect saline purity



Monel transducer body and diaphragms resist corrosive saline solutions for long, reliable service. Transducer is made by Sanborn Company, 175 Wyman St., Waltham, Mass.

WALTHAM, MASS.: This sensitive pressure transducer measures a wide range of physiological pressures — from 400 mm Hg down to less than 1 mm Hg.

Absolute and differential pressures travel from source (needle or catheter) through a saline-filled tube to actuate two small Monel* nickel-copper alloy diaphragms. Monel diaphragm rods pivot a tiny differential transformer core, producing a signal which is fed to amplifiers for quick reading.

Monel alloy was chosen for the parts above because it withstands corrosive attack from all common saline and sterilizing solutions. As a result, Monel alloy does not affect saline purity. In addition, Monel alloy is easy to form, machine, to braze, solder and weld.

Pertinent Literature: Write for Bulletin T-5; "Engineering Properties of Monel and R Monel".

Circle (107, 108, 109) Reader's Service Card.

*Trademark, The International Nickel Company, Inc.

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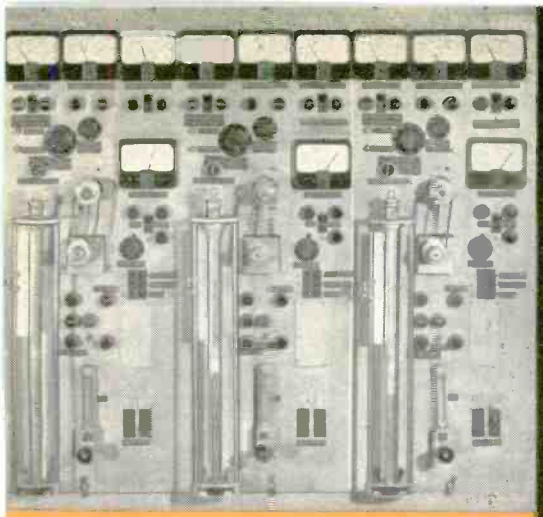
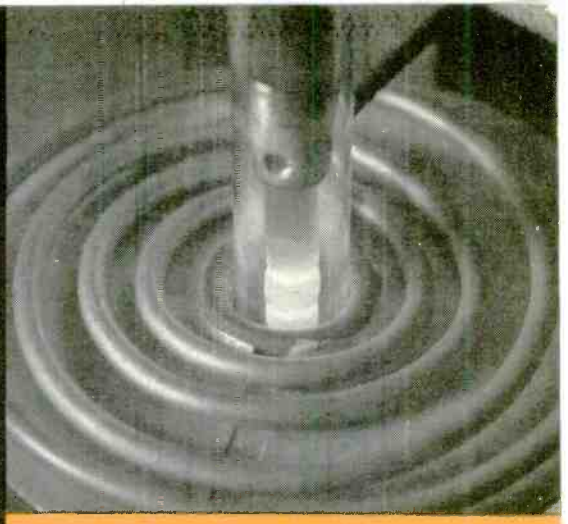


Trancoa's unique automated process assures product uniformity.

TRANCOA SILICON... *Key to increased yields!*



Multiple Zone Refining of every lot permits accurate boron content measurement.

Rigid cleanliness test requires three-sixteenths inch clearance between test crystal and crucible.

Three characterization crystals are grown from each lot — one for resistivity, type and lifetime determination; another for cleanliness; a third for boron content.

Higher quality silicon can improve your semiconductor device yields. *Trancoa* offers this higher quality at no increase in price!

Grade for grade, the superior quality of Trancoa Silicon is assured by our unique process and exacting specifications. In addition to the standard tests for resistivity, lifetime and base boron level — every lot of Trancoa Silicon must also meet two other important requirements:

Cleanliness — the vital factor directly affecting your crystal yield! Trancoa specifications require that a doped single crystal be drawn with only three-sixteenths of an inch clearance between crystal and crucible. Any fuming, dross, or wetting of the quartz is cause for internal rejection.

Resistivity Ratio — resistivity uniformity of doped crystals is improved perpendicular and parallel to the growing axis. Furthermore, the occurrence of P-N junctions is eliminated. Ratio of the resistivities at the 10% and 60% points on the test crystal may not exceed 3:1.

This combination of a new improved process plus added quality standards assures you of receiving better silicon, thus better yields, at no increase in cost.

PRODUCT SPECIFICATIONS

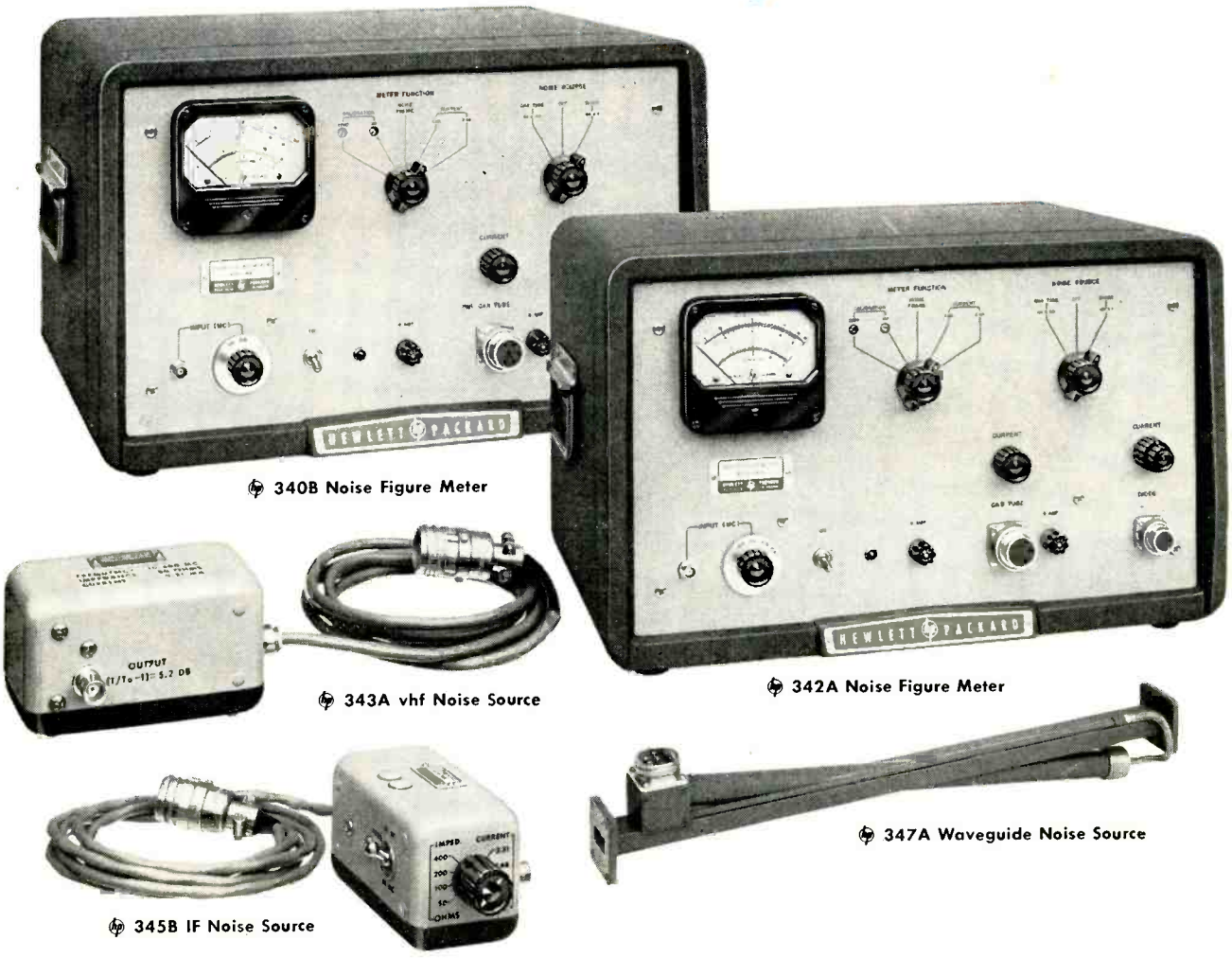
Grade	Resistivity P-Type	Resistivity N-Type	Max. Resistivity Ratio for 10% & 60% Points	Max. Boron Content (ppb)
IA	500	250	3:1	0.5
I	100	50	3:1	0.5
II	50	20	3:1	1.0
III	25	10	3:1	2.0
IV	2.5	1.0	3:1	4.0

For complete information write for brochure, *Trancoa Methods for Evaluating Silicon.*

Trancoa
chemical corporation

312-326 Ash Street, Reading, Massachusetts
Cable address: Trancoa

All-New hp Noise



Now enjoy totally new speed, simplicity and accuracy in measuring and optimizing radar receivers and components, and making related measurements involving noise figure. Tasks previously requiring hours of professional engineering time now can be done in minutes by non-technical personnel. Receiver performance often can be improved over the best adjustment ever before possible. Frequently, receiver improvement equals doubling transmitter output. With accurate alignment simplified, equipment is better maintained and peak performance obtained regularly.

Again throughout 1959, a parade of

Figure Instruments

TWO NOISE FIGURE METERS

- MULTI-FREQUENCY; UP TO 5 SEPARATE INTERMEDIATE FREQUENCIES
- SPECIFY I–F'S YOUR SYSTEMS REQUIRE
- DIRECT READINGS, "NON-TECHNICAL" SIMPLICITY

THREE NOISE SOURCES

- I–F, VHF AND WAVEGUIDE NOISE SOURCES

340B Noise Figure Meter. Automatically measures and continuously displays rf or IF noise figure. Supplied with 30 and 60 MC standard intermediate frequencies, *or any two intermediate frequencies between 10 and 60 MC.** Independent adjustments on gas tube and diode current controls (diode control has vernier) insure highest accuracy settings. Meter offset provision permits use of high sensitivity external meter for expanding noise figure readings.

342A Noise Figure Meter. Multi-frequency model normally supplied to accept 60, 70, 105 and 200 MC intermediate frequencies plus 30 MC. *Also available with standard IF of 30 MC plus any 4 additional frequencies from 38 to 200 MC.** Like 340B, has front panel intermediate frequency selection, extreme operating simplicity, direct readings.

343A vhf Noise Source. 10 to 600 MC, a broad-band temperature-limited diode noise source providing 5.2 db excess noise into 50 ohms. Specifically designed for use with 340B and 342A Noise Figure Meters. $75.00.

345B IF Noise Source. 30 and 60 MC, *or any two frequencies 10 to 60 MC.** Similar to 343A; front panel control selects frequencies; a second switch selects source impedances of 50, 100, 200 and 400 ohm impedances. 5.2 db excess noise. $75.00.

347A Waveguide Noise Sources. 2.6 to 18.0 KMC, six models covering S, G, J, H, X and P bands. Provide uniform excess noise of approximately 15.2 db over the full waveguide range. SWR is 1.2 or less, even when source is cold. Noise sources are Argon gas discharge tubes mounted in waveguide sections. $190.00 to $180.00.

Brief specifications of Models 340B and 342A are given here; for complete data on these instruments and new Noise Sources please call your Representative or write direct.

**On special order at slight extra cost.*

SPECIFICATIONS

Model 340B Noise Figure Meter

Frequency Range:	Depends on noise source used.
Noise Figure Range:	3 to 30 db, indication to infinity with Waveguide Noise Source. 0 to 15 db, indication to infinity, with vhf and IF Noise Sources.
Zero Offset:	Permits low values to be read on sensitive external meter.
Accuracy:	Noise Diode Scale, ±0.5 db, 0 to 15 db. Gas Tube Scale, ±0.5 db, 10 to 25 db; ±1 db, 3 to 10 db and 25 to 30 db.
Input:	−60 to −10 dbm (noise source on). Corresponds to gain between noise source and 342A of: vhf or IF Noise Source, Approx. 50 to 100 db. Waveguide Noise Source, Approx. 40 to 90 db.
Input Frequency:	30 and 60 MC. Any two frequencies between 10 and 60 MC on special order.
Bandwidth:	1 MC minimum.
Input Impedance:	50 ohms.
Price:	$700.00 (rack mount). $715.00 (cabinet).

(Note: This instrument is available in the U.S.A. and Canada only)

Model 342A Noise Figure Meter
(same as 340B except)

Input Frequency:	30, 60, 70, 105 and 200 MC. 30 MC and any four other frequencies between 38 and 200 MC are available on special order.
Price:	$800.00 (rack mount). $815.00 (cabinet mount).

(Note: This instrument is available in the U.S.A. and Canada only)

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

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CABLE "HEWPACK" • DAVENPORT 5-4451
FIELD REPRESENTATIVES IN ALL PRINCIPAL AREAS

major new instruments from hp

15,000 WATTS P. E. P.
New Ceramic Tetrode for SSB

Eimac's new, high-power 4CW10,000A is ideal for use in Class AB_1 single sideband service. This new tetrode is a water-cooled version of the widely-used Eimac 4CX5000A, with plate dissipation capability increased to 10,000 watts and a peak envelope power of 15,000 watts. Water-cooling makes the 4CW10,000A excellent for heavy duty applications where reserve plate dissipation is required.

Eimac offers the most complete line of tetrodes with the high-power gain, low distortion and excellent stability required in Class AB_1 operation. Each has proved reserve ability to handle the high peak powers encountered in single sideband service. Efficient integral-finned anode coolers on the air-cooled types keep blower requirements to a minimum, allowing compact equipment design.

Ceramic-metal design means compactness, ruggedness, high performance, and reliability. These proved advantages of Eimac ceramic tetrodes make possible more compact, efficient single sideband equipment.

Write our Application Engineering Department for a copy of the technical bulletin "Single Sideband."

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA
Eimac First with ceramic tubes that can take it

Eimac®

Cable address
EIMAC
San Carlos

CLASS AB_1 SSB OPERATION

	4CX250B	4CX300A	4CX1000A	4CX5000A	4CW10,000A
Plate Voltage	2000 v	2500 v	3000 v	7500 v	7500 v
Driving Power	0 w	0 w	0 w	0 w	0 w
Peak Envelope Power	325 w	400 w	1680 w	10,000 w	15,000 w

ELECTRONICS NEWSLETTER

MICROMODULES are now available for military electronic applications, it was announced last week by the Army Signal Corps and RCA, which had a two-year, $5-million R&D prime contract. Development of micromodules was reported in ELECTRONICS, p 18, June 26'58. The miniature packages are expected to be available for use in consumer products in two or three years; samples are now available to design engineers. Some 60 firms did subcontract work in the program and more than 300 have inquired about the micromodules. Conventional electronic component packages are expected to be reduced to 1/10 the size through the use of micromodules. Army hopes to add to $13 million now available for the program.

DEATH KNELL to uhf television was sounded last week in a report by the Television Allocations Study Organization after a two-and-a-half year investigation. TASO study, carried out with FCC sanction by Electronic Industries Association, National Association of Broadcasters and other groups, rated uhf as technically inferior to vhf. The report is expected to spur FCC efforts to swap some uhf spectrum space with the military to make room for a few more vhf channels in a continuous band. Though uhf is "as good as" vhf in short range over level terrain and is less subject to interference, these deficiencies weighed heavily: the uhf signal deteriorates rapidly as distance increases; the antenna and receiver are less efficient than vhf; and a uhf station is more expensive to operate.

ELECTRON TUBES are now strongly counter-attacking the challenge of transistors. Cold cathode amplifier tube, said to have several operating advantages over transistors, was announced in January by Tung-Sol Electric. This month, a new prong of the counterattack came from RCA, with announcement of the tiny Nuvistor tube, and a demonstration of its normal functioning from −320 F to 660 F as well as under shock and vibration conditions. Limited commercial production is expected to begin in 1960; samples of a small-signal triode and a small-signal tetrode, aimed especially at the market in tv tuners and intermediate-frequency amplifiers, will be offered in a few months. Later will come a beam power tube, said to be well suited for audio output and horizontal-deflection applications in tv sets. Ceramic base-wafer is platform for Nuvistor's array of tube electrode assemblies. Electrodes are supported from one end by cantilever construction which eliminates mica support disks or spacers. RCA says design permits a high-degree of mechanized assembly, foresees even smaller tubes with 1/20 the power consumption of ordinary tubes and useful lifetimes of hundreds of thousands of hours.

British Treasury says the government will spend $28-$42 million on electronic computers and data processing gear in the next 10 years. UK government departments, now using six data systems, will get 30 by the early 1960's.

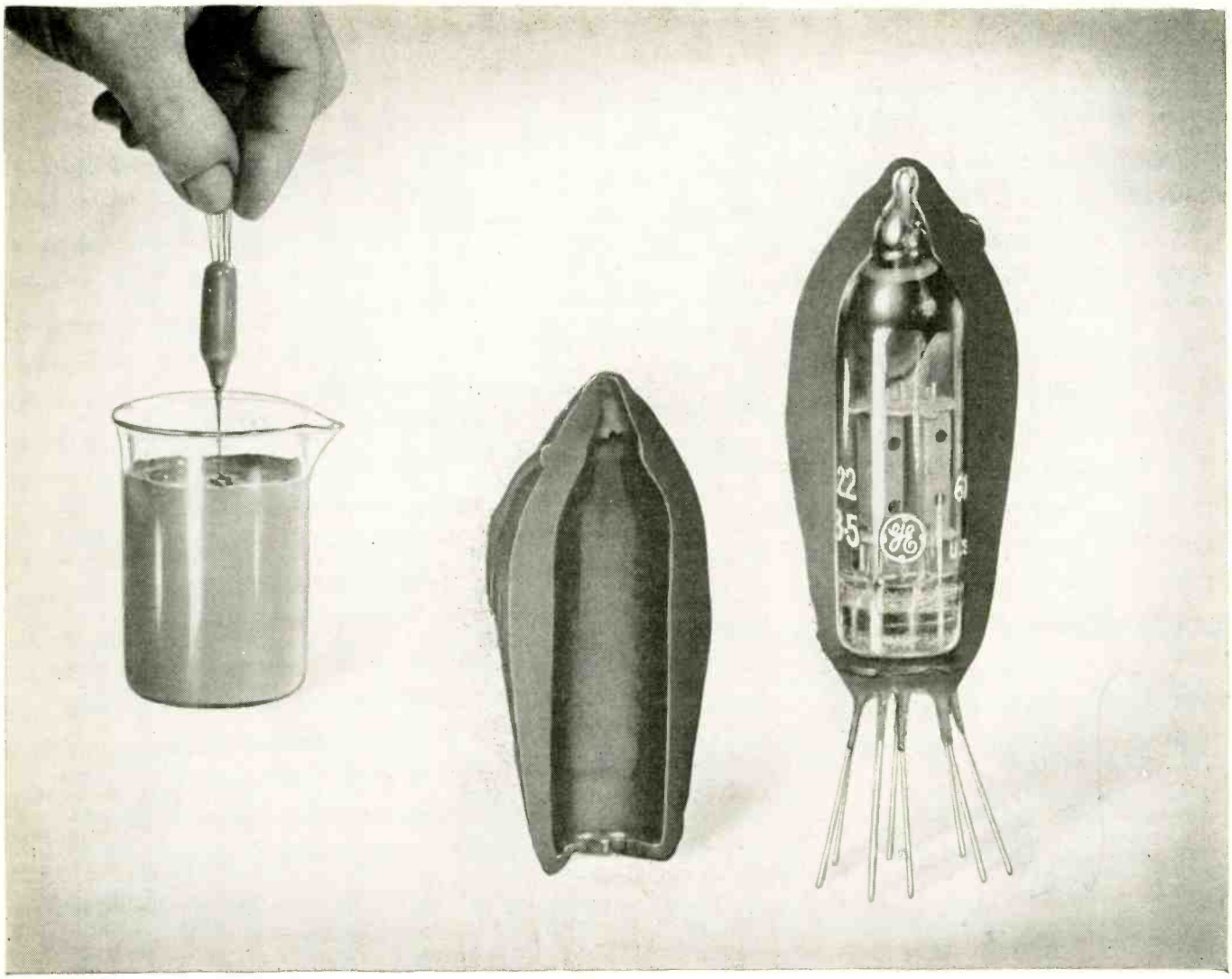
FLASH X-RAY equipment for producing "shadow pictures" of ballistic and high explosive fragmentation, and the burning pattern of solid fuel propellants, has been developed by Zenith Radio Research Corp., Redwood City, Calif. The Zenith Radio subsidiary says newly developed air-core pulse transformer and triggering circuits give new reliability and accuracy to flash x-ray use. Firm says gear permits projectile motion to be stopped at precisely the desired position during 1/6 of a microsecond x-radiation flash; two or more units may be used in measuring the speed of hyper-velocity objects.

MANNED EXPLORATION OF THE MOON will require a rocket payload weight of four or five tons, about equal to the potential payload of the Atlas ICBM. That's what Homer Stewart, NASA's program planning and evaluation director, said recently. He said it was too early to define precisely what kind of equipment would be built. But he added that "initiation of this critical item may well be expected to save us many years of time." NASA contract announcements are expected soon on Project Vega, designed to exploit the Atlas with conventional techniques.

AUTOMATIC CONTROL of 800 different start-up and shut-down steps for a 225,000-kw Louisiana Power and Light Co. station, to be completed in 1961, will be handled by a system to be supplied by Daystrom Systems, La Jolla, Calif. Contract was placed by Ebasco Services for LP&L. At each of the 800 steps a solid-state computer will determine if 700 temperatures, pressures, flow rates, and valve and switch positions are in order before the system signals the devices to switch to the next position.

Project Scout, the $500,000 four-stage test vehicle being developed for mid-1960 tests by NASA, will have a simplified gyro guidance system and spin stabilization equipment provided by Minneapolis-Honeywell.

JAPAN'S ELECTRONICS industry expects more sales resistance this year in the U.S. and is trying to line up other markets in southeast Asia, India, and Latin America, especially for transistor radios. Meanwhile, the industry expects to increase its production of all electronic products by one-third and top $700 million.



G-E RTV is an easily applied potting and encapsulating material. Tough, heat-resistant, resilient, it does not shrink or form voids during cure.

New RTV silicone rubber from G.E.

CURES WITHOUT HEAT • LOW VISCOSITY • SOLVENT-FREE • NO VOIDS OR SHRINKAGE

CURES WITHOUT HEAT G.E.'s RTV (room temperature vulcanizing) silicone rubber cures at room temperature in any time you select up to 48 hours. It comes in a wider viscosity range than any similar compound—from 250 poises (pourable) to 15,000 poises (spreadable). Easily applied by pouring, dipping, spreading or with a pressure gun.

WON'T SHRINK, VOID-FREE RTV compounds are 100% solids (no solvents). They cure without shrinkage; form no voids; provide resilient, shock-absorbent protection against physical damage or moist and corrosive atmospheres. Tensile and tear strength exceed those of previously available materials and are retained after prolonged heat aging.

RESISTS HEAT ABOVE 300°C General Electric RTV silicone rubber keeps its high dielectric strength at temperatures above 300°C. It has the well-known properties of silicone rubber, such as ability to withstand moisture, weathering, ozone, corona, oxidation and exposure to fuels and solvents.

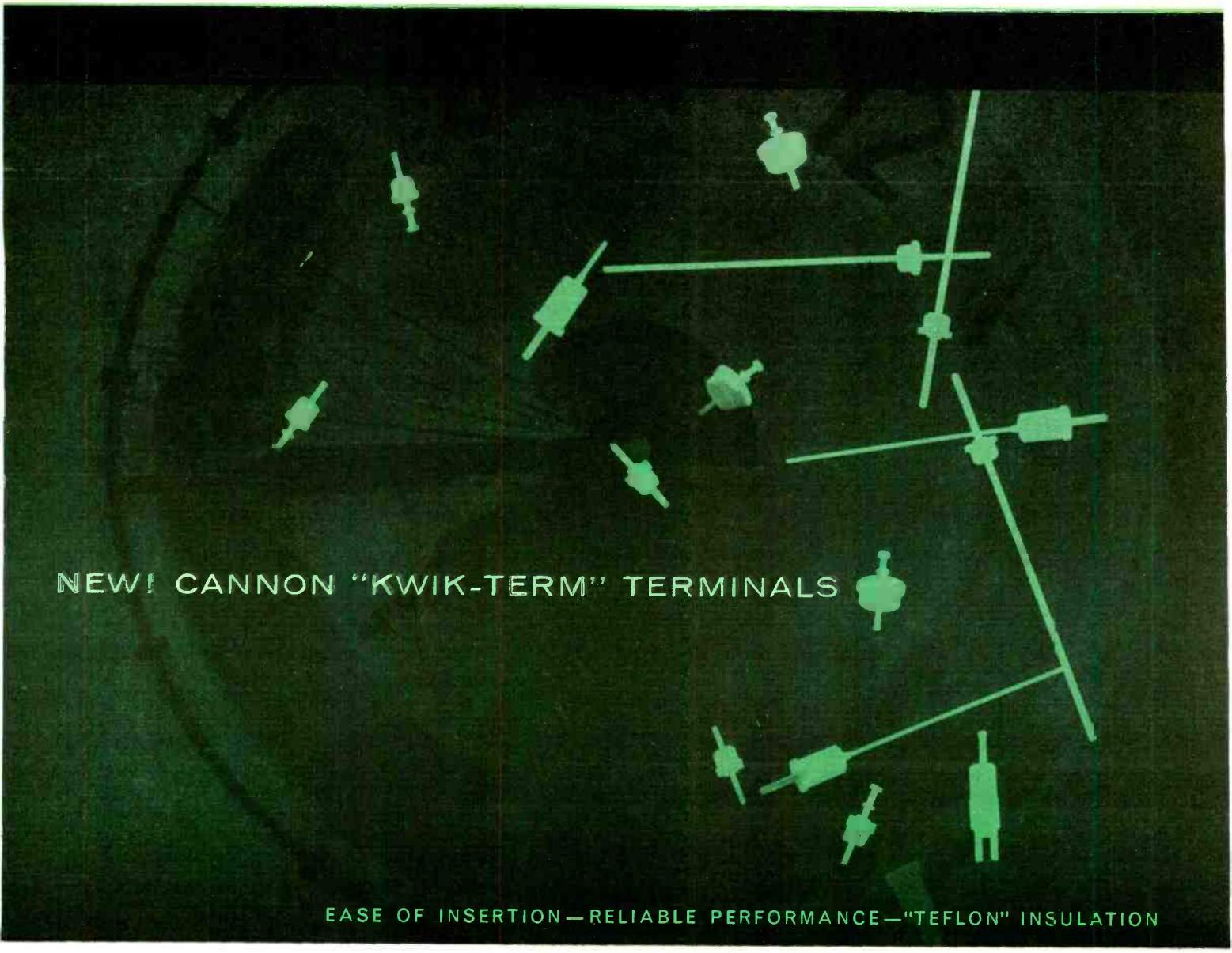
IDEAL FOR POTTING AND ENCAPSULATING General Electric RTV compounds flow easily into and around complex shapes. They are ideal for potting and encapsulating. Other uses include caulking and sealing in hard-to-reach places, performing "on-the-spot" rubber repairs, model making and molding in low-cost plastic tooling.

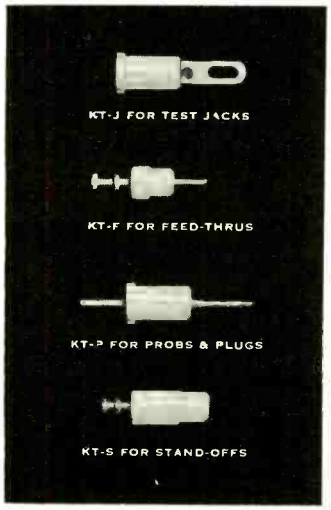
For complete application data, check Reader Service Card. If you'd like a sample for evaluation, drop us a note telling us about your proposed application.

OPERATION up turn GENERAL ELECTRIC

GENERAL ELECTRIC

Silicone Products Dept. **Waterford, N. Y.**





PERMANENTLY INSTALLED IN 4 SECONDS OR LESS by pressing the self-fastening insulator through pre-drilled mounting holes. The resilient properties of the "Teflon" insulation secures the terminal and provides permanent vibration proof installation, with no soldering or screw attachment needed to hold terminal in place. New Cannon "KT" Terminals offer simplified electrical connection especially adapted for circuitry in microwave communications, radar, scientific instrumentation and other crowded space applications. ▪ **VOLTAGE RATINGS FROM 2380 V. TO 4250 V.** (Sea Level) depending on size of terminal. Special types are available where higher operating voltages are encountered. ▪ **TEFLON BUSHINGS** available in diameters of 0.148″ to 0.264.″ Terminal lengths range from 0.120″ to 2.500.″ Standard pin diameters are 0.040,″ 0.046,″ 0.050,″ and 0.078.″ Pin material is brass with 0.003″ silver plate. A wide variety of finishes, colors and soldering lugs can be supplied to order. ▪ "KT" Terminals are immediately available in a wide variety of sizes and shapes. Cannon also produces special configurations for specific applications: Write for Cannon Catalog KT-1. Please refer to Dept. 120. Cannon Electric Company—3208 Humboldt Street, Los Angeles 31. Factories in Los Angeles, Santa Ana, Salem, Toronto, London. Paris, Melbourne and Tokyo. Distributors and Representatives in the principal cities of the world.

CANNON PLUGS

MARCA REG. IN MEXICO

CIRCLE 10 READERS SERVICE CARD

WASHINGTON OUTLOOK

ADMINISTRATION LEADERS are mulling over a proposal to increase production of ICBM's in fiscal 1960 beyond present plans by diverting funds now earmarked in the new budget for bomber production.

The proposal reflects the feeling of many Washington officials that ICBM production must be boosted next year.

The proposal also represents a belief that if missile expenditures are to be hiked, military budget reductions can be made elsewhere to maintain the delicate budget balance that has been planned for next year.

The most obvious area for cuts, as some officials see it, is the budget for bombers and related equipment. The new budget provides for additional procurement of B-52's, B-58's, KC-135 jet tanker planes, plus accelerated development of the B-70. The bomber bill now totals some $2.4 billion in new orders next year. This is $800 million more than the volume of new contracts planned for Atlas and Titan production, and Minuteman R&D work.

Some Pentagon planners argue that while U.S. superiority in bombers is already established, the Russians will outproduce the U.S. at least three times in ICBM's in the next two to three years. So, the argument runs, the budget diversion from bombers to ICBM's should be made. The Air Force's chief of staff opposes the proposal.

But continued Congressional pressure for a step-up in ICBM output could force some diversion of this sort. It's a foregone conclusion that Congress will boost the missile budget. It's almost as certain that the administration will freeze these extra funds.

The defense budget difficulties are underscored by a new Pentagon estimate that spending in the current fiscal year, ending June 30, will total at least $41 billion. This is more than $200 million above the last official estimate.

New estimate results mainly from continuing overruns in costs of major weapon development projects. For example, one Defense Dept. official says, the Air Force will get delivery on 66 B-58 bombers under outstanding orders, but that the funds earmarked for the program were originally intended to buy 77 planes. Plans for next year are for procurement of 40 more B-58's at a cost of $670 million. Cost overruns are expected to show up again next year, which means fewer than 40 B-58's will probably be obtained.

- **The House Ways and Means Committee** plans to start its investigation of how the Renegotiation Act is administered. Probe will begin soon after the Congressional Easter recess.

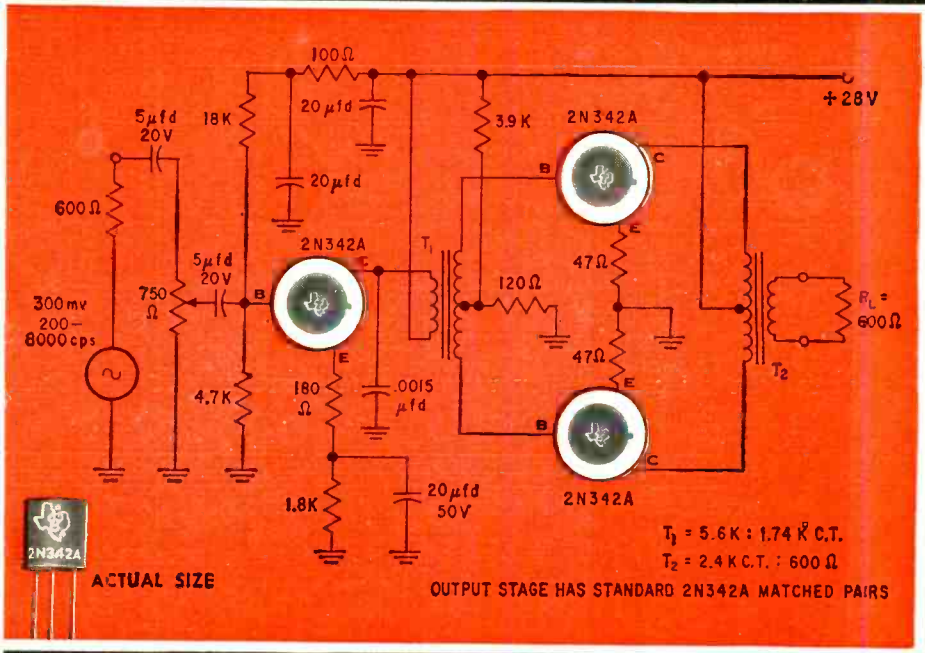
  Meanwhile, advocates of renegotiation reform are pushing a bill introduced by Rep. Cecil R. King (D., Calif.). The bill extends the law for two years, but contains these important amendments: (1) the stipulation that "a comparison of (defense contractor costs and profits) with the costs and profits of other industries" be used as a new factor in determining excessive defense profits; (2) a guarantee of "agreed" profits which the renegotiation board could not reduce; (3) greater access for defense contractors to renegotiation board records pertaining to their cases.

  Aim of foreign companies to capture U.S. military sales under the mutual security program is underscored again—this time by Nord-Aviation, prominent French missile and aircraft producer, which has just opened an office in Washington. Foreign firms hope Washington will pay closer attention to them in the face of recent Congressional penny pinching on foreign aid while NATO requirements for advanced weapons continue to increase.

CIRCLE 12 READERS SERVICE CARD→

TI Silicon Transistor Application Note

TRANSISTORIZED INTERCOM EXCEEDS MIL-E-5272B SPECS



CIRCUIT SPECIFICATIONS

150-mw output from -55°C to 100°C at less than 10% harmonic distortion over frequency range

Frequency response @ 25°C stable within ±2 db of 1000 cps 100 mw reference level from 200 to 8000 cps

Frequency response @ -55°C and 100°C within ±3 db of 25°C frequency response

Less than 3-db gain variation @ -55°C and 100°C compared to 25°C measurement

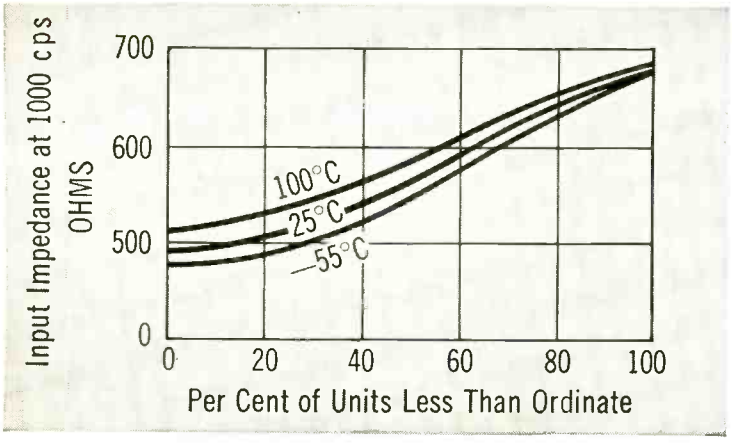
LOUD AND CLEAR AT 100°C!

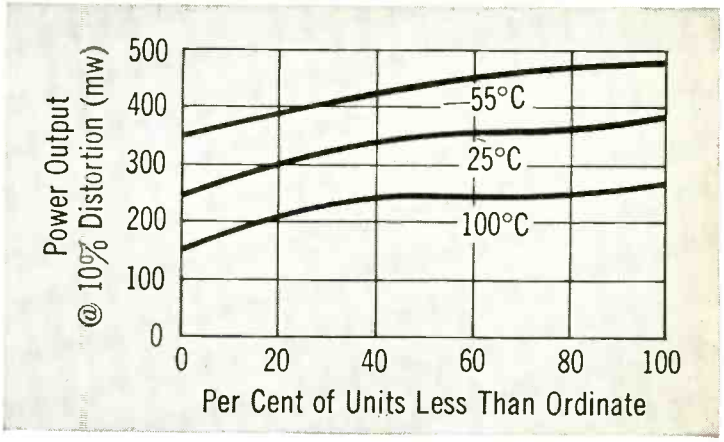
...with TI 2N342A silicon transistors from stock

You can satisfy the 71°C equipment requirements of MIL-E-5272B at 100°C with the intercom amplifier circuit shown above — using TI 2N342A silicon transistors with . . . guaranteed 3-to-1 linear beta characteristics . . . 85-v collector-to-emitter breakdown, giving a wide safety range with 28-v aircraft supplies . . . plus dissipation capability of 1 watt at 25°C and 200 mw at 125°C.

The newest addition to the *use-proved* TI 2N339 series introduced in 1957, this medium-power unit carries the full-year TI guarantee and is immediately available *off-the-shelf* from all TI distributors in 1-249 quantities. For production quantities, contact your nearest TI sales office.

TYPICAL INTERCOM AMPLIFIER PERFORMANCE CHARACTERISTICS USING 2N342A TRANSISTORS





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ADVANCED
SEMICONDUCTOR PRODUCTS
FROM
PSI

Silicon
General Purpose Diodes


ACTUAL SIZE

EIA TYPE NUMBER	Minimum Saturation Voltage @ 100 μa @ 25°C (volts)	Minimum Forward Current @ +1.0 VDC @ 25°C (mA)	Maximum Inverse Current at Maximum DC Operating Voltage (μa @ volts)		Maximum Average Rectified Current (mA)	
			@ 25°C	@ 150°C	@ 25°C	@ 150°C
1N456	30	40	.025 @ 25	5 @ 25	90	
1N456A	30	100	.025 @ 25	5 @ 25	200	70
*1N457	70	20	.025 @ 60	5 @ 60	75	
1N457A	70	100	.025 @ 60	5 @ 60	200	70
*1N458	150	7	.025 @ 125	5 @ 125	55	
1N458A	150	100	.025 @ 125	5 @ 125	200	70
*1N459	200	3	.025 @ 175	5 @ 175	40	
1N459A	200	100	.025 @ 175	5 @ 175	200	70
1N461	30	15	.5 @ 25	30 @ 25	60	
1N461A	30	100	.5 @ 25	30 @ 25	200	70
1N462	70	5	.5 @ 60	30 @ 60	50	
1N462A	70	100	.5 @ 60	30 @ 60	200	70
1N463	200	1	.5 @ 175	30 @ 175	30	
1N463A	200	100	.5 @ 175	30 @ 175	200	70
1N464	150	3	.5 @ 125	30 @ 125	40	
1N464A	150	100	.5 @ 125	30 @ 125	200	70

*JAN Types

OTHER ABSOLUTE MAXIMUM RATINGS:
Power Dissipation 0.5 Watts @ 25°C. Power Dissipation 0.25 Watts @ 150°C. 1 Second Surge Current 1.5 Amperes 25°C. Storage and Operating Temperature Range —80°C to 200°C.

Silicon
High Conductance Diodes


ACTUAL SIZE

PSI or EIA TYPE NUMBER	Minimum Saturation Voltage @ 100 μa @ 25°C (volts)	Maximum Forward Voltage DC @ 25°C (volts)		Maximum Inverse Current at Maximum DC Operating Voltage (μa @ volts)		Maximum Average Rectified Current (mA)	
		@ 100 mA	@ 200 mA	@ 25°C	@ 150°C	@ 25°C	@ 150°C
1N482	40	1.1		.250 @ −30v	30	125	50
1N482A	40	1.0		.025 @ −30v	15	200	70
1N482B	40	1.0		.025 @ −30v	5	200	70
PS603	40		1.0	.250 @ −30v	30	200	100
PS604	40		1.0	.025 @ −30v	15	200	100
PS605	40		1.0	.025 @ −30v	5	200	100
1N483	80	1.1		.250 @ −60v	30	125	50
1N483A	80	1.0		.025 @ −60v	15	200	70
1N483B	80	1.0		.025 @ −60v	5	200	70
PS609	80		1.0	.250 @ −60v	30	200	100
PS610	80		1.0	.025 @ −60v	15	200	100
PS611	80		1.0	.025 @ −60v	5	200	100
1N484	150	1.1		.250 @ −125v	30	125	50
1N484A	150	1.0		.025 @ −125v	15	200	70
1N484B	150	1.0		.025 @ −125v	5	200	70
PS615	150		1.0	.250 @ −125v	30	200	100
PS616	150		1.0	.025 @ −125v	15	200	100
PS617	150		1.0	.025 @ −125v	5	200	100
1N485	200	1.1		.250 @ −175v	30	125	50
1N485A	200	1.0		.025 @ −175v	15	200	70
1N485B	200	1.0		.025 @ −175v	5	200	70
PS621	200		1.0	.250 @ −175v	30	200	100
PS622	200		1.0	.025 @ −175v	15	200	100
PS623	200		1.0	.025 @ −175v	5	200	100
1N486	250	1.1		.250 @ −225v	50	125	50
1N486A	250	1.0		.050 @ −225v	25	200	70
1N486B	250	1.0		.050 @ −225v	10	200	70
PS627	250		1.0	.250 @ −225v	50	200	100
PS628	250		1.0	.050 @ −225v	25	200	100
PS629	250		1.0	.050 @ −225v	10	200	100
1N487	330	1.1		.250 @ −300v	50	125	50
1N487A	330	1.0		.100 @ −300v	25	200	70
PS632	330		1.0	.250 @ −300v	50	200	100
PS633	330		1.0	.100 @ −300v	25	200	100
1N488	420	1.1		.250 @ −380v	50	125	50
1N488A	420	1.0		.100 @ −380v	25	200	70
PS636	420		1.0	.250 @ −380v	50	200	100
PS637	420		1.0	.100 @ −380v	25	200	100

OTHER ABSOLUTE MAXIMUM RATINGS:
Maximum Power Dissipation 0.5 Watts @ 25°C. Maximum Power Dissipation 0.25 Watts @ 150°C. Maximum 1 Second Surge Current 1.5 Amperes @ 25°C. Storage and Operating Temperature Range —80° to 200°C.

Silicon
Subminiature Rectifiers


ACTUAL SIZE

MEDIUM POWER TYPES

EIA TYPE NUMBER	MAXIMUM RATINGS			ELECTRICAL CHARACTERISTICS			
	Peak Inv. Voltage (v)	Maximum Avg. Rectified Current (mA)[1]		Minimum Saturation Voltage @ 100°C	Maximum Reverse Current @ PIV (μA)		Max. Avg. Voltage Drop @ Io —400 mA @ 25°C (v)[2]
		@ 25°C	@ 150°C		@ 25°C	@ 100°C	
1N645	225	400	150	275	0.2	15	1.0
1N646	300	400	150	360	0.2	15	1.0
1N647	400	400	150	480	0.2	20	1.0
1N648	500	400	150	600	0.2	20	1.0
1N649	600	400	150	720	0.2	25	1.0

400 MILLIAMPERE PSI TYPES

400 mA @ 25°C—150 mA @ 150°C

PSI TYPE NUMBER	MAXIMUM RATINGS @ 100°C			ELECTRICAL CHARACTERISTICS	
	Peak Recurr. Inverse Voltage (volts)	Maximum RMS Input Voltage[1] (volts)	Maximum Average Rectified Current[1] (mA)	DC Forward Voltage @ Specified Current @ 25°C (volts @ mA)	Maximum Average Inverse Current[2] @ 100°C (μa)
TYPE		@ 150°C		@ 25°C	@ 150°C
PS 405	50	35	150	1.5 @ 500	500
PS 410	100	70	150	1.5 @ 500	500
PS 415	150	105	150	1.5 @ 500	500
PS 420	200	140	150	1.5 @ 500	500
PS 425	250	175	150	1.5 @ 500	500
PS 430	300	210	150	1.5 @ 500	500
PS 435	350	245	150	1.5 @ 500	500
PS 440	400	280	150	1.5 @ 500	500
PS 450	500	350	125	1.5 @ 500	500
PS 460	600	420	125	1.5 @ 500	500

250 MILLIAMPERE PSI TYPES

250 mA @ 25°C 140 mA @ 100°C

PS 005	50	35	140	1 @ 100	100
PS 010	100	70	140	1 @ 100	100
PS 015	150	105	140	1 @ 100	100
PS 020	200	140	140	1 @ 100	100
PS 025	250	175	140	1 @ 100	100
PS 030	300	210	140	1 @ 100	100
PS 035	350	245	140	1 @ 100	100
PS 040	400	280	140	1 @ 100	100
PS 050	500	350	140	1 @ 100	100
PS 060	600	420	140	1 @ 100	100

1. Resistive or inductive load.
2. Averaged over one cycle for half wave resistive or choke input circuit with rectifier operating at full rated current and maximum RMS input.

Storage and Operating Temperature Range—65°C to 200°C.

PSI 1959 IRE SHOW BOOTHS 2529-2531

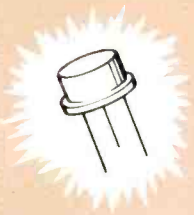
PSI

Pacific Semiconductors, Inc.

A SUBSIDIARY OF THOMPSON RAMO WOOLDRIDGE INC.

NEW!

Very High Frequency Silicon Power Transistors



Triple-diffused npn mesa structure

Six new types, three oscillator transistors and three amplifier transistors, are currently available in limited quantities for evaluation orders.

- Power capabilities at 70 megacycles of ¼, ½, and ¾ watts output.
- High voltage capability permitting operation at collector voltages up to 100 volts DC.
- Collector power dissipation rating of 2¼ watts at 50°C case temperature.
- Typical amplifier gain of 10 db at 70 mc.

Specification sheets, curves, and additional information are available on written request. Address your inquiries to Department T-10.

Please Note:

All specifications and information contained herein are current as of March 27, 1959. This advertisement has been inserted in the March 27th issue of Electronics to speed the communication of PSI product information to the specifying engineer. Similar product advertisements, compiled from latest PSI specifications, will appear regularly in this and other leading electronic publications.

NEW!

Zener Diodes
500 mW Power Dissipation

ACTUAL SIZE

LOW VOLTAGE GROUP

PSI Type Number	Elect. Equiv.	Zener Voltage @ 5 mA @ 25°C E_z Min. (v)	E_z Max. (v)	Maximum Dynamic Resistance (ohms) 1	Maximum Inverse Current I_b @ 25°C (μA)	I_b @ 100°C (μA)	At Inverse Voltage (v)
PS6465	1N465	2.0	3.2	60	75	100	1
PS6466	1N466	3.0	3.9	55	50	100	1
PS6467	1N467	3.7	4.5	45	5	100	1
PS6468	1N468	4.3	5.4	35	5	100	1.5
PS6469	1N469	5.2	6.4	20	5	100	1.5
PS6470	1N470	6.2	8.0	10	5	50	3.5

1. Measured at 10mA DC Zener current with 1mA RMS signal superposed.

MEDIUM VOLTAGE GROUP

PSI Type Number	Elect. Equiv.	Zener Voltage @ 200 μA @ 25°C E_z Min. (v)	E_z Max. (v)	Maximum Inverse Current I_b@ 25°C (μA)	I_b @ 100°C (μA)	At Inverse Voltage (v)
PS6313	1N1313	7.5	10	.5	5	6.8
PS6314	1N1314	9	12	.5	5	8.2
PS6315	1N1315	11	14.5	.5	5	10.0
PS6316	1N1316	13.5	18	.5	5	12.0
PS6317	1N1317	17	21	.5	5	15.0
PS6318	1N1318	20	27	.1	10	18.0

HIGH VOLTAGE GROUP

PSI Type Number	Elect. Equiv.	Zener Voltage @ 200 μA @ 25°C E_z Min. (v)	E_z Max. (v)	Maximum Inverse Current I_b @ 25°C (μA)	I_b @ 100°C (μA)	At Inverse Voltage (v)
PS6319	1N1319	25	32	.1	10	22
PS6320	1N1320	30	39	.1	10	27
PS6321	1N1321	37	45	.1	10	33
PS6322	1N1322	43	54	.1	10	39
PS6323	1N1323	52	64	.1	10	47
PS6324	1N1324	62	80	1.0	50	56
PS6325	1N1325	75	100	1.0	50	68
PS6326	1N1326	90	120	1.0	50	82
PS6327	1N1327	110	145	1.0	50	100

MAXIMUM Power Dissipation 500 mW @ 25°C.
Operating Range −65°C to 200°C.

NEW!

Eight new EIA types Fast Recovery Silicon Diffusion Computer Diodes

ACTUAL SIZE

Type Number	Min. Sat. Voltage @ 100 μa (v)	Min. Fwd. Current @ +1.0v	Maximum Reverse Current (mA)		Reverse Recovery Characteristics	
			25°C	100°C	Reverse Res. (ohms)	Max. Recov. Time (μs)
1N789	30	10	1 (20v)	30 (20v)	200K	0.5
1N791	30	50	5 (20v)	30 (20v)	200K	0.5
1N792	30	100	5 (20v)	30 (20v)	100K	0.5
1N793	60	10	1 (50v)	30 (50v)	200K	0.5
1N795	60	50	5 (50v)	30 (50v)	200K	0.5
1N801	150	10	1 (125v)	30 (125v)	200K	0.5
1N802	150	50	5 (125v)	50 (125v)	200K	0.5
1N804	200	50	10 (175v)	50 (175v)	200K	0.5

...added to the broadest line of Fast Recovery Silicon Computer Diodes in the industry!

MILITARY TYPES

Type Number	Min. Sat. Voltage @ 100 μa (v)	Min. Fwd. Current @ + 1.0 v	Maximum Reverse Current (μa)		Reverse Recovery Characteristics	
			25°C	100°C	Reverse Res. (ohms)	Max. Recov. Time (μs)
*1N643	200	10	.025 (10v)	5 (10v)	200K	0.3
#1N662	100	10	1 (100v) 1 (10v)	15 (100v) 20 (10v)	100K	0.5
§1N663	100	100	20 (50v) 5 (75v)	100 (50v) 50 (75v)	200K	0.5

*Mil-E-1/1171 (SigC). #Mil-E-1/1139 (SigC). §Mil-E-1/1140 (SigC).

HIGH CONDUCTANCE TYPES

PS700	30	100	5 (20)	25 (20)	100K	1.0
PS701	60	50	5 (45v)	50 (45v)	100K	0.5
PS702	100	75	20 (75v)	50 (75v)	200K	1.0
PS703	100	50	5 (75v)	50 (75v)	100K	0.5
PS704	150	50	5 (75v)	50 (75v)	100K	0.5
PS705	200	50	5 (75v)	50 (75v)	100K	0.5

MEDIUM CONDUCTANCE TYPES

PS720	30	3	5 (20v)	25 (20v)	100K	0.5
PS721	60	5	5 (45v)	50 (45v)	100K	0.3
PS722	100	5	5 (75v)	50 (75v)	100K	0.3
PS723	200	3	20 (175v)	100 (175v)	100K	0.3
PS724	150	4	20 (125v)	100 (125v)	100K	0.3

LOW CONDUCTANCE TYPES

1N625	30	4 @ 1.5v	1 (20v)	30 (20v)	400K	μsec
1N626	50	4 @ 1.5v	1 (35v)	30 (35v)	400K	μsec
1N627	100	4 @ 1.5v	1 (75v)	30 (75v)	400K	μsec
1N628	150	4 @ 1.5v	1 (125v)	30 (125v)	400K	μsec
1N629	200	4 @ 1.5v	1 (175v)	30 (175v)	400K	μsec

Switch to Silicon!

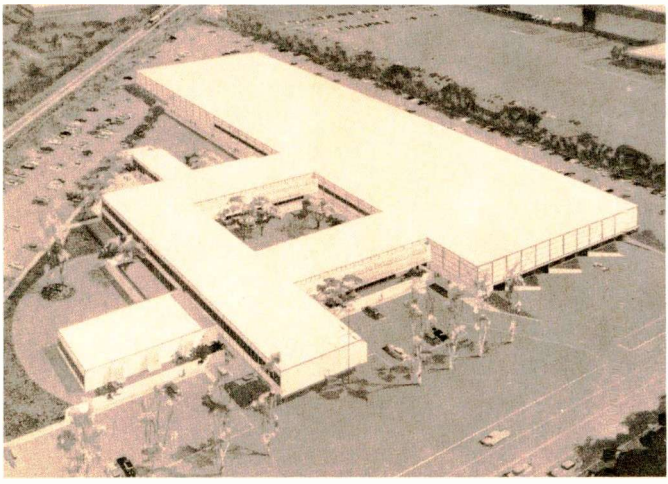
Unusual Opportunities in Semiconductor Electronics

Rapidly expanding programs in Very High Frequency and Very High Power silicon transistors, silicon microdiodes, voltage-variable capacitors and other advanced diode types have created a number of exceptional technical staff opportunities at Pacific Semiconductors, Inc.

ELECTRICAL ENGINEERS . . . diode and transistor applications and test equipment development.

PHYSICISTS . . . product research including development of transistors, diodes, and other semiconductor components.

PHYSICAL SCIENTISTS . . . challenging research programs in crystal growth and perfection studies employing the latest infrared and etch pit technique . . . solid state diffusion techniques and the study of surface phenomena.



Some of these positions encompass full supervisory responsibility. All offer an opportunity for growth and individual recognition that is unique in the semiconductor field.

If you are interested in associating yourself and your future with a dynamic, growing company such as Pacific Semiconductors, Inc., you should investigate these opportunities at once.

For specific information in your particular field, write to Technical Staff Placement, Pacific Semiconductors, Inc., 10451 W. Jefferson Blvd., Culver City, California.

Silicon

Miniature Rectifiers

ACTUAL SIZE

500 MILLIAMPERE TYPES — 500 mA @ 25°C, 200 mA @ 150°C

PSI TYPE NUMBER	MAXIMUM RATINGS @ 150°C			ELECTRICAL CHARACTERISTICS	
	Peak Recurr. Inverse Voltage (volts)	Maximum RMS Input Voltage[1] (volts)	Maximum Average Rectified Current[1] (mA)	DC Forward Voltage @ Specified Current @ 25°C (volts @ mA)	Maximum Average Inverse Current[2] @ 150°C (μa)
PS 105	50	35	200	1.5 @ 500	500
PS 110	100	70	200	1.5 @ 500	500
PS 115	150	105	200	1.5 @ 500	500
PS 120	200	140	200	1.5 @ 500	500
PS 125	250	175	200	1.5 @ 500	500
PS 130	300	210	200	1.5 @ 500	500
PS 135	350	245	200	1.5 @ 500	500
PS 140	400	280	200	1.5 @ 500	500
PS 150	500	350	150	1.5 @ 500	500
PS 160	600	420	150	1.5 @ 500	500

1. Resistive or inductive load.
2. Averaged over one cycle for half wave resistive or choke input circuit with rectifier operating at full rated current and maximum RMS input.

Storage and Operating Temperature Range—65°C to 200°C.

Silicon

HighVoltage Rectifiers

⅔ ACTUAL SIZE

EIA TYPE NUMBER	Peak Inverse Voltage @ 25 & 100°C (volts)	Continuous DC Voltage @ 25 & 100°C (volts)	Average Rectified Current (mA) @ 25°C	Average Rectified Current (mA) @ 100°C	RMS Input Voltage @ 25 & 100°C (volts)	Max. DC Fwd. Voltage Drop @ 100mA DC 25°C
1N1730	1000	1000	200	100	700	5
1N1731	1500	1500	200	100	1050	5
1N1732	2000	2000	200	100	1400	9
1N1733	3000	3000	150	75	2100	12
1N1734	5000	5000	100	50	3500	18

Maximum DC Reverse Current @ Rated PIV—25°C: 10μA; 100°C: 100μA.
Maximum Surge Current (8msec.) @ 25 & 100°C—2.5 Amps.

Dimensions: Length: 1N1730 and 1N1731: .50", 1N1732, 1N1733 and 1N1734: 1.0".
Diameter: .375" (1N1734: .50").
Leads: .030" diam., 1¼" long on all units.

Silicon Very High Voltage

Cartridge Rectifiers

¼ ACTUAL SIZE

EIA Type	Length Inches	Absolute Max. Rtgs. H. W. Res. Load at 75°C Ambient: Peak Inverse Voltage Volts	Absolute Max. Rtgs. H. W. Res. Load at 75°C Ambient: Max. Rectified DC Output Current MA	Electrical Characteristics at 25°C Ambient: Forward DC Volt Drop at Rated DC Current Volts	Electrical Characteristics at 25°C Ambient: Reverse DC Current at Rated PIV MA
1N1139	4 3/16	3600	65	27.0	.025
1N1140	2½	3600	65	18.0	.025
1N1141	4 3/16	4800	60	36.0	.025
1N1142	2½	4800	50	24.0	.025
1N1143	4 3/16	6000	50	45.0	.025
1N1143A	4 3/16	6000	65	30.0	.025
1N1144	6 1/16	7200	50	54.0	.025
1N1145	4 3/16	7200	60	36.0	.025
1N1146	6 1/16	8000	45	60.0	.025
1N1147	6 1/16	12000	45	60.0	.025
1N1148	6 1/16	14000	50	52.0	.025
1N1149	6 1/16	16000	45	60.0	.025

Storage and Operating Temperature Range—55°C to 150°C

Varicap®

Voltage-Variable Capacitor

ACTUAL SIZE

Varicap Type	Capacitance @ 4VDC μμf	Capacitance Approx. Range μμf*	Quality Factor (Q) @ 50 mc. Minimum @ 4VDC	Quality Factor (Q) @ 50 mc. Typical @ 4VDC	Quality Factor (Q) @ 50 mc. Typical @ MWV	Maximum Working Voltage (MWV) Volts D.C.
MODULATION, AFC AND OTHER APPLICATIONS						
V-7	7	3.0-18	13	18	43	25
V-10	10	4.3-26	13	18	43	25
V-12	12	5.2-31	13	18	43	25
V-15	15	6.5-39	13	18	43	25
V-20	20	10-50	7.0	18.7	40.2	20
V-27	27	14-70	7.0	15.7	33.8	20
V-33	33	17-85	7.0	14.6	31.4	20
V-39	39	20-100	7.0	15.1	32.4	20
V-47	47	24-120	7.0	15.4	32.4	20
V-56	56	32-145	7.0	13.5	24.8	15
V-68	68	39-175	9.0	14.0	25.8	15
V-82	82	47-210	9.0	13.0	23.9	15
V-100	100	57-260	8.0	11.0	20.2	15
HIGH VOLTAGE TYPES—TUNING AND OTHER APPLICATIONS						
V-7E	7	1.5-18.0	3.0	4.5	22.5	100
V-10E	10	2.2-26.0	3.5	5.5	27.5	100
V-12E	12	2.7-31.0	4.0	6.5	32.5	100
V-15E	15	3.3-39.0	4.5	7.5	37.5	100
V-20E	20	5.0-50.0	7.0	18.7	78.5	70
V-27E	27	7.0-70.0	7.0	15.7	63.5	65
V-33E	33	9.0-85.0	7.0	14.6	56.5	60
V-39E	39	11.0-100.0	7.0	15.1	55.8	55
V-47E	47	14.0-120.0	7.0	15.4	53.8	50
V-56E	56	20.0-145.0	7.0	13.5	41.8	40

*C range specified from 0.1 volts to maximum working voltage.

"VARICAP" is the registered trade-mark of silicon voltage-variable capacitors manufactured by Pacific Semiconductors, Inc.

Non-Linear Resistors

ACTUAL SIZE

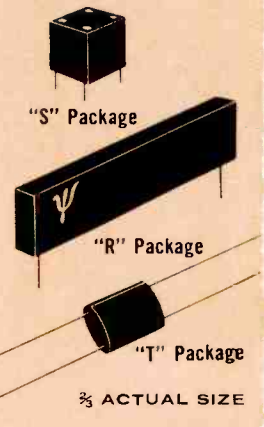
PSI Type	E/@ 1mA (volts)	I/@ 1VDC min (mA)	Max Dyn Res @ 1mA (ohm)	Ib @ 25°C (μA) Max.
PS594	0.62 ± 10%	100	60	1.0 @ −5v
PS594G	0.62 ± 5%	100	60	1.0 @ −5v
PS595	0.62 ± 10%	250	60	5.0 @ −5v
PS595G	0.62 ± 5%	250	60	5.0 @ −5v

Standard Encapsulations

A variety of assemblies can be furnished for matched pairs and quads, ring modulators, full wave and bridge rectifiers and many other applications.

Numerous lead arrangements are possible in these three basic configurations. Up to four diodes or rectifiers can be encapsulated in the "S" or "T" packages. Up to 12 units can be contained in the "R" package. The number of units contained determines its maximum length.

Leads .020" diameter,
½" minimum length.
Spaced on .1" grid centers.



⅔ ACTUAL SIZE

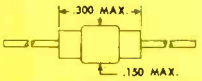
DIMENSIONS

	"R" Package	"S" Package	"T" Package
Length	.375" to 1.75"	.45"	.50"
Width	.25"	.39"	—
Height	.50"	.40"	—
Diameter	—	—	.375"

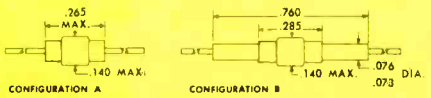
Standard Packaging...
Immediate Delivery

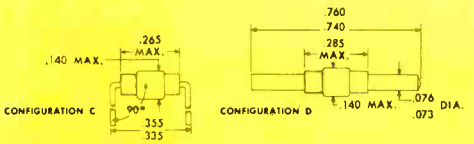
"Off-the-shelf" delivery is available from the leading distributor in all major electronic centers.

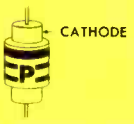
Call your nearest PSI sales office for delivery and price quotations on production quantities.



Normally supplied in the MIL Specification dimensions shown above. On special request dimensions shown below can be supplied.







Physical Characteristics

HERMETICALLY SEALED – Glass-to-metal fused and metal-to-metal welded seals.

TERMINALS – Tinned copper leads .020 inches diameter. Lead length 1¼ inch minimum.

MARKING – Wide color band indicates cathode end. (Wide band indicates positive bias on Varicaps.) Type number designated by color bands reading from cathode.

ALL DIMENSIONS SHOWN IN INCHES – Patented under one or more of the following United States Patents: No. 2815474, No. 2827403.
Other patents pending.

PSI T.M.

PSI *Pacific Semiconductors, Inc.*

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"Tiny" Yewell takes the stand for electronics

Paul G. Yewell is president of Yewell Associates, Inc., Burlington, Massachusetts — an electronics manufacturers' representative firm.

Manufacturers' representatives play a key role in the distribution of electronics products and equipment, accounting for a far larger portion of the sales of instruments and components than do representatives in the average American industry. This type of technical selling is a highly specialized business, in the case of Yewell Associates, Inc., requiring graduate engineers, trained as salesmen, capable of discussing detailed specifications or demonstrating instrumentation or other products.

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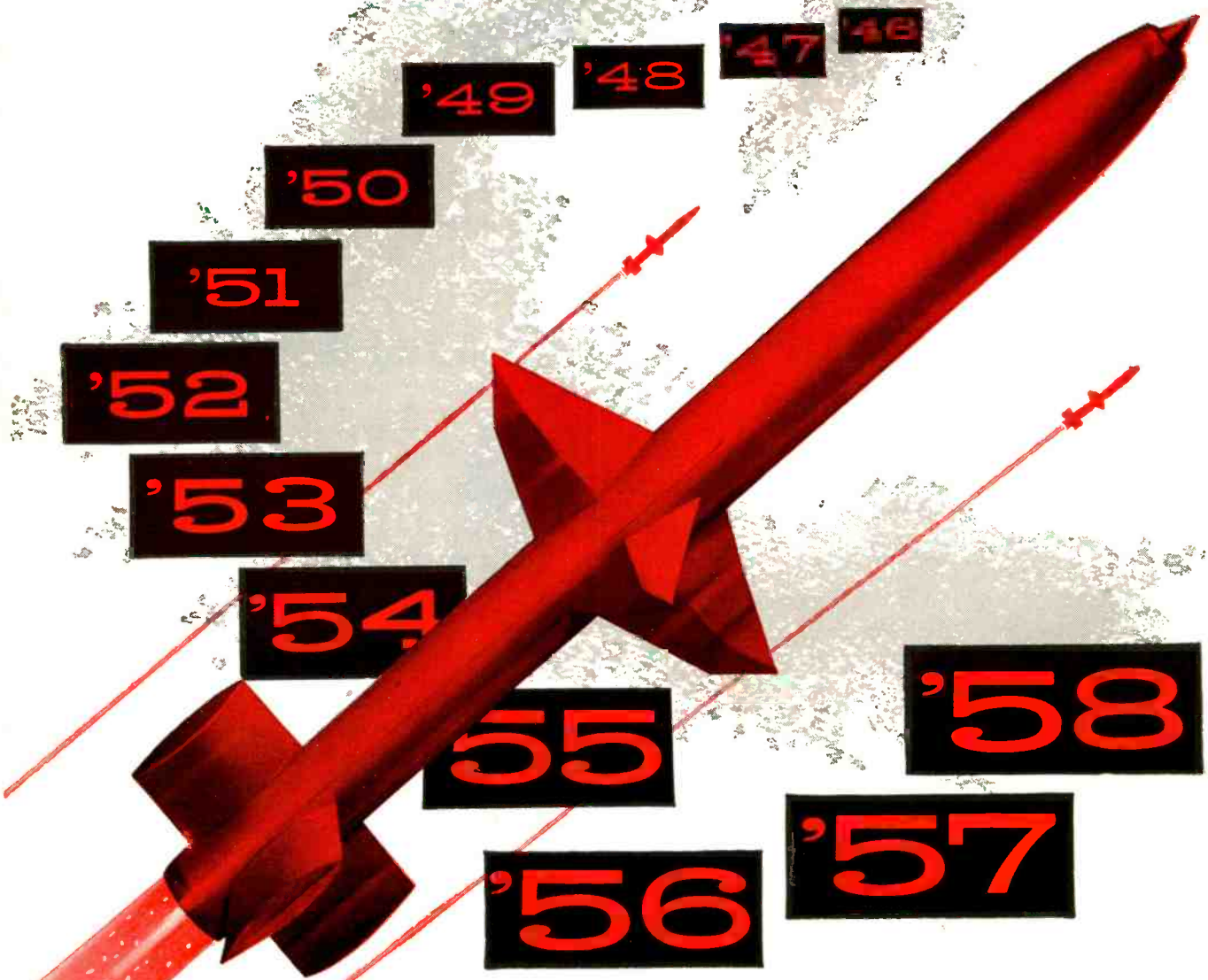

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Airborne Telemetering Components and Systems
Telemetering Receiving Stations
Missile Field Testing
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Missile Guidance
Radar Beacons

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Agency Sets Small Firm Meetings

AS PART of its nationwide program to provide new financing for small electronics and other firms, the Small Business Administration is holding a regional informational meeting today in New Orleans. Another is slated for Boston on April 9.

The new SBA program—creating small corporations to lend money—is going along well. Seventeen applications to form corporations have been approved. Fifty more are in the works.

• **International Electronic Research Corp.**, Burbank, Calif., manufacturer of electronic and nucleonic instrumentation gear, announces purchase of **Millrich Engineering Corp.**, Glendale, Calif.

• **Amphenol-Borg Electronics Corp.**, Chicago, seeks permission from SEC to register 100,000 outstanding shares of common stock to be offered by an investment group headed by Hornblower & Weeks. Initial public offering will be at a price related to market prices on the New York Stock Exchange at the time of offering.

• **Avco Manufacturing Corp.**, New York, seeks registration of more than 587,000 shares of common stock. Of these shares, 226,916 were issued during the first two months of this year under Avco's employee stock option plan.

• **Bendix Aviation Corp.** has entered into an agreement for the acquisition, for an undisclosed amount, of **M. C. Jones Electronics Co.**, Bristol, Conn., manufacturer of test equipment for monitoring coaxial transmission lines. Bendix will promote development and sales of Jones products.

• The board of directors of **Northrop Corp.**, Beverly Hills, Calif., has approved expenditure of $4 million for new engineering, R&D, and pilot production work related to expansion of the company's **Nortronics** division. The electronics division of the aircraft firm will step up its work in guidance systems, navigational computers, infrared systems and electronic ground equipment.

• Directors of **Collins Radio Co.**, Cedar Rapids, Iowa, have authorized a meeting next week (Mar. 31) for the purpose of reclassifying Class A (voting) common stock and Class B (nonvoting) common stock into a single common stock in which all shares have equal voting privilege.

OVER THE COUNTER

1958 BIDS LOW	HIGH	COMMON STOCKS	WEEK ENDING Mar. 6 BID	Mar. 13 BID	ASKED
3¾	20½	Acoustica Assocs	22¾	29	33½
1⅝	3	Advance Industries	3⅝	3⅜	4⅛
3⅛	6⅝	Aerovox	7	6¾	7¾
16¾	24¼	AMP Inc	25	25½	28⅞
5½	15	Appl'd Sci Princet	12	12½	14⅜
1⅛	8⅞	Avien, A	8⅛	8	9½
6¾	24	Baird-Atomic	26½	26¼	29⅜
9¾	13⅜	Burndy	17¼	16½	18⅝
6¾	9	Cohu Electronics	7	8¼	9⅛
11	22½	Collins Radio, A	27¾	29¾	34⅜
10¼	22¼	Collins Radio, B	27¾	29¾	33½
4	7	Craig Systems	7¾	7⅞	10½
17⅝	25⅜	Eastern Industries	19¾	22¼	24⅝
1¾	8⅜	Elco Corp	8¾	8¼	9¾
10½	21	Electro Instr	24¾	24¾	28¾
34	49	Electronic Assocs	45	45½	50⅞
5	11	Electronic Res'rch	15	19	25⅛
8½	12¾	Electronic Spec Co	12⅜	12¾	15¾
15¼	49½	Epsco, Inc	34	34½	39⅞
5½	9⅜	Erie Resistor	9⅞	9¾	11⅛
10	17½	Fischer & Porter	14½	14¾	16¼
5½	10½	G-L Electronics	12	12	16¾
12	27	Giannini	28¾	28	32
...	...	Haydu Elec Prod	5¼	5¼	6½
30	39½	Hewlett-Packard	41½	42	46⅜
23¼	48	High Voltage Eng	60	64	71½
1¾	3	Hycon Mfg	3	3⅝	4⅝
1⅛	5⅛	Industro Trans'tor	3	3¼	4
1½	4¾	Jerrold	5⅜	6⅛	7⅛
21	30	D. S. Kennedy	34	33¼	37
3¾	29	Lab For El'tronics	34½	35¾	43½
19¼	28	Leeds & Northrup	28	28⅜	31¾
2	3⅛	Leetronics	2½	2⅝	3¼
5	18¾	Ling Electronics	18¾	23	25⅝
16	20½	Machlett Labs	26¼	26¼	29⅜
3¼	8¼	Magnetic Amplifiers	8	9¾	10¾
2⅞	4½	Magnetics, Inc	4⅛	4¾	5⅞
4⅝	12	W. L. Maxson	13⅜	13¼	15⅛
10⅝	29	Microwave Assocs	31½	35	43
5¼	11¾	Midwestern Instr	12¼	11	13⅞
1⅛	7	Monogram Precis'n	10	11	12⅞
3½	7¼	Narda Microwave	6	6¾	8⅛
...	...	Narda Ultrasonics	8⅛	8	9
9¾	16	National Company	21¼	21	23¼
14¼	56	Nuclear Chicago	37	41	46⅝
4½	7⅜	Pacific Mercury, A	11¼	11½	15⅛
10⅛	27½	Packard-Bell	34½	35¼	40⅞
4¼	9⅜	Panellit, Inc	7¼	7¾	8⅝
21	53¾	Perkin-Elmer	50¼	51¼	55¼
11⅜	19½	Radiation, A	21½	21¾	23⅞
2⅛	7⅜	Reeves Soundcraft	7¾	7⅜	8½
13	32½	Sanders Associates	32½	30½	33½
...	...	Silicon Transistor	7½	5⅜	8⅜
7	12	SoundScriber	15	19¼	21¼
22¾	40	Sprague Electric	40½	41¾	45⅜
26	35	Taylor Instruments	37	38½	41⅝
5½	15	Technical Operat'ns	20½	20	26¾
5½	15¾	Telechrome Mfg	16¾	16½	22½
3¼	7¾	Telecomputing	9⅜	10¾	12⅝
1⅛	2¾	Tel-Instrument	2¾	2¾	3¼
8¾	16¼	Topp Industries	12¾	12¾	14⅛
3¾	10¾	Tracerlab	11	11½	13⅜
1⅛	3⅜	Universal Trans'tor	⅞	⅞	1¼
14¼	40	Varian Associates	47¼	45¾	49½

The above "bid" and "asked" prices prepared by the NATIONAL ASSOCIATION of SECURITIES DEALERS, INC., do not represent actual transactions. They are a guide to the range within which these securities could have been sold (the "BID" price) or bought (the "ASKED" price) during preceding week.

ELECTRONICS

EXPANDING THE FRONTIERS OF SPACE TECHNOLOGY

ELECTRONICS: In the half century since the invention of the original audion tube by De Forest, the art of electronics has expanded to a fourteen billion dollar industry that is contributing in hundreds of ways to our knowledge of the universe and our understanding of life itself. At Lockheed, for example, over half the technical staff is engaged in electronics research and development.

Significant contributions to the advancement of the state of the art in electronics have been made by Lockheed engineers and scientists in such areas as: computer development; telemetry; radar and data link; transducers and instrumentation; microwave devices; antennas and electromagnetic propagation and radiation; ferrite and MASER research; solid state electronics, including devices, electrochemistry, infrared and optics; and data reduction and analysis.

Over one-fifth of the nation's missile-borne telemetering equipment was produced by Lockheed last year. Its PAM/FM miniaturized system provides increased efficiency at one-fourth the weight of FM/FM missile-borne systems.

Advanced development work in high-energy batteries and fuel cells has resulted in a method for converting chemical energy directly into electrical power that promises a fuel utilization of almost 100% and an energy conversion efficiency of 70% or better.

Areas of special capability in computer development include the design of large scale data handling systems; development of special purpose digital computing and analog-digital conversion devices; development of high-speed input-output equipment; and advanced research in computer technology, pattern recognition, self-organizing machines, and information retrieval.

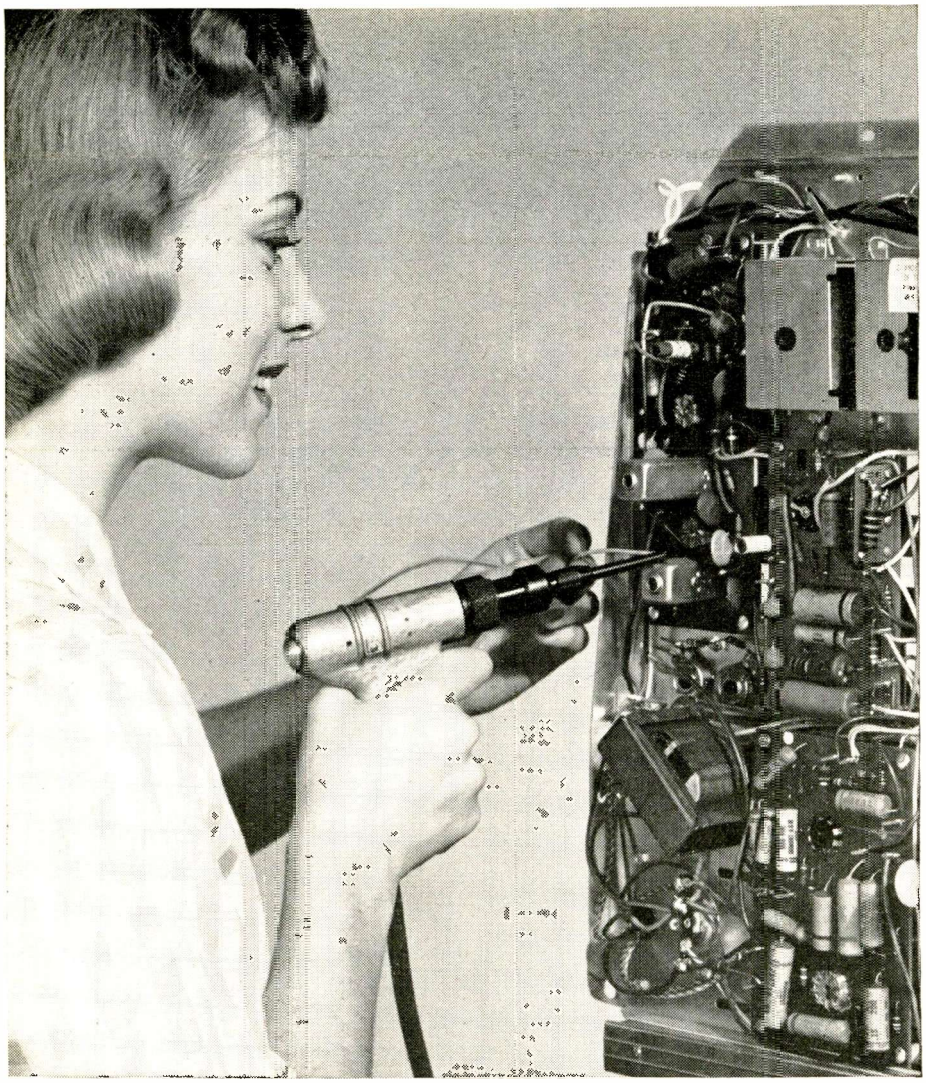
Other major developments are: a digital flight data recorder able to record each of 24 channels every few seconds; digital telemetry conversion equipment to reduce telemetered test data to plotted form rapidly and inexpensively; advancements in the theory of sequential machines; and a high-speed digital plotter that can handle some four thousand points per second with the finished plot programmed into the data tape as a continuous curve.

Lockheed Missiles and Space Division is engaged in all fields of the art—from concept to operation. Its programs reach far into the future and deal with unknown environments. It is a rewarding future which scientists and engineers of outstanding talent and inquiring mind are invited to share. Write: Research and Development Staff, Dept. C3-22, 962 W. El Camino Real, Sunnyvale, California.

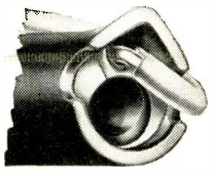
"The organization that contributed most in the past year to the advancement of the art of missiles and astronautics."
NATIONAL MISSILE INDUSTRY CONFERENCE AWARD

Lockheed / **MISSILES AND SPACE DIVISION**

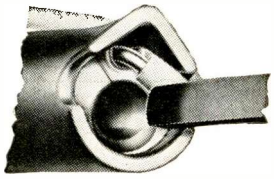
SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA
CAPE CANAVERAL, FLORIDA · ALAMOGORDO, NEW MEXICO



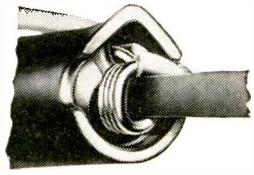
CONNECTIONS IN ONLY THREE SECONDS



Wire insertion and anchoring



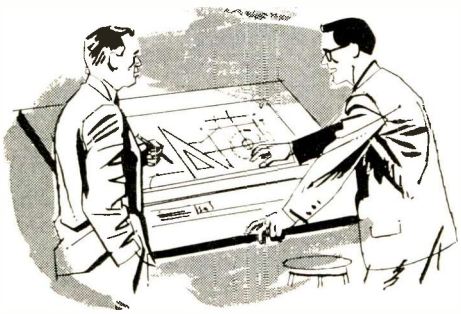
Terminal insertion



Wrapping

Finished connection

Wrap up wiring jobs fast with solderless wrapped connections



Research takes the long view as Gardner-Denver engineers strive to improve existing products . . . to develop new ones to keep ahead of a fast-paced, rapidly growing industrial world.

Fast, economical, solderless, metal-to-metal electrical connections which resist vibration failure and corrosion. That's the solderless wrapping method—proved superior by billions of connections without a reject.

With a lightweight, fast-acting Gardner-Denver "Wire-Wrap"® tool, you wrap up wiring jobs fast . . . and you get these profit-building benefits:

Greater production. Only three seconds total time per solderless connection. Actual connecting time, 1/10 second.

Lower production costs. You eliminate the expense of precise process control required by other methods.

Reduced labor costs. More connections per operator, with less fatigue. No faulty connections that require expensive hand repair work.

Higher quality. Mechanically strong connections electrically stable —proved most reliable in the industry.

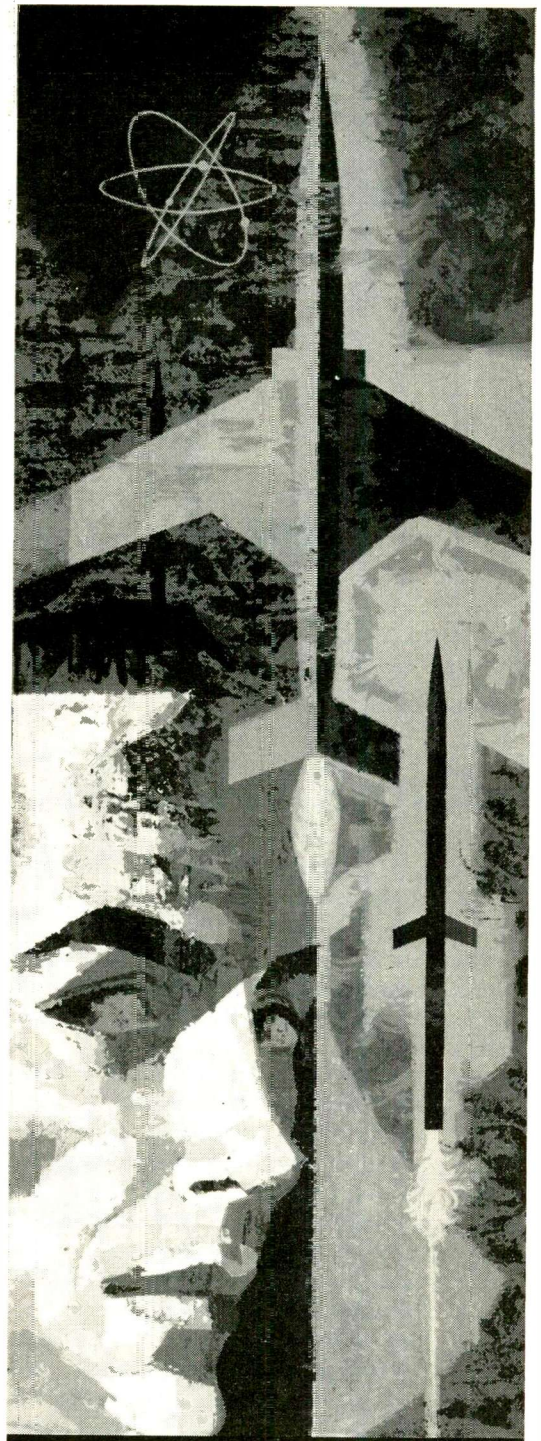
Write for Bulletin 14-1

GARDNER-DENVER Since 1859 — 100 1959 YEARS

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario



SYSTEMS MANAGEMENT | DIRECTED RESEARCH

DEVELOPMENT | PRODUCTION

TEMCO®

ELECTRONICS • AIRCRAFT • MISSILES

STRAIGHT TALK FROM

TEMCO | AIRCRAFT DALLAS

QUESTION: What is Temco's experience in the fields of electronics, aircraft and missiles contracts?

ANSWER: During the past 14 years, Temco has successfully completed 35 major programs requiring solutions to engineering design problems in all technical fields involved in the aeronautical sciences. It has produced more than 5,000 components of high performance military weapons systems.

QUESTION: What is the scope of management's knowledge and participation?

ANSWER: Programming under top management is initiated at the earliest project stage and maintained throughout the existence of the job. Overall progress is reviewed at periodic check points, to permit timely corrective action if necessary, and to keep management and the customer informed on the program status.

QUESTION: What are Temco's plant facilities?

ANSWER: Temco has three major plants, comprising over 2,000,000 square feet, fully equipped for the development and manufacture of complete aircraft, missiles and major components. Included is a new Engineering Center with ultra-modern laboratories and experimental design area. Construction is scheduled early this year on vastly increased production facilities.

QUESTION: What are Temco's engineering capabilities?

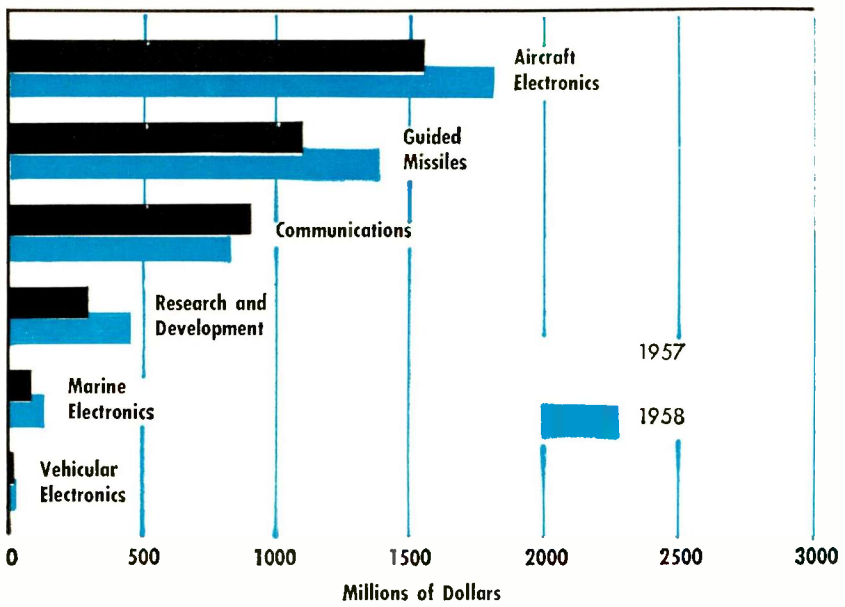
ANSWER: Temco has over 1,200 engineers whose combination of skills and unique capabilities has established Temco as a leader in advanced technology.

QUESTION: What is the range of Temco's product familiarity and production know-how?

ANSWER: Temco is prime contractor and weapons system manager for the Navy's Corvus air-to-surface "stand-off" missile; it has designed, developed and produced the TT-1 "Pinto" jet trainer and the XKDT-1 "Teal" rocket powered target drone. In the component field Temco products range from integrated antenna systems to high production major assemblies for such advanced aircraft and missiles as the F3H, F-101, F-104, B-52G, Hawk, jet engines and work on classified ballistic missiles. In the modification and overhaul field, activities have spread all the way from "PARC" overhaul of C-97s to development and installation of advanced electronics systems.

QUESTION: What *plus* does Temco offer?

ANSWER: Temco is known by its customers as a "follow-through" company, from design to production . . a partner on the job . . a company that delivers quality products on schedule at the lowest possible cost.



Military Spending Rises 12%

MILITARY ELECTRONICS spending increased last year by nearly 12 percent over 1957, according to recently released military expenditure data for calendar year 1958.

Some 29 percent of total Department of Defense spending for military hard goods and research and development went to electronics manufacturers in 1958. Electronics' share of $15,725 million was $4,606 million. In the preceding year our share was $3,945 million out of $13,480 million.

Aircraft electronics and guided missiles continued as the leading items bought by the military in 1958. About $1,806 million was spent on aircraft electronics and $1,380 million on guided missiles.

Comparison of estimated spending, by major procurement categories, for electronic equipment in 1957 and 1958 follows:

	1957	1958
	Millions of Dollars	
Aircraft Electronics..	$1,560	$1,806
Guided Missiles	1,100	1,380
Communications	900	820
Research & Development	297	457
Marine Electronics ..	81	134
Vehicular Electronics	7	9
Totals	3,945	4,606

• **Magnetic Recording Industry Association** reports 1958 sales of tape recorders topped 450,000 units. Forecast for 1959 is 750,000 units and $250 is claimed as rough average unit price.

• **Marketing appointments: Thomas D. Hinkelman,** manager of product planning and market research, Motorola Semiconductor Product division; **W. R. Lonergan,** manager product planning and market analysis, Burroughs Corporation Electrodata division; **Dana A. Griffin,** manager marketing and application engineering, Daven Company Reliability Assurance division; **Lawrence C. Oakley,** director of marketing, Mid-Eastern Electronics Inc.; **D. L. Dailey,** marketing research manager, Texas Instruments Semiconductor-Components division.

FIGURES OF THE WEEK

LATEST WEEKLY PRODUCTION FIGURES

(Source: EIA)	Mar. 6, 1959	Feb. 6, 1959	Change From One Year Ago
Television sets	95,794	129,499	+9.5%
Radio sets (ex. auto)	277,682	290,190	+54.1%
Auto sets	99,847	107,905	+91.8%

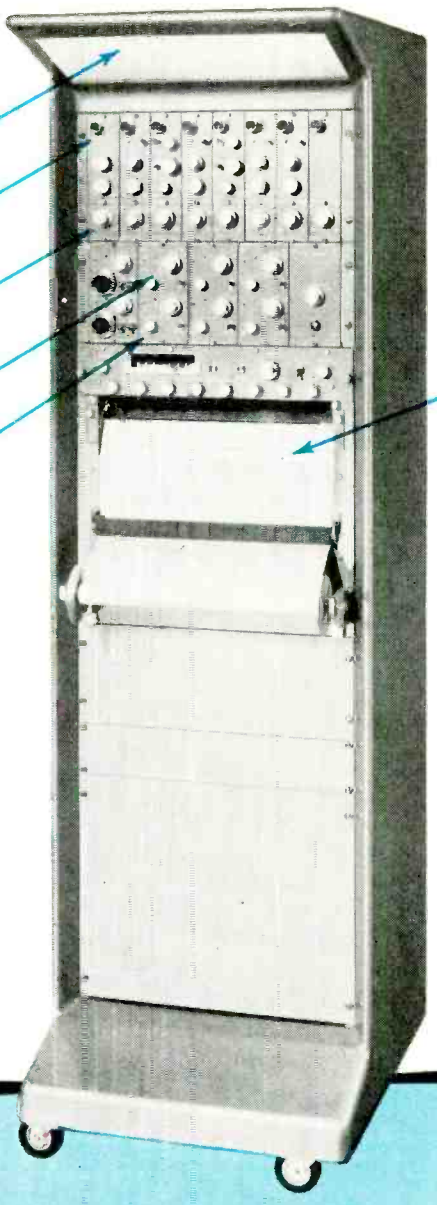
STOCK PRICE AVERAGES

(Standard & Poor's)	Mar. 11, 1959	Feb. 11, 1959	Change From One Year Ago
Electronics mfrs.	80.20	72.26	+50.4%
Radio & tv mfrs.	93.97	79.22	+102.5%
Broadcasters	87.20	81.47	+53.5%

OFFNER
ALL TRANSISTOR

TYPE R DYNOGRAPH

the most versatile . . . most sensitive direct writing unit available



Illuminated canopy

Type 9800 series input couplers provide all input, control and balance functions. Input available both front and rear.

Type 481 Preamplifier provides sensitivities from one microvolt to 5 volts per mm.

Type 482 power amplifiers—may be used without preamplifiers for up to 10 mv/cm sensitivity

Zero suppression control

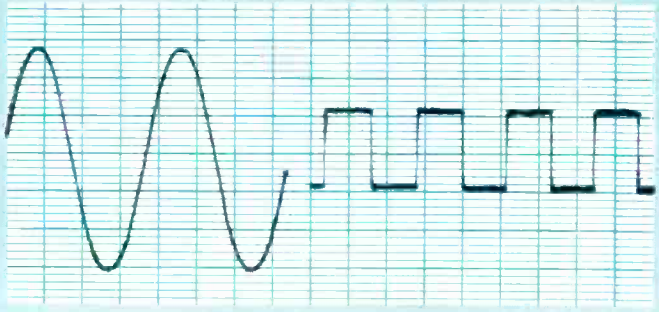
504-A paper drive—speeds from 1 to 250 mm/sec. Electrical speed shift 1 to 250 mm per minute available. Zero weave high precision drive, 850 ft. capacity (heat or electric) 1500 ft. (ink). Front loading, with full unobstructed record visible from front.

Combining all these features...

- *stable d-c sensitivity of one microvolt per mm*
- *true differential input*
- *high input impedance*
- *response to beyond 150 cps.*
- *reluctance, differential transformer, strain gage with a-c or d-c excitation, thermocouples, etc., used with all preamplifiers*
- *deflection time less than 1.5 milliseconds (2.5 ms with preamplifiers)*
- *fixed precision calibration*
- *instant warm-up*
- *precision source for d-c and 400 cycle excitation, self-contained*
- *zero suppression, twenty times full scale, both directions*

Thanks for your patience in awaiting deliveries of the Type R. Schedules were temporarily disrupted by the large volume of orders received for this radically new instrument. We are now in our new plant, with 300% more space, and are rapidly increasing production capacity. Deliveries will soon be on a current basis.

FULL SCALE, UNRETOUCHED CHARTS PRODUCED ON THE TYPE R DYNOGRAPH



EXTREME SENSITIVITY

10 Microvolt RMS Sine Wave — **Ten Microvolt D-C Square Wave**

Four recording media. Heat or electric rectilinear—ink or electric curvilinear. Readily convertible.

All these features . . . plus 8 channels in only 35″ of rack space. Whatever your application for direct writing records . . . you should investigate the ability of the Offner Type R Dynograph to do the job *better* and more *simply*. Using transistor circuits* developed and tested for over three years in thousands of channels of Offner equipment, the Type R Dynograph has already proved its superiority in practically every respect to *any other* direct writing oscillograph. Write on your company letterhead for literature giving details and specifications.

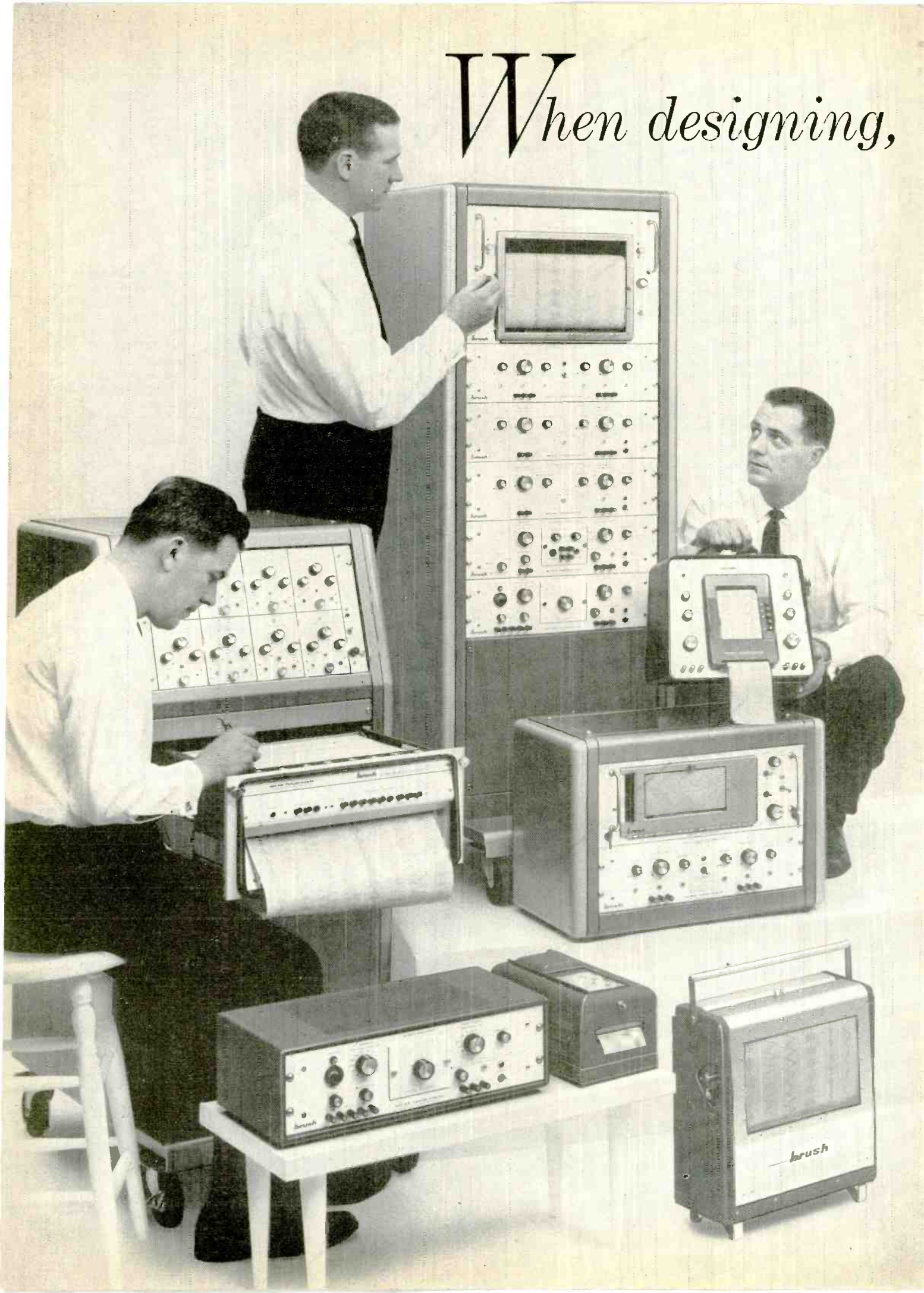
**Patents granted and pending*

OFFNER ELECTRONICS INC.

3906 River Road, Schiller Park, Ill.
(Suburb of Chicago)

CIRCLE 23 READERS SERVICE CARD

When designing,



testing or monitoring . . .

YOU CAN RECORD RESULTS BETTER WITH BRUSH

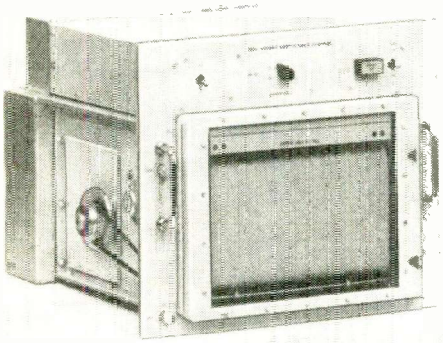
All Brush Recording Systems reflect advanced concepts in design that mean exceptional versatility, accuracy and reliability in your data collecting operations.

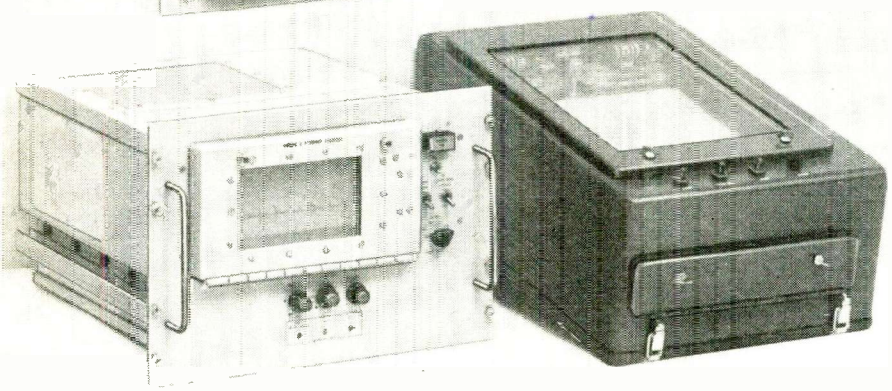
Your most exacting requirements can be met by these *direct writing* systems whether military or industrial. They display information *instantly*—give you precise data for quick decisions. You control the data you need, exclude the extraneous, and have optimum flexibility for future applications not yet contemplated.

Widest choice of equipment in the industry. Ink, electric or thermal writing . . . curvilinear or rectilinear readout . . . horizontal or vertical presentation . . . chart speeds from 10 inches/day to 4 feet/second . . . complete selection of amplifiers . . . rack mounted, bench top or portable configurations.

A pioneer in instrumentation since 1930, Brush has always built for ruggedness and precision. Installations are right. Operating manuals contain clearly written instructions. Your personnel are trained properly.

In designing, testing or monitoring you can get better results from Brush *Ultralinear* Recording Systems. Let's talk it over. Set a date. We'll be there.





Write for free informative booklet, "New Concepts in Recording." Contains helpful ideas and suggestions.

brush INSTRUMENTS

DIVISION OF

37TH AND PERKINS — CLEVITE CORPORATION — CLEVELAND 14, OHIO

Factory branches, service and warehousing at Arlington, Va., Boston, Cleveland, Los Angeles, San Francisco and Seattle; engineering representatives in all key locations.

Politics Clouds Spectrum Issue

Two camps—military vs commercial—are forming in vhf-uhf reallocation issue, and no one has full power to run the show

WASHINGTON—There's no spectrum frequency allotted to politics.

But it's clear this week politics will play a major role in any vhf-uhf space reallocation.

Political lines shape up this way: Administration (military) vs. Congress (commercial).

And the entire spectrum investigation stage is further cluttered by this: everyone's interested but no single agency or person has complete, clear-cut authority to run the show.

Everyone agrees that a study of authority over the airwaves is needed, but Washington seems to be unable to decide who should do the job.

Compromise Needed?

A few weeks ago the House voted $150,000 for a Commerce Subcommittee study. The Eisenhower Administration countered with a proposal for a five-man presidential commission—which Congress feels would favor the Pentagon. House Commerce Chairman Oren Harris (D-Ark.) says he is going ahead with his study "as soon as possible." Most observers feel, however, that a compromise will have to be reached to give balanced representation between Congress and the Administration, since both branches rely on each other to perform their functions.

Possible outcome of such a study might be a commission or board having both branches represented to make continuing studies of spectrum use, with final authority over both civilian and military. This would be similar to the Federal Aviation Agency set up recently to control both civil and military air traffic.

In addition to finding solutions to the military vs. civilian problems of communications, the study group will need to determine policy on television spectrum usage, particularly in regard to the vhf vs. uhf controversy. Last week a fact-finding committee of the broadcasting industry reported to the FCC that uhf television was technically inferior to vhf (see Newsletter, p 11).

The electronics experts emphasize that no rapid revision of the tv spectrum can be made in one step without rendering millions of dollars worth of equipment obsolete.

Congressional sources feel that the spectrum study problem can't be put off any longer. Increased demand for frequency allocation, particularly for space navigation, has sharpened the civilian-military conflict.

Military communications and civil communications are each administered separately. The Communications Act of 1934 gives dual authority in the field, with no one to settle problems. The FCC controls civilian usage; the office of Civilian Defense Mobilization controls government uses.

Dual control has meant that nobody can get at the spectrum wastage. The government and military take up about half the available space.

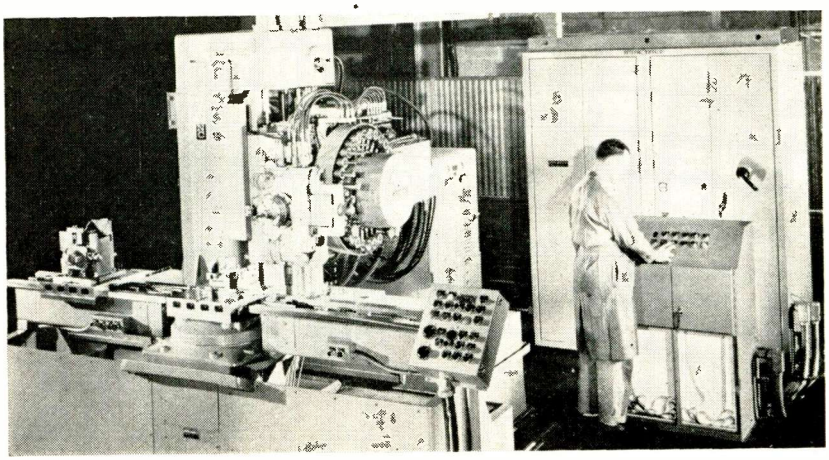
In the civilian segment, an enormous band of 420 mc in the most highly sought and least used part of the spectrum is assigned exclusively to uhf television. Only 85 stations are operating in space that could accommodate 1200. Vhf television channels, on the other hand, are nearly all used up.

Development of commercial radio uses—such as dial-from-your-car telephone—is being held up because the FCC is running out of frequencies to hand out. The broadcasters are fighting to hold on to uhf frequencies, arguing that uhf still has potential and should not be killed too soon.

Crowding of the spectrum has increased tremendously since World War II, when crash programs in electronics set off a whole round of new developments in radio. Missile and antimissile defense or radar tracking stations are taking up frequencies at a fast rate.

At an international conference next August the U. S. will ask that seven bands of frequencies be set aside on a worldwide basis for space operations and 27 frequencies for radioastronomy.

Tape Changes Tools Automatically



New tape-controlled combination machine developed by Kearney & Trecker Corp. for use by small-lot manufacturers. Up to 31 tools can be loaded into machine simultaneously. Operator stands at GE control console

As a result of growing demand from the military, government, safety services and other "musts," spectrum space is particularly short for trucking and construction business, radiotelephone, or remote control operations.

Meanwhile, insiders claim, waste of radio frequencies is painfully apparent, even outside the military and uhf television. A certain frequency, for instance, may be assigned to "forestry services." In Oregon this frequency might be crowded, while no one is using it in New York. At the same time there might be an acute shortage of mobile radio frequencies in New York. Experts say there has been insufficient "doubling up."

Hearings Underway

Since World War II, when a big study of spectrum use was carried out by the FCC, no authoritative central agency has taken a detailed look at frequency allocations. The FCC, say industry spokesmen and a number of Congressmen, has shown little initiative. When a new assignment has to be made, the agency may just "sandwich" it in.

Technical developments in past years have made it possible to narrow frequency bands and squeeze in more and more new assignments. But the experts feel there is little on the drawing boards now that will extend the useful spectrum beyond the current 30,000 mc limit in the near future.

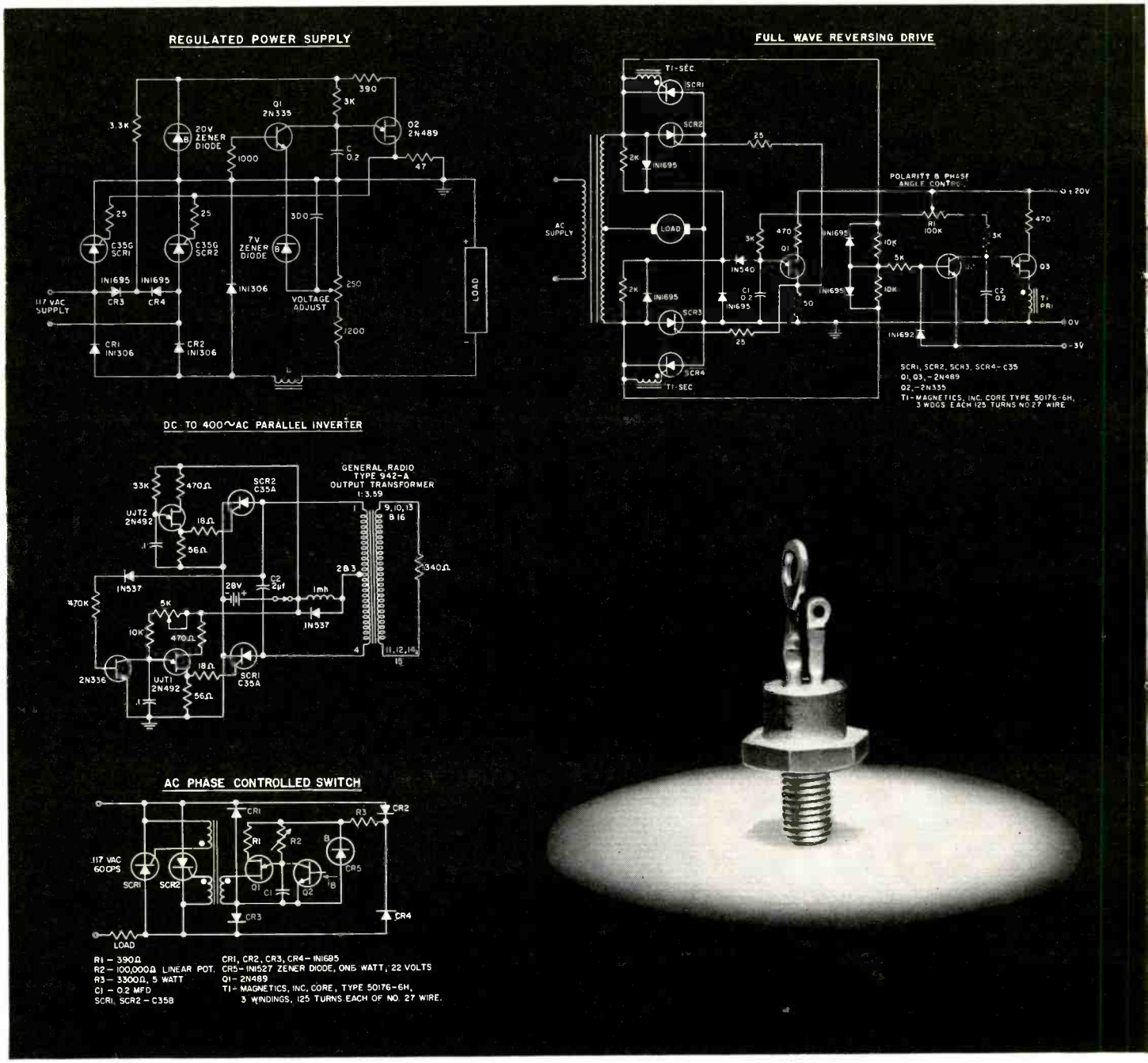
In an effort to uncover wasted space, the FCC has recently held hearings on the segment above 890 mc, and is now holding hearings on the 25-890 mc segment, which includes television.

Lack of Evaluation

The agency says the information will be useful at the international conference on frequency assignments this summer. But FCC apparently has no intention of issuing any report or recommendations for a general overhaul of allocations.

"There's no shortage of information," complains a spokesman for the electronics industry. "But there has been a serious lack of evaluation and no one with real authority to do anything about the problems."

New prices, new circuits for



FOUR BASIC CIRCUITS. Above are four basic designs for the Controlled Rectifier using the unijunction transistor as the firing means. The unijunction is a precision trigger, putting out short, high current pulses. The frequency of these pulses will not vary with the supply voltage or temperature, yet can be variably controlled with a silicon triode from a low level feedback signal. Unijunction firing circuits are easily synchronized with 60 cycle line frequency. In short, the unijunction provides the simplest and least expensive means for precision firing of the Silicon Controlled Rectifier.

General Electric's new silicon medium-current rectifiers, Types 1N2154 thru 1N2160, are ideal as companion devices to the controlled rectifier for reverse-voltage protection and, also, for applications in full-wave circuitry.

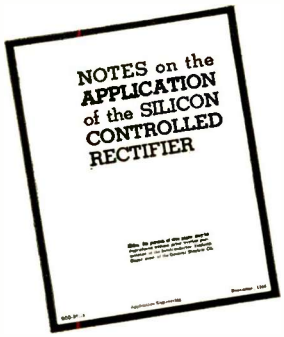
SAMPLE LIST OF POWER HANDLING AND OTHER JOBS THAT CAN NOW BE DONE BETTER BY THE G-E CONTROLLED RECTIFIER

- Converters, DC to DC, DC to AC
- Phase controlled DC power supplies, regulated & unregulated
- Frequency converter, current control
- Power switch for automatic temperature control electronic flash
- Reversible motor control
- AC variable speed induction motor
- Dynamic braking
- Light dimmers
- Thyratron replacement for relay drivers
- Pulse width conversion
- High speed printer for digital computer
- Welding control
- Ignitron firing
- Circuit breaker replacement

revolutionary G-E Controlled Rectifier

"Controlled rectifiers may revolutionize the electrical industry." This statement was made a year ago by a respected news publication. Since then samples have been studied by hundreds of firms. Many new circuits have been developed which promise important improvements in functions, reliability, simplicity, accuracy and lower cost. In just one year prices have been reduced 75 percent (see chart below). And now, the G-E Silicon Controlled Rectifier is a standard, production-line item, warranted in writing and available at sharply reduced prices.

This is the time for design engineers to exploit the inherent advantages of the Silicon Controlled Rectifier in their circuit designs. Many applications are proved . . . the firing circuits have been refined . . . the product line is stabilized . . . and it makes sound economic sense. Call or write your G-E Semiconductor Sales Representative for complete details. The Controlled Rectifier is also available from many local G-E Distributors.



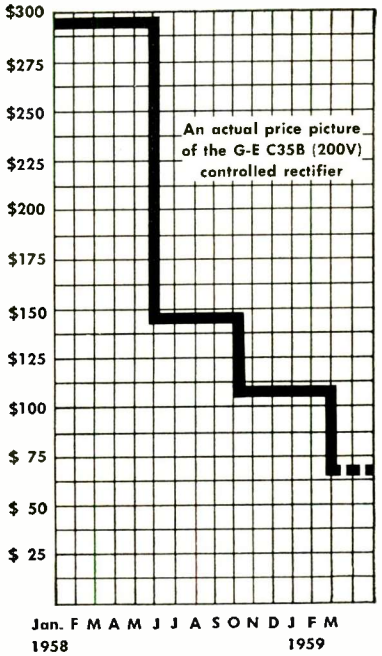
HOW THE G-E CONTROLLED RECTIFIER WORKS. The Silicon Controlled Rectifier is a three junction semiconductor device for use in power control and power switching applications requiring blocking voltages up to 400 volts and load currents up to 16 amperes. Series or parallel circuits may be used for higher power applications.

The G-E Controlled Rectifier's reverse characteristic is similar to a normal silicon rectifier in that it represents essentially an open circuit with negative anode to cathode voltage. The forward characteristic is such that it will block positive anode to cathode voltage below a critical break-over voltage if no signal is applied to the gate terminal. However, by exceeding the forward break-over voltage or applying an appropriate gate signal the device will rapidly switch to a conducting state and present the characteristically low forward voltage drop of a single junction silicon rectifier.

DETAILED NOTES are available on the application of the G-E Silicon Controlled Rectifier, plus reprints of articles that have appeared in technical journals. Write to Section S25359, Semiconductor Products Dept., General Electric Company, Electronics Park, Syracuse, New York.

STEADY PRICE DROP. Since its introduction one year ago, the price of the typical G-E Controlled Rectifier has dropped more than 75 percent. This results from improved manufacturing techniques and volume production. The G-E Controlled Rectifier is now a production-line item, warranted in writing for one year and subjected to the same quality control tests imposed on all General Electric transistors and rectifiers.

The G-E Controlled Rectifier is also available at even less cost (ZJ39L series) for use at 100°C and below, with currents up to 10 amperes.



MAXIMUM ALLOWABLE RATINGS (Resistive or Inductive Load)

	C35U	C35F	C35A	C35G	C35B	C35H	C35C	C35D
Continuous Peak Inverse Voltage (PIV)	25	50	100	150	200	250	300	400 volts
Transient Peak Inverse Voltage (Non-Recurrent<5 millisec.)	35	75	150	225	300	350	400	500 volts
RMS Voltage (V_{RMS}), Sinusoidal	17.5	35	70	105	140	175	210	280 volts
Average Forward Current (I_F)	Up to 16 amperes							
Peak One Cycle Surge Current (I_{surge})	150 amperes							
Peak Gate Power	5 watts							
Average Gate Power	0.5 watts							
Peak Gate Current (I_G)	2 amperes							
Peak Gate Voltage (V_G) (forward)	10 volts							
Storage Temperature	−65°C to +150°C							
Operating Temperature	−65°C to +125°C							

CHARACTERISTICS (At Maximum Ratings)	C35U	C35F	C35A	C35G	C35B	C35H	C35C	C35D
Minimum Forward Breakover Voltage (V_{BO})	25	50	100	150	200	250	300	400 volts
Maximum Reverse (I_R) or Forward (I_S) Leakage Current (Full Cycle Average)	6.5	6.5	6.5	6.5	6.0	5.5	5.0	4.0 ma
Maximum Forward Voltage ($V_{F\ AVG}$)	0.86 volts (Full Cycle Average)							
Maximum Gate Current To Fire (I_{GF})	25 ma							
Maximum Gate Voltage To Fire (V_{GF})	3 volts							
Typical Gate Current To Fire (I_{GF})	10 ma at +1.5 volts (Gate to Cathode Voltage)							

ZJ39L Series—lower cost series with ratings similar to above, but for use up to 100°C maximum, with forward current ratings up to 10 amperes.
ZJ50 Series—a high-current series now in development, and available on a prototype-sample basis.

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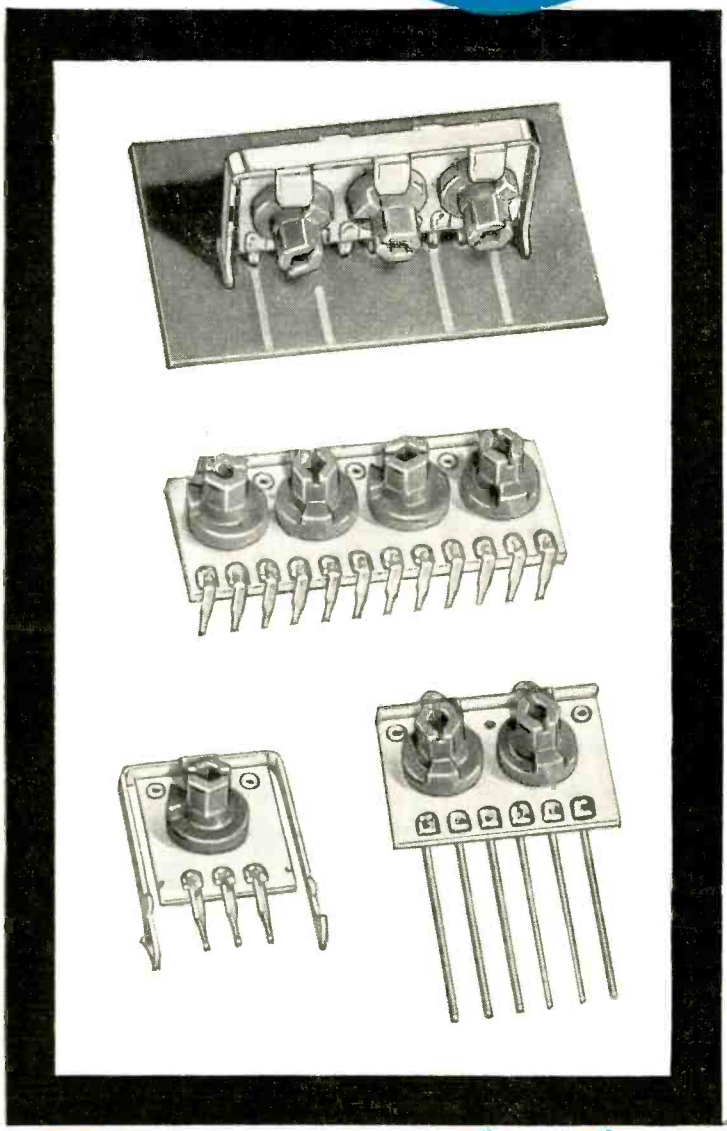
(Component Density: 16.2 per cu. in.)*



The Model 5 is a new proven design concept, not merely an improvement of an existing component. This is typical of CENTRALAB's approach to product design. It is available with up to 4 variable and 9 fixed resistors on a single steatite plate measuring 2¼" x ¾" x 15/32", including knobs . . . proportionally smaller when fewer variable resistors are required. This remarkable increase in component density is another CENTRALAB "first," setting the example for the electronics industry.

A WIDE RANGE OF MOUNTING STYLES AND TYPES

Model 5 Radiohms® are available with horizontal or vertical mounting brackets, plug-in terminals for printed circuit boards or wire leads for metal chassis.

SPECIFICATIONS

Resistance Range: 1000 ohms to 5 megohms, linear taper

Wattage Rating: ¼ watt at 70°C. ambient

Breakdown Voltage: 1250 volts RMS, between adjacent sections and to bracket

End Resistance: Less than 1% of total

Initial Torque: 2 inch ounces average

Complete specifications and design data are given in CENTRALAB Bulletin EP-539; write for your copy today.

* **Cubic inch, rather than cubic foot, is used to provide a more realistic and more readily visualized standard of comparision.**

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What Financiers Look For

Today underwriters are seeking new yardsticks to measure the economic health of electronics firms. This is a report on what's going on

THE BUSINESS of financing electronics firms is entering a new phase these days.

More underwriters are interested, more are taking longer looks, and all are examining new yardsticks by which to measure electronics companies.

In the long run, this much is clear: Our industry stands to gain.

Underwriters who bring out new stock issues now find that some of the older yardsticks used in evaluating a company's soundness are not always applicable to electronics firms. One such gage is the past financial record the company shows.

A spokesman for one New York underwriter points out that "the short corporate life of many electronics firms" complicates underwritings. In cases of short histories, the financial records of other firms in the same area of electronics are often studied.

Two Key Factors

A researcher at Smith Barney & Co., N. Y., says one way of measuring an electronics firm's financial progress is to determine the total market for the product line, then measure the percentage of that total being handled by the firm under study. This method will reveal absence or presence of growth. S. B. & Co. has handled underwritings for such firms as Emerson Electric and Lear Inc.

Underwriters are unanimous in agreeing that a firm's financial health depends on two factors: management and product. They say these outweigh all other features.

An example of company evaluation on this basis is pointed out by the underwriting firm of Pearson Murphy & Co., N. Y. The group brought out a stock issue at the end of last year for a two-month-old company on the basis of a management and product evaluation.

A spokesman for the underwriters says the company, Northeast Telecommunications Inc., Plantsville, Conn., has in its management the balance between technical and business ability that makes for sound operations.

The underwriters point out the firm's executive vice president in charge of engineering has technical experience ranging from the first broadcast studio in Manhattan, to design and development of control equipment for the Vanguard project. The vice president in charge of sales has for many years been associated with major electronics firms and key military groups. NTI's secretary-treasurer has held key posts in the financial world.

As for product, the young firm has obtained a memorandum of intent from a major electronics corporation to manufacture and market a new type of mobile radio designed by the new firm. It also has promise of R&D work in communications.

Investor enthusiasm for electronics stocks is a current factor in favor of new stock issues. The reasons for this are not based on glamor alone, according to New York investment banker Ira Haupt & Co., which has brought out stock issues for Servo Corp. of America. A spokesman for the company points out that a properly run electronics firm is usually able to produce a good margin of profit on invested capital.

Unlike some industries, which require very high plant installation financing, electronics firms are able to concentrate a sizable portion of their capital on actual product development and sales.

In general, this underwriter feels that firms relying entirely on military-derived income will not be as sound as firms balancing their activities with commercial markets.

One of the complicating factors for electronics underwriters can be a lack of technical knowledge by their financial expert. To overcome this, several Wall Street houses now include engineers in their organizations. In some cases, underwriters hire consultants to aid them in their evaluations.

Balance Stressed

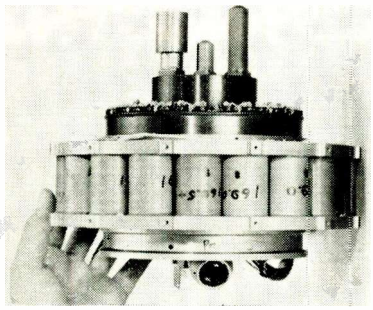
The balance, however, is often lacking in companies seeking financial aid, according to some financial men. Electronics firms often have high technical competence, but lack financial knowhow. In some cases (90 percent by one estimate), the underwriter is represented on the board of the newly-formed company.

One underwriting firm, Berry & Co., Plainfield, N. J., which includes Haydu Electronics Products among its clients, says this is done because of the dual responsibility the underwriter owes both firm and clients.

A firm will benefit from the financial advice the underwriter gives. Later financing may be made in a form other than common stock. Preferred stock, convertible debentures, long-term bonds or some other financing may be picked.

The purchaser of securities runs less risk on his investment if the firm has sound financial advice to guide it, says Berry. In addition, the underwriter points out that if the financial value of a company is to grow, the management team must also grow.

Circling Moon



Pioneer IV's instrument package. Two Geiger-Mueller tubes (top) reported radiation levels. Tube on left was shielded to eliminate all but high-level radiation in its report. Below tubes is electronic circuitry associated with them. Radio transmitter was enclosed in wide central band of batteries. Bottom: lens of photoelectric scanning device

SINGLE-GUN COLOR TUBE RETROFITS!

We've been hearing comments that have the ring of praise about them. They have been comments on the simplicity of our Lawrence-type color display tube, 5CGP29. We build other color and monochrome cathode ray tubes, *e.g.*, for applications requiring high definition of a hush-hush nature, or for fine character writing and many other applications. But let us discourse on the 5CGP29.

First of all it adapts to a great many equipments now limited by monochrome. It adapts with the same yoke you are now using and without the need to build a six-foot voltage-control console. The 5CGP29 does not have fussy requirements.

Post-Deflection Focusing is incorporated in the design. The electron beam paths are directed through an array of grid wires to an aluminum-backed phosphor screen on the face of the tube. Switching voltages on adjacent grid wires change the impact point of the focused beam. None of this is particularly critical in operation. And the operating voltages are such as not to produce what the low-temperature lab men call "thermal chaos."

There is very likely nothing more dramatic in the world of electronics than the face of a 5CGP29 discriminating between different classes of information in extra dimensions with bold colors. Military people appreciate it when, again with different colors, the 5CGP29 promptly discriminates in radar between hazardous and non-hazardous objects, or between friendly and unfriendly targets, for example.

A number of commercially available phosphors, with differing responsive qualities, afford wide variations in persistence and colors. There are dozens of uses for the tube in science, industry, and the military service. Let us tell you about them. Electronic Display Laboratory, Litton Industries Electron Tube Division, Office E11, 960 Industrial Road, San Carlos, Calif.

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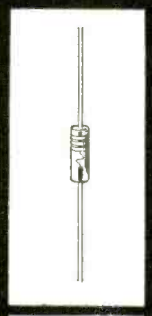
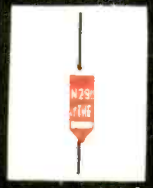
Germanium GLASS DIODES



TYPE	Working Voltage (max.) v	Forward Current at +1 volt mA	Reverse Current μA at v
1N55B	150	5	500 at −150
1N66A	60	5	50 at −10
1N67A	80	4	50 at −50
1N68A	100	3	625 at −100
1N95	60	10	800 at −50
1N126	60	5	50 at −10
1N127	100	3	25 at −10

Type	Working Voltage (max.) v	Forward Current at +1 volt mA	Reverse Current μA at v
1N128	40	3	10 at −10
1N191	90	5	25 at −10
1N198	80	5†	75† at −10
1N294A	60	.5	10 at −10
1N297A	80	3.5	100 at −50
1N298A	70	30*	250 at −40

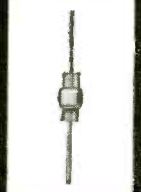
*at +2 v †at 75°C



Germanium VIDEO DETECTOR Diodes

for TV video and portable radio application;
low capacity video detection; efficiency controlled at 50 Mc

Silicon DIFFUSED JUNCTION GLASS RECTIFIERS



TYPE	Peak Operating Voltage −65°C to +150°C Volts	Ave. Rectified Current 25°C mA	Ave. Rectified Current 150°C mA	Reverse Current (Max.) in μA at Specified Voltage Volts	25°C	100°C
1N645	225	400	150	225	0.2	15
1N646	300	400	150	300	0.2	15
1N647	400	400	150	400	0.2	20
1N648	500	400	150	500	0.2	20

Silicon DIFFUSED JUNCTION RECTIFIERS

WIRE IN TYPES

TYPE	Peak Operating Voltage −65°C to +165°C Volts	Ave. Rectified Current 25°C mA	Ave. Rectified Current 150°C mA	Reverse Current (Max.) at Specified PIV, 150°C mA
1N536	50	750	250	0.40
1N537	100	750	250	0.40
1N538	200	750	250	0.30
1N539	300	750	250	0.30
1N540	400	750	250	0.30
1N1095	500	750	250	0.30
1N547†	600	750	250	0.35

† Same as 1N1096

STUD TYPES

TYPE	Peak Operating Voltage −65°C to +165°C Volts	Ave. Rectified Current 25°C Amps.	Ave. Rectified Current 150°C Amps.	Reverse Current (Max.) at Specified PIV, 25°C μA
1N253	95*	3.0	1.0*	10
1N254	190*	1.5	0.4*	10
1N255	380*	1.5	0.4*	10
1N256	570*	0.95	0.2*	20
CK846	100	3.5	1.0	2
CK847	200	3.5	1.0	2
CK848	300	3.5	1.0	2
CK849	400	3.5	1.0	2
CK850	500	3.5	1.0	2
CK851	600	3.5	1.0	2

All illustrations actual size. Ratings at 25°C unless otherwise indicated. *to +135°C

Types in red available to MIL Specifications.

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EIA Opposes Unified

Electronic Industries Association says central purchasing of electron tubes for all armed services will cut out small manufacturers

THE Electronic Industries Association this week airs in detail its opposition to centralized military procurement of electron tubes.

The Pentagon proposes that one service buy tubes for the entire Defense Department. Final decision is due on April 15.

EIA believes that single procurement for all services is not in the best interests of the government. Furthermore, the association says, such a consolidation will:

- Eliminate competition and raise costs to the Government.
- Cut down available personnel and facilities.
- Weaken defense structure through loss of production capabilities.
- Eliminate small manufacturing.

Explains Stand

Spelling out its reasons, EIA says:

1. The effect of the plan will be to eliminate competition by establishing a single source of supply. This ultimately will result in increased costs to the Government.

2. The complex scientific technologies required for the development and manufacture of electron tubes is such as to require continuity of both technical personnel and facilities. If single source supply is established, other sources will be forced to discontinue production. Once discontinued, long-time intervals and high costs will be incurred in order to re-establish such personnel and facilities, as well as quality and reliability in their product.

3. The elimination of multiple sources of supply will weaken the entire defense structure through loss of production capability of the single source as a result of strikes, fire, floods, storms, and other conditions beyond the contractor's control.

4. Its effect will be to eliminate the small manufacturer from the tube industry, since he could not produce in quantities sufficient to meet combined requirements of all military services.

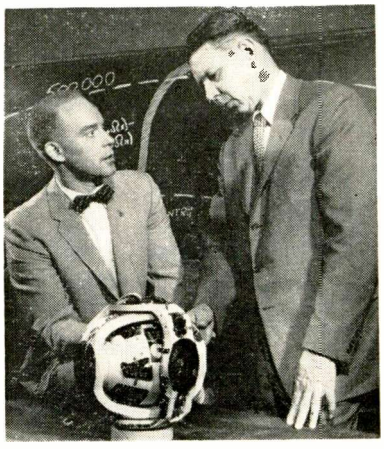
Pentagon's Views

On the other hand, the Pentagon feels that a single procurement office would make it easier for suppliers to do business with the Defense Department. Also, scheduled procurement would result in an orderly impact on total production capacity.

If the plan goes through, USAF stands a good chance of getting the purchasing assignment. It now buys $42 million worth of the Defense Department's $63 million annual bill for tubes. Navy spends $18 million for tubes, Army $3 million.

The centralized buying plan has been under study by the Army-Navy-Air Force Ad Hoc Committee

Guides Spaceman



Heart of inertial system to guide nation's first man in space is examined by an engineer and (right) President Carl A. Frische of Sperry Gyroscope, which developed system. This stable platform uses miniature gyros and accelerometers which feed data to computers and instruments needed to guide space vehicles

Buying

for Procurement of Electron Tubes since late 1957.

The electron tube proposal is part of the Defense Department's program to set up single managers or single buyers for common-use commodities bought by the military in large quantity.

System Pinpoints Missile Ships

INSTALLATION is being completed this month on a new positioning network for missile launching ships off Cape Canaveral.

Plans for the project, called Lorac (Long Range Accuracy) are expected to play a major role in new phases of U. S. guided missile programming.

The Lorac system consists of three transmitters which broadcast continuous signals. These signals establish two hyperbolic patterns which form a grid. By phase comparison, receivers convert the broadcast signals into positioning information. The network will provide accuracies of the order of 10 to 200 feet at distances of 10 to 200 miles. It consists of three transmitters and one reference station and will measure 120 miles from end to end.

Specific role of Lorac will be to pinpoint the location of missile launching ships immediately prior to firing. Lack of knowledge of the exact point of launching creates difficulties in control and tracking during the missile's flight.

Transmitters for the network were supplied by Seismograph Service Corp., Tulsa, Okla., system developers, who have also completed testing of the first of the 144-ft antenna masts to be erected at Canaveral.

Eight other networks have been made for the Navy by SSC, consisting of 24 transmitters and 40 receivers.

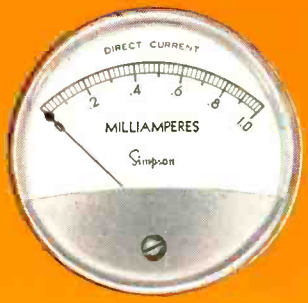
Lorac was also used by the Navy in laying the submarine cable which links tracking stations along the Canaveral range.

Meter Relays: 2" and 3"; AC and DC

Edgewise: Vertical, DC

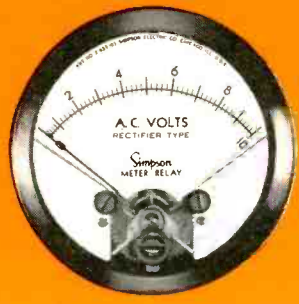
Wide-Vue: 2½", 3½", 4½"; AC and DC

These are Simpson



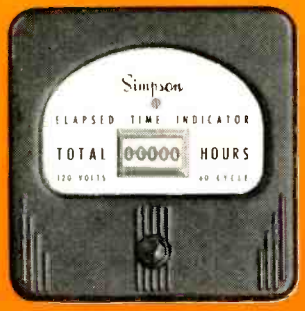
Round: 3", DC

Rectangular: 4", 4½", 5½", AC or DC, RF; 7" and 9", DC or RF

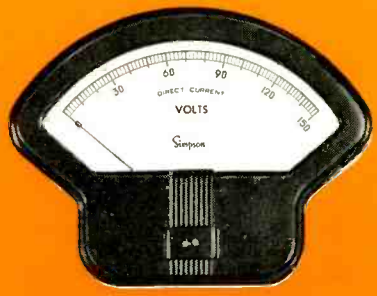


Front Adjust Relay: 2½", 3½", 4½"; DC. Rectangular also.

engineered and built to



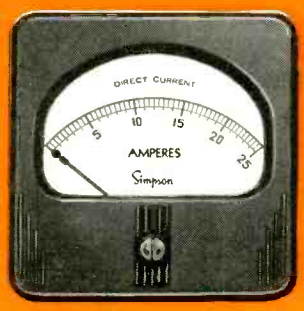
Elapsed Time: 3½"; 60-cycle AC



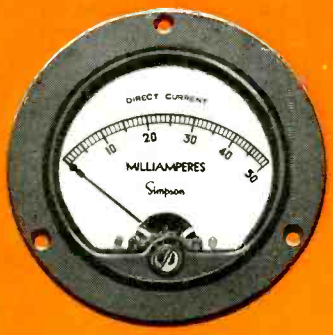
Fan Shape: 4½", AC or DC

Modernistic: 2½", 3½", 4½", 5½"; AC, DC, RF

available from stock or



Rectangular: 2½", 3½"; AC and DC, RF and Wattmeter



Round: 2½", 3½"; AC and DC, RF and Wattmeter

Rectangular: 4½", DC

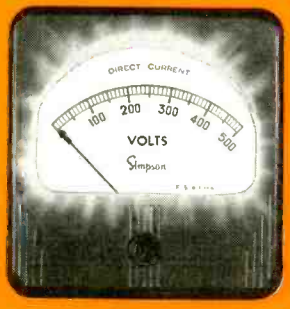
panel instruments...

Threaded Ring: 1½", 2½", 3"; DC

Edgewise: Horizontal, DC

Sealed or Sealed & Ruggedized: 1¾", DC

stay accurate...



Illuminated: rectangular 2½", 3½", 4", 4½"; round 2½", 3½"; AC, DC, RF

Round: 4½", DC

Wide-Vue: 2½", 3½", 4½"; AC, DC

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How to Find Technical Articles

Here are nine ideas for engineers who want to write about the electronics industry

THERE ARE HUNDREDS of technical articles waiting to be written in the electronics industry. Finding them is the problem.

Nine solutions are offered by Tyler Hicks in his new book, "Successful Technical Writing," to be published next month by McGraw-Hill.

• **Ask your associates** what their technical problems are, and how they solve them. If the answer involves a solution different in one or more aspects from usual procedures, you probably have an article idea.

• **Study the articles** and ads in the magazines in your field. Some articles you read may tell only part of a story that you know well. If so, check with the editor about doing another piece from a different viewpoint. Almost every advertised product interests the reader. The more ads about a given type of product, the greater the interest.

• **Expand your know-how** of a subject. Courses and research, coupled with your previous education and experience, can give you a valuable knowledge of your field. Editors spot shallow articles immediately. Get a good, solid background of information before you sit down to write.

• **Survey a field,** and summarize its literature. Review the major statistics of a field you're interested in, the firms doing business in it, the literature available, the outstanding personnel and its history. A survey should give you many article ideas.

• **Check with your** firm's public relations director or agency. He may have so many article ideas he'll keep you busy for years.

• **Study the handbooks** in your field. Certain key words will suggest article ideas.

• **Look for photo** and sketch subjects. With a good camera, or an industrial photographer, search your job and plant for picture stories. Look for any step-by-step operation that's important to your business. Before taking the pictures, however, check your idea with some editors.

• **Watch for graphical ways** to solve problems. Many firms prepare charts, slide rules, schedule boards and other devices to make routine jobs easier. Make a list of the graphical solutions available. Some of these are excellent subjects for graphical-solution articles or short departmental features.

• **Ask your associates** what subjects they think need dicussion in articles. This scheme has the advantage of timeliness. The ideas you're given are those that are important at the moment. And very good business-paper editors are always interested in these. They help him give better and hotter news to his readers.

King-Size Radome

Seven stories high and 68 ft in diameter is fiberglass radome designed, built by Goodyear Aircraft. Firm says it is world's largest such unit, is air transportable and can be erected by six-man crew in about 80 hours

MEETINGS AHEAD

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. 1-May 6: Transistor Circuits Workshop, Six Weekly Evening Sessions, IRE, John Hancock Hall, Boston.

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

Apr. 6-7: Astronautics Symposium, Air Force Office of Scientific Research, Sheraton-Park Hotel, Washington, D. C.

Apr. 6-9: British Radio and Electronic Components Show, Great Hall, Grosvenor House, Park Lane, London.

Apr. 6-10: Instrument Show, International, 4 Tilney St., Park Lane, London.

Apr. 8-10: Atomic Energy in Industry, Annual Conf., EJC, ANS, Statler-Hilton Hotel, Cleveland.

Apr. 12-19: Aircraft and Space Communications, World Congress of Flight, EIA, Las Vegas, Nev.

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

Apr. 14-15: Industrial Instrumentation & Control Conf., PGIE of IRE, Armour Research Foundation, Illinois Inst. of Tech., Chicago.

Apr. 15-17: Information and Decision Processes, Dept. of Engineering, Purdue Univ., Lafayette, Ind.

Apr. 16-18: Southwestern IRE Conf. and Electronics Show, SWIRECO, Dallas Memorial Aud. & Baker Hotel, Dallas.

Apr. 20-21: Analog & Digital Recording & Controlling Instrumentation, AIEE, PGIE & PGI of IRE, Bellevue-Stratford Hotel, Philadelphia.

Apr. 20-22: Instrument Society of America, Southeastern Conf. & Exhibit, Gatlinburg, Tenn.

There's more news in ON the MARKET, PLANTS and PEOPLE and other departments beginning on p 88.

DID YOU SAY PRINTED CIRCUITS

A—A-MP Molded Edge Connector affords a solderless, reliable multi-circuit connection on printed circuit board edges.

B—AMPin split tip firmly holds pin in board during solder dipping, assures good capillary flow. AMPin attaches to your leads with high speed A-MP tooling.

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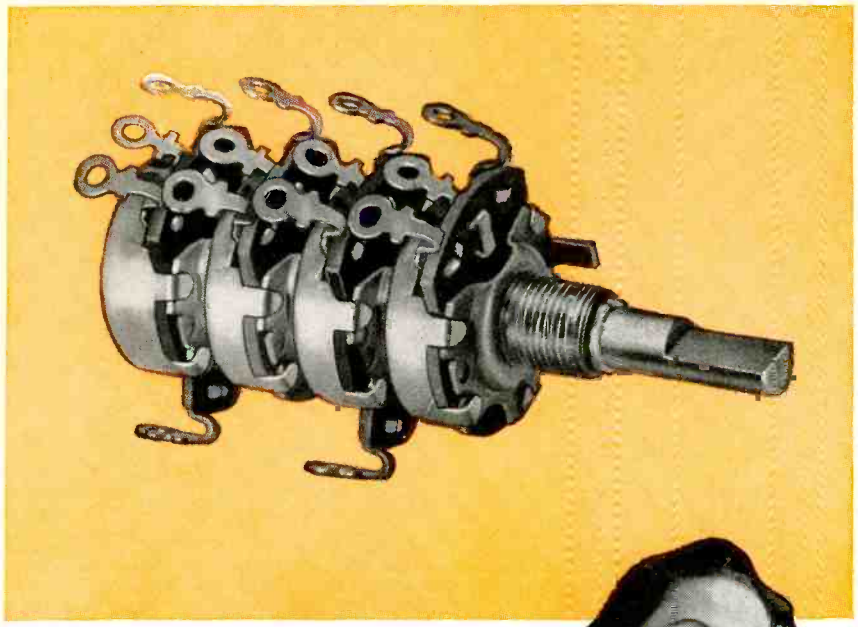

Sound..

NEW MATCHED TANDEM CONTROLS FOR STEREC

—a Mallory "first." Single-knob control of two amplifiers . . . with perfect tracking across the entire control range . . . can be obtained with these new Mallory carbon controls. Special Mallory processing methods produce tapers which match within ±5% tolerance. Balance is maintained by pre-set mechanical alignment as control is adjusted . . . no uncertainty of "matching by ear." A variety of dual controls and concentric quad units . . . with or without line switch . . . is available. Shown here is a ganged quad control, with single tap on sections 2 and 4. A feature of this line is the Mallory element, unequalled for low noise, long life, excellent stability and high wattage . . . without premium cost.

..True to Life

Mallory precision-made controls put extra performance in your high fidelity sound systems

The listening public, attracted to hi-fi by its realness, and to stereo by its uniqueness, will now settle for nothing less than the best in quality of sound reproduction. And the extensive line of Mallory controls can help you solve the more complex circuit problems now confronting you.

Several of these controls are completely new developments for stereo and hi-fi. Others have been extensively applied in commercial sound systems and in laboratory-grade equipment and offer special performance for high-quality entertainment equipment. All have built into them the long engineering experience and skilled craftsmanship which are the hallmarks of Mallory components.

Some typical Mallory controls which you will find valuable in your designs are shown here. In addition to standard models, we're well qualified to produce special custom tapers for special audio effects. For a consultation with a Mallory control specialist, or for engineering data, just write or call us.

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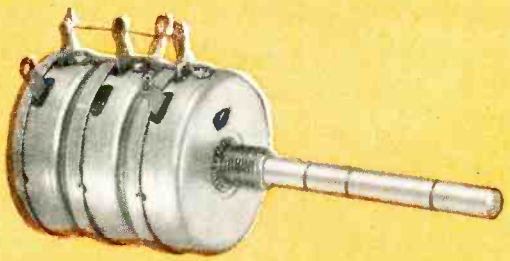
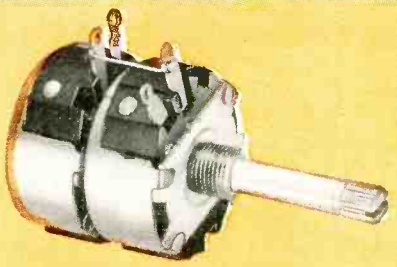


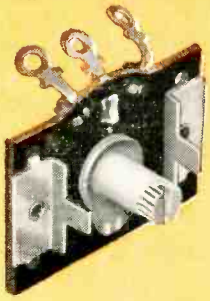
TYPE M WIRE-WOUND

Ideal for impedance matching attenuators and balance controls for stereo and other multiple speaker systems. Wire-wound pads are rated 4 watts continuous at 40°C ambient, can handle 15 watt audio. Linear and special tapers, tandem L-pads, bridged or single section L-pads, and H-pad units are available. High wattage pads available on request. Above is a typical T-pad tandem control.



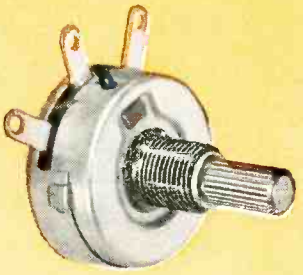
TYPE R WIRE-WOUND L-PADS

These are rated at 2 watts continuous, at 40°C ambient. 1⅝" in diameter, with insulated contact arm. Audio and reverse audio tapers, standard and special, are available. Many combinations of attached switch, tandems and dual concentric arrangements can be supplied. Shown is a 2-section L-pad.



ECONOMY CARBON CONTROL TYPE EC

Recommended for circuit balance control, preamp input channels and other uses where only occasional adjustment is needed. Uses the same high quality element as all Mallory carbon controls, but is stripped down to basic essentials for low price. Single, dual and triple units, strip mounted, are available.



ECONOMY WIRE-WOUND L-PAD, TYPE C

2-watt grounded slider unit, 1¾" in diameter, widely used as a single section potentiometer or dual contact arm L-pad for balance or fader control on small extension speakers. Variety of tapers is available.

PHILCO Transistors operate

51,614,343

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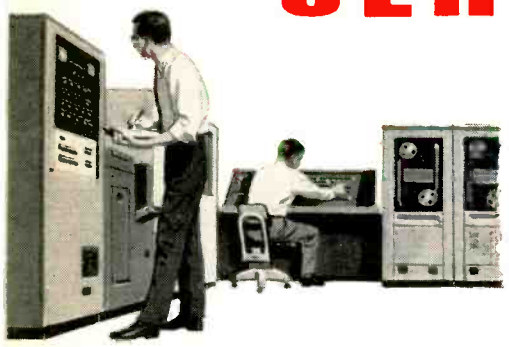

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with only 8 Failures!‡

Total Transistor Service Hours To Date	Total Transistors	Total Failures‡	Report
1,068,111	99	0	ELECTRONICS, Oct. 1, 1957, pg. 167
5,460,000	600	1	ELECTRONICS, Oct. 1, 1957, pg. 167
1,250,000	125	0	PHILCO REPORT, Feb. 10, 1959
16,000,000	10,192	2	WJCC REPORT, Feb. 1957
8,640,000	8,000	2	PHILCO REPORT, Feb. 12, 1959
19,196,232	18,601	3	PHILCO REPORT, Nov. 19, 1958

‡Failures due to all causes including human error.

Carefully documented reports now reveal that Philco electro-chemical transistors have amassed more than fifty-million hours of operation in six computers under actual field conditions. Here is proof of the outstanding performance and reliability that electronics engineers and designers have come to expect from Transistor Center, U.S.A. Of course, these transistors are still operating in their original high speed computer switching circuits . . . extending service life data on these transistors beyond the limits of any previously published information.

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*Documented service hours in these six computers only. Total transistors hours in similar circuits are many times this amount.

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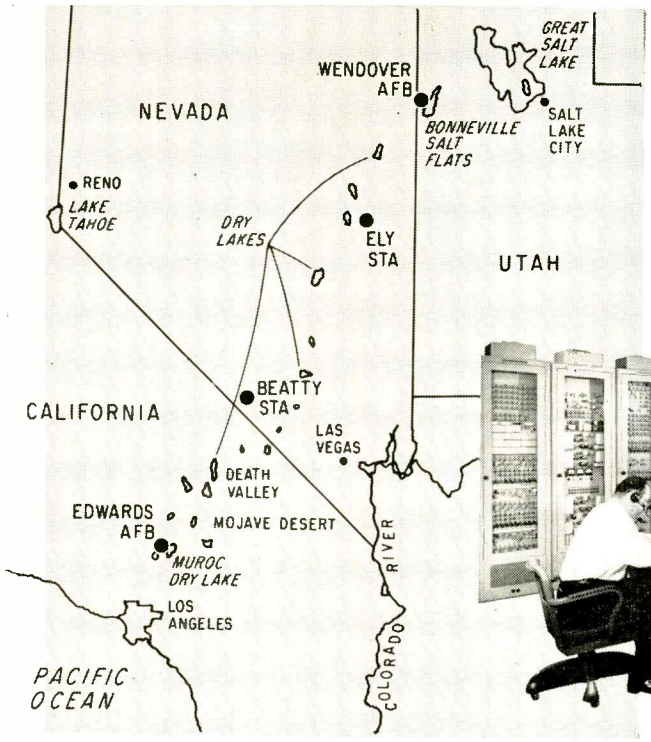
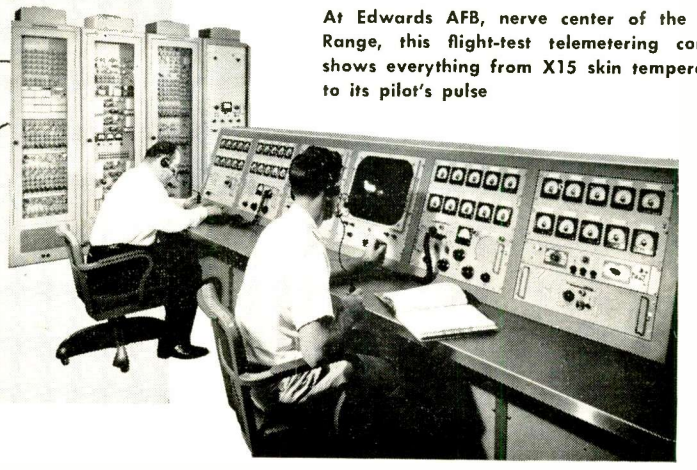


FIG. 1—X15 High Range extends 340 miles from Air Force Flight Test Center at Edwards AFB to terminal substation at Ely, Nev., thence by radar to launch point at Wendover AFB



At Edwards AFB, nerve center of the High Range, this flight-test telemetering console shows everything from X15 skin temperature to its pilot's pulse

Flight Testing Spacecraft

High Range is new flight-test facility in the West for checking out rocket X15 research vehicle. It's half missile range, half flight range—and all dealing with research on the fringes of space

By **ROGER SCHOCK and R. F. LANDER,** Electronic Engineering Co. of California, Santa Ana, Calif.

SPACE-AGE development is keyed to the feasibility of man's being able to function in the space environment. The research aimed at finding out if he can relies on a carefully controlled and instrumented test environment.

North American Aviation's X15 research aircraft is the test vehicle for one series in the current experiments investigating the fringes of space. The rocket X15 is designed to fly at altitudes in excess of 100 miles and at speeds above 3,600 mph (Mach 5 plus).

Air Force trials of the X15, and National Aeronautics & Space Administration's project Mercury, will both carry man into an environment about which his current information is at best only a challenge.

The X15 program is a cooperative venture of the Air Force, NASA and the Navy. Its goal is to explore the outer reaches of the earth's protective envelope of atmosphere, and to find out what problems need solving before man can put his foot on the next step in the exploration of space.

Test range for the X15, called High Range, is an amalgam of flight-test ranges and missile-test ranges. It begins where the former leave off in the volume of data collected on the craft's space position and performance, and the pilot's condition and behavior. Unlike missile ranges, it provides

Boresight camera on AFMTC Mod II radar minimizes tracking errors by permitting calibration through comparison of optical and radar information

for safety of both the range and the missile—for the X15 is in reality a manned missile. The range cannot avail itself, for example, of a command destruct system; such a system might protect range property but have unfortunate consequences for the pilot.

High Range was developed by Electronic Engineering Co. of California under prime contract from USAF's Flight Test Center at Edwards AFB, Calif. It is now undergoing final checkout preparatory to the long-awaited start of the X15 trials.

THE RANGE—High Range reaches, in effect, from Wendover AFB in Utah, release point for the X15, to the master station at Edwards AFB in California (see map, Fig. 1). It extends some 400 miles over a series of dry lakes which provide emergency landing facilities.

Midway station is at Beatty, Nev. The station at Ely, Nev., is the anchor of the three-point data-collection network, but its 400-mile radar radius extends range coverage to the pickup point at Wendover.

As with a missile range, the primary activity at High Range is the collection of data, principally space-position data. The range provides a master plot of space position at Edwards; a telemetering system which serves as a dynamic monitor of flight-test conditions; precision recording facilities for both telemetered and radar-acquired data; and constant air-ground communications (see Fig. 2).

Information is processed at a central data-processsing facility at Edwards which uses an IBM 704. Data from a flight can be processed on a quick-look basis within minutes after arrival at the Flight Test Center. Time for complete processing of all data from a flight will be about 30 hours.

RADAR TRACKING—To determine space position of the X15, the range uses radars identical to those used on the Atlantic Missile Test Range, designated the AFMTC Mod. II. These are extensively modernized SCR 584 systems. Working with them are boresight cameras to provide optical calibration; an Electronic Associates PACE system consisting of computers to translate coordinates from polar form to rectilinear form and vice versa, plus velocity computers; and Leeds & Northrup velocity data recorders. EECo data receivers and transmitters and data-selection system complete the radar data system shown in Fig. 3.

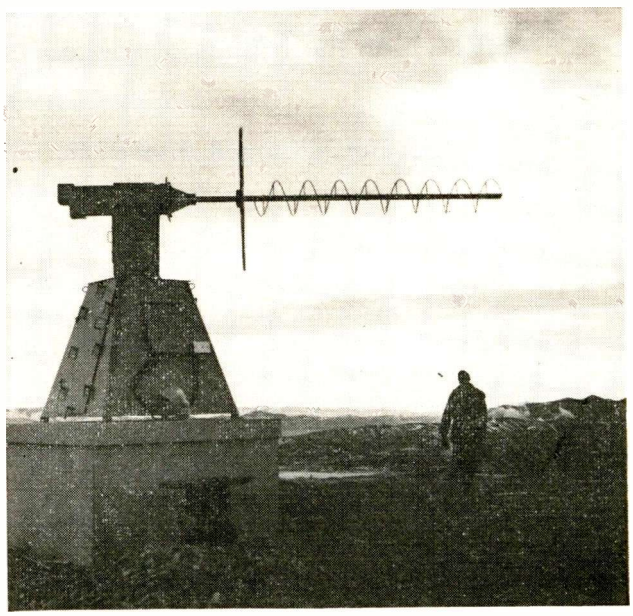
At the NASA station at Edwards, radar data is supplied to a master plotting board to draw the flight path of the craft over the entire range. Local plotting boards at each station present the flight path of the vehicle as tracked by local radars. Plotting boards as well as coordinate converters are Electronic Associates equipment.

Radar azimuth, elevation and range information is sampled in digital form and transmitted from one station to another to serve as target acquisition data and weld the radar chain together.

The Mod II radar presents angular and range data as three varying d-c voltages; these are sampled 10 times a second and converted into an 11-digit binary code. Transmitting the data in digital form prevents amplitude or phase distortion, or noise errors, from affecting the accuracy of the data. Accuracy is approximately ± 0.035 percent.

Besides the three data channels, velocity data may be transmitted on an 8-bit channel, and two channels of yes-no information are transmitted and sampled 10 times/sec.

TELEMETERING—Flight-test data is normally the essential aim of a test range. The High Range, testing the reaction of a pilot in the extreme environment posed by the high-performance X15, has



Telemetering systems share eight-turn Bendix antenna

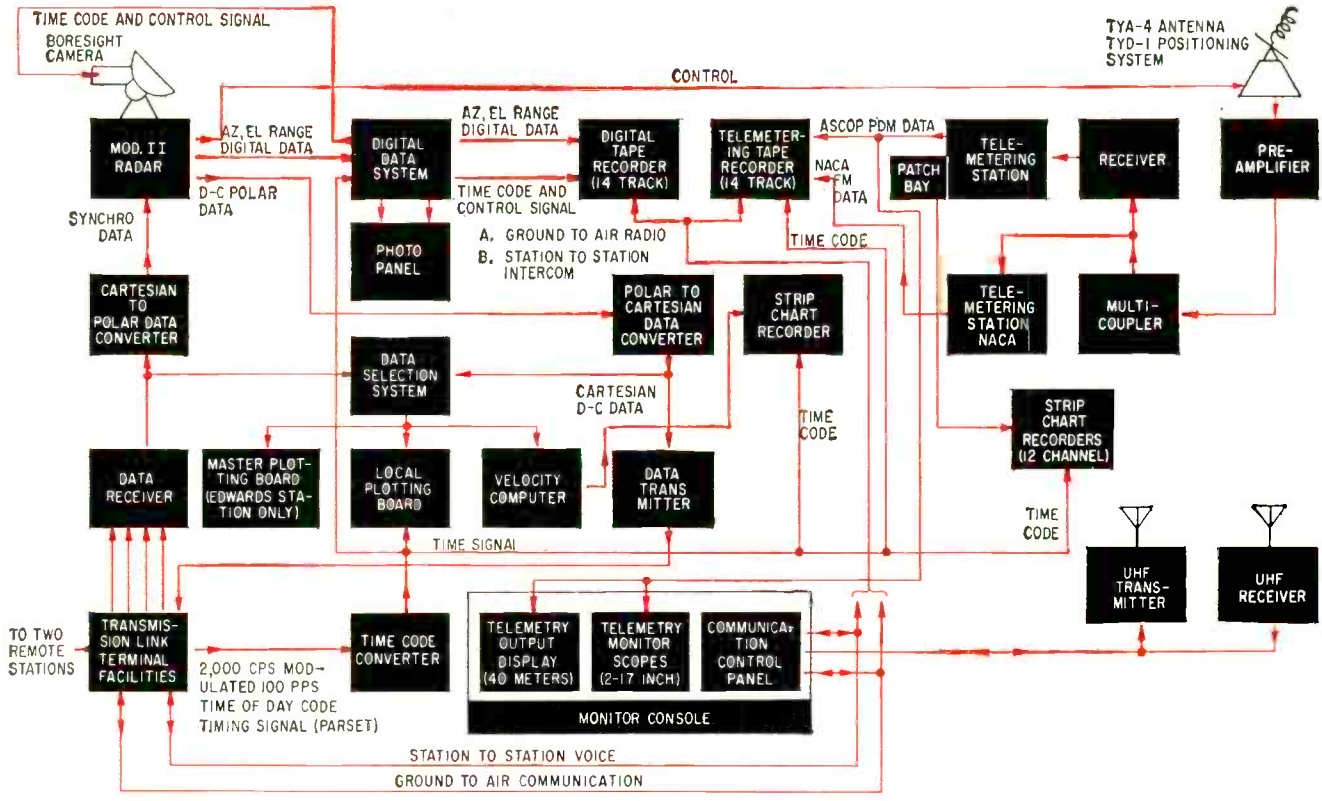


FIG 3—Block diagram of High Range tracking station shows coordination communications and data processing

the additional responsibility of acquiring data about the pilot, as well as his test vehicle.

The X15 carries over 1,300 pounds of instrumentation involving approximately 600 temperature pickups and 140 pressure pickups. Aboard also is equipment to measure control positions, air vehicle response, and pilot reaction on the controls. The sensing system also provides for strain gages at strategic locations to measure structural and aerodynamic loads of specific surface areas.

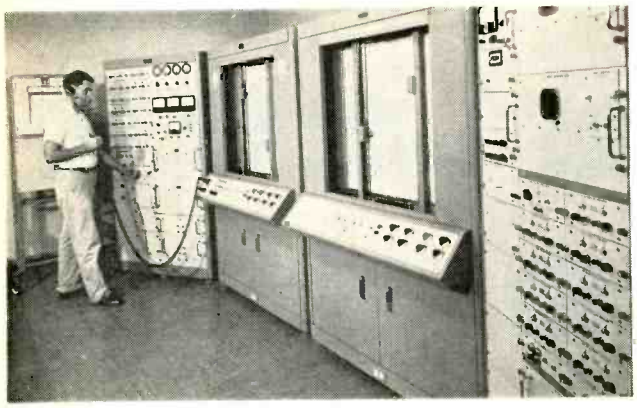
Console of Mod II radar. The set is an updated SCR 584, presents polar coordinates in both analog and digital form

The telemetering system ground station is a pulse-duration-modulated receiver made by Applied Science Corp. of Princeton (N. J.). Its antenna is a Bendix TYA-4 with a TYD-1 positioning system. Sharing the antenna is an 8-channel f-m/f-m NASA research telemeter. An ASCOP multicoupler couples the r-f signal from the antenna to both the pdm and the NASA telemeter.

A monitor console permits engineers on the ground to look at data from the test vehicle as it is received. Two 17-in. oscilloscopes present data in vertical bar form. Forty panel meters calibrated in actual values of test parameters under measurement provide quick-look surveillance. North American Aviation's flight-test engineers will be able, for example, to look at X15 skin temperatures to determine whether or not the vehicle is reentering too fast.

The ASCOP ground station (see Fig. 4) detects the telemetry signal, decommutates the pulse-duration modulation, and converts the commutated signals into analog voltages. Commutation formats of 30 × 30, 45 × 20 or 90 × 10 may be used. Any 12 of a maximum of 45 data channels may be routed through a patch panel to two 6-channel strip recorders.

DATA-RECORDING—An Ampex FR-114 tape recorder is used to pick up additional channels of telemetered data. The recorder is equipped with the necessary circuits to handle pdm data. Any



Master plot of X15 flight is kept at Edwards AFB

channels may be played into the ASCOP ground station and decommutated for recording on the strip-chart recorders. Three channels of direct record circuits permit time and communications signals to be recorded on other tracks of magnetic tape.

Precision radar-data recording system was designed and developed by EECo for AFFTC to operate in conjunction with the Mod II radar. The system converts angular data to digital numbers with a precision of 0.1 mil, range data to precision of 7.8 yards.

Angular data is derived from the Mod II in terms of angular displacement of azimuth and elevation shafts. Range data is derived in terms of the position of the range unit gear shaft. These are translated into digital signals by encoders mechanically coupled to the shafts. The signals are first converted to 16-digit Gray code and then reconverted to binary code.

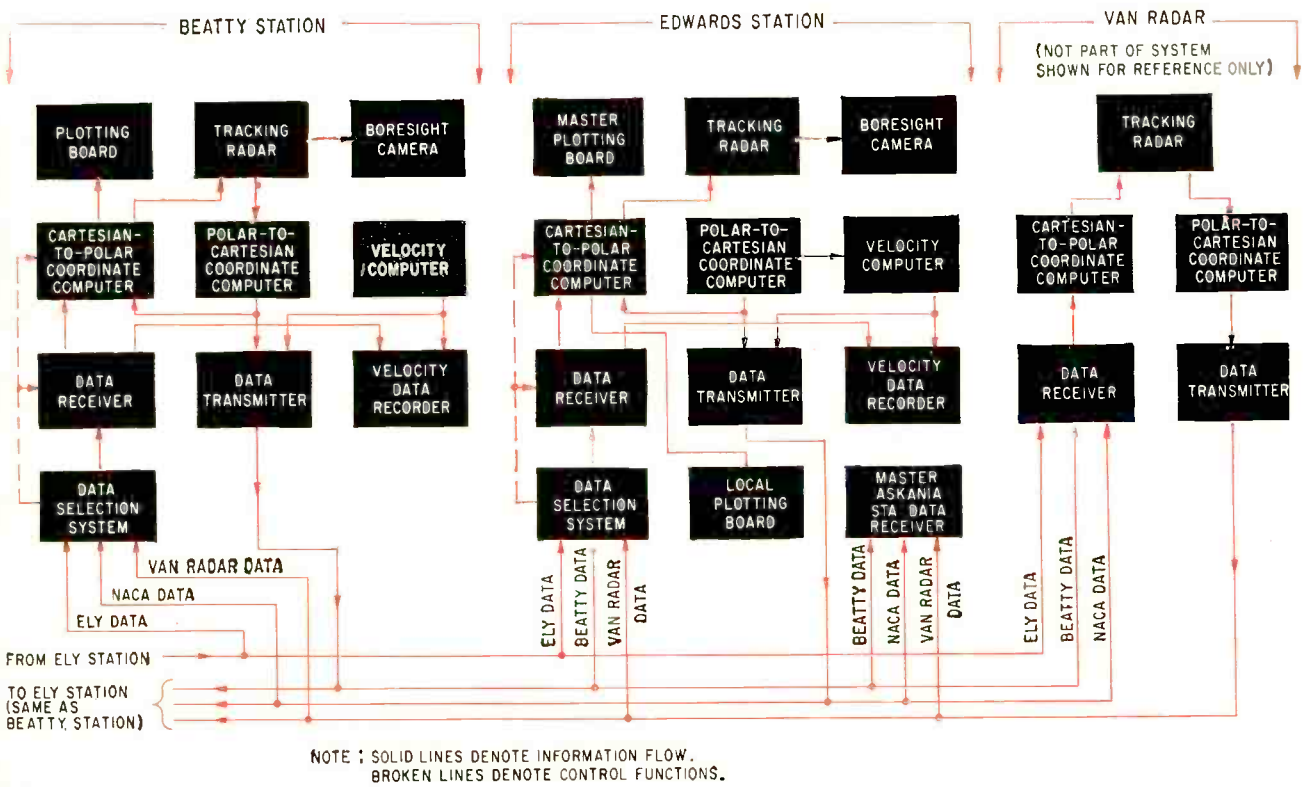
The binary-coded data are then recorded on magnetic tape, displayed on and photographed from a data panel and visually displayed on a monitor panel with neon lamps. Synchro-operated dials also display shaft position on the photo panels.

Range encoder is an etched-disk brush-contact unit made by G. M. Giannini Co. Encoder output is applied to a group of gates. On receipt of gate pulse, the coded data is transferred to a flip-flop storage register, and thence is converted from Gray to binary code.

Azimuth and elevation encoders are optical units made by Baldwin Piano Co. They employ a photoengraved code disk, behind which is a pulsed light source. Photodiodes located at the opposite surface of the disk collect the light transmitted by the transparent portions of the disk. Digital output from the diodes is amplified and shaped before being supplied to a flip-flop storage register and the Gray-to-binary converters.

Gray code is used as an initial stage to prevent ambiguities in readings. Misalignment of code-wheel slits and readout brushes could cause a miscount if binary code were used. In Gray code, one and only one digit changes when proceeding from one number to the next.

This establishes a clearly defined relationship between the two systems. In a 4-place code (adequate to count from 0 through 10), this relationship has the least significant bit the same for two counts and the opposite for two; the second place digit the same for four counts and the opposite for four;



NOTE : SOLID LINES DENOTE INFORMATION FLOW.
BROKEN LINES DENOTE CONTROL FUNCTIONS.

FIG. 3—Radar tracking and plotting system in the High Range illustrates role played by computing equipment

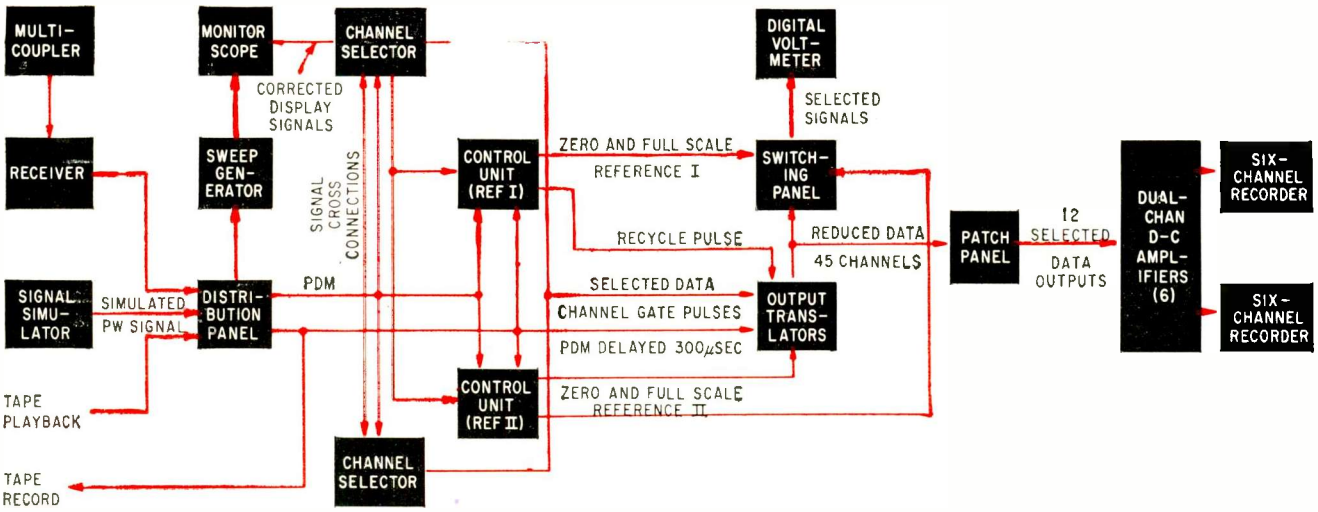


FIG. 4—ASCOP telemetering system ground station. The multicoupler is fed from an ASCOP preamp on the Bendix antenna system

the third place the same for eight and then reversing, and the most significant bit the same throughout.

Registers made up of bistable trigger pairs, connected by coincidence gates, are used to translate from one number system to the other. Since the more significant position affects the sense of the less, the circuits that pass the interrogation pulse from one storage element to another contain delay elements.

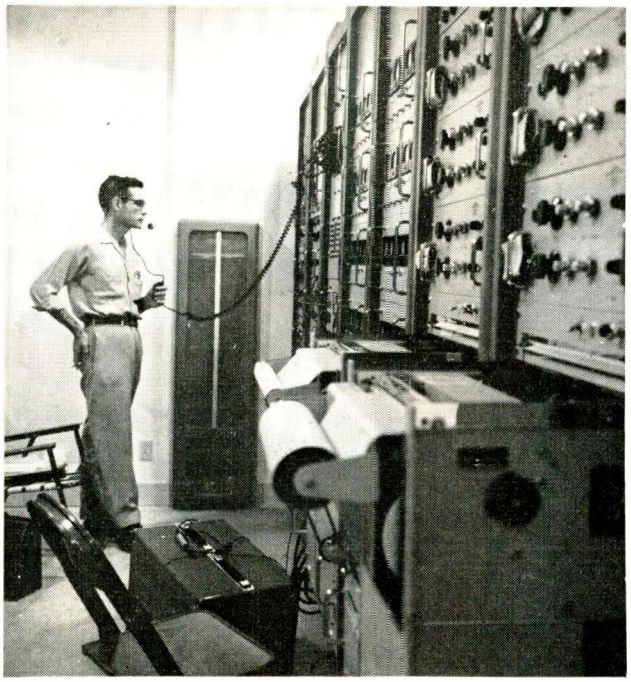
For a large register, many delay elements and amplifiers to compensate for decay of the transfer pulse are required.

Novel circuitry developed by EECo for the Gray-to-binary converters eliminates delay stages and compensating amplifiers. In essence, the EECo system simply involves pulsing all stages of a register simultaneously with a series of pulses. The number of pulses is always dependent on the number of digits in the register, but is always an odd number. This method takes advantage of the fact that shift-register flip-flops are characteristically slow in changing state to eliminate the delay elements.

For the 16-digit register used in this system, 15 conversion pulses are used. These are supplied at a 50-kc rate, and the entire conversion is completed in 300 microseconds.

Novel circuits developed by EECo for the Gray-to-binary converters eliminates delay stages between conversion flip-flops, taking advantage of the fact that these circuits are characteristically slow to change state.

After conversion to binary code, the data are displayed on the monitor and photo panels and read out in serial form onto magnetic tape. All three data channels are recorded on one track of the tape as time-shared multiplexed data. Time of day is recorded on a separate track of the tape.



ASCOP telemeter at the Ely station. Strip-chart recorders can be seen in foreground

COMMUNICATIONS—The air-ground communications system provides not only communications between the ground installations and both test vehicle and mother ship, but also communications between and within the three stations. Link from ground to air is a uhf system which enables men at any one of the three tracking stations to carry on two-way conversation with either the B52 mother ship or the X15. It is made up of Collins Radio AN/GRC-27 transmitter and receiver sets, plus a uhf communications control panel, uhf relay, amplifier and mixing panel.

Transmitters at all three stations are keyed to transmit simultaneously when any one is placed in operation. If a receiver at one ground station gets information from the air, the information is also fed to the other two. Regardless of the craft's position over the range, two-way communications from ground to air are always possible.

The other two subsystems enable men in one station to communicate with other men in the same station or in either of the other two.

Recognition system scans nuclear emulsion strips coated on glass, using image orthicon tube sighting through microscope. Tracks in emulsion caused by nuclear particles are recognized and counted by electronic circuits. Device greatly reduces labor, increases volume of data available from cyclotron

By PAUL V. C. HOUGH, J. A. KOENIG and W. WILLIAMS,
Michigan Memorial Phoenix Project and Randall Laboratory of Physics, U. of Michigan, Ann Arbor, Mich.

Scanner Recognizes

SPECIAL SILVER-BROMIDE-rich photographic emulsions are widely used as particle detectors. Nuclear emulsions are simple, record continuously in many energy channels simultaneously and have low background. But these advantages have been nearly vitiated by the need for slow and expensive microscopic scanning by human observers. This scanning problem is met by a recognition machine, equivalent to 15 human observers, which has been developed to read emulsions.

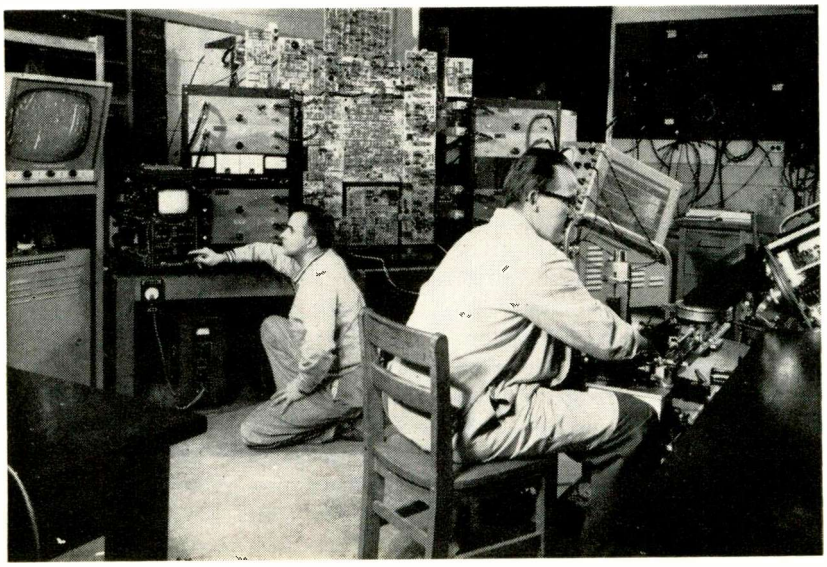
Protons from nuclear reactions are deflected by an analyzer magnet and brought to a focus on 1-in. by 10-in. by 0.004-in. emulsion strips. The relative position of a proton track from one end of the emulsion measures the proton's energy. If the number of proton tracks in 0.5-mm swaths across the 1-in. dimension of the emulsion is counted, an energy spectrum is obtained. The position and intensity of each peak gives information about a particular state of motion of neutrons and protons produced under bombardment by the cyclotron.

The machine recognition problem is complex because real tracks enter the emulsion over a range of angles and are often curved. Also, a great variety of background patterns in the emulsion must be rejected.

Detection of the faint tracks of high-energy particles and machine recognition of events such as nuclear explosions occurring in the emulsion are not yet possible but are the objectives of research.

Recognition System

In the recognition system, a standard microscope is arranged to project an image of an emulsion scene onto the photo surface of a 5820 image orthicon camera tube used as pickup in a television system. The nuclear emulsion, coated on glass, rests in a channel under the microscope objective. Figure 1A shows an emulsion scene photographed from a television receiver wired to the camera. The diagonal stripe is introduced by the motion of the focal plane shutter of the camera taking the photograph. The scene shows the background grains present in all nuclear emulsion and a proton track. The microscopic



Typical strip of nuclear emulsion on glass backing used in cyclotron

Nuclear particle tracks are clearly visible on tv screen at left as emulsion scene is scanned by tv camera through microscope at right

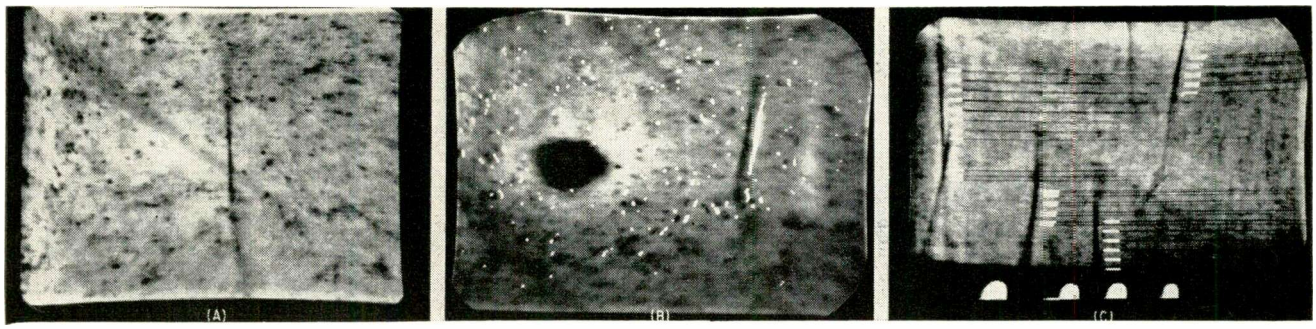
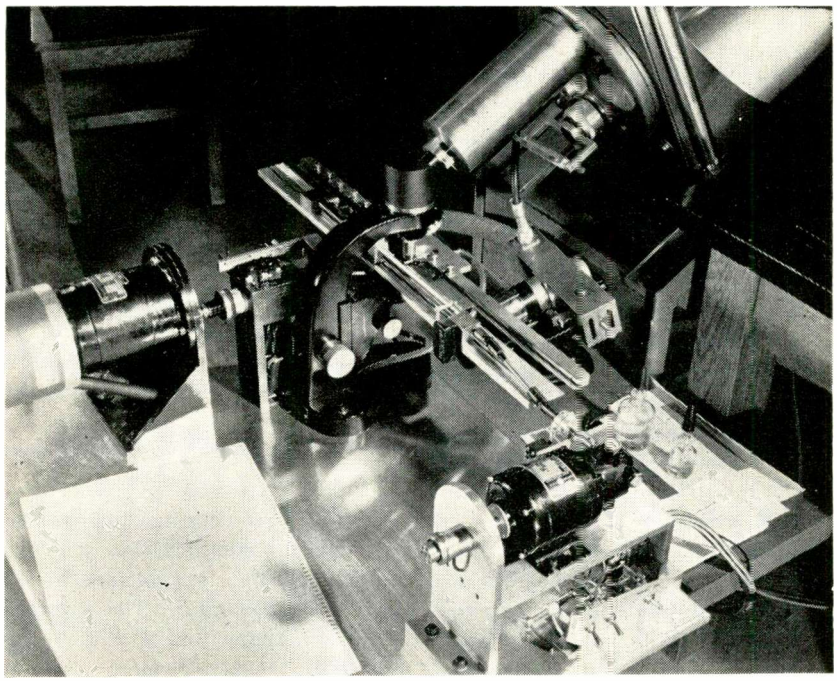


FIG. 1—Emulsion scenes photographed from tv receiver. (A) shows typical scene with background grains and proton track in center. In (B) pulses obtained from screening circuit are mixed with video. In (C) four tracks are clearly delineated by marks obtained from counters

Atomic Particle Tracks

depth of field is less than the thickness of the emulsion and the track can be seen to come into and go out of focus. The television scan lines are horizontal in the picture.

Track recognition proceeds in three steps: first, a unit pulse is generated when the television scanning spot crosses an opacity narrow enough to be part of a track. Large-area opacities are ignored. The result of the screening process is shown in Fig. 1B. In the background is an emulsion scene with background grains, a track, and a blob of silver—a common background element in emulsions. Mixed with the video signal are the unit pulses just mentioned which show white in Fig. 1B. The track and background grains are clearly marked but the blob is screened out.



Microscope projects image of emulsion scene enlarged 200 times onto photosurface of image orthicon

Binary Scaler

Second, a combination of a fast binary scaler and four ultrasonic delay lines is used to count up successive passes across a track. The circuit performs the count at all lateral positions in the field of view, counts up several tracks in the field simultaneously and tests clumps of background grains continually for track possibilities.

Third, only one count is obtained for each track. The situation is illustrated in Fig. 1C. A scene is shown with four tracks (dark vertical lines), the maximum number normally encountered per field. The white marks to the right of each track are obtained from the counting circuits at the 32nd, 40th, 48th, etc., successful pass across each track. Because of fluctuations in dip angle and quality of development, the various tracks show different total counts. What is needed is a summing of whatever number of white marks may occur for a given track; however, summing is complicated by the fact that pulses from different tracks occur interleaved in time.

The solution to the summing problem can be seen at the bottom of Fig. 1C. An auxiliary oscilloscope is swept in synchronism with the horizontal scanning beam of the television camera. The oscilloscope trace is brightened when each of the counting markers of Fig. 1C occurs; therefore one spot per track appears on the oscilloscope. To make use of the excellent light-integrating properties of the image orthicon tube, the spots are projected onto the bottom of the television camera field of view. Finally a single television scan line through the spots is selected for

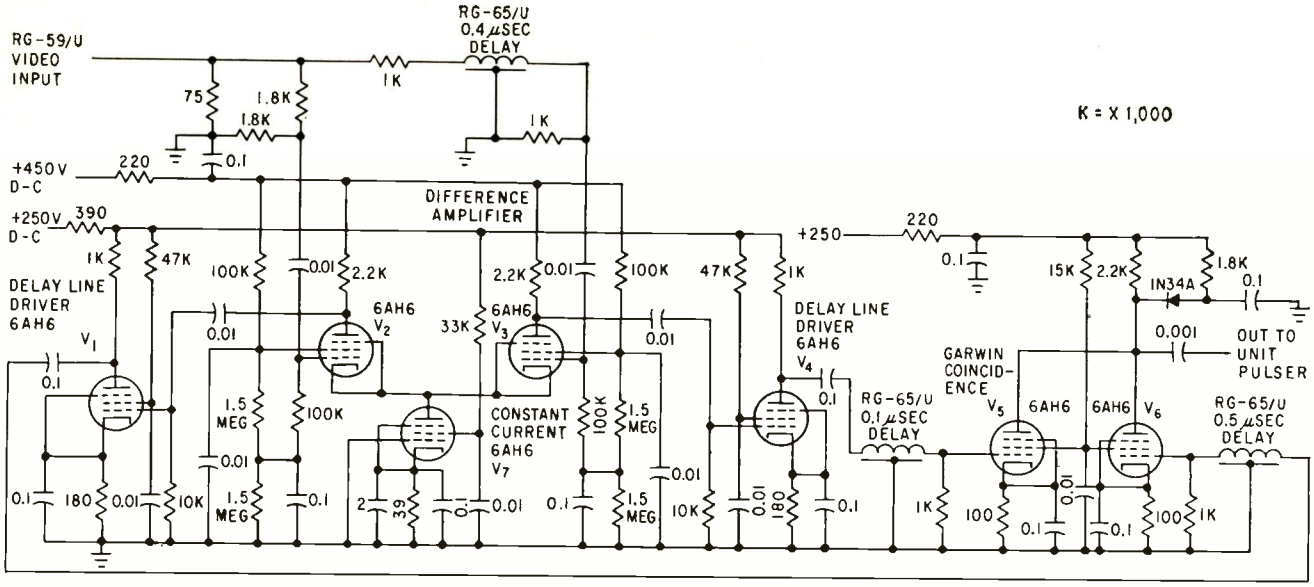


FIG. 2—Schematic diagram of the video screening circuit. Opaque regions on emulsion which meet narrowness criteria trigger monostable multivibrator (not shown)

readout and the number of spots is recorded by a counter.

The summing technique just described is limited to tracks deviating by less than about ±20 deg from the vertical. Steps 1 and 2 operate successfully for tracks inclined at angles up to about 45 deg.

Video Screening

Initial screening for narrowness is accomplished in the circuit of Fig. 2. The video signal from the television camera is presented directly to the grid of one stage of a difference amplifier V_2 and after a 0.4-μsec delay, to the grid of the other stage V_3. The output of the difference amplifier represents the difference in light level at two points along a scan line separated by half the width of a track.

The negative output of delay line driver V_1, which occurs as the television scanning spot enters the track, is delayed 0.5-μsec to coincide with the negative output from delay line driver V_4 as the scanning spot leaves the track. The two coincident negative pulses are applied to the grids of a Garwin coincidence circuit[1], V_5 and V_6, whose output drives a 0.5-μsec monostable multivibrator which generates the white unit pulses of Fig. 1B. Any opacity greater than twice the width of a track fails to trigger the Garwin circuit and is therefore ignored.

The unit pulses resulting from the video screening are inserted in a quartz ultrasonic delay line[2] as damped 40-mc oscillations each about 0.1 μsec long. The damped oscillation generator of Fig. 3 has proved to be satisfactory.

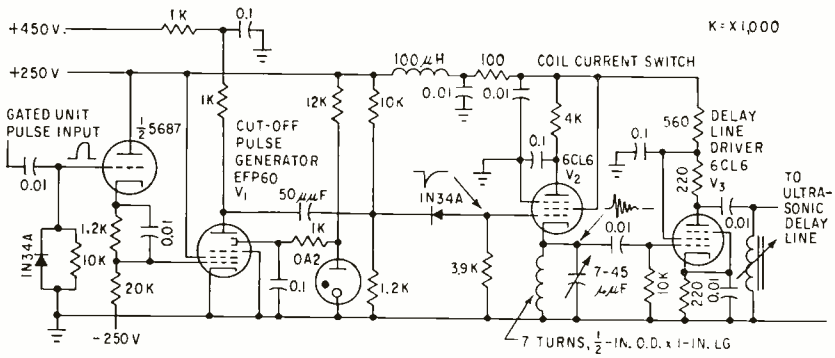


FIG. 3—Circuit diagram of the 40-mc damped oscillation generator

The EFP60 secondary emission pentode V_1 drives pentode V_2 to cutoff in a few milliμsecs. Cutoff time must be a quarter period or less to get a large-amplitude damped oscillation in the tuned circuit in the cathode. On extraction from the delay line the damped oscillations are amplified by two commercial broadband amplifiers and detected at a level of about 1 v.

The overall ultrasonic delay time is 63 μsec as compared with a time between successive television scan lines of 63.5 μsec. Extracted pulses are used to close a gate on the first delay line and open a gate on a second line, both for 1 μsec. If a second pass across a track occurs within the 1-μsec period a pulse is inserted in the second line. Figure 4 is a block diagram of the system.

Delay Lines

A total of 4 delay lines is used. At any stage of the counting, the number of track passes N is inserted in the 4 lines as a binary number ($N \leq 15$). At the next count, $N + 1$ is formed in a fast binary scaler, gating the four lines in binary representation of $N + 1$. The gate time of 1 μsec allowed for receipt of the $(N + 1)$th successful track pass permits tracks at angles up to ±45 deg to be counted.

Moderately curved tracks are counted as well as straight tracks. Ordinarily, counting goes on at several lateral positions in the field at once, since clumps of background

grains are continually tested for track qualification.

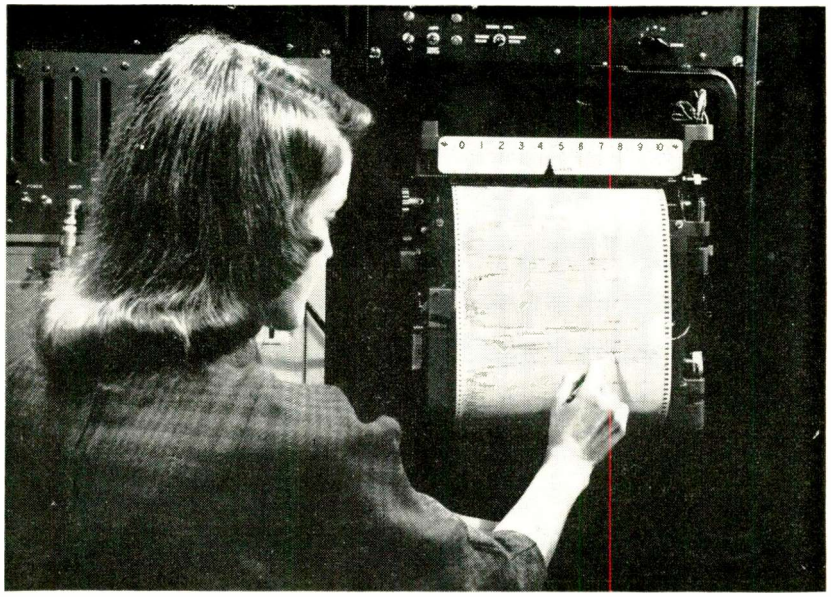
Readout Line

A commercial synchronizing generator provides the master timing for the television system. In this circuit the field repetition rate is obtained by a binary countdown from the line repetition rate. Associated with each line of the television raster is a particular pattern of on and off for the countdown binaries. A standard multidiode coincidence gate[3] senses any desired pattern and selects any line of the raster. A cathode follower direct-connected to the proper plate on each binary drives each diode of the gate without loading the binary.

Pulsed Light Source

New fields of view are presented by the microscope stage drive each 1/60th sec. Under steady illumination the picture blurs, so illumination is provided in short bursts at the end of each television field. A 0.3-μf capacitor charged to 3,000 v is discharged through a xenon flash-tube by a 5C22 hydrogen thyratron on command of the television vertical drive pulse. The light pulse lasts about 10 μsec.

The total number of tracks encountered in a 0.5-mm by 1-in. swath representing four passes across the emulsion is printed on a tape and plotted on a chart recorder. Scales of 0-100 and 0-1,000 tracks are provided. The number of tracks n is plotted with its standard error $\pm\sqrt{n}$. The error magnitude is derived from a square root potentiometer mounted on the same shaft as the balancing potentiometer of the recorder.



Final readout of recognition system is energy spectrum chart shown being examined by analyst

Performance

Over a recent three-week period the scanner read 52 emulsions corresponding to 35 man-weeks of human scanning, and was therefore equivalent to a crew of about 12. With more experience this equivalence figure may reach 20. One highly trained technician is required to run the machine and close collaboration with the physicist responsible for the experiment is essential.

Spurious counts produced by the machine arise almost entirely from real tracks which fail to satisfy criteria easily applied by human observers. For example, in long exposures at the cyclotron, neutrons produced elsewhere in the room collide with hydrogen atoms in the emulsion, producing tracks with one end wholly within the emulsion. Such tracks are rejected by humans but not always by the machine. At its lowest, the spurious count by the machine is 2 or 3 per 0.5 mm by 1-in. swath; hence about a dozen tracks are required in a real proton group for reliable detection.

The machine saturates at about 2,500 tracks per 0.5-mm by 1-in. swath. Over its useful intensity range of say 10 to 1,500, it is accurate to within ± 5 percent which is sufficient for most nuclear reaction studies.

Development of the scanner has been supported by the U. S. Atomic Energy Commission and the Michigan Memorial Phoenix Project. G. R. Garrison, Director, and F. M. Remley, Jr., Technical Director of the University television station provided support and technical assistance at critical stages of the research. The work of B. Cosby on the recording system and R. O. Winder on problems of logical design is gratefully acknowledged.

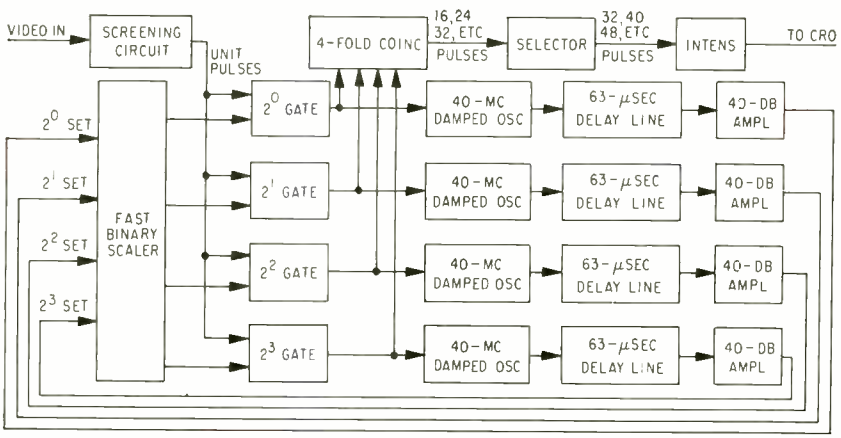


FIG. 4—Block diagram of counting circuits which convert number of track passes to binary number inserted into four delay lines

References

(1) R. L. Garwin, *Rev Sci Inst*, 24, p 618, 1953 and 21, p 569, 1950.
(2) Supplied by Andersen Laboratories, West Hartford, Conn.
(3) J. Millman and H. Taub, "Pulse and Digital Circuits", Sec 13-3, McGraw-Hill Book Co., Inc., New York, N. Y., 1956.

A-C Computing Resolvers:

This roundup of size 15 resolvers follows the tabulation in the previous issue of ELECTRONICS, which listed sizes 8, 10 and 11. The next issue will list sizes 18, 23 and 25

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SINCE RESOLVER manufacturers do not present data in a standardized way, the following tabulation can only serve as a general guide to electrical resolvers. For example, some manufacturers obtain performance data from typical current-production resolvers and some manufacturers obtain their data from their best resolvers.

When the tuned input impedance, Z_{it}, is not listed, it may be computed from Z_i, the input impedance measured when the secondary is open. The input current and power can then be calculated from Z_{it} and the input voltage.

The stator is the input winding unless the notes column specifies the rotor. The transformation ratio, TR, is the ratio of the output to the input voltage (rotor to stator for stator input and stator to rotor for rotor input).

When either of the two compensator winding ratios, TR_{sc} or TR_{cr}, is given, the other can be calculated from the relation $TR = TR_{sc} \times TR_{cr}$.

An x in a tabulation space indicates the column head does not apply. A blank space indicates the information was unavailable or that it can be calculated.

KEY

AE	American Electronics
CPP	Clifton Precision Products
Kear	Kearfott
M	Muirhead
NK	Norden Ketay
V_i	maximum input voltage
Z_i	Input Z, secondary open
Z_{it}	tuned input Z
Acc.	accuracy in % of function deviation or minutes of spread
Axis	interaxis error
TR	transformation ratio, output/input voltage
TR_{sc}	TR, stator/compensator v
TR_{cr}	TR, compensator/rotor v
θ	phase shift
Comp.	compensator winding

Mfr., Model No.	Size	Diam (in)	Length (in)	Test f (cps)	V_i (v)
AE, 1R15W4-424	15	1.437	1.916	400	26
AE, 1R15W4-425	15	1.437	2.5625	400	60
AE, 1R15W4-426	15	1.437	1.954	400	60
AE, 1R15W4-432	15	1.437	2.0	500	5
AE, R15-3500A	15	1.437	2.356	3,500	60
AE, R15-3500B	15	1.437	2.356	3,500	60
AE, R40739	15	1.437	2.5	400	70
Bendix, AY910A1	15	1.437	2.027	400	26
Bendix, AY220S5	15	1.437	1.631	400	26
Bendix, AY221S25	15	1.437	1.631	400	26
Bendix, AY221S27	15	1.437	1.631	400	26
Bendix, AY220S38	15	1.437	1.631	400	26
Bendix, AY221S51B	15	1.437	1.631	400	26
Bendix, AY240S5	15	1.437	1.631	400	26
Bendix, AY251S24	15	1.437	1.631	70,000	2
Bendix, AY251S39	15	1.437	1.631	70,000	2
CPP, CZC15JS2	15	1.437	1.886	500	115
CPP, CZC15JS3	15	1.437	1.886	1,600	115
CPP, CZC15JS4	15	1.437	1.886	400	60
CPP, CZC15JS5	15	1.437	1.886	400	60
CPP, CZC15JS6	15	1.437	1.886	1,000	30
CPP, CZC15JS7	15	1.437	1.886	1,000	23
CPP, CZC15JS9	15	1.437	1.886	400	100
CPP, CZC15JS01	15	1.437	1.886	400	60
CPP, CS15D1	15	1.437	1.640	400	26
CPP, CS15D4	15	1.437	1.640	400	26
Edison, S215RX20	15	1.437	1.631	400	11.8
Ford, 76-161	15	1.437	1.631	400	21
Ford, 76-162	15	1.437	1.631	400	24
Ford, 76-163	15	1.437	1.631	400	24
Ford, 76-164	15	1.437	1.631	400	24
Ford, 76-165	15	1.437	1.631	400	24
Ford, 76-166	15	1.437	1.631	400	24
Kear., T980-51	15	1.437	3.565	400	26
M, F15C6-A/1	15	1.437		400	40
M, F15M6-A/1	15	1.437		400	40
NK, 105D2C (15RS4L)	15	1.437		400	26
NK, 105D2D	15	1.437		400	26
NK, 105D2E	15	1.437		400	26
NK, 105D2A2	15	1.437		400	90
NK, 105D2K1	15	1.437		400	26
NK, 105D2K2	15	1.437		400	26
NK, 105D2K3	15	1.437		400	26
NK, 105D8D	15	1.437		1,000	30
NK, 105D2Z	15	1.437		400	26
NK, 105D9E	15	1.437		500	50
NK, 105D2F	15	1.437		400	26
Oster, 15-4011-02	15	1.437		400	11.8
Oster, 15-4015-04	15	1.437		400	18
Oster, 15-4013-02	15	1.437		400	26
Oster, 15-4012-06	15	1.437		400	11.8
Reeves, R150-102	15	1.437	1.923	400	12
Reeves, R150H-102	15	1.437	1.923	400	30
Reeves, R150HH-102	15	1.437	1.923	400	10
Reeves, R151-102	15	1.437	1.923	400	60
Reeves, R151S-102	15	1.437	1.923	400	60
Reeves, R151H-102	15	1.437	1.923	400	30
Reeves, R151HH-102	15	1.437	1.923	1,000	30
Reeves, R151HM-102	15	1.437	1.923	400	20
Reeves, R151L-102	15	1.437	1.923	400	100

Size 15 Tabulation

Z_t (ohms)	Z_{tt} (ohms)	Acc. (% or min)	Axis error (min)	TR	TR_{ec}	TR_{er}	θ (deg)	Null (mv)	Low f (cps)	High f (kc)	Res Stator (ohms)	Res Rotor (ohms)	Res Comp. (ohms)	Notes
480 + j2,500	13,500	0.1%	5	0.98			8.5	26	60	80	390	320		Compensated
240 + j1,000	4,400	0.1%	5	0.98			8.0	60	60	80		130		Compensated
475 + j2,760	17,000	0.1%	5	0.98			6.0	60	60	60	300	200		Compensated
50 + j220	1,020	0.1%	5	0.98			3.5	5	60	60	15	15		Compensated
1,060 + j3,080	10,000	0.1%	5	1.0	x	x		60					x	
2,520 + j8,150	28,800	0.1%	5	1.0	x	x		60					x	
3,500 + j10,500	35,000	0.1%	10	1.0	x	x	0.5	70	30	2.8	500	4,000	x	
400 + j2,000		15′		0.350		0.990	5				420	22	420	Compensated
400 + j120		20′		0.662	x	x	10				175	400	x	Rotor input
108 + j440		12′		0.455	x	x	7	40			11.5	50	x	Rotor input
108 + j425		12′		0.455	x	x	6				12.5	53	x	Rotor input
510 + j2,500		12′		0.693	x	x	8.7				160	375	x	Rotor input
83 + j415		0.0185%	3	0.455	x	x	6.3				11.5	50	x	Rotor input
240 + j130		20′		0.693	x	x	55				180	239	x	Rotor input
		60′		0.68	x	x		20			1.6	4.2	x	
		30′		0.65	x	x		20			1.65	4	x	
605 + j3,320	19,000	0.1%	5	0.98	x	x	4.5	75	35	28	247	440	x	
3,000 + j9,100	33,000	0.1%	5	1.08	x	x	1	70	35	35	240	530	x	
500 + j2,830	14,000	0.1%	5	0.98		0.97	6.0	60	41	40	296	243	290	Compensated
370 + j2,880	19,000	0.1%	5	0.98	x	x	2.75	60	18	35	122	243	x	
69 + j245	925	0.1%	5	0.98		0.98	4	30	63	210	16	13	32	Compensated
32 + j113	424	0.1%	5	1.00		1.00	3	23	45	475	5.6	4.7	10.8	Compensated
1,325 + j5,655	22,000	0.1%	5	0.99		1.00	7	100	51	30	682	575	682	Compensated
256 + j2,794	23,000	0.1%	5	0.30		0.244	2.5	60	18	175	128	22	44	Compensated
110 + j520		10′		0.455	x	x	8.5	26			13	74	x	Rotor input
480 + j6,300		10′		0.455	x	x	8.5	26			53	314	x	
25 + j100		12′		1.75	x	x					12	50	x	
650 ∠78°		0.10%	5	0.12	x	x	9	24					x	
650 ∠78°		0.15%	5	0.12	x	x	9	24					x	
650 ∠78°		0.15%	5	0.24	x	x	9	24					x	
650 ∠78°		0.25%	5	0.24	x	x	9	24					x	
650 ∠78°		0.15%	5	1.02	x	x	9	24					x	
650 ∠78°		0.25%	5	1.02	x	x	9	24					x	
220 + j1,000		0.1%		0.98	0.950		8.5	8						Compensated
		0.4%		1	x	x							x	
		0.2%		1	x	x							x	
585 ∠81°		20′	10		x	x		25					x	
2,000 ∠72.5°		40′	10		x	x		50					x	
465 ∠61.3°		20′	5		x	x		50					x	
3,280 ∠82.1°		0.1%	5	1										Comp.; Null 10 mv at 10 v
890 ∠78°		0.1%	5	1										Compensated
890 ∠78°		0.15%	5	1										Compensated
890 ∠78°		0.20%	5	1										Compensated
		0.20%	5		x	x							x	Sweep
950 ∠82°		40′	20	1	x	x							x	Resolver
	15,000	0.15%	5	1	x	x							x	
740 ∠80°		0.10%	5	1	x	x							x	
72 + j497		20′		1	x	x	6.8	50			14	55	x	Rotor input
831 + j2,381		20′		0.99	x	x	7.28	40			160	375	x	Rotor input
37 + j194		45′		1.01	x	x	4.56	40			206	22	x	Rotor input
139 + j1,134		0.14%		1	x	x	2.3				175	70	x	Rotor input
463 + j2,750	20,000	0.1%	5	0.955	x	x			24		170	190	x	
95 + j780	7,000	0.1%	5	0.955	x	x			24		47	60	x	
30 + j182	1,100	0.1%	5	0.955	x	x			24		11	15	x	
560 + j2,750	16,000	0.1%	5	0.980	0.985				42		295	190		Compensated
560 + j2,750	16,000	0.1%	5	0.980	1.000				42		295	190		Compensated
	4,300	0.1%	5	0.950	0.955						90	60		Compensated
52 + j1,250	1,200	0.1%	5	0.985	1.000				48		16	12		Compensated
	2,500	0.1%	5	0.980	0.990				45		60	40		Compensated
1,100 + j5,500	27,500	0.1%	5	0.980	0.985				40		550	425		Compensated

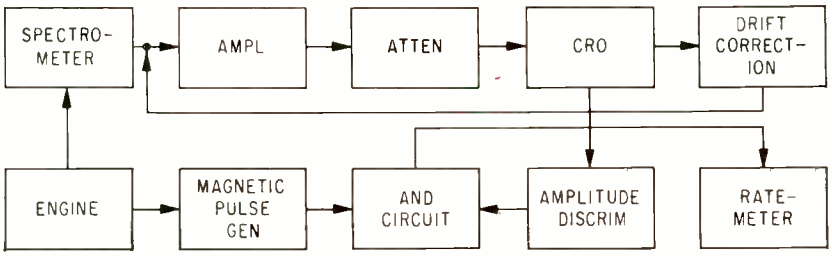

FIG. 1—Block diagram of combustion analyzer system

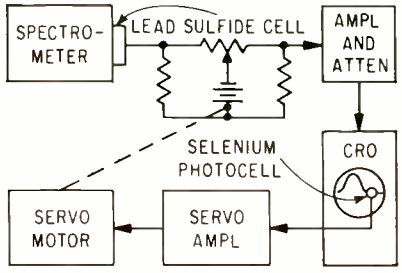

FIG. 2—Method of drift compensation

Gated amplitude ratio indicator accurately measures cylinder gas temperature as a function of engine-cycle phase angle. Gas temperature is determined by synchronous sampling combined with infrared spectroscopy. System drift is compensated by photocell mounted on oscilloscope

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Gated Ratio Indicator

AN ACCURATE METHOD for measuring the temperature of engine cylinder gas as a function of phase angle of the engine cycle is provided by the gated amplitude ratio indicator. This instrument indicates the ratio of two infrared radiation intensities emitted by the gas at two known wavelengths. The relationship between temperature and radiation intensity of a radiating medium is derived from Planck's law.

The system block diagram is shown in Fig. 1. A commercial infrared spectrometer determines the wavelength of the radiation which is diffracted to an associated lead sulfide detector and subsequently converted to an analog voltage signal. The infrared radiation is transmitted to the spectrometer through a quartz window in the engine cylinder wall.

Sampling Pulse

The synchronous sampling pulse is produced by a magnetic pulse generator connected to the engine cam shaft. This pulse occurs once each engine cycle at a phase angle which can be adjusted to any desired value. The pulse generator is electromechanical and uses a commercial magnetic proximity pickup.

After amplification, the radiation signal is applied to an amplitude discriminator. The discriminator output state is determined by whether or not the instantaneous signal amplitude is greater than the discriminator threshold. If, at the instant the sampling pulse is generated, the radiation signal is greater than the threshold, a coincidence pulse is produced by the AND circuit. The average coincidence pulse rate is indicated by a ratemeter calibrated in percent. A 100-percent indication results when, during the averaging time of the ratemeter, a coincidence pulse occurs each time the sampling pulse is generated.

Threshold

To measure the amplitude ratio, the spectrometer is adjusted to the wavelength yielding the smaller of the two signals. The amplified signal is coupled to the amplitude discriminator without attenuation by the calibrated attenuator. The discriminator threshold is adjusted to the median value of the sampled signal amplitude (50 percent coincidence rate). The spectrometer is then set to the second wavelength. The calibrated attenuator is adjusted so that the ratemeter indicates that the median value of the attenuated signal amplitude is equal to the previously set discriminator threshold. The median ratio of the sampled amplitudes is indicated by the calibrated attenuator dial. Repeating this operation at other sampling phase angles yields the amplitude ratio versus phase angle relationship.

Drift Compensation

Frequency components of the radiation signal are such that direct coupling is required throughout the system. Large d-c drifts must be compensated, especially in the lead sulfide detector. The method used is shown in Fig. 2. A differential photocell is mounted on the face of the oscilloscope so that it sees a portion of the radiation waveform which is constant and independent of the spectrometer wavelength setting. The differen-

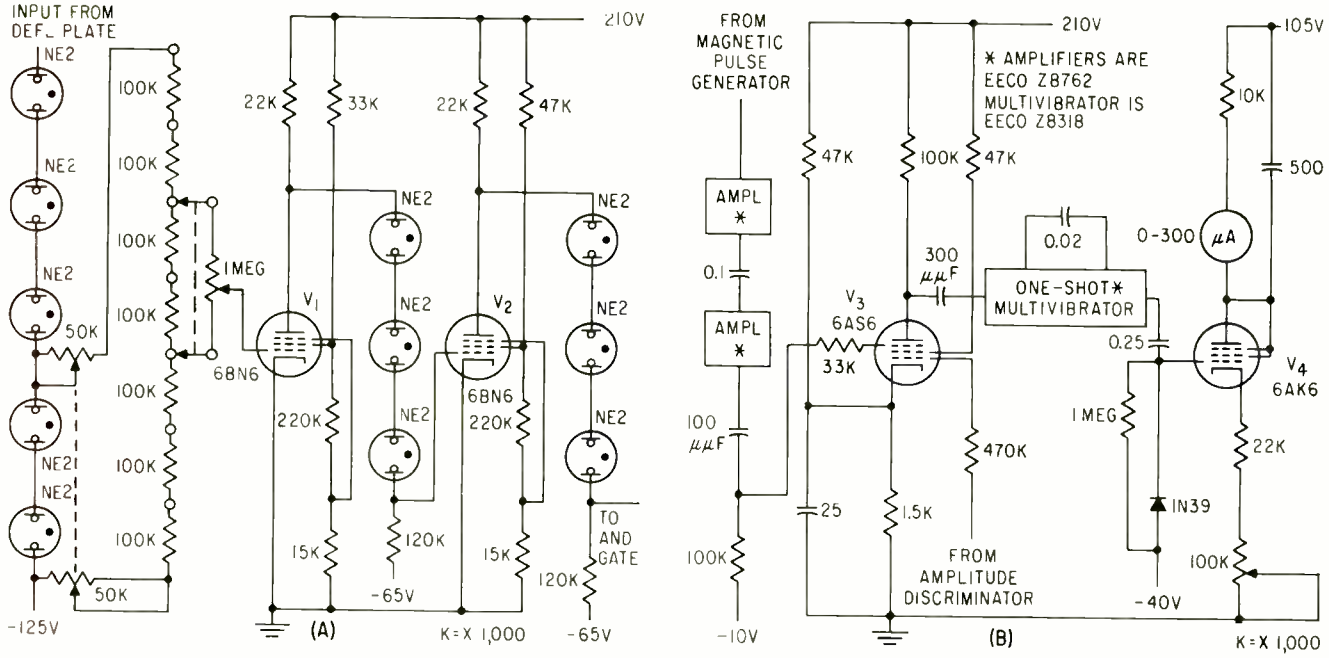


FIG. 3—Schematic diagram of (A) amplitude discriminator and (B) AND gate and ratemeter circuit. Three-control voltage-divider network in (A) provides coarse, medium and fine threshold adjustment

Aids Engine Research

tial photocell generates a voltage proportional to the displacement of the oscilloscope trace from the horizontal centerline of the photocell. This error voltage is amplified by a servo amplifier which drives a servo motor. The servo motor drives a potentiometer whose position determines the amplitude and polarity of a correction voltage added to the radiation signal. Thus, the correction voltage is controlled to a value which clamps the radiation waveform at a constant vertical position on the oscilloscope. Therefore the deflection plate voltage waveform is clamped to a fixed d-c level.

The differential photocell is made by scribing a narrow groove along the centerline of the sensitive surface of a commercial selenium barrier-layer cell. The two semicircular sections which result are connected in series opposition.

Amplitude Discriminator

The direct-coupled amplitude discriminator circuit of Fig. 3A, uses slicing techniques rather than trigger discrimination, because of the hysteresis inherent in the latter method. Discrimination is accomplished by amplifying a 0.1-percent slice of the radiation signal to a value which is sufficient to reliably actuate the AND gate following the discriminator.

Total gain of the two direct-coupled 6BN6 gated-beam amplifiers V_1 and V_2 is about 250. A 50-mv change in the instantaneous signal amplitude produces a 12.5-v change in the plate voltage of V_2. This value is more than sufficient to actuate subsequent gating circuits. A 4-v change in grid voltage is sufficient to drive a 6BN6 from cut-off to saturation. The resulting clipping action limits the dynamic range over which the neon coupling networks must operate.

The quiescent voltage upon which the radiation signal is superimposed at the grid of V_1 is determined by the voltage divider which is connected across two of the five neon bulbs in the input network. Thus, circuit threshold is adjustable over a nominal 120-v range. A three-control voltage-divider network provides coarse, medium and fine threshold adjustment.

The AND gate and coincidence ratemeter circuits are shown in Fig. 3B. The proximity pickup in the magnetic pulse generator produces a signal proportional to the flux rate of change resulting when a thin blade is rotated past the pickup. The resulting derivative signal overdrives the two amplifier stages providing positive and negative clipping. The amplifier output is differentiated, yielding a narrow positive pulse which occurs when the rotating blade is directly beneath the magnetic proximity pickup. This pulse is applied to the suppressor grid of conventional gate V_3. If the amplitude discriminator output signal is simultaneously present at grid no. 1, a coincidence pulse is produced at the plate of V_3.

The coincidence pulses are shaped by a one-shot multivibrator whose output drives the ratemeter circuit. This ratemeter circuit consists of cathode follower V_4 whose average plate current flows through a 300-μa meter. The meter is calibrated in percent coincidence.

The indicator is expected to yield a better understanding of the combustion process.

Underwater Telemeter

Telemeter determines the exact depth of trawl net under the water, making it easy to intercept schools of fish that travel at various depths. Continuous depth information is available down to 1,200 feet. Temperature information is impressed on a modulated f-m carrier as an a-m tone

By **FRANK H. STEPHENS, JR.,** President, F. Hastings Stephens Laboratories, Miami, Florida

MIDWATER TRAWL method of catching great quantities of fish at one haul intercepts fish which travel at intermediate depths of the ocean. Fish in schools usually travel at various depth levels and, unless definite information is available concerning net position, a miss is more probable than a successful haul.

The telemeter system described here supplies accurate information on trawl-net depth and water temperature. In midwater trawling, a definite target is seen on the electronic depth sounder. Navigation is then established to adjust the towed trawl net to the proper depth required to intercept the fish spotted on the sonar. The net may be at the end of a 3,000 to 5,000-ft steel cable. The actual position of the net below the surface is a function of such factors as vessel speed, rigging, adjustment, various current directions and net content.

A successful intercept results in a valuable catch, since it consists of food fish of one kind, and contains few undesirable fish.

The telemeter provides continuous depth information over a range of zero to 200 fathoms—to 1,200 feet—with a resolution accurate within one percent. Reliable transmission is obtained up to 5,000 feet, barring extreme hydrographic conditions. Temperature is sensed to an interface of 0.5 C, which is sufficient for this operation.

The telemetering system transmits information as modulation of a high-frequency sonic carrier. The transmitter, powered by self-contained batteries good for 15 hours, is affixed to the trawl net rigging, so that its directional transducer is aimed towards the towing vessel. At the receiving end, a similar transducer, suspended over the side of the towing vessel below the water line, is aimed towards the trawl net. Figure 1 shows the trawl attached to the fishing vessel.

To obtain high resolution, an f-m system uses exceptionally large frequency deviations to express depth. The variable frequency range of the carrier allows an instability of ±150 cps as a one-percent error. Temperature information is impressed on the modulated f-m carrier as an a-m tone whose frequency varies approximately as the temperature.

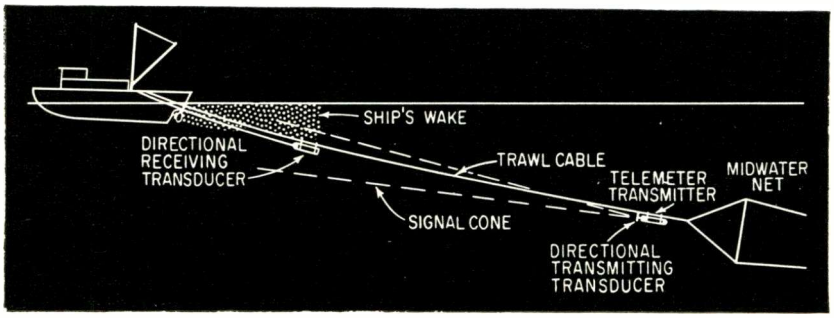


FIG. 1—Diagram of the depth-temperature telemeter shows trawling position

Readout of depth and temperature at the receiving end is accomplished by comparing carrier and tone frequencies against a calibration chart.

Transmitter

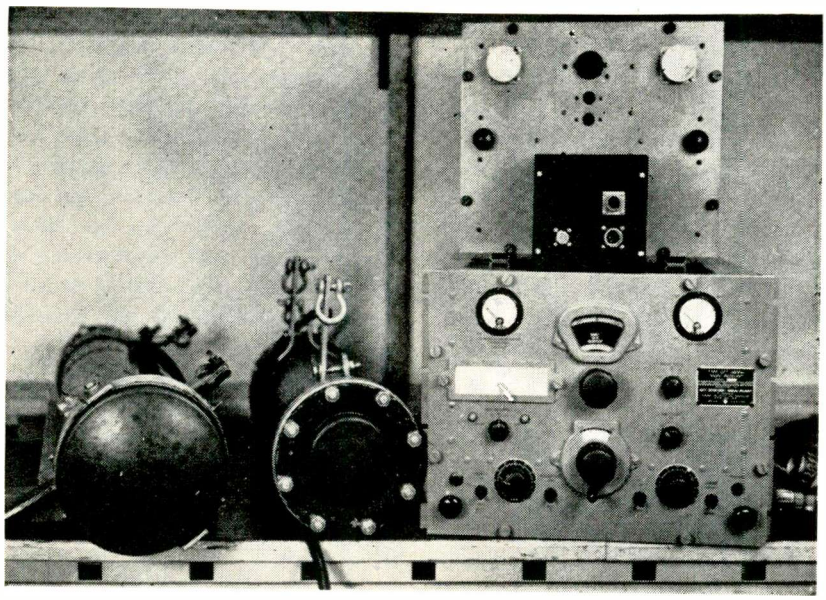
The transmitter, Fig. 2, generates a carrier between 21 and 36 kc at one to two watts. The oscillator is extremely stable to power supply fluctuations. Negative feedback and a variable mu pentode for amplitude control practically eliminate frequency shift due to supply voltage changes.

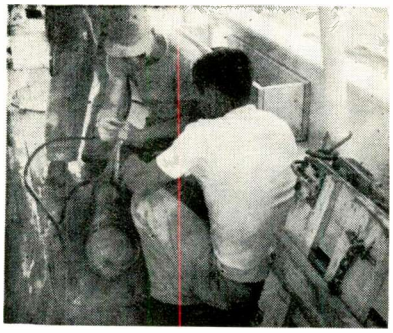
The completed unit has an operating efficiency approximately equal to $1\sqrt{2\pi RC}$, where R and C are effective resistance and capacitance of the arms of the Wien bridge circuit. Variation of frequency is linear with respect to changes in R or C. Rough measurements of oscillator linearity indicate a value of better than 3 percent over the entire range.

In the phase-shifting network, which is mounted on one end cap of the instrument, R_1 and C_1 are high-frequency and low-frequency adjustments respectively. Diode D_1 functions as the agc rectifier and supplies the control bias for the variable-mu amplifier V_1. Positive feedback, adjusted at R_2, sets the oscillation level. This adjustment, made at the lowest operating frequency, provides −5-v d-c at point A.

Modulator tube V_6 mixes the depth and temperature signals so they may be transmitted together. The plate circuit of V_6 contains a

For Trawl Fishing





Telemeter hydrophone is being adjusted in preparation for a midwater trawl

Telemeter assembly showing transmitter, receiving hydrophone, power supply, preamplifier and conventional radio receiver

single-section, constant-K, high-pass T filter which has a low-frequency cutoff of about 10 kc. It prevents the modulating signal, about 200-800 cps, from appearing at the grid of V_3. The carrier level, adjusted independently of modulation level by R_3, is set while observing the output waveform at the secondary of T_1 when it is properly loaded. Tube V_3 supplies the energy to drive the grids of V_4.

Output transformers T_2 and T_1 and the filter reactor L_1, were especially designed for this application.

The modulating signal is supplied by V_5. The temperature-sensing element, a thermistor, is encased in a special oil-filled brass housing which is screwed to the end cap of the instrument. High-temperature and low-temperature adjustments are provided by R_4 and R_5 respectively. The sawtooth output from V_5 is shaped by an R-C network and D_2, to provide a modulating waveform more closely resembling a sine wave.

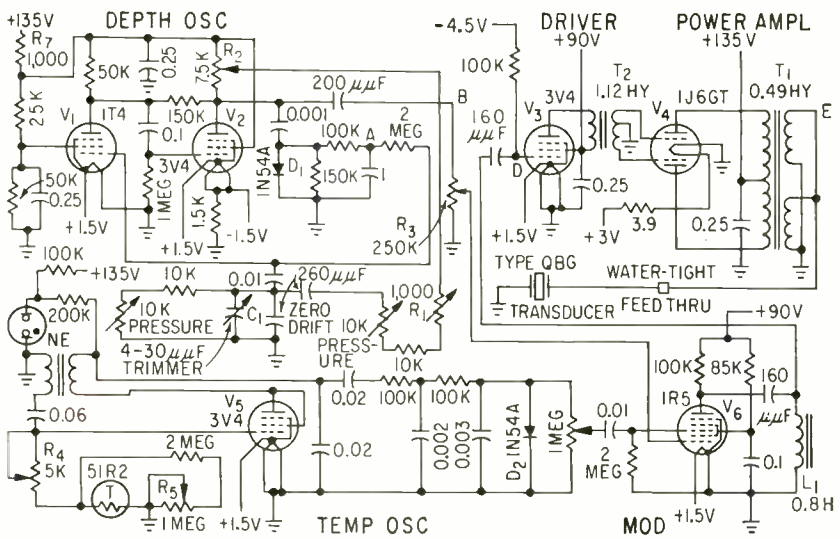


FIG. 2—Telemeter transmitter circuit diagram. The modulating signal is supplied by V_5

This makes the tone at the receiver more easily identified and provides efficient modulation within the bandpass of the receiver. The modulation percentage varies inversely with modulation frequency at about 12 db per octave, which is not undesirable. Modulation is increased in colder water which, in general, is deepest.

Other information could be impressed on the carrier by the fairly linear modulator. Modulation percentage, independently of carrier level, made at the 1 meg adjust from V_6, is made at the low-temperature limit, while observing output waveform at the secondary of T_1, to avoid overload. Overload would cause a multiplicity of sidebands making it difficult to identify the carrier on the receiver.

The transducer, affixed to the telemeter housing, allows angular positioning for its transmitting direction. The transducer, a Navy QBG crystal unit, was chosen for its directional characteristics and power gain. Its resonant point lies somewhere around 26 kc when fed from a 150-ohm impedance source. The high efficiency point is near the proposed optimum operating depth, 100 fathoms.

The modulated waveform, taken at point D, Fig. 2, measured 9.5-v

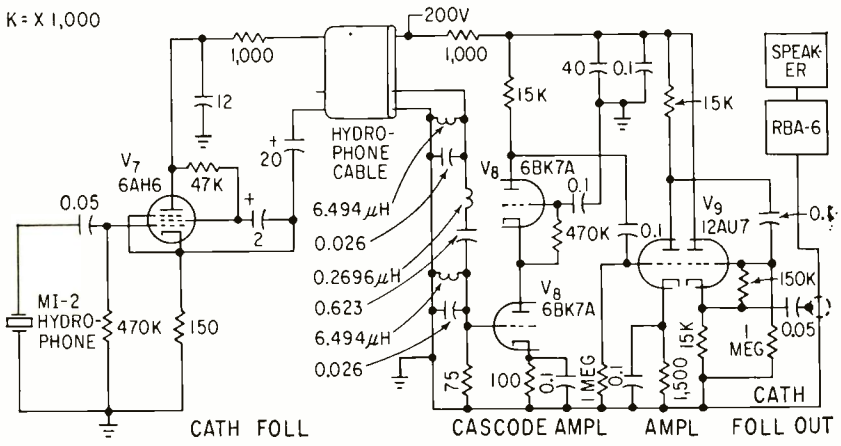


FIG. 3—Telemeter receiving preamplifier consists of a cathode follower transducer isolation amplifier and a low-noise, high-gain preamplifier

peak-to-peak. Modulated waveform, taken at point E, showed a compression of modulation due to nonlinearity in V_4, at the 2-watt level. Voltage at this point is about 50-v peak-to-peak. The 21-kc carrier at point B is 10-v peak-to-peak. Slight distortion, caused by the agc diode, had no harmful effects. The depth oscillator showed a slight tendency to lock to harmonics of the temperature or modulating waveform when waveform peaks coincided; however, pulling was slight.

The modulating waveform taken at a point above D_2 measured 3.2-v peak-to-peak at 520 cps.

Receiver

A USN Model RBA-6, low-frequency, radio receiver, Type CFT 46300 is used in an unaltered condition. Auxiliary equipment consists of a cathode-follower transducer isolation amplifier and a low-noise, high-gain preamplifier, Fig. 3. Tube V_7, contained in the receiving transducer housing, is powered through the multiconductor cable connecting it to the preamplifier at the receiver. Tube V_7 isolates the crystal receiving transducer from the low-impedance cable connecting it to the preamplifier, and prevents loading. This tube also provides a low-impedance source to drive the band-pass filter located in the preamplifier.

A 1.5-100-kc band-pass filter at at the input of V_8 and V_9 excludes undesirable voltages outside the useful frequency range, and prevents cross modulation and generation of interference. The preamplifier increases the signal-to-noise ratio of the receiver and provides the utmost sensitivity.

The receiving transducer is a Navy MI-2 hydrophone. It consists of a salt array about 3½ inches in dia., which, when considered as a piston, has a useful directivity pattern over the entire frequency range. The unit is fitted into a large flanged pipe, capped at one end, which contains tube V_7. This assembly rides down the trawl cable on a trolley until it is just below the ship's wake, or hangs over the side on a piece of pipe.

During one test, the telemeter transmitter was suspended from a small motor launch at a depth of about seven feet. Despite considerable ambient noise, excellent signals were received out to one mile. Extremely strong signals were received at 3,000 ft. Tone modulation was readable at all times. Received signal voltages at the preamplifier input measured between 100 and 500 microvolt at one mile distance. These levels were at least 20 db above the ambient noise levels at the receiver output.

Self noise of the receiver preamplifier combination is 6 db below 0.09 microvolts at 21 kc, which shows a great margin of sensitivity for use in quiet waters.

Multiple path transmission caused extreme variation in signal strengths during this test and it was difficult to establish exact figures for directivity. Fading was strikingly similar to that affecting low- or medium-frequency radio transmissions at or near groundwave limits. Amplitude excursions of 20 db were noticed under certain conditions.

Variations in the position of the transmitting transducer within a 40 deg. horizontal angle did not seriously affect the received signal up to one mile. In fact, transmission was obtainable at times with reflected energy from a large stone breakwater 100 ft behind the transmitter. At 1,500 ft, overload of the receiver was experienced and extremely strong signals were received regardless of the transmitter's direction.

Observations are approximate. Transducer gain is greater at the higher frequencies due to the sharper directivity patterns expected and the figures may vary widely.

Application

The depth-temperature telemeter was used by the Fish and Wildlife Service in their exploratory fishing program. Approximately 200 tows were made, and satisfactory performance was obtained 75 percent of the time. The maximum depth obtained was 225 fathoms. Catches of rockfish and hake were taken in midwater in quantities up to 5,000 pounds per 20 minutes.

The depth of the net was determined with sufficient accuracy to operate very close to the bottom without snagging or damaging the trail gear.

The Gear Research and Development Station of the United States Fish and Wildlife Service, Department of the Interior, located at Coral Gables, Florida, contracted with the University of Miami Marine Laboratory to develop the system.

Appreciation is expressed for assistance and information rendered by Willard Dow of Woods Hole Oceanographic Institution whose previous work on depth telemetering aided materially in the determination of operating parameters for this equipment.

Invaluable help was received from M. Frank Shea and Robert Thornhill, both of the University of Miami Marine Laboratory.

Reidar Sand administered the contract.

A-C Rate Generators

Tabulation of commercially available precision induction tachometers for application in integration of alternating voltages

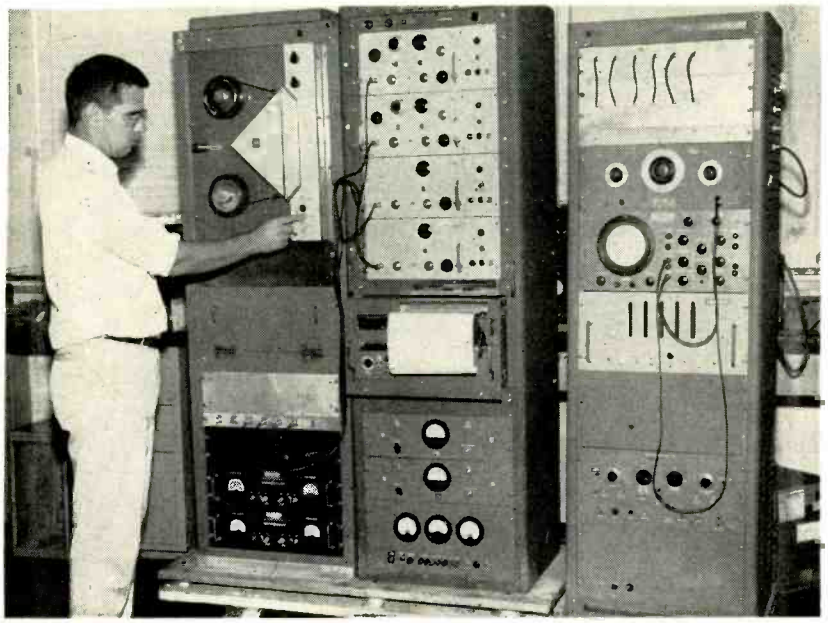
By **FRANKLIN G. FINK,** Senior Development Engineer, Loral Electronics Corp., New York, N. Y.

Table I—Commercially Available Precision A-C Rate Generators

1	2	3	4	5	6	7	8	9	10	11	12	13
15 E J2GM07-1C**[a]	1.437	2.032	1	0		1	0.3% total −55 to +71 C	0.04	0.012	0.1% of 4,000 rpm	1.9	
15 K R700	1.437	1.937	3.2	6	16	12	0.25% per deg C			0.2% of 3,600 rpm	5.4	2.1
15 K R701[c]	1.437	2.688	2.75	0	12	7				0.1% of 3,600 rpm	5.2	2.1
15 K T703[d]	1.437	2.677	2.75	1.5	12	7	0.35% total −54 to +60 C	0.009	0.02	0.05% of 3,600 rpm	5.6	5.9
15 N 105T2H**[a]	1.437	2.953	1	0	5	2	0.3% from −55 to +85 C			0.12% of 3,600 rpm	1.9	16
15 S 15J1-1[g]	1.437		1	0	1	1	0.05% total −55 to +75 C	0.01		0.03% of 4,000 rpm	3.5	20
15 S 15J2-1[e]	1.437		1	0	1	1	0.25% total +10 to +70 C	0.01		0.05% of 4,000 rpm	3.5	20
18 K 423792-1[f]	1.75	2.434	2	0	10	5				0.09% of 3,600 rpm	11	31
D FPE 21L-45-5*[b]	2.035	2.469	6	9	50	5	0.03% per deg C			0.25% Of 1,000 rpm	5	0.02
20 K Y720[e]	1.95	3.111	2	0			0.15% total −54 to +85 C	0.005	0.04	0.16% of 3,600 rpm	0.9	104
23 B FT 2000-1-A1[a]	2.25	3.22	2	0	10	3				0.15% of 3,600 rpm	8	1.05
F 1372212*	2.31	2.75	6.8	90	100					0.1% of 1,800 rpm	4.5	0.15
F 1372213*[b]	2.31	3.45	5	90	100		1% total −10 to +55 C			0.1% of 1,800 rpm	4.5	0.15
F 951J96	2.31	2.75	4.6	90	100					0.1% of 1,800 rpm	4.5	0.15
23 O 20TG-6777-0[a]	2.25	3.245	2	0		5				0.15% of 3,600 rpm	8	1.05

1. BuOrd frame size, mfg and model 2. Diam (in.) 3. Length (in.) 4. Sensitivity (v/1000 rpm) 5. Phase shift (deg) 6. Zero speed volts (mv) 7. Zero speed in phase volts (mv) 8. Temperature coefficient (%/C) 9. Voltage coefficient (% change/v change in excitation volts) 10. Frequency coefficient (% change in output volts/cycle change input volts) 11. Linearity (% deviation below rated speed) 12. Input power (w) 13. Rotor inertia (gm-cm²)

All units are 400 cps with 115 v excitation except those marked with asterisks. * 60 cps ** 24 v excitation B—Bendix D—Diehl E—Eastern Air Devices F—Ford K—Kearfott N—Norden Ketay O—Oster S—Servomechanisms [a] external resistor required [b] temperature compensated [c] maintained at 100 C by heater [d] maintained at 115 C by heater [e] thermistor compensated [f] maintained at 105 C by heater [g] magnetic amplifier controlled heater



Complete playback system. The right-hand rack contains calibration oscillators and associated test equipment. The center rack mounts the recorder and power supplies. The left rack mounts the primary playback electronic equipment

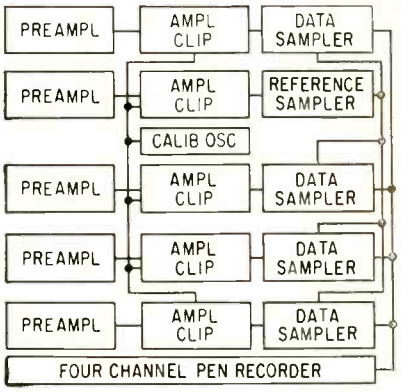


FIG. 1—Block diagram of the playback system

Sampling Discriminators

New method for discrimination of f-m signals from magnetic tape uses the outputs of two types of discriminators combined in a wideband system to compensate wow and flutter. The equipment features fast unfiltered response and minimum circuit complexity

By **PHILLIP S. BENGSTON***, U. S. Naval Ordnance Lab., Silver Spring, Md.

DISCRIMINATION of f-m signals from magnetic tape has been improved by a new type of discriminator that performs with the fastest possible response to wide-deviation frequency-modulated transients. A constant reference frequency is recorded on one of the channels. When the output voltage of the playback is made proportional to the quotient of the data frequency and reference frequency, the output becomes independent of tape speed. Wow and flutter components introduced in the recorder are cancelled in playback.

Complete Playback

The complete playback is shown in block diagram form in Fig. 1. The system has a bandwidth from about 200 to 500 cps. The tape playback speed is 0.5 ips. The record speed is about 60 ips. Record frequencies ran from 25 to 60 kc. The playback was designed to feed a four channel pen recorder. The characteristics of the data samplers are sufficiently uniform to permit optimum compensation for each channel to occur simultaneously with a single adjustment of the reference sampler.

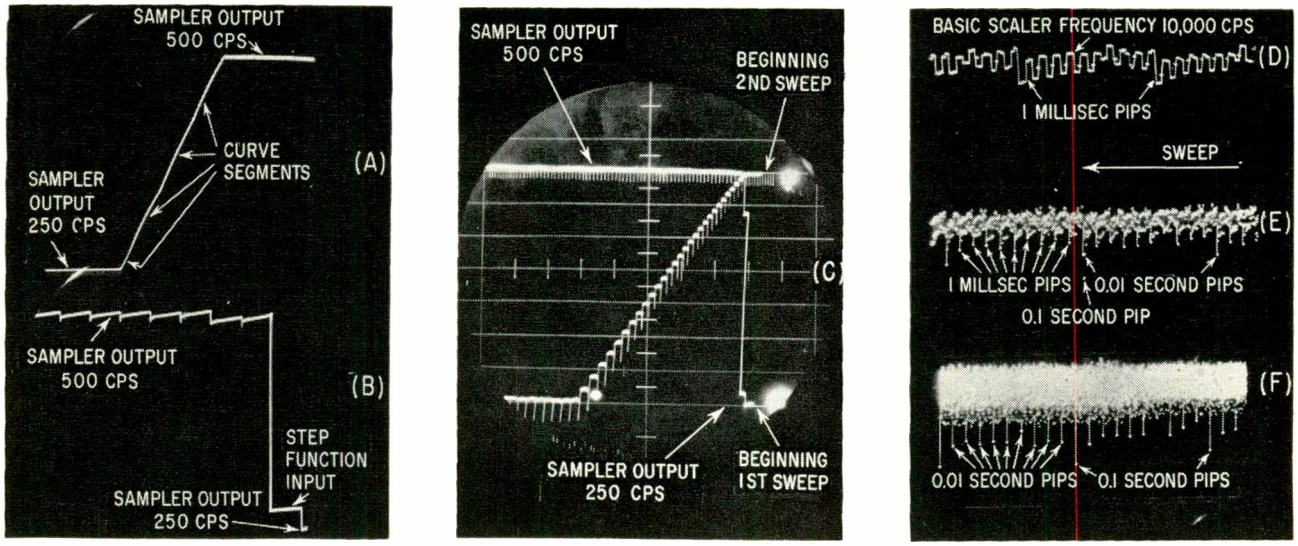
Sampler

The basic sampler circuit is shown in Fig. 2. The voltage across C_1 can never exceed the voltage across C_2 due to conduction through the semiconductor diode. Assuming a negative bias at terminal A, the voltage at C_1 may drop to nearly the bias voltage with C_2 holding the highest positive value C_1 had previously attained. If at any time it is desired to sample the voltage at C_1, conduction through tube V_1 to equalize the voltage between C_1 and C_2 may be completed by pulsing the grid of V_1 positively. Since $C_1 << C_2$, the voltage EC_2 falls to the voltage EC_1. The pulse duration is many times the product of the effective conduction resistance of the tube and the capacitance of C_2. The voltage across C_2 is directly coupled to cathode follower V_2.

Reference Sampler

The diagram for the reference sampler is shown in Fig. 3. The

* Now with Minneapolis-Honeywell Regulator Company



Waveform *A* shows data sampler output with linear frequency change from 250 to 500 cps. Sweep rate is 500 millisecs per div. Waveform *B* shows step function frequency change from 250 to 500 cps at sweep rate of 2 millisecs per div. Waveform *C* shows data sampler output with step function from 250 to 500 cps followed by linear change back to base line. Waveforms *D*, *E* and *F* show compensated output of complex tape recorded signal from the playback system

For Data Reduction

square-wave output from the channel amplifier-clipper is applied to the input terminal. The amplitude should be at least 15 v. The positive differentiated pulse triggers the biased trigger stage V_{1A}. The output winding of pulse transformer T_1 is polarized so that the initial output pulse will be positive. This pulse is directly coupled to the cathode of V_{1B} and the grid of V_{2B}, the sampler stage. The voltage on C_1 is sampled at that instant and appears across the sampling capacitor C_2 and the input to cathode follower V_{3A}.

Tube V_{1B} is normally cut off by the −28-v bias so that the initial positive pulse to its cathode has no effect. The pulse excursion is damped by resistor R_1, but only sufficiently to prevent another positive excursion. Capacitor C_1 discharges almost completely through V_{1B} when it is triggered by the negative pulse excursion.

Sampled capacitor C_1 is continually charging at a constant rate through V_{2A}. After discharge through V_{1B}, there is no load and the voltage across capacitor C_1 increases linearly with time until the cycle repeats itself.

The voltage across sampled capacitor C_1 is a sawtooth with linear rise time as shown in Fig. 4. The voltage across sampling capacitor C_2 is always the peak voltage that sampled capacitor C_1 reached before discharge. This peak voltage is held until sampled capacitor C_1 voltage rises above it or until a new sampling pulse arrives. Actually, sampling capacitor C_2 voltage does change somewhat during the period depending on whether the grid of cathode follower V_{3A} emits or receives electrons within tube. With

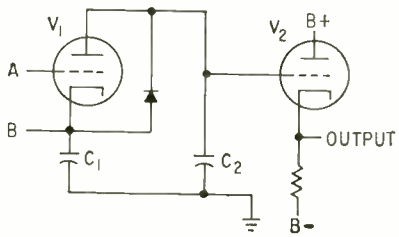


FIG. 2—Basic sampler circuit

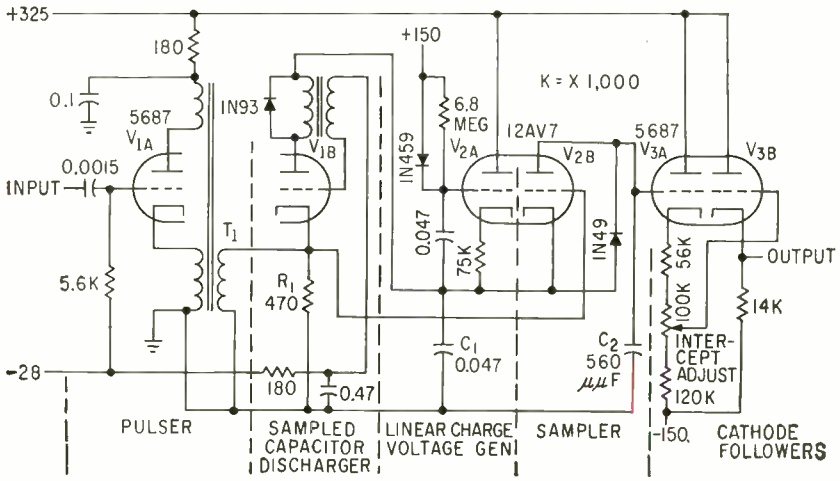


FIG. 3—Schematic of the reference sampler

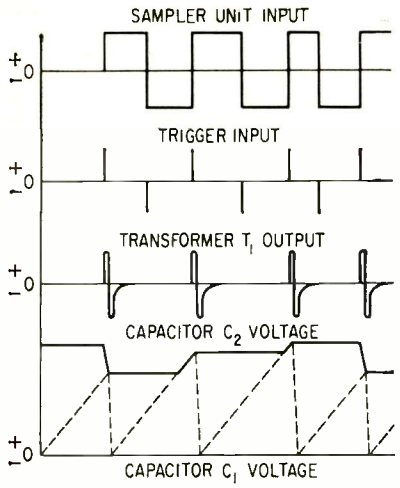


FIG. 4—Reference sampler waveforms

most tubes, and a fairly high cathode impedance, the sampling voltage is constant during the time period associated with this unit.

The result is a reference discriminator that at any instant provides a voltage output proportional to the period of the preceeding cycle.

The reference sampler voltage output is $E_r = m_r T_r + E_o$; where m_r is the slope or gain factor, T_r is the period of the reference carrier, and E_o is the voltage intercept. The usual data instrumentation discriminator provides an output proportional to frequency by averaging the block area of a one shot multivibrator and removing the carrier components with a filter. When E_1 = maximum positive amplitude, E_2 = maximum negative amplitude, t_1 = duration of square wave, and t_d = time for one cycle, then output voltage E_d is:

$$E_d = \frac{(E_1 - E_2)t_1}{t_d}$$

Suppose $E_1 = E_r$ from the reference sampler. This may be accomplished by clipping the one-shot multivibrator output voltage with the sampler output voltage. When E_2 and t_1 are constant

$$E_d = \left[\left(\frac{m_r}{f_r} + E_o\right) - E_2\right] t_1 f_d$$

$$E_d = \frac{m_r t_1 f_d}{f_r} + E_o t_1 f_d - E_2 t_1 f_d$$

When E_o is set equal to E_2, f_r equals $1/t_r$, and f_d equals $1/t_d$: that is, if the intercepts of the two discriminators are set equal, the condition for perfect compensation is derived. The equation $E_d = m_r t_1 f_d / f_r$ indicates that compensation is independent of the gain of either discriminator or the carrier frequency for either channel. Instead of E_1, t_1 may be made the variable controlled by the reference sampler with similar results.

These simplified equations ignore delays introduced in the electronics such as the one period delay of the sampler. Other factors such as head alignment tend to reduce the effective compensation, particularly at higher frequencies. The degree of compensation is dependent on the discriminator linearity, the output filter characteristics, and the wow and flutter amplitude already present. Both systems have been built and perform as predicted although the system varying t_1 is somewhat more complex. Noise due to wow and flutter can be reduced by a factor of 5:1 up to much higher values.

Data Sampler

The diagram of a data discriminator that incorporates the sampling technique is shown in Fig. 5. The first stage, V_{1A}, of the data sampler and the reference sampler are identical. The positive pulse operates sampling stage V_{3A}. Because sampling is done on a decaying voltage waveform, the position of the sampled and sampling capacitors are reversed with respect to the sampling tube elements. As the smaller capacitor is now in the cathode it is necessary to introduce a resistance in series with the grid pulsing line to limit grid current. If this is not done, the sampling capacitor voltage waveform is distorted.

Tubes V_{1B} and V_{2A} constitute a one-shot multivibrator. It is fired by the negative excursion from V_{1A}. The output of the multivibrator is clipped by the reference sampler output. Tube V_{2B} is a cathode follower with an unusual network for the cathode impedance. The purpose of the network is to actually create the curve for the average area of the voltage block at any time during the data period for a given blockwidth. The blockwidth used here is about 1.4 milliseconds. The equation for the curve is a hyperbola.

The curve is pieced together with normal exponential decay rates changed abruptly at voltage ratios determined by the cathode resistance divider. The voltage across the effective capacitance of the network is sampled at the end of the data period. The sampler output voltage is supplied to output cathode follower V_{3B}. The cathode load resistor is tapped to furnish an output voltage near zero for data carriers encountered in the playback.

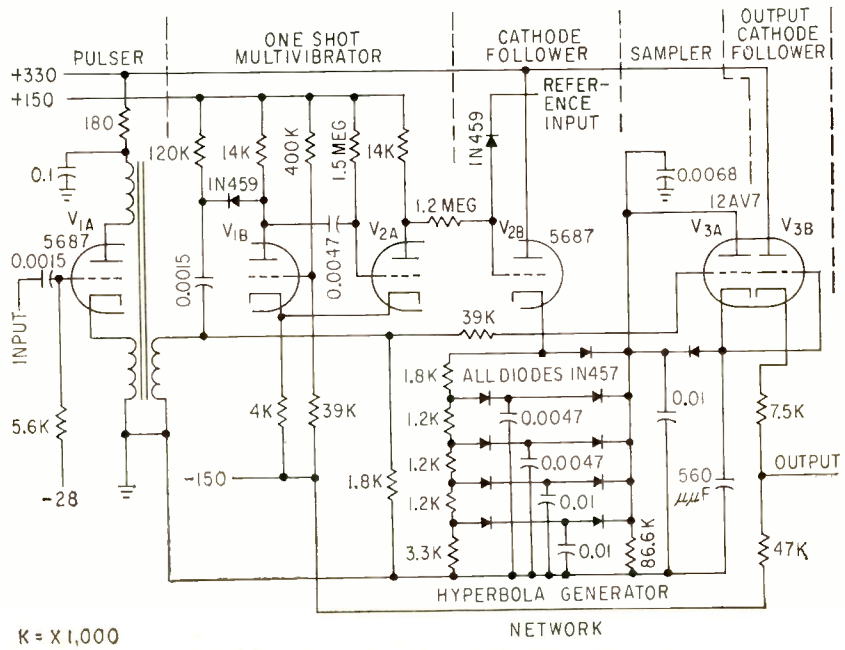
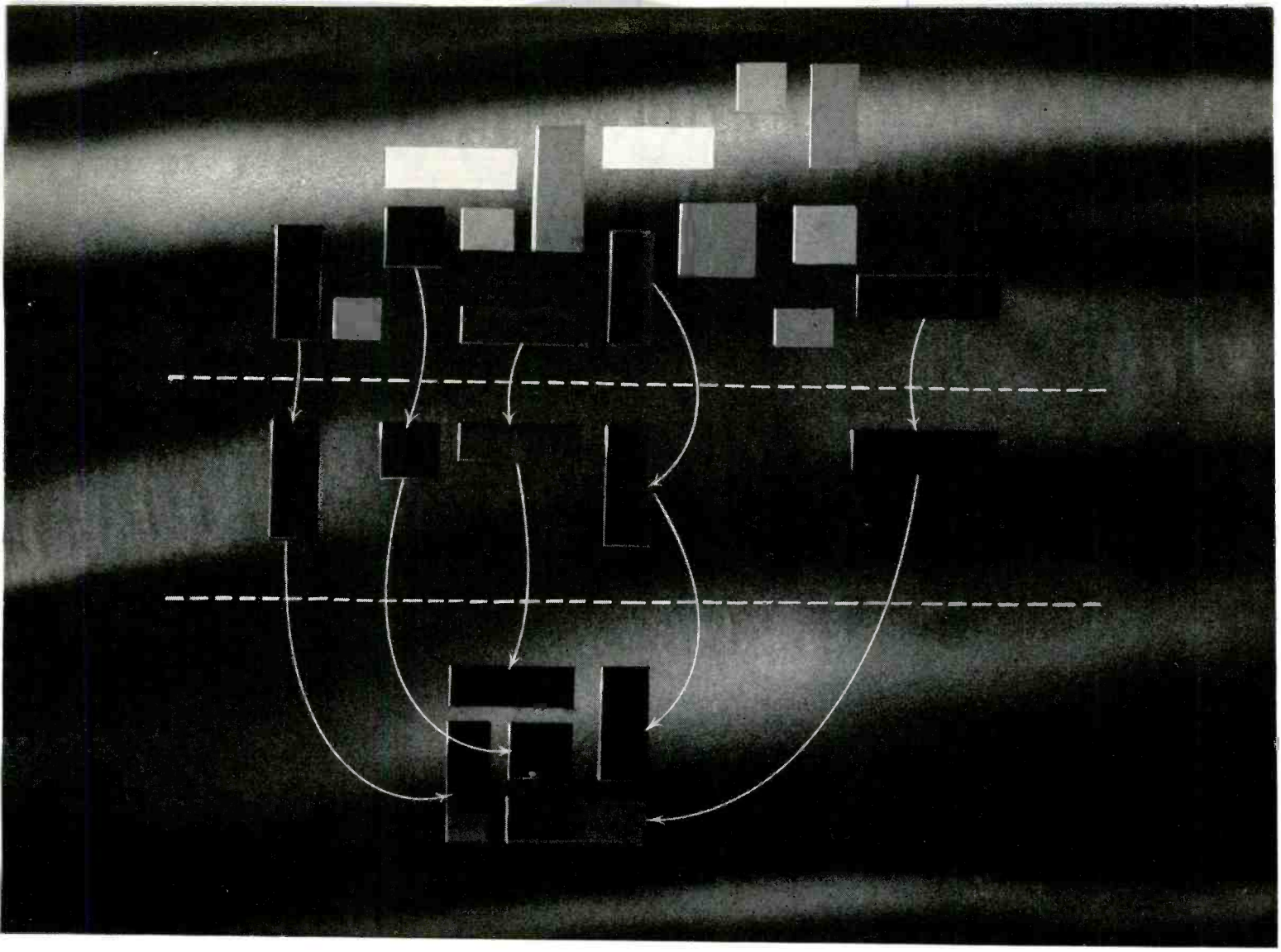


FIG. 5—Schematic of data sampler showing hyperbola generator network



Report from IBM *Yorktown Research Center, New York*

OPTIMUM COMPUTER DESIGN FROM SYMBOLIC LOGIC

Symbolic logic sets up special languages in which problems of inference and definition are dealt with rigorously. At the Poughkeepsie Laboratory of the IBM Yorktown Research Center, a group of research workers is making a general study of the application of symbolic logic to computer design. This work is yielding important results of both practical and theoretical interests.

Let us assume that computers are made up of many input-output devices hooked together in various sequences. Because these devices can be neatly correlated with a special class of logical functions, they may be thought of as logical boxes. Two chief problems have been posed by the IBM research group: (1) Which *selections* of logical boxes will best serve the needs of design, and (2) How are the boxes *to be put together* most effectively in given cases? An impressive body of answers is being gathered to each question. These are often possible just because an engineering problem has been reduced to a logical one. This reduction provides new design techniques in which computers are used as more effective aids. For example, suppose we wish to know which five-input, one-output device is lgically most efficient. There are billions of alternatives, but a directed computer search can be set up so that the answer is obtained in a short time merely by scanning a small part of these.

The application of symbolic logic to machine design poses many challenging questions, some of great theoretical interest, others more specific within important practical consequences. Logic has had a marked effect upon the design of electronic computers but should play an even greater role in the future.

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Yoke Performance Chart

Nomograph aids precision deflection yoke design by predicting performance in terms of sensitivity and settling or response time if values of tube accelerating voltage and coil inductance are known

By W. W. H. CLARKE and T. A. RILEY, Cossor (Canada) Ltd., Halifax, Nova Scotia, Canada

THE CLASSICAL DEFLECTION-yoke formula is based on a model deflection field bounded by two planes perpendicular to the tube axis, between which parallel magnetic fields X and Y may be excited in proportion to applied currents. The deflection for the flat-faced tube is $x = C_1 \tan(\sin^{-1} C_2 i_x)$, where x is the deflection and C_1 and C_2 are constants.

This nonlinear characteristic for the two axes leads to the well-known pincushion effect. The basis of yoke design methods used by the authors is mainly empirical, using a knowledge of the degree of pincushion effect usually encountered in yokes with parallel fields in their center planes and the effects on geometry of small perturbations of the winding distribution. Core materials are similar to those described in (ELECTRONICS, p 59, Mar. 20, 1959).

The nomograph of Fig. 1 is based on relationships which specify performance in terms of response time and sensitivity. This is given by $\theta = K_1 I\sqrt{L/E_a} = K_2\sqrt{L}$, where θ is the deflection in deg, I is the whole-axis current in ma, L is the whole axis inductance in henries, E_a is the accelerating voltage in kv, K_1 is a constant depending on core material and equal to the time in μsec to 99.9 percent settling (critically damped), and K_2 is also a constant depending on core material and yoke capacitance. Typical values of K_1 and K_2 are shown in Table I.

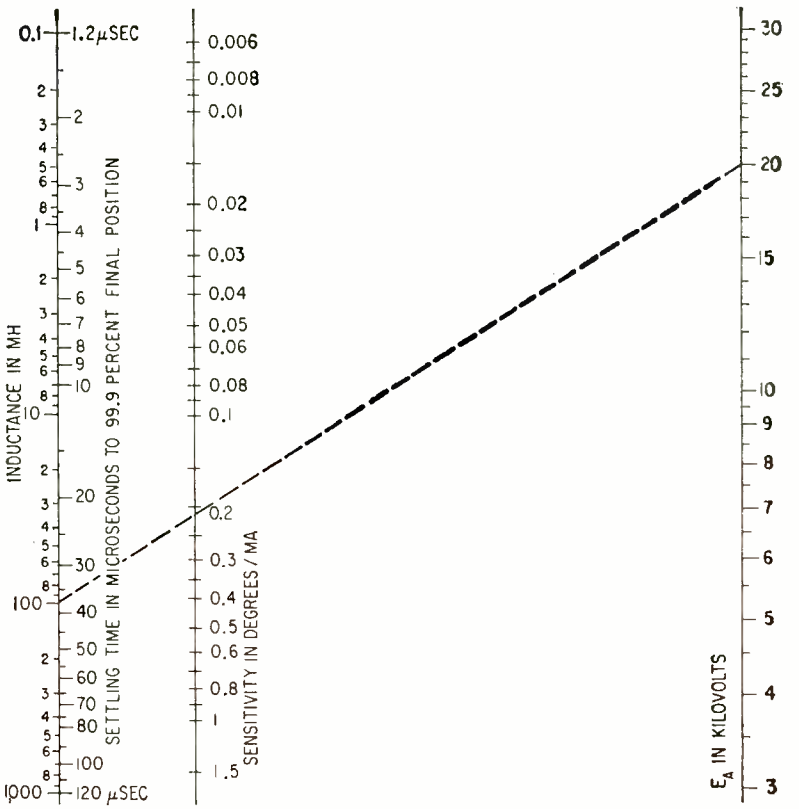


FIG. 1—Deflection yoke performance nomograph

Yoke performance may be predicted with reasonable accuracy by use of Fig. 1 which is based on values for K_1 and K_2 of 3 and 120, respectively. Thus, in the example shown, a yoke with an inductance of 100 mh used in conjunction with an accelerating voltage of 20 kv will have a sensitivity of 0.23 deg/ma and a settling time of 38 μsec.

Table I—Values of K_1 and K_2

	Mumetal	Ferrite	Coscanite	Nonmagnetic
K_1	3.12	2.88	2.63	1.93
K_2	120	120	112	97

Tung-Sol moves ahead!

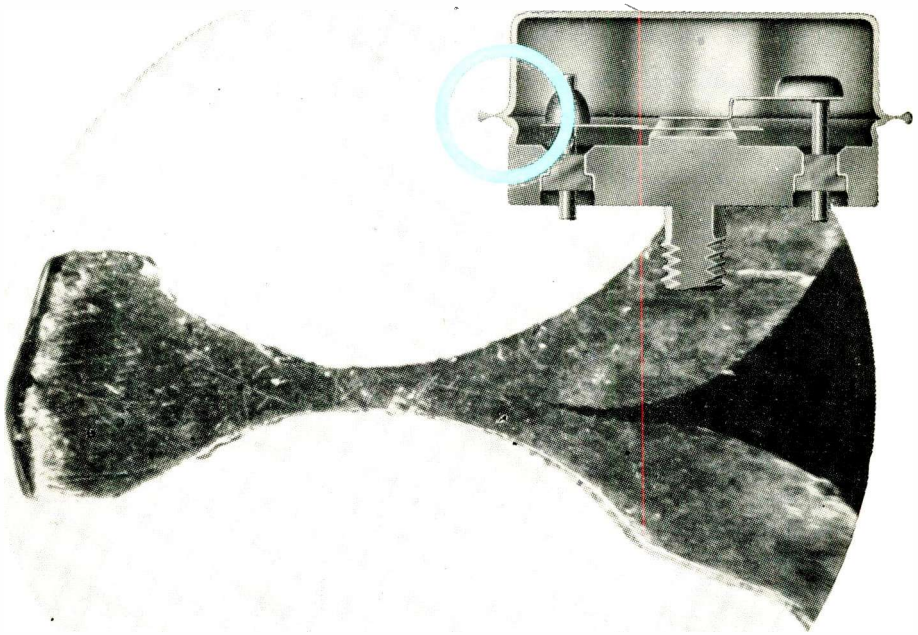
High power transistors with new **cold-weld** seal

Improved cold-weld seal gives new Tung-Sol high-power transistors three-way quality boost

True hermetic, copper-to-copper seal improves transistor thermal characteristics.

Elimination of heat-damage, heat-caused moisture and "splash" increase reliability.

Vacuum-tight, moisture-proof cold-weld seal lasts even through "breathing" over long life operation.



Photomicrograph (45X) shows circled area of cross section of Tung-Sol high-power germanium transistor cold-weld seal. Note absence of seam, indicating actual integration of copper molecules and a true, hermetic, copper-to-copper seal.

Once again Tung-Sol shows the way. Now, for the first time, Tung-Sol brings designers high-power germanium transistors with quality benefits of the advanced cold-weld seal.

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Technological advancements such as this keep Tung-Sol ahead of the field. For full data on the new high-power switching transistors . . . to meet any need with the latest in transistor design and efficiency, contact: Semiconductor Division, Tung-Sol Electric Inc., Newark 4, New Jersey.

Satellite to Study Ultraviolet

ELECTRONIC techniques play a decisive role in plans disclosed this week for ultraviolet mapping of the entire celestial sphere by an astronomical telescope in space.

The project conceived by the Smithsonian Astrophysical Observatory, Cambridge, Mass., is part of NASA $100 million program for launching six satellites.

The scientists say a space telescope in a one-ton satellite of nearly spherical configuration will be launched into an orbit with a mean altitude of 1,000 miles in two to three years. A one-million pound thrust rocket engine now on the drawing boards will be used. Contracts have been let for shelf items.

Spectral Region

Televising data back to the earth, the space telescope will open up a hitherto inaccessible spectral region in the ultraviolet range below 3,000 A. Present spectroscopic studies of electromagnetic radiation from the sun's surface and surrounding gaseous envelope are limited to the small fraction of the emitted spectrum that the earth's atmosphere allows to pass.

A rather conventional optical system will be used, and the tv image tube will be placed at prime focus. After exploring the best features of vidicon and orthicon tubes, Smithsonian scientists decided on a new tube, now under development, with good characteristics of both types.

The image tube determines the resolving power, sensitivity, spectral response, stabilization requirements and power requirements of the satellite system. Spectral response and sensitivity are ultimate determining factors. The tube must have zero response at wavelengths longer than 3,000 A and be able to detect a star that delivers as little as 10^{-13} watts of power to a photosensitive surface.

The tv picture channel will be the primary telemetry channel, and several secondary channels will inform the ground station of operation of satellite components. The shortest frame time that can be tolerated is one sec. The telemetry system will require bandwidth of 250 kc if ultimate resolving power of the image tube is to be realized. Radiated power will be about 0.5 watt. Most satellite functions will be controllable from the ground, so exposure time can be increased and bandwidth decreased if necessary.

Solar energy can not be relied upon completely for power. More than half the energy must be obtained from batteries.

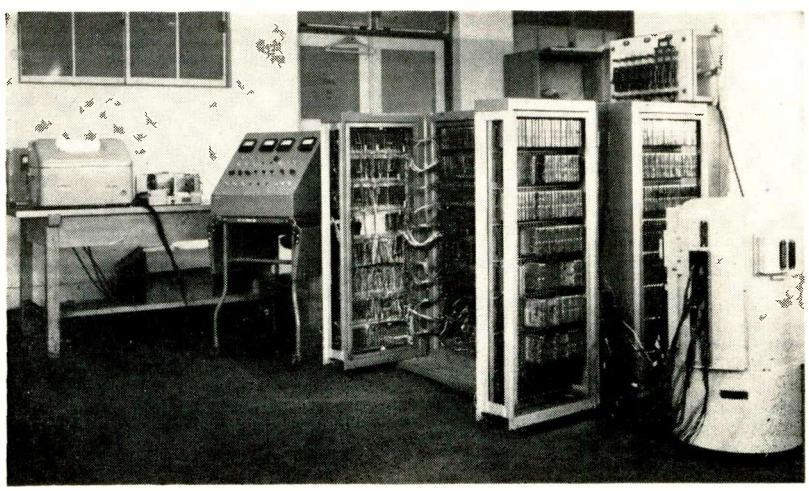
The satellite will be as simple as possible. The ground equipment will be complex, including high-sensitivity receiver-antenna combinations, and a computation and analysis center. Two ground stations will be used, one on each U. S. coast, at sites with clear horizons and low r-f interference levels.

Control Room

In the control room, incoming information will be displayed on tv monitors, scopes and meters. Signals from the station will control orientation of the satellite telescope, positioning of a filter wheel and mirror cover, and mode of operation of tv camera and transmitter.

The ground station will receive data that includes outputs of the sun sensor and sun seekers, positions of various moving parts in the telescope and the tv signal. Tape recorders will keep complete records for later automatic analysis. Image tube scanning will be controlled from the ground, so the operator will be able to adjust synchronization and will not be required to rely on proper operation of automatic synchronizing circuits.

Machine Translates to Japanese



Prototype translating machine with memory capacity of 2,000 words translates simple English sentences to Japanese. Capacity of 10,000 words is planned by the end of this year. System, developed by Electric Technological Laboratory in Japan, uses tape reader, logic circuits, memory unit and printer

Fast WWV Check of Frequency Standard

By JOSEPH F. BRUMBACH,

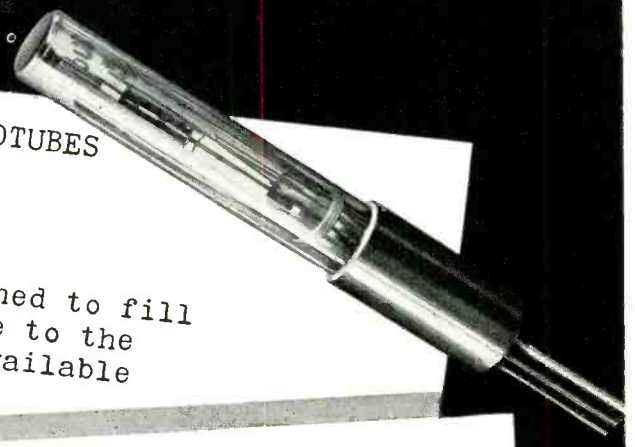
Principal Electronics Engineer,
Union Thermoelectric Corp., Evanston, Ill.

ACCURATE check of a local frequency standard can be made quickly and easily. The arrangement provides a direct r-f beat for comparison with WWV.

Usual method for making such checks is to observe a clock run by a standard and check against WWV. For accuracy of one part in 10^8, the clock must run continuously for two months. In practice, the clock often stops. Also, short-term frequency variations of several parts in 10^8 are not observable.

Attempts were made to compare two local frequency standards. However, discrepancy between the

Fallen Barriers....



"SOLAR" BLIND MULTIPLIER PHOTOTUBES
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PHOTOSENSITIVE DEVICES DEPARTMENT

Several photocathodes have been designed to fill the need for high ultraviolet response to the presence of white light and are now available in a series of multiplier phototubes.

HIGH RESOLUTION CATHODE-RAY TUBES
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CATHODE-RAY TUBE ENGINEERING DEPARTMENT

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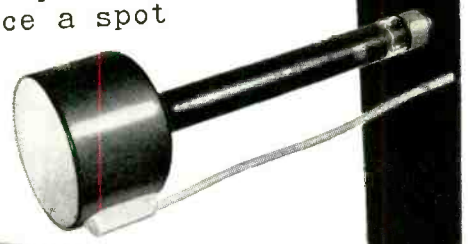

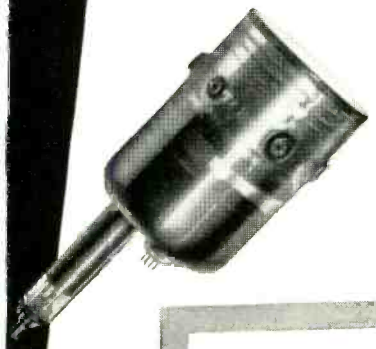

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two reached several parts in 10^8, and it was impossible to determine which standard was correct.

Circuit Arrangement

The arrangement shown in Fig. 1 requires that two receivers be connected to one antenna. With a meter connected between the second detectors, no change in indication results from fading.

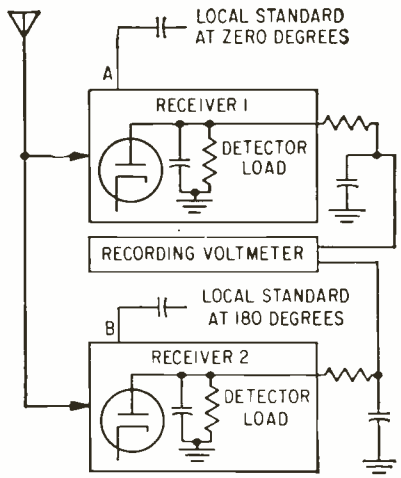


FIG. 1—Using two receivers to receive WWV from the same antenna and injecting the standard frequency in opposite phase to each receiver provides indications not affected by fading

A local standard loosely coupled into one of the receivers at point A will result in a beat note. By coupling the standard to point B out of phase with point A, the beat indication is doubled in amplitude.

The same result may be obtained with one receiver, as shown in Fig. 2. Essential requirements are a source of the standard frequency at zero and 180 degrees and storage capacitors C_1 and C_2, across which the meter is connected. Also, a switch (12AU7) is needed to connect alternately the zero-degree signal to the antenna simultaneously with detector output to C_1 and the 180-degree signal to the antenna simultaneously with detector output to C_2. The tube acts as two grid-controlled diodes, and switching voltage is obtained from a 60-cps transformer.

Doppler error is minimized by an averaging process whereby hourly 3-minute readings are averaged for an 8-hour period. Typical hourly and daily averages range between 0.54 and 3.18 parts in 10^8, with an

average of 1.51×10^{-8}.

Low morning readings and high evening readings are typical and reflect the movement of the Heaviside layer with sunrise and sunset.

All data was collected while receiving WWV on 15 mc. To maintain an accurate check on a frequency standard, it is recommended that the standard be offset about 2 parts in 10^8 (18 beats per minute at 15 mc). All beat frequencies monitored should be on one side of the WWV frequency to avoid error.

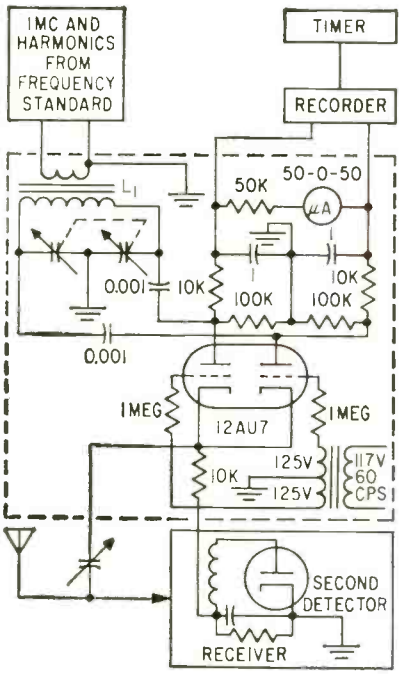


FIG. 2—Timer operates recorder for three minutes of each hour to check frequency standard against WWV

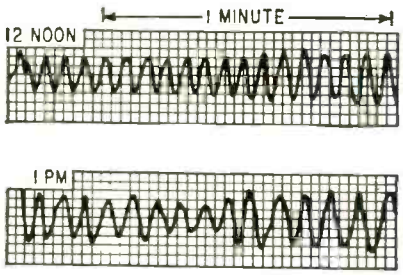


FIG. 3—Sample recordings of WWV beat against local frequency standard

We monitor only during daylight, as the most unstable Doppler shifts occur at night. When setting a frequency standard, the beat note obtained between 11 AM and 1 PM will be the most accurate.

This work was done under U. S. Army Signal Supply Agency contract DA36-039-sc-71061.

Dual Input Rotary Computing Element

SOLUTION of three-dimensional equations is possible with a new, single component known as the Rodiac—a *rotary dual input analog computing* element. Developed by and available from Trio Laboratories, Inc., the new unit is intended for use in analog computers solving the equation: $z = f(x, y)$.

Construction

Two shafts protrude from the housing of the Rodiac. These are the inputs to the unit and may be controlled completely independently. Electrical output may be any arbitrary function of the two mechanical inputs. In the equation mentioned previously, z is the electrical output and x and y are the independent mechanical inputs.

Heart of the element is a potential cylinder the flat surface of which contains the potential plane over which a pickoff element travels. Either an a-c or d-c reference voltage is applied to the two end terminals. The device then distributes this applied potential over the plane surface in a manner determined by the given function.

The two mechanical inputs serve to position the brush relative to the potential surface. They thereby provide a voltage at the pickoff that is a function of the two independent variables. This voltage is made available directly at the third terminal. It may be measured with respect to either end of the reference signal.

Mathematical, chemical and electrical efforts have been combined to develop the technique of distributing the potential field and enable the pickoff to transmit the output voltage accurately and reliably. Basically, the potential field is established by a series of equipotential lines properly spaced and aligned to obtain maximum accuracy and compatability with the pickoff element motion. These lines are connected electrically by resistive coatings. Each line is held at its fixed voltage by a chain of miniature precision resistors soldered on a printed-circuit board and cast in epoxy compound to assure maximum stability and reliability.

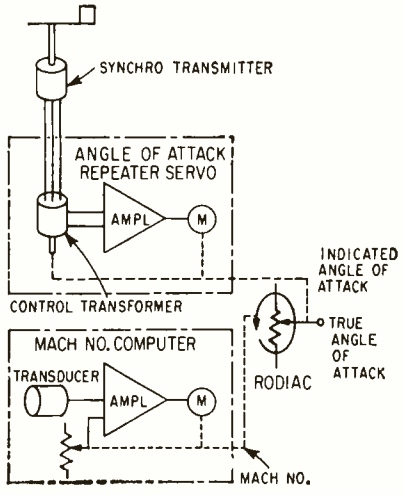


FIG. 1—Rodiac as a true-angle-of-attack computer

The potential cylinder is housed in a standard potentiometer case. Servo-type mounting is provided although other methods are possible.

Previous Techniques

Usual techniques call for solving the equation $z = f(x, y)$ in one of two ways. First, a mechanical three-dimensional cam plus its follower arm, linkages and electrical transducer or synchro may be used. This method has the limitations of excess size and weight, decreased accuracy in regions of high slope and complex mechanical design.

The second approach involves use of a series of potentiometers. This method is applicable only if the arbitrary function of x and y can be expressed in a rapidly-converging mathematical series of terms added together to obtain the value of z. If the series does not converge rapidly enough, required accuracy cannot be obtained with reasonable package sizes.

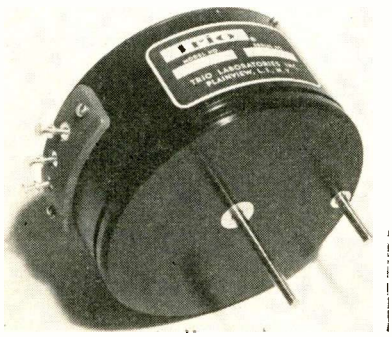
Applications

The new unit is useful, as stated previously, in any computer operation in which a single-valued electrical output must be obtained as a predetermined function of two inputs. As an example, consider the case of a navigational computer.

A potential cylinder can be designed which will store the information representing the magnetic variation of the earth's field. The two shaft inputs are positioned for latitude and longitude respectively. By rotating the center shaft to an angle representing longitude and the outside shaft to the latitude position of the point in question on the earth's surface, the voltage output represents the value of the magnetic variations.

As a true-angle-of-attack computer, the Rodiac can be useful. Angular positions of angle-of-attack vanes deviate from their true positions in an empirical relationship functionally dependent on Mach number. When this data has been determined for a particular aircraft model, information is fixed by a potential cylinder. If one shaft is positioned by the angle-of-attack vane and the second shaft rotated by the Mach number computer, the electrical output will be proportional to true angle of attack as shown in Fig. 1.

Excitation voltage applied to the end terminals may be used to modify the output level in accordance with any desired function resulting in solution of the equation



Unit shown has 3-in. diam and is 1-7/16-in. deep. Weight is less than 7 oz and each shaft is 1/8-in. diam and can be brought out from either or both sides of the housing

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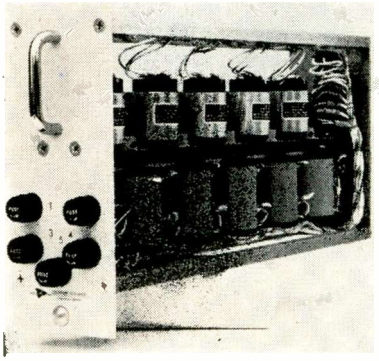
$z = v\ f\ (x, y)$ where v is the excitation voltage.

Advantages

In airborne applications, application of the Rodiac gives savings in size and weight. It is possible for two entire servo loops including a separate package for a three-dimensional cam to be eliminated completely since many packaging techniques demand repeated systems to position each cam element. Also, the new unit is economical because of its basically simple design.

Servo-Setting Potentiometer Module



MANUAL ADJUSTMENT of ten-turn potentiometers for coefficient entry into analog computer setups is time consuming, costly and often a source of error. Servo systems have been developed to speed up the process of coefficient entry but, without exception, the systems have suffered from mechanical inaccuracies introduced by clutches or other forms of mechanical switching. Also, the mass of ponderous mechanical systems made it difficult if not impossible to produce a tight, accurate servo loop. Pushbutton switches used to establish voltages in the reference divider and address matrix, proved cumbersome and tiring for the operator.

To overcome these deficiencies, Colorado Research Corp. has designed a unique system for servo-setting potentiometers. Each potentiometer is driven by its own individual d-c motor. Coupling of the motor to the potentiometer shaft is through a reliable friction drive that eliminates clutching problems entirely.

The motors are high-precision ball-bearing units. Because there are no mechanical coupling elements to drive, the torque requirements of the system are low, resulting in a servo loop that is fast and accurate.

Five potentiometers with their drive motors are assembled in a module that rack mounts as a front-access plug-in unit. The pot modules have been engineered and designed to provide complete accessibility to motor, drive and pot. Visual inspection of the entire unit can be made by withdrawing the module; maintenance is speeded up. Further convenience is provided by placing the protective potentiometer arm fuses on the front panel of each module.

Potentiometer addresses and values are selected through two separate keyboards of ten keys each. The keys operate fast-acting miniature switches and thus have very short travel and an extremely light touch.

Silicon Duo-Diode Has High Photosensitivity

MADE UP AS an *npn* double-diode, a new photosensitive unit developed by Texas Instrument Inc. passes up to 1,200 μamp when exposed to 1,200 ft-candles of light. In darkness, it passes less than 0.5 μamp. Dissipation of the 1N2175 diode is 250 mw at 25 C. Any biasing voltage up to 50 v will operate it.

New Adhesive for Circuit Boards

DIP SOLDERING of XXXP-36 printed-circuit boards can now be done safely at 500 F rather than 450 F without affecting blister time because of a new adhesive system developed by Formica Corp.

According to St. John Bain of Formica, the new system incorporates a new adhesive formulation and a special surface treatment process of the copper foil.

Other improved properties are satisfactory resistance to all normal plating solutions including cyanide baths and improved copper bond strength at elevated temperatures.

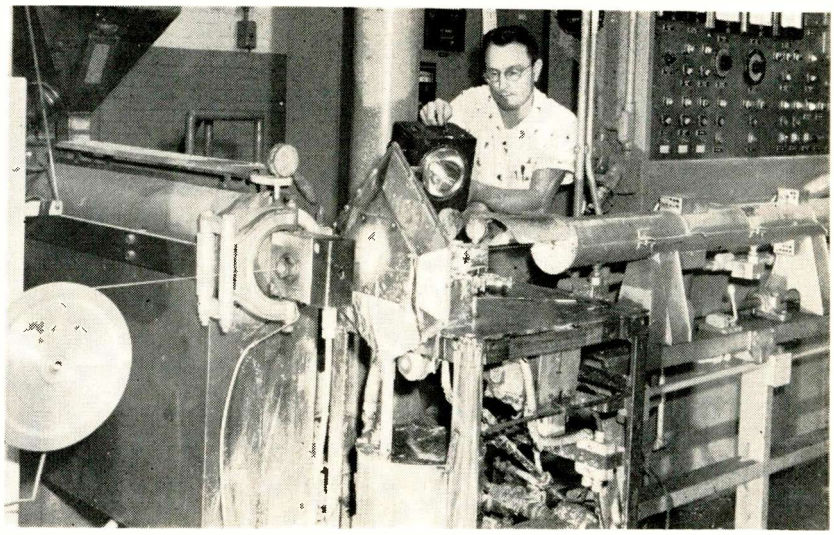
Revolving Disks Color Code Wire

By WILBUR L. HOFF, Western Electric Co., Hawthorne Works, Chicago, Ill.

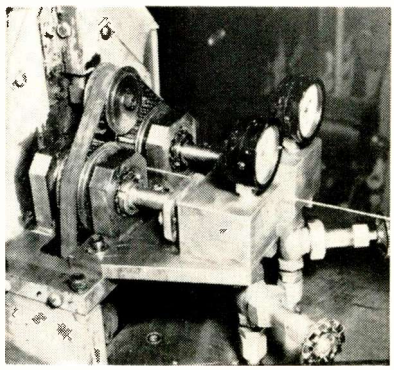
POLYVINYL CHLORIDE insulated wire used in the Bell Telephone System is color coded with dots and dashes. Development of a high speed coding machine and special inks has played a large part in the successful use of cables with all-plastic insulation and hundreds of readily identifiable wires.

The machine codes the wire as it emerges from the extruder at speeds of 2,500 feet per minute and higher. It can be reset to produce a wide variety of dot and dash codes. The dots and dashes extend almost all around the wires so the code is seen from any angle.

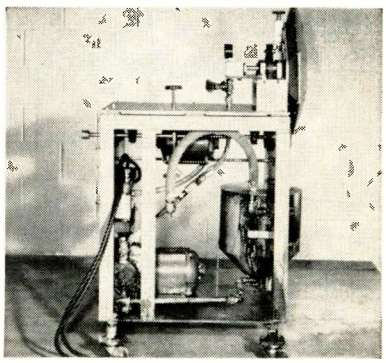
There is no contact of the device and the wire, avoiding depressions in the thin, hot plastic coating and electrical breakdown. Adjustments may be made and ink and thinner added while the wire is in motion.



Operator corrects code registration as wire is coded at 2,500 fpm, or 4,000 spots a second. Left to right are wire preheat shive, insulation extruder, color coder, electrical drying furnace and control panels



Timing device as it appears on the wire coder



Machine is rolled away on casters for rim and ink changes

Disks Spray Dots

Ink is applied through 2 revolving disks, typically at 2,400 RPM rotating speed. Each has a retaining rim which is V-shaped on the inside and flat on the outside. Holes, 0.018 inch in diameter, are drilled in the rim at the apex of the V. The distance between the holes determines the spacing between dots and dashes. The wire is run through the machine parallel to the drive shaft of the disks (Fig. 1).

As the ink sprays out the tiny holes onto the moving wire, dots are made. When the dots are placed close together, they merge into a dash before drying.

Each disk, $3\frac{3}{4}$ inch diameter and $\frac{11}{32}$ inch deep, puts dots on one side of the wire. Dots are lined up by coordinating the disks with the timing belt shown in Figure 2. Adjustments during full speed operation are made with a stroboscopic light where the wire emerges from the machine's hood. To synchronize the disks with line speed the color coder may be driven by either a line shaft from the capstan or a power selsyn drive.

The plumbing and valves shown in Fig. 1 enable the ink pressure to be varied to suit the disk and wire extrusion speed. A 100 mesh filter in the bottom of the ink tank strains out particles too large to pass through the spray holes. The gear pump is run by a separate motor.

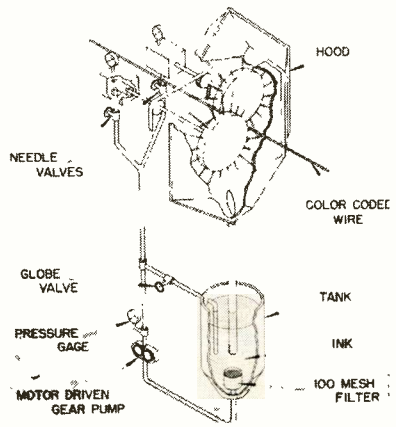


FIG. 1—Schematic drawing of plumbing and essential parts of color coder

Splashes Trapped

Excess ink in the spray is trapped in the hood, returns to the reservoir and mixes with fresh ink. The hood is sharply angled so that excess ink splashes away from the wire. Splashing is further reduced by partitions and baffles.

Vellum gaskets are used under all screw heads in the ink system and between the coding rims and their

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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.

See us at Booths 2205 and 2207 IRE Show.

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	$f_{\alpha b}$ 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.

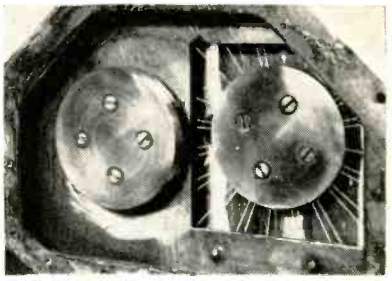
You grow fastest with the products that serve you best. Prove it to yourself **today** with GT.

GENERAL TRANSISTOR CORPORATION
91-27 138TH PLACE • JAMAICA 35, NEW YORK

"YEARS AHEAD IN RELIABILITY"

CN

CIRCLE 50 READERS SERVICE CARD



Ink jets emerging from a double-dot rim

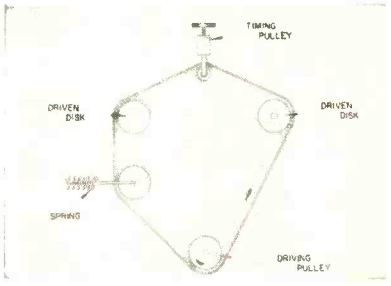


FIG. 2—Disk timing device

baseplates to check false sprays. Most small holes outside of the hood become plugged by dried ink.

To change from one code to another, the rims are changed. To change colors, if only one machine is used, the inks are rotated from white to yellow to red to black or other intermediate colors as required. To go from a darker to a lighter color, the system is first flushed with cleaner and then a small amount of white ink.

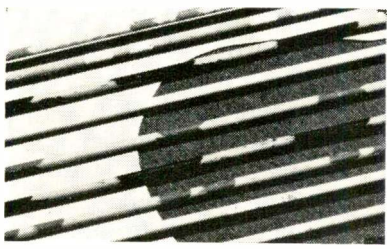
Vigorous removal of the ink vapors is imperative for health and safety of the operators. Exhaust ducts are provided for top and bottom levels of the machine. The exhausts are tied into the controls so that the machine cannot be started until the exhaust fans are on. While ink is being changed or rinsed, the machine is rolled into an adequately equipped utility room.

Casters enable the machine to be rolled about and lined up with the shaft from the capstan and the extruder. Once aligned, the machine is fastened in place with taper pins to adjustable brackets in the floor. If a selsyn drive is used the color coder is lined up with the wire emerging from the extruder.

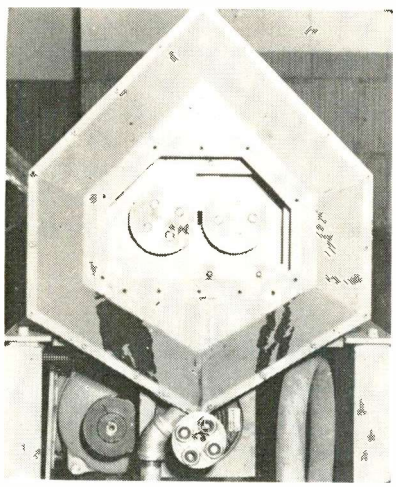
The inks are PVC color concentrates mixed with tetrahydrofuran and methyl ethyl ketone. It sets almost instantly on the hot plastic and will not be washed off or become sticky when the wire passes

through a cooling water trough. Pigments do not centrifuge out inside the code disks if the ink pigments are properly colloidalized. Approximately 300 grams of PVC color concentrates are dissolved in a mixture of 1,500 cubic centimeters of methyl ethyl ketone and 1,500 cc of tetrahydrofuran. Pure tetrahydrofuran is faster drying but marks are not as well defined and heavier ink pigments tend to centrifuge out between the holes in the rims. Depending somewhat on color intensity desired, less than 300 grams of black and red concentrates are used while more than 300 grams are required for good yellow and white marks.

The pressure in the system is kept as low as possible consistent with good marking. At 2,500 F.P.M. 1 psi or less is used. If the line is stopped, the pressure rises to 3 pounds.



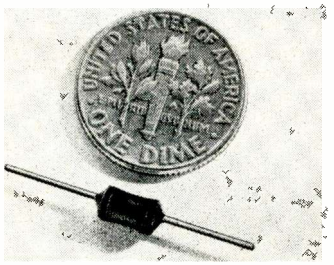
Typical dot-dash codes on wire



End view of color coder with hood plate removed

Once the system is started, the ink circulating pumps are not shut off until the end of the run. Because of the quick drying qualities of the ink, the tiny holes in the rims would clog after a while, even in the hood of the machine.

ON THE MARKET

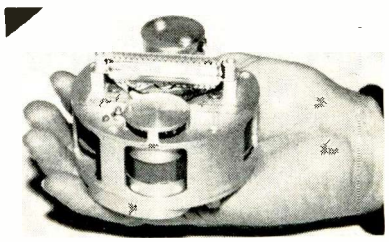


Wire Wound Resistor microminiature

THE DAVEN CO., Livingston, N. J. Type 1282 precision wire wound resistor measures $\frac{1}{8}$ in. ($\pm\frac{1}{64}$ in.) in diameter and $\frac{1}{4}$ in. ($\pm\frac{1}{32}$ in.) in length. Minimum resistance is 10 ohms; maximum resistance, 100 K ohms. The following tolerances are available: 10 ohms to 100 ohms, 0.5 percent; 100 ohms to 10 K ohms, 0.25 percent; and 10 K ohms to 100 K ohms, 0.1 percent. Maximum voltage is 100 v. Wattage rating is 0.05 w at 125 C derated to zero at 145 C. **Circle 200 on Reader Service Card.**

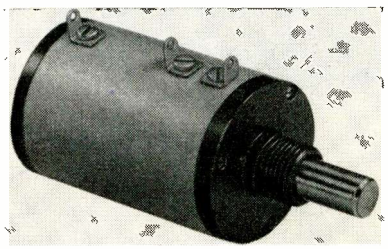
Tiny Tape Recorder weighs 24 oz

LEACH CORP., 18435 Susana Rd., Compton, Calif., announces a completely ruggedized airborne tape recorder. It has been tested under actual operating conditions for vibration of 15 times gravity without shock mounting (5 to 2,000 cps) and impact of 2,000 g (X, Y and Z planes). Tape speeds are 0.25, 0.5, 1.0, 1.875, 3.75, 7.5, 15 ips. Wow and flutter (under static conditions) are less than 1 percent. **Circle 201 on Reader Service Card.**



Precision Pot 3-turn unit

SPECTROL ELECTRONICS CORP., San Gabriel, Calif. Model 550, a 3-turn precision wire wound potentiometer, is offered in ranges from 10 to 75,000 ohms with a linearity tolerance of ± 0.3 percent. Linearity tolerance of ± 0.1 percent is available on special order. Only $\frac{3}{4}$ in. in diameter, unit features precision ball or sleeve bearing mounts at both shaft ends, aluminum lids for bushing or servo mounting. **Circle 202 on Reader Service Card.**

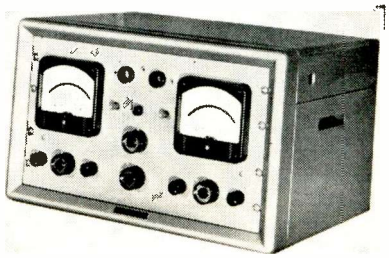


Frequency Generator high stability

MANSON LABORATORIES, INC., 375 Fairfield Ave., Stamford, Conn. Frequencies in the range from 1.095 kmc to 1.405 kmc are generated and held stable to better than 1 part in 10^8 per day by the new model RD-175. Output is tunable over the range in steps of 10 mc, and the unit delivers a minimum of 50 mw power to a 50-ohm load. **Circle 203 on Reader Service Card.**

Megohmmeter portable unit

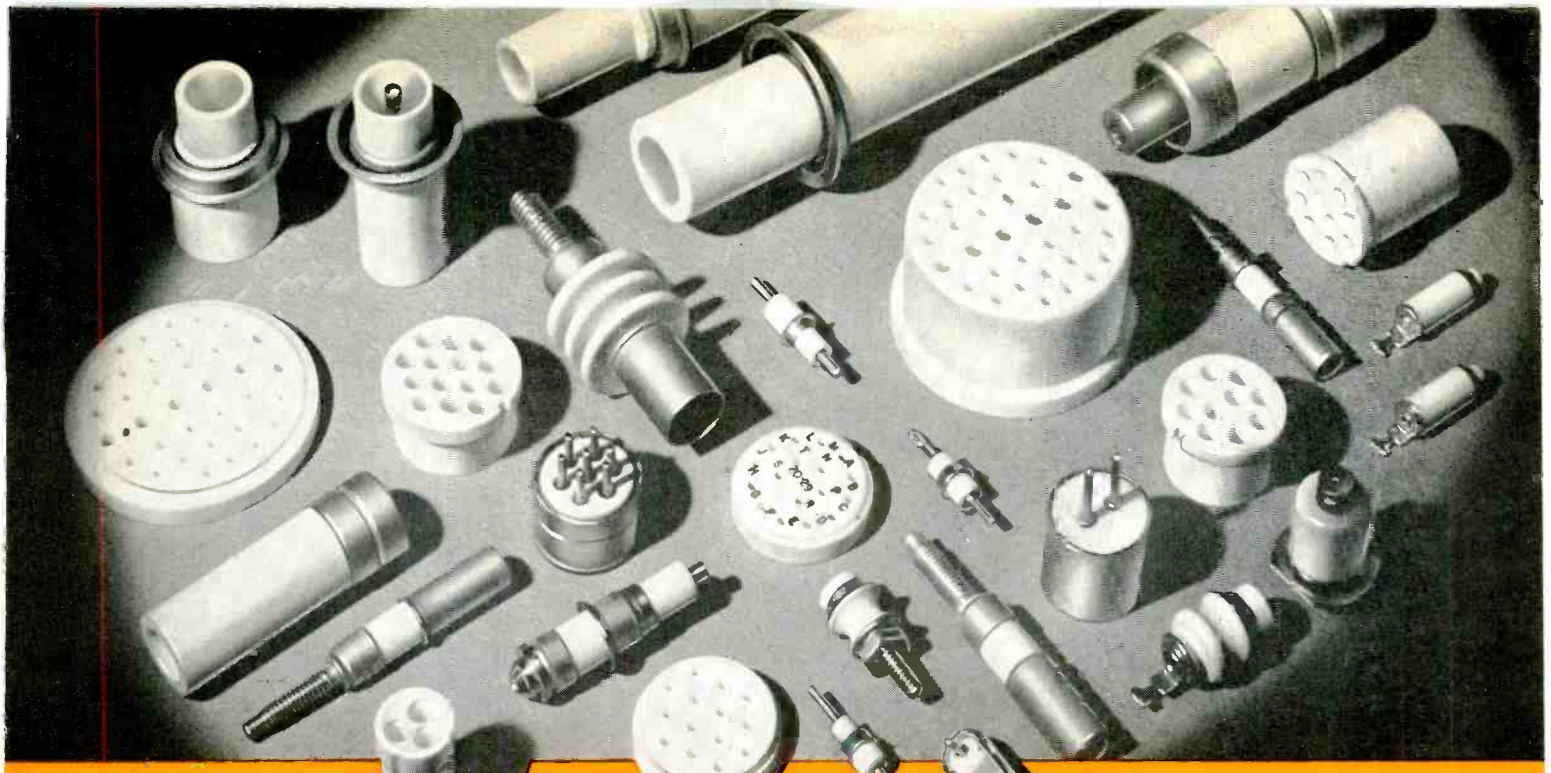
MID-EASTERN ELECTRONICS, INC., 32 Commerce St., Springfield, N. J., announces the model 710 Megatrometer for the measurement of resistance values to 5,000 million megohms. Accuracy in the upper half scale is ± 3.0 percent. Unit incorporates its own transistorized power supply for test potentials to 1,000 v d-c, continuously variable. Mercury cells provide voltage stability with less than 0.0005 percent change per hr at 1,000 v. Price is $865. **Circle 204 on Reader Service Card.**



Paper Capacitor subminiature

ASTRON CORP., 255 Grand Ave., East Newark, N. J. A 50-v hermetically sealed subminiature type AQF paper capacitor made in conformance with MIL-C-25A specs is announced. Offering superior per-

CIRCLE 53 READERS SERVICE CARD→



AlSiMag®

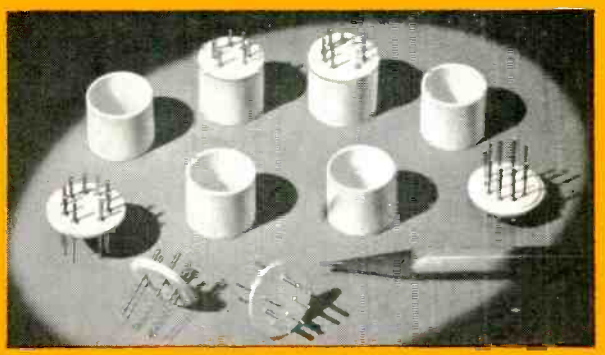
CERAMICS and METAL-CERAMICS for MISSILES

AlSiMag high-alumina ceramics offer unusual reliability. High temperature resistance, superior insulating characteristics, great mechanical strength, resistance to abrasion, corrosion and chemical attack are among the advantages particularly important when maximum performance and reliability must be packed into minimum space.

Both soft solder and hard solder terminals are available. A new technique is producing strong high temperature metal-ceramic hermetic seals

Precision tolerances can be maintained. Custom designs are made in an unusually broad range including ultra-thin or miniature components of unusual complexity.

AlSiMag special purpose compositions based on alumina, steatite, zircon, Forsterite, cordierite, titania, aluminum silicate, magnesium silicate, silicon carbide and other materials may answer special requirements. The AlSiMag family of ceramic compositions is the largest in the industry . . . and it is backed by more than half a century of specialized experience over the widest area of design and production in the technical ceramic field. Your inquiries will have prompt and interested attention.



Multiple pin headers for use in electron tubes and other demanding applications are made in AlSiMag with pins hermetically sealed. The AlSiMag ceramic may be safely used in working temperatures up to 2800° F. The limiting factors are the metal components. The parts shown have tantalum pins with nickel braze alloy combined with the ceramic in a strong hermetic seal for operating temperatures in the 1000° F. range. The materials have been carefully selected for ruggedness and for their low vapor pressure characteristics. This base and envelope allow higher bake-out temperatures during assembly.

A Subsidiary of Minnesota Mining and Manufacturing Company

AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENN.
57TH YEAR OF CERAMIC LEADERSHIP

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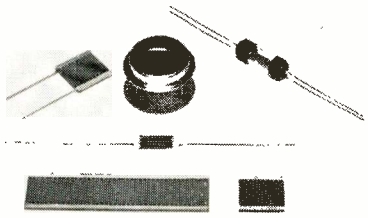
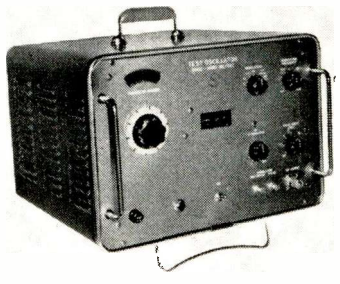
formance in low voltage transistorized applications, it operates at temperatures from −65 C to +125 C without derating, has a capacitance variation of less than ±3 percent over the entire operating temperature range. The compact light-weight units are available in ratings from 0.027 μf to 2.0 μf. **Circle 205 on Reader Service Card.**



Photoconductive Cells
cadmium sulphide

NATIONAL SEMICONDUCTORS LTD., Montreal 26, Quebec, Canada. New cadmium sulphide photoconductive cells feature several new physical shapes designed to meet the most common mounting problems. The unsealed types with or without pigtails are rated at 0.5 w. The head-on type, hermetically sealed by a glass-to-metal seal, is rated at 1.0 w dissipation, and when mounted on a suitable heat sink, may dissipate up to 3.0 w for short periods. The tubular hermetically sealed variety has a power rating of 0.15 w. **Circle 206 on Reader Service Card.**



Test Oscillators
two models

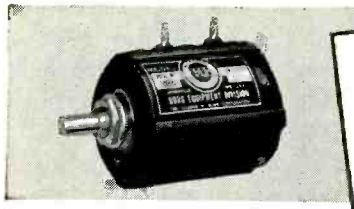
FXR, INC., 26-12 Borough Place, Woodside 77, N. Y. New signal sources, models C772A and X772A are test oscillators with frequency ranges from 3,950 to 8,000 mc and 7,000 to 11,000 mc, respectively. Power output is from 10 to 100 mw. Other features include an

STANDARD COMPONENTS

built by BORG®

FIT MANY SPECIAL DESIGN NEEDS

Design flexibility of standard Borg components often eliminates the need for expensive, specially designed units. Borg offers a complete line of precision potentiometers, turns-counting dials and fractional horsepower motors. Many of these standard Borg components are currently on duty in missile launching platforms and firing control stations, radar and sonar equipment, computers and similar electronic apparatus. Production of standard Borg components assures quick delivery. A partial selection is shown on this page. Write for complete data on all Borg components. Ask for catalog BED-A90.



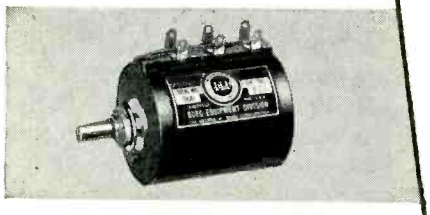
205 SERIES, 10-TURN MICROPOTS

SIZE: 1¾" dia.; 2⅛" long; shaft extension ⅞" or special to order.

LINEARITY ACCURACY: ±0.1% and 0.05% (independent or zero based).

RESISTANCES: 50 ohms to 100,000 ohms, tolerance ±5%.

POWER DISSIPATION: 5 watts at 40° C.



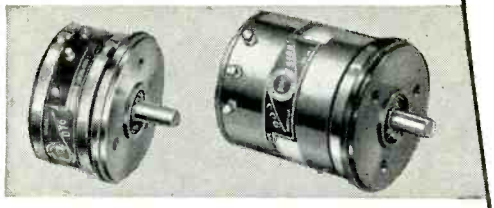
1100 SERIES, 10-TURN MICROPOTS

SIZE: 1⅞" dia.; 2⅛" long; shaft extension ⅞" or special to order.

LINEARITY ACCURACY: 0.5% to 0.1% (independent linearity).

RESISTANCES: 50 to 100,000 ohms, tolerance ±5%.

POWER DISSIPATION: 3 watts at 40° C.



900 SERIES MICROPOTS

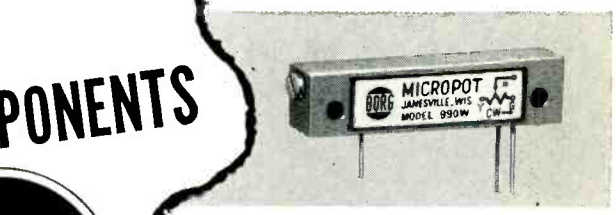
Borg 900 Series Micropots are available in single-turn, 3-turn and 10-turn models.

SIZE: Single-turn — 2" dia.; 1⁵⁄₆₄" long
3-Turn — 2" dia.; 1⅜" long
10-Turn — 2" dia.; 2¹⁄₁₆" long
Shafts — ¼" dia.
Bushing Mount — ⅞" long
Servo Mount — ⅝" long

LINEARITY ACCURACY: Single-turn — ±.5% (independent)
3-Turn — ±0.1% (independent, zero based, or absolute reference).
10-Turn — .05% (independent, zero based, or absolute reference).

RESISTANCES: Single-Turn — 50 to 50,000 ohms
3-Turn — 15 to 60,000 ohms
10-Turn — 50 to 300,000 ohms

TEMPERATURE LIMITS: Tested to 350° F.



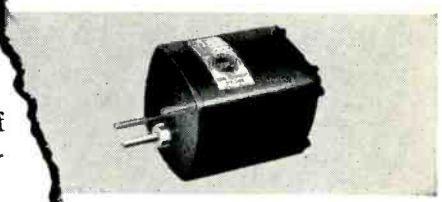
990 SERIES TRIMMING MICROPOTS

SIZE: 1¼" x 5⁄16" x 17⁄64"

RESISTANCES: 10 to 30,000 ohms standard. Other values on special order.
Tolerances — ±5% 100 ohms and over
±10% below 100 ohms

ADJUSTMENT: Screw driver slot provides adjustment of complete range in 40 turns.

TERMINALS: Printed circuit, soldered lug, insulated wire leads.



PRECISION INSTRUMENT MOTORS

Borg-Motors offer you fractional horsepower motors in synchronous or induction models with or without gear-trains in 2-pole or 4-pole models for your precision equipment. Borg-Motors are totally enclosed, using precision machined die cast alloys for end bells and gear train cases. Die cast rotors, mounted on two ball bearings, assure long life, continued accuracy.

DIRECT READING MICRODIALS

Borg Direct-Reading Microdials provide the highest accuracy of perception when forced-fast-reading and setting is required because of their inline digital presentation. Borg Direct-Reading Microdials are available in 3-digit 10-turn models, 4-digit 100-turn models and 5-digit 1,000 turn models. Also available are Borg Concentric Scale Microdials which indicate the position of any multi-turn device of 10 turns or less.

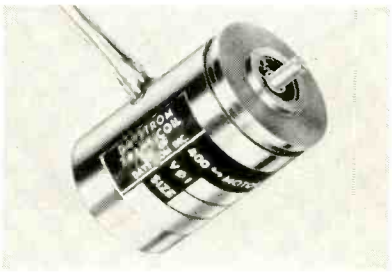
WRITE FOR COMPLETE DATA ON ALL BORG COMPONENTS — CATALOG BED A90

BORG EQUIPMENT DIVISION
Amphenol-Borg Electronics Corporation
JANESVILLE, WISCONSIN

BORG®

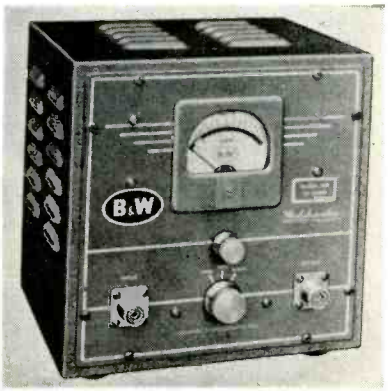
- MICROPOTS
- MICRODIALS
- MOTORS

integral power supply and modulator, a 40 db r-f attenuator; single knob, direct reading frequency obtained by automatic tracking of the reflector voltage. **Circle 207 on Reader Service Card.**



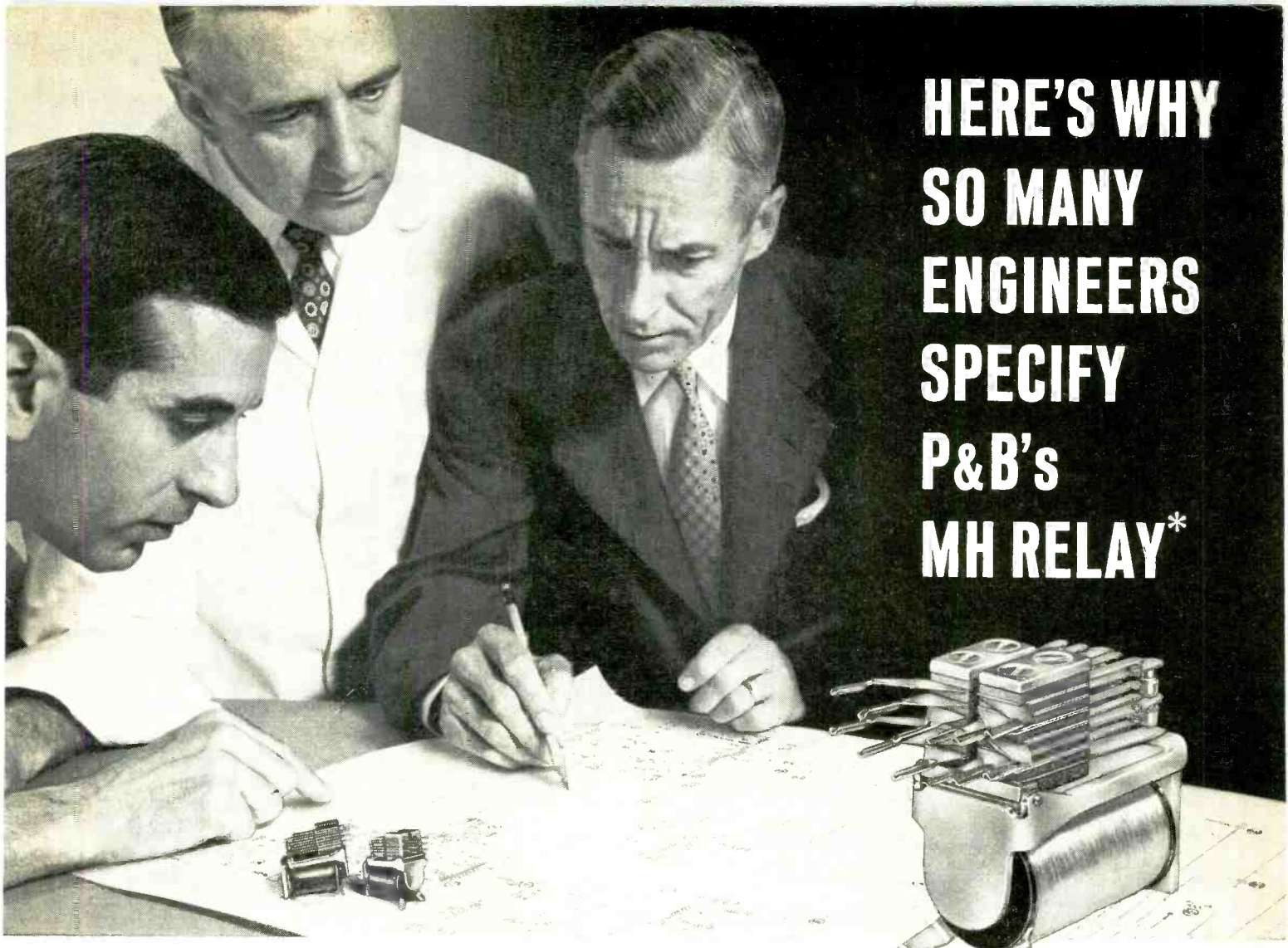
Motor Generator
2.75-oz unit

DAYSTROM TRANSICOIL, Worcester, Montgomery County, Pa. A new size 10 motor generator is designed for operation directly from transistor servo amplifiers, and will develop a stall torque of 0.3 oz in. Free speed is 6,500 rpm, and viscous damping is 31.1 dyne-cm/radian/sec. Generator output is 0.16 v per 1,000 rpm at 10 v input, and 0.41 v per 1,000 rpm at 26 v input. Maximum generator null is 35 mv and 91 mv at inputs of 10 and 26 v respectively. **Circle 208 on Reader Service Card.**



Dummy Load Device
versatile unit

BARKER & WILLIAMSON, INC., Bristol, Pa. By means of a versatile instrument called the Matchmaster, transmitters may be tested without putting signals on the air. Unit consists of dummy load with direct reading r-f wattmeter and swr bridge. It is useful in electronic lab or factory maintenance shop for measuring the swr in an-



HERE'S WHY SO MANY ENGINEERS SPECIFY P&B's MH RELAY*

*AND VARIATIONS OF THIS BASIC STRUCTURE SHOWN BELOW

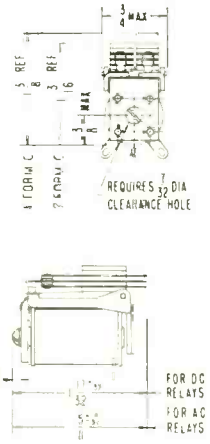
Shown with printed circuit terminals

VERSATILITY and adaptability

are prime reasons why designers have made the MH a P&B best seller. This relay series, for example, does yeoman duty in such diverse applications as jet aircraft, street lighting equipment, computers and missile ground controls.

When multiple switching is required ... when size, weight, long life and reliability are critical ... our MH relay can usually fill the bill. It's RIGHT for countless jobs, often at countable savings.

Let us send you complete information about this miniature telephone-type relay and the variations we've evolved for special applications. Write or call today.



ENGINEERING DATA/MH RELAY

Insulation: Laminated phenolic.

Insulation Resistance: 100 megohms minimum.

Breakdown Voltage: 500 volts RMS between all elements.

Shock: Up to 30g.

Vibration: Up to 10g from 55 to 500 cps.; .065" max. excursions from 10 to 55 cps.

Ambient Temperature: −45°C. to +85°C. −(65°C. to +125°C. on special order).

Weight: 2½ oz. max. (open relay)

Pull-In: Approx. 75% of nominal voltage.

Pull-In Speed: Approx. 15 ms.

Drop-Out Speed: Approx. 10 ms.

Terminals: Pierced solder lugs; special lugs for printed circuits, taper tab (AMP #78).

CONTACTS:

Arrangements: Up to 9 springs per stack.

Material: ⅛" silver; also Palladium or gold alloy.

Load: Dry circuits to 5 amps @115V AC resistive.

COILS:

Resistance: 22,000 ohms max.

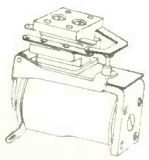
Power: 100 milliwatts per movable minimum to 4 watts at 25°C. max. (200 mw. min. to meet max. shock/vibration spec.)

Duty: DC: Continuous. AC: Intermittent (2 pole relay max.)

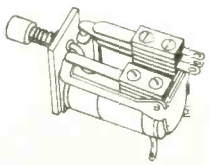
Voltages: DC: Up to 110 volts. AC: Up to 230 v. 60 cycles.

Current: 2.5 ma to 10 amps DC.

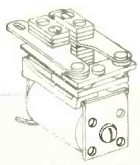
P&B STANDARD RELAYS AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR



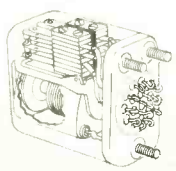
MC FOR RF SWITCHING
For RF switching where intercontact capacitance losses must be minimized. Ceramic contact spacers.



MA LATCHING
Electrical latch; mechanical reset. Small, versatile and offered with selection of contact arrangements.



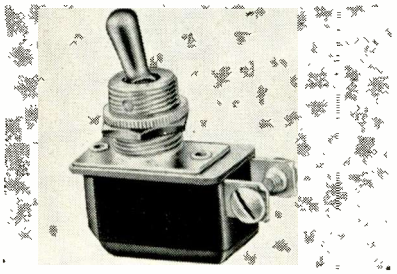
MB CONTACTOR
Contacts rated 60 amp. 28 volts DC non-inductive. Will carry 150 amp. surge for a duration of 0.3 seconds.



MH SEAL-TEMP
Features sealed coil to minimize contact contamination. Available as hermetically sealed relay only.

POTTER & BRUMFIELD INC.
PRINCETON, INDIANA • SUBSIDIARY OF AMERICAN MACHINE & FOUNDRY COMPANY

tenna feed lines, adjustment of radio transmitter power output before going on the air and many other applications. **Circle 209 on Reader Service Card.**



Toggle Switch
general purpose

SARGENT ELECTRIC CORP., 630 Merrick Road, Lynbrook, N. Y., announces a new series of general purpose, precision built toggle switches. Designed specifically for fractional h-p motors and electronic circuits, it features quick make, quick break, wiping contacts. Small and compact, it is rated at 3 amperes 250 v, 6 amperes 125 v. It is available in spst, in two bushing lengths, with either wire leads, screw terminals, solder lugs or quick disconnect tabs. **Circle 210 on Reader Service Card.**

Power Meter
stable, accurate

NARDA MICROWAVE CORP., 118-160 Herricks Rd., Mineola, N. Y., announces a fully-transistorized microwave power meter, self-balancing to provide accurate, automatic direct-reading measurements of c-w or pulsed power. It may be used with all 100 or 200 ohm bolometers or thermistors—positive or negative temperature coefficient—requiring any bias current up to 18 ma, in any frequency range for which there are bolometers or thermistor mounts. Meter provides wide power meas-

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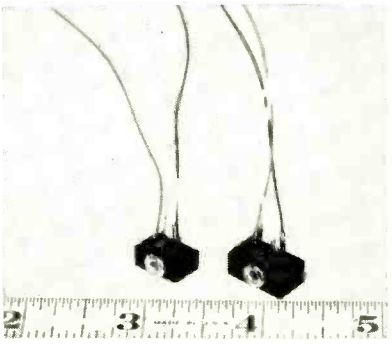
uring range, with 0.001 to 0.01 mw and 0.003 to 0.03 mw scales, in addition to the five standard scales up to 10 mw. **Circle 211 on Reader Service Card.**

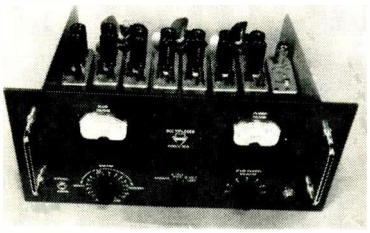
Power Supply transient free

PERKIN ENGINEERING CORP., 345 Kansas St., El Segundo, Calif., has developed a 6-36 v d-c at 15 amperes transistorized transient free power supply. Model MTR636-15 is especially designed for testing transistorized circuits where transistor failure occurs with the conventional statically regulated power supplies due to line and load transients. For further information write directly to the company.



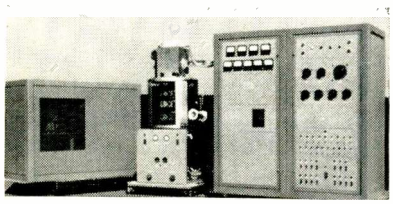
Instrument Rectifiers rugged, stabilized

EDAL INDUSTRIES, INC., 64 Franklin St., New Haven 11, Conn. Copper oxide instrument rectifiers are completely enclosed in a phenolic housing for high moisture, humidity and salt spray resistivity. The internal construction utilizes helical springs to insure minimum change of characteristics with temperature. An eyelet through center of the unit clears No. 2 screw for mounting. Leads are flexible 3 in. long stranded wire, high temperature vinyl insulation, colored for identification. **Circle 212 on Reader Service Card.**



Multiplexer
accurate, flexible

THE GEOTECHNICAL CORP., 3401 Shiloh Road, Garland, Texas. Remote real-time recording, computing, simulating, or control are made practical by coupling the multiplexer directly to a single voice-frequency telephone, radio, or microwave circuit to transmit several channels of analog data long distances. From 1 to 8 adjustable and serviceable voltage-controlled f-m subcarrier oscillators may be plugged into the multiplexer. **Circle 213 on Reader Service Card.**

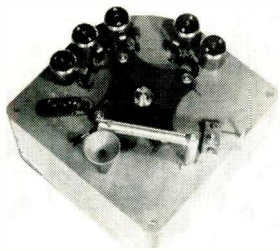


Klystron Transmitter
compact system

LEVINTHAL ELECTRONIC PRODUCTS, INC., 760 Stamford Industrial Park, Palo Alto, Calif. Model 215 klystron transmitter is a research unit for radar, communications, and propagation work. Utilizing an Eimac X581Q klystron with a power gain of 45 db, the unit is capable of producing 50 kw of peak power at a maximum duty cycle of 0.06. It operates over the band 700 to 900 mc. The complete system is packaged in three cabinets. **Circle 214 on Reader Service Card.**

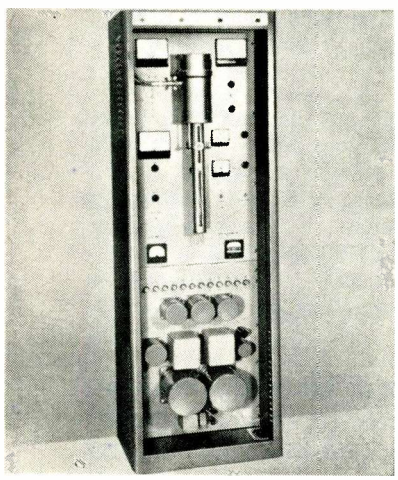
Printed Circuit
flexible type

INTERNATIONAL RESISTANCE CO., 401 N. Broad St., Philadelphia 8, Pa., announces a flexible printed circuit—etched copper patterns bonded between thin flexible sheets of plastic insulating materials such as Kel-F, Teflon epoxy, etc. Available in single or multiple layers, this flexible printed circuit gives lower manufacturing cost, lighter weight, space saving, increases reliability, lowers assembly errors, and gives uniform production. **Circle 215 on Reader Service Card.**



Core Handler
for 80 mil types

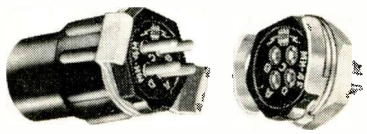
RESE ENGINEERING, INC., 731 Arch St., Philadelphia 6, Pa., announces model 4012 automatic memory core handler for fully automatic or manual rate feeding of standard, 0.080 in. o-d, ferrite cores to a testing point, in pilot line or full scale production line testing. Operating at a maximum handling rate of 3,600 cores per hr, the 4012 provides for the separation of the tested cores in 5 different grades. **Circle 216 on Reader Service Card.**



UHF Tv Translator
100 w unit

ADLER ELECTRONICS, INC., One LeFevre Lane, New Rochelle, N. Y. Type RA-7 translator-amplifier provides 100 w of peak visual output power in 470-890 mc range

when driven by a suitable modulated uhf tv signal. This output power enables communities shielded from orginating stations and beyond the range of 10 w translators to receive tv service. Features include variable bandwidth, and an exclusive method for adjusting the position of the feed point along the cathode line to insure proper drive impedance and very low vswr. **Circle 217 on Reader Service Card.**



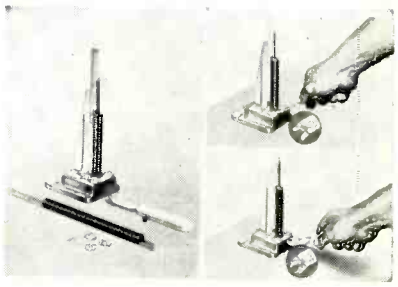
Hex Connectors
positive locking ring

U. S. COMPONENTS, INC., 454 E. 148th St., New York 55, N. Y. Miniature hex connectors with 4 to 10 contacts are now being produced with the positive locking ring described in U. S. Patent No. 2,848,-702. The MH series connectors are ideal for uniting cables subject to vibration, pulls, or other in-use stresses. **Circle 218 on Reader Service Card.**

Oscilloscope
dual-beam

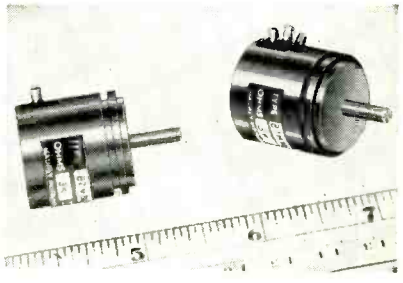
ALLEN B. DUMONT LABORATORIES, INC., 760 Bloomfield Ave., Clifton, N. J. A dual-beam oscilloscope with outstanding sensitivity which is capable of displaying x-y plots and simultaneously displaying either the x- or y-signal against time is available. A unique switching arrangement on the front panel of the type 411 develops nine ma-

jor modes of display. By introducing Z-axis modulation, 27 additional useful display modes are possible. **Circle 219 on Reader Service Card.**



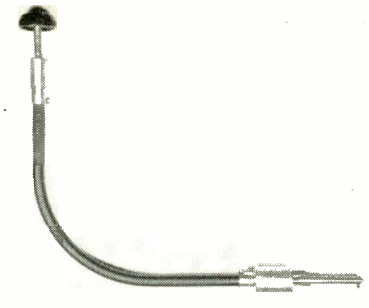
Applicator/Dispenser for retaining rings

WALDES KOHINOOR, INC., 47-16 Austel Place, Long Island City 1, N. Y., has developed a new applicator and dispenser designed for faster, more efficient and more economical assembly of Truarc series 5139 Prong-Lock retaining rings. The applicator is available in eight sizes to accommodate rings for shafts ranging in diameter from 0.092 in. to 0.438 in. The dispenser is available currently in four sizes to accommodate size —15, —18, —25 and —31 rings. **Circle 220 on Reader Service Card.**



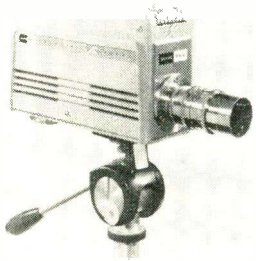
Servo Pot wire wound

MAUREY INSTRUMENT CORP., 7924 S. Exchange Ave., Chicago 17, Ill. The 87-M30 is a ¾ in. diameter servo precision potentiometer. Resistance range is 25 to 50,000 ohms. Torque is less than 0.10 oz-in. Independent linearity is ±5 percent above 1,000 ohms. Except for the shaft end, the unit is completely sealed from moisture and foreign material. It will pass applicable requirements of MIL-R-19A, MIL-E-5272A, 4 mils. **Circle 221 on Reader Service Card.**



Rotary Seal for high vacuum

HIGH VACUUM EQUIPMENT CORP., 2 Churchill Road, Hingham, Mass., announces a push-pull rotary seal for installation in units where a 90 deg translation of motion is required between the vacuum chamber and the operator's position in front of the system. It is capable of introducing both rotary and vertical motion into vacuum systems operating as low as 1 x 10^{-6} mm Hg. The device is capable of continuous 360 deg rotation, and 4 in. of vertical motion. **Circle 222 on Reader Service Card.**



Tv Camera withstands noise

KIN TEL, a division of Cohu Electronics, Inc., 5725 Kearny Villa Road, San Diego 12, Calif. Model 1986 CN camera is designed for closed-circuit tv systems where noise and vibration are severe operating hazards. It can operate in noise environments up to ± 145 db without an acoustical housing. Immediate application is on rocket or jet engine test stands. The camera is essentially free of microphonics. It features a video-signal amplifier with subminiature tubes mounted in a unique heat sink. Result is a dampening out of sound vibrations, plus full thermal protection. **Circle 223 on Reader Service Card.**

Literature of the Week

MATERIALS

Teflon Tubing. Continental-Diamond Fibre Corp., Newark, Del., has available a new bulletin on the CDF line of flexible thin-wall paste-extruded tubing and spaghetti extruded Teflon. **Circle 250 on Reader Service Card.**

Potting and Molding Compound. Electronic Production & Development, Inc., 138 Nevada St., El Segundo, Calif., has published a loose-leaf perforated bulletin on TC-459 connector potting and junction molding compound. **Circle 251 on Reader Service Card.**

Ceramic Tooling. Duramic Products, Inc., 262-272 Mott St., New York 12, N. Y. Bulletin 117 is a 2-page technical data sheet describing Duramic Grade M120F-T ceramic, a new wear-resistant high-temperature tooling material for use in alloying of semiconductor materials. **Circle 252 on Reader Service Card.**

COMPONENTS

Resistance Card. Filmohm Corp., 48 W. 25th St., New York 10, N. Y. Bulletin P-2 describes the metal film fiberglass plastic resistance card, a new highly stable microwave attenuator material. **Circle 253 on Reader Service Card.**

Large Waveguide. I-T-E Circuit Breaker Co., 1900 Hamilton St., Philadelphia 30, Pa. A four-page report reviews a full family of large waveguide components and associated test equipment. **Circle 254 on Reader Service Card.**

Flexible Shafting. F. W. Stewart Corp., 4311-13 Ravenswood Ave., Chicago 13, Ill. A new bulletin explains briefly the advantages and the simplicity of designing a flexible shaft into products having an application which requires con-

trol from remote places. **Circle 255 on Reader Service Card.**

Electronic Control System. D. W. Thomas Engineering Inc., 367 W. Seventh St., San Pedro, Calif. Bulletin 3079 describes Ra-Trol, a transistorized subminiature electronic control system. **Circle 256 on Reader Service Card.**

Resistors/Capacitors. Ohmite Mfg. Co., 3670 Howard St., Skokie, Ill. Bulletin 162 describes three unusual assortments of precision resistors and tantalum capacitors marketed by the company to meet complex missile age needs. **Circle 257 on Reader Service Card.**

EQUIPMENT

Industrial Automation Equipment. Radio Corp. of America, Camden 2, N. J. A new product information folder contains descriptions and specifications of a wide variety of building-block type automation machines for mechanizing and integrating production and assembly operations. **Circle 258 on Reader Service Card.**

Recorder/Reproducer. Minnesota Mining & Mfg. Co., 2049 So. Barrington Ave., Los Angeles 25, Calif. A four-page technical brochure describes the new Mincom 7-track video band magnetic recorder/reproducer. **Circle 259 on Reader Service Card.**

Liquid Density Instrumentation. General Communication Co., 677 Beacon St., Boston 15, Mass. Bulletin LD1-58 describes high resolution liquid density instrumentation for process application. **Circle 260 on Reader Service Card.**

FACILITIES

Equipment and Systems. Milgo Electronic Corp., 7601 Northwest 37th Ave., Miami 47, Fla., has published a brochure discussing its personnel, products, and facilities for the design and manufacture of individual pieces of equipment as well as complex electronic systems. **Circle 261 on Reader Service Card.**

NEW BOOKS

Le Calcul Analogique Par Courants Continus

By M. DANLOUX-DUMESNILS

Dunod, Paris, France, 1958, 257 *p.*

THIS introduction to the subject of analog computers fills an important void, as it is one of the few non-English publications on the subject.

A strong recommendation for the book is that it is written for the person who is going to use the computer. The author attempts to instill a basic pattern of thought for the novice to follow in trouble-shooting the computer. This approach has been lacking to a certain extent in American texts on analog computers.

Contents—The topics covered are materially the same as those found in American books but do not cover any new additions. It is, perhaps, in this respect that there is some weakness.

In general, the book should indeed be helpful to the beginner. The author presents the material lucidly, important points are summarized and at the same time the reader is introduced to the parlance of the art. — WALTER BRUNNER, *Electronic Associates Inc., Princeton Computation Center, Princeton, N. J.*

Control System Components

By J. GIBSON and F. TUTEUR

McGraw-Hill Book Company, New York, 1958, 493 *p*, $12.00.

IN "Control System Components" the authors have successfully laid the foundation for bridging the gap between the more theoretical treatises on control systems engineering and the somewhat shocking, hard cold facts of equipment design.

The transitional problems involved in progressing from concept to the physical realization of control system hardware are many; and their solution requires a fundamental knowledge of components, their limitations and some of the really practical considerations that

govern their usage. It is exactly these areas that Gibson and Tuteur cover in realistic detail and in a thoroughly modern and workmanlike, if not imaginative, manner.

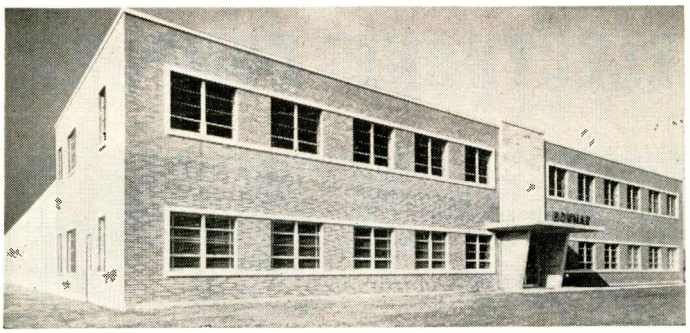
The textbook is admirably not weighted too heavily in favor of the electronic elements of the servomechanism. Devoting approximately 60 percent of its pages to electrical and electromechanical components, the remaining 40 percent of the book is reserved for a good treatment of mechanical, hydraulic and pneumatic elements of the servo system. It is felt this division of emphasis is roughly in proportion to the physical design problems after the initial system synthesis has been performed.

To summarize, Control System Components appears to be a generally useful text, one which should find application in the schools in both undergraduate and graduate classes, as well as in the bookcase of the practicing engineer, and which is a worthy and necessary complement to the more theoretical, advanced texts on control system analysis and synthesis. As such, it is highly recommended.—A. E. NASHMAN, *Executive Engineer, ITT Laboratories, Nutley, N. J.*

THUMBNAIL REVIEWS

Vistas in Astronautics. Edited by M. Alperin, M. Stern and H. Wooster, Permagon Press, New York, 1958, 330 p. $15.00. These unclassified portions of the proceedings of the Astronautics Symposium sponsored in 1957 by the Air Force Office of Scientific Research of the Air Research and Development Command and Convair Division of General Dynamics Corp. includes articles on reentry, tracking and communications, environment and measurements, propulsion, orbits, and human factors. Articles in the second, third and sixth sections should be of interest to electronics engineers.

The Electrical Production of Music. By A. Douglas, Philosophical Library, New York, 1957, 223 p, $12.00. Addressed to the reader possessing an elementary knowledge of both music and electronics, this book starts with an introduction to the physics of musical instruments and then leads into characteristics and applications of electronic circuits in music production.



Bowmar Growth Continues

BOWMAR INSTRUMENT CORP., producer of precision control and indicating components, has added more than 6,000 sq ft of floor space to its new Ft. Wayne, Ind., facility.

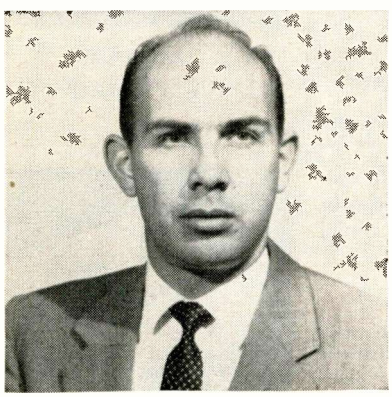
The new area is for the company's engineering and sales groups, says E. A. White, president. New construction has taken the form of a second-floor addition at the front end of the present plant.

Layout plans for Bowmar's new 30,000 sq ft facility had scarcely taken a curl after the Oct., 1957 dedication, when a year later management took another look to see what it could do to take care of additional demand. Even in the recession year, Bowmar expanded its personnel and equipment.

Bowmar manufactures a broad line of precision servo gearheads, counting devices and electromechanical packages for control and guidance systems. The company's components are used widely in U. S. missile and space exploration systems.

The latest expansion is right on schedule for Bowmar, which each year since its forming in 1951 has had to move or expand to double and even triple its space.

Bowmar growth, although rapid, is just well underway, according to White. This year the company expects to complete plans for further expansion in its laboratory, research and development, and environmental testing facilities.



Forrest Joins Epsco-West

STANLEY C. FORREST recently joined Epsco-West, Anaheim, Calif., as project engineer.

His initial assignment is the design and development of a switch timing and monitoring system for Convair-Pomona to be used in conjunction with the preflight checkout equipment of the Atlas missile.

Prior to joining Epsco, Forrest was a project engineer for the B. J. Electronics Corp. of Santa Ana, Calif.

Harkness Takes Bendix Post

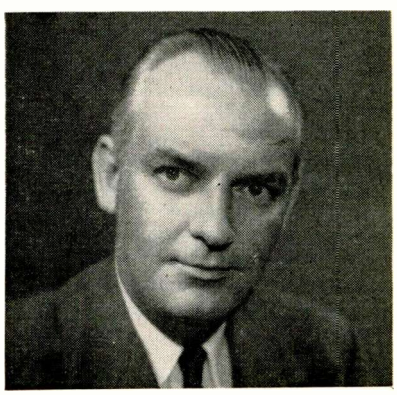
THE NEW post of electronics manager at Bendix-Pacific division, No. Hollywood, Calif., was recently taken over by John R. Harkness.

Bendix-Pacific's electronics projects, which he will head, include telemetry, radar, sonar, and missile guidance systems.

Harkness' experience in electronics, spanning 20 years, includes positions as chief engineer of Pacific Scientific Co.; vice-president, engineering, G. M. Giannini Co.; western division manager, Kearfott Co.; and most recently, vice-president and general manager of the electronics division, Byron Jackson division of Borg-Warner Corp.

Watkins-Johnson Hires St. John

GRANT E. ST. JOHN has joined the technical staff of Watkins-Johnson Co., Palo Alto, Calif. He was formerly with Bell Telephone Laboratories in the East, which he joined in 1952 to work on low-noise traveling-wave tubes.

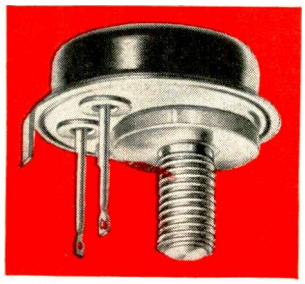


Elect Truesdell Board Member

VICE-PRESIDENT and director of sales of Zenith Radio Corp., L. C. Truesdell, has been elected a member of the corporation's board of directors.

Trusdell joined Zenith in 1949 as vice-president and sales manager

HIGH efficiency at HIGH operating temperatures



SILICON POWER TRANSISTORS

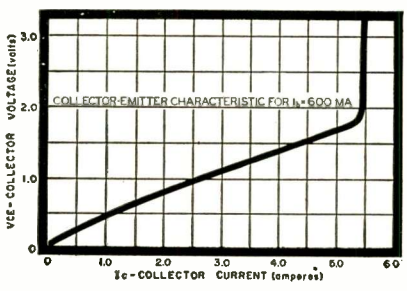
Available Now in production quantities!

The Westinghouse Silicon Power Transistor pictured above is a highly efficient device which greatly increases the range of applications for transistors which must operate without high losses in the "true power range." Thanks to a remarkably low saturation resistance—less than .750 ohms at 2 amperes and .5 ohms at 5 amperes—these transistors possess very low internal dissipation, and can be efficiently used in applications where they must handle as much as 1000 watts. For example, as a DC switch, handling 750 watts (150 volts at 5 amps) the internal dissipation is about 9 watts, with an efficiency of better than 99%.

Additionally, and unlike germanium units which are limited to approximately 85°C, these transistors can operate in ambient temperatures up to 150°C. Thus, even where the higher power rating is not required, these units may be used for their high temperature capabilities.

There are a great many applications for which this new type of silicon power transistor is ideally suited. It will find use in inverters or converters (AC to AC; AC to DC; DC to AC; DC to DC), regulated power supplies, servo output, and other aircraft circuits, as well as in certain amplifiers and switching applications.

Westinghouse Silicon Power Transistors are available in 2 and 5 ampere collector ratings. Both of these are available in 30, 60, 100, and 150 volt ratings in production quantities for your immediate applications. Sample quantities are available in higher voltage ratings. Call your Westinghouse representative or write directly to Westinghouse Electric Corporation, Semiconductor Department, Youngwood, Pennsylvania.



LOW SATURATION RESISTANCE

Important improvements in silicon purification and transistor fabrication have produced a new series of Westinghouse Power Transistors of exceptionally low saturation resistance.

YOU CAN BE SURE...IF IT'S

Westinghouse

in charge of radio and television. He was named director of sales in 1955.

Allied Control Ups Bachorik

NEW general sales manager of Allied Control Co., Inc., New York City, is Edward Bachorik. The firm manufactures electrical relays, miniature electronic switches and solenoid valves.

Bachorik joined Allied Control in 1947 and had served as regional sales manager prior to his recent promotion.

Burnell Names Walter Bein

CHIEF engineer for Burnell & Co., Walter Bein has been elected an officer of the company and director of engineering with broad research and development responsibilities. He will supervise Burnell's design program at its main plant in Pelham, N. Y.

Components manufactured by

Burnell are currently in use in computers, telemetering communication systems and guidance for such missiles as the Jupiter, Thor, Polaris, Falcon, Talos, LaCrosse and Atlas ICBM.

News of Reps

James W. Murray of Cincinnati, Ohio, is new sales rep for Technical Wire Products, Inc., Springfield, N. J., manufacturer of r-f shielding equipment. He will cover southwestern Ohio, southern Indiana and Kentucky.

The following recent rep appointments have been announced by Vis-U-All Products Co., Grand Rapids, Mich., manufacturers of a line of tube testing equipment:

Edwin A. Schultz of Indianapolis, Ind., covering Indiana and Kentucky; **L. J. McTaggart** of Buffalo, N. Y., covering upstate New York; and **L. E. Barnhart** of Jacksonville, Fla., covering Alabama, Florida, Georgia, North Carolina and South Carolina.

General Ceramics Corp., Keasbey, N. J., recently appointed three new sales reps:

Chapin & Associates of Los Angeles will handle southern California, including San Luis Obispo, Kern and San Bernardino counties.

Northern California, including the counties of Monterey, Kings, Tulare and Ingo will be handled by **Cerruti & Hunter Associates** of Redwood City, Calif.

Fryco, with offices in Scottsdale, Ariz., will cover the Arizona and New Mexico sales territory.

Three sales reps are named by the Mansol Ceramics Co., Belleville, N. J. Reps and their territories are as follows:

H. S. Bancroft & Co. of Westmont, N. J., for Virginia, eastern Pennsylvania, southern New Jersey, Delaware, Maryland and District of Columbia; **Henry Lavin Associates** of Meriden, Conn., for all six New England states; **Henry Lazor** of Rochester, N. Y., for all New York state, from the Westchester County line north.

COMMENT

SAC Electronics

Congratulations on the excellent series on Strategic Air Command (p 30, Feb. 13; p 35, Feb. 20; p 35, Feb. 27). You have packed a tremendous amount of information into a few pages, and it's all crystal clear.

I am filing the clips . . .

T. J. BERNARD
RADIO CORP. OF AMERICA
CAMDEN, N. J.

Microwave Hazards

Your article "Researching Microwave Health Hazards" (p 49, Feb. 20) was indeed timely.

The subject of microwave hazards is a difficult one to treat fairly, and you have conveyed a more nearly accurate impression of the present state of our knowledge in this field than most of those who have written about it for newspapers.

In my opinion, most people reading the statement "Within the last two years, a massive research program has attempted to enlarge our understanding of the biological effects of microwave exposure" will be so conditioned by the adjective *massive* that they will overlook the verb *has attempted*. I am personally grateful for every effort being made to enlarge the available data on biological effects, and trust that the research program will continue to be increased until it becomes massive. We in industry have been told several times to be patient and to realize that biological experiments are apt to be time-consuming.

The comparison of irreversible damage to the eye and to the testis on p 51 seems to be based on opinion. The work of Drs. C. J. Imig, J. D. Thomson and H. M. Hines of the University of Iowa does not support that view.

Would it be possible to give Dr. J. F. Herrick of Mayo credit for discovering the clearly nonthermal phenomenon, or, if it was discovered by several independently, to give each credit?

I seriously doubt that there is

any significant difference between prescription lenses and plain lenses with regard to focusing r-f energy from radars now in use. I agree that goggles using various kinds of wire mesh do cause the concentrations expected from the lenses.

One should still monitor at 0.001 w/cm^2 even if harmonics and unwanted frequencies are eliminated, because multiple reflections and the types of signals used cause such complex fields that not only monitoring at 0.001 w/cm^2, but also using several types of indicators and several types of antennas is necessary to determine the nature of the field with a reasonable degree of certainty. To date, there is no single instrument that may be relied upon to provide complete information with regard to maximum field strengths. Also, one should expect to have to monitor both harmonics and unwanted frequencies to prevent their becoming significant contributors to microwave hazards in some installations.

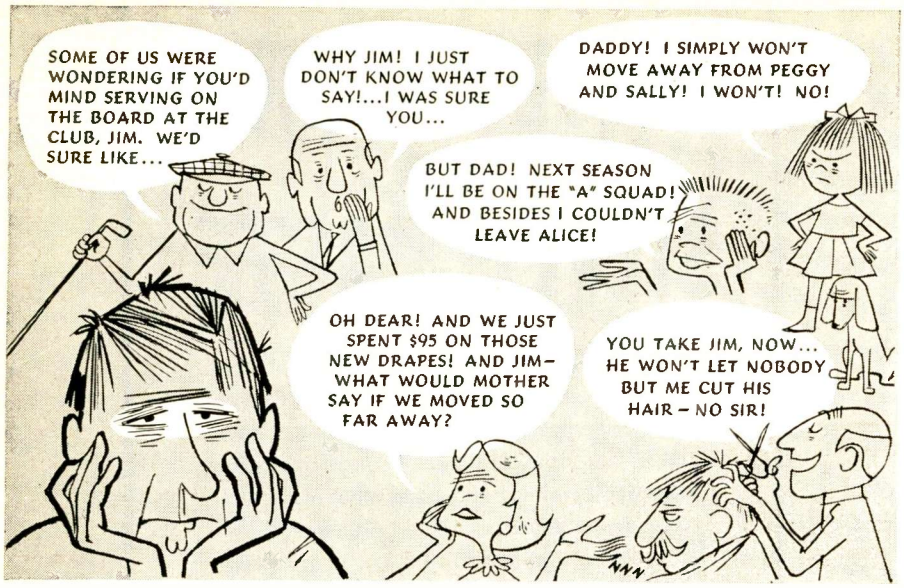
The material you have presented on this important subject should prove to be of considerable value to those interested in this problem.

HARRY R. MEAHL
GENERAL ELECTRIC
SCHENECTADY, N. Y.

Our search of the medical and electromedical literature did not present any opinion that would seriously confute this statement, made by Lt. Cdr. (Dr.) Thomas Ely of Naval Medical Research Institute: "Testicular reactions to heat injury from a radar source appear to be basically the same as those due to hyperthermia associated with other conditions. Even in the most severely exposed testicles in this study, it is unlikely that the damage is of a permanent nature. Many of the tubules remained undamaged, while many more were only slightly damaged."

Dr. Herrick worked on pearl-chain formation in lymph and other substances, but her work stemmed from colloid experiments dating as far back as 1921.

We might point out, in passing, that reader Meahl has made substantial contributions to the bio-effects program in the area of high-frequency measurement.



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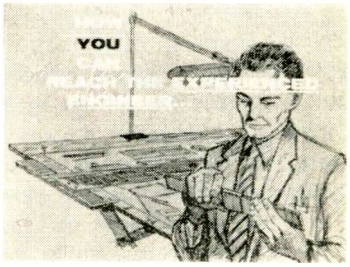

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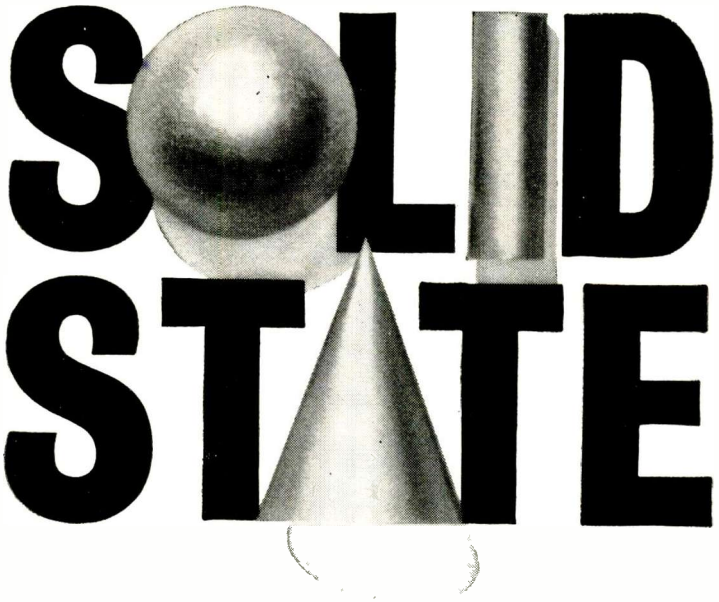

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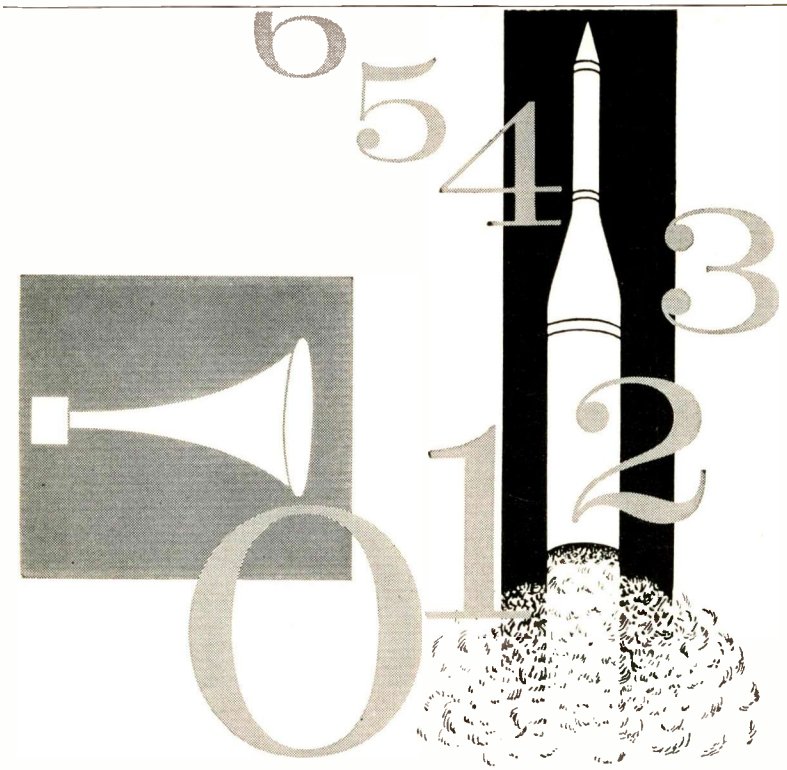

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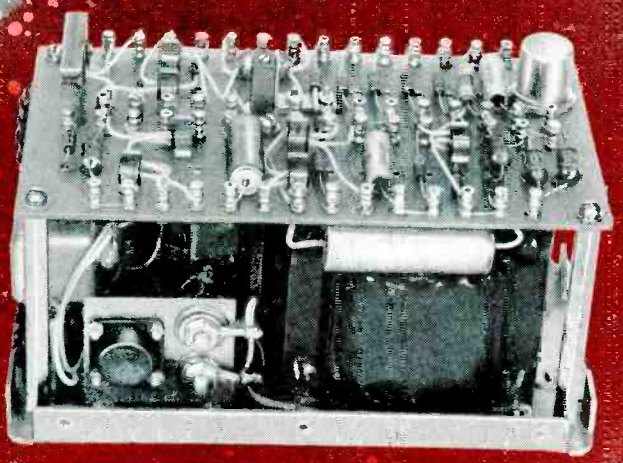

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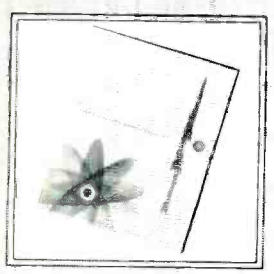

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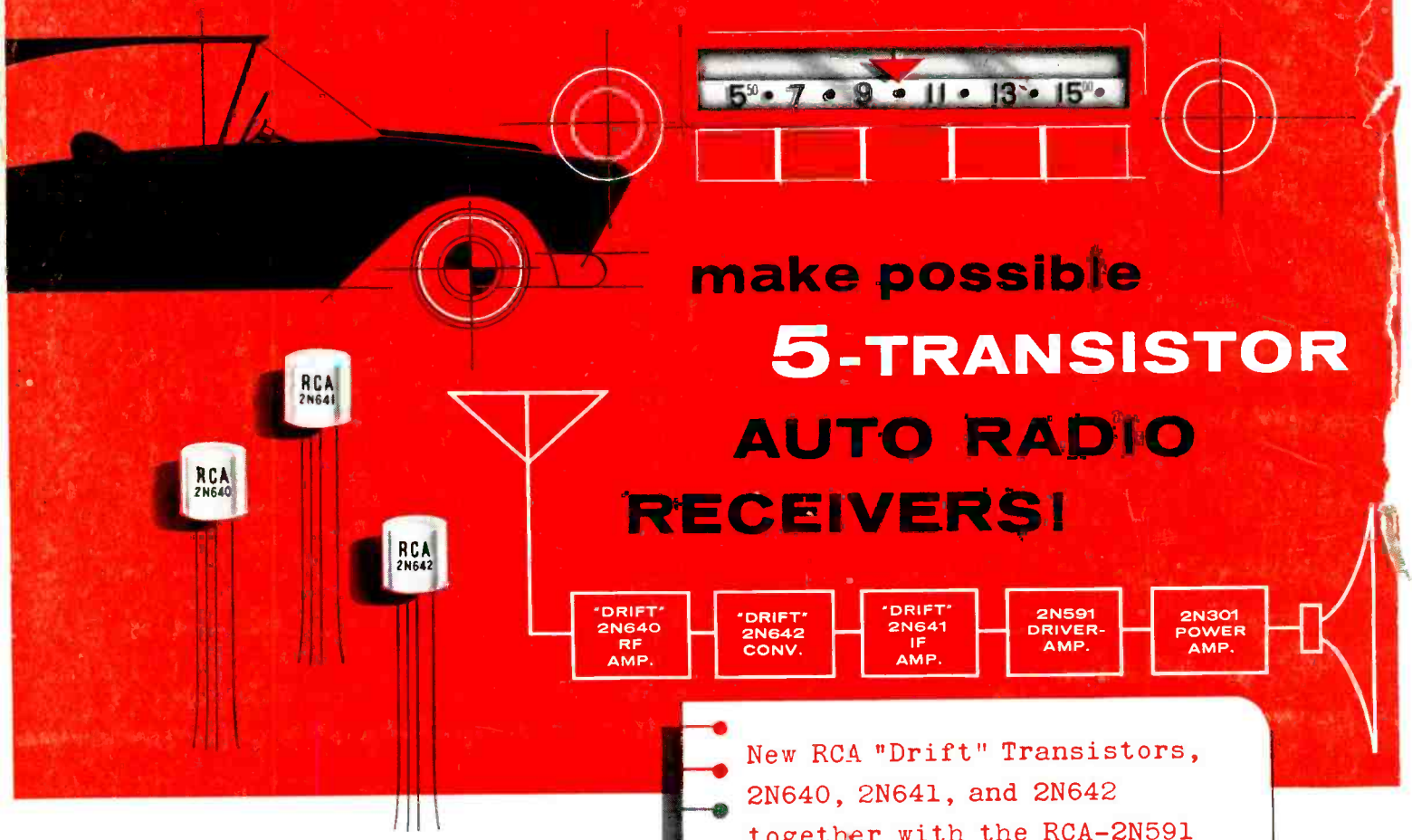

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2N641	−1	60	262.5	−1	41	−12	−7
2N642	−1	60	1000	−0.6	40●	−12	−7
2N591	−2	70	1	−2	41	−1	−7
2N301	−1000	70▲	0.4	−1800■	33	−0.5	−100

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