

# ELECTRONIC DESIGN

AUGUST 19, 1959

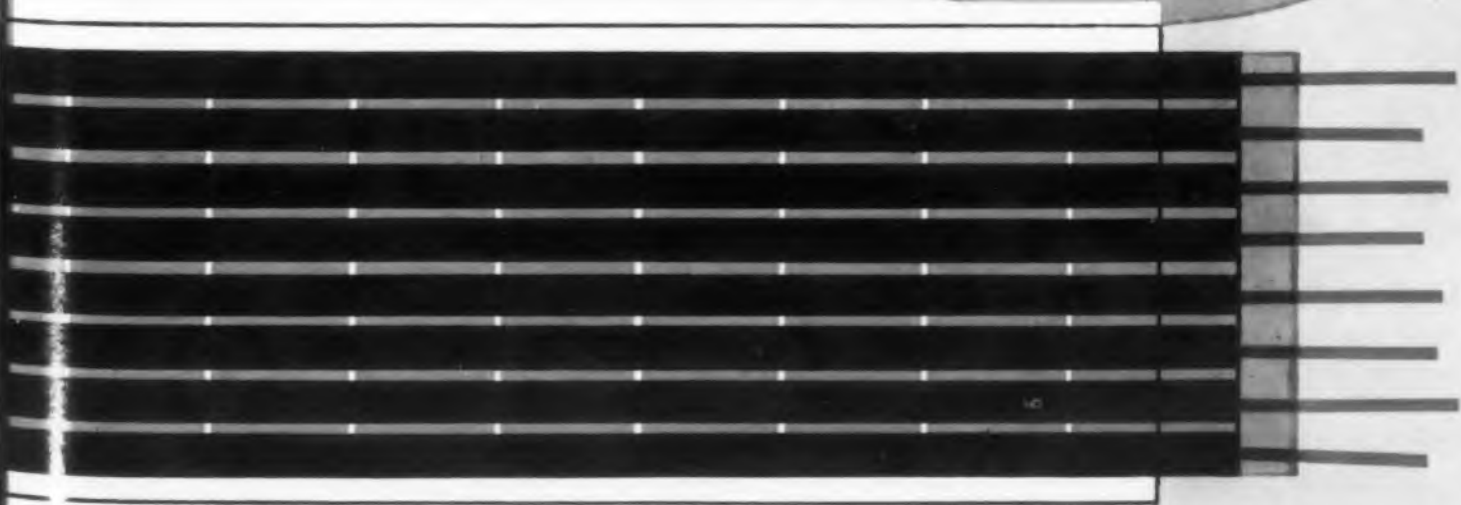
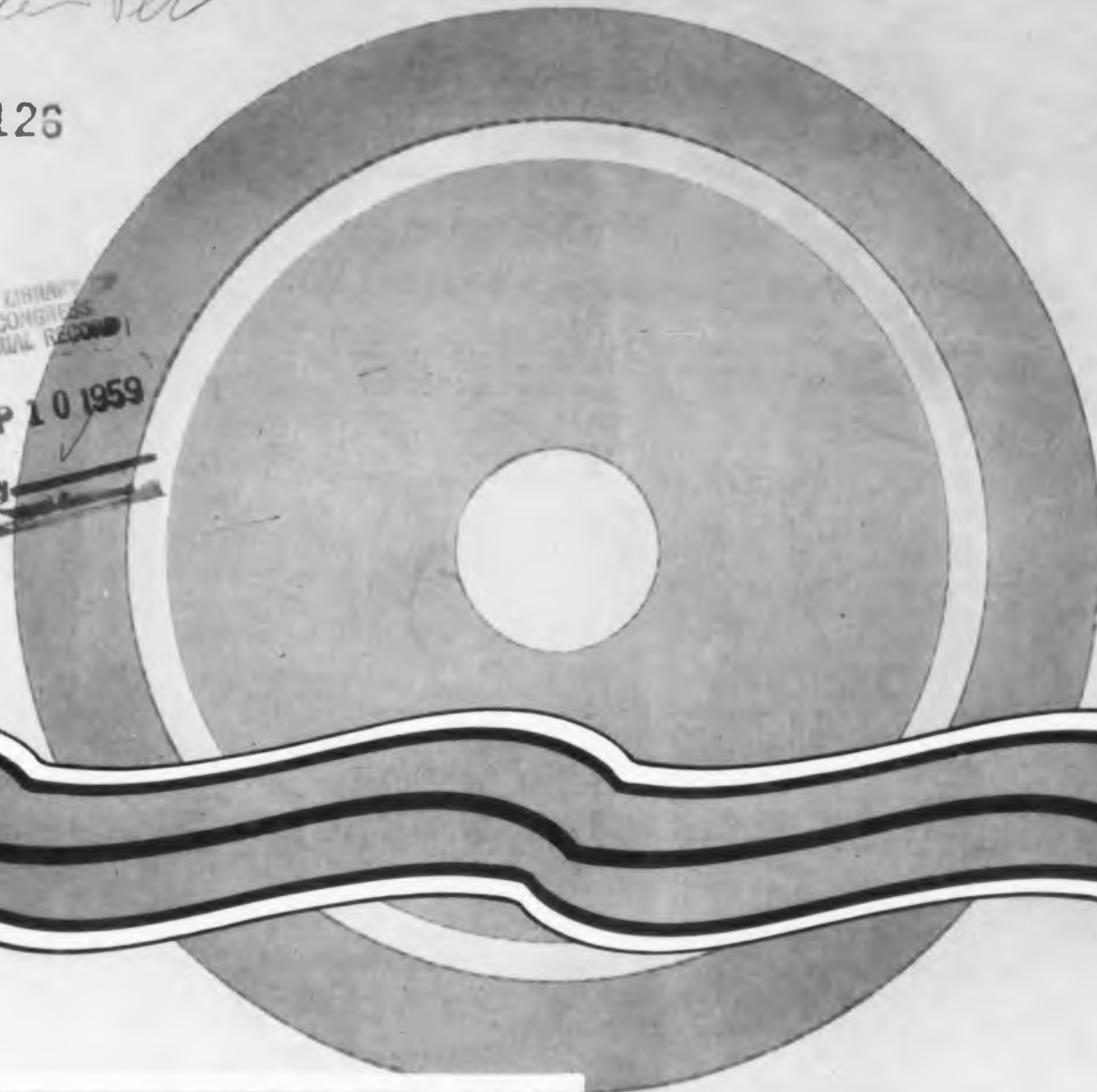
*AID the Pk*

B 789126

THE LIBRARY  
CONGRESS  
SERIAL RECORDS

SEP 10 1959

~~SEP 10 1959~~



Flat, Multi-Conductor Coax  
Cuts Radiation Losses

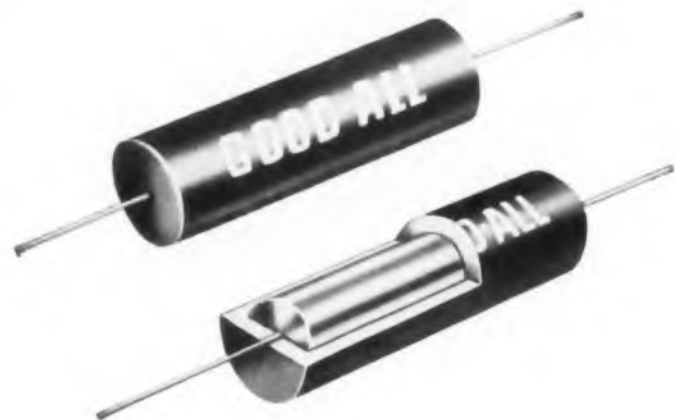
p. 38

**Canadian General Electric Co., Ltd.**

New streamlined transformers, molded in Epon resins, have superior insulation and dielectric strength. Accuracy and over-all performance are greatly improved.



## Specify Epon<sup>®</sup> Resins...



**Good-All Electric Manufacturing Co.**

New Epon resin-molded 600 UE capacitors have superior moisture resistance. Offer rugged, trouble-free performance because Epon resin assures high dielectric strength, low leakage.

## for potting, molding, sealing, encapsulating

SWITCH TO EPON resin-based compounds for potting, molding, sealing, and encapsulating to upgrade the performance of your electrical or electronic units . . . cut costs through design simplification.

Why? Because the excellent physical properties of Epon resins eliminate the need for conventional containers and housings. Size, weight, and com-

plexity of components are reduced.

To lower costs and speed up production, manufacturers have moved in the direction of automation. In the new mixing, metering and dispensing equipment, even the most heavily filled Epon resin formulations can be used for high-volume, rapid-curing potting, encapsulating, and sealing operations.

Epon resins can be adapted to a wide variety of formulations designed to meet your specific needs. Write now for full information including a list of suppliers of Epon resin-based formulations and manufacturers of automatic mixing, metering, and dispensing equipment.

SHELL CHEMICAL CORPORATION  
50 West 50th St., New York 20, N.Y.

### SHELL CHEMICAL CORPORATION PLASTICS AND RESINS DIVISION

CHICAGO • CLEVELAND • LOS ANGELES • NEW YORK  
IN CANADA Chemical Division, Shell Oil Company of Canada, Limited, Montreal • Toronto • Vancouver



CIRCLE 1 ON READER-SERVICE CARD

### HIGHLIGHTS OF ISSUE



**Flat-Strip Coaxial Cable  
(Cover) . . . . . 38**

Flat, multiconductor coax cables yield many advantages in high frequency transmission. They cut down radiation losses and save size and weight.

**How to Generate Time Intervals  
with Transistors and Cores 28**

Transistors and magnetic cores can be used to generate time intervals, but they must be used properly. Roland Van Allen gives several circuits and shows how to use them.

**How Connection Methods  
Affect Capacitance  
Measurements . . . . . 34**

Errors in low capacitance measurements often crop up. This can be traced to the way connections to the capacitors were made. Various connection methods used to measure the capacitance of two and three terminal capacitors are described in this article.

**Light Bulbs for Special  
Applications . . . . . 40**

Household light bulbs, inexpensive and versatile, are often overlooked by design engineers. These components can serve as excellent nonlinear elements. Mr. Jaensch provides convenient tables giving their characteristics for other than standard conditions.

## NEWS

- Multifunction Design Achieved In First Tunnel Diode Circuits 3

## EDITORIAL

- Ideas Pay Off 27

## FEATURES

- How To Generate Time Intervals With Transistors And Cores 28  
*Basic circuits for generating time intervals with transistors and magnetic cores ..... R. L. Van Allen*
- IR Cells Read Coded Film 32  
*Black and white dots yield coded information to IR cells*
- How Connection Methods Affect Capacitance Measurements 34  
*Various connection methods and the precision they provide are covered ..... John F. Hersh*
- Flat-Strip Coaxial Cable 38  
*Flat, multi-coax cable provides many advantages over coax bundles*
- Light Bulbs For Special Applications 40  
*Characteristics and possible applications of light bulbs in electronic equipment ..... K. H. Jaensch*
- Paramistors Cut Computer Costs 42  
*Japanese built units simplify design*
- You, Too, Can Create, if— 58  
*A look at the instructive approach to innovation*
- Protection Against Trade Secret Disclosures 62  
*Growing trend for courts to recognize a property right in ideas*
- Modular Antenna Pedestals 100  
*Afford rapid interchangeability and maintenance*
- Electromagnetic Thickness Gage 44  
*Ideas For Design*
- Sampling Papers From Soviet Universities 74  
*What the Russians are writing*
- Design Of Low-Noise Transistor Amplifiers 78  
*Ferrites As Temperature Transducers  
German Abstract*
- Thermal Equivalent Circuit Of A Transistor 80  
*Abstracted from IBM Journal*

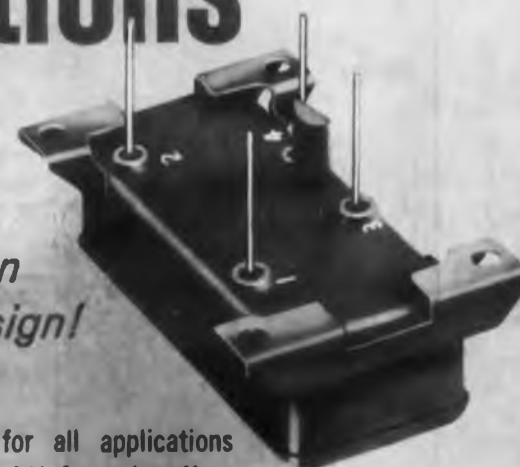
## DEPARTMENTS

- |                      |    |                     |     |
|----------------------|----|---------------------|-----|
| Washington Report    | 22 | German Abstracts    | 78  |
| Meetings             | 24 | Abstract            | 80  |
| Ideas for Design     | 44 | Report Briefs       | 82  |
| Patents              | 56 | Standards and Specs | 86  |
| Careers              | 58 | Books               | 88  |
| Career News          | 65 | New Literature      | 90  |
| Career Brochures     | 67 | New Products        | 98  |
| Russian Translations | 74 | Production Products | 166 |
| Advertisers' Index   |    | 170                 |     |

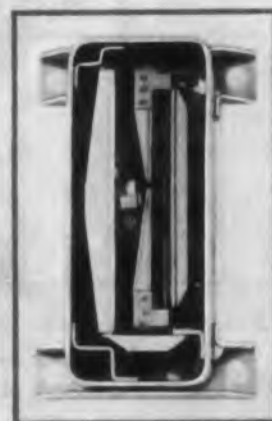
CIRCLE 2 ON READER-SERVICE CARD ➤

# The most precise, sturdiest thermal relay ever built... best for missile applications

...from the leader in  
thermal relay design!



Now, for missile environments and for all applications where greater precision is necessary, G-V Controls offers the revolutionary new PT Thermal Relay—the most precise thermal relay ever-built! And the PT's sturdiness is unequalled in thermal relays. It withstands missile vibration and shock far better than any other thermal relay.



## SPECIFICATIONS

Time Delay: 3 to 60 seconds (Factory Set)  
Setting Tolerance:  $\pm 5\%$  ( $\pm \frac{1}{4}$  sec. min.)  
Temperature Compensation: Within  $\pm 5\%$  over  $-65^{\circ}\text{C}$ . to  $+125^{\circ}\text{C}$ . range ( $\pm \frac{1}{4}$  sec. min.)  
Heater Voltages: 6.3 to 115 v. for delays up to 12 sec.; 6.3 to 230 v. for longer delays.  
Power Input: 4 watts. Rated for continuous energization at  $125^{\circ}\text{C}$ .  
Contacts: SPST, normally open or normally closed. Rated 2 amps. re-

sistive at 115 v. AC or 28 v. DC.  
Insulation Resistance: 1,000 megohms  
Dielectric Strength: 1000 v. RMS at sea level. 500 v. RMS at 70,000 ft.  
Vibration: Operating or non-operating, 20 g up to 2000 cps  
Shock: Operating or non-operating, 50 g for 11 milliseconds  
Unidirectional Acceleration: 10 g in any direction changes delay by less than 5%, 50 g by less than 10% with proper orientation.  
Weight: 2 to 2½ ounces.

Write for Product Data Bulletin #PD-1015

**G-V CONTROLS INC.**  
Livingston, New Jersey










**PNP**

# SILICON TRANSISTORS







**NPN**

in quantity production

Other significant advantages include:

- Low saturation voltage
- Twenty volts BVEBO
- Low noise type available in both PNP and NPN
- Minimum change in characteristics with temperature, current, and voltage
- Suitability for complementary circuits

For both PNP and NPN Silicon Transistors specify RAYTHEON

FOR LARGE SIGNAL APPLICATIONS (Temperature Range  $-65^{\circ}\text{C}$  to  $+160^{\circ}\text{C}$ )

Type	$I_{EO}$ or $I_{CO}$ at $V_{CE} = 20\text{ Vdc}$ $\mu\text{A}$	$V_{CE}$ max. volts	$H_{FE}$ ave.	$r_b'$ $f = 1\text{ Mc}$ ohms	$r_c$ kilohms	Noise Figure db (max.)	$C_{ob}$ $f = 100\text{ Kc}$ ave. $\mu\text{f}$	$f_{ab}$ ave. Kc
<b>2N327A</b>	0.005	-40	15	1200	500	30	65	200
<b>2N328A</b>	0.005	-35	30	1400	500	30	65	300
<b>2N329A</b>	0.005	-30	60	1500	500	30	65	400
<b>2N619</b>	0.005	50	15	2000	500	30	35	200
<b>2N620</b>	0.005	40	30	2500	500	30	35	350
<b>2N621</b>	0.005	30	60	2700	500	30	35	500

†for PNP,  $I_B = -0.1\text{ mA}$ ;  $V_{CE} = -0.5\text{ V}$ . for NPN,  $I_B = 0.5\text{ mA}$ ;  $V_{CE} = 1.5\text{ V}$

FOR SMALL SIGNAL APPLICATIONS (Temperature Range  $-65^{\circ}\text{C}$  to  $+160^{\circ}\text{C}$ )

Type	$I_{EO}$ or $I_{CO}$ at $V_{CE} = 20\text{ Vdc}$ $\mu\text{A}$	$V_{CE}$ max. volts	$h_{FE}$ ave.	$h_{ie}$ max. ohms	$h_{oc}$ max. $\mu\text{mhos}$	Noise* Figure db	$C_{ob}$ $f = 100\text{ Kc}$ ave. $\mu\text{f}$	$f_{ab}$ ave. Kc
<b>2N1034</b>	0.005	-40	15	3000	70	30	65	200
<b>2N1035</b>	0.005	-35	30	3000	85	30	65	300
<b>2N1036</b>	0.005	-30	60	3000	100	30	65	400
<b>2N1037</b>	0.005	-35	30	3000	85	15	65	250
<b>2N1074</b>	0.005	50	15	3500	70	30	35	200
<b>2N1075</b>	0.005	40	30	3500	85	30	35	350
<b>2N1076</b>	0.005	30	60	3500	100	30	35	500
<b>2N1077</b>	0.005	30	25	3500	85	15	35	300

\* $V_C = 5\text{ V}$ ;  $I_E = 3\text{ mA}$

## SEMICONDUCTOR DIVISION

SILICON AND GERMANIUM DIODES AND TRANSISTORS-SILICON RECTIFIERS-CIRCUIT PACKAGES

New York, Plaza 9-3900 • Boston, Hillcrest 4-6700 • Chicago, National 5-4000 • Los Angeles, Normandy 5-4221  
Baltimore, Southfield 1-1237 • Cleveland, Winton 1-7716 • Kansas City, Plaza 3-5330 • Orlando, Garden 3-1553  
San Francisco, Flreside 1-7711 • Government Relations: Washington, D.C., Metropolitan 8-5205

### STAFF

EDITOR: Edward E. Grazda; MANAGING EDITOR: J. A. Lippke; ASSOCIATE EDITORS: L. D. Shergalis, G. H. Rosky, H. Bierman; ASSISTANT EDITORS: E. E. Mount, D. S. Viebig, L. N. Tolopko, A. Corneretto, F. Muehleck, A. Caprioglio; CONTRIBUTING EDITORS: S. H. Hubelbank, E. Brenner, B. Bernstein, E. Kohn, B. B. Daien; EDITORIAL ASSISTANTS: M. S. Buckley, A. M. Sickler, A. R. Abramoff, R. N. Ross, S. Manes, R. M. Moore, D. Kartzman; ART DIRECTOR: R. A. Schulze; TECHNICAL ILLUSTRATOR: B. L. Armstrong; ART ASSISTANTS: C. Bank, M. J. Malatak; PRODUCTION MANAGER: T. V. Sedita; ASST. PRODUCTION MANAGER: H. DePolo; PRODUCTION ASSISTANT: M. C. Alexich; CIRCULATION MANAGER: N. M. Elston; ASST. CIRCULATION MANAGER: A. C. Lovett; READER-SERVICE: J. E. Medina.

### CO-PUBLISHERS

T. Richard Gascoigne  
James S. Mulholland, Jr.

### ADVERTISING REPRESENTATIVES

ADVERTISING SALES MANAGER: Bryce Gray, Jr.; NEW YORK: Owen A. Kean, Robert W. Gascoigne, Richard Parker, Blair McClenachan, James P. Quinn 830 Third Avenue, PLaza 1-5530; CHICAGO: Thomas P. Kavooras, Berry Conner, Jr., Fred T. Bruce 664 N. Michigan Avenue SUPERior 1-8054; LOS ANGELES: Robert E. Ahrens Dorf, John V. Quillman, Stanley I. Ehrenclou 3275 Wilshire Blvd., DUNkirk 2-7337; SOUTH-EASTERN: Lucien Neff 15 Castle Harbor Isle, Fort Lauderdale, Florida, LOGan 6-5656.

### SUBSCRIPTION POLICY

ELECTRONIC DESIGN is circulated only to qualified electronic design engineers of U. S. manufacturing companies, industrial consultants, and government agencies. If design for manufacturing is your responsibility, you qualify for subscription without charge provided you send us the following information on your company's letterhead: Your name and engineering title, your company's main products, and description of your design duties. The letter must be signed by you personally.

ANY ADDRESS CHANGES FOR OLD SUBSCRIBERS NECESSITATE A RE-STATEMENT OF THESE QUALIFICATIONS. Subscription rate for non-qualified subscribers—\$25.00 per year U.S.A., \$30.00 per year all other countries. Single copy \$1.50.

ELECTRONIC DESIGN is published bi-weekly by Hayden Publishing Company, Inc., 830 Third Avenue, New York 22, N. Y., T. Richard Gascoigne, President; James S. Mulholland, Jr., Vice-President & Treasurer; and David B. Landis, Secretary. Printed at Hildreth Press, Bristol, Conn. Accepted as controlled circulation at Bristol, Conn. Additional entry, New York, N. Y. Copyright 1959 Hayden Publishing Company Inc., 36-150 copies this issue.

# Multifunction Design Achieved in First Tunnel Diode Circuits

CIRCUITS using a single tunnel diode in up to four different functions have been designed and operated. Researchers at GE, RCA and Bell Labs have reported new orders of performance in circuit designs using the tunnel diode's unusual combination of properties.

■ The frequency converter shown above and designed by Dr. J. J. Tiemann of GE utilizes a single tunnel diode for rf amplification, local oscillation, mixing, and the first if stage.

■ An amplifier built by an RCA researcher develops a 20-db power gain with a noise factor of only 4.5 db. (see p. 6).

■ GE has gotten a half-mile range from an fm transmitter the size of a one-inch cube (see p. 6).

■ Bell Labs has achieved switching speeds of a tenth of a millimicrosecond with an indium antimonide tunnel-diode circuit.

Other GE circuits just announced perform microwave oscillation, binary counting (see p. 6), and fm reception. The fm receiver is stable enough to lock onto the seventieth harmonic of a standard transmitted signal.

The new circuits are significant because they show the variety of functions and multifunctions

the tunnel diode can perform, even at this very early stage of their development. Also, the tunnel diode is registering new levels of performance, despite the early models used.

Not since the arrival of the transistor has there been such industry-wide optimism over a new development. All major companies are believed working on tunnel diodes, and both RCA and GE have hailed its appearance as a major step forward in the electronic art.

Tunnel diodes may be the long-sought breakthrough to wide application of the powerful

negative-resistance principle, and, according to GE, to new types of oscillators, amplifiers, mixers, detectors, computer elements, sensors, controls, drivers, and even new ultrasonic sources.

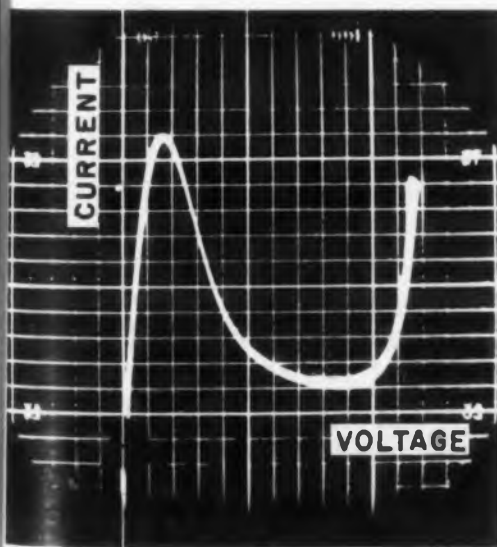
Design engineers have these tunnel diode characteristics ready to work for them, say RCA, GE, and Bell Labs researchers:

- Extremely high response speed, in fractions of a millimicrosecond.
- Stability unaffected by nuclear radiation or cryogenic-to-340 C temperatures.

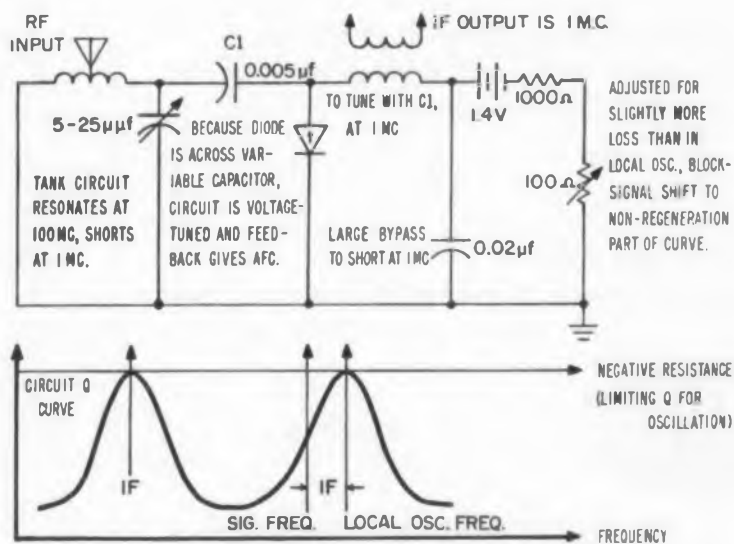
## How Tunnel Diode Compares With Other Communication Devices

Noise temperatures in this GE-compiled table are for operation at 1 kmc. Power requirements for the paramp include its pump signal source; for the maser, its cooling equipment and magnet.

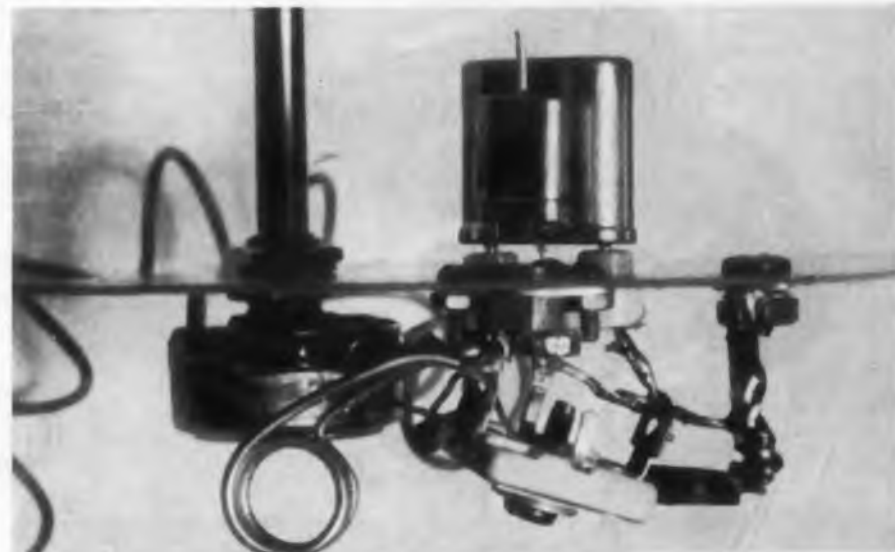
Circuit Device	Max. Operation Freq. in Kmc	Min. Drain In Watts	Noise Temperature
Tunnel Diode	2	$10^{-6}$	100-300 K
Transistor	2	$10^{-3}$	3000 K
Paramp	6	10	35 K
Maser	10	400	20 K
Close Space Triode	10	$10^{-1}$	900 K
Trav. Wave Tube	60	10	300 K
Klystron	75	10	300 K
Magnetron	100	20	



Now-famous EI curve of tunnel diode shows negative-resistance characteristics that can be used to do old jobs better, new, much-needed jobs.



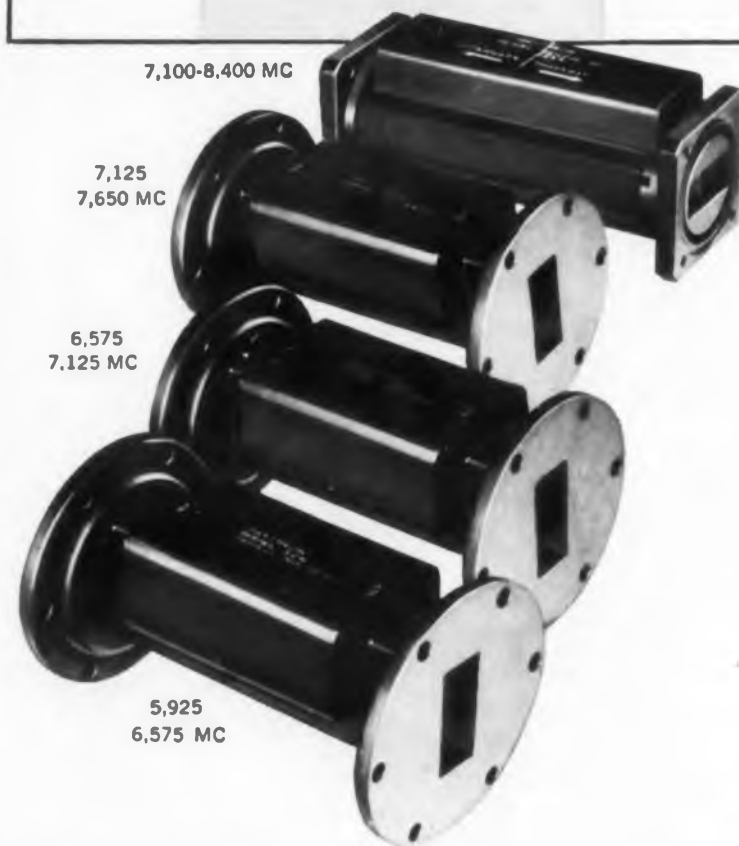
Ingenious frequency converter changes 100 mc to 1 mc, is a good example of multifunction application of a single tunnel diode. Q plotted against frequency help show how tunnel diode serves as first if stage, rf signal



amplifier, and local oscillator. Gain is infinite at  $F_{osc}$ , extremely high at  $F_{sig}$ . Oscillator circuit is very regenerative, but signal circuit, which is just off resonance, is not. Diode also handles mixing.

## ISOLATORS FOR COMMERCIAL AND GOVERNMENT BANDS

TYPICAL SPECIFICATIONS				
	ICM13	ICM12	ICM21	ICM22
Freq. range (mc)	5,925-6,575	6,575-7,125	7,125-7,650	7,100-8,400
Isolation				
Minimum	43 db	42 db	42 db	40 db
Maximum	54 db	57 db	50 db	60 db
Insertion loss				
Minimum	0.6 db	0.75 db	0.6 db	0.5 db
Maximum	0.7 db	0.85 db	0.7 db	0.8 db
Power Average	10 watts	10 watts	10 watts	100 watts
VSWR				
Minimum	1.03 db	1.07 db	1.05 db	1.08 db
Maximum	1.15 db	1.15 db	1.09 db	1.19 db
Weight (max.)	2.6 lbs	2.6 lbs	2.6 lbs	4.0 lbs
Max. dimension	5.0 in.	5.0 in.	5.0 in.	5.0 in.
Flanges	UG-344/U	UG-344/U	UG-344/U	UG-51/U
Waveguide	RG-50/U	RG-50/U	RG-50/U	RG-51/U



THREE REPLACE TEN. These three isolators cover C-band frequencies in both government and commercial bands—5,925-7,650 mc. A fourth unit covers the entire range from 7,100-8,400 mc.

### THREE C-BAND UNITS OFFER MAXIMUM PERFORMANCE FROM 5925-7650 MC

Three isolators where ten were formerly needed!

Advanced development work at Raytheon now allows greater interchangeability of isolator parts, simplifies the stocking of spares for system requirements and offers a significant price advantage in ordering.

The three units, designated ICM13, ICM12, ICM21, cover the frequencies from 5,925-7,650 mc in three steps—5,925-6,575, 6,575-7,125, and 7,125-7,650 mc respectively. Maximum insertion loss is less than 1 db; minimum isolation is 40 db. Maximum VSWR is 1.15 for the ICM12 and ICM13 and 1.10 for the ICM21.

A fourth unit—the ICM22—covers the entire range from 7,100-8,400 mc (see specifications at left).

To learn more about this significant development or other important Raytheon advances in microwave ferrite devices, please write, stating your particular requirement, to the address below.

**RAYTHEON COMPANY**  
SPECIAL MICROWAVE DEVICES, WALTHAM, MASS.



*Excellence in Electronics*

**RAYTHEON AT WESCON—BOOTHS 2131-2134**  
CIRCLE 4 ON READER-SERVICE CARD

### What Makes Tunnel Diodes Different?

A charge is transmitted through an ordinary p-n junction diode when the electrons comprising its field diffuse through the solid barrier of the semiconductor junction. This charge is carried at a faster rate than in an electron tube, where the charge moves with a particular group of electrons in transit from emitter to collector.

But in the tunnel diode heavy doping thins the junction barrier—the space-charge depletion region of the p-n junction—to less than a microinch so that a particle can, in effect, tunnel through the barrier, though underpowered, and appear simultaneously on both sides of it. This quantum-mechanical tunneling is equivalent to the charge passing through

- Power drain as low as one microwatt, with attendant advantages of low heat generation.

- Noise level surpassed only by paramps and masers but reached without klystrons or refrigeration.

- Ability to handle high frequencies—2 kmc now, with 20 kmc appearing practical.

- Two-terminal simplicity and tiny size.

- Characteristics can be built into crystals to create a family of special-purpose tunnel diodes.

- Negative resistance, with wide application in amplifiers and oscillators.

- High current-handling ability. GE has achieved current densities of 20,000 amp per cm<sup>2</sup>.

- Ability to generate ultrasonic waves. Vibrations up to 10,000 kmc with wavelengths of just a few angstroms have been produced in GE tunnel-diode crystals. If a piezoelectric crystal could be made to vibrate at tunnel-diode frequencies it would produce submillimeter waves.

Some non-communications applications of tunnel diodes suggested by GE include:

Current switching (in conjunction with controlled rectifiers), thermostats, protective devices, current-flow indicators, dc-to-ac converters (tunnel diodes in a circuit contribute less loss than any other part), and high-speed, stable computer elements, possibly replacing the phase-locked oscillators planned for microwave computers.

In communications the tunnel diode will have important applications whenever small size, light

the tunnel diode junction at the speed of light.

In addition, as the density of the charge carriers in the junction is increased by doping, and the reverse breakdown voltage reaches zero, particles tunneling through generate an additional current at a small forward bias. Further doping will maintain the reverse breakdown condition even though a small forward bias is present. This is the origin of the tunnel diode's negative resistance. Increasing the forward voltage removes the reversing effect and the current falls to a small level, as is apparent in the diode's EI curve.

Also, particle tunneling causes, or is assisted by, vibrations of the semiconductor crystal that are of such high frequency—in the X-ray range—that they suggest entirely new possibilities for the tunnel diode as an ultrasonic generator.

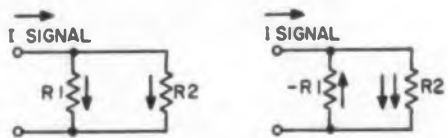
weight, low battery drain or extreme stability and ruggedness are needed. Some examples are: personal communications transmitters; Vernote telemetry where power requirements are stringent, such as in weather balloons, satellite communications; medical research and diagnosis and a pill-sized transmitter can relay information about its surroundings within a living organism to the outside world without the encumbrance of wires.

In radio reception the tunnel diode will be useful whenever simplicity, low noise, low power requirements or high frequencies are important, namely:

Personal communication, television receivers (especially if uhf is included), fm receivers, detectors for broadcast and shortwave receivers, special low-noise receivers for high frequency.

In amplifiers tunnel diodes will be useful

### How Tunnel Diodes Amplify



Signal current dividing between equal resistances  $R_1$  and  $R_2$  in schematic A is halved in direction shown. But, as in B, if  $R_1$  is made negative, current passing through it is increased and flows in the opposite direction to reinforce flow from signal source for use in  $R_2$ .

it's  
for  
the  
**BIRDS\***

**THE KERNEL**

... A New Microminiaturized Toroidal Inductor

The new Burnell & Co. MT 34 and MT 35 microminiature Kernel toroidal inductors are made to order for the engineer who isn't content with outer husk solutions but gets right to the core of second generation missile communication problems.

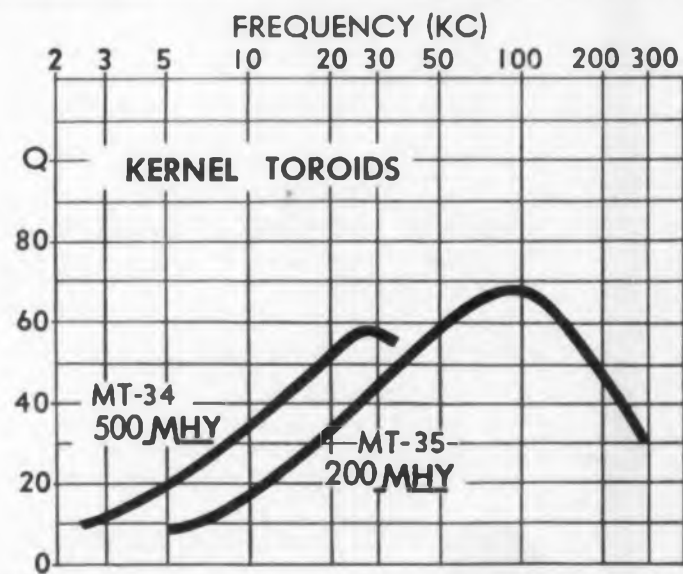
MT 34 microminiature Kernels can be supplied with inductances up to 500 mhy and the Kernel MT 35 is available in inductances up to 200 mhy. MT 34 Kernels are recommended for frequencies to 30 kcs and the MT 35 is applicable to frequencies up to 200 kcs depending on inductance values. Q for the MT 34 is greater than 55 at 25 kc and for the MT 35 more than 60 at 100 kcs.

Size of the MT 34 is .437" OD x 9/32", spacing between leads .3" x 1" L with a weight of .06 ounces.

The new microminiature Burnell MT 34 and MT 35 Kernels provide maximum reliability as well as considerable economy in printed circuit use. Completely encapsulated, the Kernels will withstand unusually high acceleration, shock and vibration environments.

Write for special filter bulletin MTF to help solve your circuit problems.

\*missiles



Make sure to see us  
at The Wescon Show!

*Burnell & Co., Inc.*

PIONEERS IN microminiaturization OF  
TOROIDS, FILTERS AND RELATED NETWORKS

EASTERN DIVISION  
DEPT. 533  
10 PELHAM PARKWAY  
PELHAM, N. Y.  
BELHAM 9-3090  
TELETYPE PELHAM 3422



PACIFIC DIVISION  
DEPT. D-23  
720 MISSION ST.  
SOUTH PASADENA, CAL.  
RYAN 1-2841  
TELETYPE PASADENA 7378

CIRCLE 5 ON READER-SERVICE CARD

## HIGH SPEED alphanumeric PRINTER with integrated storage and programming electronics

prints up to  
**48,000**  
digits per minute

adaptable to all digital data sources

**SOLID STATE DESIGN  
MODEL 3260**

A POTTER EXCLUSIVE  
Stellite Type Fonts To Order.

## Check these features...

### OPERATING SPEEDS

4 BIT DATA @ 20 lines/sec.  
6 BIT DATA @ 10 lines/sec.  
PAPER FEED TIME.....15 Ms  
SERIAL LOADING RATE 20 kcs

### RELIABILITY

Solid state storage, transistorized hammer drive and paper feed . . . troublesome contacts and wiper arms eliminated by reluctance pickup. Digital logic throughout.

### CUSTOM DESIGNS

Designs to meet MIL or Commercial Specs.

### COMPATIBILITY

4 or 6 bit input data in parallel or serial-parallel form and in any coding system.

### FLEXIBILITY

Self-synchronized or random (slaved) operating modes  
Tailored horizontal and/or vertical formats  
Modular construction permits wide variation of characteristics  
Accessible input/output command functions for maximum utility

Look to Potter for a complete line of magnetic and perforated tape handlers, associated equipment and system combinations.



**POTTER INSTRUMENT COMPANY, INC.**

Sunnyside Boulevard, Plainview, N. Y.  
Overbrook 1-3200

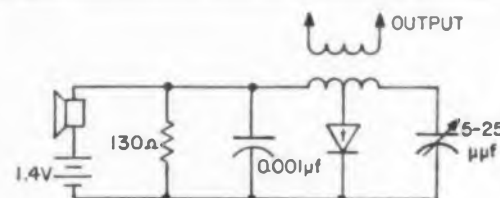
The mark of  
Engineering Quality

Potter has career opportunities for qualified engineers who like a challenge, and the freedom to meet it.

CIRCLE 6 ON READER-SERVICE CARD

## NEWS

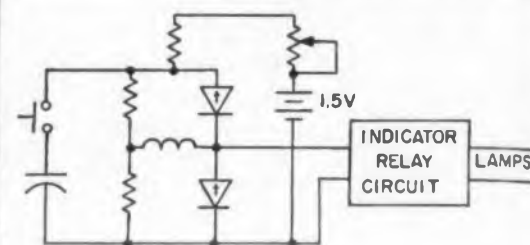
### Four More Tunnel Diode Circuits



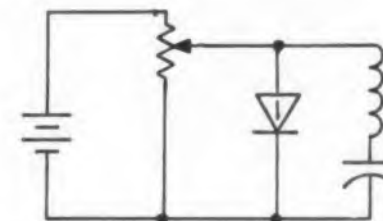
**Fm transmitter** designed by GE uses tunnel diode as an oscillator, reactance modulator, and as an amplifier of current developed by dynamic earpiece of hearing aid serving as microphone. Normal current-dissipating effect of varying bias across resistor is compensated for by diode's negative resistance. Tap is placed for impedance matching. Output is 0.1 mu at 90-120 mc. One-inch set was inductively coupled to simple dipole to get half-mile range.

**Low-noise amplifier** of RCA achieves gain through negative conductance, uses a tunnel diode with low negative conductance to give stable gain of about 20 db in the 30-100-mc range.

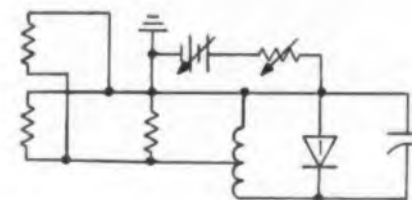
whenever environment makes conventional devices inefficient or inoperative; examples are atomic power facilities—the tunnel diode provides a radiation resistant amplifier for relaying measurements inside atomic reactors. This may



**Bistable flip-flop** circuit was developed by GE to utilize extremely fast switching speeds of tunnel diode, which operates at such low voltage, relays are used here to boost voltage so lamps will flash. Closing switch opens one diode, makes other conductive.



**Self-exciting oscillator** of RCA is tuned around 1 kmc. Operating point is in negative resistance region of tunnel diode's curve. Multifunctioning diode is part of both dc and ac-tank circuit.



make possible reactors that are better controlled and safer to operate; low noise pre-amplifiers for high frequency radio purposes; control devices for rockets and nose cones where high-temperature operation is needed.



The low-noise amplifier built by RCA's Dr. K.K.N. Chang uses the negative conductance characteristic of a tunnel diode to achieve a performance in the 30-100-mc range similar to that of a sophisticated paramagnetic amplifier, but without a paramp's hf-oscillator drawbacks.

A self-exciting oscillator designed by H. S. Sommers Jr., also of RCA, uses a tunnel diode as part of both the dc and ac tank circuit (see p. 6). Operating point falls on the negative resistance region of the diode's curve.

GE has built logic and counting circuits using up to six tunnel diodes, and the company states that both functions can be performed by the same diode.

Bell Labs, which is working actively on switching circuits using indium antimonide tunnel diodes at 78 K and 0 C temperatures, has achieved switching speeds of a tenth of a milli-microsecond. According to Bell Labs researcher R. L. Batdorf, the  $10^{-10}$  sec speed could have been greatly exceeded had faster oscilloscopes been available for measuring.

Both RCA and GE are getting ready to offer sample quantities of tunnel diodes for research. Included in GE's first batch to be made available in early September at about \$75 each will be tunnel diodes in three or four impedances for computer and communication circuit functions. Later will come diodes suitable for sensing elements.

RCA will offer experimental tunnel diodes on a limited basis toward the end of this year. ■ ■

#### What About a Symbol?



No standard symbol has been picked for the tunnel diode. For the present GE is placing a lower-case t in the diode triangle; the company believes that a capital T would degenerate to a plus sign. In published RCA literature, the symbol appears as above right. Bell Labs has not yet adopted a special symbol.

CIRCLE 7 ON READER-SERVICE CARD ➤

# NEW FROM PHILCO

## HIGH FREQUENCY NPN SILICON DIFFUSED-BASE TRANSISTORS\*

**30mc  
PULSE RATE  
SWITCHES**

Type Number	h <sub>fe</sub>	Typical Power Gain	Typical Switching Times (Saturated Test Circuits)	
2N1199	12-60 (DC)		t <sub>r</sub> 35 μsec t <sub>s</sub> 10 μsec t <sub>f</sub> 25 μsec	
2N1267 2N1268 2N1269	6-18 11-36 28-90	} 25 db at 4.3 mc		
2N1270 2N1271 2N1272	6-18 11-36 28-90		} 25 db at 12.5 mc	
Maximum V <sub>cb</sub> —20 V Maximum temperature—150° C Maximum dissipation—100 MW				

**60mc  
AMPLIFIERS**

#### 2N1199

This high speed switch has exceptionally low saturation voltage (typically 0.125 V), permitting *practical* design of 5 mc pulse circuits, using conventional saturated switching configurations. 30 mc pulse rates are obtainable in *practical* circuits using non-saturating techniques.

#### 2N1267-68-69

The high gain characteristics of these units make possible the design of high efficiency IF amplifier circuits for communications equipment. These devices have unusually low collector capacitance . . . typically 1.5 μf . . . and are available with restricted beta ranges to simplify design problems.

#### 2N1270-71-72

The excellent high frequency response of these transistors makes practical the design of high performance communications systems at frequencies up to 60 mc. They have the same low collector capacitance and are available with restricted beta ranges.

*Immediately available for prototype design from your Philco Industrial Semiconductor Distributor.*

*Write Dept. ED 859 Lansdale Tube Company, Division of Philco Corporation, Lansdale, Pa.*

*\*SADT . . . Trademark Philco Corp. for Surface Alloy Diffused-base Transistor.*

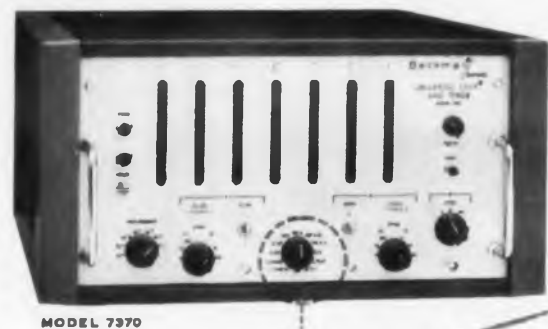
# PHILCO

**LANSDALE TUBE COMPANY DIVISION  
LANSDALE, PENNSYLVANIA**



# 10 Mc COUNTER

does everything without plug-ins



MODEL 7370

8 3/4"

## FUNCTION



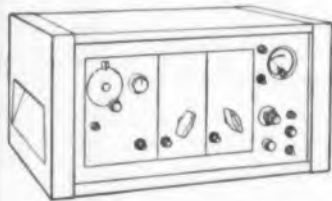
Frequency counting to 10Mc with 0.1v sensitivity

Period measurements in 0.1μsec units

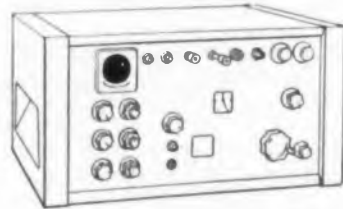
2-channel time interval measurements

Phase difference measurements

Frequency ratio measurements



Add this heterodyne unit (Model 7570 Series) to measure frequencies up to 1000Mc.



Or add this computing transfer oscillator (Model 7580) to get a counter display of frequencies up to 15,000Mc.

Complete specifications on Models 7370, 7570 and 7580 will be sent on request.

# Beckman

Berkeley Division

2200 Wright Avenue, Richmond 3, California  
a division of Beckman Instruments, Inc.

CIRCLE 8 ON READER-SERVICE CARD

## NEWS

### 18 of 140 Design Entries Picked for Wescon Display

Eighteen electrical products out of a contest entry of 140 have been chosen for design honors at the 1959 Western Electronic Show and Convention in San Francisco, Aug. 18-21.

The finalists in the first annual industrial design competition of Wescon, were selected in Los Angeles by a panel of southern California industrial designers. The leading products, now being marketed by 13 companies, will be displayed at San Francisco's Cow Palace and will be in line for awards for excellence and merit.

Harold W. Lindsay, chairman of Wescon's industrial design committee, reported that the finalists had been chosen on the basis of "visual clarity of function, ease and safety of operation and appropriateness of appearance."

The companies, products and designers to be represented are as follows:

- Ampex Corp., Redwood City, Calif., four selections—FR-300 digital tape handler, FR-400 digital tape recorder, VR-1000B videotape television recorder and AR-200 airborne magnetic tape recorder; Frank T. Walsh, Richard L. Ketcham, Glenn A. Smith, Harold W. Lindsay and Melvin Best Associates, designers.

- Autonetics Division of North American Aviation, Downey, Calif., RECOMP digital computer; R. E. Davis, designer.

- Cannon Electric Co., Los Angeles, XLR audio/electronic connector; Sam Arson, Carlos Beeck and Josh Noiley, designers.

- Digitron Co., Division of Endevco Corp., Pasadena, Calif., a digiswitch; John Powell Industrial Designers.

- Electronic Associates, Inc., Long Branch, N. J., two selections—an analog computer and vari-plotter; James Patmore, designer.

- Electronics International Co., division of International Electronic Research Corp., Burbank, Calif., ELIN precision power oscillator; Matt Jacobson, designer.

- General Electric Co., defense electronics division, Syracuse, N. Y., two selections—military aircraft ground-support equipment and airborne UHF kilowatt transmitters; John Wilson, John Gaska, Robert Robb and Noland Vogt, designers.

- Hewlett-Packard Co., Palo Alto, Calif., clip-on dc current probe; Thomas L. Lauhon, designer.

- International Telephone & Telegraph Co., Industrial Products Division, San Fernando, Calif., closed circuit television camera; Charles Gilson and William Brewer, designers.

- Librascope, Inc., Glendale, Calif., Libratrol 500 industrial process control computer.

- Santa Anita Engineering Co., Pasadena, Elec-

tropack, a system of individualized standard cabinetry; Jim Powell Industrial Designers.

■ Tally Register Corp., Seattle, 60-cycle pulser; Wade Vaughn, designer.

■ Voltron Products, South Pasadena, Calif., portable watt-meter; Tor Peterson, designer.

### Computer to Solve Matric, Integral, Differential Equations Now in R & D

The first matric calculus computer to work with both general matric equations and with differential and integral calculus equations has been developed in theory and in rudimentary equipment. It will be built at Washington University, St. Louis.

Digital computers use the fundamental mathematical concepts of adding and subtracting almost exclusively, matric equation analyzers work with entire equation systems. The matric calculus computer designed by P. M. Honnell is the first to work with general matrix equations as well as with differential, and some integral, calculus equations.

Because of increasing use of matric calculus, computing machines designed specially to solve matrically-formulated problems will become important tools of applied mathematics, Honnell has said.

The theory behind the matric computer is based on the synthesis of electronic networks on an admittance basis. The basis is such that each matric entry of the mathematical equations being solved is represented by only one physical component in the synthesis network. A complete 1-to-1 correspondence exists, which theoretically can be made as exact as desired, between physical network components and mathematical matrix entries.

Honnell's theory synthesizes networks which exhibit the solutions of matrically formulated mathematical problems, such as systems of differential equations.

### Clathrates: New Radiation Source for Designers

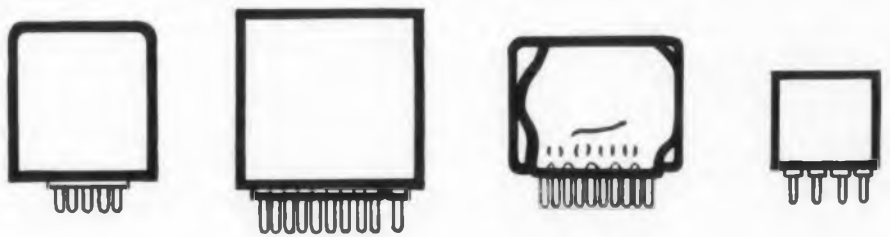
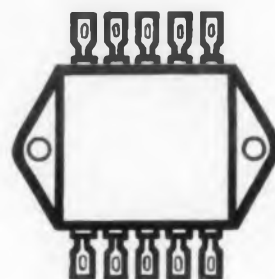
A crystalline form of hydro-quinone combined with gaseous krypton-85 and called a clathrate is available as a safe, concentrated radiation source for use in thickness gages, static eliminators and other applications.

According to Tracerlab, Inc., from whom the new radiation source is available, a clathrate may be considered a solid source of krypton-85, itself a virtually pure beta emitter that does not require heavy shielding for handling.

Specific activity of the clathrate is 3 curies per gram,  $\pm 20$  per cent, Tracerlab states.

# SHIFT REGISTER ASSEMBLIES

for aircraft  
for missiles  
for computers  
for controls



SPRAGUE MAGNETIC SHIFT REGISTER ASSEMBLIES get the full treatment! Every component that is used in their construction is carefully checked for performance and reliability. Only the very best get by. All complete assemblies are 100% pulse performance tested before they leave the plant... assuring on-the-job reliability and long register life... at the least possible cost.

Sprague register assemblies matched to your specific application requirements are your best buy! You get just the right case styles, type of sealing, number of stages, read and write provisions you need. Standard designs are easily modified to meet most system requirements. For Data Sheets on core-diode type magnetic shift register assemblies, write the Technical Literature Section, Sprague Electric Company, 347 Marshall St., North Adams, Massachusetts.

**SPRAGUE**<sup>®</sup>  
the mark of reliability

#### SPRAGUE COMPONENTS:

MAGNETIC COMPONENTS • TRANSISTORS • RESISTORS • CAPACITORS • INTERFERENCE FILTERS • PULSE NETWORKS • HIGH TEMPERATURE MAGNET WIRE • PRINTED CIRCUITS  
CIRCLE 9 ON READER-SERVICE CARD

## MODEL FL-4C WIDE BAND FLUTTER METER

INSTRUMENTATION

TELEMETERING

DATA REDUCTION

TELEVISION RECORDING



### Features

A very sensitive broadband instrument for laboratory use in the precise measurement of small amounts of flutter with components up to 5000 cps. Most frequently used in telemetering and data reduction systems.

### Specifications

Carrier Frequency - 14,500 cps, crystal controlled  
Bandwidth - D-c to 5000 cps within 6 db  
Bandwidth Selection - Full range above, 0.5 to 30 cps, 30 to 300 cps, 300 to 5000 cps  
Scale Ranges - 0.2%, 0.6% and 2.0% rms full scale  
Drift Meter -  $\pm 1.0\%$  frequency change d.c. to 2 cps  
Display - 3-inch flat-face oscilloscope for flutter analysis  
Price \$1195.00 rack mounted, \$1250.00 in cabinet

**d&r**  
LTD.

## MODEL FL-3D FLUTTER & WOW METER

AUDIO

BROADCASTING

MOTION PICTURES

RECORDING



### Features

A convenient instrument of moderate cost for use in field maintenance of music-system tape recorders and reproducers, and phonograph turntables.

### Specifications

Carrier frequency - 3000 cps, stabilized oscillator  
Bandwidth - within 3 db to 250 cps modulation  
Bandwidth Selection - 0.5 to 6 cps, 6 to 250 cps, 0.5 to 250 cps  
Scale Ranges - 2% and 0.5 full scale rms  
Price: \$265.00

WRITE US FOR FURTHER INFORMATION

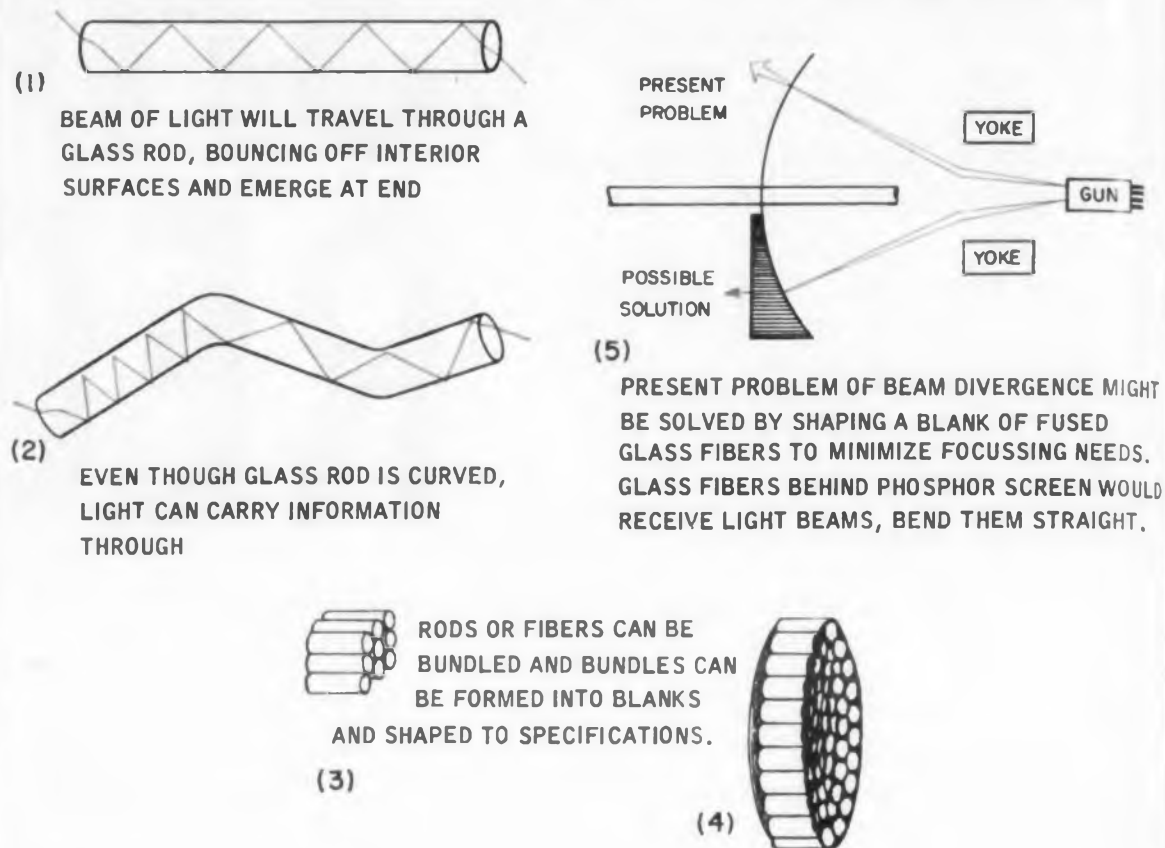
402 East Gutierrez Street  
P.O. Box 1500, Santa Barbara, California  
Telephone: WOODLAND 3116

**d&r**  
LTD.

CIRCLE 10 ON READER-SERVICE CARD

## NEWS

### How Properties of Light and Glass Can Solve Electronic Design Problems



(1) BEAM OF LIGHT WILL TRAVEL THROUGH A GLASS ROD, BOUNCING OFF INTERIOR SURFACES AND EMERGE AT END

(2) EVEN THOUGH GLASS ROD IS CURVED, LIGHT CAN CARRY INFORMATION THROUGH

(3) RODS OR FIBERS CAN BE BUNDLED AND BUNDLES CAN BE FORMED INTO BLANKS AND SHAPED TO SPECIFICATIONS.

(4)

Light can be bent or straightened out by glass fibers, that's why . . .

## Fiber Optics Could Solve Many Electronic Design Problems

THE DRAWINGS above show why designers are considering glass-fiber devices for electronic applications: fibers could be used to modify direction of radiation. This is a job frequently done by electronic design; if it could be handled by fibers, of glass or other material, the electronic designer's load would be lightened.

According to Will Hicks, president of Mosaic Fabrications, a Southbridge, Mass., firm active in development of fibers, many applications in electronics are about to come within range of the state of the glass-fiber art. Some include:

- Remote pickups for TV cameras whose targets are in environments hostile to delicate equipment. Viewing jet engine exhaust in a test cubicle would be an application of this type. A view could

be piped through a lens on the end of a glass-fiber cable to the camera's pickup.

- A flexible periscope for space-tight areas. In aircraft cockpits, for instance, bulky cathode ray tubes could be moved elsewhere in the plane and the tubeface image relayed to the pilot through a fiber cable.

- Internal viewers. Cables could be run into black boxes to view interior conditions. Light could be pumped into the box through a portion of the fiber channel just as images could be carried out.

According to Harold B. MacDonald, a value engineer with Raytheon, his firm is considering the use of fiber optics in cathode-ray-tube displays. In another application within the company, Raytheon is also working with these fibers to eliminate a series of prisms and lenses.



How an image would look through a lens on the end of a glass-fiber bundle.

Elaborates MacDonald: "We are considering use of the fiber-scopes for piping a series of oscilloscope images into one picture to obtain a single reading in a hurry."

MacDonald also reveals that his company is definitely interested in the use of fiber optics for dielectric waveguides.

"Instead of having waveguides transmit rf pulses, it would be possible to use the fiber bundles as conductors of light. Existing waveguides are expensive and troublesome. If we used light waves instead of microwaves in some applications, the system would be simpler and less bulky. A lot of rf plumbing has to be built in to pipe microwaves. For this reason, the fiberscope principle is highly appealing."

This ties in with what Hicks says on the subject.

"Light waves and radio waves being of the same nature," he amplifies, "there is the possibility that some of the operations now performed in the rf range could be carried out in the optical region—with a reduction in equipment bulk and an increase in resolution and bandwidth."

Hicks also points out that a digital computer might be wired optically instead of electrically. And this would not mean converting into an electrical signal. The signal would be kept optical, thus saving space, power, weight, and eliminating adjustments.

In the present digital process a card is punched, conveyed to various points. By means of electronic switching, the signal is also stored. When the signal is taken out of storage, it is converted back to electronic pulsations until read out on punched tape or some other visual form. With an optical signal in use all along the line, everything is simplified.

But Hicks adds that an optical computer would be practical only for very special applications.

(continued on following page)

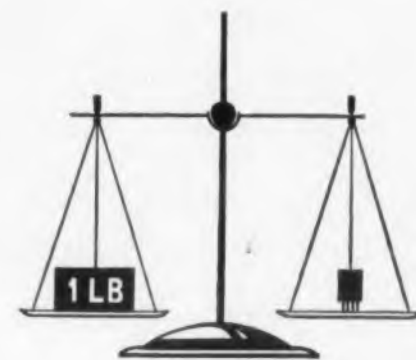


SERVING YOU ON THE WEST COAST

H. M. DENNY CO.  
111 W. HARRISON STREET.  
SEATTLE 99, WASHINGTON

ROLLINS ELECTRIC CO  
804 S. ATLANTIC BLVD  
MONTEREY PARK, CALIFORNIA

BELILOVE COMPANY  
420 MARKET STREET.  
SAN FRANCISCO, CALIFORNIA



## A POUND OF PERFORMANCE IN A 0.4-OUNCE UNIT

Into its diminutive Crystal Case Relay Wheelock Signals packs a bipolar magnetic coil structure, a DPDT contact assembly, low coil power and superior environmental stability.

The entire assembly is terminated in a superior glass-to-metal header and the case is then secured to the header by positive hermetic seal techniques.

Observe! The end product is an astounding item of space age engineering providing a full measure of performance and reliability . . . as light as an autumn leaf as tiny as an elf with the survival potential of a bulldog and the consistent reliability of Tuesday.

In your airborne equipment, isn't there a place now awaiting these functional benefits?

Crystal Case Relays by Wheelock Signals are available in a wide selection of voltage ratings, termination styles and meet a variety of mounting methods.

WRITE FOR BULLETIN 165-1

Wheelock SIGNALS  
INC.



LONG BRANCH, N. J.

CIRCLE 11 ON READER-SERVICE CARD



## Hold your frequency under fire (and ice)!

New linear permalloy core keeps filters frequency-stable over a wide range of temperature conditions—at half the cost

Designers of audio filter networks, faced with the high price of components and the need for frequency stability over a wide swing in ambient temperatures, can now benefit from a most significant development—the linear molybdenum permalloy powder core.

The linear cores we've developed are used with polystyrene capacitors. This combination costs as little as half the price of temperature-stabilized moly-permalloy cores and the silvered mica capacitors with which they must be used.

What's more, frequency stability is increased! For temperatures ranging from  $-55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  we have observed frequency stability variations as low as 0.05%. This is consider-

ably less frequency shift than normally expected with temperature-stabilized combinations.

We guarantee the temperature coefficient of these linear cores within a very narrow range! Information regarding sizes, prices and performance behavior awaits your request. Popular sizes, in 125 permeability only, available immediately from stock. *Magnetics, Inc., Dept. ED-74, Butler, Pa.*

**MAGNETICS inc.**

CIRCLE 12 ON READER-SERVICE CARD

## NEWS

### How Glass Fibers Work

If light shines on the end of a jacketed glass rod, much of the light that enters will be caught inside the rod, unable to escape out the sides because the angle of incidence on the walls is greater than the critical angle for total internal reflection. This light will be reflected a number of times from the walls and finally escape from the far end.

The same phenomenon operates when the diameter of the rod is made very small. In fact, there is no substantial change in the behavior until the diameter of the rod becomes comparable to the wavelength of light, at about 5 to 10 microns. Therefore, a fiber 50 microns (0.002 in.) in diameter behaves just like a rod. This is because light is still trapped in the fiber by total internal reflection and carried to the far end. The only difference is an increase in the number of reflections per unit length. For this reason, the surface quality of a fiber must be very high if the light is not to be lost by surface scattering.

If many such glass fibers are gathered together into an orderly array, they will transmit an image by breaking it up into separate components, transmitting each of these components independently from one end of the fiber to the other. The fibers must be in exactly the same arrangement at each end or the picture will be scrambled or distorted at the exit end of the bundle. However, the fibers need not be precisely arranged in the middle where the light is trapped, and strands may be scattered at random, forming any conceivable pattern.

Different rays in the beam, will, however, follow quite different paths in azimuth depending on how far they are from the meridian, and on their steepness. In addition, the fiber is not apt to be perfectly round. The result here is that the light leaves as a cone rather than a ray.

When flexible glass fibers are systematically arranged into a bundle so that they have the same relationship to each other at each end, they will transmit an image which will be undisturbed when the bundle is bent. If the fibers are completely loose from each other (except at the ends), the bundle will be very flexible.

When a lens is then mounted on one end so that it casts an image on the ends of the fibers, and an eyepiece is mounted at the other end so the fibers can be seen under some magnification, the result is a flexible fiberscope.

With such an arrangement, it is possible to see around a corner. A useful endoscope can be made in this fashion for looking into the human body.

Field flatteners are another potential application of glass-fiber optics. If the field of a lens on

CIRCLE 13 ON READER-SERVICE CARD ➤

ELECTRONIC DESIGN • August 19, 1959

ADVANCED  
SEMICONDUCTOR  
PRODUCTS FROM

PSI



class  
light  
icles  
is  
rnal  
ber  
rom

the  
fact,  
vior  
able  
mi-  
) in  
ause  
rnal  
only  
re-  
the  
n if  
ing-  
ther  
age  
ents,  
end-  
The  
ment  
l or  
ver,  
the  
nds  
con-

fol-  
ling  
on  
t to  
the

ally  
ame  
will  
bed  
om-  
ds),

so  
ers,  
d so  
ion,

see  
ade  
dy.  
ca-  
on  
>  
59

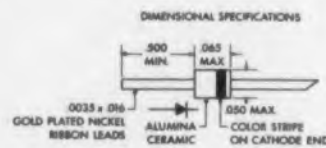
# NEW!

Latest product advances in Micro-Miniaturization... immediately available from PSI

## PSI microdiode

ACTUAL SIZE

TYPE No.	Min. Sat. Voltage @ 100 μA (V)	Min. Fwd. Current @ ±1.0 V (mA)	Maximum Reverse Current (μA)		Reverse Recovery Characteristics	
			25°C	100°C	Reverse Res (ohms)	Max. Recov Time (μs)
PD-1	50	5	1(10v)	25(10v)	100K	1.0
PD-021	50	20	5(10v)	25(10v)	100K	0.3
PD-031	100	5	5(10v)	25(10v)	100K	0.3
PD-034	100	20	5(10v)	25(10v)	100K	0.3
PD-041	200	10	0.25(10v)	5(10v)	200K	0.3
PD-042	200	10	5(10v)	25(10v)	200K	0.3



A major advance in micro-miniaturization featuring high standards of reliability. Volume and weight of these new PSI types are approximately 1/20 of present subminiature diodes.

These six types of silicon diffusion computer Microdiodes, except for power ratings, are the electrical equivalent of PSI subminiature computer diodes.

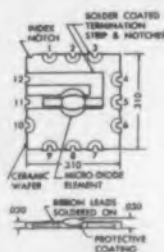
All types immediately available.

## PSI micro module



ACTUAL SIZE

The new PSI Micromodule is available now, in all of the above Microdiode types. Phone, wire, or write your nearest PSI Sales Office for detailed specifications, curves, reliability data, prices and delivery schedules.



## PSI Hi-Q Varicap

ACTUAL SIZE

VARICAP TYPE	Capacitance* @ 4VDC 50MC (μf)	Quality Factor Min. (Q) @ 4VDC 50MC	Max. Working Voltage (VDC)	Minimum Saturation Voltage @ 100 μADC (VDC)	Maximum Inverse Current @ 50VDC (μADC)
PC-112-10	10	50	80	90	1.0
PC-113-22	22	50	80	90	1.0
PC-114-47	47	50	80	90	1.0

CAPACITANCE CHANGE: From 2VDC to 80VDC, 4.0 to 1 Min.

VARICAP TYPE	Capacitance* @ 4VDC 50MC (μf)	Quality Factor Min. (Q) @ 4VDC 50MC	Max. Working Voltage (VDC)	Minimum Saturation Voltage @ 100 μADC (VDC)	Maximum Inverse Current @ 25VDC (μADC)
PC-115-10	10	100	100	110	1.0
PC-116-22	22	100	100	110	1.0
PC-117-47	47	100	100	110	1.0

CAPACITANCE CHANGE: From 2VDC to 100VDC, 5.2 to 1 Min.

\*All capacitance values are ± 20% All values at 25°C

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

An entirely new approach to the design of electronic tuning, automatic frequency control, harmonic generation and numerous other circuits is made possible by the introduction of these new silicon voltage-variable capacitors. The Q specifications of 50 and 100 at 4VDC at 50 mc. for the first time combine wide tuning range and high Q.

All High Q Varicap types are available on good delivery schedules.

## Fast Recovery Silicon Diffusion Computer Diodes

ACTUAL SIZE

Type Number	Minimum Saturation Voltage* @ 100 μA (volts)	Minimum Forward Current @ ±1.0 volt (mA)	Maximum Reverse Current (μA)		Reverse Recovery Characteristics	
			25°C	100°C	Reverse Resistance (ohms)	Maximum Recovery Time (μs)

MILITARY TYPES

TYPE	Min. Sat. Voltage @ 100 μA (V)	Min. Fwd. Current @ ±1.0 V (mA)	Max. Rev. Current @ 25°C (μA)	Max. Rev. Current @ 100°C (μA)	Reverse Res. (ohms)	Max. Recov. Time (μs)
1N631*	200	10	0.25 (10v)	5 (10v)	200K	0.3
1N621*	100	10	1 (10v)	15 (100v)	100K	0.5
1N623*	100	100	20 (50v)	100 (50v)	200K	0.5
			5 (75v)	50 (75v)	200K	0.5
			†Mil-E-1-1171 (SigC) ‡Mil-E-1-1139 (SigC) *Mil-E-1-1140 (SigC)			
1N789	30	10	1 (20v)	30 (20v)	200K	0.5
1N790	30	10	5 (20v)	30 (20v)	200K	0.25
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
1N794	60	10	5 (50v)	30 (50v)	200K	0.25
1N795	60	50	5 (50v)	30 (50v)	200K	0.5
1N796	60	100	5 (50v)	30 (50v)	100K	0.5
1N797	120	10	1 (100v)	30 (100v)	200K	0.5
1N798	120	10	5 (100v)	30 (100v)	200K	0.25
1N799	120	50	5 (100v)	30 (100v)	200K	0.5
1N800	120	100	5 (100v)	30 (100v)	100K	0.5
1N801	150	10	1 (125v)	30 (125v)	200K	0.5
1N802	150	50	5 (125v)	50 (125v)	200K	0.5
1N803	200	10	5 (175v)	50 (175v)	200K	0.5
1N804	200	50	10 (175v)	50 (175v)	200K	0.5
1N659	60	6	5 (50v)	25 (50v)	400K	0.3
1N660	120	6	5 (100v)	50 (100v)	400K	0.3
1N661	240	6	10 (200v)	100 (200v)	400K	0.3
1N625	30	4 @ 1.5v	1 (20v)	30 (20v)	400K	1 μsec
1N626	50	4 @ 1.5v	1 (35v)	30 (35v)	400K	1 μsec
1N627	100	4 @ 1.5v	1 (75v)	30 (75v)	400K	1 μsec
1N628	150	4 @ 1.5v	1 (125v)	30 (125v)	400K	1 μsec
1N629	200	4 @ 1.5v	1 (175v)	30 (175v)	400K	1 μsec

\*Maximum DC working inverse voltage is 85% of minimum saturation voltage.

OTHER SPECIFICATIONS:

Peak Pulse Current, 1 μsec, 1% duty cycle: 3.0 Amps.  
Storage and Operating Temperature Range: -65°C to 200°C.

Please Note: All specifications and information contained herein are current as of: August 1, 1959

## Zener Diodes 500 mW Power Dissipation

ACTUAL SIZE

LOW VOLTAGE GROUP

PSI Type Number	Elect. Equiv.	Zener Voltage @ 5 mA @ 25°C		Maximum Dynamic Resistance (ohms) 1	Maximum Inverse Current		At Inverse Voltage (v)
		E. Min. (v)	E. Max. (v)		I <sub>z</sub> @ 25°C (μA)	I <sub>z</sub> @ 100°C (μA)	
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		Maximum Inverse Current		At Inverse Voltage (v)
		E. Min. (v)	E. Max. (v)	I <sub>z</sub> @ 25°C (μA)	I <sub>z</sub> @ 100°C (μA)	
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		Maximum Inverse Current		At Inverse Voltage (v)
		E. Min. (v)	E. Max. (v)	I <sub>z</sub> @ 25°C (μA)	I <sub>z</sub> @ 100°C (μA)	
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.

Now Also Available ...

EIA TYPES	Zener (Breakdown) Voltage @ 5 mA		Maximum Inverse Current		At Inverse Voltage (v)	Maximum Dynamic Resistance (ohms) 1
	Ez Min. (v)	Ez Max. (v)	I <sub>z</sub> @ 25°C (μA)	I <sub>z</sub> @ 100°C (μA)		
1N702	2.0	3.2	75	100	-1	60
1N703	3.0	3.9	50	100	-1	55
1N704	3.7	4.5	5	100	-1	45
1N705	4.3	5.4	5	100	-1.5	35
1N706	5.2	6.4	5	100	-1.5	20
1N707	6.2	8.0	5	50	-3.5	10

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

All of the above types can be supplied in ± 5% Tolerance. Add "A" suffix to indicate units with ± 5% Tolerance of center Zener Voltage Value.

... Just released  
Zener 1N 708 thru 1N 725  
Zener 1N 746 thru 1N 759

# PSI

PSI Pacific

INCORPORATED

SEATTLE, WASHINGTON

USDA SUBSIDARY



## 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,  
1" minimum length.  
Spaced on .1" grid centers.



"S" Package



"R" Package



"T" Package

3/8 ACTUAL SIZE

### DIMENSIONS

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

## Silicon High Conductance Diodes

ACTUAL SIZE

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

## Silicon General Purpose Diodes

ACTUAL SIZE

EIA TYPE NUMBER	Minimum Saturation Voltage @ 100 $\mu$ A @ 25°C (volts)	Minimum Forward Current @ +1.0 VDC @ 25°C (mA)	Maximum Inverse Current at Maximum DC Operating Voltage ( $\mu$ A @ volts)		Maximum Average Rectified Current (mA)	
			@ 25°C	@ 150°C	@ 25°C	@ 150°C
1N456	30	40	0.25 @ 25	5 @ 25	90	—
1N456A	30	100	0.25 @ 25	5 @ 25	200	70
1N457	70	20	0.25 @ 60	5 @ 60	75	—
1N457A	70	100	0.25 @ 60	5 @ 60	200	70
1N458	150	7	0.25 @ 125	5 @ 125	55	—
1N458A	150	100	0.25 @ 125	5 @ 125	200	70
1N459	200	3	0.25 @ 175	5 @ 175	40	—
1N459A	200	100	0.25 @ 175	5 @ 175	200	70
1N461	30	25	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.

## Varicap Voltage-Variable Capacitor

ACTUAL SIZE

Varicap Type	Capacitance		Quality Factor (Q) @ 50 mc.		Maximum Working Voltage (MWV) Volts D.C.	
	@ 4VDC $\mu$ mf	Approx. Range $\mu$ mf*	Minimum @ 4VDC	Typical @ 4VDC @ MWV		
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-35	35	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
MODULATION, AFC 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-35E	35	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
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-35E	35	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.

## Very High Frequency Silicon Power Transistors

*N-P-N Triple-diffused silicon mesa*

### VHF POWER AMPLIFIER TYPES

**PT-518** TYPICAL 70 MC POWER GAIN 10 db WITH 75 mw POWER OUTPUT; 4 db WITH 250 mw POWER OUTPUT.  $V_{CB} = 75V, I_C = 30 mA$ .

**PT-519** TYPICAL 70 MC POWER GAIN 10 db WITH 250 mw POWER OUTPUT; 4 db WITH 500 mw POWER OUTPUT.  $V_{CB} = 75V, I_C = 30 mA$ .

**PT-520** TYPICAL 70 MC POWER GAIN 10 db WITH 500 mw POWER OUTPUT; 4 db WITH 750 mw POWER OUTPUT.  $V_{CB} = 75V, I_C = 30 mA$ .

See Footnotes 1 and 2.

### ABSOLUTE MAXIMUM RATINGS (25° $\pm$ 3°C except as noted)

Collector-Base Voltage	$V_{CB}$	160 Vac Peak
Collector Current	$I_C$	75 mAdc
Emitter-Base Voltage	$V_{EB}$	4 Vdc
Junction Temperature	$T_J$	150°C
Collector Dissipation	$P_C$	2.8 W @ 25°C case temp. 2.25 W @ 50°C case temp. 1.1 W @ 100°C case temp.

### OTHER ELECTRICAL CHARACTERISTICS (25° $\pm$ 3°C except as noted)

Symbol	Characteristics	Test Conditions	Min.	Typical	Max.	Unit
$I_{EBO}$	Emitter Cutoff Current	$V_{EB} = 2V, I_C = 0$			100	$\mu A$
$I_{CBO}$	Collector Cutoff Current	$V_{CB} = 10V, I_E = 0$			1.5	$\mu A$
$I_{CBO}$	Collector Cutoff Current	$V_{CB} = 100V, I_E = 0$			1.0	$\mu A$
$h_{fe}$	HF Current Gain	$V_{CB} = 50V, I_C = 30mA, f = 70mc$	1.0	1.5		
$h_{fe}$	LF Current Gain	$V_{CB} = 50V, I_C = 30mA, f = 1kc$		13		
$r_b'$	HF Base Resistance	$V_{CB} = 12V, I_E = -10mA, f = 150mc$			100	ohm
$C_{ob}$	Output Capacitance <sup>1</sup>	$V_{CB} = 50V, I_E = 0, f = 140kc$			7.5	$\mu f$
$r_e + r_e'$	Emitter Resistance	$I_E = -10mA, I_C = 0, f = 1kc$		7		ohm
$r_c'$	Collector Series Resistance	$I_E = -20mA, I_C = 10mA, f = 1kc$		15		ohm

Footnotes:

- Case temperature 50°C maximum.
- Neutralized common emitter power gain with input and output conjugate matching.
- Includes approximately 1.5 $\mu$ f header capacitance.

### VHF POWER OSCILLATOR TYPES

**PT-515** OSCILLATOR POWER OUTPUT 250 mw MIN. @ 70 mc.  $V_{CB} = 80V, I_C = 30 mA$ .

**PT-516** OSCILLATOR POWER OUTPUT 500 mw MIN. @ 70 mc.  $V_{CB} = 90V, I_C = 30 mA$ .

**PT-517** OSCILLATOR POWER OUTPUT 750 mw MIN. @ 70 mc.  $V_{CB} = 100V, I_C = 30 mA$ .

See Footnotes 1 and 2.

### ABSOLUTE MAXIMUM RATINGS (25° $\pm$ 3°C except as noted)

Collector-Base Voltage	$V_{CB}$	160 Vac Peak
Collector Current	$I_C$	75 mAdc
Emitter-Base Voltage	$V_{EB}$	3 Vdc
Junction Temperature	$T_J$	150°C
Collector Dissipation	$P_C$	2.8 W @ 25°C case temp. 2.25 W @ 50°C case temp. 1.1 W @ 100°C case temp.

### OTHER ELECTRICAL CHARACTERISTICS (25° $\pm$ 3°C except as noted)

Symbol	Characteristics	Test Conditions	Typical	Max.	Unit
$I_{EBO}$	Emitter Cutoff Current	$V_{EB} = 1V, I_C = 0$		100	$\mu A$
$I_{CBO}$	Collector Cutoff Current	$V_{CB} = 10V, I_E = 0$		1.5	$\mu A$
$I_{CBO}$	Collector Cutoff Current	$V_{CB} = 100V, I_E = 0$		1.0	$\mu A$
$h_{fe}$	LF Current Gain	$V_{CB} = 50V, I_C = 30mA, f = 1kc$	6		
$r_b'$	HF Base Resistance	$V_{CB} = 12V, I_E = -10mA, f = 150mc$	60		ohm
$C_{ob}$	Output Capacitance <sup>1</sup>	$V_{CB} = 50V, I_E = 0, f = 140kc$	4.0		$\mu f$
$r_e + r_e'$	Emitter Resistance	$I_E = -10mA, I_C = 0, f = 1kc$	7		ohm
$r_c'$	Collector Series Resistance	$I_E = -20mA, I_C = 10mA, f = 1kc$	15		ohm

Footnotes:

- Case temperature 50°C maximum.
- Power output in parallel line oscillator.
- Includes approximately 1.5 $\mu$ f header capacitance.

Note: The above transistors will soon be designated by EIA Type numbers. Watch for announcement.

# Pacific Semiconductors, Inc.

SUBSIDIARY OF THOMPSON RAMO WOOLDRIDGE INC.

## Silicon Subminiature Rectifiers

ACTUAL SIZE

### MEDIUM POWER TYPES

EIA TYPE NUMBER	MAXIMUM RATINGS			ELECTRICAL CHARACTERISTICS			
	Peak Inv. Voltage (V)	Maximum Avg. Rectified Current (mA) <sup>1</sup>		Minimum Saturation Voltage (@ 100°C)	Maximum Reverse Current (@ PIV (µA))		Max. Avg. Voltage Drop (@ I <sub>o</sub> = 400 mA (@ 25°C (V) <sup>2</sup> )
		(@ 25°C)	(@ 150°C)		(@ 25°C)	(@ 100°C)	
IN645	225	400	150	275	0.2	15	1.0
IN646	300	400	150	360	0.2	15	1.0
IN647	400	400	150	480	0.2	20	1.0
IN648	500	400	150	600	0.2	20	1.0
IN649	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 Recur. Inverse Voltage (volts)	Maximum RMS Input Voltage <sup>1</sup> (volts)	Maximum Average Rectified Current <sup>1</sup> (mA)	DC Forward Voltage (@ Specified Current (@ 25°C (volts @ mA)	Maximum Average Inverse Current <sup>2</sup> (@ 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

PSI TYPE NUMBER	MAXIMUM RATINGS (@ 100°C)			ELECTRICAL CHARACTERISTICS	
	Peak Recur. Inverse Voltage (volts)	Maximum RMS Input Voltage <sup>1</sup> (volts)	Maximum Average Rectified Current <sup>1</sup> (mA)	DC Forward Voltage (@ Specified Current (@ 25°C (volts @ mA)	Maximum Average Inverse Current <sup>2</sup> (@ 100°C (µA)
TYPE		(@ 150°C		(@ 25°C	(@ 150°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.

500 MA TYPES IN MINIATURE PACKAGE ALSO AVAILABLE.

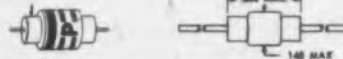
## Silicon Very High Voltage Cartridge Rectifiers



EIA TYPE	Length Inches	Absolute Max. Rtg. M W Res. Load at 75°C Ambient		Electrical Characteristics at 25°C Ambient	
		Peak Inverse Voltage Volts	Max. Rectified DC Output Current MA	Forward DC Volt Drop at Rated DC Current Volts	Reverse DC Current at Rated PIV MA
IN1139	4 1/4	3600	65	27.0	0.25
IN1140	2 3/4	3600	65	18.0	0.25
IN1141	4 3/4	4800	60	36.0	0.25
IN1142	2 3/4	4800	50	24.0	0.25
IN1143	4 3/4	6000	50	45.0	0.25
IN1143A	4 3/4	6000	65	30.0	0.25
IN1144	6 1/4	7200	50	54.0	0.25
IN1145	4 3/4	7200	60	36.0	0.25
IN1146	6 1/4	8000	45	60.0	0.25
IN1147	6 1/4	12000	45	60.0	0.25
IN1148	6 1/4	14000	50	52.0	0.25
IN1149	6 1/4	16000	45	60.0	0.25

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

CATHODE



### Physical Characteristics

**HERMETICALLY SEALED**—Glass-to-metal fused and metal-to-metal welded seals.

**TERMINALS**—Tinned copper leads .020 inches diameter. Lead length 1 3/4 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.

## Unusual Opportunities in Semiconductor Electronics ... in the New PSI Facility

With the opening of the first unit of the newest and most modern semiconductor manufacturing facility in the world, Pacific Semiconductors, Inc., announces exceptional technical staff opportunities in expanding programs for advanced semiconductor devices.

**ELECTRICAL ENGINEERS ... APPLICATION ENGINEERS ...** diode, rectifier, transistor and test equipment development.

**PHYSICISTS ...** product research and development.

**PHYSICAL SCIENTISTS ...** research programs in crystal growth and perfection studies ... solid state diffusion techniques ... the study of surface phenomena.

**SALES ENGINEERS ...** attractive openings East and West Coast and Mid-Continent areas.



PSI now occupies the first unit of its new facility near Los Angeles International Airport.

All of these positions offer opportunity for growth and individual recognition in a dynamic, rapidly expanding company. For specific information in your particular field, write to Technical Staff Placement, Pacific Semiconductors, Inc., 10451 West Jefferson Blvd., Culver City, Calif.



\*A.F.  
APPROVED

IN645 • IN646 • IN647 • IN648 • IN649  
ALL TYPES AVAILABLE

*Pacific Semiconductors, Inc.*

10451 West Jefferson Boulevard, Culver City, California  
ORegon 8-9013, OSborne 9-4561 • TWX: HAWTHORNE CAL 7414

**EXPORT**—Pacific Semiconductors, Inc., 431 Fifth Ave., New York 16, N.Y., U.S.A. CABLE: TELTECHNAL, NY

### SALES OFFICES

**NEW YORK**—2079 Wantagh Ave., Wantagh, L.I., N.Y.

• SUNset 1-7470 • TWX: WANTAGH NY 2320

**Boston**—471 Washington St., Wellesley 81 • CEdar 5-0171

**Philadelphia**—320 Huntingdon Pike, Rockledge • Pilgrim 2-8089

**Madeira Beach, Fla.**—P.O. Box 8215 • Phone 7-6126

**Ottawa**—227 Laurier Ave. West • CE 2-8504

**DISTRIBUTORS: BALTIMORE**—Wholesale Radio Parts Company

• **BOSTON**—Cramer Electronics, Inc. • **BUFFALO**—Genesee

Radio & Parts Co. • **MELBOURNE and ST. PETERSBURG**—

Electronic Supply • **NEW YORK**—Peerless Radio Distributors

and Terminal Radio Corporation • **PHILADELPHIA**—Almo Radio

Company • **ROCHESTER**—Rochester Radio Supply Company

• **SYRACUSE**—Syracuse Radio Supply Company • **TORONTO**

—Electro Sonic Supply Company, Ltd. • **WASHINGTON, D.C.**—

Electronic Industrial Sales.

**ILLINOIS**—6957 W. North Avenue, Oak Park, Illinois • Village 8-9750 • TWX: OKP 1547

**Dallas**—954 Magellan Circle • Riverside 7-1258

**DISTRIBUTORS: CHICAGO**—Allied Radio • **CLEVELAND**—

Pioneer Electronic Supply Co. • **DALLAS**—Wholesale Electronic

Supply • **DAYTON**—Srecco, Inc. • **DETROIT**—Ferguson

Electronic Supply Co. • **HOUSTON**—Sterling Radio Products

Inc. • **MINNEAPOLIS**—Lew Bonn Co.

**CALIFORNIA**—8271 Melrose Ave., Los Angeles 46, Calif.

• Olive 3-7850

**Palo Alto**—701 Welch Road, Suite 305 • Davenport 1-2240

**DISTRIBUTORS: ALAMOGORDO**—Radio Specialties Company •

**DENVER**—Denver Electronic Supply Co. • **LOS ANGELES**—

Electronic Supply Corporation and Kierulff Electronics, Inc. •

**OAKLAND**—Elmar Electronic Supply, Inc. • **PHOENIX**—Radio

Specialties Corporation • **SALT LAKE CITY**—Standard Supply

Company • **SEATTLE**—C & H Supply Company.

## New Types! Silicon High Voltage Rectifiers

3/4 ACTUAL SIZE

EIA TYPE NUMBER	Peak Inverse Voltage (volts)	Average Rectified Current (mA)		MAX RMS Input Voltage (volts)	MAX DC Fwd Voltage Drop (@ 100 mA DC 25°C)	Dimensions (inches)	
		@ 25°C	@ 100°C			L.	Dia.
IN1730	1000	200	100	700	5	5	.375
IN1731	1500	200	100	1050	5	5	.375
IN1732	2000	200	100	1400	9	1.0	.375
IN1733	3000	150	75	2100	12	1.0	.375
IN1734	5000	100	50	3500	18	1.0	.5
IN2382	4000	150	75	2800	18	1.0	.5
IN2383	6000	100	50	4200	27	1.5	.5
IN2384	8000	70	35	5600	27	1.5	.5
IN2385	10000	70	35	7000	39	2.0	.5

Maximum DC Reverse Current (at Rated PIV 10mA @ 25°C, 100µA @ 100°C.  
Maximum Surge Current (8msec.): 2.5 Amps.  
Continuous DC Voltage same as PIV.  
Operating temperature range—55°C to 150°C.

which the picture is sharpest is curved, and it is necessary to focus the image on a flat surface, it is possible to grind and polish one surface of a solid fiber bundle to conform to the field of the lens and to grind the other surface flat to conform to the recording medium. Fiber optics makes changing the curvature of the field a simple matter.

This technique might be useful in an electronic image intensifier where the phosphor could be put on a curved surface conforming to the field of the electron lens, and a photo-emissive surface put on the other side of the bundle, curved to conform to the field of best focus for the following electron lens. In other words, one side of a face plate could be dished out (curved) in order to conform to the electronic optics of the cathode-ray tube, and the other side of the face plate could remain plain.

Metal fibers are already in use. A. B. Dick in its Videograph high-speed printer fragments an electron beam into alphanumeric characters by focusing a beam on one end of a bundle of wires. The charge is picked up at the other end. (*ED*, July 22, 1959, p. 3)

Other materials could be used differently. Platinum in fiber form could conduct and bend infrared waves. And research is being conducted on semiconductor fibers.

Glass fibers at present can be drawn down to 5 micron diameters. Lengths reach 50 feet and should eventually reach 100 feet. Faceplates for cathode ray tubes can be formed of fiber bundles up to 5 inches across. ■■

## NEMA and EIA Integrate Semiconductor Programs

The National Electrical Manufacturers Assoc. (NEMA) and the Electronic Industries Assoc. (EIA) have moved to integrate and broaden their coverage of technical standards and marketing data in semiconductors.

Under the agreement, announced in New York, NEMA will cover rectifiers and controlled rectifiers, while EIA will concentrate on diodes and transistors generally used in signaling and low-level switching applications. The two associations will share programs in power transistors.

The two are already conducting joint activity on standardization through the Joint Electron Device Engineering Council (JEDEC). Liaison is maintained in matters of industry statistics, industrial relations and legislative problems.

A more recent program of NEMA aims at establishing standards for industrial control systems. The association's industrial automatic systems section has been pressing efforts affecting numerical control, computer types of control and the more sophisticated analog systems.

◀ CIRCLE 13 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 19, 1959



Ancient Egyptian artifacts from University of Nebraska State Museum

## INHERENT STABILITY Assured in a DALOHM RS Resistor

IN-HER-ENT, *adj.* Firmly infixed; esp., involved in the essential character of anything.

Stored on the shelf for months... or placed under continuous load... operating in severe environmental, shock, vibration and humidity conditions... Dalohm precision resistors retain

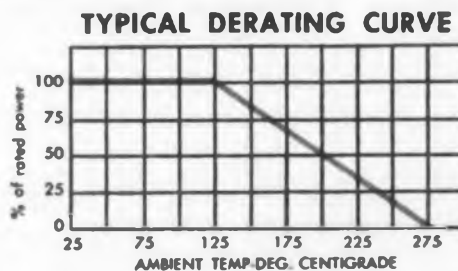
their stability because it has been "firmly infixed" by Dalohm design and methods of manufacture.

For all applications demanding resistors that meet or surpass MIL specifications, you can depend on Dalohm.

### WIRE WOUND • PRECISION • POWER DALOHM TYPE RS RESISTORS

When space is at a premium, and precision and power are needed, specify DALOHM RS Type resistors.

Configurations: Type RS with radial leads and in most ratings and resistances shown; Type RLS with axial leads for printed circuits, and Type RSE for clip mounting.



Write for Bulletins R-23, R-25 and R-30, with handy cross-reference file cards.

CIRCLE 14 ON READER-SERVICE CARD

- Rated at 1, 2, 3, 5, 7, and 10 watts
- Resistance range from .05 ohm to 175K ohms, depending on type
- Tolerance 0.05%, 0.1%, 0.25%, 0.5%, 1%, 3%
- Temperature coefficient within 0.00002/degree C.
- Operating temperature range from -55° C. to 275° C.
- Smallest in size, ranging from 3/32" by 13/32" to 3/8" by 1-25/32". Nine choices.
- Completely protected, impervious to moisture and salt spray
- Complete welded construction from terminal to terminal
- Silicone sealed, offering high dielectric strength and maximum resistance to abrasion.
- Surpass requirements of MIL-R-26C.

### SPECIAL PROBLEMS?

You can depend on Dalohm, too, for help in solving any special problem in the realm of development, engineering, design and production. Chances are you can find the answer in our standard line of precision resistors (wire wound, metal film and deposited carbon); trimmer potentiometers; resistor networks; collet-fitting knobs; and hysteresis motors. If not, just outline your specific situation.

from **DALOHM**  
Better things in  
smaller packages  
**DALE PRODUCTS, INC.**  
1328 28th Ave., Columbus, Nebr.



# EAGLE

QUALITY BUILT • EASY TO USE  
*timers and counters*



Bulletin 110  
20 TURN DIAL RESET TIMER



Bulletin 120  
SINGLE DIAL RESET TIMER



Bulletin 150  
ELECTRONIC RESET TIMER



Bulletin 170  
TIME DELAY RELAY



Bulletin 320  
ADJUSTABLE REPEAT CYCLE TIMER



Bulletin 720  
AUTOMATIC RESET COUNTER

## Now in stock for immediate delivery

To better serve your needs without delay, EAGLE now makes available the above Timers and Counters for immediate delivery direct from stocks of EAGLE Representatives in principal cities from coast to coast. See your local phone directory for name and location of your nearest EAGLE Representative. He will be happy to make recommendations and help you engineer your TIME-COUNT problems.

Write EAGLE SIGNAL COMPANY, Dept. ED-859, Moline, Illinois, for descriptive Catalog 351 showing EAGLE'S line of popular TIME-COUNT Controls.

EAGLE



SIGNAL COMPANY

MOLINE, ILLINOIS

MANUFACTURERS OF THE MOST COMPLETE LINE OF INDUSTRIAL TIME-COUNT CONTROLS

CIRCLE 15 ON READER-SERVICE CARD



Ground-control combat team guides Lacrosse, the Army's first missile for close support of infantry. Missile is launched from a truck assembly. Then the ground team takes over. An angular tracker (front) picks up signals from Lacrosse as it streaks toward the target. Other equipment includes a power supply unit (right), a computer and a range and direction indicator. The missile, launcher and guidance controls were developed by the Martin Co. of Orlando, Fla.

## Surveillance in Spotlight at Army Association Conference

**A**MONG the new design features of army equipment revealed at the 1959 meeting of the Association of the United States Army were details of some of the latest surveillance and network communication devices.

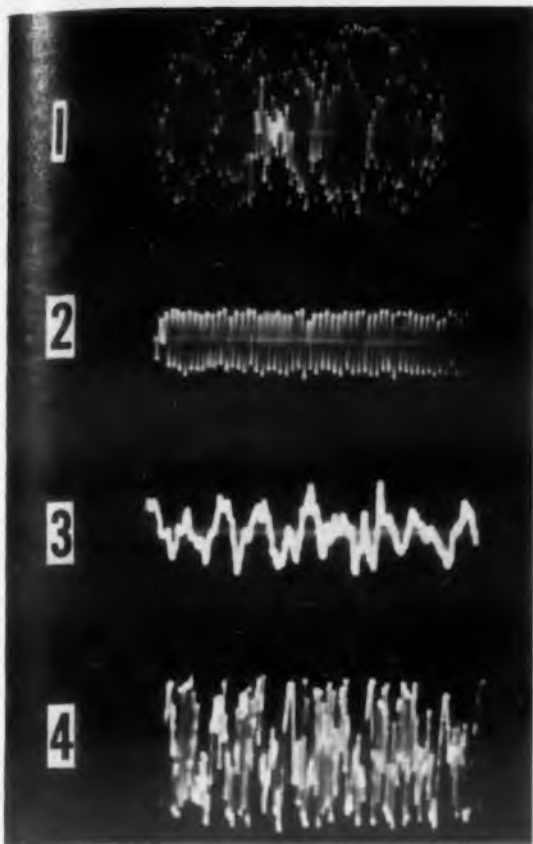
Disclosed at the Washington meeting was the fact that Hazeltine's highly regarded, highly sensitive ground surveillance radar can spot moving targets at a range of 21,000 yards, double the range of complementary medium-range ground radars.

The set, AN/TPS-25, is a transportable combat surveillance radar that utilizes pulse doppler techniques. The radar

transmits pulses and receives reflected pulse energy from moving targets as well as from surrounding stationary terrain.

The portion of energy received from a moving target is shifted in frequency; a target approaching the radar will produce a tone of 30 cycles per mph, which is aurally presented to the operator. Not only single tones are heard by the operator, but various components such as those produced by the arms and legs of personnel and the tracks of vehicles. The set can differentiate between a walking and crawling target.

The radar is normally operated in a search mode in which it automatically



**New Army surveillance radar** that can spot a man crawling at 10,000 yards and a vehicle moving at 20,000 yards shows an almost-human ability to distinguish between targets. Displayed here are images of (1) a train, (2) an automobile, (3) a walking man, and (4) a walking girl. Set, called the AN/TPS-25, is being produced by the Hazeltine Corp. of Little Neck, N. Y.

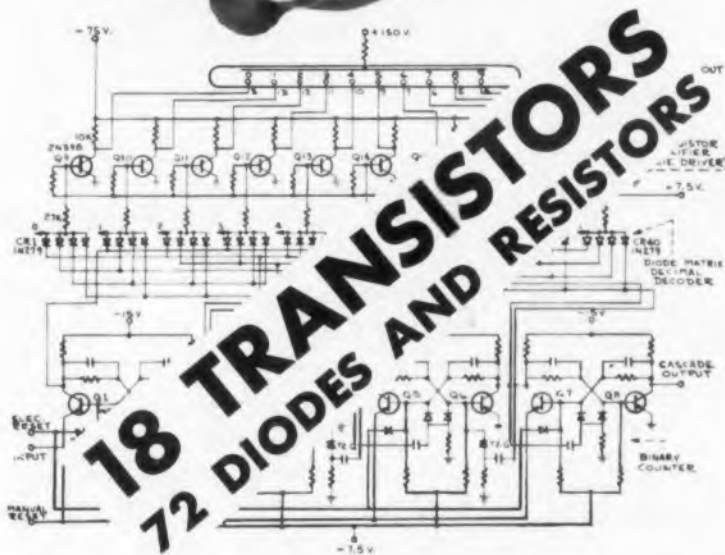
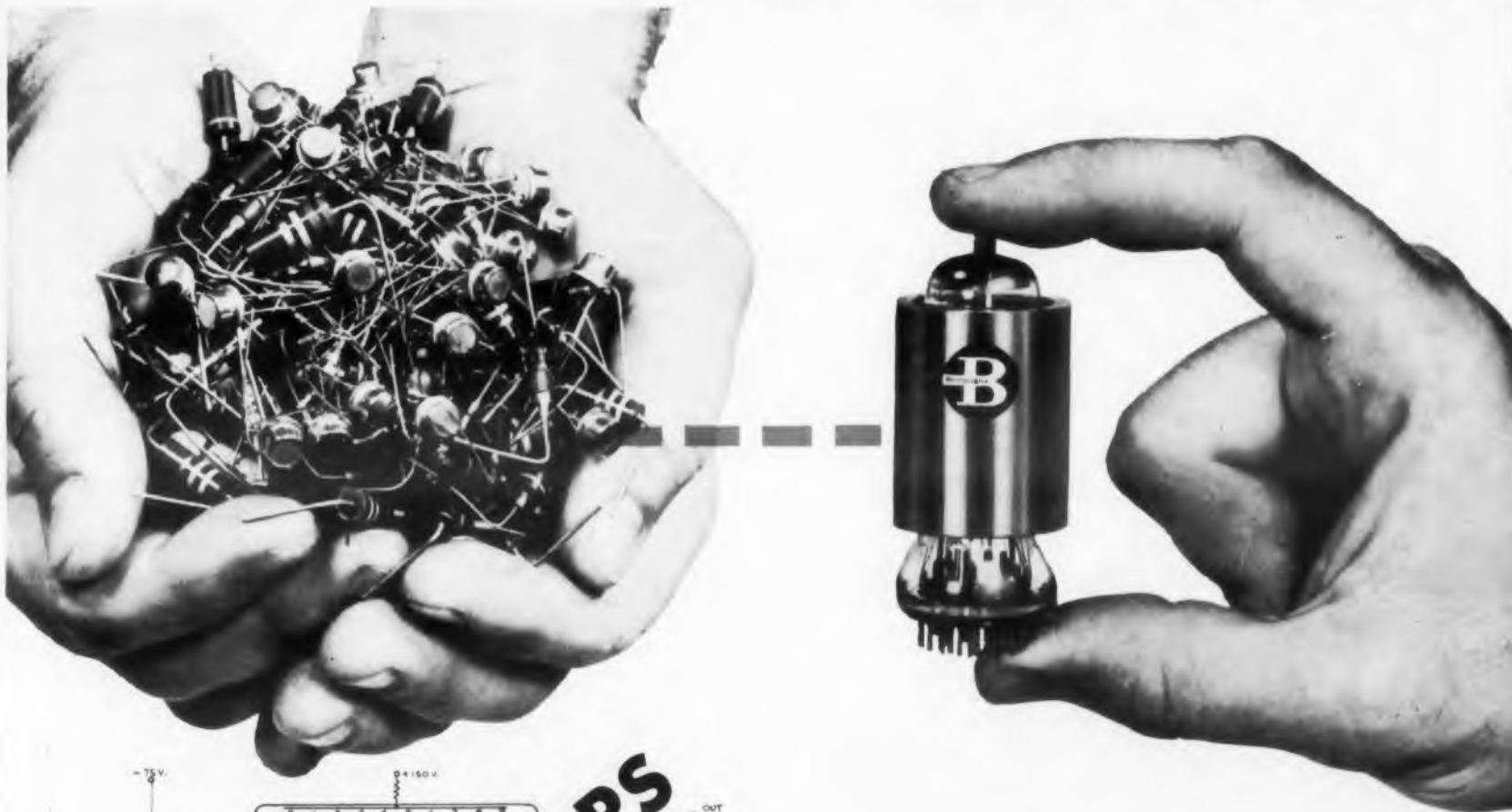
searches an assigned area for an aural indication of target movement such as infiltrating troops. By the use of suitable controls, the operator also can track and pinpoint a detected movement. Accurate target location data is displayed by digital indicators. The XY indicators may be offset to provide direct reading coordinate data with respect to any chosen point such as an artillery position.

An oscilloscope and a plotting table are also provided as operator aids. The oscilloscope displays both fixed and moving targets in the 1000-yard range segment being searched, as well as a gate designating the 80-yard segment being examined at any given time. A map placed on the plotting table permits the operator to observe the map area being searchlighted by the radar through the use of a moving spot of light which shines through the map.

Another radar available for inspection at the meeting was the improved Sperry Silent Sentry. Transistorizing of this

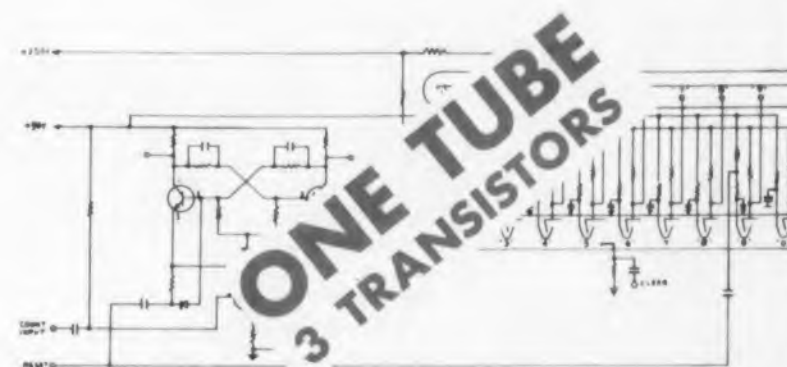
CIRCLE 16 ON READER-SERVICE CARD >

# New MINIATURE BEAM SWITCHING TUBE ELIMINATES *transistor* HYSTERISTOR



**ALL TRANSISTOR DECADE COUNTER WITH NIXIE® TUBE READ-OUT** — Since transistors are "on-off" or binary devices, they require complex and multi-component circuitry to perform simple electronic distributing, switching, counting and other decimal functions.

\* **Hysterical Total Use of Transistors,  
Resulting in Multi-Component Unreliability.**



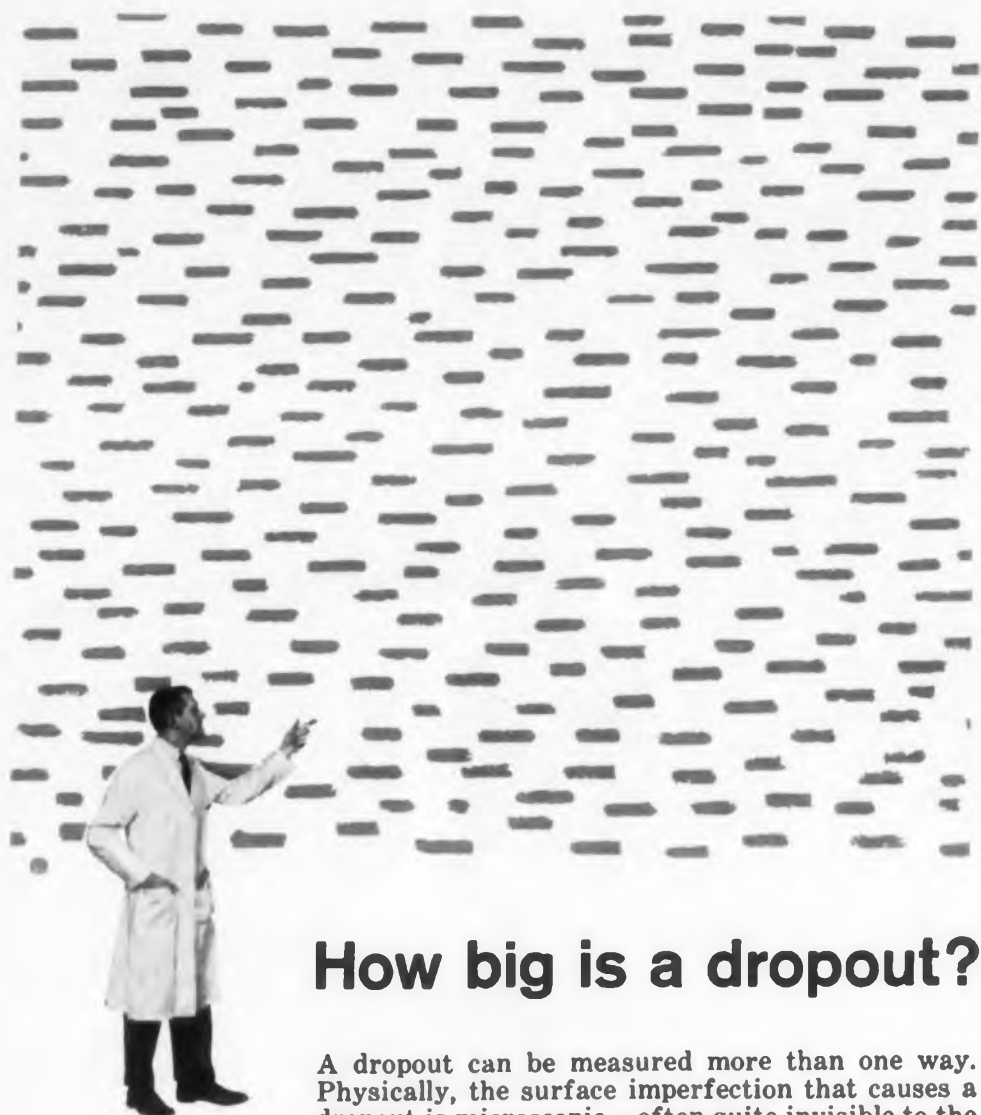
**MINIATURE BEAM SWITCHING TUBE DECADE COUNTER WITH NIXIE TUBE READOUT** — One Miniature Beam Switching Tube eliminates 90 transistors, diodes and resistors. The result is a Beam Switching Tube-Transistor circuit which utilizes the best features of both components.

*Write for* **COMPARISON CHART WHICH OUTLINES BEAM SWITCHING TUBE ADVANTAGES IN SIZE, WEIGHT, POWER, COST, TEMPERATURE, SHOCK, VIBRATION, LIFE AND RELIABILITY.**

ANOTHER ELECTRONIC CONTRIBUTION BY  
**Burroughs Corporation**

ELECTRONIC TUBE DIVISION

Plainfield, New Jersey SEE US AT WESCON BOOTH 3818-3821



## How big is a dropout?

A dropout can be measured more than one way. Physically, the surface imperfection that causes a dropout is microscopic — often quite invisible to the naked eye. Financially, though, this molehill can become a mountain — may cost you thousands of dollars from a single error.

That's why our customers invariably demand perfection from our EP Audiotape, the extra precision magnetic recording tape. They just can't afford dropouts.

Audio Devices' battery of Automatic Certifiers is one of the unique means used to make sure EP Audiotape always meets customer specifications. The Automatic Certifier records and plays back every inch of the EP Audiotape under test. These tests can be so demanding that if the tape fails to reproduce just one test pulse out of the 40 million put on a single reel, the entire reel is rejected. There are no ifs, ands, or buts.

This is one of many special quality-control operations to which EP Audiotape is subjected. From raw material to hermetically sealed containers, every reel gets individual attention.

EP Audiotape quality is so well verified by instruments like the Automatic Certifier that every reel is guaranteed to be defect-free! For more information write for free Bulletin T112A. Write Dept. TD, Audio Devices, Inc., 444 Madison Avenue, New York 22, N. Y.

**TYPE EP audiotape**

**AUDIO DEVICES, INC.**  
444 Madison Ave., N. Y. 22, N. Y.  
In Hollywood: 840 N. Fairfax Ave.  
In Chicago: 5428 Milwaukee Ave.  
Export Dept.: 13 East 40th St., N. Y., 16  
Rectifier Division: 620 E. Dyer Rd., Santa Ana, Calif.

CIRCLE 17 ON READER-SERVICE CARD

## NEWS

equipment cut power requirements in half and made possible use of a battery pack.

This unit also converts movement to sounds for the operators. It is claimed to provide range, azimuth and elevation data to an accuracy of better than 25 yards.

Another application of electronics to surveillance applications shown in Washington was the AN/USD-5 system using a remotely controlled drone operated from a trailerized computer and control center.

The drone will carry radar, infra-red detection, and photographic equipment.

Hughes' Frescaner radar, which uses frequency scanning simultaneously to provide range altitude and azimuth of radar with a pencil beam, was also discussed at the meeting because it is part of a large-scale air-defense system, AN/MSQ-18. Separate height-finding radar is not needed with this system.

The system is digitalized to provide response at less-than-a-second rates, and can be operated from standard trucks.

Because the Nike-series missile stations for which the AN/MSQ-18 system is designed are analog, operations centers send target data in digital form to



**Electronic command center** permits Army field battalion commanders to coordinate the fire power of anti-aircraft missile batteries in seconds. Developed by Hughes Aircraft Co., the center uses a new type of long-range radar called Frescanar. The radar simultaneously provides range, azimuth and altitude of aircraft, eliminating the need for a separate height-finding radar and allowing automatic tracking of hundreds of targets simultaneously. The equipment is now being used by U. S. Forces in Europe.

coder-encoder units for conversion to analog information.

Interesting design features were evident in the DIGICOM on display. This ITT development is an all-digital switching system that automatically bypasses

## Need New Communications Aids—but Not Too Many

That modern communications are good for the Army is self-evident. But too much of a good thing can be bad. This problem was underscored this month separately by two high military men.

Gen. Lyman L. Lemnitzer, Army Chief of Staff, addressing the annual meeting of the Association of the United States Army in Washington, noted:

"The great tactical dispersion to be expected in modern battle, due to increased ranges and effectiveness of firepower and to increased mobility, greatly magnifies the requirement for efficient, reliable, extensive communications."

But the introduction of complex electronic and other equipment to meet the requirement is creating logistical headaches. Writing in the August issue of *Army*, publication of the Army association, Col. Benjamin H. Pochyla, chief of combat developments, operations and training in the Office of the Chief Signal Officer, reported:

"The quantity of communications-electronics equipment in the combat area is increasing at an alarming rate. . . . It may be that we are blindly spinning a communications web from which we will not be able to escape if we are forced to fight. It may be that the electronic environment we are developing will include so many electronic radiators that the enemy will not have to worry about jamming us because we will do it to ourselves."

What Colonel Pochyla recommends is eliminating "nice-to-have gear that provides only an occasional or marginal capability" and developing the "very best" of the essential equipment.



**DIGICOM**, an all-digital, transistorized communication system is designed for use with Army battlefield phone lines in a grid-like setup. The device, a development of ITT Labs at Nutley, N. J., uses time-sharing principles to reduce from almost 10,000 to less than 500 the crosspoints necessary to carry on 48 simultaneous conversations on 24 trunk channels. Digicom converts all types of information to delta pulse code modulated signals, while automatically re-routing messages over the fastest available path. The system is described as virtually immune to interference.

battle-damaged lines. It handles information from computers, radar, analog signals, teleprinters, tape readers, voice and telemetering systems.

The equipment makes use of the ITT-designed Delta pulse code modulation system.

In this system speech signals are converted to a binary pulse code that requires only baud-rate synchronization of transmitter and receiver for single-channel operation.

A framing pulse is sent on a 1-mc carrier, with the coded signal, over telephone lines to a pickup that re-establishes a time reference at the receiving end.

Because of signal attenuation on the telephone lines, repeaters are installed every quarter of a mile. These are operated by a phantom circuit.

Only three transistors are used in the Delta PCM system, according to ITT, rather than the six or so flip flop normally required. And only the user's telephone is analog. It houses a converter; the rest of the system is digital. ■ ■

# Now ..... SOLID tantalum capacitors

join

## ITT Components Division

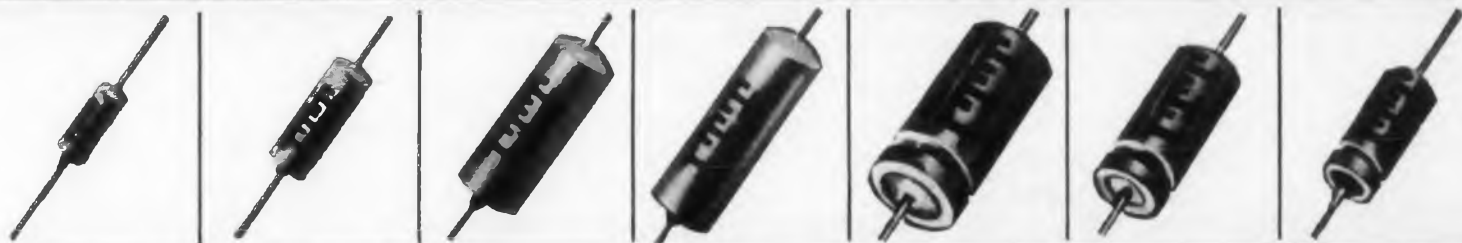
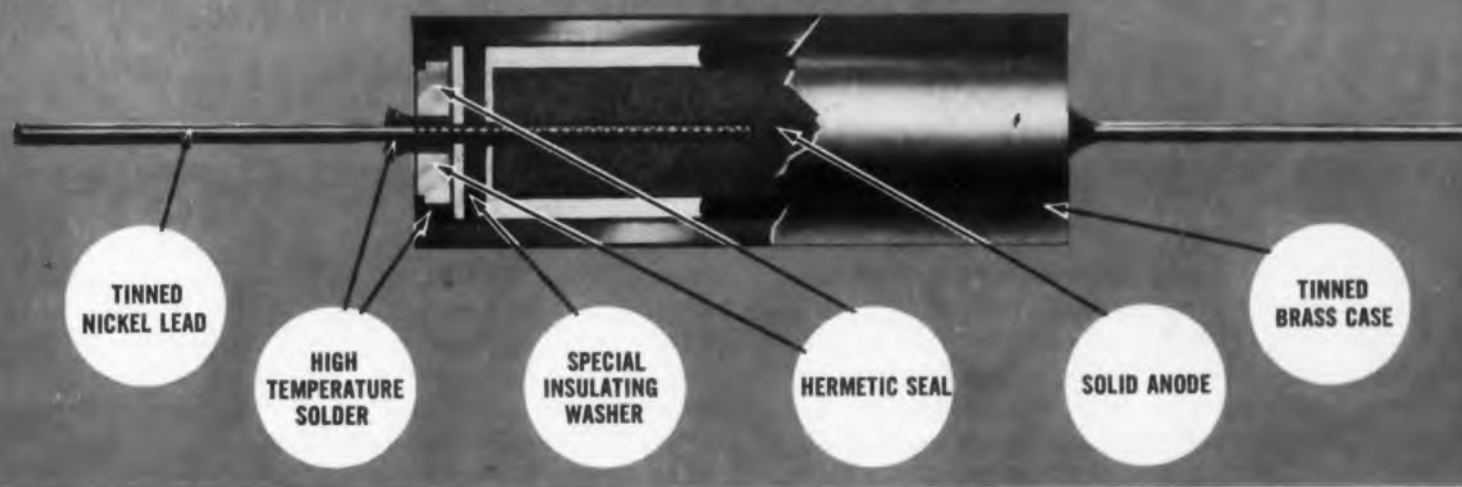
### LINE OF WET TANTALUM CAPACITORS

The new line of ITT Solid Tantalum Capacitors, with increased capacity and reduced case sizes, affords design engineers reliability, small size and extended operating temperatures. These quality units are backed by the research, development, manufacturing and technical experience of the world-wide International Telephone and Telegraph Corporation and feature these design advantages:

- SUBMINIATURE CASE SIZES
- HERMETICALLY SEALED
- SHOCK RESISTANT DESIGN
- CORROSION RESISTANT FINISH
- RUGGED DEPENDABLE CONSTRUCTION
- GREATER ELECTRICAL STABILITY
- MEETS MIL SPECIFICATIONS

Solid Tantalum Capacitors will be available at Authorized ITT Industrial Distributors or direct from factory.

Write today for complete technical data. Bulletin #355



SEE US AT WESCON BOOTH 2510 - 2512

# ITT

## Components Division

INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION  
P. O. BOX 412, CLIFTON, NEW JERSEY

CIRCLE 18 ON READER-SERVICE CARD



## 50% lighter . . . 40% Smaller . . . Daven's new miniature Egg Crate LC Filters

Now, for airborne and missile applications, Daven offers a miniature version of the popular Egg Crate LC Filter; 50% lighter and 40% smaller than any previous filter!

Frequency range is 0.4 MC to 60.0 megacycles . . . temperature range is  $-55^{\circ}\text{C}.$  to  $+125^{\circ}\text{C}.$  . . . different physical configurations are available depending on allowable space.

The new Filter is suitable for pulse-type circuits and those where the phase shift characteristics must be uniform. It can be pre-tuned in the actual circuit, thus eliminating additional adjustment during assembly. With new production facilities,

these Filters are available in quantity, and each unit is identical in performance to the prototype.

Utilizing no critical materials, the LC Filter is also excellent for medium and wide band-width filters. It can be used for bandwidths down to 0.5%, if under-coupled response is permitted.

Daven's extensive engineering staff, also producing other types of filters extending into the low audio range, is ready to assist you in your filter problems. Just send details of your specific requirement.

THE **DAVEN** CO.



LIVINGSTON, NEW JERSEY

TODAY, MORE THAN EVER, THE DAVEN © STANDS FOR DEPENDABILITY



## NEWS

### Static Regulator Controls Silicon Rectifier Voltage

A static voltage regulator has been devised for use with silicon rectifiers. It will be used in a 600-kw rectifier to maintain 250 volts.

The regulator uses partial-range saturable reactors, a magnetic amplifier, a series transformer and a tertiary winding on the rectifier transformer. The regulating principle, its designer, Westinghouse says, consists merely of increasing the commutating reactance when the voltage tends to rise and decreasing it when the voltage tends to drop.

"The tertiary winding," according to the designer, "feeds a portion of the power to the rectifier through a series transformer and saturable reactors. The amount of resistance in the circuit is determined by the bias current in the dc winding of the saturable reactor .

"By comparing the output voltage of the rectifier with a reference voltage, the magamp regulator provides the appropriate amount of reactor bias current to regulate the dc voltage."

### Electronic Box Clears Line for Missile Talk

A newly designed black box called Commswitch (Communications Failure Detecting and Switching Equipment), senses unwanted noise, signal distortion or other undesirable conditions along a telephone line and switches the conversation automatically to a second line.

The unit, developed by the Kellogg Switchboard and Supply Co. of Chicago, a division of the International Telephone and Telegraph Co., has been installed at Vandenberg Air Force Base, Calif., to assure reliable voice communications in launching Atlas missiles. Commswitch, the developer has reported, operates this way:

An incoming voice signal of 250-2800 cps enters the first Commswitch and is split into two paths by

◀ CIRCLE 19 ON READER-SERVICE CARD



a hybrid. Frequencies above and below 250-2800 cps are filtered out.

One signal is sent directly along the line to a hybrid in the second Commswitch where a test sample is extracted by a filter network and the rest sent on to the receiving subscriber set.

The sample is amplified and sent to a special envelope detector which filters a 0-50-cps envelope from the 250-2800 cps signal. This is used to modulate the output of a 3100-cps oscillator in the first Commswitch.

The modulated oscillator output is employed as a checking tone signal and is sent along the same line, with the original voice signal, to the hybrid in the second Commswitch.

From the second hybrid three signals are obtained: the original 250-2800 cps voice signal going to the subscribers, an extracted sample for testing, and the 3100-cps checking tone modulated by a 0-50-cps signal.

The instrument can prevent the injection of false information on the line and even warn the operator of incipient trouble, according to Kellogg's engineers. If trouble strikes both lines, the device picks the line least affected.

In its present design, Commswitch monitors two-way voice communications only. But with modification, it may be built to handle more than two lines and other types of signals transmitted over lines, the company said.

The equipment is designated to operate over cable or equivalent microwave circuits up to 60 miles.

### U.S. Tallying Statistics On Scientific Manpower

The National Science Foundation is acting as a federal clearinghouse for statistical data on scientific and technical personnel. Under a new program set up by the independent government agency at the request of the Bureau of the Budget, facts on the training, supply, demand, pay and utilization of scientists are being gathered. The data will be made available to federal departments and the public.

Skills  
+ Experience  
-----  
Top Quality

**Benefit from the experience**

**gained in building**

**21,000,000 picture tubes...**

**specify RCA!**



#### FIELD OFFICES

EAST: 744 Broad Street, Newark 2, N. J.  
HUmboldt 5-3900

MIDWEST: Suite 1154  
Merchandise Mart Plaza, Chicago 54, Ill.  
WHitehall 4-2900

WEST: 6355 E. Washington Blvd.  
Los Angeles 22, Calif.  
RAYmond 3-8361

In over a decade of experience, RCA has produced more than 21,000,000 picture tubes. What does this experience promise you?

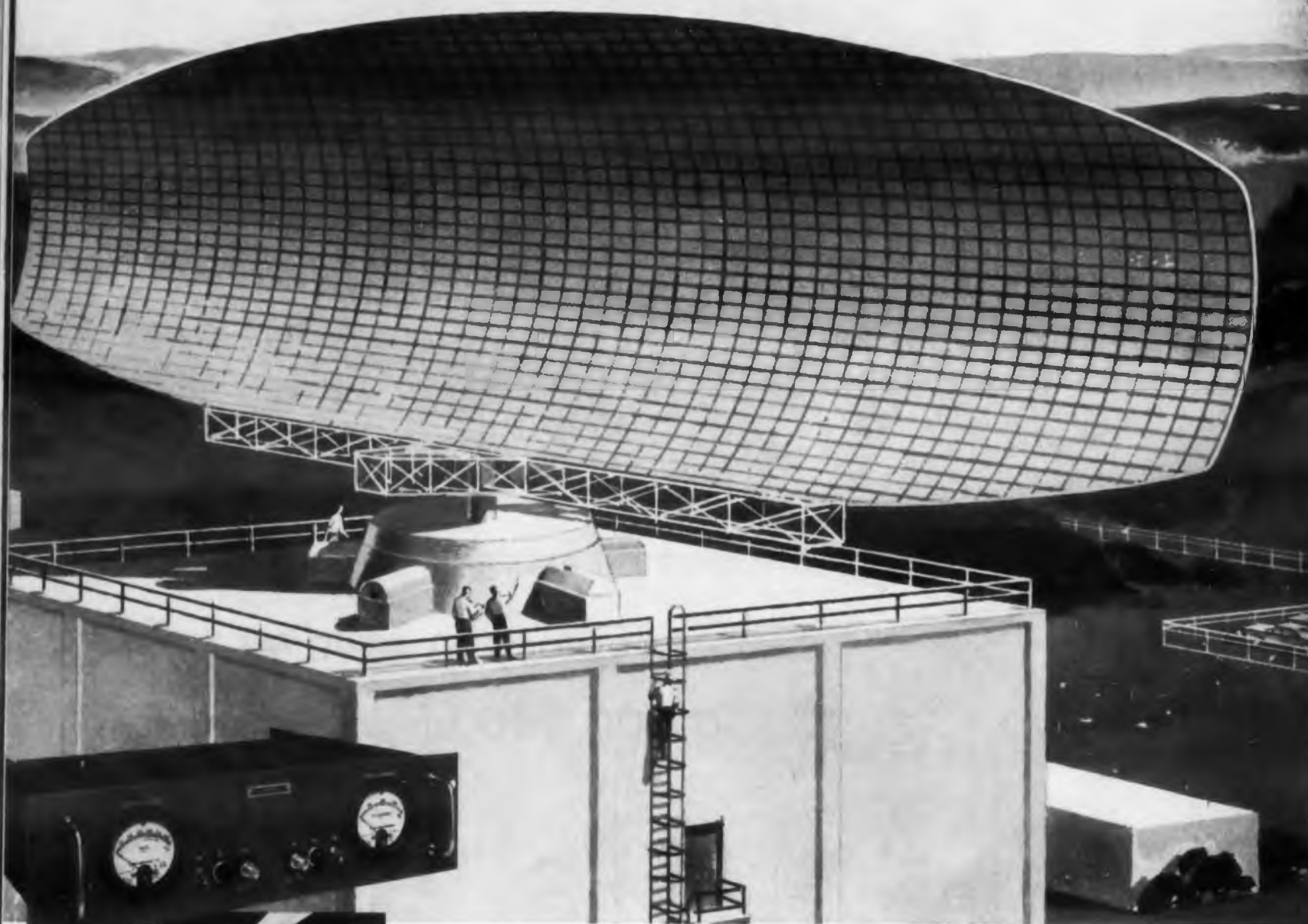
First, it promises *quality*...high standards for checking every tube component every production step. It promises *improvements*...the constant research that has given you the latest developments in picture-tube design. Every improvement in technique, every new design is thoroughly proved-out before release. Further, this "know-how" promises the *dependability* and *availability* you need to meet tight production schedules. Why settle for less

RCA offers you every active picture-tube type for black-and-white television...types with either low or high grid-No. 2 voltage, either short or long neck, either 90° or 110° deflection, as well as the very latest in color picture tubes. For details, get in touch with the RCA Field Representative at our office nearest you.



**RADIO CORPORATION OF AMERICA**  
Electron Tube Division  
Harrison, N. J.

# Lambda Power Supplies specified for newest radar installation



## Meet MIL-E 4158 environmental test requirements

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

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

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

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



## LAMBDA ELECTRONICS CORP.

11-11 131 STREET • COLLEGE POINT 56, NEW YORK  
INDEPENDENCE 1-8500 CABLE ADDRESS: LAMBDATRON, NEW YORK

## NEWS

### Molecular Amplifier Unit Ordered by Air Force

The Air Force has awarded a \$232,310 contract to Airborne Instruments Laboratory of Mineola, N.Y., for the development of a "molecular amplifier group."

Design objectives include a minimum gain of 20 db, minimum bandwidth of 4 mc, noise factor of less than 0.5 db (maximum effective input noise temperature of 35 K) and rapid tuning over the 2150 to 2350 mc band. The equipment must be capable of operating under severe shock, vibration and other conditions encountered in military field use.

The Flight Control Laboratory of Wright Air Development Center plans to use the equipment as low-noise front end for an existing telemetry system.

### High Sensitivity Cited In Infra-Red Detector

Sensitivity improvement of "several orders of magnitude" is claimed for a new infra-red detector that utilizes the microwave concept.

General Bronze Corp. of Garden City, L. I., working under a research contract for the Wright Air Development Center at Dayton, Ohio, lists these features of the new detector, which uses microwave energy to excite magnetically the infra-red sensing elements:

- Greatly reduced noise level, resulting from elimination of dc bias and electrical contacts to the photosensitive semiconductor. (A paramagnetic amplifier is used.)
- Improved signal sensitivity that utilizes the total variation of complex dielectric constant of the semiconductor.
- Noiseless electronic amplification by a high-Q microwave cavity.
- Inherently large bandwidth, desirable for high-resolution reconnaissance and mapping applications. Sensitivity ranges from infrared through ultraviolet.
- Further improvement in sensi-

← CIRCLE 20 ON READER-SERVICE CARD

tivity th  
microwa  
claimed  
limit.

Name  
crowave  
new co  
these m  
■ Recor  
siles or  
■ Surve  
objects-  
■ Airbo

Don't



Noise e  
during m  
put out  
speaker  
tronic co  
conventi  
kilowatts  
2000 ac  
new unit  
horn is 1  
foot mo  
sine-wav  
electrica  
flow (25  
amplifier  
the comp  
Anaheim  
Electroni  
the Boei

Corre

Credi  
cuits in  
article  
July 22,  
given t  
sistor A  
St., Bos  
Robert  
oratorie  
for Fig  
Sulzer  
ton, D.C.

tivity through use of a bridge-type microwave circuit. Sensitivity is claimed to approach the theoretical limit.

Named Usmid (Ultrasensitive Microwave Infrared Detector), the new component is designed for these military uses:

- Reconnaissance by Aircraft, missiles or satellites.
- Surveillance of high-temperature objects—from aircraft to meteors.
- Airborne vehicle guidance.

### Don't Stand Too Close



Noise equivalent to that encountered during missile or aircraft flight will be put out by this air-modulated loudspeaker to test aerial panels and electronic components. It would take 300 conventional speakers, driven by 15 kilowatts of electricity, to equal the 2000 acoustic watts of power of the new unit, the manufacturer reports. The horn is 15 feet long with a 36-square-foot mouth. It generates energy on a sine-wave, random, or speech basis by electrically modulating a powerful air-flow (25 psi at 150 cfm). A 50-watt amplifier triggers the air supply from the compressor. Aitec Lansing Corp. of Anaheim, Calif., a subsidiary of Ling Electronics, Inc., built the speaker for the Boeing Airplane Co. in Seattle.

### Correction

Credit for the semiconductor circuits in the ELECTRONIC DESIGN article starting on page 44 of the July 22, 1959 issue should have been given to Arthur W. Carlson, Transistor Applications, Inc., 103 Broad St., Boston 10, Mass., for Fig. 1; Robert E. McMahon, Lincoln Laboratories, MIT, Cambridge, Mass., for Fig. 2; and Peter G. Sulzer, Sulzer Laboratories, Inc., Washington, D.C.



**NEW LINK F8U-1 JET FIGHTER TRAINER**  
The mobile F8U-1 is one of the latest flight simulators built by Link Aviation, Inc., subsidiary of General Precision Equipment Corp. The F8U-1 includes cockpit, instructor's area, computer sec-

tion and maintenance shop in an air-conditioned trailer. In World War II, famous Link "Blue Boxes" trained over half-million Allied airmen. Today, Link units like the F8U-1 ready commercial and military pilots to handle jet aircraft.



## Tung-Sol tubes help **LINK** AVIATION, INC. trainers put fledgling pilots in the air!

A Link electronic trainer acquaints both the beginner and experienced pilot with precise flight conditions from takeoff to touchdown. It familiarizes him with on-ground responsibilities . . . teaches crew coordination, radio procedure, navigation, instrument flying . . . and records student reactions. The fledgling gets the 'feel' of flying without ever leaving the ground.

The complex and sensitive simulators function over long periods and get rough treatment from beginner hands. Precision operation demands more-than-ordinary reliability and performance from every simulator compo-

nent, including up to 3,000 electron tubes.

Tung-Sol dc summing amplifier tubes and buffer tubes used in the various Link simulators consistently meet these exacting requirements. The tubes feature outstanding electrical stability . . . ruggedness under hardest usage . . . minimum short-life failure rate. And tube quality stays uniformly high from one tube lot to another.

The same premium tube performance Link enjoys is available to you. Specify Tung-Sol power tubes for any military and industrial socket you must fill! Tung-Sol Electric Inc., Newark 4, New Jersey.



**ts TUNG-SOL**

# WASHINGTON REPORT



Ephraim Kahn

## Air Force Changing Procedure for Evaluating Systems

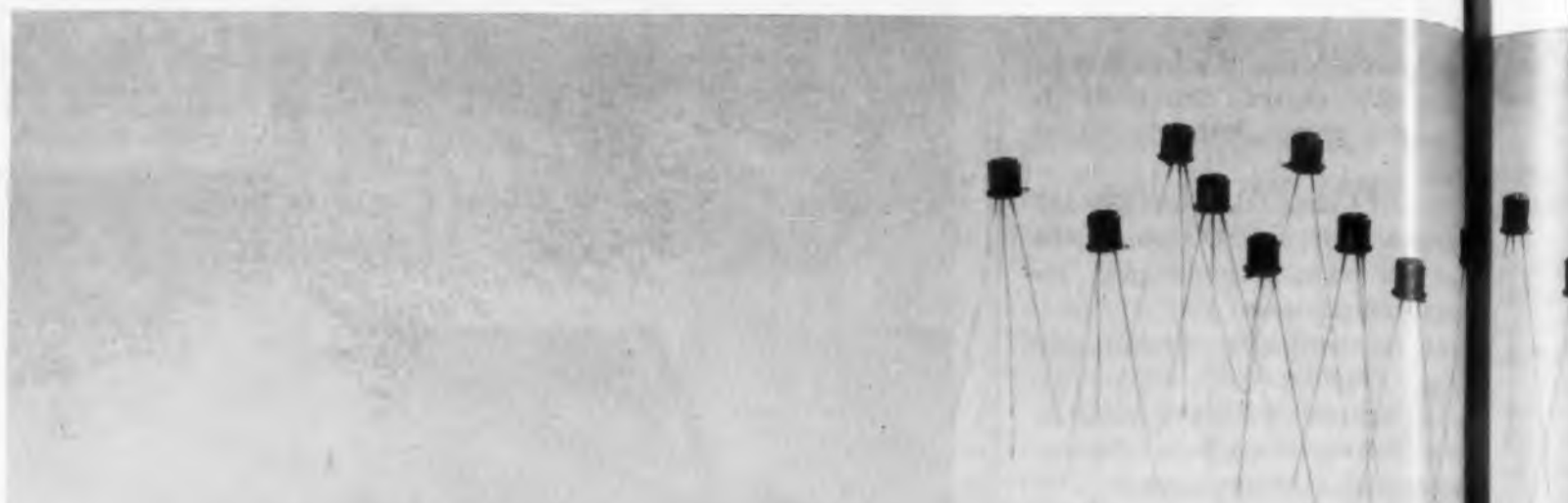
Electronics firms working on weapons systems can expect to have the Air Force watching them closely. Procedures for evaluating weapons systems are being changed, and much thought is being given to the need for a greater separation of requirements for today's operational devices and for long-term development. Along with this will go changes in administrative organization in the Air Force itself.

As a result of some fast footwork, designed to help the military keep a closer eye on weapons systems as they evolve, it appears as though there will be a wider gap between criteria for Required Operational Capability (ROC) and the longer-term System (and Subsystem) Development Requirement (SDR). The Deputy Chief of Staff, Operations, will handle ROC while the DCS, Development, will be in charge of SDR. If this split-up becomes final, then there is expected to be some additional paperwork since the General Operational Requirements documents now used for both operational and technical material that deals with proposals for weapons systems will have to be further refined. New types of documents will be forthcoming for ROC and SDR data. Needless to say, the Directorate of Development Requirements (now run by the DCS, Development) would have its name changed to Directorate of Operational Requirements (under the DCS, Operations). Note, however, that technical requirements of proposed weapons systems would continue to be evaluated by DCS, Development.

### Systems to be High Policy

Under the new set-up, System Development Requirements would be high policy documents. They would be "broad in approach to permit the flexibility and latitude required in development, yet specific in purpose to guide and orient the development toward a definite goal." The SDR would be designed to describe a needed weapon which is beyond the current state of the art.

Actual production responsibility for new weapons systems would be given to the DCS, Operations, who would have to first be satisfied that both ROC and SDR needs are met by the system. The system would then be ordered into produc-



## NEW FAIRCHILD 2N706 provides TRANSISTOR LOGIC OF MAXIMUM PE

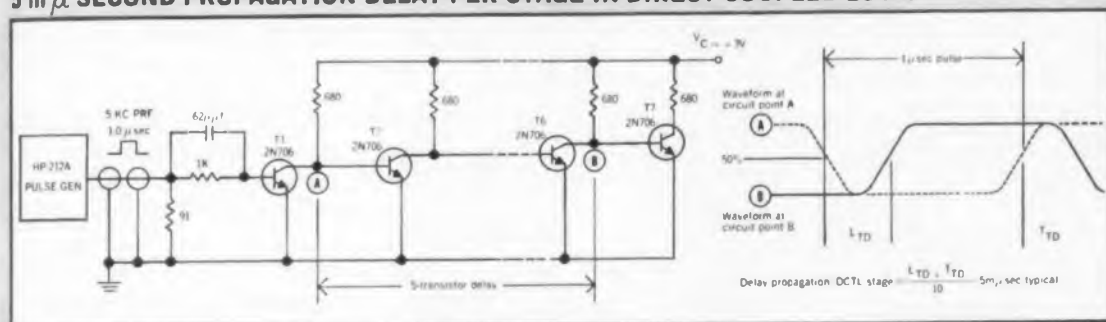
Saturating high-speed silicon logic ends the need to sacrifice one requirement in favor of another. The Fairchild 2N706 diffused silicon mesa transistor is as fast as the fastest germanium — and in addition has the inherent advantages of silicon. This combination fulfills all these logic-circuit design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

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

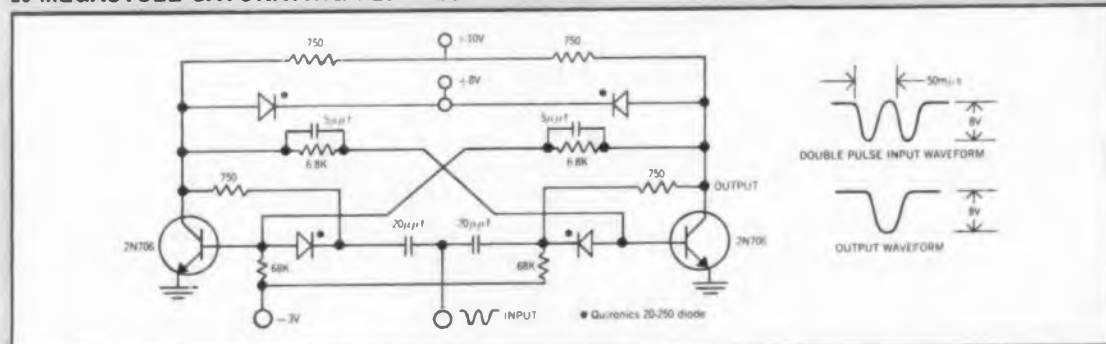
Fairchild's 2N706 provides optimum performance in the most-used logic circuit configurations and has a broad current and power range that covers many alternate approaches. It is ideally suited for high-density modular equipment because of its small size and its high performance in simple, low-power saturated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

# SPEED, RELIABILITY, SIMPLICITY

## 5 m $\mu$ SECOND PROPAGATION DELAY PER STAGE IN DIRECT COUPLED LOGIC



## 20 MEGACYCLE SATURATING FLIP-FLOP CIRCUIT



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

Symtol	Characteristics	Rating	Min.	Typ.	Max.	Test Conditions
V <sub>CB0</sub>	Collector to base voltage	25 v				
V <sub>EB0</sub>	Emitter to base voltage	3 v				
	Total dissipation, 100° C free air ambient	150 mw				
h <sub>FE</sub>	D.C. pulse current gain		15			I <sub>C</sub> = 10mA V <sub>C</sub> = 10v
V <sub>BE(SAT)</sub>	Base saturation voltage			0.9		I <sub>C</sub> = 10mA I <sub>B</sub> = 1mA
V <sub>CE(SAT)</sub>	Collector saturation voltage		0.3	0.6		I <sub>C</sub> = 10mA I <sub>B</sub> = 1mA
h <sub>fe</sub>	Small signal current gain at f = 100 mc		4			I <sub>C</sub> = 20mA V <sub>C</sub> = 10v
C <sub>ob</sub>	Collector capacitance (140Kc)		3.5 pf	6 pf		I <sub>E</sub> = 0mA V <sub>C</sub> = 10v

For specification sheets, write Dept. B-8-19



545 WHISMAN ROAD • MOUNTAIN VIEW, CALIFORNIA  
YORKSHIRE 8-8161 • TWX: MOUNTAIN VIEW CAL 122

REGIONAL SALES OFFICES: Philadelphia area: 100 Old York Road, Jenkintown, Pa.  
TU 6-6623 and 6624, TWX: Jenkintown Pa 1056 • Los Angeles area:  
8833 Sunset Blvd., Los Angeles 46, Calif., OLeander 5-6058 and 6059, TWX: BV 7085

tion though issuance of a Specific Operational Requirement. This SOR would set forth in detail the characteristics of the weapons system.

Research and development is being quickly reorganized by the Air Force so that it will readily fall in line with impending changes in the requirements set-up. There are to be three primary R & D programs: (1) Operational Development; (2) Advanced Development; and (3) Research. Design engineers probably will become most familiar with the first, since it covers both engineering and development of specific weapons systems. The Operational Development Program will also carry out the wishes of its superior officers as expressed through SOR or Operational Support Requirement (OSR) orders.

SDR's, normally dealing with projects that would exceed the capabilities of systems known, will usually be worked on by the Advanced Development Program of the Air Force. This program is expected to cover development of advanced components, subsystems, and systems, as well as new instrumentation devices.

The broadly-titled third aspect of Air Force R & D—Research—is equally far-ranging in its activities. Basic and applied research are included, and electronics is a subject for both.

## NASA Adds Push to Government Procurement from Small Firms

Small companies are to get "a fair proportion" of business placed by the National Aeronautics and Space Administration. The agency's new small business policy asserts that when NASA buys, its primary consideration is "securing contract performance, including obtaining deliveries of required items or services at the time, in the quantity, and of the quality prescribed." The agency adds that while it seeks to deal only with competent outfits, it "is in the interest of the civilian space program that the number of firms engaged in research and development work for NASA be expanded and that there be an increase in the extent of such work by competent small business men."

This is how NASA's plans to help the littler companies shape up: (1) when the agency expects to spend more than \$2500, small business specialists will check over the proposals to see if they are suitable for set-aside for small business or whether small firms are likely to compete. The Small Business Administration will be told of proposed purchases estimated to exceed \$10,000.

NASA also expects to encourage competent small firms to submit unsolicited proposals for R & D work in areas of interest to the agency. It will also encourage the formation of contractor pools or joint ventures to perform R & D contracts.

CIRCLE 22 ON READER-SERVICE CARD

**ISOMICA** Mica Paper Insulation. Epoxy and silicone bonded. Extremely uniform. High electricals. Heat resistance up to 300 C continuously. Thicknesses down to 0.001 in. For capacitor, transformer, motor insulation, cable tapes, coil covering.



**SILICONE** Coated Glass. Either silicone rubber or varnish coating. Cloth or tape form. High dielectric. Low power factor. Good moisture and chemical resistance. For Class B and H use, for coil wrappings, spacers in motors, generators, transformers and for cable wrapping.

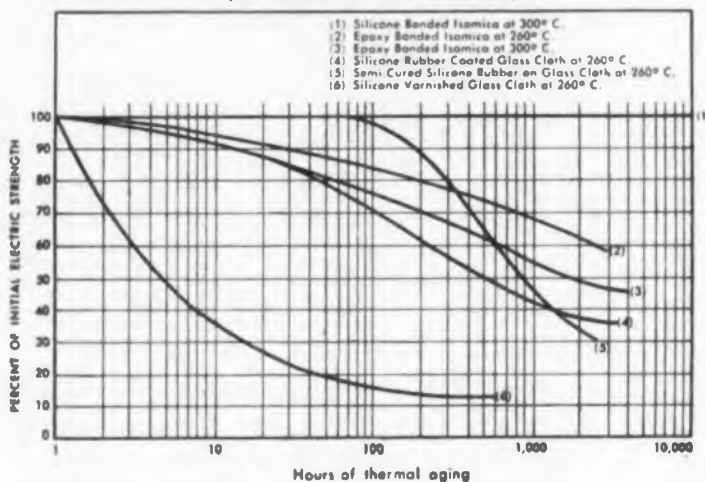


**TEFLON** Coated Glass. Coated on one or both sides. Exceptionally tough, resilient and abrasion resistant. Good electricals, chemical resistant. Very low power factor. Heat resistance up to 250 C. For coil wrappings, cable wrapping, high temperature lead wrapping on electronic gear, motors, transformers, generators.



Improve reliability, cut rejects of high temperature electrical equipment with a Mico flexible insulation

PERCENT RETENTION ELECTRIC STRENGTH VS. HOURS AGED  
(10 mil flexible sheet insulation)



Effect of Heat Aging on electric strength of MICO flexible insulating materials. Note relative stability of ISOMICA materials.

Looking for heat resistant cable tape, slot linings, capacitor or transformer insulation, coil wrappings or other flexible combinations?

Then take a look at Mica Insulator's broad line of flexible insulating materials — capable of operation at temperatures from 130 to 300 C, with almost limitless property possibilities.

FOR COMPLETE DETAILS on MICO flexible insulating materials, write MICA INSULATOR, 1812 Broadway, Schenectady 1, N. Y., or contact the insulation specialist at the nearest 3M sales office.

## MICA INSULATOR

Division of Minnesota Mining & Manufacturing Company  
SCHENECTADY 1, N. Y.

MICANITE® AND ISOMICA® PRODUCTS LAMICOID® LAMINATES  
SILICONE AND TEFLON® COATED CLOTHS AND TAPES

\* Reg. T. M. E. I. DuPont de Nemours & Company

CIRCLE 23 ON READER-SERVICE CARD

# MEETINGS

## Calendar of Events

### August

- 18-21 WESCON Show and Convention, Cow Palace, San Francisco, Calif.\*
- 20-21 Symposium on Industrial Uses of Radioisotopes, U. S. Atomic Energy Commission, in cooperation with the Buffalo Chamber of Commerce, University of Buffalo, and Canisius College, Buffalo, N. Y.
- 23-26 AIEE, 6th Electrical Conference of the Petroleum Industry, Wilton Hotel, Long Beach, Calif.
- 31-2 Semiconductors Conference, Metallurgical Society of AIME, Statler Hotel, Boston, Mass.

### September

- 1-2 Conference on Chemistry in Aerodynamic and Space Flight, Air Force Office of Scientific Research, General Electric Co., University of Pennsylvania, Philadelphia, Pa.
- 1-3 14th National Meeting, Association of Computing Machinery, MIT, Cambridge, Mass.\*
- 6-12 International Conference for Standards on a Common Language for Machine Searching and Translation, Western Reserve University and Rand Development Corp., Tudor Arms Hotel, Cleveland, Ohio.
- 7-10 6th Annual International Meeting; The Institute of Management Sciences, (TIMS), Paris, France.
- 17-18 Engineering Writing and Speed Symposia, IRE, Boston, Mass. and Los Angeles, Calif.\*
- 18-19 3rd Technical Symposium, Cedar Rapids section IRE, Sheraton-Montrose Hotel, Cedar Rapids, Iowa.
- 18-20 8th Annual High Fidelity Show, International Sight and Sound Exposition, Inc., Palmer House Chicago, Ill.
- 20-25 14th Annual Conference and Exhibit, Instrument Society of America, Chicago, Ill.
- 21-22 Standard Engineers Society 8th Annual Meeting, Boston Section, Hotel Somerset, Boston, Mass.
- 23-25 4th Annual Special Technical Conference on Non-Linear Magnetics and Magnetic Amplifiers, AIEE, IRE, Shoreham Hotel, Washington, D.C.\*
- 28-30 National Symposium on Telemetry, IRE, Civic Auditorium and Whitcomb Hotel, San Francisco, Calif.

\*Includes meetings described herewith.

### WESCON Show and Convention, August 18-21

The show will feature numerous exhibits which will fill the Cow Palace in San Francisco. Complementing the product lines will be papers covering all phases of professional group interests. A "new look" in the technical program is being planned this year which will limit each of the usual 40 daytime sessions to three full-length papers in each. A second innovation will be the introduction of a "panel of peers," a group of experts in the field, invited to comment on the group of papers at the completion of each session. Registrants will be able to obtain and review all papers prior to their presentation through the Convention Record.

CIRCLE NOS. 800 THROUGH 809 RESPECTIVELY FOR TYPES M-100 THROUGH GG37 ON READER-SERVICE CARD



GS

Cow Palace,  
diolisoopes,  
In coopera-  
Commerce,  
us College.

the Petro-  
Beach, Calif.  
urgical So-  
Mass.

ynamic and  
cientific Re-  
iversity of

of Comput-  
ss.\*

ards on a  
rching and  
ersity and  
rms Hotel,

The Insti-  
(S), Paris,

posia, IRE,  
Rapids sec-  
cel, Cedar

International  
mer House

nstrument

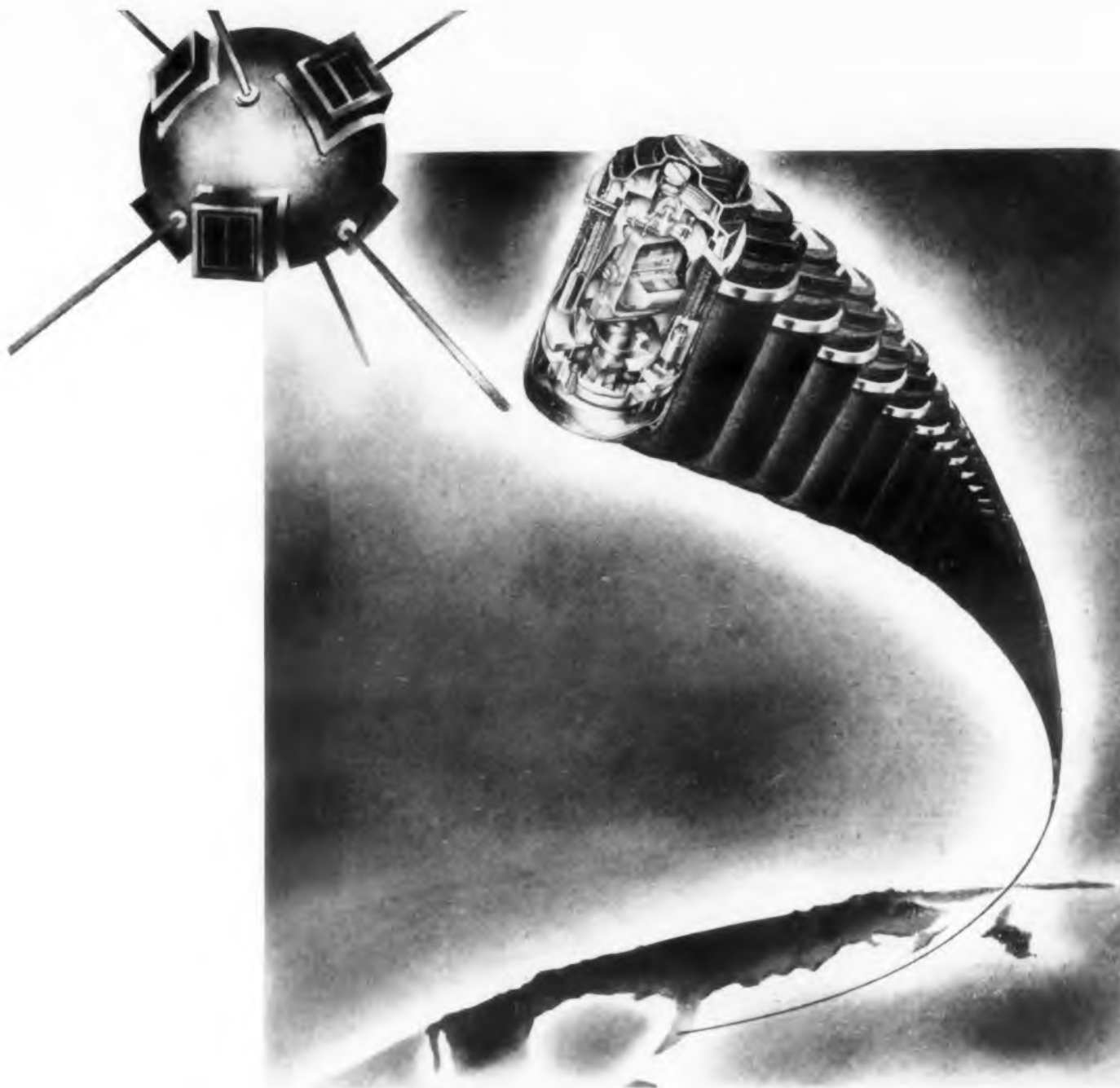
Annual Meet-  
t, Boston,

erence on  
Amplifiers,  
gton, D.C.\*  
Ing, IRE,  
otel, San

st 18-21

bits which  
co. Com-  
pers cov-  
interests.  
is being  
h of the  
ull-length  
ll be the  
up of ex-  
t on the  
each ses-  
and re-  
through

R TYPES >  
CARD



## 300,000 Gyros Later...

Honeywell's accomplishments in the design and manufacture of precision gyros date back to World War II. From the thousands of Mark XV Fire Control Gyros used by our Navy to the famous C-1 Autopilot, used in the B-17, B-24, and B-29 bombers, Honeywell has been instrumental in helping the Armed Services solve their fire control and stabilization problems.

Today, Honeywell supplies gyros for leading missile and aircraft programs, including the Titan, Thor, Atlas, and Talos, Project Scout and Project Mercury, the F-106 and the airborne MA-1 Fire Control System. The know-how gained through production of over 300,000 gyros enabled Honeywell to design the gyros which helped Vanguard I achieve a near-perfect orbit . . . so nearly perfect that experts estimate this satellite will remain in orbit up to 200 years.

You can take advantage of Honeywell's long and successful experience in the design and production of gyros and accelerometers. Honeywell offers a complete line of inertial components for all applications or can manufacture specific instruments to your own design requirements.

# Honeywell



*Military Products Group*

# HONEYWELL OFFERS A COMPLETE LINE ... to meet the need all a



## RATE GYROS

**TYPE M-100** miniature rate gyro assures constant damping over a wide operating temperature range without the use of heaters. The typical damping of .6 at  $-65^{\circ}\text{F}$  is obtained without benefit of heat from the spin motor, and is held virtually constant up to a temperature of  $+250^{\circ}\text{F}$ . The gyro spin motor will run on one (split), two, or three phase power, and is isolated from ground to prevent circulating ground currents. *Write to Boston Division for Bulletin M-100.*



- Full Scale Range: to 400 degrees/sec.
- Threshold-Resolution: Less than 0.01 degrees/sec.
- Linearity: Less than 0.1% of full scale to 1/2 range, less than 2% to full range
- Damping: 0.5 to 0.8 from  $-65^{\circ}\text{F}$  to  $+250^{\circ}\text{F}$
- Shock and Linear Acceleration: to 150 G
- Vibration: 20 G to 2000 cps
- Size: 1" diameter,  $2\frac{1}{32}$ " long
- Weight: Less than 6.0 ounces

**TYPE GN** or "Golden Gnat" is in full production in a wide variety of different models, and has been proven in operational aircraft during the past two years. Because of its small size and high performance it has been successfully used in a number of miniature rate packages. Type GN is gold plated for improved corrosion resistance and positive hermetic sealing. *Write to Boston Division for Bulletin GN.*



- Full Scale Range: to 600 degrees/sec.
- Threshold-Resolution: 0.01 degree/sec.
- Linearity: 0.1% of full scale to 1/2 range, within 2% to full range
- Damping: Fluid damped, temperature compensated
- Shock and Linear Acceleration: to 100 G
- Vibration: 10 G to 2000 cps
- Size: 1" diameter,  $2\frac{1}{4}$ " long
- Weight: 3.8 ounces

**TYPE JR** is particularly well suited for those applications where proven reliability must be combined with high performance. A unique quadrilever spring suspension assures high sensitivity and a wide full scale range under severe environmental conditions. The Type JRT gyro is available with heaters for those critical applications requiring constant damping over the entire operating temperature range of the instrument. *Write to Boston Division for Bulletins JR and JRT.*



- Full Scale Range: to 1000 degrees/sec.
- Threshold-Resolution: Less than 0.01 degree/sec.
- Linearity: 0.25% of full scale
- Damping: JR: 0.5 to 1.0 from  $+32^{\circ}\text{F}$  to  $+175^{\circ}\text{F}$   
JRT: 0.6 to 0.9 from  $-65^{\circ}\text{F}$  to  $+175^{\circ}\text{F}$
- Shock and Linear Acceleration: to 100 G
- Vibration: 15 G to 2000 cps
- Size: 2" diameter;  $4\frac{3}{32}$ " long
- Weight: 1.8 lbs.

**GG79** is a descendant of the JG-7005 rate gyro and incorporates an advanced damper and design features which adapt it to far more rugged applications. A wide selection of maximum turning rates, potentiometer resistance, and damping ratios is available. The GG79 meets MIL-E-5272 requirements. It is available with one or two potentiometers. With a single potentiometer a rate switch operating at a predetermined turning rate can be included. *Write to Aero Division for Bulletin GG79.*



- Power Requirements: 115 volts, 400 cps, single phase
- Potentiometer Resistance: Available in any size from 420 ohms to 15,000 ohms
- Threshold-Resolution: 0.1 degree/second or less
- Run-up time: 5 minutes maximum
- Ambient Temp. Range:  $-65^{\circ}\text{F}$  to  $+165^{\circ}\text{F}$
- Size: 4" long,  $3\frac{3}{4}$ " wide,  $3\frac{1}{2}$ " high
- Weight: 1.75 lbs.

## LOW COST, GAS DRIVEN GYRO

**GG99** is an expendable, low-cost self-energizing 2 axis gyro designed for single-shot, short-run use under high shock, vibration, and acceleration loads. A cylinder of compressed gas actuates the rotor and uncages the gimbals within 100 milliseconds after firing. The GG99 has less than 40 parts, is designed to withstand 100 G shock loads and 20 G vibration stresses. Rugged simplicity in design provides overall predicted reliability of 0.988. *Write to Aero Division.*



- Warmup and uncaging time: less than 100 milliseconds
- Drift: 0.5 degree per minute
- Outer axis freedom: Unlimited
- Inner axis freedom: Limited to  $\pm 45$  degrees
- Size: 4.5" long, 2.75" diameter
- Weight: Less than 4 lbs.

*For technical bulletins write to Aero Division or Boston Division as indicated.*

MINNEAPOLIS-HONEYWELL, BOSTON DIVISION, 40 LIFE STREET, BOSTON 35, MASSACHUSETTS  
MINNEAPOLIS-HONEYWELL, AERO DIVISION, 2600 RIDGWAY ROAD, MINNEAPOLIS 13, MINNESOTA



# LINE OF INERTIAL COMPONENTS

needed for all applications



## 2 AXIS GYROS

**GG48 FULL FREEDOM GYRO** is a hermetically sealed, two-axis, full-freedom gyro. Its all-attitudes capability results from the mounting of a conventional 2-degree of freedom gyro on a third servo-driven gimbal which maintains perpendicularity between the free gimbals eliminating tumbling and gimbal lock. It offers substantial savings in weight and complexity in flight control, fire control and all attitudes indicating and/or bombing systems. Available with synchros, potentiometers or both. An electro-mechanical initial fast erection system permits rapid realignment of all three gimbals from any position during motor warmup. Write to Aero Division for Bulletin GG48.



- Power requirements (gyro motor): 115 volts, 400 cps, 3-phase
- Static accuracy: 12 minutes error spread
- Gimbal freedom: 360 degrees in both longitudinal and transverse axis.
- Initial erection or warmup time: 1 minute maximum
- Erection rate: 2 to 6 deg./min. (factory adjustable)
- Free drift rate: average is within 0.25 deg./min. corrected for earth's precession rate
- Accuracy: 0.15 degrees or better of true vertical about each axis
- Size: 9.1" long, 5.1" wide, 5.3" high
- Weight: Approx. 9 lbs. including amplifier and pre-amplifier assemblies

**GG64 RAM gyro** has been specifically designed to withstand the severe environmental stresses encountered in rocket and missile applications. Fewer than 100 parts, full monocoque gimbal construction and complete hermetic sealing combine to insure high reliability and consistent operation under extreme vibration and acceleration loads inherent in missile firings. Supersonic sled tests have proven reliable operation under shock loads up to 80 G. Write to Aero Division for Bulletin GG64.



- Power requirements: 208 volts, 400 cps, 3-phase
- Warmup time: 50 seconds
- Precession rate: Will precess at rates up to 25 deg./sec
- Erection system: Will erect the gyro spindle to vertical up to 12 deg./min. without external amplifiers
- Shock: Will withstand up to 80 G shock — meets all pertinent requirements of MIL-E-5272A
- Size: 5.5" long, 4.2" wide, 4.5" high
- Weight: 4.5 lbs.

## FLOATED GYROS

**GG49 MIG (Miniature Integrating Gyro)** combines small size and light weight with high accuracy. It is a single-degree-of-freedom gyro with floated gimbal construction. Based on previous design and production experience with the HIG-4, HIG-5, and HIG-6 gyros, the MIG differs from these in that it employs a "Dualsyn" combination signal and torque generator. It is particularly applicable for use in central station instrument platforms and in short-time inertial and aided inertial systems. Write to Aero Division for Bulletin GG49.



- Power Input: 26 volts, 400 cps, 3-phase start and run
- Fixed Drifts:
  - Acceleration sensitive: 1 deg./hr/G linear acceleration maximum, either axis
  - Non-acceleration sensitive: 1 deg./hr maximum
- Drift rate: Extremely low (exact rate classified)
- Shock: Will withstand shocks in excess of 50 G
- Size: 2.73" long, 2" diameter
- Weight: 0.48 lbs.

**WIDE-ANGLE MIG family**, only slightly larger than the standard MIG, provides a small gyro with an input angular freedom up to  $\pm 60$  degrees. Because of this wide input freedom it is particularly adaptable to strapped down attitude reference systems, rate packages and fire control systems. The wide-angle MIG also uses a permanent magnetic torquer which allows torquing rates up to 80,000 degrees per hour. Write to Aero Division.



- Power input:  $26 \pm 1$  volts, 3 $\phi$ , 400 cps
- Torque generator scale factor: 400 dcm/ma (800 degrees/hr/ma)
- Gimbal freedom  $\pm 10$  degrees
- Input notch alignment: 3 mr
- Operating temperature: 180° F up to 500° F
- Size: 3.5" long, 2.15" diameter
- Weight: 0.9 lbs.

**GG37 GYRO** is an advanced version of the Hermetic Integrating Gyro. It is a small, highly precise single-degree-of-freedom control gyro specifically designed for inertial platform stabilization application and features a permanent magnetic torquer. Performance figures, though presently classified, are available on a need-to-know basis. Write to Aero Division.



**GG76 GYRO** is a small, lightweight, hermetically-sealed integrating gyro specifically designed to meet increasingly rigid requirements for platform stabilization and rate measurement applications. It combines the basic features of the HIG-4 gyro with significant advancements in acceleration sensitive and non-acceleration sensitive drift rates. Detailed information covering the GG76 is classified.

## LINEAR ACCELEROMETERS

**TYPE LA-500** linear accelerometer is a potentiometer output device that features constant damping and linear response. These instruments are fluid damped, and are designed to operate between  $-65^{\circ}\text{F}$  and  $+175^{\circ}\text{F}$ . These non-pendulous accelerometers are inherently insensitive to cross coupling accelerations, and are provided with mechanical stops to prevent damage from input accelerations beyond the specified range. Write to Boston Division for Bulletin LA-500.



- Full Scale Range:  $\pm 1$  to  $\pm 60$  G
- Threshold: 0.02 G
- Potentiometer Resistance: 1,000 $\Omega$  to 14,000 ohms
- Damping Ratio: 0.75  $\pm$  0.35 typical
- Natural Frequency: 5 to 19 cps
- Cross-axis Sensitivity:  $\frac{1}{2}$  % of full scale
- Shock: to 50 G
- Vibration: MIL-E-5272
- Size:  $\frac{1}{16}$ " diameter,  $\frac{3}{4}$ " long
- Weight: 1 lb.

**TYPE LA-600** is an A-C Linear Accelerometer in which friction is eliminated to permit resolution of extremely low level inputs. This unit consists of a non-pendulous seismic mass, supported by a frictionless spring suspension, and incorporated on A-C variable reluctance pickoff. This accelerometer features magnetic damping for near constant damping ratio throughout its wide range of operating temperatures from  $-65^{\circ}\text{F}$  to  $+250^{\circ}\text{F}$ . Write to Boston Division for Bulletin LA-600.



- Full Scale Range:  $\pm 1$  to  $\pm 40$  G
- Full Scale Output: to 25 volts
- Threshold-Resolution: 0.0001 G
- Damping Ratio: 0.6  $\pm$  .2 typical from  $-65^{\circ}\text{F}$  to  $+250^{\circ}\text{F}$
- Natural Frequency: 16 to 100 cps
- Cross-axis Sensitivity: 0.005 G per G maximum
- Shock: to 60 G
- Vibration: 10 G to 2000 cps
- Size:  $1\frac{1}{8}$ " diameter,  $2\frac{3}{8}$ " long
- Weight: 1.2 lbs. maximum

**TYPE LA-700** accelerometer is a complementary unit to the LA-600 for those applications requiring a high full scale range combined with a low natural frequency. This linear accelerometer is a non-pendulous seismic mass, supported by a frictionless spring, incorporating compensated fluid damping, an A-C variable reluctance pickoff, and assures reliable operation over a wide operating temperature range. Write to Boston Division for Bulletin LA-700.



- Full Scale Range:  $\pm 1$  to  $\pm 60$  G
- Full Scale Output: to 25 volts
- Threshold-Resolution: 0.0001 G
- Damping Ratio: 0.6 at  $25^{\circ}\text{C}$  typical
- Natural Frequency: 5 to 30 cps
- Cross-Axis Sensitivity: 0.005 G/G maximum
- Shock: to 100 G
- Vibration: 15 G to 2000 cps
- Size:  $2\frac{1}{32}$ " diameter,  $2\frac{7}{16}$ " long
- Weight: 1.2 lbs. maximum

**GG56 MPA** (Miniature Pendulous Accelerometer) designed as a companion unit for the MIG series of gyros, offers the advantage of few moving parts, high reliability, and a life expectancy of 10,000 hours. Special features include a multiple pole-moving iron pickoff with a permanent magnet-moving coil torquing element. Honeywell's fully transistorized EG135 pre-amplifier and EG134 amplifier-demodulator, specifically designed for use with the GG56, are also readily available to provide the user with a complete unit. Write to Aero Division for Bulletin GG56.



- Threshold: Less than  $1 \times 10^{-5}$  G
- Proportional Linearity Error: 0.05 % to 1 G; 0.10 % to 10 G
- Shock and Vibration: Will withstand shock loads over 100 G and vibration over 20 G
- Size: GG56C — 1.76" diameter, 1.8" long  
GG56D — 2" diameter, 1.8" long  
EG134 — 2.5" square, 3" long  
EG135 — 1.5" long, 1.1" wide, .85" high
- Weight: GG56 — 0.4 lbs, EG134 — 1.0 lbs, EG135 — 0.14 lbs.

For information on how the Military Products Group can best serve your needs, contact the Regional office nearest you.

### Military Products Group

#### Regional Offices

##### ALBUQUERQUE, NEW MEXICO

2502 Garfield Avenue S.E.  
Phone: CHapel 7-0276

##### BOSTON, MASSACHUSETTS

1230 Soldiers Field Road  
Phone: ALgonquin 4-8730

##### DAYTON, OHIO

1441 Milburn Avenue  
Phone: BALdwin 6-1492

##### DENVER, COLORADO

1600 West 13th Avenue  
Phone: AComa 2-4866

##### DETROIT, MICHIGAN

Box 3901, Strathmoor Station  
Phone: TExas 4-6020

##### FORT WORTH, TEXAS

Suite 10, McKeever Building  
2509 West Berry Street  
Phone: WALnut 7-7080

##### HUNTSVILLE, ALABAMA

6811 Chadwell Road  
Phone: JE 9-1305

##### LOS ANGELES, CALIFORNIA

6620 Telegraph Road  
Phone: RAymond 3-6611

##### NEW YORK, NEW YORK

24-30 Skillman Avenue  
Long Island City  
Phone: EXeter 2-4300

##### ST. LOUIS, MISSOURI

4354 Olive Street  
Phone: JEFFerson 1-5100

##### ST. PETERSBURG, FLORIDA

13350 U.S. Highway 19  
Phone: HEMlock 5-1151

##### SAN DIEGO, CALIFORNIA

2153 Moore Street  
Phone: CYprus 8-9908

##### SAN FRANCISCO, CALIFORNIA

949 Main Street, Santa Clara  
Phone: CHerry 3-4217

##### SEATTLE, WASHINGTON

401 Pontius Avenue N.  
Phone: MUTual 2-5610

##### UNION, NEW JERSEY

Box 161  
Phone: MURdock 8-9000

##### WASHINGTON, D. C.

4926 Wisconsin Avenue N.W.  
Phone: EMerson 2-4480

##### WICHITA, KANSAS

P. O. Box 305  
2801 South Madison Street  
Phone: AMherst 7-5304



**CUSTOM GYROS** Data for all units shown in this folder are nominal. Variations in specifications can be made to suit the application. Honeywell also manufactures instruments designed by others.

# Honeywell

**Military Products Group**

14th AC

Confer  
Machiner  
stitute of  
nical pap  
analysis  
ming, lar  
devices,  
Chairman  
Verzuh,  
Mass.

Engineer  
Septembe

To be  
West Co  
"More Ef  
Engineer  
sion will  
Angeles,  
make the  
ability, w  
how to  
further i  
will mee  
Square, I  
"Commun  
in Com  
Man," "H  
Scientists  
Symposia  
Corporat  
N.J.

4th Ann  
Non-Line  
Sept. 23-

To be  
will be h  
D.C. The  
sions dev  
tion of:  
urating c  
semicond  
(3) magn  
and digit

October  
1960 IRE  
Waldorf-A  
New York  
including  
500-word  
paper, na  
Chairman  
The Insti  
St., New

◀ CIRCLE  
THROU

#### 14th ACM National Conference, September 1-3

Conference of the Association of Computing Machinery will be held at the Massachusetts Institute of Technology, Cambridge, Mass. Technical papers to be presented will cover numerical analysis, data processing, automatic programming, language translation, digital and analog devices, and various applications of computers. Chairman of Local Arrangements is: Frank M. Verzuh, Computation Center, MIT, Cambridge, Mass.

#### Engineering Writing and Speech Symposia, September 17-18

To be held simultaneously on the East and West Coast, the IRE Symposia will be devoted to "More Effective Communication of Scientific and Engineering Information." The West Coast session will be held at the Ambassador Hotel, Los Angeles, Calif., and will feature motivations that make the engineer want to improve his writing ability, what he can do to improve himself and how to go about it, and educational steps for further improvement. The East Coast session will meet at the Sheraton-Plaza Hotel, Copley Square, Boston, Mass. Four sessions will cover: "Communication in Modern Society," "Problems in Communications Facing the Professional Man," "How To-Do-It Topics for Engineers and Scientists," and "Writing and Editing." National Symposia Chairman: T. T. Patterson, Jr., Radio Corporation of America, Bldg. 13-2, Camden, N.J.

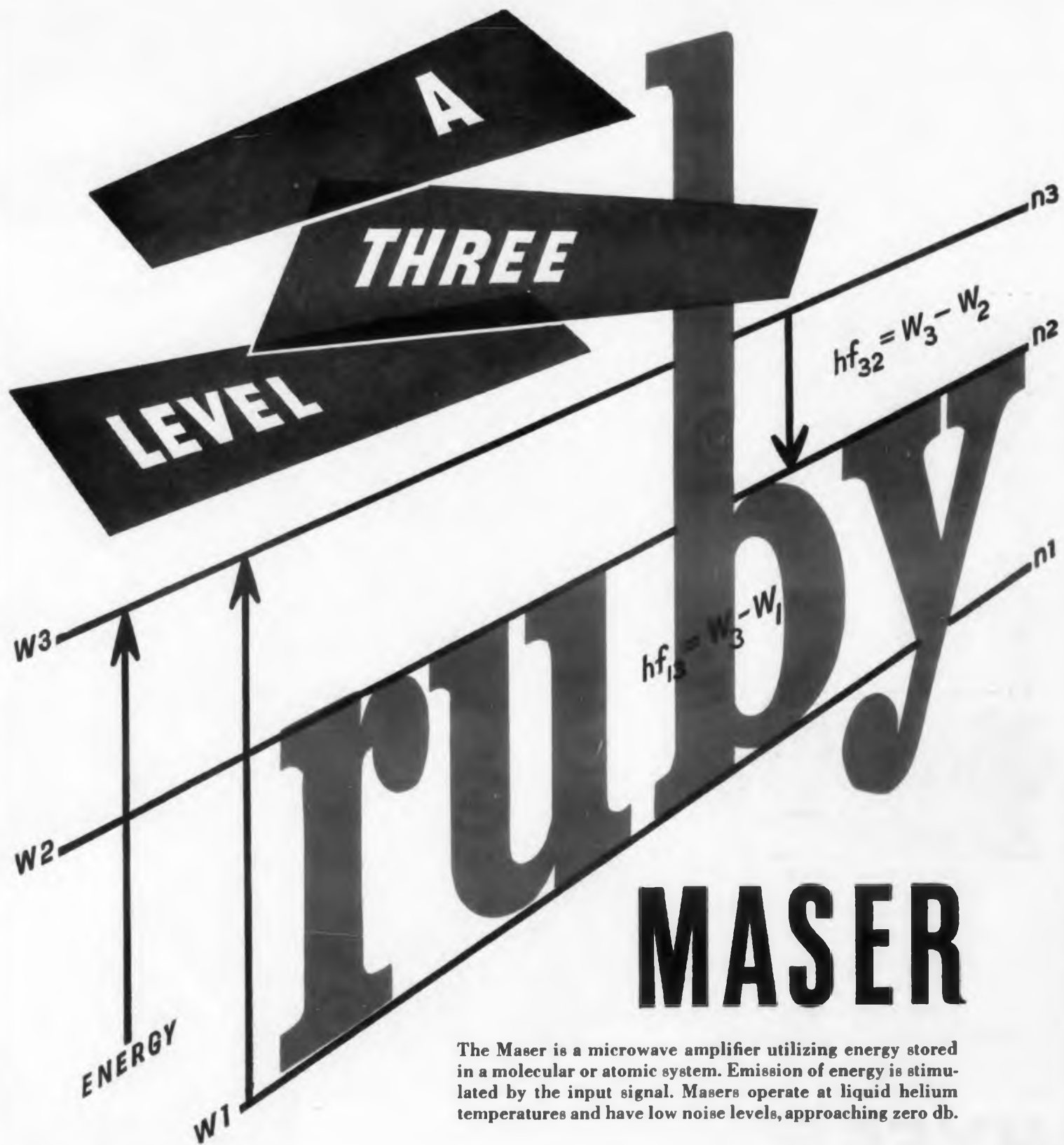
#### 4th Annual Special Technical Conference on Non-Linear Magnetics and Magnetic Amplifiers, Sept. 23-25.

To be sponsored by the AIEE and IRE and will be held at the Shoreham Hotel, Washington, D.C. The technical program will consist of sessions devoted to the theory, design, and application of: (1) magnetic amplifiers and similar saturating core devices, (2) magnetic amplifiers and semiconductor devices in circuit combinations, (3) magnetic components for switching circuits and digital computers.

#### Paper Deadlines

October 23: Deadline date for papers for the 1960 IRE Convention to be held March 21-24, Waldorf-Astoria Hotel and New York Coliseum, New York. Send a 100-word abstract in triplicate, including title of paper, name and address, and a 500-word summary in triplicate, including title of paper, name and address to: *Gordon K. Teal, Chairman, 1960 Technical Program Committee, The Institute of Radio Engineers, Inc., 1 E. 79 St., New York 21, N.Y.*

◀ CIRCLE NOS. 810 THROUGH 813 FOR TYPE LA-500 THROUGH GG56 MPA ON READER-SERVICE CARD



The Maser is a microwave amplifier utilizing energy stored in a molecular or atomic system. Emission of energy is stimulated by the input signal. Masers operate at liquid helium temperatures and have low noise levels, approaching zero db.

Recently, a university research laboratory† used LINDE single crystal synthetic ruby ( $Al_2O_3$  with  $Cr_2O_3$  additive) in a three-level solid state Maser. The ruby crystal was placed in the Maser's tuned cavity and a magnetic field of 4200 gauss was applied. To bring electrons from a ground state into a permissible higher energy level, a pumping frequency of 24 kMc was used and the Maser amplified signals at 9.3 kMc.

LINDE supplies other crystals, including rutile, spinel, and sapphire. ( $Al_2O_3$ ). Sapphire is used in infrared optical sys-

tems, windows for higher power microwave tubes, spacers and supports in vacuum tubes, radiation pipes. It has strength at elevated temperatures, melts at  $2040^\circ C.$ , is hard, inert, non-porous, and can be sealed to metals and glasses. Sapphire is available in the shape of domes, windows to  $4\frac{1}{2}$  inches in diameter, rods and special configurations.

For more information, write Crystal Products Department ED-82, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N.Y.

†Maser Action in Ruby, by G. Makhov, C. Kikuchi, J. Lambe, and R. W. Terhune. "Physical Review," Vol. 109, No. 4, p. 1399, Feb. 15, 1958.

"Linde" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

**Linde** **UNION CARBIDE**

CIRCLE 595 ON READER-SERVICE CARD

# CRIMP

at bench...or at equipment

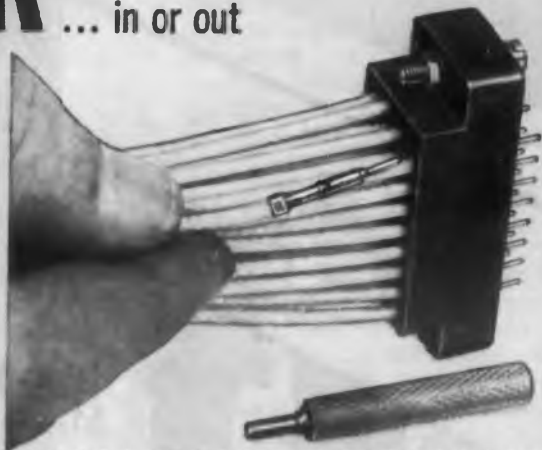


Precision hand, pneumatic, or automatic tooling guarantees uniform and complete crimp for each connection—a measurable quality control—at a high speed production rate.

# SNAP-LOCK

... in or out

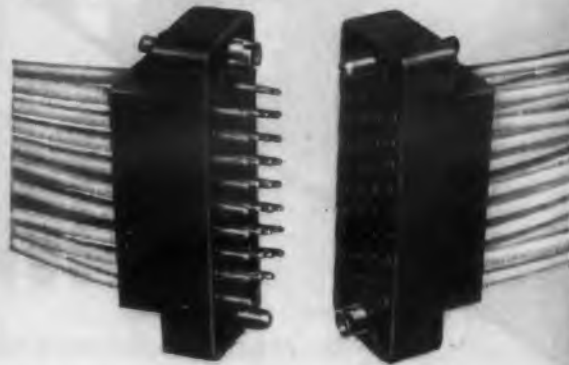
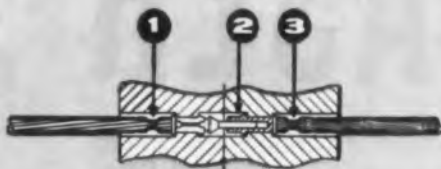
Pins and sockets are easily and quickly snap-locked into plugs and receptacles. They may be removed with a simple extraction tool for circuit changes or checks.



# CONNECT

... only 3 points of contact

The HYFEN method provides the minimum number of contacts—3—thereby reducing reliability problems. Exceeds the requirements of MIL-C-5015C and MIL-C-8384A.



## HYFEN<sup>®</sup> connectors

with crimp-type snap-locked contacts

BURNDY's HYFEN method, already widely accepted in the industry, speeds the wiring of electronic harnesses and systems, and achieves greater dependability and versatility than has heretofore been possible. Crimp-type connections eliminate time-consuming solder operations and the disadvantages in the use of solder.

For complete information, write: OMATON DIVISION

# BURNDY

Norwalk, Connect.

In Europe: Antwerp, Belgium

Toronto, Canada

3324-3326

## ACCEPTED!

Hyfen Variations



ME rack and panel HYFEN connector. 8 or 26 place configuration. One-piece shell and one-piece block. Also available for coaxial or shielded cable.



Feed-thru modular design multiple insert connector. 35 contact inserts can be removed from frame for easy contact insertion or removal. 5 or 8 insert frames available.

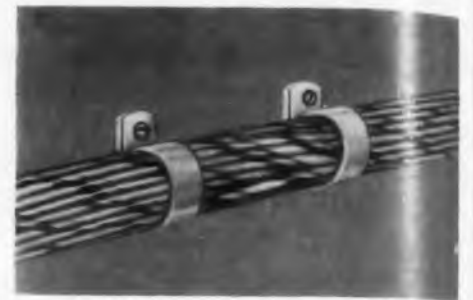


Printed circuit connector in either 31 or 45 place configuration. Accommodates single wire or combinations of wire sizes.

HYFEN types illustrated are typical of those already supplied to the industry by BURNDY. HYFEN connectors are engineered to meet specific requirements. For other types or sizes, contact BURNDY.

(Advertisement)

## NYLOCLIP



NYLOCLIP<sup>®</sup>, a product of the Burndy Corporation's Omaton Division, is a pre-formed molded nylon cable hanger which has been time-proven and widely accepted by industry.

NYLOCLIPS weigh only 30% as much as comparable metal clips and yet have high tensile strength. In addition to their light weight, the cable hangers are temperature resistant from -60 F to 250 F for sustained periods and they are unaffected by oils, gasoline, alcohol, or hydraulic fluids, including non-flammable types.

NYLOCLIPS are available in seventeen standard diameter sizes, accommodating single cables or groups of cables from 1/8" to over 2". Their flexibility makes them easy to install because they are pre-formed in an almost closed position allowing them to be snapped onto cable and stay in place until mounted. Cable insulation is protected by rounded edges and matte-finish on inside surfaces prevent slippage of cable under vibration, without injuring insulation. Inside serrations provide positive alignment when screw is tightened.

BURNDY type HP-N NYLOCLIPS are self-insulating and thus cannot cause grounds or shorts, and are free from hysteresis losses. One, two, and three hole tongue types give maximum efficient diameter range with each size cable hanger.

Burndy Corporation,  
Norwalk, Connect.

CIRCLE 26 ON READER-SERVICE CARD

← CIRCLE 27 ON READER-SERVICE CARD

# EDITORIAL

## Ideas Pay Off

Machines can make money. They can get out a product faster than can human hands. They can turn out a more uniform product. They can handle objects that are too large, or too small, or that require superhuman accuracy.

Nobody is surprised to learn that a hundred-thousand dollar machine may have tripled a company's production and paid for itself in a year or two. And everybody knows that an automatic tester may test twenty times as many pieces and test them better than can a man.

So everybody looks to the fancier, costlier machine to up production, to eliminate human error, to make an end product more reliable—or cheaper.

But there's another, even better source of improved production—ideas, even "small" ideas.

- The fellow who figures out how to combine three operations in two can make an enormous contribution.
- The one who realizes that a certain part can be die cast, rather than machined, can save money on large production lots.
- The "Rube Goldberg" who modifies an inexpensive kitchen gadget to obviate a costly machine can take some of the bite out of the cost of short-run production.

In the last analysis, almost every one of us is involved in production. Even the basic research engineer, investigating the wild blue yonder, is working towards a tangible product. And each of us, at one time or another, has had an idea—an idea that makes a product more reliable, or less expensive—an idea that saves production time or makes a machine easier to operate—an idea that takes the drudgery or danger out of some manual operation.

These ideas, the building blocks of American industry, will find their place in ELECTRONIC DESIGN's forthcoming "Production" report.

We'd like to include your ideas for better production of electronic equipment. Write to us, describing (with pictures, if possible) the production short-cuts that your company is willing to share with the industry. Send us your favorite working or workable production ideas. We'll publish the best we get and give credit where credit is due.

*George H. Rostky*

## NEW TOOL FOR THE DESIGN ENGINEER



### A BREAK-THROUGH IN

1. Control system design.
2. Network synthesis.
3. Transient and frequency analysis.

An ingenious computer using powerful Laplace transform methods to simplify complex dynamic system problems. System performance can be quickly and graphically demonstrated by plotting its characteristic equation on the ESIIAC. The ease and speed with which the ESIIAC determines and plots these quantities makes possible rapid analysis and synthesis of system parameters and ready comparison of various proposed system changes.

see it in action at booth **1808-1810**

**esi**

**WESCON**

SEND FOR DESCRIPTIVE LITERATURE

**ELECTRO-MEASUREMENTS, INC.**

7524 S. W. Macadam Avenue • Portland 19, Oregon

CIRCLE 28 ON READER-SERVICE CARD

# How To Generate Time Intervals With Transistors and Cores

Roland L. Van Allen

Magnetics, Inc.  
Butler, Pa.

Roland Van Allen has been manager of a Circuit Research Group at Magnetics, Inc. since 1957. He has spent twelve years with the Naval Research Lab, where he helped design the telemetering system for Vanguard and worked on Project Greenhouse, the 1951 atom bomb tests at Eniwetok.

He wrote this article to show the many ways combined magnetic-transistor circuits can solve problems that are difficult for conventional transistor circuits.

**S**QUARE LOOP magnetic cores can be used to establish timing intervals. With their extreme nonlinear properties, their action can be made more positive than that of conventional RC circuits.

While core flux is changing, a voltage is induced in all windings and the current is low. Upon saturation of the core, the voltage drops rapidly and the current increases, giving an impulse to terminate the timing interval.

The application of transistors, with their characteristic low impedance, has, in many cases, made RC networks difficult to use. At the same time, this characteristic has improved the feasibility of using magnetic circuits.

Since the highest precision with magnetic timing devices is achieved when they are powered from a low impedance voltage source, the combined transistor-magnetic time interval generator offers another advantage—circuit simplicity. This comes about because appreciable power can be delivered directly from the timing circuit without additional amplification.

## Equal and Unequal Intervals

Among the first to recognize the value of combined transistor-magnetic circuits was Royer.<sup>1</sup> His basic circuit, shown in Fig. 1, produces a period of oscillation that is inversely proportional to the applied voltage.

This circuit is an excellent example of using square loop cores to produce a constant volt-second interval. When the total volt-seconds is a constant, changes in applied voltage produce an inverse change in time. The circuit's output is a symmetrical square wave.

Rochelle,<sup>2</sup> has shown how to use the same simple circuit to produce unequal time intervals by adding resistance in series with each transistor switch. The total change in flux is the same on each half cycle.

An asymmetrical square wave is obtained because the rate of flux change is not the same on alternate half cycles. When magnetizing current and load current pass through unequal resistance in the two collector circuits, unequal voltages are applied to the respective windings, causing one half-cycle to be longer than the other.

## Single or Repetitive Pulses

Based on this principle, a novel telemetering circuit was developed, in which pulse width modulation was accomplished using variable voltages and resistances. This circuit has proven very valuable as a repetitive pulse forming device in telemetry applications.

The same concept can be applied to single non-repetitive pulses. Fig. 2 resembles one half of the Royer circuit. The transistor is normally biased off, and a negative trigger pulse is applied to turn it on. The voltage induced in the 1000 turn base winding clamps the transistor into conduction by positive feedback.

This provides an output pulse as long as there

is flux change in the core. When the core reaches saturation, the transistor switch opens, and the core is reset through a current limiting resistor.

The time interval of the pulse is determined by the volt-second capacity of the core and the applied voltage. To repeat the pulse, the flux must be reset in the core through the 0-50 K current limiting resistor.

The output can be obtained from the collector or from a secondary winding on the core. As long as the core is supplied from a low impedance, considerable power can be delivered during the pulse interval, as with the Royer circuit.

## Effects of Temperature and Voltage

Certain factors must be understood if this circuit is to be used to generate pulses of constant duration. Variation in the supply voltage produces inverse variations in time. Hence, it is important to maintain a stable supply voltage.

The total flux change in the core, which is considered a constant, actually varies slightly with temperature and has a negative temperature coefficient of about 0.07 per cent per deg C. To reproduce pulse intervals with high precision, it is necessary to compensate for temperature variations in the core.

Zener diodes are available which have a negative coefficient very similar to that of the core material. Since it is necessary to regulate the supply voltage to insure constant time interval pulses, a Zener diode regulator can serve the dual function of regulating the supply voltage and compensating for the temperature coefficient of the core material.

With increased temperature, the total flux in the core decreases. This tends to shorten the time interval. If the supply is regulated with a negative coefficient Zener, the voltage to the winding will decrease with increased temperature, thus

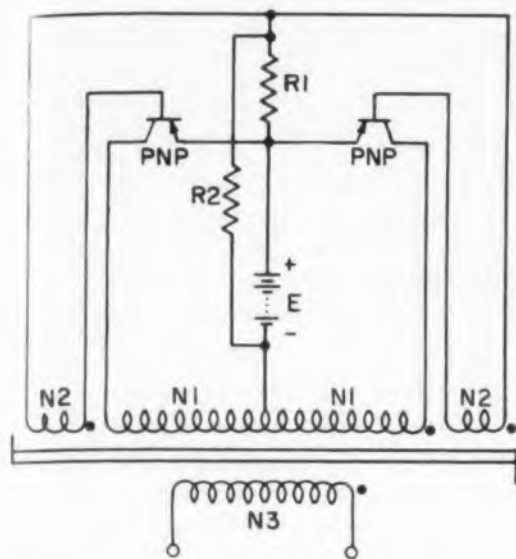


Fig. 1. The basic Royer circuit produces an oscillation period inversely proportional to applied voltage.

tending to maintain the time interval constant.

If the supply voltage is regulated, and Zener diodes are not required, another means is available for temperature compensating the core. If an appropriate negative coefficient resistor is shunted across the 0-50 K resistor which provides the resetting current to the core, when the temperature is increased, the resetting current is increased, thus raising the flux density and correcting for the core's negative temperature coefficient.

#### Effect of Reset Current

If the reference point, or beginning of the next pulse interval, changes, this will have a direct effect on the duration of the generated pulse. Hence, it is necessary to insure constant reset current if the pulse interval is to remain constant.

Should a variable pulse width be desired, and should it not be practical to vary the supply voltage, a variable resistance (0-10 K) can be introduced in series with the windings and the transistor switch as shown in Fig. 2. When the resistance is increased, the voltage to the core is decreased and the pulse duration increased.

In all square loop core materials, magnetizing current varies as a function of the volts per turn applied to the core. It is this change in magnetizing current which produces a nonlinearity in the plot of time vs resistance. The linearity is improved with increased loading since the effects of changes in magnetizing current are swamped out.

In the circuit of Fig. 2, the output pulse is delivered to the load through a diode to prevent the reset pulse from appearing at the load, and also to prevent the core from being loaded during reset, thus conserving reset current.

This circuit can generate very precise and highly reproducible pulses, especially when the core is powered from a voltage source. For ex-

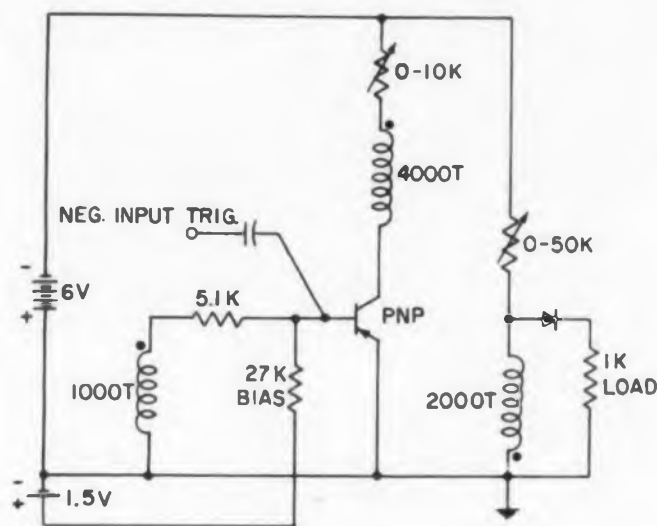


Fig. 2. Single transistor pulse former with constant current reset.

ample, when the variable resistance (0-10 K) is 1000 ohms or less, the duration of the pulse varies less than one part in 10,000 from pulse to pulse with constant supply voltage and temperature.

However, when the variable resistance is increased to approximately 10 K, causing the pulse width to increase by a factor of 10, the repeatability is impaired. The core is no longer driven from a low impedance voltage source and the repeatability of successive pulses is about one part in a thousand.

While the series resistance provides a convenient means of varying pulse width, the added resistance raises the impedance of the supply voltage and slightly affects the repeatability of the pulse.

#### Simple Pulse Formers

The simple circuit may be used as a pulse forming network in a variety of ways. For example, when a mechanical switch is closed, contact chatter usually results. It may persist for many milliseconds depending on the characteristics of the switch. Usually, a capacitor across the switch eliminates the chatter.

However, the capacitor will spoil the performance if the switch must activate a gate which requires a very square pulse.

If the impulse from the switch is capacitively coupled to the base of the transistor, the transistor is clamped on during the time the switch contacts bounce, thus giving an output pulse which does not contain switch chatter.

#### One Cycle Multivibrators

Another variation of this circuit is one which operates as a one cycle multivibrator or as a delayed pulse generator. As a one cycle multi, it employs the same principle as the Royer circuit, with the added feature of an inhibitor to allow

only one output cycle. This is not a one shot multi, which delivers a single output pulse. It delivers both a positive and negative pulse upon application of a trigger.

Fig. 3 shows the circuit with two transistors operating regeneratively and a third transistor functioning as an inhibitor. This circuit delivers first a negative, then a positive pulse. The duration of either polarity pulse can be changed essentially independently of the other.

The negative pulse is obtained with a positive knee-to-knee flux change. It is followed immediately by a positive pulse which results from a negative knee-to-knee flux change. The negative pulse is fed through a rectifier to the base of the inhibiting npn transistor, reversing the polarity of its bias, which causes it to turn off.

The 1  $\mu$ f capacitor stores this negative charge long enough to maintain the base circuit of the pnp effectively open circuited till the inductive kickback from the negative pulse has collapsed. This prevents sustained oscillation by the two pnp transistors which normally receive positive feedback from the core.

#### Effects of Pulse Stretching

If the RC time constant is made short, the circuit may be fired again after a brief delay. This circuit's reproducibility, with near-zero values of R1 and R2, is better than one part in 10,000. However, when these resistors are increased to

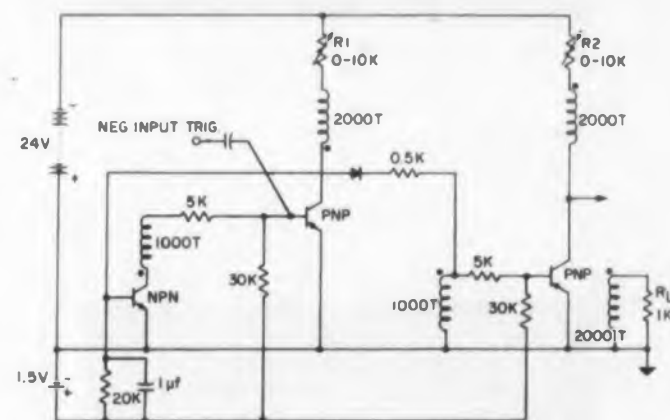
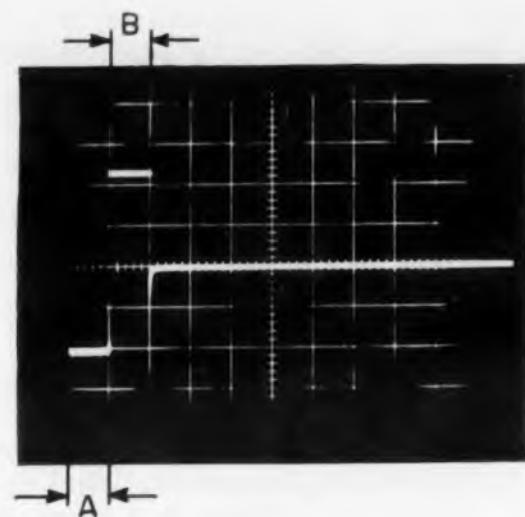


Fig. 3. A positive and negative one-cycle pulse former.

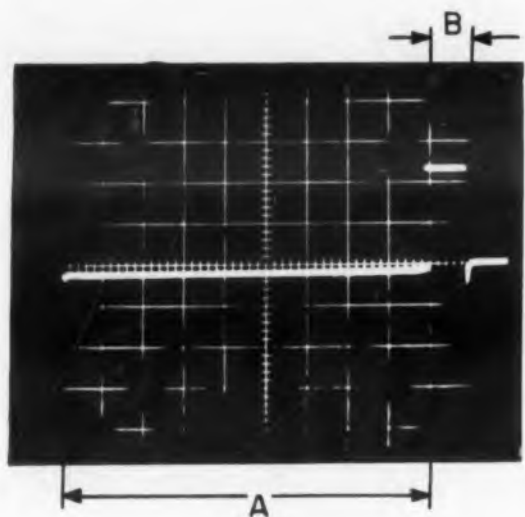
greater than 1 K each, to stretch the pulse time of the positive and negative pulses, the reliability of timing decreases to about one part in a thousand.

If only one pulse of a complete cycle is stretched and the other pulse is left short, both pulse intervals will be reproducible to about one part in 10,000. This suggests that a reference is established at one knee of the hysteresis loop by the short pulse which drives the core well into saturation once each cycle, permitting the high degree of repeatability.

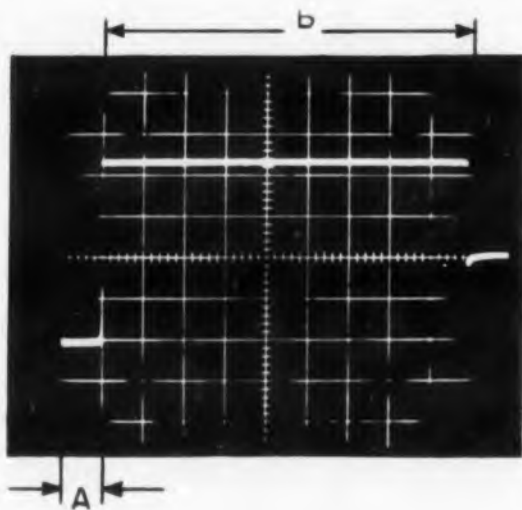
In Fig. 3, the preferred output is shown taken from one of the collectors since full supply volt-



A.  $R_1 = R_2 = 0$



B.  $R_1 = 7.7 \text{ K}, R_2 = 0$



C.  $R_1 = 0, R_2 = 7.7 \text{ K}$

**Fig. 4.** The two output waveforms for the one-cycle pulse former of Fig. 3. Scope calibration is 10 v/cm, 10 msec/cm.

age is switched by the transistor, giving a constant amplitude rectangular pulse.

If a voltage output is taken from a secondary winding, the amplitude of the output pulse varies in proportion to the winding voltage.

When the variable resistance values are high, most of the voltage is dropped by magnetizing current flowing through the resistance, leaving a very small voltage across the winding for output across load resistor  $R_L$ .

Load resistor  $R_L$  is essential to the proper operation of the circuit; it serves to damp high frequency oscillation produced by winding inductance and capacitance. Fig. 4 shows typical pulse waveforms measured at the output for several values of resistance in each branch of the circuit.

### Cross Talk

The circuit of Fig. 3 generates one full cycle of square wave upon initiation of a negative trigger. The duration of each half cycle can be changed independently by varying the appropriate resistor. However, there is a certain amount of cross talk from one half cycle to the other.

For example, if the negative pulse A and positive pulse B are each ten milliseconds long, and the resistance is changed in one branch to vary the positive pulse, stretching it to 100 milliseconds, the negative pulse will decrease. The

amount of decrease in A for a ten to one change in B may be as much as two per cent.

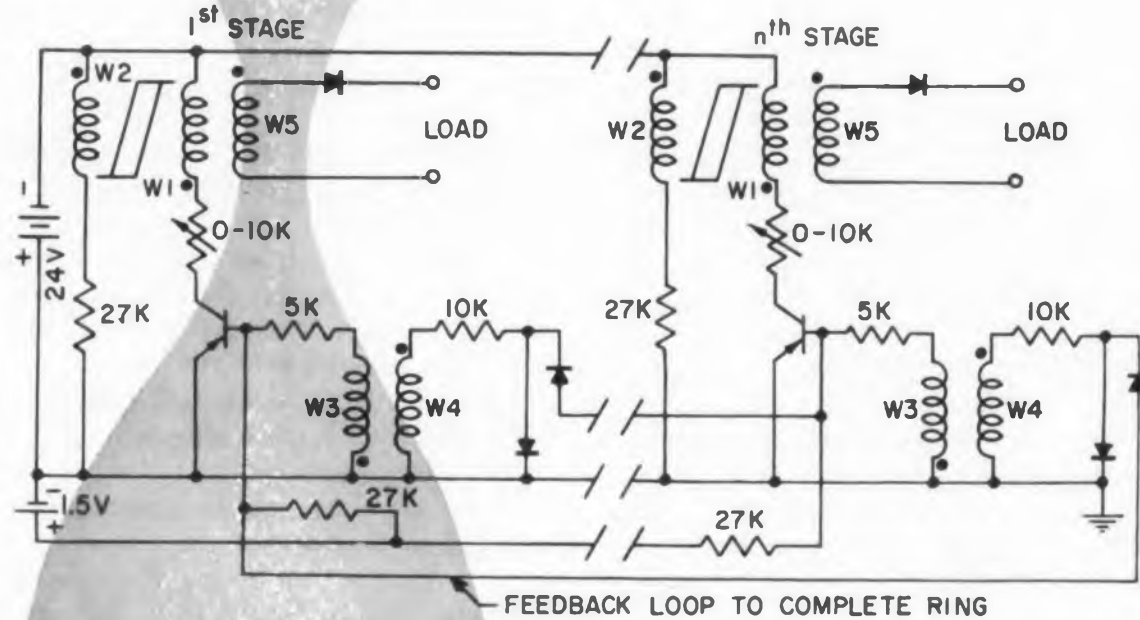
The stretching of pulse B by introduction of a high resistance, prohibits a high degree of saturation on this half cycle, since the current is limited by the resistance. As a result, the flux level is lower for the returning half cycle when A is switched. Hence, a shorter duration results in A.

It was believed that this was completely a function of reduced magnetizing force applied during the B interval. It was found later that this is not entirely the problem. When pulse B is made long by introducing resistance, the winding voltage is reduced, and the induced voltage to the base of the transistor switching pulse B is reduced.

Thus, when the core approaches saturation for the long pulse, the transistor loses positive feedback prematurely and switches early. When the next interval A follows, the total flux excursion of the A interval is lower.

This is a combination of two effects: reduced mmf and premature cutoff. This problem of cross talk between positive and negative pulses only follows changes made in the pulse duration. After a given positive and negative pulse interval has been established, the reproducibility is as good as ever.

Pulse duration varies, not only as a function of resistance, but also, to a small extent, as a function of temperature.



**Fig. 5.** Solid state commutator or ring counter showing the first and last stage. Windings 1, 2, and 5 have 2000 turns each, W3 has 1000, W4 has 500.



The one cycle pulse circuit of Fig. 3 has advantages over the circuit of Fig. 2 in that it is more efficient, drawing no standby resetting current. It can be loaded more readily and, in general, has a higher degree of reproducibility.

#### One Cycle Pulse Circuit Applications

As a delayed pulse generator, it can provide a variable time delay followed by a pulse of variable width. The positive and negative single cycle pulse have been used to clear and reset a memory core. It has also been used to provide constant volt-second pulses to multilevel magnetic memory storage cores.<sup>3,4</sup>

The high degree of repeatability of such circuits suggests their use in tachometer and counting circuits which require a sampling gate to determine events per unit time.

The accuracy of the magnetic time gate does not compare with that of a crystal oscillator whose frequency has been divided down to establish a long period gate. But it does eliminate a number of components and offers a time gate accurate to five places.

These circuits have been operated in the range from a few microseconds to a few tenths of a second using different size tape wound cores. Lowrance<sup>5</sup> has used magnetic cores and transistors to produce time delays of several seconds.

#### Solid State Commutators

By connecting several pulse forming circuits in series, such that one triggers the next, a train of pulses can be generated, producing commutated time intervals.

A method of pulse width encoding using magnetic cores and transistors was reported by Lucke,<sup>6</sup> in which a number of circuits similar to that shown in Fig. 2 were used.

Pulse width modulation of each channel was obtained by varying the voltage reset to each individual core. This provided an amplitude to time converter capable of handling a number of different voltage sources in a telemetering system.

In this particular application, the time sequence was triggered by a clock pulse and ran through a series of pulsing circuits. Upon command of the clock pulse, the time sequence was repeated. Pulse width modulation of each pulse was accomplished by individual voltage sources from each respective channel of information.

#### Ring Modulators

Other circuits have been devised in which there is a series of pulse circuits operating sequentially in a closed loop such that the train of pulses forms a ring. D. G. Scorgie proposed such a circuit in which the pulses were width modulated

by individual control voltages to each pulse former.

When variable pulse width circuits are closed in a ring in this manner, the frame time, or time around the ring for each circuit to be commutated, also becomes a variable. This may or may not be a disadvantage in telemetering.

However, more information is contained per unit time than when the pulse width channels are steered by a clock pulse.

R. W. Rochelle<sup>2</sup> devised such a closed ring type of pulse width modulator which is used in earth satellite telemetry. In this particular circuit, commutation is accomplished using binary counters and a switching matrix.

Only a single core is used to form each individual pulse. The commutator is arranged so a number of transducers are alternately switched in or out of the pulse forming circuit, resulting in variable pulse width channels from a large number of transducers using only one core.

#### Ring Counters

A ring counter can be constructed using the simple circuit of Fig. 2 and a few coupling diodes. Such a circuit, shown in Fig. 5, may be connected in a closed loop. The stability of each pulse may be as good as that indicated for the single pulse forming circuit.

When connected in a closed ring, there should be enough channels (three or more) to allow time for complete reset of any individual core before it is pulsed on again.

In this circuit, each pulse is generated by reversal of flux in a core, and each core is individually reset. Hence, variation in the pulse time of an individual core cannot affect any adjacent pulse. In other words, there is no cross talk between channels. ■ ■

#### References

1. G. H. Royer, "A Switching Transistor Dc to Ac Converter Having an Output Frequency Proportional to the Dc Input Voltage," *AIEE Transactions*, Part I, Vol. 74, pp 322-325.
2. R. W. Rochelle, "Earth Satellite Telemetry Coding System," *Electrical Engineering*, Vol. 76, No. 12, Dec. 1957, pp 1962-1965.
3. D. H. Schaefer, "Magnetic Core Event Counter for Earth Satellite Memory," *Electrical Engineering*, Vol. 77, No. 1, Jan. 1958, pp 52-56.
4. C. B. House and R. L. Van Allen, "Commutation and Non-destructive Readout of Magnetic Memory Cores in Earth Satellites," *National Telemetering Conference Record*, 1957, pp I-A-2-I and following.
5. J. L. Lowrance, "Magnetic Saturable-Core Timing Device," *Communications and Electronics*, July 1958, pp 393-396.
6. W. H. Lucke, "A Solid State Commutating and Pulse Width Encoding Circuit," *Naval Research Laboratory Report No. 5082*, Washington, D. C.



## PROVIDES 100% RELIABILITY WITH ANY D-C INPUT VOLTAGE

- Inverters now developed with inputs up to 130 volts DC. Higher voltages available on request.
- Eliminates the most common cause of transistor failure
- Provides substantial reductions in size and weight
- Inverter unaffected by supply voltage transients. Will meet Mil-E-7894A.
- Eliminates noise and transient feedback into supply source.
- Eliminates need for input filter or transient eliminator.
- Lower cost results from simplified circuitry.

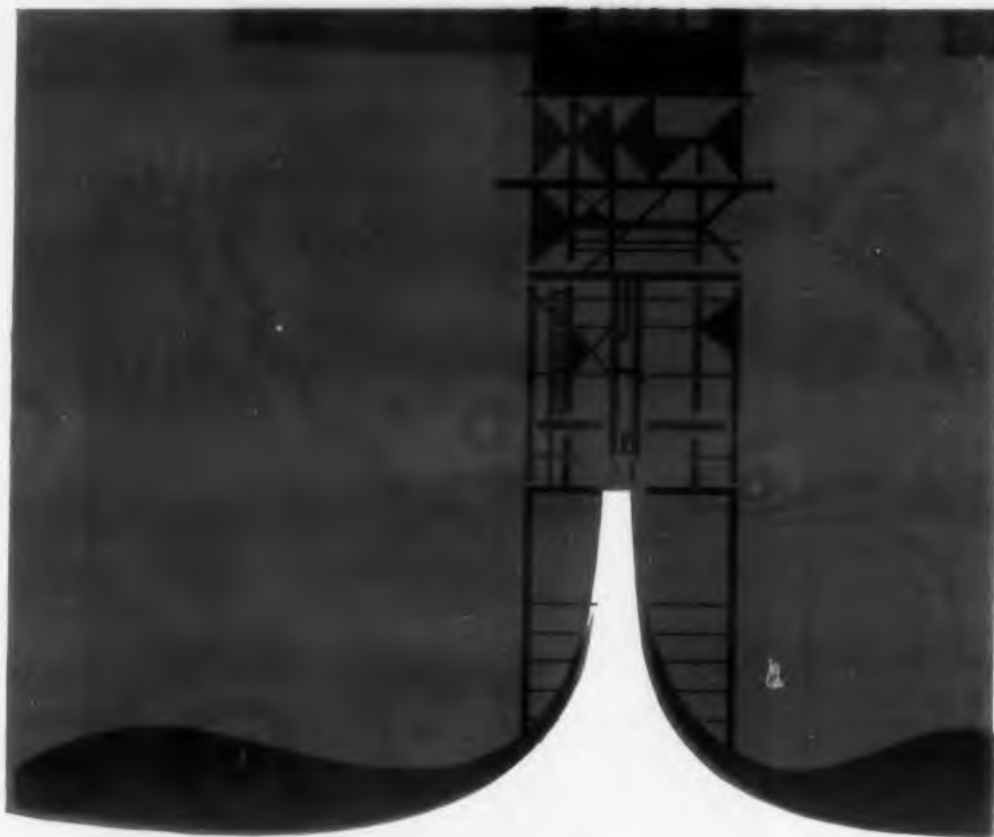
Write for information about the application of this exclusive technique to your high voltage input problems.



Specify POWER SOURCES  
BY  
POWER SOURCES, INC.

Burlington, Massachusetts

CIRCLE 29 ON READER-SERVICE CARD



## A NEW PRESSURE PICKUP

**PERFORMANCE: OUTSTANDING.** The Type 4-326 Pressure Pickup, capable of gage and absolute pressure measurement to 10,000 psi, represents CEC's finest achievement in strain-gage transducers. These sealed instruments provide stability, acoustic noise isolation, low acceleration response...for such applications as rocket test stands. An outstanding feature of the 4-326 is provision for adjustment of bridge balance, temperature compensation, and sensitivity external to the sealed strain-gage sensing element, allowing sensitivity and bridge unbalance to be set within  $\pm 1\%$ . The pickup operates without damage at temperatures from  $-320^\circ\text{F}$  to  $+300^\circ\text{F}$ , is rugged—usable in a 1000g environment. Write for Bulletin CEC 1620-X1.



Transducer Division **CEC**

CONSOLIDATED ELECTRODYNAMICS / 360 sierra madre villa, pasadena, california

FOR EMPLOYMENT OPPORTUNITIES WITH THIS PROGRESSIVE COMPANY, WRITE DIRECTOR OF PERSONNEL

CIRCLE 30 ON READER-SERVICE CARD

## DESIGN FORUM

# IR

## IR Cells Read Coded Films

In this high-speed code reading system, IR cells were chosen as detectors because of their extremely small size. Another unique feature of the system is the method of pulsing the polarizing voltages of the detector amplifiers, to coincide with the scanning rate.

**I**NFRARED detectors are used to read code dots on miniature filmed cards. Similar in operating theory to punched cards, this system is a photographic version of an electronic information retrieval system.

Coded information takes the form of black and white square dots reproduced

in an area about  $1 \times 1\frac{1}{2}$  in. Each film card can contain up to 2730 code bits when fully utilized.

Designed and developed by Eastman Kodak, Minicard utilizes Kodak's Ektrom detectors. These lead sulfide detectors are arranged in a mosaic design (Fig. 1) with 4 cells reading 44 lines of code in-

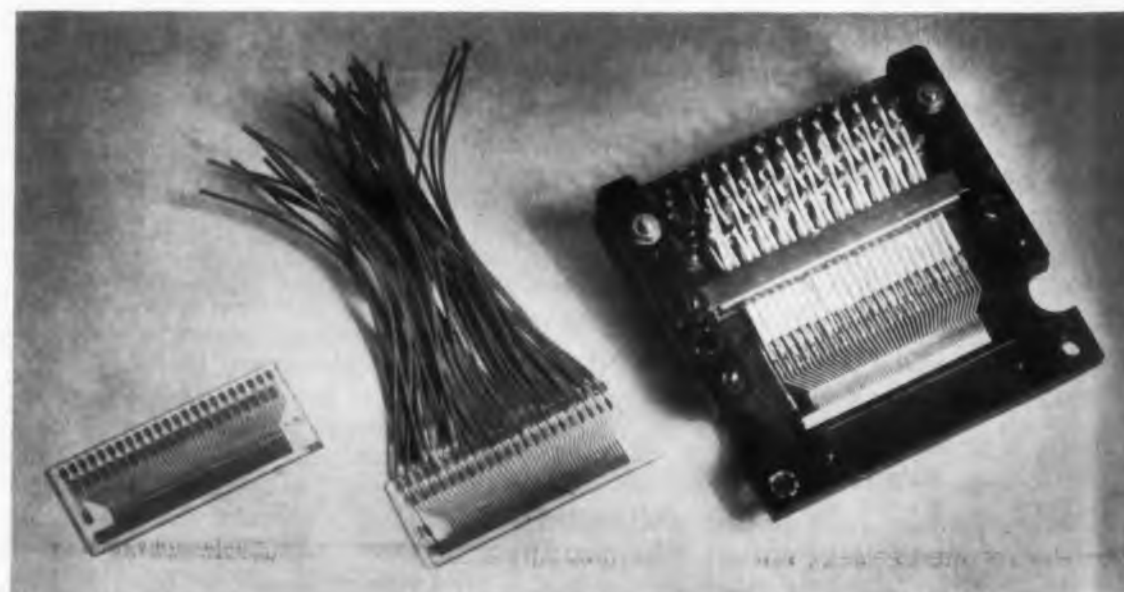


Fig. 1. Lead sulfide cells mounted on base, left, and successive steps, in their assembly for the Minicard scanner.

Fig. 2  
unit at



Fig. 3  
wavef

forma  
per m  
to infr  
in Mi  
visible  
it is j  
very s  
curacy  
Size  
cell is  
of the  
is cor  
half tl  
conne  
One  
with

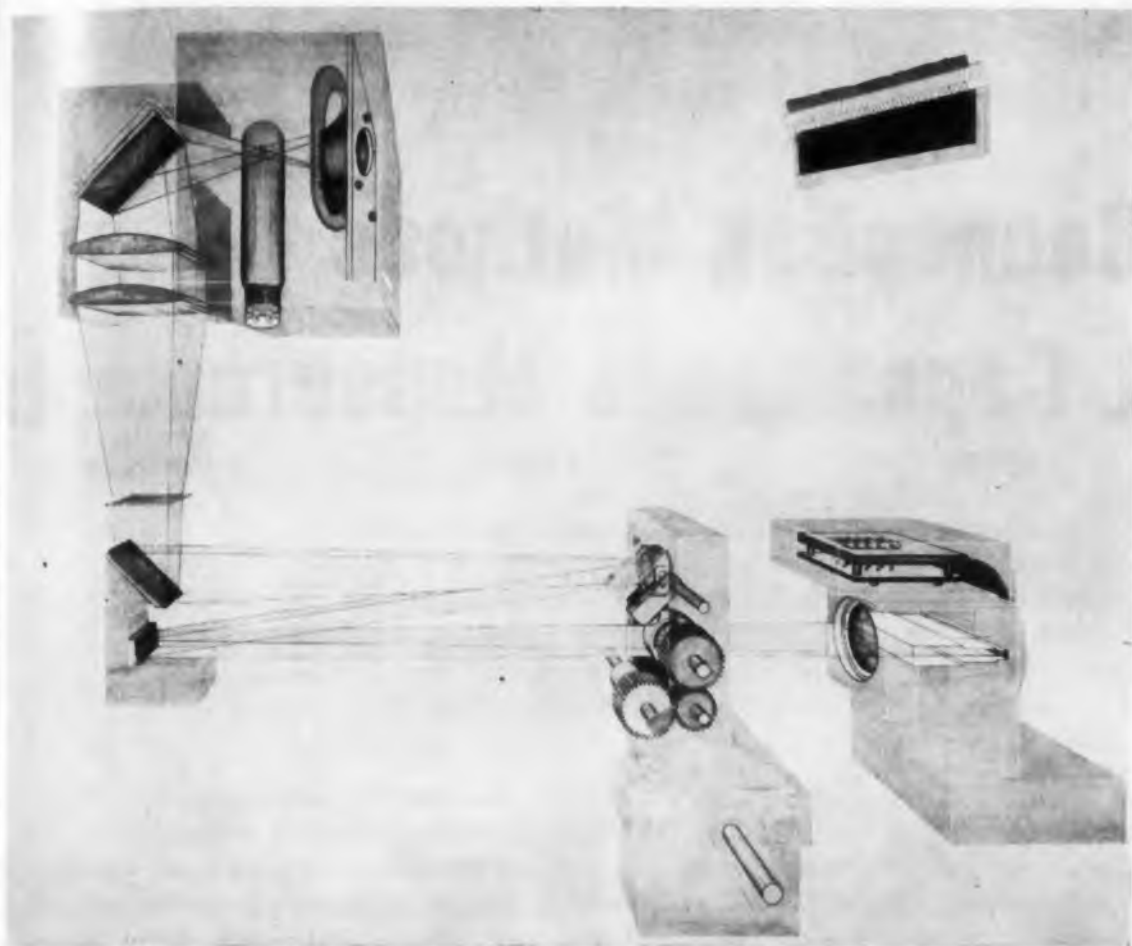


Fig. 2. Sketch of optical system of the Minicard code reader. IR cells are arranged in rows in the unit at the right.

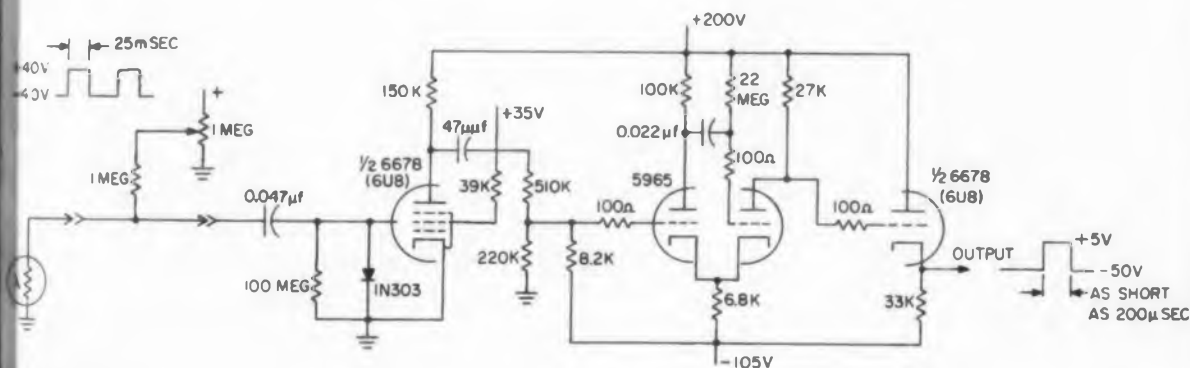


Fig. 3. Schematic of one of the IR lead sulfide detector amplifiers. Polarizing and output pulse waveforms are shown.

formation at the rate of 1000 film cards per minute. Although detectors sensitive to infrared are theoretically not necessary in Minicard machines (which could use visible light), they were selected because it is possible to produce them with the very small size and high dimensional accuracy required.

Size of each sensitive lead sulfide cell is 0.007 x 0.018-in. During scanning of the Minicard film record, the light spot is condensed optically until it is about half the size of the cell, Fig. 2. Amplifier connections are gold conductors.

One detector-amplifier (Fig. 3) is used with each lead-sulfide cell. Polarizing

voltage is pulsed to coincide with scanning of the rows of coded dots. Voltage pulses are 25 millisecond duration, 80 v peak to peak. Output consists of pulses of 55 v peak to peak with durations as short as 200  $\mu$ sec, depending upon the input signal.

Forty-four such amplifiers are used in each of the three major pieces of the Minicard system: the duplicator, selector and sorter. Magnavox Corp. has worked with Kodak in the development of some components of the system. The first complete Minicard system is in use by the Air Force at Rome Air Development Center, Rome, N.Y. ■ ■

# Mycons

Consistently  
Dependable  
metallized-dielectric  
capacitors

## MYCONS

TYPE TWMM—Metallized Mylar\*

TYPE MTWK—Metallized Mylar and Paper Film

### Specifications and Features

- Ratings from .01 mfd. to 12.0 mfd. Voltages of 200, 400, or 600 volts DC Working.
- Wide useful temperature characteristics within range of  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .
- Hermetically sealed in miniature tubular metal cases with metal-to-metal end-seals.
- Wire lead or solder lug terminals.
- Various bracket-mounting or threaded-neck mounting styles.

## New Metallized Mylar\* (Type TWMM) and Mylar-Paper (Type MTWK) Capacitors by Cornell-Dubilier.

Whether you specify miniature metallized capacitors for military or industrial electronic equipment—for critical power-supply filter circuits or bypass applications—Cornell-Dubilier's new MYCON metallized capacitors assure top performance and dependability. Backed by over 47 years of capacitor engineering and manufacturing leadership, MYCONS combine better high-temperature operation and better insulation resistance with low dissipation factor and fault count. Available in a wide choice of mounting styles, MYCONS meet the requirements of applicable military specifications. For complete specifications, write for Engineering Bulletins 190 and 185 to Cornell-Dubilier Electric Corp., 4144 Glencoe Avenue, Venice, California.

\*Du Pont Reg. T.M.

Consistently Dependable  
**CORNELL-DUBILIER**  
CAPACITORS

CIRCLE 31 ON READER-SERVICE CARD

John F. Hersh, Engineer  
General Radio Co.  
West Concord, Mass.

# How Connection Methods Affect Capacitance Measurements

**E**RRORS in low capacitance measurements can be traced to the way in which connections to the capacitors were made. Various connection methods used to measure the capacitance of two-terminal and three-terminal capacitors are described here.

Capacitance is determined by the geometrical configuration of the conductors and by the dielectric material (assumed here to have simple and constant characteristics). Only when one conductor completely surrounds the other is the capacitance simply defined by the form and nature of materials inside the capacitor. When terminals needed for use or measurement are provided, they add increments to the capacitance. These increments are affected by the nature and position of objects external to the capacitor which are seldom easy to define or control.

As an example of this, consider a typical two-terminal capacitor built as shown in Fig. 1. The capacitance has been arbitrarily broken into four components:  $C_0$ , between the multiple-plate capacitor and leads within the case;  $C_1$  between the binding posts;  $C_2$ , between the high terminal and the case, which is connected to the other terminal;  $C_3$ , between the high terminal and all objects outside the capacitor and its terminals. Typical of these components are:  $C_0 = 100$  pf (pf =  $\mu\mu\text{f}$ ),  $C_1 = 0.2$  pf;  $C_2 = 1.3$  pf;  $C_3 = 0.03$  pf.

The "free" capacitance (capacitance of the isolated capacitor with no connections to the terminals) of this unit is:  $C_0 + C_1 + C_2 = C_3$ . Since capacitance  $C_0$  is surrounded by the case, it is independent of the position of external objects. Capacitance  $C_1$  is influenced only by intrusions nearby or between the terminals. But  $C_3$  and  $C_2$  (to a lesser extent) are easily affected by more distant environments. Changes of 0.01 pf

or more can result from a slight position change.

More radical changes in these external capacitances are produced by connections made to the terminals. A wire connected to the high terminal, for example, obviously introduces new capacitance components between the wire and the capacitor parts. It also, not so obviously, reduces the "free" capacitance by as much as 0.1 pf by changing the distribution of field around the terminals. There is a similar reaction of the capacitor on the connections to make the capacitance of the leads, when connected to the capacitor, differ from that of the leads alone. The complexity of this mutual interaction makes it impractical to

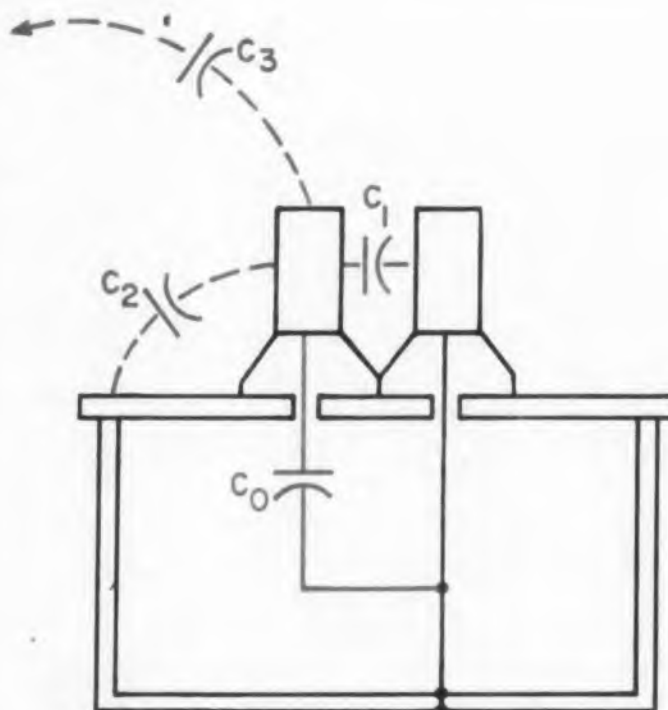


Fig. 1. Terminal capacitances at a two-terminal capacitor.

define the dividing line between capacitor and leads more precisely than  $\pm 1$  pf.

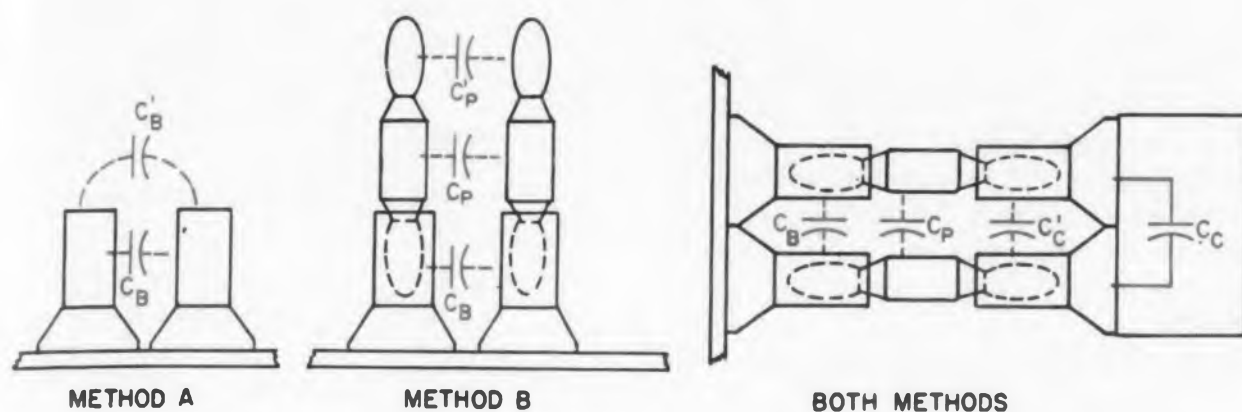
These difficulties suggest several possible methods to reduce or eliminate errors and uncertainties and get accurate measurements of very small capacitances. Three methods of calibration, for two-terminal capacitors, and their limitations in accuracy follow.

## Capacitance Added Method

Since capacitance of the unit depends on both environment of the unit and the connection method, their geometry has to be sufficiently defined before an accurate calibration can be made. One practical and highly accurate method is to calibrate in terms of the capacitance change at a pair of terminals when some change is made in the capacitor or its position. Two measurements are required to determine the capacitance change. Terminal conditions for both measurements must hence, be either invariant or precisely known.

When the capacitor has variable capacitance, the shielded internal capacitance can be varied in an environment determined only by the capacitor construction. The external capacitance at the terminals, although dependent upon external connections and environment, can easily be held so constant during the capacitance change that they make no real contribution to the difference. Such variable capacitors can be calibrated in terms of the capacitance added or removed by rotating the capacitor plates with essentially no limitation of accuracy by connection errors.

When the capacitor has a fixed capacitance, highly accurate calibration of the capacitance added requires that the capacitor be connected with specified leads to a specified set of terminals



**Fig. 2.** One way of measuring capacitance is by taking terminal capacitance of the test instrument into account. In method "A" the initial measurement is made with the bridge terminals open and the final measurement with the capacitor connected by means of the double-ended plug. In method "B" the initial measurement is made with the plugs in the bridge terminals. A lower capacitance is measured in method "B" because of the capacitance added to the bridge terminals by the plugs in the initial measurement.

For example, some capacitors are calibrated in terms of the capacitance they add when the banana plugs on the capacitor are plugged into binding posts with 3/4 in. spacing on a test instrument. When care is used while making the connections, the reproducibility of measurement is better than 0.1 pf.

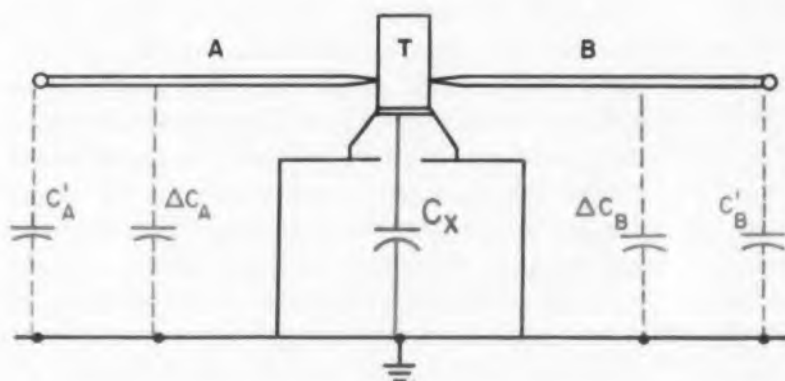
For greater accuracy the environment of the terminals must also be defined. Any change in terminal position or panel size (which results, for example, from the use of different bridges or of terminals on an external capacitor instead of the bridge terminals) can produce a change in the measured capacitance. The value assigned to the capacitor is the difference between two bridge measurements: the first with the bridge terminals open; the second with the capacitor connected to the terminals. In the second measurement the capacitor case and bridge panel are usually effective in shielding the bridge terminals so that this measurement is not very sensitive to changes outside the radius of a few inches. This is shown in Fig. 2. The capacitance of the open bridge terminals in the first measurement (and of any open terminals on the capacitor) is affected to a greater extent by panel size and terminal position.

#### "Free" Capacitance Method

Another way of defining capacitance with high accuracy eliminates all connections and defines the "free" capacitance of the capacitor with all disturbing connections and surroundings removed. This method substitutes the difficulties of measuring the capacitance of a capacitor isolated from its surrounding and without connections for the difficulties of controlling the geometry of the connections and the environment.

A method for doing this was described by Rosa and Dorsey.<sup>1</sup> The method determines "free" capacitance by evaluating the disturbing effects of the connections and applying a correction for these effects to the measured capacitance. The effects of the connections can be eliminated from the measurement by using two sets of connecting leads that are necessarily identical but have no mutual interaction. A simplified illustration of this method is shown in Fig. 3.

The capacitor to be measured has a "free" capacitance consisting of  $C_x$  plus external components corresponding to  $C_1, C_2, C_3$  in Fig. 1. For simplicity only the high terminal,  $T$ , is shown in Fig. 3, but the ground connection to the case and to one side of the capacitor can be made to a second, similar terminal on the unit. A first measurement is made with connecting wire  $A$  attached to the terminal and to the bridge and with wire  $B$  removed. The measured capacitance is  $C_1 = C_A^0 + C_B^0 + \Delta C_A + C_x - \Delta C_{x^A}$ . A similar measurement with wire  $B$  connected and  $A$  removed gives  $C_2 = C_A^0 + C_B^0 + \Delta C_B + C_x = \Delta C_{x^B}$ , where:



**Fig. 3.** Measurement of "free" capacitance by the Rosa and Dorsey method takes into account the disturbing effects of the connections.

- (a)  $C_A^0 + C_B^0$  is measured capacitance of leads, bridge, etc. when both wires  $A$  and  $B$  are removed,
- (b)  $\Delta C_A^0$  and  $\Delta C_B^0$  are the increments added by wires  $A$  and  $B$ , and
- (c)  $\Delta C_{x^A}$  and  $\Delta C_{x^B}$  are the changes in  $C_x$ , which result from the presence of  $A$  and  $B$ .

With both wires  $A$  and  $B$  connected to the terminal the capacitance measured is:  $C_{12} = C_A^0 + C_B^0 + \Delta C_A + \Delta C_B + C_x - \Delta C_{x^A} - \Delta C_{x^B}$ . These relations can be combined to show:  $C_x = C_1 + C_2 - C_{12} - (C_A^0 + C_B^0)$ . The "free" capacitance  $C_x$  can thus be determined from four measured capacitances:  $C_1, C_2, C_{12}$ , and  $C_A^0 + C_B^0$ .

Wires  $A$  and  $B$  are assumed to have no mutual interaction, e.g., the capacitances  $\Delta C_A$  and  $\Delta C_{x^A}$  are not altered by adding wire  $B$  when  $C_{12}$  is being measured. There is some mutual effect (which can, with care, be kept below 0.01 pf) in the simple connection shown in Fig. 3. But in a spherical capacitor the two leads can be shielded from each other by their locations on opposite sides of the spheres.

The assumption that the calculated  $C_x$  is the "free" capacitance requires the initial measurement of  $C_A^0 + C_B^0$  to be made with all measuring apparatus so far removed from the terminal  $T$  that it has no significant effect on the capacitance. In practice it is difficult to approximate this condition to better than 0.01 pf unless one of the conductors surrounds and shields the other.

#### Fine-Wire Connection Method

Another method which removes most, but not all, of the effects of the connections is the fine-wire-connection method described by R. F. Field.<sup>2</sup> In this method, shown in Fig. 4, the connection between the bridge and the high terminal of the unknown capacitor is made by a small diameter wire pivoted near the bridge terminal so that its separation from the capacitor terminal can be varied. An initial measurement is made with the wire separated from the terminal by a distance  $h$ . Assuming the capacitance  $C_h$  between the wire and terminal is small compared to the unknown  $C_x$ , so that  $C_h C_x / (C_h + C_x) \cong C_h$ , the measured

capacitance is  $C_1 = C_g^h + C_h$ .  $C_g^h$  is the capacitance between wire and ground when the separation is  $h$ . When the wire moves to touch the terminal, the capacitance  $C_h$  becomes infinite and the capacitance between wire and ground increases to  $C_g^0$ . The measured capacitance now is:  $C_2 = C_g^0 + C_x$ . The unknown capacitance can thus be related to the measured values  $C_1$  and  $C_2$  by  $\Delta C = C_2 - C_1 = C_x + (C_g^0 - C_g^h - C_h)$ . At some particular distance  $h$ , the capacitance  $C_h$  is equal to the change in  $C_g$  as the wire is moved, i.e.,  $C_g^0 - C_g^h$ , and the term in parentheses vanishes, leaving simply  $C_x = C_2 - C_1$ .

When the wire is curved and pivoted at the bridge end to approach the capacitor terminal from above, the change of  $\Delta C$  with  $h$  is fairly linear as shown in Fig. 5. A plot of  $\Delta C$  against  $h$  can then be extrapolated to  $h = 0$ , where  $\Delta C = C_x$ , and the value of  $h$  which corresponds to this  $\Delta C$  is 1/4 in. The difference between the two capacitances measured with the wire touching the terminal and then 1/4 in. above it should, therefore, be the value  $C_x$  of the unknown capacitor.

This method is simple and useful for calibration where uncertainties less than 0.1 or 0.2 pf are not significant. There are, however, several reasons why this method has connection errors which can be of the order of 0.1 pf or more. First, even when other errors are absent, the capacitance measured,  $C_x$ , is not the "free" capacitance ( $C_x^f$ ), but the capacitance ( $C_x^w$ ) in the presence of the connecting wire. Even though the added capacitance to ground of the wire has been eliminated from the measurement, the wire still reduces the capacitance of the terminal from its "free" value by disturbing the field around the terminal and, hence, the charge distribution on it.

A recent analysis of the component capacitances in the fine-wire method with a three-terminal capacitance bridge showed that even the capacitance  $C_x^w$  in the presence of the wire is hard to determine without errors of the order of 0.1 pf. The measurements were made on a capacitor which had internal, guarded connections to the terminals to permit measurement of the "free" capacitance and the effects of the connector upon it. To simulate the stray capacitance to external grounds in two-terminal measurements, the three-terminal measurements were made with a wire cage (30 x 30 x 30 in.) surrounding the capacitor and its connections and connected to the "ground" terminal of the capacitor.

#### What the Curves Show

The measured capacitances,  $C_x$ ,  $C_g^h$ ,  $C_g^h + C_h$ , and  $\Delta C = C_x + C_g^0 - (C_g^h + C_h)$ , are plotted in Fig. 6 as a function of the separation  $h$  between wire and terminal. For convenience, the capaci-

tance scale has been adjusted to make  $C_x^f = 100$  pf. The upper curve shows the variation in  $C_x$  as the wire moves away from the terminal, with an increase of about 0.1 pf as the influence of the wire vanishes with increasing  $h$ . The next curve shows the results of the fine-wire method, with  $\Delta C$  plotted as a function of  $h$ . The lower curves, with the level of the capacitance axis shifted, show the variations of the wire capacitances,  $C_g^h$  and  $C_g^h + C_h$ , with  $h$ .

The fine-wire method, when corrected for the effects of the wire on  $C_x$ , predicts that at the distance which makes  $C_g^h + C_h = C_g^0$ , the capacitance difference  $\Delta C$  will be equal to  $C_x^w$ . In Fig. 6 this condition is shown to be satisfied at a distance  $h = 2$  in. Any attempt, however, to determine  $C_x^w$  here by extrapolation of the  $\Delta C$  curve to  $h = 0$  is difficult because the curve is not very linear. Examination of the  $C_g^h$ ,  $C_g^h + C_h$ , and  $C_x$  curves shows that  $C_h$  causes deviation from linearity at small  $h$ , that  $C_g^h$  is itself not linear for  $h$  less than about 2.5 in., and that  $C_x$  is not constant with  $h$ , as assumed in the derivation of the method. In the region beyond 2.5 in.  $C_x$  is almost constant and  $C_g$  relatively linear, as desired, and it seems possible that a linear region beyond the range of the graph might extrapolate to  $C_x^w$  at  $h = 0$ .

The important point is the obvious difficulty in determining  $C_x^w$  by this method without variations of 0.1 pf. Attention should also be given to the difference between the  $\Delta C$  value at the 1/4 in. separation and the values of  $C_x^w$  and  $C_x^f$ . With the 1/4 in. spacing, the fine-wire method would give under these conditions a capacitance 0.14 pf less than the capacitance  $C_x^w$  in the presence of the wire and 0.25 pf less than the "free" capacitance  $C_x^f$ .

These results of three-terminal measurements in an environment which approximates two-terminal conditions can be altered slightly by the differing environment in a true two-terminal measurement. Results show no significant change in the order of magnitude of these differences.

The fine-wire connection method, therefore, is not satisfactory for determining either the "free" capacitance or the capacitance in the presence of the wire with errors less than 0.1 or 0.2 pf unless much care is taken in both making and correcting the measurements. As in the other methods of making connection to two-terminal capacitors, the results are reproducible with a precision of 0.01 or 0.02 pf if care is taken to keep the geometry of the connections invariant. The fine-wire method can, therefore, be used to calibrate in terms of added capacitance with an accuracy of better than 0.1 pf even though it is not this accurate in the determination of an absolute value.

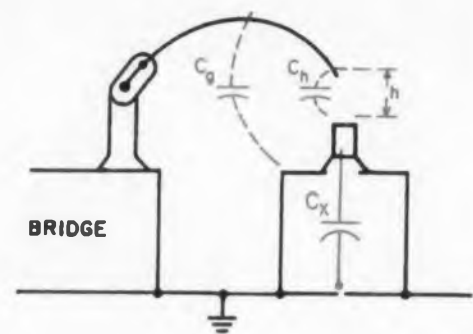


Fig. 4. The fine-wire connection method removes most of the effects of the connections.

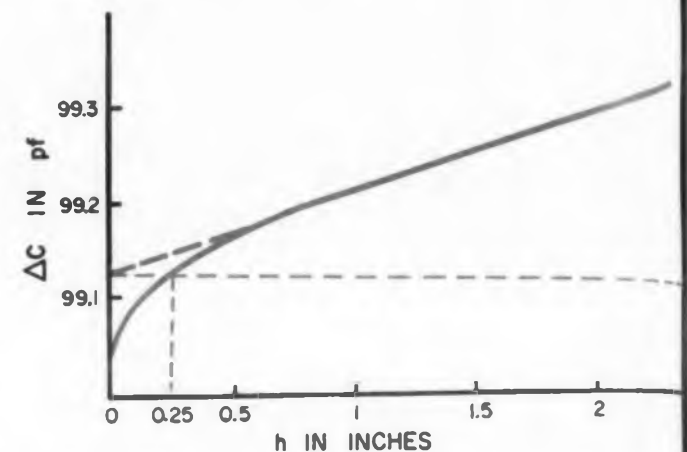


Fig. 5. Determination of unknown  $C_x$  from  $\Delta C$  measured with fine-wire connector. At  $h = 1/4$  in.,  $C_x = \Delta C$ .

#### Third Conductor Helps

The uncertainties and errors in capacitance measurements covered here have been the result of the variations in terminal capacitances produced by changes in the connections and in the environment. These problems, associated with the capacitor terminals, can be eliminated if the terminal capacitances can be separated from the capacitance to be defined and measured. One way of doing this is to introduce a third conductor. This is used as a shield or guard which completely surrounds all of at least one of the pair of conductors forming the capacitor to be measured (except the area which produces the desired direct capacitance). The pair of conductors of the original capacitors and the added shield form a three-terminal capacitor, such as the one shown in Fig. 7, along with its equivalent circuit.

Adding the shield changes the capacitance that existed between 1 and 2 before introducing the shield by altering the field. It also results in new capacitances,  $C_{13}$  and  $C_{23}$ , between the original conductors and the shield. If the shielding is complete, however, the capacitance  $C_{12}$  is now independent of the surroundings outside the shield and connections to the terminals 1 and 2 can affect only  $C_{13}$  and  $C_{23}$ . The direct capacitance  $C_{12}$  (usually referred to as the capacitance of the three-terminal capacitor) is quite definite and not sub-

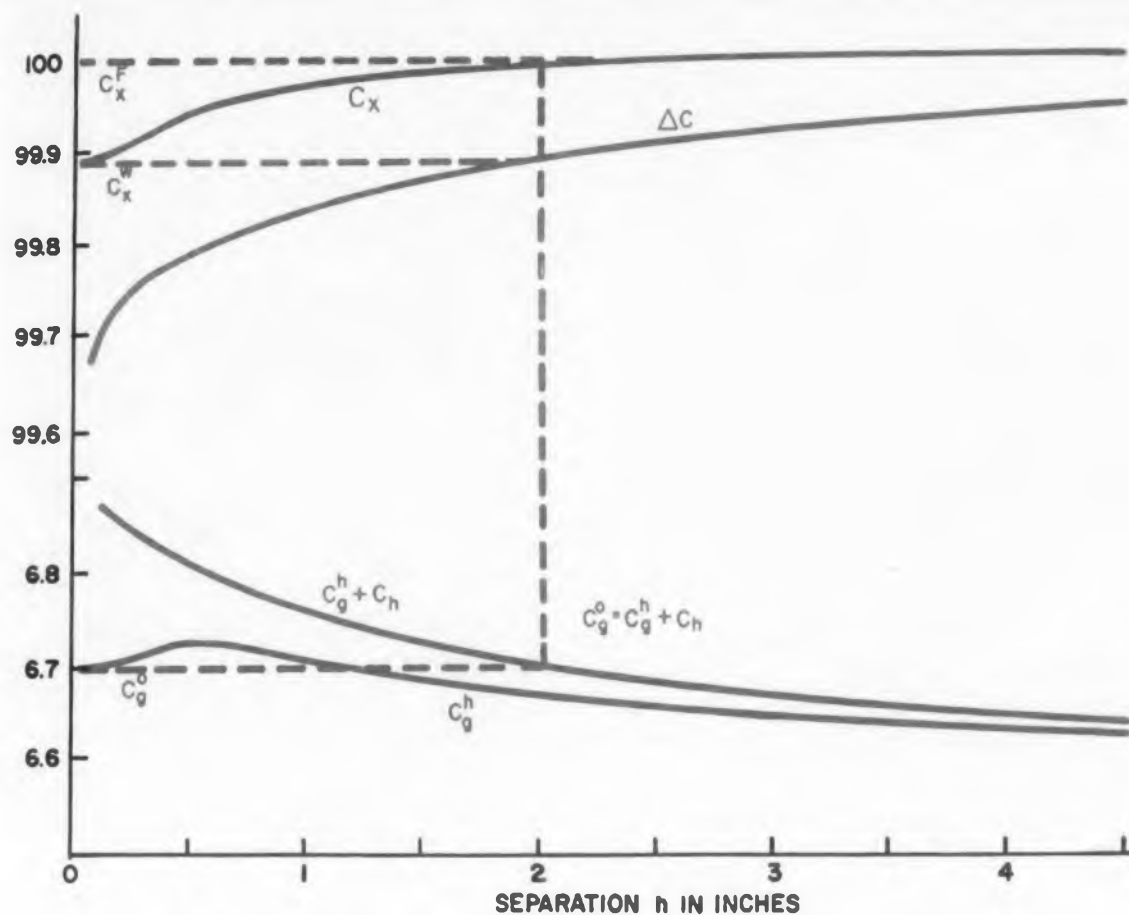


Fig. 6. Variation of capacitance of fine-wire connector.

ject to the connection errors.

If in this three-terminal capacitor one of the capacitor terminals, say 2, is connected to the shield, 3, the capacitor reverts to the usual two-terminal capacitor with terminals 1 and 2. The capacitance  $C_{23}$  has thus been shorted; the capacitance  $C_{13}$  is now parallel with  $C_{12}$ , and the capacitor has the capacitance  $C = C_{13} + C_{12}$ . The capacitor is, thus, equivalent to that shown in Fig. 1. Although  $C_{12}$  is still shielded from external influences,  $C_{13}$  is a function of connections and environment, and the total capacitance measured is subject to the variations described for such two-terminal capacitors.

The well-defined direct capacitance of the three-terminal capacitor is of practical use in a capacitance standard only if it can be measured with high accuracy and with reasonable ease. A bridge with transformer ratio arms is well-suited for just such measurements.<sup>3</sup>

#### Using a Transformer Bridge

In the transformer bridge shown in Fig. 8, the unknown and standard capacitors are driven by emfs of opposite phase and known ratio from a tapped transformer secondary winding, and the difference in the capacitor currents is measured by a detector. When the bridge is balanced for zero current through the detector, the currents through the direct capacitances  $C_{12}$  and  $C_s$  must be equal, and the balance relation is  $C_{12}/C_s = n$ .

Any capacitance, such as  $C_{23}$ , across the detector has no effect at balance because there is no

potential across it. Any capacitance, such as  $C_{13}$ , across the transformer winding will have negligible effect on the emf as long as the output impedance of the transformer is small compared to the load reactance of the capacitors. Bridges with such transformer ratio arms have been built for the accurate measurement over a wide range of values of the direct capacitance of three-terminal capacitors. Direct capacitance can be measured by several other null methods, such as those using bridged-T and twin-T networks. Most bridge networks can be adapted to the three-terminal measurement by the use of auxiliary bridge arms to balance the unwanted components, but the double balance required is never convenient. And it is difficult to obtain accuracy when the direct capacitance is very small compared to the other capacitances.

In some bridges three-terminal measurements can also be made over a limited range by connecting the unwanted capacitances across low-impedance arms of the bridge and across the generator or detector where the shunting effect is negligible.

In all of these three-terminal measurement methods the connection errors in capacitance can be eliminated by having a complete external shield around at least one of the capacitor terminals. In Fig. 8 the case of the capacitor and a shield lead from terminal 2 to the shielded detector complete the shielding around that terminal of the capacitor. A shielded lead to the other terminal is not usually required to eliminate connection capacitances but may be needed to prevent

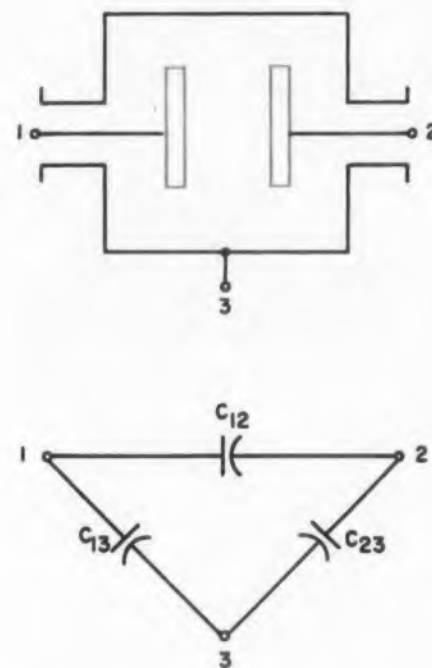


Fig. 7. Three-terminal capacitor and its equivalent circuitry.

pickup from other sources.

With such three-terminal measurements the measured direct capacitance should depend solely upon the construction of the capacitor and the accuracy of measurement should be limited only by the bridge or the reference standards used. ■ ■

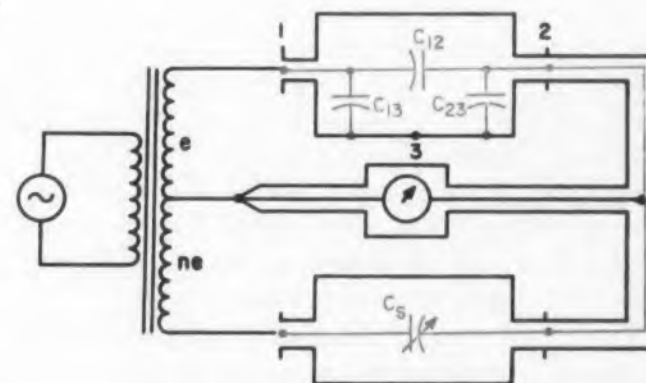
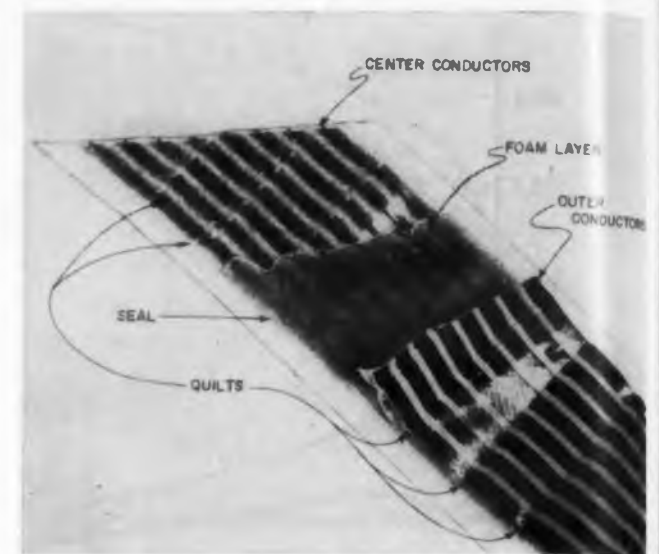


Fig. 8. Measurement of three-terminal capacitor using transformer-ratio-arm bridge.

#### References

1. E. B. Rosa and N. E. Dorsey, A New Determination of the Ratio of the Electromagnetic to the Electrostatic Unit of Electricity, *Bull. Bureau of Stand.*, Vol. 3, No. 3 and 4, 1907.
2. R. F. Field, Connection Errors in Capacitance Measurements, *General Radio Experimenter*, Vol. 12, No. 8, January, 1938, pp. 1-4; reprinted: Vol. 21, No. 11, April, 1947, pp. 1-4.
3. A. M. Thompson, The Precise Measurement of Small Capacitances, *IRE Transactions of Instrumentation*, Vol 1-7, Nos. 3 & 4, Dec., 1958, pp. 245-253.

# Flat-Strip Coaxial Cable



**Fig. 1.** Cutaway shows construction of Flexprint multi-conductor coaxial cable. "Quilts" or crimping of the outer insulation and conductors permits bending without discontinuities in the shielding.

**F**LAT, multiconductor coaxial cable provides the solution to obtaining a high frequency transmission line with a high degree of flexibility. It eliminates the problems of radiation losses due to discontinuities in the material, since both signal-carrying and ground-potential conductors are continuous strips, without holes or openings of any kind. This new cable, being made by Sanders Associates, Nashua, N.H., is a combination of their Flexprint and Tri-Plate printed circuit techniques.

Fig. 1 shows the basic construction of the cable. Essentially, etched signal-carrying conductors are laminated between layers of insulation. A layer of urethane foam is applied to both sides of the encapsulated conductors, and over these, a layer of insulated ground conductors in register with the signal-carrying conductors is attached.

The inner (signal-potential) conductors are slightly shorter than the outer shield conductors to permit flexing of the cable by extension of the shield conductors and a stretching of the outer layer of insulation. The inner conductors are narrower than the outer (ground-potential) conductors and their position is maintained midway between the pair of ground conductors.

The distance between inner and outer conductors is periodically varied along the length of the cable by indentations or "crimping" which compresses the foam dielectric to give a "corrugated" effect and to provide increased flexibility of the cable while minimizing extraneous disturbances to the passage of electrical energy introduced by flexing of the cable. Urethane foam provides desired mechanical characteristics—light-weight, flex-

ible, and shock-withstanding—as well as suitable dielectric properties.

## Saves Size and Weight

The eight-conductor cable shown in Fig. 1 is typical of a cable with an upper frequency limit of approximately 200 mc and a characteristic impedance of 93 ohms. The center conductors are 0.025 in. wide and are made of 8 mils thick copper spaced on 0.14-in. centers. This is equivalent to No. 26 wire or No. 24 copper-weld wire which is normally used in conventional coaxial cables. Velocity of propagation of the cable is approximately 78 per cent of air. Isolation between conductors is approximately -55 db. Contrasted with a cable built up of eight conventional coaxial lines (Fig. 2 of approximately 1/4-in. diam (for 93-ohm impedance), the Flexprint cable offers impressive savings in both size and weight. Its overall dimensions are 0.11 x 1.38 in., and it weighs only one-seventh as much as the "bundle" of eight conventional lines.

Note that the impedance and transmission characteristics given here are for a particular cable developed specifically for a single, special purpose application. Since impedance and transmission characteristics are functions of cable design, insulation, wire sizes, etc., other cables can be made.

Fabrication of the cable does not impose mechanical strain on the center conductor as in conventional manufacturing techniques. Cables can be made with precious metal center conductors to improve transmission characteristics. Isolation between conductors can be increased by widening

the space between them. Different foam dielectrics can be substituted to provide other characteristics. The use of silicone-based foam for high temperature operation is an example. Other characteristics can be similarly changed by changes in the materials and construction of the cable.

## Why Corrugated?

One of the unique features of the Sanders' transmission line is the "corrugated" ground plane by means of which the spacing between the outer and inner conductors is periodically varied. This is a radical departure from any prior strip line art. It permits bending of the shielded cable, essentially a three-member "beam," with predictable mechanical and electrical characteristics.

Because of the inherent balance of the ideal strip line configuration, the fields above and below a central plane through the line are equal and opposite. No parallel plate TEM, or wave guide modes exist as long as the symmetry of such structure is maintained. In the ordinary flat-strip line, however, longitudinal tilting of the center strip between the ground planes excites higher order modes. Tilting may arise under pressure or any condition which separates the ground planes. From this, it appears that any kind of indentation in the ground planes would produce a serious impedance discontinuity. In the Sanders' development the indentations in the ground planes do not, in fact, appear as impedance discontinuities because of the relatively close positioning from indentation to indentation. These indentations in the ground planes are positioned at intervals of





Fig. 2. "Flat-strip" coaxial cable on the right replaces the bundle of coaxial lines on the left.

less than  $1/4$  wavelength at the highest operating frequency of the line.

Another unique feature of the cable is the character of the crimping of the shields so that there is some slack built into each shield. The cross-section of the cable is "loosened" by employing a compressible, porous, insulating material such as urethane foam to occupy the space between the inner and outer conductors. This makes it possible for stretching to occur in the outer layer around a bend and compression to occur in the inner layer. Unless this can occur, serious changes in electric properties accompany any deformation of the cable since the center conductor tends to crush the dielectric and move toward the outer ground plane while the inner ground plane buckles and separates widely from the center conductor. With indentations occurring, for example, every half inch in the ground planes, the total deformation for each narrowed cross-section does not exceed about 5 deg while bending the cable around a 4.5-in. radius. Furthermore, the indentations operate to locate the center conductor accurately in the center between the ground planes and to maintain the over-all thickness of the cable by tying the ground planes together. The over-all thickness of the transmission line is controlled so as not to exceed  $1/2$  wavelength at the highest operating frequency of the line to avoid waveguide modes of propagation.

Another feature of the cable is that the indentations in the upper and lower ground planes are offset with respect to each other so that they fall along lines in different planes laterally perpen-

dicular to the transmission line. This feature not only provides increased flexibility but it enables a closer over-all spacing of the indentations which, in turn, enables the transmission line to operate at higher frequencies without "seeing" the indentations as discontinuities, as would be the case if the indentations of the upper and lower ground planes were in the same lateral plane perpendicular to the transmission line.

A variation of this technique is one in which indentations in the outer conductors fall in the same plane laterally perpendicular to the transmission line. By encapsulating the inner and outer conductors in a relatively non-porous, thermoplastic insulation the outer and inner conductors may be bonded together at the indentations. This results in a structure having air gaps, which provides a transmission line with the dielectric constant of the separating material approaching that of air. Such a feature is desirable for certain applications.

Again, the indentations occur at space intervals less than  $1/4$  wavelength at the highest operating frequency of the transmission line. In addition to providing predetermined points at which the transmission line will flex, the indentations also serve the function of providing extra conductor length for a given length of transmission line, thereby permitting conductors on the outside of a bend to stretch. This inhibits a sharp buckling at any particular point.

For further information on this flat coaxial cable, turn to the Reader-Service Card and circle 101.

## CONDUCTIVE PLASTIC PRECISION POTS



$10^8$  revolutions at  
2000 rpm . . .

...AND NO END IN SIGHT! That's what life expectancy tests of these new conductive plastic precision pots have shown. And checks during testing have shown near-infinite resolution, no measurable change in linearity or noise, and only 5% change in total resistance.

Stock resistance values are 1, 2, 5, 10 and 20K. Values between 100 ohms and 10 megohms supplied on special order.

### A COMPLETE LINE OF wirewound precision pots

Included in this outstanding line is Model 158: a 4-watt, multi-section pot that passes a rigid noise test at  $-55^{\circ}\text{C}$ , and is available in resistances up to 150K ohms. Also included in the complete NEI



wirewound line are servo mounting and low torque types. Sizes range from  $1/2$ " to 3" in diameter.

### ... AND special CONDUCTIVE PLASTIC ELEMENTS

... including rectilinear elements for slide-wire applications and other precisely built conductive plastic elements for use in fuel gauges, accelerometers, pressure transducers and other instruments.

NEI is the only source to offer precision wirewound AND conductive plastic potentiometers. WRITE TODAY for full information. Spec sheets and the convenient NEI Fact File are yours on request.

NEW ENGLAND  
INSTRUMENT  
COMPANY



350 MAIN STREET, WOONSOCKET, RHODE ISLAND  
CIRCLE 33 ON READER-SERVICE CARD

# Light Bulbs For Special Applications



Mr. Jaensch was graduated from the Technical University of Berlin in 1939. He has been active in the development and design of electronic and electromechanical apparatus. He feels that these data on light bulbs should be invaluable to engineers seeking to use lamps as nonlinear elements.



**C**OMMON incandescent lamps can serve as reliable and inexpensive current and voltage regulators, as well as safety resistors. Additional applications include volume-expander service in audio equipment and bias stabilization in R-C oscillators.

The characteristics of tungsten-filament bulbs are presented in Tables 1 and 2. Using the information there, circuit designs, incorporating cheap bulbs, can be achieved without extensive tests on lamps.

## Interpretation of Tables

The relation of current, resistance, power, life and light output for bulbs operated at other than the rated voltage is shown in Table 1. All values are given in percentage, the rated value being 100 per cent. As  $E$  approaches 200 per cent of nominal, the values of Table 1 should be taken as a rough reference only.

Table 2 presents nominal values for various

lamps. For more exact calculation of current resistance and wattage approaching  $E$  equals zero,

the correct value  $\frac{R_{(E=0\%)}}{R_{(E=100\%)}}$  from Table 2 may be

used for the type considered instead of the average  $R$  equals 7 per cent as shown in Table 1. From this ratio, the lower part of characteristics can be corrected accordingly.

The manufacturers' life-expectancy ratings for bulbs are empirical averages only and should not be taken as guarantees. Nevertheless they are a worthwhile guide for design.

Wherever highest stability of characteristics is desirable, a bulb should be used at a lower than nominal (100 per cent) voltage rating. At the end of rated average life, the resistance of a bulb has increased about 5 per cent from the original. If a special application does not allow more than 0.5 per cent change in the bulb's resistance or current characteristics, this point would be reached after 100 hours for a 1000-hour rated life.

As an opposite extreme, Table 1 shows how the output of a bulb can be increased considerably by applying higher-than-normal voltage. Though this improvement is obtained by sacrificing a great part of the bulb's possible life, this choice is practiced in the design of floodlight bulbs for photography and other special purposes.

As a matter of common interest, the relationship

**Klaus H. Jaensch**  
Senior Electronics Engineer  
Stromberg-Carlson Co.  
Rochester, N. Y.

The common household light bulb can serve as an extremely useful electronic component. It has seen little use simply because its characteristics have not been presented for conditions other than rated values.

Two convenient tables are given together with several typical applications possible with light bulbs.

between "Life" and "Lumen/Watt" explains why manufacturers usually rate general-purpose lamps for an average life of only 1000 hours. The same bulb operated at a lower voltage could last almost indefinitely. But this would not be economical for the customer. What he wants is a certain light output at the lowest cost. This includes both the cost of the lamps and of power consumption. A graph of the sum of these two items versus deviations from rated voltage for a certain light output shows a clear minimum in cost close to the point of 100 per cent rated voltage.

## Regulator Applications

In circuits calling for constant dc or ac current, a lamp used as series resistor is a reliable and inexpensive regulator. Special ballast-regulating tubes are available for higher stability in this application. These employ iron wire instead of the tungsten filament of common incandescent lamps. The current versus voltage characteristic of iron wire is practically flat over a certain range (see Fig. 1).

For comparison, the typical curve of an iron-wire regulating ballast tube (Amperite) is inserted in the diagram. With the same relative burn-out voltage, the characteristics of both materials show a similar course in the lower part. Above 70 per cent of voltage scale, the current regulation of the iron bulb is superior. In practice,

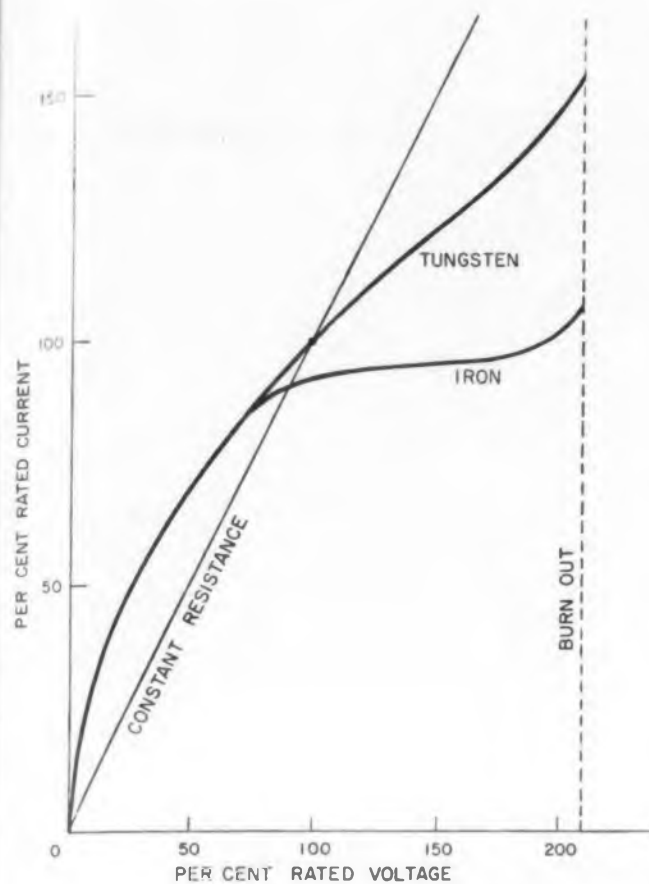


Fig. 1. Current versus voltage, in percentage of rated values, for a tungsten lamp.

these regulators are operated in the range from 80 per cent to 190 per cent, stabilizing the current to within a few percentage points.

Employing voltage-stabilizing tubes, it is often advantageous to use a lamp in place of the fixed series resistor. This is advisable only if greater variations are expected in input voltage than in load impedance. In this case, three advantages occur from employing a lamp. Variation of current through the voltage-regulating tube becomes smaller, thus avoiding overloading of this tube. For the same reason, voltage regulation is nearly twice as good. Finally the voltage-regulator tube starts easier with a light bulb in series.

#### Forming Electrolytic Capacitors

For reforming and testing electrolytic capacitors, light bulbs are very useful as safety resistors. As is well known, electrolytes often show excessive leakage after some years of storing. If the full rated voltage is applied at once in such cases, the unit may be destroyed. It can generally be reformed by slowly increasing the voltage, starting from about half the rated value of the capacitor.

By placing a low-current light bulb in series, the full voltage may be applied without harm. The varying resistance of the bulb will regulate the voltage across the electrolyte automatically. When the proper low leakage current is reached, almost full voltage is applied across the capacitor, be-

Table 1. Characteristics of Tungsten-Filament Lamps

Voltage E (%)	Current I (%)	Resist. R (%)	Power N (%)	Life (%)	Lumen (%)	Lumen Watt (%)
200	146	137	292	0.01	1200	410
190	140	136	266	0.02	1000	375
180	135	134	243	0.04	800	330
170	130		222	0.10	650	290
160	126		202	0.22	520	256
150	122		184	0.51	410	225
140	118		166	1.3	325	196
130	114		148	3.3	250	169
120	109.5		131.5	9.4	189	144
110	104.9		115.9	29	139	121
105	102.5		107.6	53	119	110
100%	100%		100%	100%	100%	100%
95	97.5		92.6	195	82	90
90	94.9		85.4	390	69	81
80	89.4		71.5	1810	45	64
70	84		59	10300	28	49
60	77		47	77000	16	36
50	71		35		9	25
40	63		25			
30	55		16			
20	45		9.0			
15	39		5.8			
10	32		3.2			
5	22		1.1			
2	14		0.3			
1	10		0.1			
0.5	6	8	0.03			
0	0	7	0			

Table 2. Rated Values of Common Light Bulbs

Voltage E (Volts)	Current I (Amp.)	Power N (Watts)	Resist. R (Ohms)	$\frac{R (E=0\%)}{R (E=100\%)}$ (%)	Life (Hours)	Lumen	Lumen Watt	Temperature (°F)
120	0.025	3	4800	8.5%				3600
120	0.050	6	2400	8.0%	1500	41	6.8	3860
120	0.083	10	1440	7.9%	1500	79	7.9	3900
120	0.125	15	960	7.6%	1000	140	9.3	4050
120	0.208	25	580	7.3%	1000	260	10.5	4190
120	0.333	40	360	6.8%	1000	465	11.7	4490
120	0.50	60	240	6.8%	1000	835	13.9	4530
120	0.83	100	144	6.6%	1000	1630	16.3	4670
120	1.67	200	72	6.4%	1000	3700	18.4	4750
120	4.17	500	28.8	6.3%	1000	10000	20.0	4850
120	8.34	1000	14.4	6.2%	1000	21500	21.5	4930

Approaching  $E=200\%$  of nominal, values of Table 1 should be taken for rough reference only. For exact calculations approaching  $E=0\%$ , the correct value  $\frac{R (E=0\%)}{R (E=100\%)}$  From Table 2 for the type considered may be used instead of the average figure  $R=7\%$  for  $E=0\%$  given in Table 1.

cause of the decreased resistance of the bulb.

Table 1 permits simplified calculation of the ratio of voltage between bulb and capacitor for different conditions. For occasional use in this application, light bulbs may be operated at higher than their nominal rating. For example, at 350 v,

two equal bulbs of 120 v rating, connected in series, are sufficient, since full voltage will be across the bulbs for a short time only.

For rough tests, the bulb can serve as an indicator at the same time. The rate of dimming would indicate the condition of the unit. ■ ■

Multi-  
turns?

We got 'em!

Multi-turn potentiometer connoisseurs...the men who buy them...turn to Helipot to succor their circuits.

They make their choice from the nineteen separate and distinct series of HELIPOT multi-turns, each with a myriad of models, scaled from 7/8" dia. x 1-1/2" up to 3-5/16" dia. x 6".

They find it easy to pick the pot that suits their circuit...linear or non-linear...high temperature or standard range...with resolution from a three-turn 0.164% up to a forty-turn 0.00073%...and linearities to  $\pm 0.01\%$ !

Join the well-informed 7 out of 10\* who turn to Helipot. Get the complete story on this profusion of multi-turns (plus a delineation of the HELIPOT single-turn line). Write for Data File C342.

\*Based on a well-known national trade publication's own survey of thousands of pot specifiers and buyers.

Beckman / Helipot®

Helipot Division of Beckman Instruments, Inc., Fullerton, California  
Engineering representatives in 29 cities

60010 © 1959 B. I. I.

potentiometers: dials: delay lines: expanded scale meters: servomotors: breadboard parts

CIRCLE 34 ON READER-SERVICE CARD



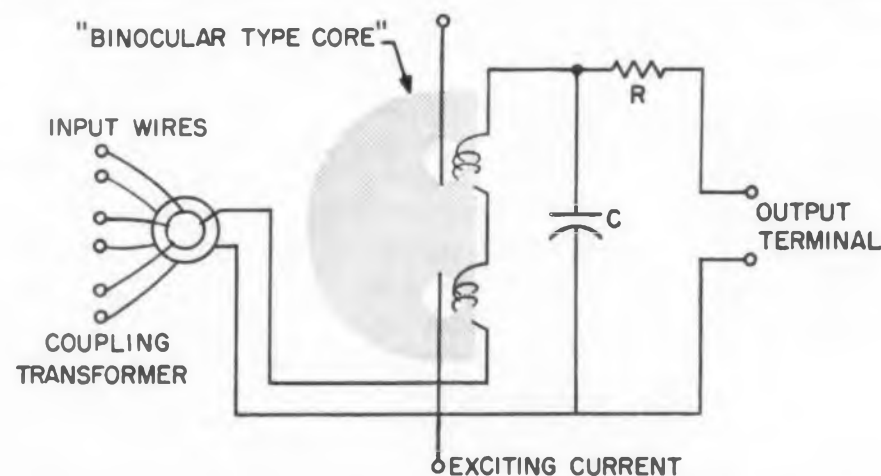
**Paramistor amplifying** logic and memory element. There are 25 Parametron circuits on this board. The device uses only about half the power required for comparable vacuum tube dc pulse circuitry. No amplifiers and limiting circuits are necessary.

## Paramistors Cut Computer Costs

**L**OW IN COST, the Paramistor, a computer logic and memory element, simplifies circuitry. Consisting of capacitors, ferrite-cored coils and resistors, the unit needs no diodes, rectifiers or transistors.

Reliability of the magnetic unit is high,

say the manufacturers, TDK Electronics Co., Ltd., of Tokyo. Since only passive components are used, there is nothing to wear out. The device is capable of self-limiting amplification, is designed for use in numerical control machine tools, tele-



**Parametron circuit.** Ferrite device in center may be viewed as two ferrite cores. Exciting current sets up parametric oscillations in circuit. Read-out is nondestructive.

graph equipment and telephone switching systems.

#### Parametron Is Key Element

Basic element of the Paramistor is the Parametron, a circuit consisting of a coupling transformer, two ferrite cores (a solid ferrite semi-circle with two holes punched in it), a capacitor and a resistor. (See circuit diagram.) These parts make up a resonant circuit with a nonlinear reactive element. Exciting frequencies have been on the order of 2 mc.

Unlike magnetic cores, which depend on the direction of a circulating current to identify the state, the Parametron's distinguishing characteristic is the phase of a subharmonic (half the exciting frequency) parametric oscillation. Parametric excitation of the ferrite resonators causes oscillation in either of two phases, 180 degrees opposed. The same parametric excitation results in a nonlinear reactance build-up, which produces self-limiting amplification.

Reading, in the case of a memory unit, is nondestructive. It is of a signal-no-signal type: if the Parametron is registering a 1, two similar phases add, and there is a positive output; if a 0 is stored, the signals are 180 degrees out of phase, and there is no resultant output.

#### Used in Variety of Circuits

The Paramistor, a combination of some 25 Parametron circuits, can be used in AND, OR and NOT circuits; in binary-counter, clock, binary-adder, binary-multiply and parallel-to-serial converting circuits.

Paramistor-built computers are somewhat slower than those using cores and diodes. But they are considerably less expensive. Kanematsu New York, Inc., 150 Broadway, New York City, N.Y., sales representative for TDK, estimates that the cost of a computer using Paramistor logic and memory would be a tenth of one using semiconductors and cores. Typical speeds of some Japanese computers using Paramistors for logic, but not for memory, are:

EACOM 212, 4 ms for add, 15 ms multiply; MUSASINO-1, 4 ms add, 20 ms multiply; PC-2, 40  $\mu$ sec add, 340  $\mu$ sec multiply.

For further information on this computer logic and memory element, turn to the Reader-Service Card and circle 102.

**DON'T INVEST IN TEST EQUIPMENT 'TIL YOU COMPARE FEATURES WITH THE**

## NEW Simpson LABORATORY LINE

### PULSE GENERATOR . . . model 2620

*No Unit Offers Such Accuracy, Versatility, and Set-Up Speed Within This Price Range*

Twin meters read pulse repetition frequency and pulse duration simultaneously. Rise time is 0.02 microseconds; decay time, 0.03 microseconds. Pulse duration, continuously variable from 0.1 to 1000 microseconds. Jitter, less than 0.005 microseconds. Pulse repetition rate, continuously variable from 10 to 100,000 pps in four ranges. Price . . . . . **\$625**

**WRITE FOR COMPLETE SPECIFICATIONS**



### WIDE-BAND OSCILLOSCOPE . . . model 2610

*For the 1001 Jobs Where You Don't Need an Expensive Specialized Scope*

Here's a high-gain scope that makes your test equipment appropriation go farther. Vertical sensitivity, 6 mv RMS. Vertical calibration accuracy,  $\pm 3\%$ . Response (linear position): DC to 5.0 mc/sec,  $\pm 0.5$  db; DC to 8.0 mc/sec,  $\pm 1.5$  db. Response (transient position): DC to 3.5 mc/sec,  $-3$  db, and  $-6$  db at 5.0 mc/sec. Triggered and recurrent sweeps. Precalibrated sweep positions of 5, 50, 500, 5000 microseconds. Price . . . . . **\$575**

**WRITE FOR COMPLETE SPECIFICATIONS**

### LABORATORY STANDARD VOLT-OHM-MILLIAMMETER . . . model 2600

*A Self-Powered Calibrator for Electrical Instrument Maintenance and High Accuracy Testing*

Two terminal connections cover all 49 ranges for unusually fast operation. DC accuracy is  $\pm 0.5\%$  F.S.; AC,  $\pm 0.75\%$  F.S. (at 77°F, 25°C). Separate meters (self shielded movements) for DC and AC readings. Price . . . . . **\$1620**

**WRITE FOR COMPLETE SPECIFICATIONS**



**AVAILABLE FROM MANY INDUSTRIAL ELECTRONIC DISTRIBUTORS, COAST-TO-COAST**

**Write to Factory for Details**

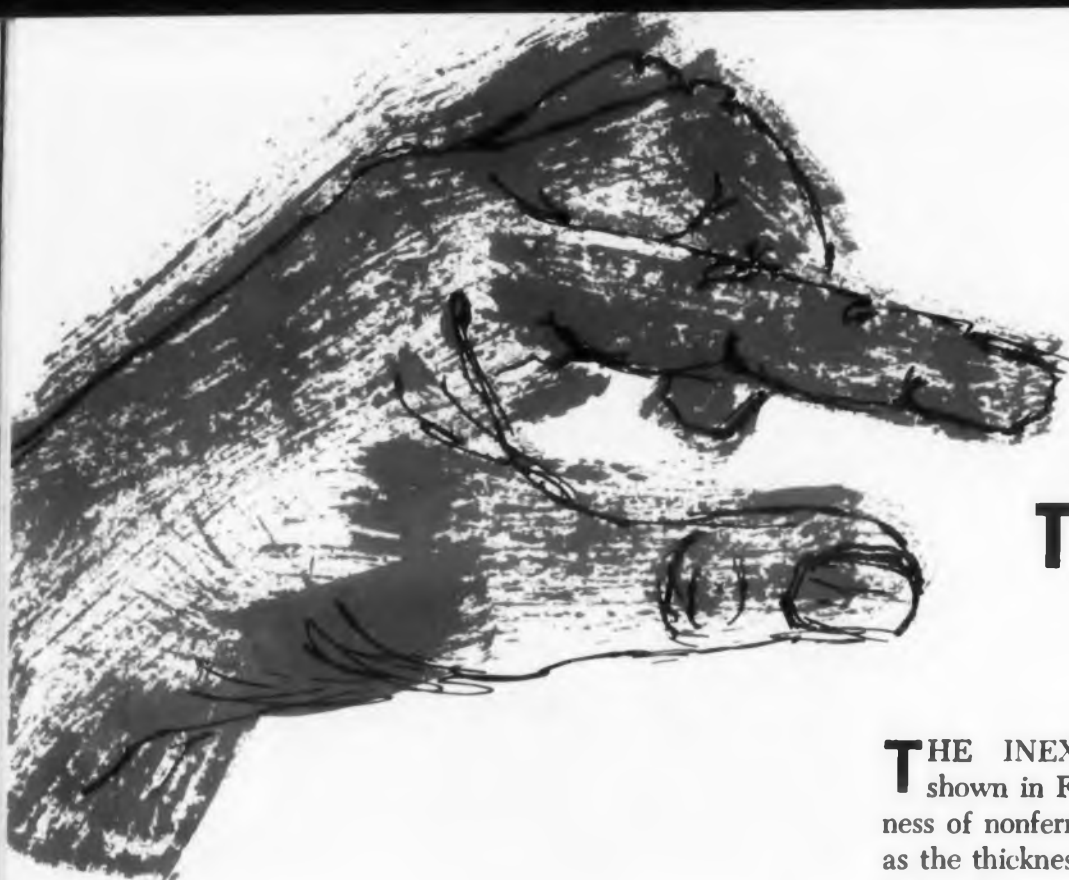
**MANUFACTURERS OF  
ELECTRONIC TEST  
EQUIPMENT FOR OVER  
50 YEARS**

# Simpson ELECTRIC COMPANY

5202 West Kinzie St., Chicago 44, Illinois • Telephone: EStebrook 9-1121  
In Canada: Bach-Simpson Ltd., London, Ontario

CIRCLE 35 ON READER-SERVICE CARD

# Electromagnetic Thickness Gage



**T**HE INEXPENSIVE, easy-to-build design, shown in Fig. 1, permits measuring the thickness of nonferrous coatings on steel parts as well as the thickness of any nonferrous sheet material. It handles sizes of approximately 0.1 to 50 thousandths of an inch, with an accuracy of several per cent.

### Magnetic Gap Determines Thickness

Two separate coils are used as primary and secondary of a transformer. A constant ac current is supplied to the primary. Variations of gap in the magnetic circuit coupling the two coils result in different mutual inductances, and these, in turn, produce an output voltage from the sec-

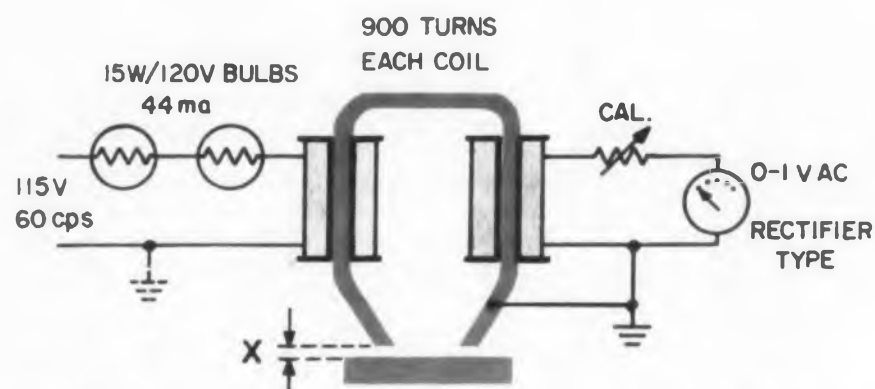


Fig. 1. Simple electromagnetic gage determines thickness (X) of nonferrous coating on steel parts.

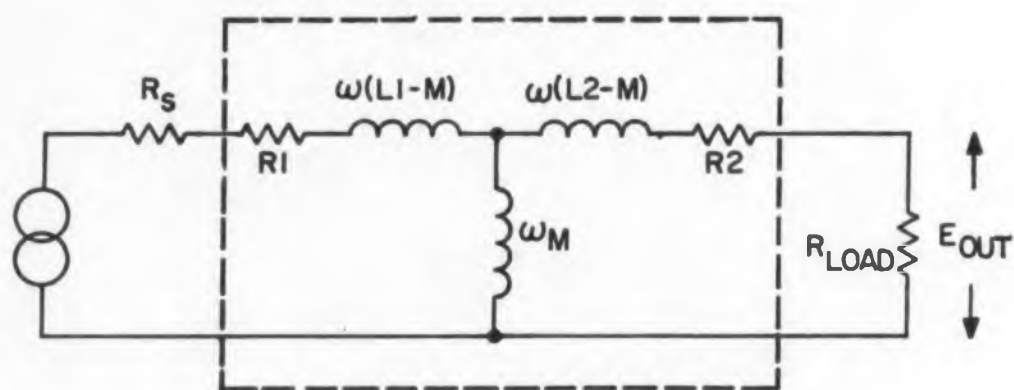


Fig. 2. Equivalent circuit of the thickness gage.

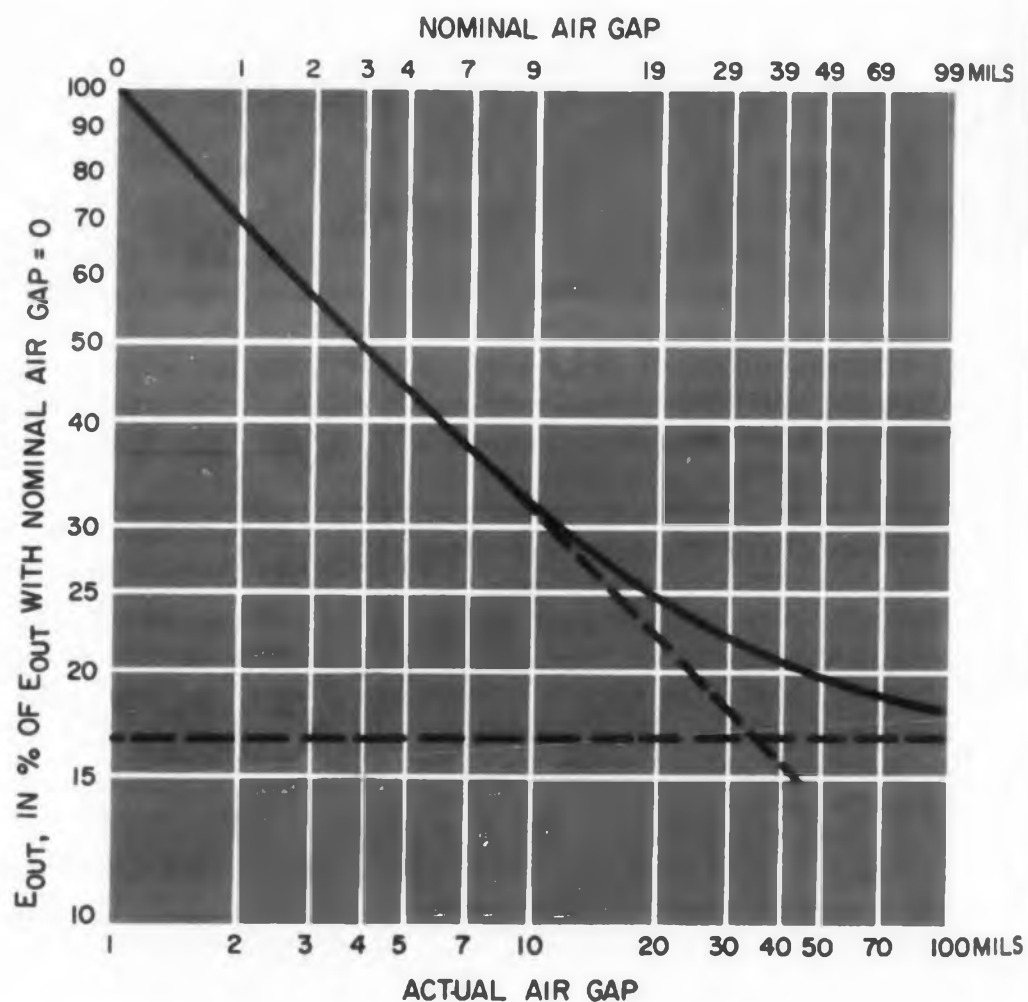
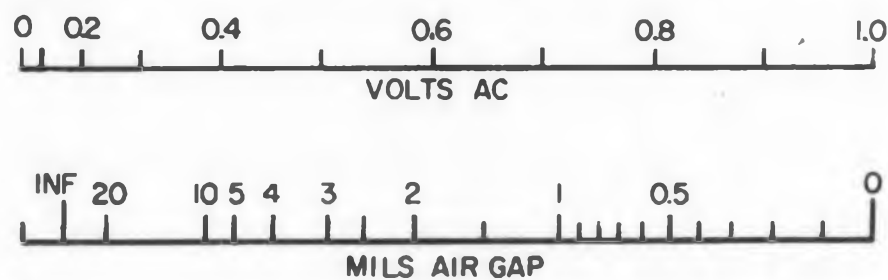
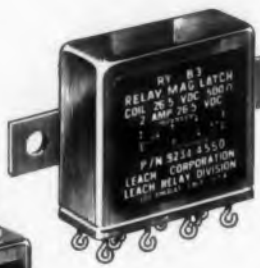


Fig. 3. Chart for determining gap from output voltage. The initial air gap due to the supposed rough surface of poles equals one mil.

Fig. 4. (left) Typical calibration of the meter scale.

TYPE 9234-4550 2PDT, 2AMP, MAGNETIC LATCH RELAY



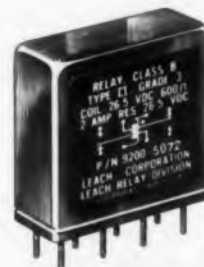
(BRACKET MOUNTING, SOLDER HOOK TERMINALS, HERMETICALLY SEALED)

TYPE 9200-5091 2PDT, 2AMP, RELAY



(STUD MOUNTING, SOLDER HOOK TERMINALS, HERMETICALLY SEALED)

TYPE 9200-5072 2PDT, 2AMP, RELAY



(PLUG-IN OR PRINTED CIRCUIT MOUNTING, HERMETICALLY SEALED)

# LEACH SUBMINIATURE CRYSTAL CAN RELAYS

(SHOWN ABOVE...ACTUAL SIZE)

**torture-tested  
to perfection  
for big  
relay performance**

These sensitive Leach subminiature relays deliver big relay performance... in a crystal can size that makes them ideal for use in missile control circuits in airborne or ground equipment and in computer and printed circuits.

Torture-tested to perfection in the Leach Production Reliability Center, these subminiatures are designed to meet the critical extremes of vibration, shock and other stringent environmental requirements in military and commercial applications.

They meet the specifications of both MIL-R-25018 and MIL-R-5757C—as well as MIL-R-6106C, including

the minimum current test requirements. Uniform contact pressure and overtravel are guaranteed for the life of these balanced-armature relays. They are available in a wide range of socket, stud and bracket mountings to meet specific customer requirements.

Write today for Leach Crystal Can Relay Brochure containing specifications, typical ratings and other information on these subminiatures! Or contact your nearest Leach sales representative to discuss your specific sub-miniature relay requirements.

**RELIABILITY** → **LOOK TO LEACH**  
RELAY DIVISION...LEACH CORPORATION  
5915 AVALON BOULEVARD, LOS ANGELES 3

DISTRICT OFFICES AND FIELD REPRESENTATIVES IN PRINCIPAL CITIES OF U. S. AND CANADA • EXPORT: LEACH CORP., INTERNATIONAL DIVISION  
CIRCLE 36 ON READER-SERVICE CARD

# Nickelonic News



DEVELOPMENTS IN NICKEL AND NICKEL ALLOYS AND THEIR APPLICATIONS



"A" Nickel laminations produce high-frequency vibrations in these cleaning and rinsing pots of the "Watchmaster" unit, developed by American Time Products, Inc.

## High magnetostrictive effect of Nickel proves useful in new ultrasonic cleaners

NEW YORK, N. Y.: The large magnetostrictive effect of Nickel makes possible the development of ultrasonic cleaners with a great range of usefulness. In radioisotope laboratories and other atomic energy installations, for example, these cleaners remove radioactive particles from equipment. In hospitals, they clean surgical instruments.

One ultrasonic cleaner, developed by American Time Products for cleaning watches, can also be used to clean tiny component parts in electronic equipment.

ATP's chief engineer writes: "Electronic-Grade 'A' Nickel enables us to produce a simple, economical transducer for converting electrical energy into high-frequency vibrations. The Nickel withstands high heats, mechanical abuse and corrosive solutions, providing a long, stable life."

**Pertinent Literature:** Write for "Design of Nickel Magnetostriction Transducers".

Circle 563 on Reader-Service Card

## Three Inco Nickel Alloys help push life of magnetron to 6,000 hours

HARRISON, N. J.: Commercial airlines need reliability and long life in components for weather radar equipment. Especially in high power tubes. And they've been getting it with the type 6521 magnetron made by the Electron Tube Division of the Radio Corporation of America. Tube 6521 delivers a peak power output of 85 kilowatts and has a normal operating life of 6,000 hours.

RCA designers give much credit for the tube's long life to outstanding properties of Inco Nickel Alloys:

**Monel "403" low-permeability nickel-copper alloy, used for the cathode sup-**

**port, provides high strength, corrosion resistance and low magnetic permeability certified not to exceed 1.1 in a field of 0.5 oersted. Monel "403" alloy has the dimensional stability needed to maintain the cathode centered in the anode over many heating cycles. It also offers easy machining and retains its non-magnetic characteristics after cold-working and forming so that high-strength parts can be assembled without annealing.**

**Monel\* nickel-copper alloy, used for the output flange and the mounting plate, provides the strength, toughness and corrosion resistance required to help push the magnetron's life into the 6,000 hour class.**

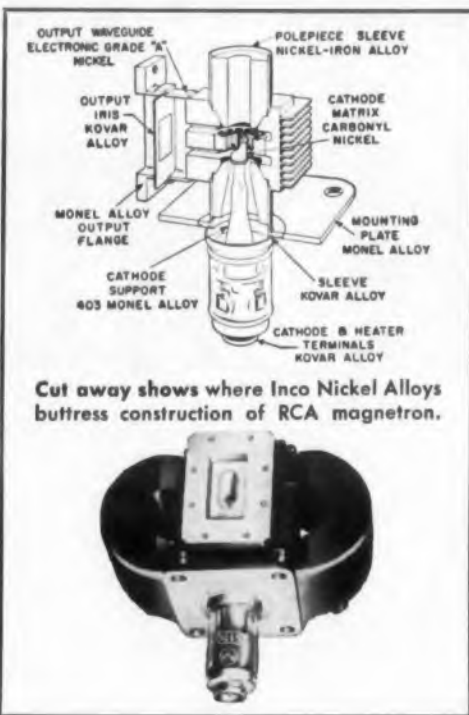
**Electronic-Grade "A" Nickel, used for the cathode foundation, supports the electron-emitting carbonyl nickel cathode matrix. The "A" Nickel provides essential strength to prevent distortion and purity to prevent contamination of the vacuum and the cathode matrix at high temperatures.**

**Two other Nickel-containing materials are also used to assure tube reliability and long life: Kovar\*\* nickel-cobalt-iron alloy, a glass sealing material, for the output iris, cathode sleeve and heater terminals; a magnetic nickel-iron alloy for the polepiece sleeve.**

**Pertinent Literature:** Write for "Basic Data - Monel "403" Low-Permeability Nickel-Copper Alloy" and Bulletins T-5 and T-15.

Circle 564 on Reader-Service Card

\*Trademark, The International Nickel Company, Inc.  
\*\*T.M. of Westinghouse Electric Corp.



## Forecast of Nickel availability spurs design of tubes with Inco Nickel Alloy parts

WALTHAM, MASS.: Notice that the production of Nickel exceeds all anticipated demands for future years is a big reason why designers at Raytheon Manufacturing Company make many klystron parts of Electronic-Grade "A" Nickel. For example, the two Raytheon tubes at right, designed for operation at 8500-9660 megacycles, have twenty-one "A" Nickel parts.

Plenty of "A" Nickel right from warehouse stocks in a wide range of

mill forms permits Raytheon designers to take advantage of this material's excellent vacuum and mechanical properties . . . and gain the benefits of simplified production and processing as well.

Electronic-Grade "A" Nickel, and other Inco Nickel Alloys, are supplied as wire, rod, strip, tubing, ribbon, clad-copper wire, bimetallic strip and wire, wire cloth, knitted mesh and a variety of other forms.

Circle 565 on Reader-Service Card



THE INTERNATIONAL NICKEL COMPANY, INC. • 67 Wall Street • New York 5, N. Y.



Circle 563 through 565 on Reader-Service Card

## IDEAS FOR DESIGN

ondary, related to the size of the gap.

The instrument is connected to the 60 cycle, 115 volt line directly. Series resistor  $R_s$  supplies the primary coil with a constant current. A light bulb used as series resistor has the advantage of stabilizing the current against variations of line voltage. For longer life, two equal bulbs in series are chosen, each operating at half voltage. Higher stability can be achieved by using an Amperite ballast regulating tube.

### Headphone Coils Make Electromagnet

Two headphone coils are placed over a strip of mild steel, about 1/4 x 0.050 in. The strip is bent to the shape of a horseshoe. The surface of the two poles of this yoke is smoothed into a common plane.

Electrical values of the arrangement can be calculated from the equivalent schematic of Fig. 2.  $R_1$  and  $R_2$  represent the ohmic resistance of the respective coils.  $M$  is the mutual inductance. Individual inductances of each coil,  $L_1$  and  $L_2$ , can be disregarded since their reactance at 60 cps is small compared to the series resistance in the attached circuit.

On the prototype, the air space between poles of the yoke is 1/4 in. long. With coils of 900 turns each, the resulting  $\omega M$  at 60 cps is approximately four ohms. Bridging the opening of the yoke as closely as possible by a piece of mild steel increases  $\omega M$  to about 24 ohms. Provided the value of primary ampere-turns is far enough below saturation of the iron yoke, secondary output voltage is directly proportional to  $\omega M$ . Fig. 3 shows a typical curve for output voltage versus air gap.

For indication, a rectifier type ac voltmeter (one volt full scale, 2000 ohms per volt), is used. Due to the nonlinear scale of this type, part of the basic output voltage in the "open" condition is suppressed, so that a greater portion of the scale is available for useful indication.

### Calibrate With Mild Steel

With a piece of mild steel closely bridging both poles, output voltage should read full scale on the meter. If the voltage is too low, turns may be added to the secondary coil. Slightly higher voltage can be corrected by a resistor in series with the meter.

A scale is calibrated by placing nonferrous shim-stock of different, known thicknesses, between the poles and the bridging steel piece, and marking the corresponding meter readings, as shown in Fig. 4.

For better readability in a certain range, the smallest thickness to be measured may be set as





the full scale point. To achieve the output voltage required, a secondary coil with more turns should be used. Increasing the number of primary turns, or the primary current, may drive the iron yoke into saturation.

Klaus Jaensch, Test Equipment Engineer, Stromberg-Carlson Div. of General Dynamics Corp., Rochester, N.Y.

### Speed Up Sawtooth Generators

The recovery time of a sawtooth generator is much greater than necessary since it usually uses ground as a reference to which it discharges.

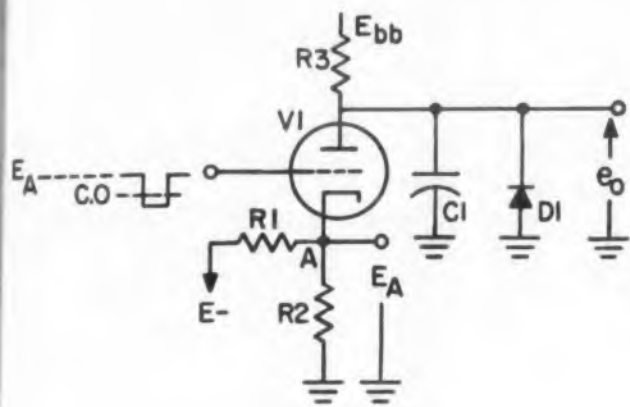


Fig. 1. Basic sawtooth generator with addition of diode and cathode bias.

By using diode  $D_1$  and negative cathode bias in Fig. 1, the fall time can be vastly improved. Since  $C_1$  now discharges toward negative voltage  $E_A$ , and diode  $D_1$  doesn't allow the discharge to go beyond ground, there is now a sharp break at ground potential, neglecting the drop within the diode itself.

The bias at point "A" can be adjusted by varying  $R_1$  and  $R_2$ .



Fig. 2. Faster fall time results when the timing capacitor discharges toward a negative voltage and the diode clamps at ground.

Fig. 2 shows the effect of using the diode. Irving Bayer, Lewyt Mfg. Co., Long Island City, N. Y.



This new precision DC VTVM is also a wide range, precision ohmmeter and ammeter!

# 1% accuracy 100 $\mu$ v to 1,000 volts!

Also 2% accuracy, 1  $\mu$ a to 1 amp full scale.

Measures 0.02 ohms to 5,000 megohms.

No zero adjustment. 1 minute warm-up.

Floating chassis. \$1,000 worth of convenience for \$350!

Haven't you wished for one compact, simple instrument that would make precision dc voltage, dc current and resistance measurements over a wide range?

The new  $\Phi$  412A is it! In its VTVM circuit, the 412A uses an exclusive  $\Phi$  photo-chopper instead of old-style mechanical vibrators—no drift, no 60 cps pickup. Input is floating, with resistance increasing from 10 megohms on the 1 mv range to 200 megohms on ranges above 100 mv. Current and voltage ranges have a 10 db sequence for

maximum readability and overlap. The ohmmeter is a modified Kelvin bridge eliminating lead resistance error; you measure resistance accurately on hook-up wire sections as short as 6".

Model 412A also includes a 1 v or 1 ma recorder output, and 3 separate probes. Call your  $\Phi$  rep today for a demonstration on your bench. Price, \$350.

#### HEWLETT-PACKARD COMPANY

1001K PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U.S.A.  
CABLE "HEWPACK" • DAVENPORT 5-4451  
FIELD REPRESENTATIVES IN ALL PRINCIPAL AREAS



#### $\Phi$ 400L LOGARITHMIC VOLTmeter—\$325

New  $\Phi$  voltmeter covers 10 cps to 4 MC; accuracy high as  $\pm 2\%$  of reading or 1% of full scale. Voltage range 0.3 mv to 300 v, 12 ranges, 1-3-10 sequence. Max. full scale sensitivity 1 mv. Large 5" true log voltage scale, linear 12 db scale, generous overlap. High stability, high input impedance. Also useful as amplifier for small signals, or to monitor waveforms.



#### $\Phi$ 400H PRECISION VOLTmeter—\$325

Extreme accuracy as high as  $\pm 1\%$  to 500 KC,  $\pm 2\%$  to 1 MC,  $\pm 5\%$  full range. Frequency coverage 10 cps to 4 MC. Large 5" meter with precision mirror scale. Voltage range 0.1 mv to 300 v; max. full scale sensitivity 1 mv. High 10 megohm input impedance minimizes circuit disturbances. Amplifier with 56 db feedback insures lasting stability. Reads direct in db or volts.



#### $\Phi$ 400D WIDE RANGE VOLTmeter—\$225

Highest quality, extremely versatile. Covers 10 cps to 4 MC. Highly sensitive, accurate to within  $\pm 2\%$  to 1 MC. Measures 0.1 mv to 300 v; max. full scale sensitivity 1 mv. Reads direct in dbm. High 10 megohm input impedance virtually eliminates circuit loading. 56 db amplifier feedback insures high stability and freedom from change due to external conditions.

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



complete precision voltage measuring equipment

CIRCLE 38 ON READER-SERVICE CARD

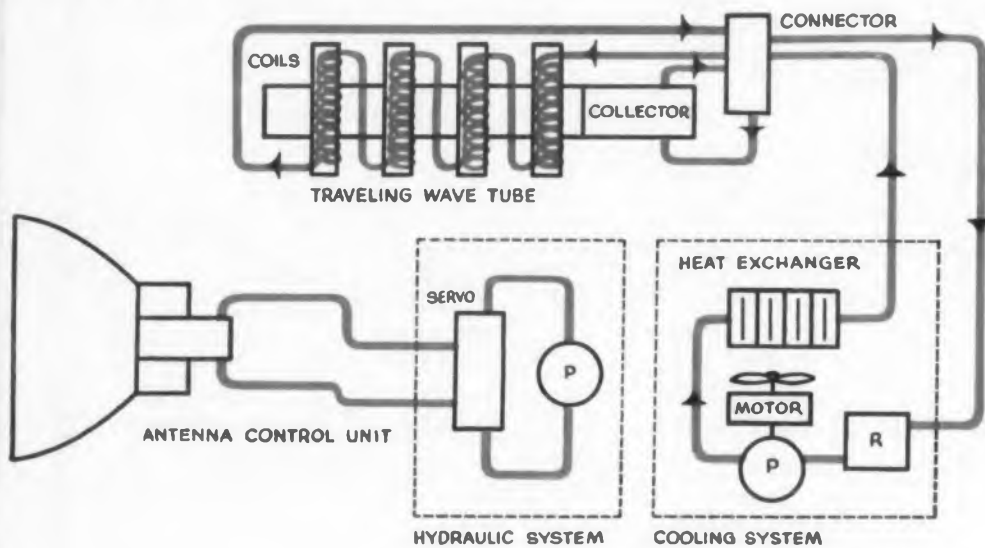
## Design Tips . . . on liquid cooling with Coolanol 45



**PROBLEM:** Cool traveling wave tube and supply hydraulic power for antenna control unit.

**SOLUTION:** Use one fluid, Coolanol 45, as coolant for tube and hydraulic fluid for power transmission.

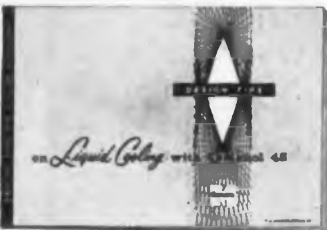
### EXAMPLE:



The schematic diagram shows how you can standardize, miniaturize, and simplify your design problem in one step with Coolanol 45. Coolanol 45 gives you efficient heat transfer for accurate temperature control . . . dielectric properties for safe operation . . . dependable power transmission . . . *all of these* over the remarkable temperature range of  $-65^{\circ}$  to  $400^{\circ}$  F!

### SEND FOR NEW DESIGN BOOKLET

"Design Tips on Liquid Cooling with Coolanol 45" discusses static and dynamic cooling methods, how to apply the package concept to cooling design, how to simplify and standardize cooling and hydraulic units. It gives you a step-by-step solution to a typical cooling problem to show you how to apply principles of heat transfer in actual practice. For your copy of this new booklet, circle the reader-service number . . . or write direct:



Coolanol: Monsanto T. M., Reg. U. S. Pat. Off.

**MONSANTO CHEMICAL COMPANY, Organic Chemicals Division  
Aviation Fluids Department, St. Louis 66, Missouri**

When you need a synthetic fluid, come to Monsanto—creator of fluids for the future

CIRCLE 39 ON READER-SERVICE CARD

## IDEAS FOR DESIGN

### Simple, Constant Voltage To Constant Current Converter

The simple and economical circuit of Fig. 1 converts a 28 v dc power supply into a constant current source. It also functions as a current limit of protective device since load current may increase with changing load till a preset maximum is reached.

Above this point no further increase may occur, as the circuit goes "into regulation . . ." This feature enables current protection of semiconductors and meters, without interfering with normal circuit operation and meter readings.

Because the regulator maintains a constant current, it presents a constant load to the power supply. Load regulation of the power source is therefore of no consequence, hence the low cost type of power supply, which uses a constant voltage transformer for line regulation only, is quite adequate. Further, input ripple voltage of up to 10 per cent peak to peak may be tolerated without the need for large ripple filter components, since ripple reduction of 96 per cent is achieved.

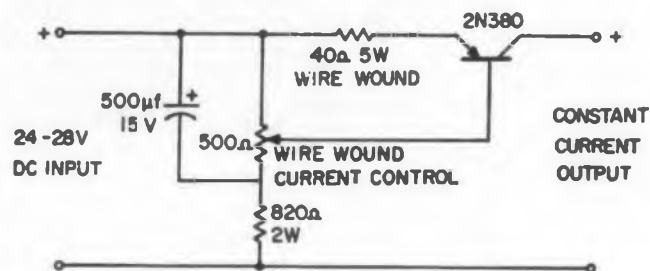


Fig. 1. Simple constant voltage to constant current converter can be used as an adjustable current limiter.

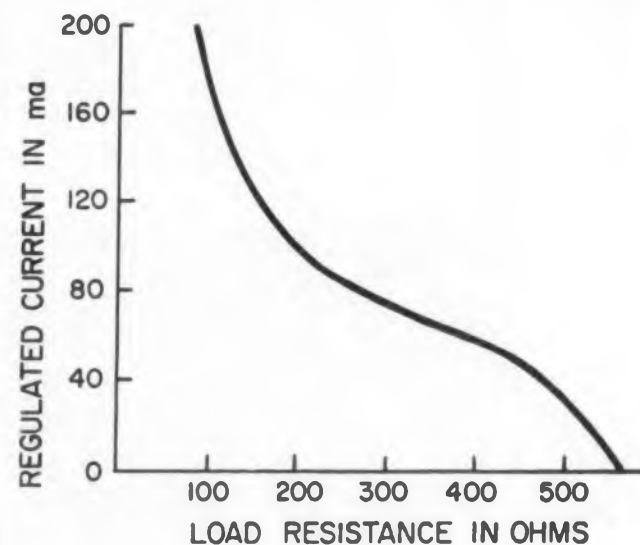


Fig. 2. The converter regulates the current in the shaded area to within two per cent. Thus with the current control potentiometer set for 80 ma, the load resistance can be varied from zero to 300 ohms.

## ENGINEERS RESEARCH OPPORTUNITIES

Aeronutronic, a new division of Ford Motor Company, has immediate need for computer engineers to staff its new \$22 million Research Center in Newport Beach, Southern California. Here, you have all the advantages of a stimulating environment, working with advanced equipment, located where you can enjoy California living at its finest.

Look into these ground floor opportunities in research and development work that is challenging and exceptionally rewarding to qualified men.

### Positions now open:

Systems Engineer  
Magnetic Memory Engineers  
Communications Engineers  
Digital Computer Programmers  
Transistorized Circuit Engineers  
Logical Designers  
Circuit Engineers  
Mechanical Engineers  
Optical Engineers

Qualified applicants are invited to send resumes or inquiries to Mr. R. E. Durant, Aeronutronic, Box NJ-486, Newport Beach, California.

Visit Aeronutronic's  
exhibit booth  
3822-24  
at the  
WESCON show.

COMPUTER OPERATION  
**AERONUTRONIC**  
A DIVISION OF  
FORD MOTOR COMPANY

Newport Beach  
Santa Ana • Maywood,  
California

CIRCLE 907 ON CAREER FORM, PAGE 61  
CIRCLE 845 ON READER-SERVICE CARD

# MICROWAVE GENERATORS

950 to 21,000 mc

## with MORE MODULATION CAPABILITIES

The extremely wide range of pulse width, delay and repetition rate are read directly on the front panel of Polarad microwave generators. In addition these units provide broadband internal FM and CW modulation, versatile external modulation capability and a sync output for all signals. These features provide the largest choice of microwave test signal combinations available in signal generators.

Internal pulse rise and decay: 0.1 microsecond.\*

External pulse modulation: positive or negative polarity, 10 to 10,000 pps, 0.2 to 100 microseconds width.\*

Output synchronization pulses: positive polarity, delayed and undelayed.

Rugged construction. Quick, easy inspection and servicing. Continuous UNI-DIAL tuning in each frequency range. Non-contacting tuning cavity chokes.

For every application, 950 to 21,000 mc.

Model	Frequency Range	Power Output
MSG-1	950 to 2,400 mc	0 dbm (1 milliwatt) to -127 dbm, directly calibrated
MSG-2	2,000 to 4,600 mc	
PMX	6,950 to 11,000 mc	+ 10 dbm (10 milliwatts) to -90 dbm
MSG-34	4,200 to 11,000 mc	
PMK	10,000 to 15,500 mc 15,000 to 21,000 mc	

### AND MICROWAVE POWER SOURCES—1,050 to 17,500 mc.

High power output: 14 to 700 milliwatts depending on frequency. Modulation: Internal square wave or external FM and square wave.



## POLARAD ELECTRONICS CORPORATION

43-20 34th Street  
Long Island City 1, N. Y.  
Representatives in principal cities

MAIL THIS CARD for specifications. Ask your nearest Polarad representative (in the Yellow Pages) for a copy of "Notes on Microwave Measurements"

### MODULATION CAPABILITIES\*

Generates CW, FM, internal pulse, internal square wave. Or can be externally modulated.

Pulse delay: adjustable from 2 to 2,000 microseconds.

Pulse repetition rate: adjustable from 10 to 10,000 pps.

Pulse width: adjustable from 0.2 to 10 microseconds.

Linear sawtooth internal FM modulation, 10 to 10,000 cps, 5 mc minimum frequency deviation.

Internal or external, pulse or sine wave synchronization.

\*Models MSG-34, PMX and PMK



### POLARAD ELECTRONICS CORPORATION:

Please send me complete specifications for:

ED - EDN

- Microwave Signal Generators, \_\_\_\_\_ to \_\_\_\_\_ mc
- Microwave Power Sources, \_\_\_\_\_ to \_\_\_\_\_ mc

My application is: \_\_\_\_\_

Name \_\_\_\_\_

Title \_\_\_\_\_ Dept. \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

# MICROWAVE GENERATORS

## 18,000 to 50,000 mc.

### MICROWAVE SIGNAL GENERATORS

18,000 to 39,000 mc

7 interchangeable plug-in tuning units  
 Calibrated power output: -10 to -90 dbm  
 Direct-reading attenuator, accurate to 2%

### MICROWAVE POWER SOURCES

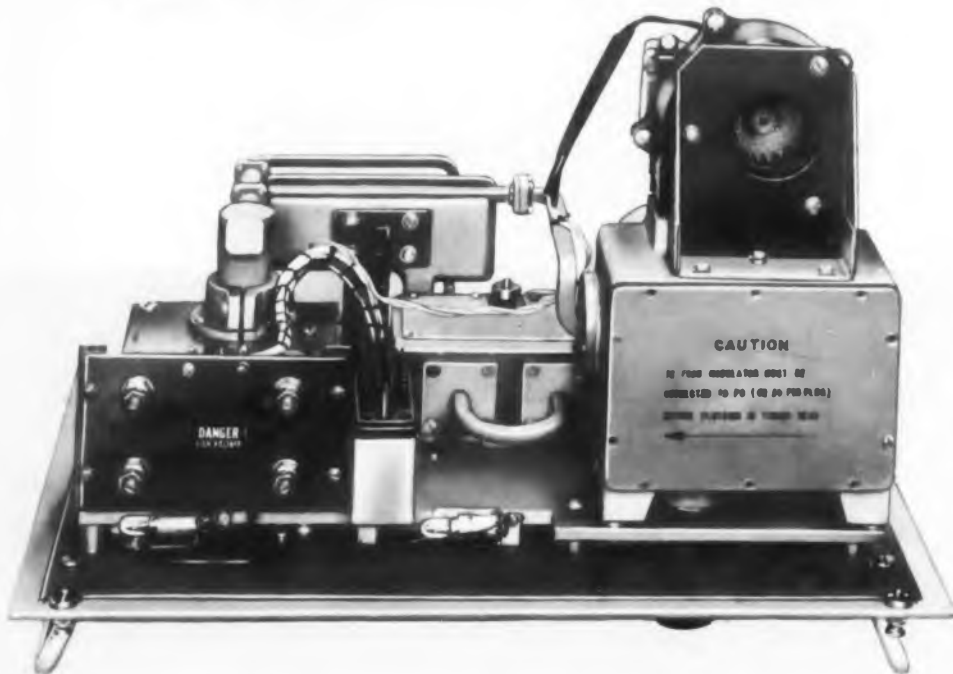
18,000 to 50,000 mc

9 interchangeable plug-in tuning units  
 High power output: 10 mw from 18,000 to 33,520 mc.  
 Between 9 and 3 mw in higher ranges, depending on frequency.

### PLUG-IN INTERCHANGEABILITY

Now you can work at Extremely High Frequencies with one basic microwave generator, using only the tuning units in the ranges you require immediately. Later, as your work expands to other frequencies, add only tuning units — not complete generators.

All instruments provide: a direct reading wavemeter, indicating frequency to 0.1% accuracy; continuous tuning over entire range; 1,000 cps internal square-wave modulation — or external modulation; direct waveguide output connectors. All are designed for quick, easy inspection and servicing.



Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

**BUSINESS REPLY CARD**  
 First Class Permit No. 18, Long Island City 1, N. Y.



**POLARAD ELECTRONICS CORP**  
 43-20 34th St., Long Island City 1, N. Y.

MAIL THIS CARD for specifications. Ask your nearest Polarad representative (in the Yellow Pages) for a copy of "Notes on Microwave Measurements".

FREE LIFETIME SERVICE ON ALL POLARAD INSTRUMENTS

**POLARAD ELECTRONICS CORPORATION**

43-20 34th Street Long Island City 1, N. Y.  
 Representatives in principal cities

Out  
 two p  
 cated  
 Fig. 2  
 of 50 t  
 output  
 current  
 load  
 leakage  
 Oper  
 current  
 through  
 tively  
 When  
 sistor i  
 rent is  
 ance. C  
 the loa  
 current  
 Anot  
 tice as  
 When  
 voltage  
 set on  
 can be  
 ect of  
 imum  
 cuits r  
 Bern  
 ramus,  
 The  
 widely  
 accide  
 low ve  
 A bi  
 resistor  
 network  
 the m  
 In F  
 bulb c  
 and, a  
 H. P  
 This p  
 played  
 ← CIRC

Output current is constant to within less than two per cent with load resistance variations indicated under the shaded areas of the graph in Fig. 2. The control provides constant currents of 50 to 200 ma. A 500 ohm resistor shunting the output terminals of the regulator will allow low currents from zero to 150 ma to be drawn by a load without introducing effects of transistor leakage current.

Operation is based on the fact that collector current of a transistor depends on the current through the emitter-base junction, and is relatively independent of the collector voltage. When functioning as a current limit, the transistor is in the saturated state and collector current is determined by the collector load resistance. Once the preset current limit is reached, the load resistance no longer determines the load current—the transistor does.

Another application of this device merits notice as having use with semiconductor circuitry. When used in conjunction with an adjustable voltage power supply, maximum voltage can be set on the power supply, and maximum current can be set with the current limit stop. The product of voltage and current being power, maximum power is then limited to safe levels in circuits requiring power dissipation limiting.

Bernard Daien, Div. of ACF Industries, Paramus, N. J.

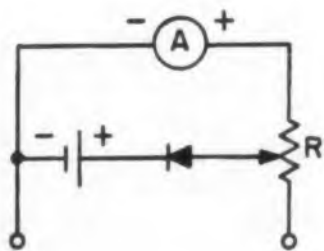
### Neon Bulb Meter Protection Gives Overload Warning

The circuit shown in the figure is rather widely used to protect meter movements against accidental over-scale currents. It is useful in low voltage circuits.

A bias voltage of, say 1.5 v, and an adjustable resistor can set the point at which this bypass network will shunt the excess current around the meter movement.

In higher voltage circuits, a miniature neon bulb can replace the bias and diode network and, at the same time, warn of excess current.

H. Hsu, General Electric Co., Syracuse, N. Y.



This popular meter protection network can be replaced by a miniature neon bulb at high voltages.

*This month's news from Raytheon . . .*

## RAYTHEON ANNOUNCES NINE NEW SUBMINIATURE TRANSISTORS

### Raytheon Distributors offer you broadest line of Submins

**WHATEVER YOUR REQUIREMENTS**—Raytheon offers 22 types of subminiature transistors for use in computers, general purpose audio, IF and RF for radio receivers and general purpose RF circuits. This broad Raytheon line now lets you select subminiature transistors to meet your exact requirements.

**TOP PERFORMANCE AND RELIABILITY**—Every Raytheon transistor features rigid processing control that insures reliability and stability of electrical characteristics. This rigid control lets you select any of these types with complete confidence in their performance.

**FAST, EFFICIENT SERVICE**—Raytheon Industrial Electronic Distributors offer these transistors and products to fill all your electronic needs from complete local stocks. You get faster, more efficient service and at no penalty in price.

**SINGLE SOURCE, ONE STOP BUYING**—Whatever your electronic needs, your local Raytheon Industrial Products Distributor offers you a complete line of industrial tubes including a new line of industrial control tubes, electronic hardware and now the broadest line of subminiature transistors available.

### About Industrial Distributors

by John Hickey,  
Raytheon Industrial Products Manager

Every industrial distributor must have you, the customer, in mind at all times. To do this he must offer at all times, the best of service—fast and efficient, complete knowledge of your electronic needs, full, one-stop coverage of all your electronic requirements, and the best in prices. Every Raytheon Industrial Distributor satisfies all these requirements. If you don't know your nearest Raytheon Industrial Electronics Distributor, write me direct and I'll be glad to give him your name or have him call you.



**RAYTHEON**

RAYTHEON COMPANY • DISTRIBUTOR PRODUCTS DIVISION

CIRCLE 41 ON READER-SERVICE CARD

**RAYTHEON**

Raytheon  
Distributors  
Serving  
Key Markets  
Include:

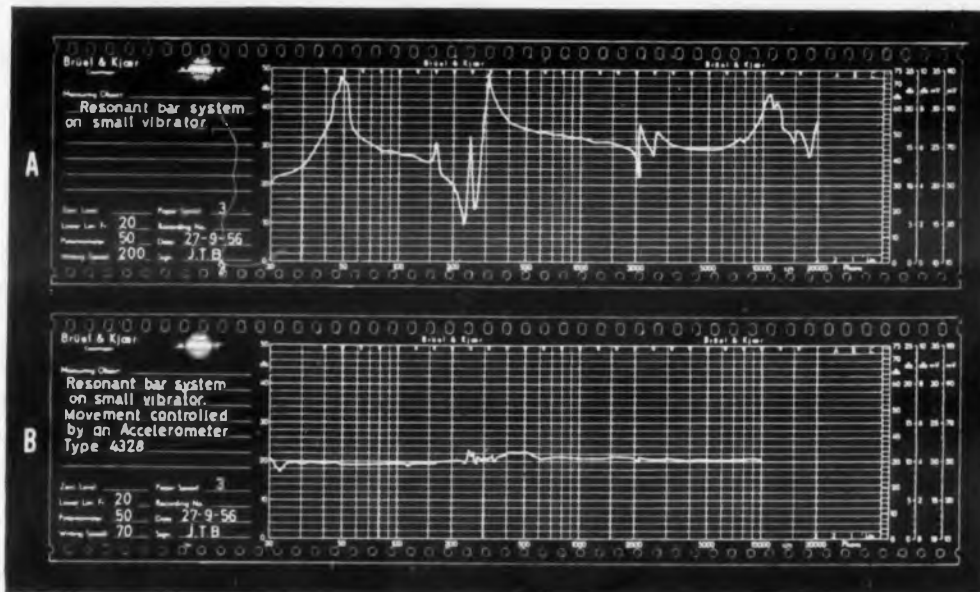
Baltimore, Md.  
Wholesale Radio Parts Company  
Birmingham, Ala.  
Forbes Distributing Company  
Boston, Mass.  
DeMambro Radio Supply Company  
Burbank, Cal.  
Valley Electronic Supply Company  
Chicago, Ill.  
Newark Electric Company  
Cleveland, Ohio  
Main Line Cleveland, Inc.  
Pioneer Electronic Supply Corporation  
Dayton, Ohio  
Srepco, Inc.  
Denver, Colo.  
Ward Terry & Company  
Detroit, Mich.  
Ferguson Electronic Supply Company  
Inglewood, Cal.  
Newark Electric Company  
Kansas City, Mo.  
Burstein-Applebee Company  
Knoxville, Tenn.  
Bondurant Bros. Company  
Los Angeles, Cal.  
Kierulff Electronics Corporation  
Milwaukee, Wis.  
Electronic Expeditors, Inc.  
Mobile, Ala.  
Forbes Electronic Distributors, Inc.  
New York City  
Arrow Electronics, Inc.  
H. L. Dalis, Inc.  
Milo Electronics Corporation  
Oakland, Cal.  
Elmar Electronics  
Philadelphia, Pa.  
Almo Radio Company  
Phoenix, Ariz.  
Radio Specialties & Appliance Corporation  
Portland, Ore.  
Lou Johnson Company  
Tampa, Fla.  
Thurow Distributors  
Tulsa, Okla.  
S & S Radio Supply  
Washington, D. C.  
Electronic Wholesalers, Inc.

This is a partial listing only. Names of other Raytheon Industrial Distributors on request from John Hickey, Raytheon Distributor Products Division, 55 Chapel St., Newton 58, Mass.

**AUTOMATICALLY...**

**Correct Test Signals  
to a Constant Level  
Scan Frequencies  
Plot Responses**

Automatic regulation of the test system frequency response (A) produces a constant level testing signal (B).



Model 3302 Response Recorder

- ▶ Cuts Testing Time —
- ▶ Greatly Reduces Possibility of Operator Error!

Three test systems for these ranges:  
2-4000 c/s; 20-20,000 c/s; 200-200,000 c/s.

Frequency response recordings of amplifiers, speakers, microphones, accelerometers, mechanical resonance, as well as other measurements requiring a controlled signal source are now performed automatically. Bruel & Kjaer measuring instruments perform this function in far less time than is possible with other techniques.

The Response Recorders are a basic module in the Bruel & Kjaer Integrated Instrument Systems for measuring sound, vibration and strain.

**Exclusive Franchised U. S. Marketing Agent for  
Bruel & Kjaer Instruments**



**B & K INSTRUMENTS, Inc.**

3030 W. 106th STREET • CLEVELAND 11, OHIO • Clearwater 1-8430

CIRCLE 42 ON READER-SERVICE CARD

**IDEAS FOR DESIGN**

**Diode Clipper Needs No Bias Supply**

The circuit shown in Fig. 1 will clip a recurrent wave at any desired level without the use of a bias supply.

Capacitor  $C$  charges through diode  $D_1$  with time constant  $R_1C$  and discharges through diode  $D_2$  with time constant  $R_2C$ . After steady state has been reached, the voltages at (a) and (b) are as shown in Fig. 2.

During charge, the voltage change across  $C$  is

$$-\frac{1}{C} \int_0^{t_1} i_1(t) dt = -\frac{1}{CR_1} \int_0^{t_1} e_1(t) dt = -\frac{A_1}{CR_1} \quad (1)$$

where  $i_1(t)$  is the instantaneous charging current and  $e_1(t)$  is the resultant voltage drop across  $R_1$  (neglecting the forward resistance of  $D_1$ ).

During discharge, the voltage change across  $C$  is

$$\frac{1}{C} \int_0^{t_2} i_2(t) dt = \frac{1}{CR_2} \int_0^{t_2} e_2(t) dt = \frac{A_2}{CR_2} \quad (2)$$

where  $i_2(t)$  is the instantaneous discharge current and  $e_2(t)$  is the corresponding voltage dropped across  $R_2$ .  $A_1$  and  $A_2$  represent, respectively, the areas below and above zero in Fig. 2. Since, under steady state conditions, the net voltage change per cycle across  $C$  must be zero,

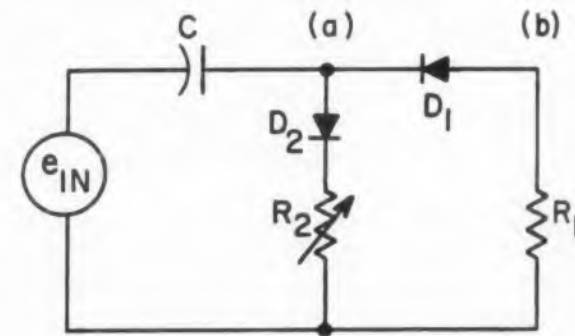


Fig. 1. Any-level clipper uses no bias supply.

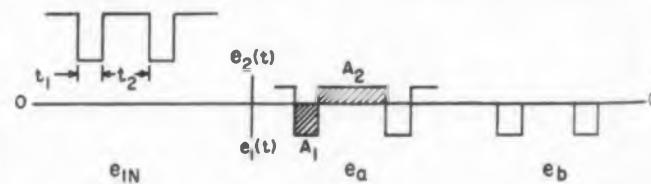


Fig. 2. Steady-state voltage levels for the diode clipper.

$$\frac{A_2}{CR_2} - \frac{A_1}{CR_1} = 0$$

and

$$\frac{A_1}{A_2} = \frac{R_1}{R_2} \quad (3)$$

Eq. (3) shows that, for a constant load, the dc level at point (a) can be controlled by  $R_2$ . Since diode  $D_1$  will not conduct until  $e_a$  goes negative, the signal may be clipped at any level by adjust-

Gentlemen:

Please send me the

- B & K Response Recorder Brochures
- B & K Complete Line Catalog

NAME \_\_\_\_\_

COMPANY \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

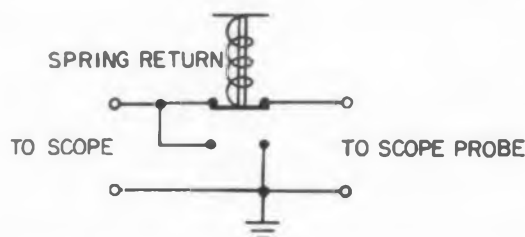
ing resistor  $R_2$ . The output,  $e_b$ , will be referenced to ground (or to any desired voltage if a bias source is used) regardless of the input dc level. Diodes  $D_1$  and  $D_2$  would be reversed for a positive-going input signal.

David E. Perlman, Eastman Kodak Co., A. & O. Division, Rochester 4, N. Y.

### Where's Ground?

Anyone who has used an oscilloscope will appreciate this little device.

When debugging a piece of equipment, or breadboard, it becomes necessary to use a scope. In the process of checking points in the circuit, ground reference is needed to determine the dc level of the signal. This is usually done by removing the scope probe and grounding it. Then the ground level is set and the reading may be taken.



Scope adaptor shows ground level quickly.

The device shown here allows instantaneous determination of the ground reference point. It is basically a small aluminum box. A male connector at one end of the box plugs into the scope. The scope probe plugs into a female connector at the other end of it. A dpst switch, on the box, is a normally closed push button type.

To determine ground level, just push the button.

Joseph J. Russo, Electrical Engineer, Burroughs Corp., Paoli, Pa.

### Colored Tape Improves Panel Design

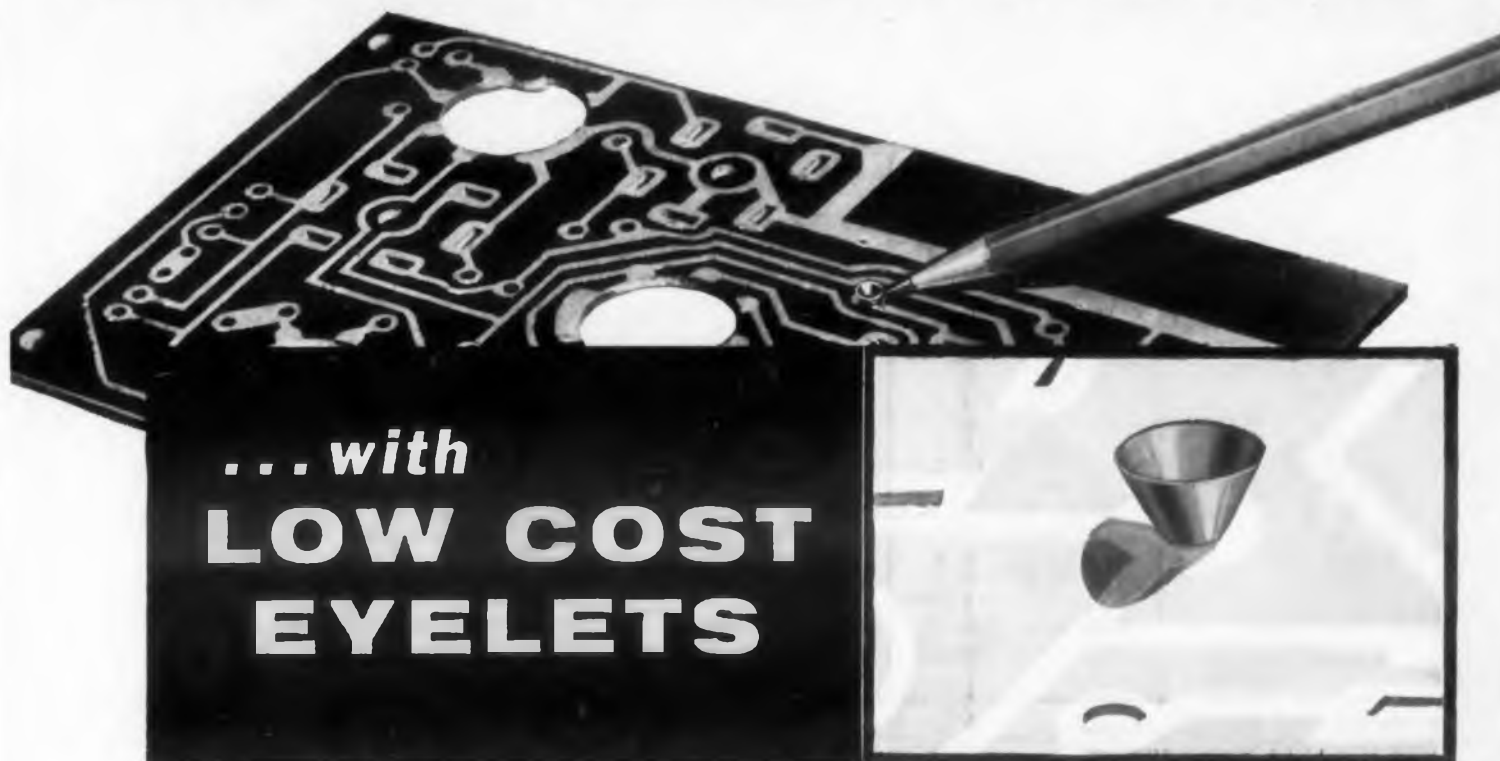
White engravings on black or gray backgrounds are harsh on the eyes. Especially on large test panels, where there may be a dozen or more multi-position rotary switches, the harshness of engraved letters and numerals can cause errors and can slow up production testing.

A simple solution requires cutting and applying yellow Scotch tape pointers to switch knobs, and green Scotch tape pointers at major switch positions—5, 10, 15, etc.

This relieves eye fatigue and minimizes testing errors.

Joseph Leeb, Project Engineer, Bulova Watch Co., Jackson Heights, N. Y.

# RELIABLE CONNECTIONS



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

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



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

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



NEW EYELET SELECTOR — FREE

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



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



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

## United

UNITED SHOE MACHINERY CORPORATION  
Boston 7, Massachusetts • Liberty 2-9100

Branches: Atlanta, Ga. • Chicago, Ill. • Cincinnati, Cleveland, Columbus, Ohio • Dallas, Texas • Harrisburg, Pa. • Johnson City, N. Y. • Los Angeles, Calif. • Lynchburg, Va. • Milwaukee, Wisc. • Nashville, Tenn. • New York, N. Y. • Philadelphia, Pa. • Rochester, N. Y. • St. Louis, Mo.

CIRCLE 43 ON READER-SERVICE CARD

# Widest Option in Low-Power Rotary Switches

## SECTIONS

<p>THROW: 30°, 36°, 45° INSULATION: stator glass silicone; rotor, KEL-F</p>	<p>THROW: 30°, 45°, 60°, 90° INSULATION: phenolic, Mycalex, ceramic</p>	<p>THROW: 25.7°, 30°, 36° INSULATION: phenolic, ceramic</p>	<p>THROW: 18°, 20°, 30°, 36°, 45°, 60°, 90° INSULATION: phenolic, Mycalex, ceramic</p>	<p>THROW: 30°, 36°, 45°, 60°, 90° INSULATION: phenolic, Mycalex, ceramic</p>
<p>THROW: 20°, 40° INSULATION: phenolic</p>	<p>THROW: 15°, 30° INSULATION: phenolic</p>	<p>THROW: 20°, 40° INSULATION: phenolic, Mycalex</p>	<p>THROW: 12.85°, 25.7° INSULATION: phenolic</p>	<p>THROW: 12.85°, 18°, 25.7°, 36° INSULATION: phenolic</p>

## METAL PARTS AND FINISHES

**STANDARD COMMERCIAL**—Punched steel parts are lead-coated, cold-rolled steel. Parts such as nuts, lockwashers, etc., are cadmium-plated steel. Shafts may be cadmium-plated steel, brass, or aluminum. Brass parts are unplated.

**TROPICAL OR 50-HOUR SALT SPRAY MILITARY SPECIFICATIONS**—All steel and brass parts are cadmium-plated and chromate-dipped. Stainless steel parts are passivated.

**200-HOUR SALT SPRAY MILITARY SPECIFICATIONS**—All brass parts are nickel plated. All stainless steel parts are passivated. Shafts, "C" washers and index springs, balls and plates are stainless steel.

## CONTACTS

**Famous Oak double wiping, high-pressure design. Riveted or eyeleted in place and keyed from turning. Rotors shorting or nonshorting.**



**TYPE 1**—Contacts are spring brass, silver-plated. Rotors are brass, silver-plated. Temperature limit: 100°C constant ambient.

**TYPE 2**—Contacts, spring tempered-silver alloy. Rotors, coin-silver alloy. Temperature limit: 100°C constant ambient.

**TYPE 3**—Contacts and rotor blades made of Oak alloy

**CMS-202.** This is a special alloy for high temperature operation to 150°C.

**GOLD-PLATED CONTACTS**—Type 1 or 2 contacts may be gold-plated .0002" thick. Not to be confused with gold flash. **FOR PRINTED CIRCUITS**—Standard Oak contacts with a lug extending from the terminal end. Lug inserts in board for dip soldering.

## ACCESSORIES



**AC SNAP SWITCHES**—36 models for use on most switch types. All are UL approved.

**POTENTIOMETERS**—Customers' choice. Mounts on rear of Oak switches. Operates by switch shaft or separate concentric shaft.

**ELECTROSTATIC SHIELDS**—Used between sections. Sizes and shapes for all switches.

**BEARING STRAPS**—Added shaft support on long switches. Steel, brass, and phenolic.

**MOUNTING BRACES**—Prevents frame twist on long switches due to torsion.

**SPECIAL SHAFTS**—Hollow, dual-concentric, and triple-concentric for many switches.

# OAK MFG. CO.

1260 Clybourn Ave., Dept. D, Chicago 10, Illinois  
Phone: MOhawk 4-2222

When your design calls for a low-power rotary switch, you want a unit that matches job requirements exactly—not an "almost" fit. But in the process you don't want the switch to involve a lot of extra tooling and delay either. At Oak, the above options, plus numerous other alternatives in construction, are *pretooled* for economy, service, and convenience.

Specify your low-power switches the easy way—from the most diversified, the most "ready-to-go" line available.

CIRCLE 44 ON READER-SERVICE CARD

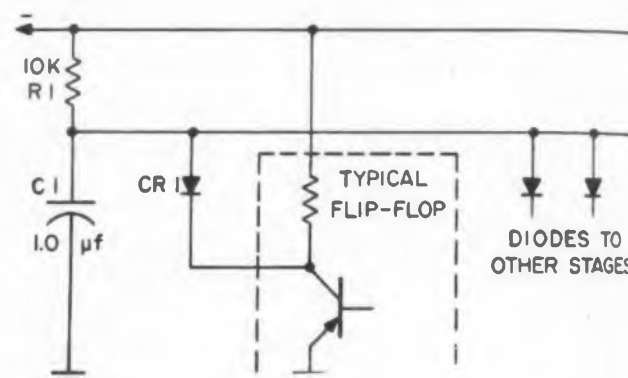
## IDEAS FOR DESIGN

### Circuit Determines Initial State of Flip-Flop

In digital circuits, when power is applied to flip-flops initially, they will often come on in a random choice between their two states. This problem can result in a mixed up computer unless something is done to control the initial state of the flip-flops.

In the circuit shown, capacitor *C1* is initially discharged. It causes the diodes to clamp one side of each controlled flip-flop to ground when the power is first applied. The resistor *R1* slowly charges *C1* until all the diodes are backbiased and the control circuit removes itself from the circuit to permit normal operation. The flip-flops are now in the proper state for operation.

Roy P. Foerster, Baltimore, Md.



Combination of *C1*, *R1*, and *CR1* insures that flip-flops always start in same state.

### Silicon Controlled Rectifiers Control High Power—Fast

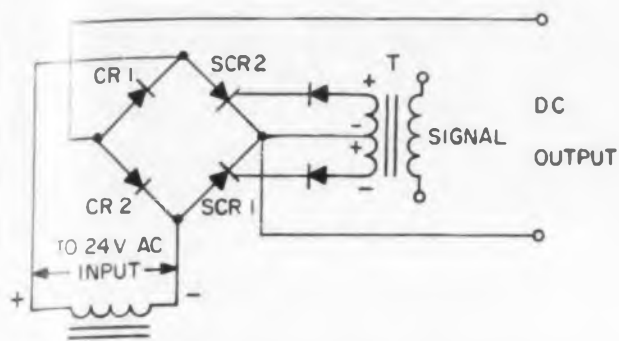
We needed a high-current, high-voltage arcless contactor with a response time of one cycle or less.

The contactor was required to switch dc power on and off into resistive, inductive, or capacitive loads. The switch had to operate in an explosive atmosphere; it had to be light and small.

We chose silicon controlled rectifiers because they are light and small and, in switching, don't have more than a few microseconds delay. No arc is developed, even with the inductive load, and the danger of flashback is minimum.

The circuitry assumes various configurations. One of them, the full wave bridge, is shown here. Instantaneous polarities are as indicated. When the transformer, *T*, is energized, the supply will be switched on instantaneously. The output of *T* is of sufficient magnitude and is in the correct phase to trigger the SCR's. The frequency is the same as that of the main power source.





Silicon controlled rectifiers help this contactor switch high power to any kind of load within one cycle of the power line frequency.

When the signal polarity is shifted or reversed, the output will be reduced or cut off completely. Reduced or controlled stepless output can easily be accomplished by replacing the signal transformer with an Avion Trigger, Model 410.

The silicon controlled rectifiers are mounted on light aluminum heat sinks. When the explosionproof contactor has to be hermetically enclosed, this contactor doesn't need more than a simple, light, standard enclosure. Very high surge currents are handled by the solid state contactor. It performs exceptionally well even when working directly into a stalled dc motor armature.

Power supplies for transistorized computers have to disconnect the input when the voltage rises above a preset level. Interruption has to be accomplished within as short a period as possible. The contactor described here is a natural for such an application.

Baruch Berman, Group Engineer, Avion, Paramus, N.J.

### Cast-in-Epoxy Search Coils For Permanent Magnet Testing

The use of a close-fitting cast-in-epoxy search coil permits one to measure both the open magnetic circuit induction values and the closed magnetic circuit (demagnetization curve) values of permanent magnets with a single, close-fitting, search coil.

Ordinarily, for the closed magnetic circuit test, the search coil is wound directly on the magnet prior to testing and removed immediately after testing. For the usual open magnetic circuit measurements, the use of a coil wound on a sleeve results in appreciable leakage flux in the gap between the coil proper and the magnet. This must be compensated for, either by the use of a bucking coil, or by calculation.

The completed coil form shown at the bottom of the accompanying photo was one of several such coils made in conjunction with a permanent magnet irradiation project undertaken by the

(Continued on page 54)

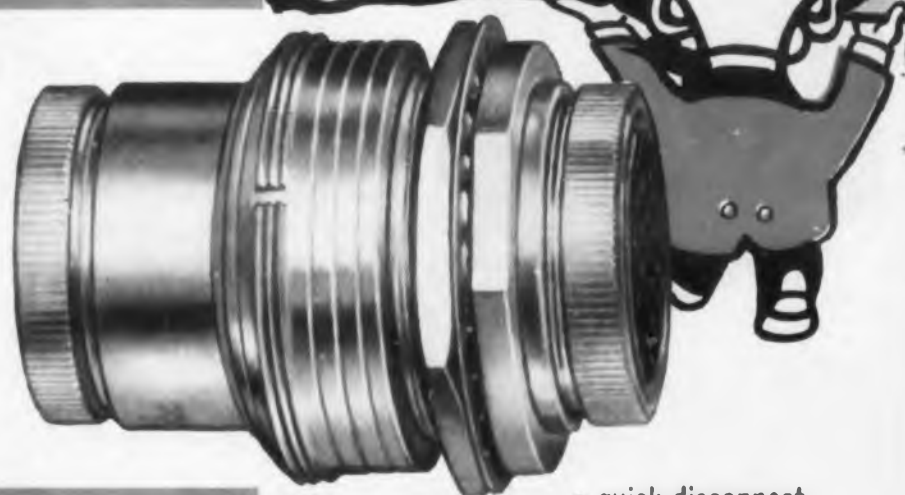
# DEUTSCH DM SERIES MINIATURE CONNECTORS

## MEET

\*or exceed

## NEW

# MIL-C-26482



- quick disconnect
- environmental
- unique ball-lock coupling
- moisture sealed
- vibration dampened
- continuous dielectric separation without voids
- positive lock without safety wiring
- operation to 250°F.

For complete technical information, contact your Deutsch Representative or write us for data file C-8



See us at WESCON, Booth 611-613

## The Deutsch Company

7000 Avalon Boulevard • Los Angeles 3, California

© THE DEUTSCH COMPANY, 1959

CIRCLE 45 ON READER-SERVICE CARD

## Bulletin: DM is MS...

Now you can freely design these advanced push-pull miniatures into your application because the Deutsch DM Series is built to meet this new miniature connector Mil Spec.

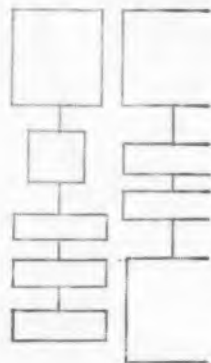
Loaded with special Deutsch-developed features, these environmental miniatures have been proved under the punishing conditions of more than one hundred major electronic systems for military and commercial use.

here's a complete  
element of your  
block diagram...

now  
readily available

# R | P | M \*

\*REGULATED POWER MODULE



All design, development and production work has been completed for you in these RPM power modules. Buy them as catalog items, and get these advantages:

**Wide choice** of overlapping adjustable voltage and current ranges—125 to 425 volts...50 to 400 milliamps.

**Excellent regulation**—0.05% NL to FL, or 10% line change.

**Compactness**—RPM units are custom designed and built with our own transformers for most efficient use of space.

**Super-rugged construction** includes one-piece, cast aluminum housings and JAN hardware. RPM modules can be mounted in any position.

**High reliability**—achieved by use of top quality components throughout, and rigid inspection during production.

Request ACDC Bulletin 400.



**ELECTRONICS, INC.**  
2979 N. Ontario St., Burbank, Calif.  
Formerly NYT ELECTRONICS, INC.

CIRCLE 46 ON READER-SERVICE CARD

## IDEAS FOR DESIGN

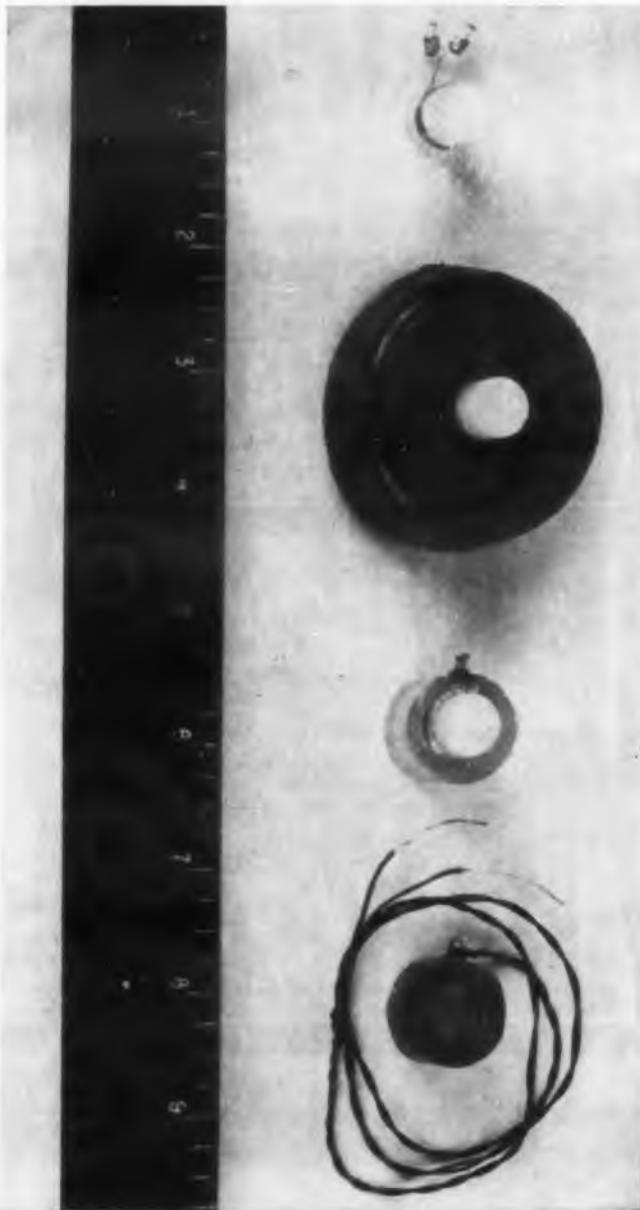
(Continued from page 53)

Naval Ordnance Laboratory, Silver Spring, Md. This project involved measuring the pre- and post-irradiation magnetic properties of a set of permanent magnets subjected to nuclear irradiation.

Because the post-irradiation measurements had to be made in a "hot cell" (using remote control master slave manipulators) some other method than the conventional one of winding 10 to 30 turns on each closed magnetic circuit sample had to be developed. The problem was solved by devising the cast-in-epoxy search coil.

The photo shows the completed form and some of the steps required in its manufacture. The procedure is as follows: A piece of Teflon is machined so that its diameter is about 0.001 in. to 0.002 in. larger than that of the magnet.

An appropriate number of turns is wound on the Teflon and tacked on with a quick drying



**Steps in the manufacture** of cast-in-epoxy search coils. From top to bottom: Search coil wound on Teflon form; plastiflex mold with Teflon form in epoxy; Teflon and search coil in cured epoxy; completed cast-in-epoxy search coil with leads soldered to terminals.

"go"/"no-go"  
voltage measurements

— specify **VOLTRON**  
for high accuracy, high  
reliability, and low cost.



### VOLTRON VOLTAGE INDICATOR

— tells the operator whether or not the monitored voltages are within predetermined limits. Indicator has an expanded scale, with each scale marked in arbitrary units. Meter can be programmed to represent a wide range of voltages.

**Accuracy:** DC — 0.25%, AC — 0.5%

**Temperature Range:** —55 to 71°C for Military meters; 0 to 50°C for Industrial meters.

**Vibration, Humidity, Shock:** Military meters meet MIL-M-10304A



### VOLTRIP VOLTAGE COMPARATOR

— built with an amplifier and relay instead of the indicating meter. The relay operates when the voltage falls outside of predetermined limits. Unit can be programmed by either analog or digital methods.

**Signal Voltage Range:** DC: —500 to —1.0, and +1 to +500 volts. AC: 5 to 500 volts.

**Accuracy of Trip Point:** **MILITARY VOLTRIPS:** DC: 0.25% of voltage programmed  
AC: 0.5% of voltage programmed from —55°C to +71°C.  
**INDUSTRIAL VOLTRIPS:** DC: 0.5% of voltage programmed  
AC: 1.0% of voltage programmed from 0 to 40°C.

**Repeatability:** Approx. 1/4 of the specified error.

**Construction:** MIL-T-27 Size FA can.

Complete data will be sent on request.  
Write for Bulletin 34.

**VOLTRON Products**

1010 Mission St., South Pasadena, California

CIRCLE 574 ON READER-SERVICE CARD  
ELECTRONIC DESIGN • August 19, 1959

cement. The free ends of the coil are soldered to modified turret terminals. The Teflon is next placed in a plastiflex mold and centered. The epoxy resin is then poured in and cured.

After curing, the mold is peeled off and the Teflon is forced or punched out. Leads of desired length are soldered to the terminals which project out of the side of the cast epoxy.

By machining or grinding the sample magnets to close enough tolerances, it was possible to use one coil form for six different irradiated magnets. Calculations show that the clearances are small enough to have negligible effects on accuracy.

A broader application of such search coils would be for sampling tests on large batches of magnets having the same nominal dimensions. This would eliminate much of the time and labor expended on individually winding each sample to be tested, particularly for demagnetization.

R. S. Sery, U. S. Naval Ordnance Laboratory, Silver Spring, Maryland.

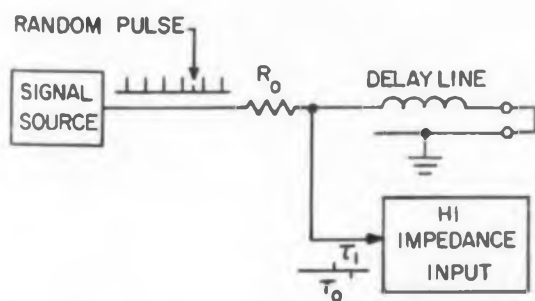
### Shorted Line Helps Detect Random Pulse

It is often necessary to detect the presence of random, high frequency pulses, which may occur during a series of pulses of equal period and duration. It is often possible to "OR" the random pulses with the series of pulses and recover them this way.

However, if the pulse series is not present alone, or if stray capacity is too large at the frequencies used, another method is required.

A short circuited delay line, connected as shown in the diagram, can recover the random pulse. For the recurrent pulses, the reflected pulses will cancel the transmitted pulses. The random pulse will remain. The delay line must be cut to the period of the recurrent pulses and must have a high bandwidth.

Irving Bayer, Lewyt Mfg. Co., Long Island City, N. Y.



Shorted delay line helps capture random pulse in a recurrent train. In this drawing  $R_0$  equals the characteristic impedance of the line,  $\tau_0$  is the time the random pulse occurs,  $\tau_1$  is the time it returns from the line. The difference between these times will be twice the length of the line.

# UNIFORM-UNIFORM-UNIFORM



## VICKERS®

## SILICON POWER RECTIFIERS

SOUND ENGINEERING • PRECISE MANUFACTURE • THOROUGH TESTING

assure

GREATER RELIABILITY • CONSISTENT QUALITY • LONGER LIFE AT LESS COST

Every Vickers Silicon Power Rectifier offers the same excellent operating characteristics: extremely low reverse current and forward drop; stability at high temperatures; greater economy, with current ratings as much as 25% above other rectifiers of similar size and price.

This uniformity is achieved through stringent manufacturing and quality control techniques, with "surgical" cleanliness at every stage of production. Uniformity in manufacturing produces higher yield of perfect rectifiers at minimum cost to you. Uniformly high product quality means exceptional reliability—low maintenance costs.

For complete information on Vickers Silicon Power Rectifiers, available in 2, 8 and 12 ampere sizes, contact the sales engineering office below, or write for Series 3300 Bulletins.

VOLTAGE	CATALOGUE NUMBERS			DIMENSIONS
	2 AMPERES	8 AMPERES	12 AMPERES	
100 V	AA 10	BA 10	CA 10	
200 V	AA 20	BA 20	CA 20	
300 V	AA 30	BA 30	CA 30	
400 V	AA 40	BA 40	CA 40	
500 V	AA 50	BA 50	CA 50	
600 V	AA 60	BA 60	CA 60	



### VICKERS INCORPORATED

DIVISION OF SPERRY RAND CORPORATION

## ELECTRIC PRODUCTS DIVISION

1841 LOCUST STREET • SAINT LOUIS 3, MISSOURI

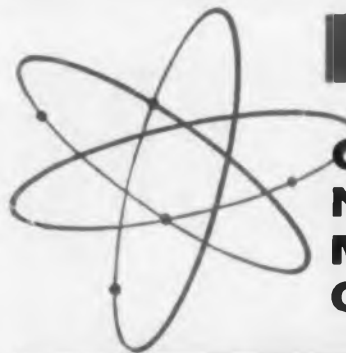
Sales Engineering Offices  
 ST. LOUIS—CEntral 1-5830  
 DETROIT—KEnwood 4-8070  
 WASHINGTON, D. C.—EExecutive 3-2650

CHICAGO—JUniper 8-2125  
 NEW YORK—LEnox 9-1515

CLEVELAND—EDison 3-1355  
 LOS ANGELES—DAvenport 6-8550  
 BOSTON (Representative)—CEdar 5-6815

CIRCLE 47 ON READER-SERVICE CARD

EPA 3300-2



# EMCOR®

**CABINETS HOUSE THE NERVE CENTER OF A MODERN MECHANIZED ORACLE**



Your copy of Catalog 106, Condensed Version, Available upon Request

Research personnel of Bell Telephone Laboratories, New York, get an "insight" into customer desires and response to new telephone services through "Sibyl," a computer-like machine and laboratory housed in EMCOR Cabinets. "Sibyl" simulates a variety of future communication devices and systems providing objective data on telephone users' response to new service. From the data collected, Bell Laboratories' engineers and psychologists hope to predict whether a new facility will be useful and attractive from a customer's viewpoint. The use of this unusual laboratory eliminates the expense of building special test equipment for one-time use. The use of EMCOR Modular Enclosures in housing the nerve center of the "Sibyl" test facility present a compact, centralized and inter-connected control center. Human engineering features of the modular cabinet design bring all equipment within easy reach and sight of the operator.



Originators of the Modular Enclosure System  
**EMCOR ELGIN METALFORMERS CORP.**  
 630 CONGDON, DEPT. 1221 • ELGIN, ILLINOIS

\*Registered Trademark of Elgin Metalformers Corporation

VISIT OUR BOOTH 1819-1821 AT THE WESCON SHOW, COW PALACE, SAN FRANCISCO, CALIFORNIA.

CIRCLE 48 ON READER-SERVICE CARD

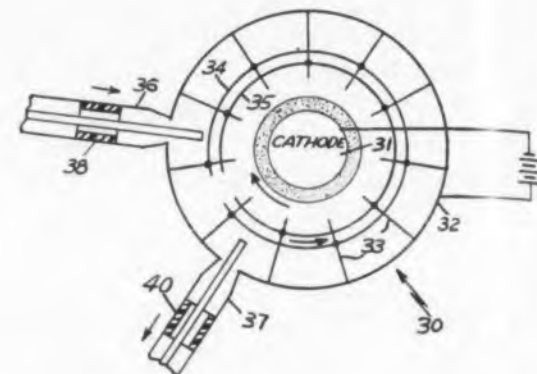
## PATENTS

### Regenerative Amplifiers

Patent No. 2,881,270. William C. Brown. (Assigned to Raytheon Manufacturing Co.)

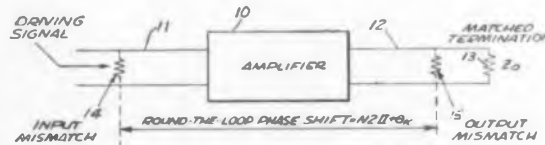
A platintron (saturated-type magnetron) operated with mismatches at both input and output is a high gain microwave amplifier with a bandwidth of 0.5 per cent of the operating frequency. The device can tune over 10 per cent in frequency.

When the phase shift around the loop from input to output and return is set to 360 deg by adjusting the distance between the input and output reflections, oscillations occur without the presence of a driver signal. It is now possible to ad-



just the input and/or output mismatches or the distance between mismatches such that the multiple reflections produce a phase shift greater than 180 deg. The network then will not oscillate but the regeneration will produce very high gain at the selected frequency.

In the illustrations, coaxial cable 36 is the input and cable 37 is the output. These cables have inserts 38 and 40 of dielectric material and dimensions to develop the required mismatches.



**marion**  
 advancement  
 in instrument  
 design



**VERSATILE  
 MULTI-RANGE  
 METER TESTER**

Model M-2

... POWER SUPPLY ... LIMIT BRIDGE

Precise, self-contained unit for laboratory and production use. For DC instrument calibration from 25  $\mu$ a full scale to 10 ma full scale, and 0-100 VDC; sensitivity and resistance measurement; DC current-voltage source; limit or bridge measurements from 0-5000 ohms. Regulated power supply. Stepless vacuum tube voltage control. Accuracy exceeds  $\frac{1}{4}\%$  (current),  $\frac{1}{2}$  ohm or  $\frac{1}{2}\%$  (resistance). For 115V, 60 cycle AC. Complete — needs no accessories. Bulletin on request. Marion Instrument Division, Minneapolis-Honeywell Regulator Company, Manchester, N. H., U. S. A.

Copyright © 1958, Marion U. S. Patent 2,740,093

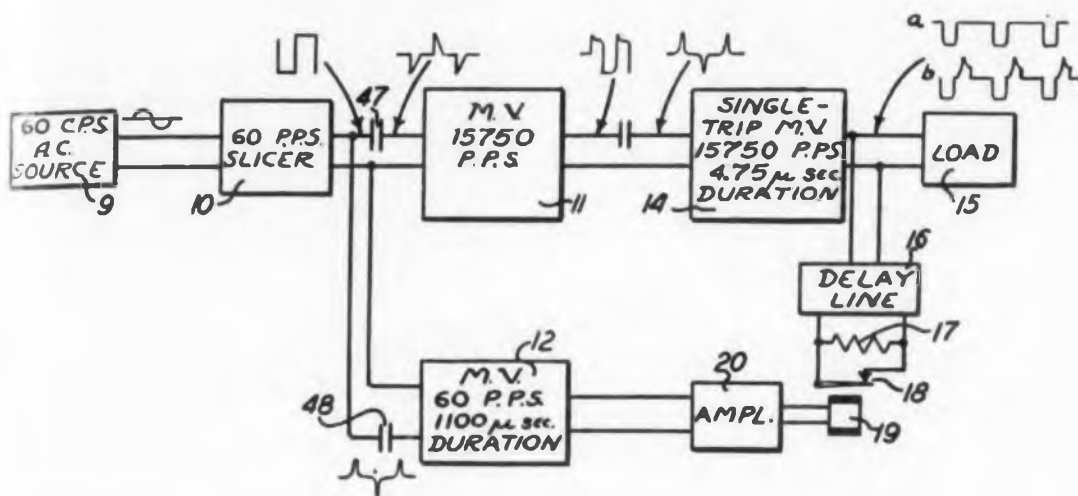
**marion**  
 "WHERE ELECTRONICS MEETS THE EYE"  
**meters**



At Wescon Booth 2614-2616

CIRCLE 575 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 19, 1959



#### Pulse Generator

Patent No. 2,878,381. George W. A. Pentico, John W. Rieke. (Assigned to Western Electric Co. and to Bell Telephone Laboratories, Inc.)

The apparatus generates positive and negative pulses of fixed duration and delay and, in addition, produces no positive pulses for a specified duration.

Negative-going 4.75  $\mu$ sec pulses from

multivibrator 14 couple to the load and to the shorted delay line 16. Upon reflection, the pulse polarity reverses and the delay is 9.0  $\mu$ sec. However, these positive-going pulses are eliminated from the output when multivibrator 12 causes the relay to open switch 18. The delay line is then terminated in its characteristic impedance and no positive-going pulses are reflected back to the load during 1100  $\mu$ sec.

**maintain  
PRE-SELECTED  
TEMPERATURE  
WITHIN CABINET**

**with REFRIGERATED  
PANEL MOUNTING BLOWERS**



BR-6 installed in cutaway MC type cabinet

- Provides dust-free, temperature- and humidity-controlled atmosphere for electronic equipment.
- Factory-set to maintain cabinet temperature at 70°F–80°F (may also be pre-set in 60°F–100°F range).
- Designed to fit into and become part of standard 19" equipment rack—14" panel, 22 1/4" deep.
- 6000 BTU capacity • 115 VAC operating voltage • Interference-free operation • Easily cleanable permanent filter
- Minimum skill and maintenance required to assure long trouble-free performance.

Supplementary features available include automatic overload and alarm system which warns of excessive heat.

Western Devices cabinets, insulated for optimum efficiency, are available in standard depths and heights for mounting electronic equipment panels above cooling unit. Universal airflow control ducts in cabinet permit concentration of cooled air at specific temperature-critical areas.

Ask for BR-6 Performance Chart and Load Calculator

Write for complete data

ORegon 8-7827

**ONE SOURCE...**

for VENTILATED RELAY RACK CABINETS, CONTROL CONSOLES, BLOWERS, CHASSIS, 'CHASSIS-TRAK', RELATED COMPONENTS

**WESTERN DEVICES, INC.**

600 W. FLORENCE AVE., INGLEWOOD, CAL.

CIRCLE 576 ON READER-SERVICE CARD

#### DATA-CABLE MINIATURIZED LOW-CAPACITANCE COAXIAL CABLE

Used for point-to-point transmission of pulsed signals between equipment cabinets or from chassis-to-chassis.

#### DATA-CABLE SHIELDED TWISTED PAIR

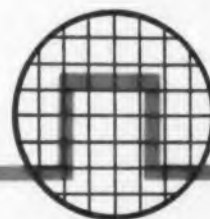
For DC to low frequency data gathering in systems requiring a balanced line on either limited or long runs.

#### DATA-CABLE LOW-LOSS COAXIAL CABLE

Up to 40% lower attenuation — as compared to equivalent diameter cable — for long-run data transmission.



*a  
complete  
data processing and  
transmission  
cable line*



# DATA-CABLE

The first comprehensive line of cables engineered for data transmission and processing requirements. DATA-CABLE cables are available on a rapid delivery basis. In addition to the specific types listed above, DATA-CABLE includes special-purpose, multiconductor cables designed and manufactured to fill any system needs. If you work with data signals, or other critical circuitry, you should know about the new Times DATA-CABLE...

Write for complete DATA-CABLE technical details

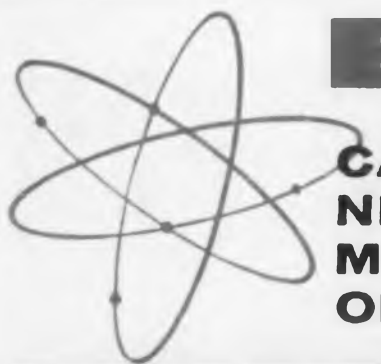


**TIMES WIRE AND CABLE CO., INC.,**

an affiliate of The International Silver Company, Inc.

358 HALL AVENUE  
WALLINGFORD, CONN., U. S. A.

CIRCLE 49 ON READER-SERVICE CARD



# EMCOR®

**CABINETS HOUSE THE NERVE CENTER OF A MODERN MECHANIZED ORACLE**



Your copy of Catalog 106, Condensed Version, Available upon Request

Research personnel of Bell Telephone Laboratories, New York, get an "insight" into customer desires and response to new telephone services through "Sibyl," a computer-like machine and laboratory housed in EMCOR Cabinets. "Sibyl" simulates a variety of future communication devices and systems providing objective data on telephone users' response to new service. From the data collected, Bell Laboratories' engineers and psychologists hope to predict whether a new facility will be useful and attractive from a customer's viewpoint. The use of this unusual laboratory eliminates the expense of building special test equipment for one-time use. The use of EMCOR Modular Enclosures in housing the nerve center of the "Sibyl" test facility present a compact, centralized and inter-connected control center. Human engineering features of the modular cabinet design bring all equipment within easy reach and sight of the operator.



Originators of the Modular Enclosure System  
**EMCOR ELGIN METALFORMERS CORP.**  
 630 CONGDON, DEPT. 1221 • ELGIN, ILLINOIS

\*Registered Trademark of Elgin Metalformers Corporation

VISIT OUR BOOTH 1819-1821 AT THE WESCON SHOW, COW PALACE, SAN FRANCISCO, CALIFORNIA.

CIRCLE 48 ON READER-SERVICE CARD

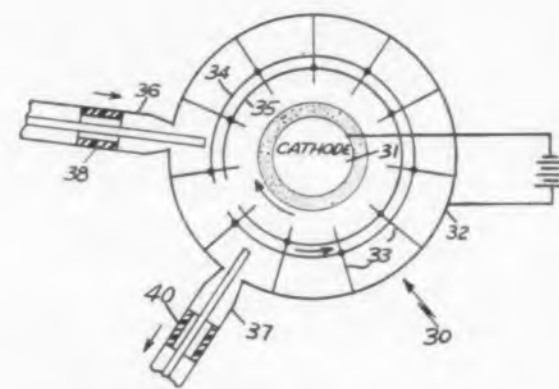
## PATENTS

### Regenerative Amplifiers

Patent No. 2,881,270. William C. Brown. (Assigned to Raytheon Manufacturing Co.)

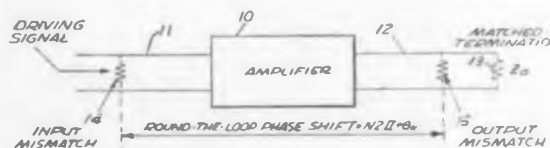
A platinotron (saturated-type magnetron) operated with mismatches at both input and output is a high gain microwave amplifier with a bandwidth of 0.5 per cent of the operating frequency. The device can tune over 10 per cent in frequency.

When the phase shift around the loop from input to output and return is set to 360 deg by adjusting the distance between the input and output reflections, oscillations occur without the presence of a driver signal. It is now possible to ad-



just the input and/or output mismatches or the distance between mismatches such that the multiple reflections produce a phase shift greater than 180 deg. The network then will not oscillate but the regeneration will produce very high gain at the selected frequency.

In the illustrations, coaxial cable 36 is the input and cable 37 is the output. These cables have inserts 38 and 40 of dielectric material and dimensions to develop the required mismatches.



**marion**  
 advancement  
 in instrument  
 design



**VERSATILE  
 MULTI-RANGE  
 METER TESTER**

Model M-2

... POWER SUPPLY ... LIMIT BRIDGE

Precise, self-contained unit for laboratory and production use. For DC instrument calibration from 25  $\mu$ a full scale to 10 ma full scale, and 0-100 VDC; sensitivity and resistance measurement; DC current-voltage source; limit or bridge measurements from 0-5000 ohms. Regulated power supply. Stepless vacuum tube voltage control. Accuracy exceeds 1/4% (current), 1/2 ohm or 1/2% (resistance). For 115V, 60 cycle AC. Complete — needs no accessories. Bulletin on request. Marion Instrument Division, Minneapolis-Honeywell Regulator Company, Manchester, N. H., U. S. A.

Copyright © 1958. Marion U. S. Patent 2,740,093

**marion**  
 "WHERE ELECTRONICS MEETS THE EYE"  
**meters**

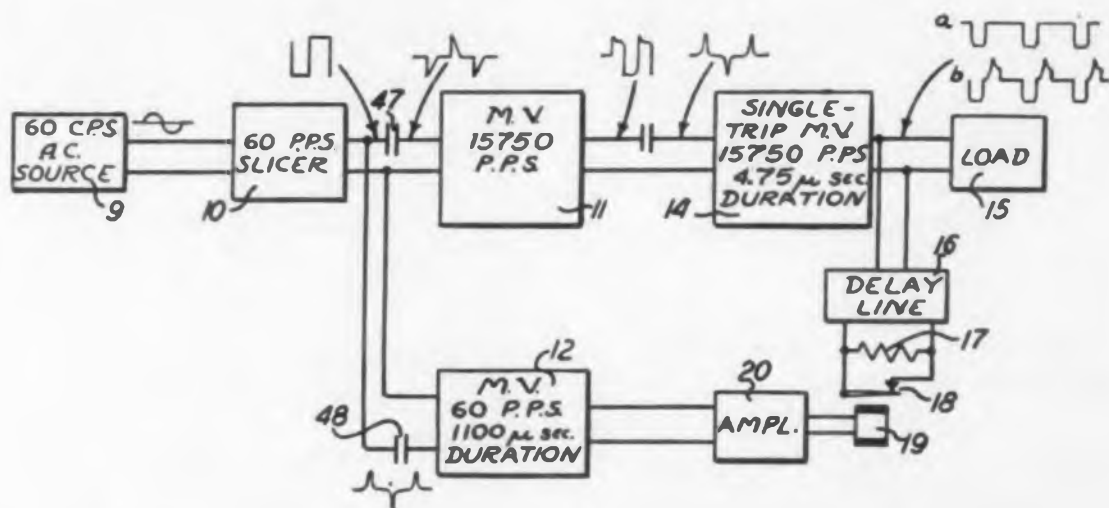


At Wescon Booth 2614-2616

CIRCLE 575 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 19, 1959

Pul  
 Pat  
 tic  
 Ele  
 rat  
 ]  
 neg  
 lay  
 pul  
 M



### Pulse Generator

Patent No. 2,878,381. George W. A. Pentico, John W. Rieke. (Assigned to Western Electric Co. and to Bell Telephone Laboratories, Inc.)

The apparatus generates positive and negative pulses of fixed duration and delay and, in addition, produces no positive pulses for a specified duration.

Negative-going 4.75  $\mu$ sec pulses from

multivibrator 14 couple to the load and to the shorted delay line 16. Upon reflection, the pulse polarity reverses and the delay is 9.0  $\mu$ sec. However, these positive-going pulses are eliminated from the output when multivibrator 12 causes the relay to open switch 18. The delay line is then terminated in its characteristic impedance and no positive-going pulses are reflected back to the load during 1100  $\mu$ sec.

**maintain  
PRE-SELECTED  
TEMPERATURE  
WITHIN CABINET**

**with REFRIGERATED  
PANEL MOUNTING BLOWERS**



BR-6 installed in cutaway MC type cabinet

- Provides dust-free, temperature- and humidity-controlled atmosphere for electronic equipment.
- Factory-set to maintain cabinet temperature at 70°F–80°F (may also be pre-set in 60°F–100°F range).
- Designed to fit into and become part of standard 19" equipment rack—14" panel, 22¼" deep.

- 6000 BTU capacity • 115 VAC operating voltage • Interference-free operation • Easily cleanable permanent filter
- Minimum skill and maintenance required to assure long trouble-free performance.

Supplementary features available include automatic overload and alarm system which warns of excessive heat.

Western Devices cabinets, insulated for optimum efficiency, are available in standard depths and heights for mounting electronic equipment panels above cooling unit. Universal airflow control ducts in cabinet permit concentration of cooled air at specific temperature-critical areas.

Ask for BR-6 Performance Chart and Load Calculator

Write for complete data

OREGON 8-7827

**ONE SOURCE...**

for VENTILATED RELAY RACK CABINETS, CONTROL CONSOLES, BLOWERS, CHASSIS, 'CHASSIS-TRAK', RELATED COMPONENTS

**WESTERN DEVICES, INC.**

600 W. FLORENCE AVE., INGLEWOOD, CAL.

CIRCLE 576 ON READER-SERVICE CARD

### DATACABLE MINIATURIZED LOW-CAPACITANCE COAXIAL CABLE

Used for point-to-point transmission of pulsed signals between equipment cabinets or from chassis-to-chassis.

### DATACABLE SHIELDED TWISTED PAIR

For DC to low frequency data gathering in systems requiring a balanced line on either limited or long runs.

### DATACABLE LOW-LOSS COAXIAL CABLE

Up to 40% lower attenuation — as compared to equivalent diameter cable — for long-run data transmission.



*a  
complete  
data processing and  
transmission  
cable line*



# DATACABLE

The first comprehensive line of cables engineered for data transmission and processing requirements **DATACABLE** cables are available on a rapid delivery basis. In addition to the specific types listed above, **DATACABLE** includes special-purpose, multiconductor cables designed and manufactured to fill any system needs. If you work with data signals, or other critical circuitry, you should know about the new Times **DATACABLE** . . .



Write for complete **DATACABLE** technical details

**TIMES WIRE AND CABLE CO., INC.,**

an affiliate of The International Silver Company, Inc.

358 HALL AVENUE  
WALLINGFORD, CONN., U. S. A.

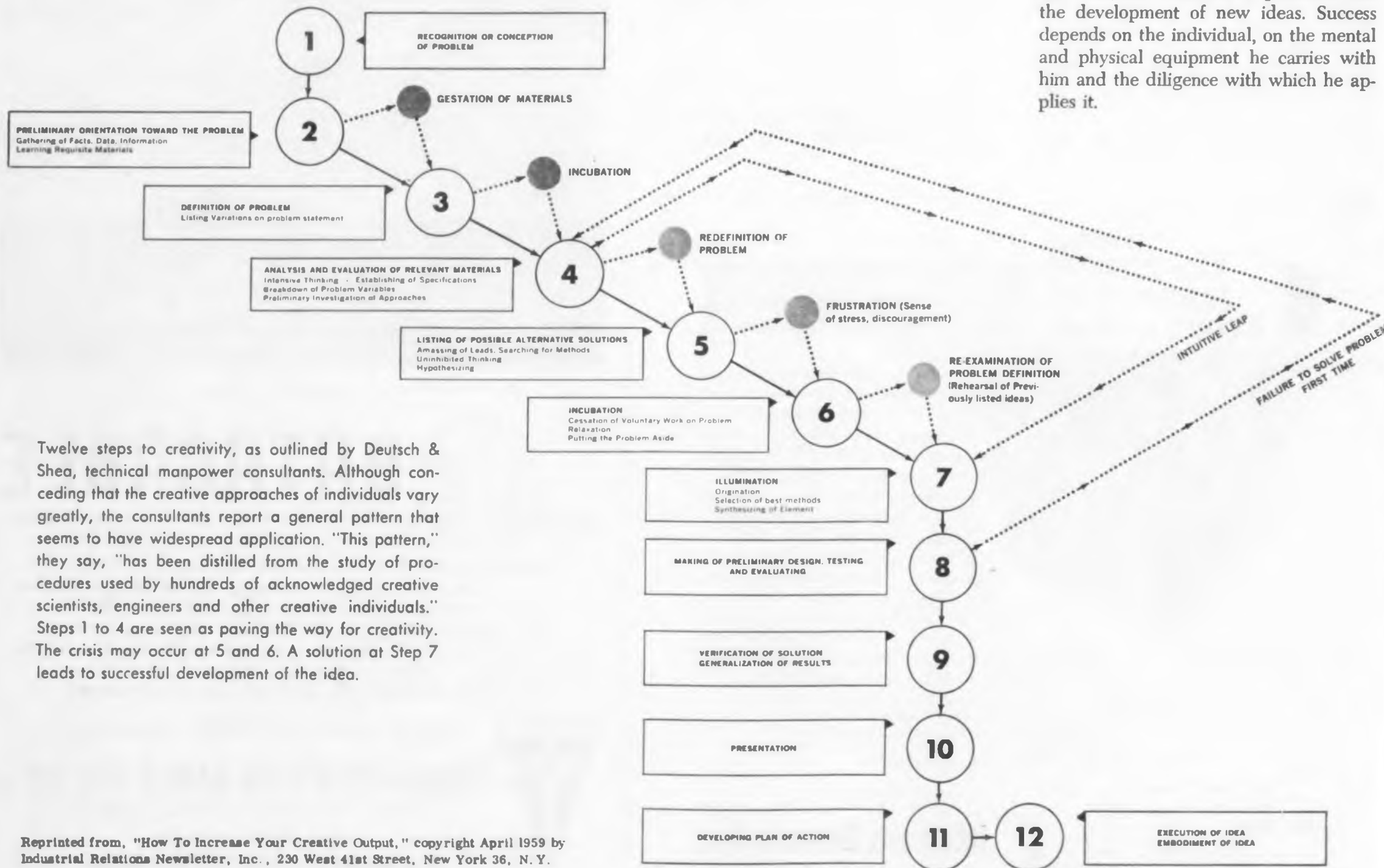
CIRCLE 49 ON READER-SERVICE CARD

## DESIGNING YOUR FUTURE

# You Too Can CREATE, If...



*In an industry whirling with automatic computers and visions of "thinking" machines, the question facing electronic engineers now is, Can a man be taught to create? Here is a glimpse of what instructors are stressing, based on the experiences of successful creators.*



Twelve steps to creativity, as outlined by Deutsch & Shea, technical manpower consultants. Although conceding that the creative approaches of individuals vary greatly, the consultants report a general pattern that seems to have widespread application. "This pattern," they say, "has been distilled from the study of procedures used by hundreds of acknowledged creative scientists, engineers and other creative individuals." Steps 1 to 4 are seen as paving the way for creativity. The crisis may occur at 5 and 6. A solution at Step 7 leads to successful development of the idea.

Reprinted from, "How To Increase Your Creative Output," copyright April 1959 by Industrial Relations Newsletter, Inc., 230 West 41st Street, New York 36, N. Y.

IN A decade of "do-it-yourself-ism," it should come as no surprise to anyone that engineers are being encouraged to think for themselves, to create designs, solutions, ideas and what have you with the help of handy guides. This instructive approach, in use at some companies for the last several years, has gained more general momentum of late.

Some may scoff and say that creativity cannot be taught, that a person is either creative or he is not. And to some extent, the scoffers are right. "Genius is born and not made" is an old saying, not without foundation.

But the teachers of creativity do not undertake to train genius. They offer simple descriptions of the creative process in the average, mentally alert person. They offer simple guideposts to encourage analytical solutions to problems and the development of new ideas. Success depends on the individual, on the mental and physical equipment he carries with him and the diligence with which he applies it.



That industry is interested in this approach is evident in such manifestations as brainstorming, productivity teams and bonus plans for individual inventions.

Advice on achieving analytical creativity is offered by a variety of published books, pamphlets, house-organ articles and in-plant lectures. One of the latest publications out is "How to Increase Your Creative Output" (\$1.50 a copy, Industrial Relations Newsletter, Inc., 230 W. 41st St., New York 36, N.Y.).

By creativity the analytical school means simply turning out something new—an idea, a process, a solution and the like. When a person solves a problem in a way that is new to him, even though the technique may have been discovered before, he is being creative, according to this viewpoint. And anyone can qualify as a creative person—engineers, chemists, researchers and others—not just artists, writers and their allies. The method does insist, though, that some action result from the thinking procedure; otherwise one is merely daydreaming.

#### Prerequisites Listed

The engineer, or any person, who would learn to create must possess certain prerequisites. Among these, most instructive authorities agree, are the following:

**Initiative, or drive**—the would-be creator must experience a strong need to create that prods him, goads him, will not let him feel satisfied until he has overcome all obstacles and found the solution; only success relieves his tension.

**Self-Confidence**—considered so important by one source that neophyte creators are urged to build up first a series of lesser successes before undertaking serious creative work.

**Self-Criticism**—the quality of feeling so secure that one is able to test one's ideas relatively objectively and bear temporary failure to eliminate flaws.

**Diversified knowledge**—a distillation of facts and observations about many subjects that are outside one's immediate specialty but not so distant as to be unrelated; can be gained by rapid reading, discussion, attendance at conventions and meetings, advanced study and writing.

**Curiosity**—the never-ending quest for scientific truth.

**Flexibility**—the ability to shift gears while creating, to follow the course of the data, to abandon, if need be, an entire approach and to start in again.

**Sensitivity**—described by one authority as the ability to distinguish between things as they are and as they should be; the knack of seeing beyond the immediate interests, tasks and goals that motivate most people.

**Keen memory**—helpful in supplying the right fact at the right time.

#### Few Have All Attributes

The channeling of such attributes as these into organized patterns of thought, the instructors say, can result in creativity. It is generally conceded that few persons possess all of the prerequisites in equal abundance. Some concerns, therefore—engineering and others—have assembled teams of creators in which the talents of the members complement one another. But the individual creator need not despair. He may proceed on his own, but he would do well to strengthen the prerequisite areas in which he is deficient.

The organized approach to creativity may then take this pattern:

The problem is defined, analyzed and sustained thinking to solve it is begun. Frustration is considered inevitable, and it calls for re-examination of data and objectives, for further mental assaults to overcome obstacles. When thinking and frustration reach a peak, the authorities say, a solution is near. Relaxation is recommended to break the deadlock. From this state of alert relaxation, the creative solution is said to flow.

#### Unexpected Insight Noted

Revelation, according to E. I. Green, executive vice president of Bell Telephone Laboratories, "is apt to be when the person is concerned with nothing of importance, when taking a walk, or riding on a train, or listening to music, or just letting his thoughts wander."

"Holidays and vacations are likely times," he wrote in a study of creativity for *Electrical Engineering*. "Often the insight takes place near the fringe of consciousness, just before going to sleep or just after waking up."

When success does not result, a check of roadblocks that line the paths of thought may be in order. Clues to some of these are contained in a list of "don'ts" in "How to Increase Your Creative Output." Samples:

"Don't load your problem statement with side problems or conditions. Strip from it as many modifying adjectives, ad-

## Electronics Engineers:

# How To Get Ahead in Radar

Engineers working in Radar today are finding it sometimes takes *more* than an individual's talent and creativity to keep pace with the field.

The element that can make *all the difference* in a man's professional growth—is his company.

Management at Light Military\* is aware of this...and recognizes that LMED's long-term growth depends upon setting the proper environment for creativity...providing advanced projects on which to exercise it...encouraging and making room for a man's professional development.

If you join Light Military this month, chances are you'll find opportunities to contribute to such systems as:

An automated AEW and control system which—for the first time—will practically eliminate Man from the control loop.

An advanced airborne Bomb Nav. & Forward Surveillance radar system which will utilize high resolution techniques and be equipped with frequency diversity capability.

Or a number of classified programs including Missile Guidance, Surveillance and Fire Control Radars with advanced capabilities.

If you'd like to learn more about how *your* talents can get you ahead in radar faster at LMED, write in confidence to Mr. William Gilmore, Dept. 76-MH.

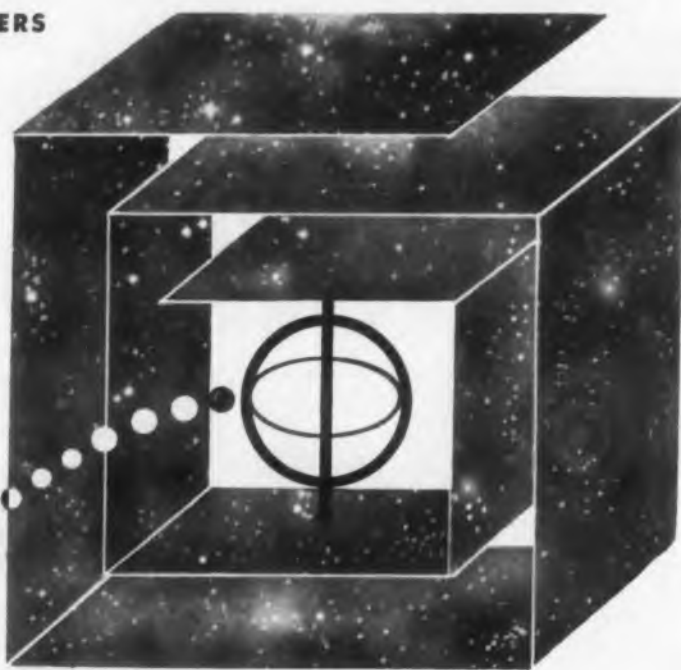
**LMED**

\*LIGHT MILITARY ELECTRONICS DEPARTMENT

**GENERAL  ELECTRIC**

FRENCH ROAD, UTICA, NEW YORK

CIRCLE 900 ON CAREER INQUIRY FORM



## Republic Aviation Offers You Dynamically Balanced Careers

### THIS MEANS:

**Choice of advancement in a scientific specialty or technical management, with equal benefits and recognition**

**Wide range electronic R&D programs that provide the opportunity you need to move ahead**

**All the added advantages that accrue from working with a prime systems contractor**

A multitude of projects in advanced electronics are now underway at Republic Aviation — projects that offer broad avenues to success for the ambitious electronic engineer. Republic has a program to match your interest, whether it be in space technology, missiles, manned aircraft or ground support equipment. And you will find your colleagues at Republic to be men of the highest ability and imagination, men who possess broad state-of-the-art knowledge that will add to your technical competence.

Facilities and equipment are of the most advanced type and will be supplemented later this year by a new \$14,000,000 Research Center.

Professional Opportunities at all levels in the following areas:

**Inertial Guidance & Navigation • Digital Computer Development • Systems Engineering • Information Theory • Telemetry-SSB Technique • Doppler Radar • Countermeasures • Radome & Antenna Design • Microwave Circuitry & Components • Receiver & Transmitter Design • Airborne Navigational Systems • Jamming and Anti-Jamming • Miniaturization-Transistorization • Ranging Systems • Propagation Studies • Ground Support Equipment**

Address your resume in strict confidence to:

Mr. George R. Hickman

Engineering Employment Manager, Dept. 12H-4.

**REPUBLIC AVIATION**

Farmingdale, Long Island, New York

Please write direct to advertiser mentioning *ELECTRONIC DESIGN*

## DESIGNING YOUR FUTURE

verbs and phrases as possible.”

“Don’t refer to any great extent to the literature for data when the creative current runs strong. cursory checking on facts is all right, but extensive literature searches at this time can divert you completely from your original line of thought.”

Mr. Green, who has been credited with some 75 patents, lists these general road-blocks: limited intellectual capacity; limited knowledge; preconception or wishful thinking; false associative thinking; group thinking or “thinking like the crowd”; credulity and others.

### Early Training An Obstacle

To create boldly, one must be prepared to shuck off mental inhibitions that may have been instilled as far back as childhood. E. K. Von Fange, a former supervisor of creative engineering at General Electric and now working on new television features for the company, traced the challenge this way in a report a few years-ago in *General Electric Review*:

“Although naturally creative, a child lacks judgment. As a result, most of his creative expressions are suppressed with choruses of ‘don’t,’ ‘no,’ ‘stop that’ and ‘just wait until I get you home.’ Similarly, from grammar school through college, emphasis is placed on subjugation to fixed and well-explained text assignments, closely directed laboratory experiments and well-disciplined study periods. Now, this in itself isn’t bad except that it provides little outlet for creative expression. Consequently creativity and curiosity lie dormant through sheer lack of exercise.

“College training also has adverse effects on creativity. For example, the assignments given in a typical engineering institution could be likened to a foot-bridge across a wide, deep chasm. The bridge represents the problem with the solution at the other end. Such factors as the detailed definition, boundary conditions and applicable formulas or procedures given in the text form strong and sturdy guide rails.

“As the student progresses, he crosses longer bridges with little difficulty because each is still protected by guard rails. Then comes graduation with a sheepskin instead of guard rails. Small

wonder that new engineers are hesitant and indecisive about what to do and how to begin. They have learned to use the safely guarded bridges and refuse to cross a creative bridge when they see it, simply because it has no guard rails to lead and guide them.”

### Creative ‘Type’ Cited

Can anyone create? Anyone who is intelligent and who will apply himself can, the instructive school argues. Few will deny, though, that for some intelligent persons creativity comes more easily than for others.

Dr. Leopold Pessel, development engineer of the Radio Corporation of America, writing in *RCA Engineer*, has cited two types of intellects: the factual mind, “bent upon acquisition of facts and knowledge, upon deepening them to the utmost, and upon their effective utilization”; and the expansive mind, “eager to engulf as many divergent fields as possible and to build associating links as it roams about.”

“Although there are very few wholly creative minds,” Dr. Pessel said, “the expansive mind is usually predominant in the creator of the new. Any origination comes from association of things so diverse that it does not become obvious until pointed out. And the man who does the pointing out is the originator, creator or inventor.”

### Simple Test Suggested

Dr. Pessel, who has more than 50 patents to his credit, suggests that potential creators can be spotted through inquiry as to their failures.

“The factual mind,” he wrote, “will be somewhat embarrassed by failures; the expansive mind will be almost proud of them.

“Ask the man to tell you about those undertakings of his which have failed! Watch for his ability to bounce back in the face of disappointment! These mental traits are mainsprings of an expansive mind. They are evident in early life and are never lost, no matter how old the individual. They account for the apparent agelessness of a genius and his ability to create up to the most advanced age.”

The value of the teachers of creativity appears to lie in helping potentially creative persons to organize their ingenuity. But there must be something basic to work with. ■ ■

# Advancement Your Goal? Use New Form To Speed Action

ELECTRONIC DESIGN's new Career Inquiry Service form is designed to help engineers advertise themselves. This new service speeds applicants to the jobs they seek. It is the first such service offered in the electronics field and is receiving high praise from personnel managers.

To present your qualifications immediately to the personnel managers of companies that interest you, simply fill in the attached standardized short resume.

Study the employment opportunity ads in this section, and circle the numbers at the bottom of the form that correspond to the numbers of the ads that interest you.

ELECTRONIC DESIGN's Reader Service Department will act as your private secretary and type neat, duplicate copies of your standardized resume and send them to all companies you may select . . . *the same day the resume is received.* (ELECTRONIC DESIGN will detach the circle number portion of the form, so that no company will know how many numbers you circled.)

The standardized resume will permit personnel managers to inspect your qualifications rapidly. If they are interested, they will get in touch with you directly. In the past much time has been lost through personnel-manager requests for resumes from applicants who proved ineligible.

Readers who desire only company brochures should use the regular Reader Service card.

Mail Career Inquiry Service form to Reader Service, ELECTRONIC DESIGN, 830 Third Ave., New York 22, N. Y.

After completing, mail career form to *ELECTRONIC DESIGN*, 830 Third Avenue, New York, N. Y. Our Reader Service Department will forward copies to the companies you select below.

17

(Please print with a soft pencil or type.)

Name \_\_\_\_\_ Telephone \_\_\_\_\_

Home Address \_\_\_\_\_ City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

Date of Birth \_\_\_\_\_ Place of Birth \_\_\_\_\_ Citizenship \_\_\_\_\_

Position Desired \_\_\_\_\_

### Educational History

College	Dates	Degree	Major	Honors

Recent Special Training \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### Employment History

Company	City and State	Dates	Title	Engineering Special

Outstanding Engineering and Administrative Experience \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Professional Societies \_\_\_\_\_

Published Articles \_\_\_\_\_

Minimum Salary Requirements (Optional) \_\_\_\_\_

Use section below instead of Reader Service Card. Do not write personal data below this line. This section will be detached before processing.

Circle Career Inquiry numbers of companies that interest you

900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923  
925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948

Share in creative engineering  
responsibility on these  
RCA

## COMMUNICATIONS AND COMPUTER PROJECTS

Imagination, applied by RCA engineers to the most challenging problems in communications and computer science, has created the airborne and ground equipment for the TDM Data-Link Systems, world-wide communications networks air and sea navigation systems, palm size television and the world's most advanced electronic data processing system.

Creative top-level engineers are needed now to work on advanced assignments in digital communications, data processing, RF communications, microwave, telemetering, tropospheric and ionospheric scatter, and visual displays. Openings include positions for engineering management, development and design, systems and project engineers.

Qualified engineers are invited to discuss their interest in our current programs. To arrange an interview with engineering management, please send résumé to: Mr. C. B. Gordon, Box Z-20H, Professional Placement, Bldg. 10-1, RCA, Camden, N.J.



**RADIO CORPORATION OF AMERICA**  
DEFENSE ELECTRONIC PRODUCTS

CIRCLE 901 ON CAREER INQUIRY FORM

## DESIGNING YOUR FUTURE

Protection Against . . .

# Trade Secret Disclosures

Albert Woodruff Gray

What happens when former employees leave a company and start their own business using their former employers' know how?" Albert Woodruff Gray sees a growing trend for courts to recognize a property right in ideas. His article discloses the legal background of an interesting recent case which may further the trend.

In light of the recent Fairchild vs. Rheem and Melpar vs. Scope suits, this article is particularly timely.

**E**IGHT former employees of Sarkes-Tarzian and their present employer, Audio Devices Inc., were sued by Tarzian for appropriating confidential information and trade secrets. Although Sarkes-Tarzian lost the case, some very important legal precedent was set by the court in arriving at its decision.

"Trade practices, to come within the obligation of secrecy, must be secret. While they need not amount to invention in the patent law sense, they must at least amount to discovery."

During the trial, Tarzian pointed out that the company had possessed certain confidential data and "know-how" in the manufacture of silicon rectifiers. When these eight employees left and joined Audio Devices they used this "know-how" on their new job. By depriving Tarzian of this data, they supposedly caused damages of about \$1 million.

Part of the evidence introduced showed that seven of the employees had signed an employment agreement with Sarkes-Tarzian which read, "The undersigned hereby acknowledges and signifies his understanding and acceptance of the fact that all trade, engineering, production and technical data, information or know-how, including but not limited to customer lists, plans specifications, drawings, sketches, lay-outs and formulae, whether or not reduced to writing are the exclusive secret and confidential property of the employer and shall be at all times regarded, treated and protected as such."

"A process . . . may be maintained in secrecy and be entitled to equitable protection even though invention is not present."  
"If it appears that there were no

Before arriving at a decision the California court first defined trade secrets. It also deliberated as to whether a person could be enjoined from using them.

Fir  
court  
ment.  
faith  
from  
a co  
court,  
a dut  
forme  
breac  
The s  
and it  
Nov  
what  
termin  
tection  
stated  
emplo  
volve  
trade  
part  
busine  
exists

- T
- g
- S
- k
- N
- th

Bas  
Sarkes  
testim  
court  
Device  
proces  
ferenc  
tion c  
Audio'  
they l  
Tarzia  
within  
court  
readily  
in the

The  
his ow  
secrets  
gaged.

ELECT

### What Is A Trade Secret?

First, a trade secret is not a patent, the court asserted. So there is no infringement. Rather, there would be a breach of faith since the information was obtained from Tarzian by their employees through a confidential relationship. So, said the court, the former employees would incur a duty not to use the information to their former employers detriment. It is this breach of duty that the court protects. The signed agreement between Tarzian and its employees wasn't even considered.

Now that the court had decided just what rights were to be protected, it determined the rules for applying that protection. A former employer, the court stated, could enjoin competition by former employees when such competition involved the unfair or fraudulent use of trade secrets which constitute a valuable part of the goodwill of the employer's business. But no ground for an injunction exists if:

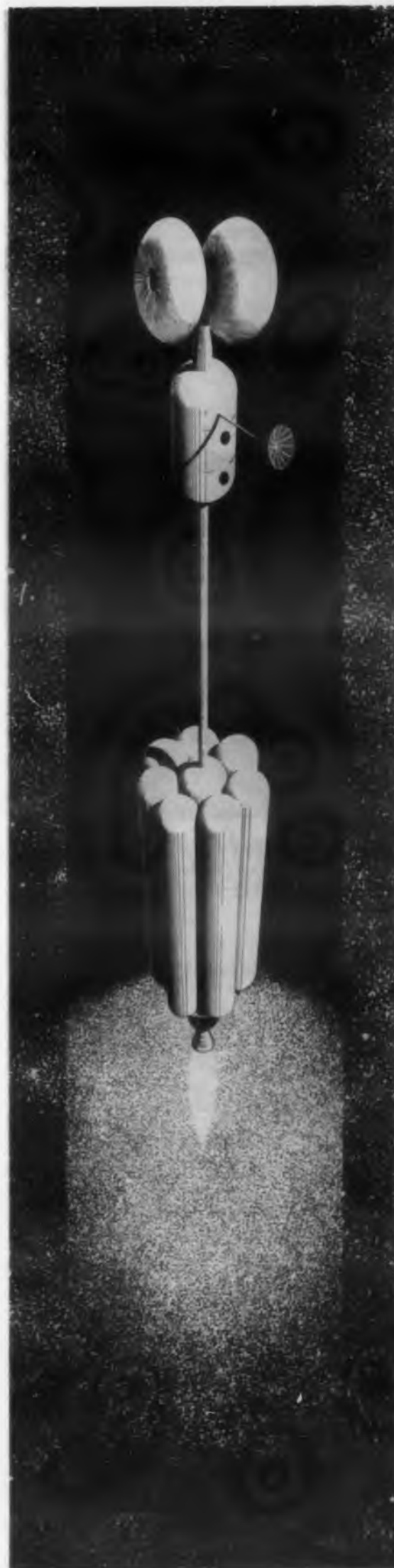
- There were no secrets or data regarded as confidential.
- Secrets or confidential data were unknown to the employee
- No use was made of the secrets by the employee

trade secrets, or that such secrets existed but were unknown to the particular employee, or that no use was made of them, then no ground for injunction exists."

### Secrets Not Used

Based on the last of these ground rules, Sarkes-Tarzian lost the case. During the testimony, witnesses pointed out to the court the differences between the Audio Devices process and the Sarkes-Tarzian process. The court considered these differences enough to eliminate the assumption of industrial plagiarism. Although Audio's employees used the knowledge they had acquired while working for Tarzian, this knowledge does not fall within the definition of trade secrets, the court stated. It is general knowledge readily discernible by anyone experienced in the field.

The manufacturer is entitled to protect his own trade secrets, but not general secrets of the trade in which he is engaged. ■ ■



## ELECTRONIC ENGINEERS

- ATLAS** Slated to become the first operational ICBM of the United States.
- VEGA** The multi-stage rocket scheduled to become the first U. S. space vehicle in the "medium energy" class. Capable of sending a 1,000 lb. payload to the moon.
- CENTAUR** Will become the first U. S. space vehicle in the "high energy" class. Capable of putting a five ton payload into satellite orbit.
- AZUSA** The most accurate missile tracking system available today. Currently being used on virtually all ballistic missiles fired at Cape Canaveral.

Electronic design and development on these and other advanced space programs at Astronautics has created a variety of interesting assignments at a most advanced state of the art. If you have a degree in electrical engineering and between three and ten years of experience, you may qualify for one of the long-range positions now available. Immediate openings exist in the following specialties:

Test Equipment · Telemetry · Radiation Systems (Not Nuclear) · Electrical Design · Missile Instrumentation · Trajectory Measurement and Orbit Determination · Automatic Controls · Autopilot · Servomechanisms · Electronic Packaging

Our engineering representatives will be conducting  
**INTERVIEWS**  
in these cities soon:

Albuquerque · Boston · Chicago · Cleveland · Dayton · Denver · Detroit · El Paso · Fort Wayne · Hagerstown · Houston · Rockford · Indianapolis · Los Angeles · Milwaukee · New Orleans · New York · Oklahoma City · Philadelphia · Pittsburgh · St. Louis · Salt Lake City · Schenectady · South Bend · Syracuse · Washington, D.C. · Youngstown

Our engineering representatives will be conducting  
**INTERVIEWS in SAN FRANCISCO during WESCON**  
Call W. MacDonald · EX 2-3434 · August 18-23

If an interview is inconvenient at this time, write to Mr. T. W. Wills, Engineering Personnel Administrator, Department 130-90, and send a detailed resume, so arrangements can be made for a future interview.

**CONVAIR/ASTRONAUTICS**  
CONVAIR DIVISION OF  
**GENERAL DYNAMICS**

5613 KEARNY VILLA ROAD, SAN DIEGO, CALIFORNIA



If your career needs  
care and feeding...

### DOUGLAS AIRCRAFT COMPANY MISSILES AND SPACE SYSTEMS

has immediate openings  
in the following fields—

#### Electrical and Electronics:

Control System Analysis & Design  
Antenna & Radome Design  
Radar System Analysis and Design  
Instrumentation  
Equipment Installation  
Test Procedures  
Logic Design  
Power System Design

#### Mechanical Engineering —

Analysis and Design of the following:

Servo Units  
Hydraulic Power Systems  
Air Conditioning Systems  
Missile Launcher Systems  
Propulsion Units and Systems  
Auxiliary Power Supplies

#### Aeronautical Engineering:

Aerodynamic Design  
Advanced Aerodynamic Study  
Aerodynamic Heating  
Structural Analysis  
Strength Testing  
Dynamic Analysis of Flutter  
and Vibration  
Aeroelasticity  
Design of Complex Structure  
Trajectory Analysis  
Space Mechanics  
Welding  
Metallurgy

#### Physics and Mathematics:

Experimental Thermodynamics  
General Advanced Analysis in  
all fields  
Computer Application Analysis  
Computer Programming and  
Analysis  
Mathematical Analysis

For full information  
write to:

Mr. C. C. LaVene  
Box 601-E  
Douglas Aircraft Company, Inc.  
Santa Monica, Calif.



## *The care and feeding of a missile system*



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

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

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

CIRCLE 903 ON CAREER INQUIRY FORM

## YOUR CAREER NEWS, NOTES, NOTIONS

What makes an engineer unhappy on the job? One reason, an industrial psychologist suggests, is that management's control over him may be too tight. This can touch off a basic conflict: the employe needs the job, but as an individual, he also has certain human needs, among them the desire to feel uncontrolled. The solution can be a happy compromise, according to the psychologist, Martin M. Bruce, vice president and director of psychological services of Clark, Channell, Inc., Stamford, Conn.

"The goals of the individual and the goals of management need not be separate and opposing," he wrote in a paper published recently by the American Society of Mechanical Engineers. "In fact, the ultimate goals of both are synonymous: growth, development and achievement. Because perspectives have been developed which have assumed contrary goals, disagreements have arisen."

To resolve the conflict, Mr. Bruce says, management should spell out its goals, encourage its employes to do the same and demonstrate to them that the objectives are compatible.

Among management goals, the psychologist lists these:

- Profits.
- Internal action.
- Markets to be exploited.
- Obligations to customers, stockholders, employes and the community.
- Ethical standards.

"Is strong control required in order to meet objectives?" Mr. Bruce asks. "As a psychologist my answer is 'no'. These objectives can be obtained and, in fact, better realized without strong controls."

What he favors is a corporate setup in which control is decentralized into separate staff functions.

"Tight control exercised from a single individual or a single group of individuals must become a thing of the past," the psychologist says.

"Ideal organizational structure combines control and freedom in satisfactory doses. The doses, however, vary from company to company and from department to department. . . . There are some functions in some companies that can and should remain essentially centralized. At General Motors there is active decentralization on the basis of product and geography, but financial and legal matters have remained centralized.

"In the last analysis, we are seeking coordinated

(Continued on page 66)

*How far  
can an engineer go  
at AC?*

### Free education for the space age

Three levels of special advanced training that can help you prepare for promotion and enhance your professional status. That's what you'll find when you go to work in AC's instrumentation business.

**Program A**—for recent graduate engineers—gives you a solid foundation in the theory and application of inertial guidance systems and servomechanisms.

**Program B**—for experienced engineers—consists of upgrading studies in inertial guidance, servomechanisms, environmental problems, engineering math and physics, plus advanced state-of-the-art courses.

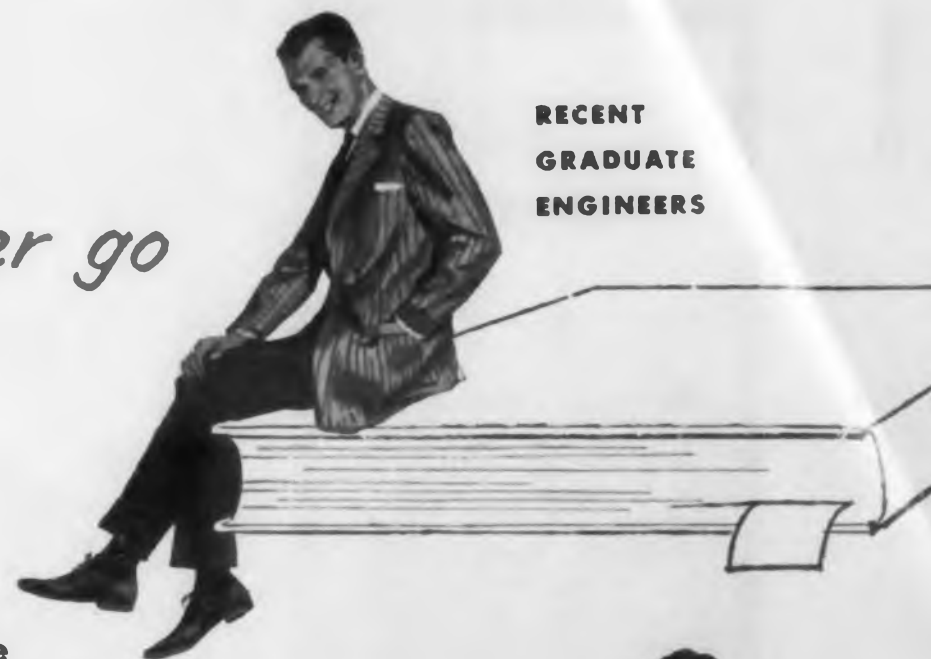
**Program C**—for all engineering supervisors—involves management training developed by a team of AC executives and University of Chicago industrial relations experts.

Comparison will prove these are the finest "in house" programs available anywhere. And they are educational "extras," for AC offers them in addition to their educational assistance programs for men who wish to study for advanced degrees in nearby universities.

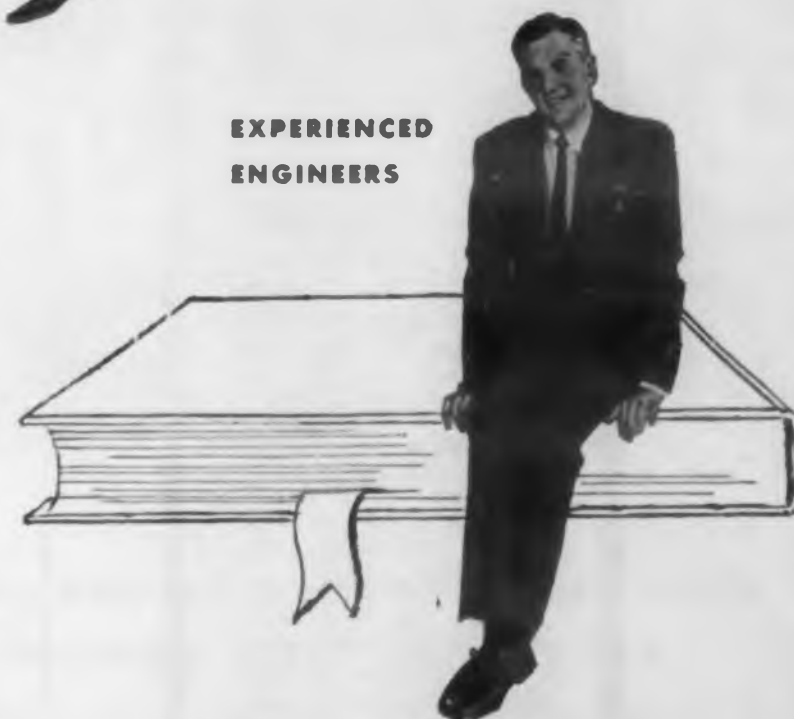
### You may be eligible for training . . .

if you are a graduate engineer in the electronics, electrical or mechanical fields, or if you have an advanced degree in mathematics or physics. You'll study while you work on the renowned AChiever inertial guidance system or a wide variety of other electromechanical, optical and infra-red devices.

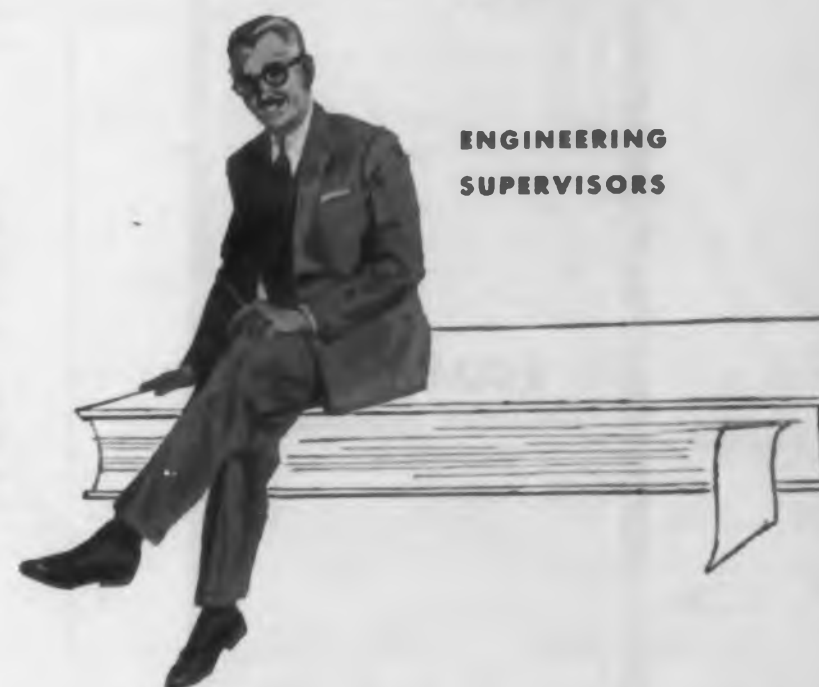
For more information, write the Director of Scientific and Professional Employment: Mr. Robert Allen, Oak Creek Plant, Dept. G, Box 746, South Milwaukee, Wisconsin.



RECENT  
GRADUATE  
ENGINEERS



EXPERIENCED  
ENGINEERS



ENGINEERING  
SUPERVISORS



SPARK PLUG ⚙ THE ELECTRONICS DIVISION OF GENERAL MOTORS

INERTIAL GUIDANCE SYSTEMS • AFTERBURNER FUEL CONTROLS • BOMBING NAVIGATIONAL COMPUTERS • GUN-BOMB-ROCKET SIGHTS • GYRO-ACCELEROMETERS • GYROSCOPES • SPEED SENSITIVE SWITCHES • SPEED SENSORS • TORQUEMETERS • VIBACALL • SKYPHONE

CIRCLE 904 ON CAREER INQUIRY FORM

*Expanding the Frontiers  
of Space Technology in*

## COMMUNICATIONS

■ As man's explorations reach further into outer space, it becomes necessary to make great improvements in communications. One of Lockheed's many contributions in this field is a miniaturized satellite tape recorder, capable of storing three million pieces of scientific data anywhere in its travels and on returning to within range of earth stations, transmit it on command.

Other Lockheed design and developed equipment is successfully providing highly accurate information on temperature, pressure, acceleration, vibration, thrust, vehicle attitude and other conditions during hypersonic flight.

### ENGINEERS AND SCIENTISTS

Lockheed Missiles and Space Division programs reach far into the future and require a bold and imaginative approach where only theory now exists. If you are experienced in space communications or in closely related work, we invite you to join us in one of the nation's most interesting and challenging basic technical programs. Write: Research and Development Staff, Dept. H-2-21, 962 W. El Camino Real, Sunnyvale, California. U.S. citizenship required.

## Lockheed

### MISSILES AND SPACE DIVISION

*Weapons Systems Manager for  
Navy POLARIS FBM,  
DISCOVERER SATELLITE,  
Army KINGFISHER,  
Air Force Q-5 and X-7*

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

CIRCLE 915 ON CAREER INQUIRY FORM

## TELL YOUR PERSONNEL MANAGER ABOUT ELECTRONIC DESIGN'S "CAREER'S SECTION"

**If your company is trying to attract skilled electronic design, development or research engineers, tell your Personnel Manager about ELECTRONIC DESIGN. Here is a concentrated audience of 27,000 engineers ready to read about the advantages offered by your plant.**

**Remember, more than 5,500 ELECTRONIC DESIGN readers inquire every issue—many of them will be interested in your job opportunities.**

**You can efficiently reach them in ELECTRONIC DESIGN'S "Career's Section."**

## CAREER NEWS

*(Continued from page 65)*

action for the company at the same time that the individual needs are fulfilled to a reasonable degree. The two can complement each other, and when they do, there is potentially the delightful result that comes from mutual 'back-scratching.'

"The goal, then, is one of centralized planning and control with authority and responsibility decentralized."

Ask the public the difference between an engineer and a scientist, and the answers will likely add up to confusion. Proceeding on this theory, the Engineers Joint Council has undertaken to set the record straight.

"Scientists make it known, but engineers make it work!" is the theme of a series of public service advertisements by the council in Editor and Publisher, business magazine for the newspaper profession. The ads are designed to create understanding of engineers and engineering by printed media, radio and television, public officials, organizations and advertising agencies.

Such messages as "Let's Get Clear on What Engineers Do," "Just Who's Firing Those Missiles" and "Say Engineer When You Mean Engineer" will appear at intervals in Editor and Publisher for the remainder of the year.

Have you heard of the wag who lost his engineering job in an economy layoff wave? He drafted a resume of his job experience but received discouragingly uniform rejections from each company he wrote to. Finally he composed a "situations wanted" ad, describing in detail the kind of position he was seeking. Through a clerical error, the ad found its way into the "help wanted" columns of the newspaper. Our engineer spied the item and was elated. "Just the job I'm looking for!" he cried—and answered his own ad. Joseph Leeb, project engineer of Bulova Watch Co., Jackson Heights, N.Y., tells the story poker-faced.

A hundred students are turning their engineering and mathematics lessons into cash this summer at Melpar, Inc., a subsidiary of Westinghouse Air Brake Co. at Falls Church, Va. The students work at the electronic equipment plant under a special summer program.

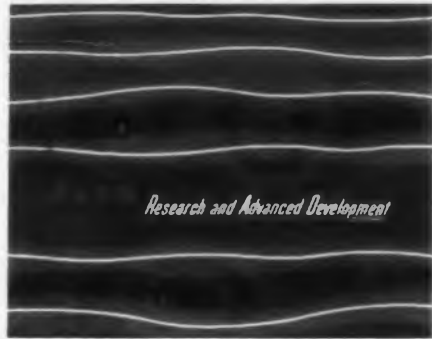
About 75 of the group are doing technical work and will use their earnings to defray college expenses in the fall. Among this group are several recent high school graduates who will enter college.

The remainder are college students working in a cooperative program set up by Melpar and the schools they attend. These student-employees alternate each quarter between work and school. Some attend colleges as far away as Georgia Tech.



# CAREER OPPORTUNITIES BROCHURES

Avco



The aim of Avco's Research and Advanced Development Division is the solution of theoretical and practical problems resulting in advanced systems development. Physics and Aerodynamics, Materials, Electronics, Mathematics and Computing, Engineering, Reliability and Quality, Field Test and Operations, and Technical Services are areas of competence generously discussed and illustrated.

Avco, RAD Division, Dept. ED, Wilmington, Mass.

CIRCLE 870 ON READER-SERVICE CARD



**Electronic Engineering Company**

The Electronic Engineering Company of California (EECO) has presented a concise outline of its history, present projects and future aims in its pamphlet, "Career or Just a Job?" Projects include missile range instrumentation, missile firing and timing systems, and digital data processing equipment for the military, to Computer Language Translators and special tape search and control equipment for both military and commercial use. Company policy and benefits are listed.

Merl Perkins, EECO, Dept. ED, 1601 E. Chestnut, Santa Ana, Orange County, Calif.

CIRCLE 871 ON READER-SERVICE CARD



*News from Raytheon's Semiconductor Division...*

## AUTOMATIC TESTING—

The operator is testing Raytheon semiconductor products at one of the new automatic test sets. This equipment, designed by Raytheon engineers, checks and classifies transistors according to the several hundred possible combinations of test parameters—including emitter and collector current cutoff, frequency cutoff, a-c beta, d-c beta, breakdown voltages, input voltage, collector capacitance, extrinsic base resistance and gain.

## POSITIONS FOR MEN WHO ARE GROWING FASTER THAN THEIR ASSOCIATES

If you have applicable experience in any of the following areas and want to learn more about Raytheon's semiconductor opportunities, please use the attached coupon.

Device Design and Development  
Process Engineering  
Mechanization  
Circuit Design  
Application Engineering

Mail to:  
Mr. Joseph McGovern  
Semiconductor Division  
Raytheon Company  
150 California Street  
Newton 58, Massachusetts

Gentlemen:  
I would like further information about Raytheon's Semiconductor Division.

NAME \_\_\_\_\_  
STREET \_\_\_\_\_  
CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_  
DEGREE(S) \_\_\_\_\_ YRS. EXPERIENCE \_\_\_\_\_  
PHONE NUMBER \_\_\_\_\_

*The place for the man who is growing faster...*

**Semiconductor Division of**



*Excellence in Electronics*

CIRCLE 906 ON CAREER INQUIRY FORM

# IDEAS FOR DESIGN—ENTRY BLANK

To the *Ideas-For-Design* Editor of **ELECTRONIC DESIGN** —  
830 3rd Ave., New York 22, N.Y. • PLaza 1-5530

Here is my design idea for possible publications in your *Ideas For Design* department. I can expect \$10 for this idea if accepted for publication.

(Ideas suitable include: 1. new circuits or circuit modifications, 2. new design techniques, 3. designs for new production methods, 4. clever use of new materials or new components in design, 5. design or drafting aids, 6. new methods of packaging, 7. design short cuts, or 8. cost saving tips)

## STATEMENT OF THE PROBLEM—

MY SOLUTION. AND WHY—(Please be explicit. Include sketches or photos that will help the idea across)

Name \_\_\_\_\_  
Title \_\_\_\_\_  
Company \_\_\_\_\_  
Address \_\_\_\_\_

(Place illustrations on separate sheet if necessary)

## CAREER OPPORTUNITIES

### Raytheon Manufacturing Company



"The Broad Spectrum of Raytheon's Capabilities" contains 44 pages of illustrated material describing in detail the work and facilities of this company. The table of contents is divided into 11 sections corresponding to the 11 operating divisions of Raytheon, each of which is annotated according to facility space, number of employees, and plant locations.

Each division is treated thoroughly: details on fields of activity, facilities, type of operation, products, and other pertinent facts are included along with full photographic treatment depicting on-the-spot job activity, plant operation, and projects.

Raytheon Manufacturing Co., Dept. ED, Waltham, Mass.

CIRCLE 872 ON READER-SERVICE CARD

### Kearfott Company



Employment opportunities aiding in the building of a career are depicted in "Your Horizons for Tomorrow at Kearfott." A brief history of Kearfott's growth and development in its seven plants in the Clifton, Little Falls, and Paterson, N.J. areas precedes an organizational chart showing the various engineering departments. This 24-page illustrated brochure lists the facilities available for work in the development of remote-response electronic and servomechanical equipment ranging from single components to complete systems.

Personnel Mgr., Kearfott Co., Inc., Dept. ED, 1150 McBride Ave., Little Falls, N.J.

CIRCLE 873 ON READER-SERVICE CARD



TI Needs More Glenn Penisten's BS EE '53 Oklahoma State University

## SENIOR ELECTRICAL ENGINEERS

Men like Glenn Penisten are needed for high-level development and supervision — EE's who have 3 to 10 years experience in specialties such as missile guidance, servo-mechanisms, telemetry, digital circuitry, infrared — design or systems studies. Following such a specialty Glenn Penisten has advanced rapidly in his 3 years at TI, and now leads several missile and space projects. Such experience can be used immediately. Your resume will get prompt attention by John R. Pinkston.

PROFESSIONAL  
PLACEMENT

APPARATUS  
DIVISION

TEXAS  INSTRUMENTS  
INCORPORATED  
6000 LEMMON AVENUE  
DALLAS 9, TEXAS

CIRCLE 908 ON CAREER INQUIRY FORM

## GROW WITH AIRESEARCH IN ELECTRONICS

**A**iResearch expansion in electronics and electromechanical activity is creating outstanding positions at all levels for qualified engineers.

### DATA SYSTEMS RESEARCH

Experience with physical measuring devices using electromagnetic, atomic, thermionic and mechanical approaches.

Openings also exist in the following areas:  
Flight Systems Research... Controls Analysis  
... Flight Data Components... Electromagnetic  
Development... Instrument Design... Airborne  
Instrumentation Analysis and Design.

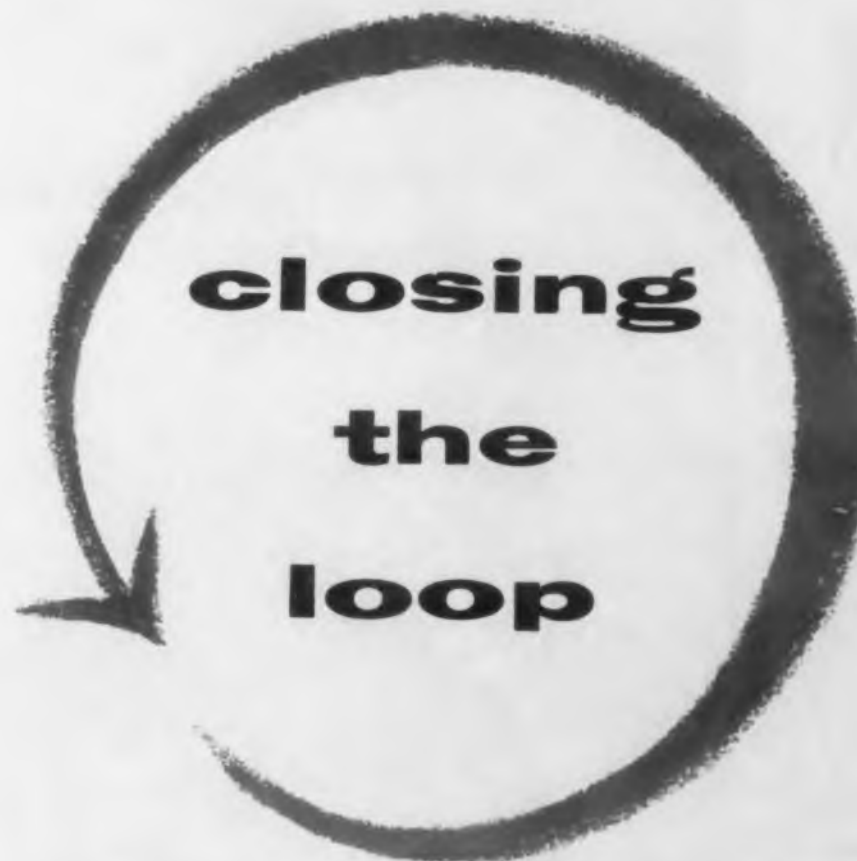
Send resume to: Mr. G. D. Bradley



AiResearch Manufacturing Division

9851 So. Sepulveda Blvd., Los Angeles 45, Calif.

CIRCLE 909 ON CAREER INQUIRY FORM



At Motorola in Phoenix, engineers find unique opportunities for personal and professional growth in an atmosphere that encourages initiative and independence. Organized on a project basis, your engineering assignments begin with the original design, follow through development and production stages, and conclude only with final field evaluation. As an engineer, you are responsible for "closing the loop". The effectiveness of this *project approach* is borne out by Motorola's achievements in the military electronics field. If you are a creative engineer interested in the opportunity to carry your ideas through to completion, and if you like the idea of living in the brightest, healthiest climate in the United States, write today to Kel Rowan, Dept. B-8.



**MOTOROLA**

Western Military Electronics Center 8201 E. McDowell Rd. Phoenix, Arizona



### OPPORTUNITIES

Electronic Engineers, Mechanical Engineers, Physicists—SYSTEM ANALYSIS, DESIGN AND TEST—Radar • Missile Guidance • Navigation • Combat Surveillance • Communications • Field Engineering • Data Processing and Display—CIRCUIT DESIGN, DEVELOPMENT AND PACKAGING—Microwave • Pulse and Video • Antenna • Transistor • R-F and I-F • Servos • Digital and Analog  
TECHNICAL WRITERS AND ILLUSTRATORS, QUALITY CONTROL ENGINEERS, RELIABILITY ENGINEERS

Motorola also offers opportunities at Riverside, California and Chicago, Illinois

CIRCLE 910 ON CAREER INQUIRY FORM

# Phone Southern California (collect)

about your future

at Hughes in Fullerton

CALL MADison 9-5211, Los Angeles  
Ask for Mr. B. P. Ramstack

Are you a qualified electronics engineer—E.E. degree, 5 years of experience...interested in truly stimulating work...with an eye for solid opportunity and personal and professional growth? Phone collect to Hughes in Fullerton, California!

Hughes in Fullerton—fastest-growing activity of the Hughes Aircraft Company—needs additional engineering talent...men to work on a variety of projects in the areas listed in the box.

Phone—any business day, up to 6:00 p.m. Pacific Daylight Time—and an authorized Hughes engineer will evaluate your qualifications on the phone and advise you of specific opportunities. Your call, of course, is in confidence—as is any subsequent correspondence.

Opportunity at Hughes is great. Environment—the place and the people—are pleasant and stimulating. Offices are private or semi-private. Average age of our engineering staff is 31 years; one out of five has an advanced degree.

Phone now—collect—or write Mr. B. P. Ramstack, at address below.

## HUGHES—FULLERTON RESEARCH AND DEVELOPMENT PROJECTS

**Electronic Scanning Radars**—to develop new advanced applications for 3-dimensional radar.

**Data Processing Systems**—to design computers which monitor activity of hundreds of aircraft, and direct the assignment of defense weapons.

**Electronic Display Systems**—to design consoles for presentation of tactical data in symbolic or language form.

# HUGHES

© 1959, H. A. C.

Fullerton—Research and Development  
Personnel Selection and Placement  
Hughes Aircraft Company  
Fullerton 18, Orange County, California





TI Needs More John Maxwell's BS EE Louisiana Polytechnic Institute

### MICROWAVE ENGINEERS

Men like John Maxwell are needed for high-level development and supervision — EE's who have 3 to 10 years experience in development, design and testing of microwave and high powered transmitter equipment prototypes. John has almost 9 years at TI, and now leads ASR transmitter and automatic performance monitor projects. Such experience can be used immediately. Your resume will get prompt attention by John R. Pinkston.

PROFESSIONAL  
PLACEMENT

APPARATUS  
DIVISION

TEXAS INSTRUMENTS  
INCORPORATED  
8000 LEMMON AVENUE  
DALLAS 9, TEXAS

CIRCLE 911 ON CAREER INQUIRY FORM

## GROW WITH AIRESEARCH IN ELECTRONICS

**A**iResearch expansion in electronics and electromechanical activity is creating outstanding positions at all levels for qualified engineers.

### FLIGHT SYSTEMS RESEARCH

General problems in motivation and navigation in air and space; required background in astronomy, physics, engineering.

Openings also exist in the following areas:  
Data Systems Research... Controls Analysis...  
Flight Data Components... Electromagnetic  
Development... Instrument Design... Airborne  
Instrumentation Analysis and Design.

Send resume to: Mr. G. D. Bradley



AiResearch Manufacturing Division

9851 So. Sepulveda Blvd., Los Angeles 45, Calif.

CIRCLE 912 ON CAREER INQUIRY FORM

## Some of Man's Greatest Creative Work is in this Building



National Gallery of Art, Washington, D.C.

... originals by Rembrandt van Ryn, Velasquez, Gauguin, Cezanne, Manet—and many others. Another kind of creativity exists a few miles away at Melpar. Here engineers and scientists create, design and produce sophisticated electronic equipment for worldwide and space application.

The Melpar design for working, which involves the finest facilities, colleagues and incentives—paves the way for engineers and scientists to achieve genuine stature in their fields. Systems planning and development project group members participate in challenging problems from idea conception through to completion of prototype. Those on staff assignments work along provocative, deep-probing lines of inquiry in specific electronic areas, as well as serving as advisors to project groups.

Another point of no little interest—living conditions in the area surrounding our modern laboratories in Northern Virginia (ten miles from Washington, D.C.) and suburban Boston, are superb with truly impressive cultural and educational facilities.

Melpar is active in virtually all phases of electronic creation, design, and production.

Opportunities are now available at Melpar in the following areas:

Reconnaissance Systems	Detection & Identification Systems
Airborne Equipment	Antenna & Radiation Systems
Ground Data Handling Equipment	Chemistry Laboratory
Ground Support Equipment	Applied Physics Laboratory
Simulation & Training Systems	Production Engineering
Communication & Navigation Systems	Quality Control

Melpar has had a remarkable growth pattern since its inception, creating significant opportunities for the uncommon engineer and scientist.

Your own intellectual dimensions govern remuneration and assignments.

INTERVIEWS ARRANGED IN YOUR LOCALE

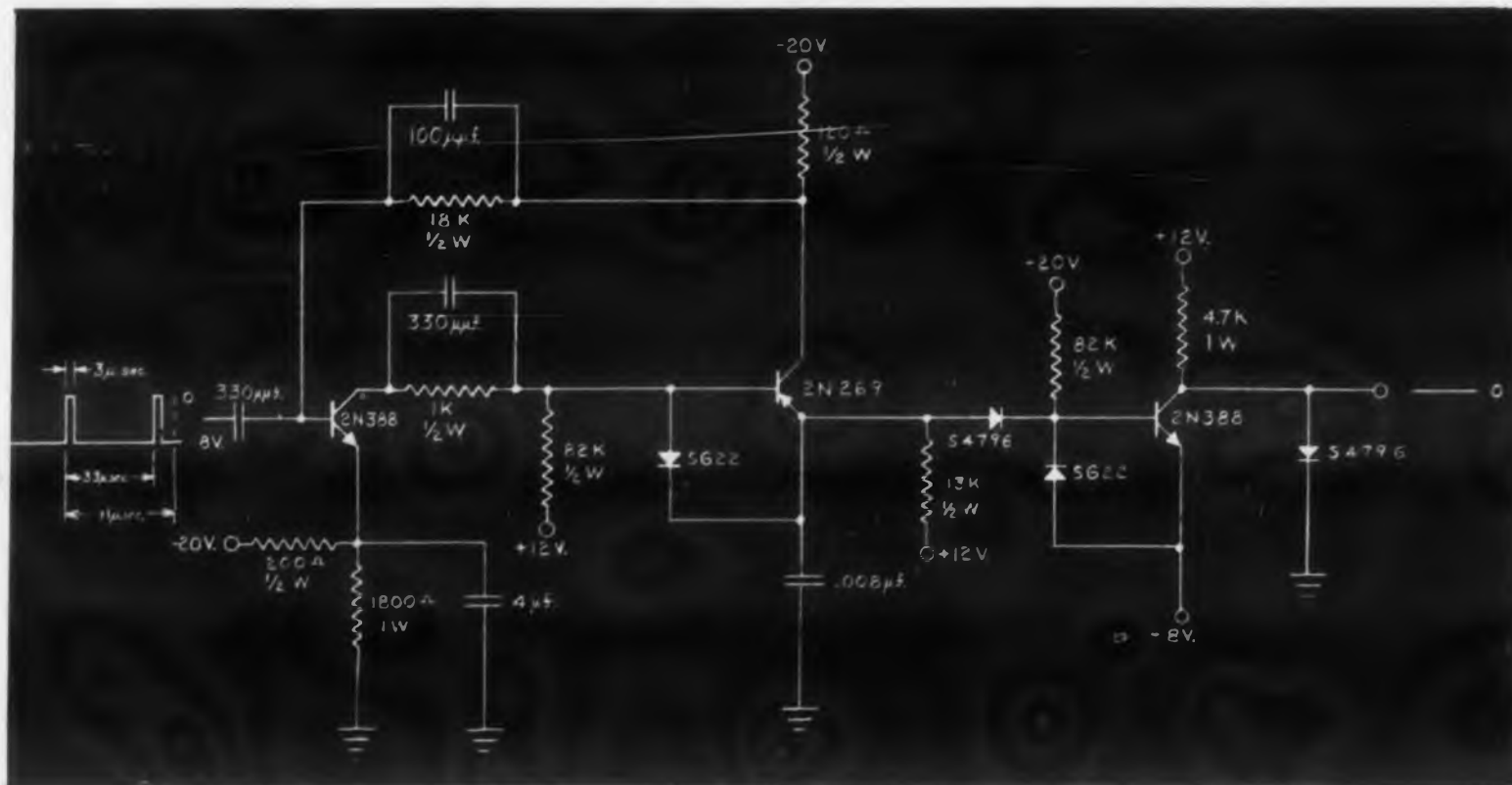
For Details  
Wire Collect or Write to:  
Professional  
Employment Supervisor

**MELPAR INC**

A SUBSIDIARY OF WESTINGHOUSE AIR BRAKE COMPANY

3307 Arlington Boulevard, Falls Church, Virginia  
In historic Fairfax County  
10 miles from Washington, D.C.

CIRCLE 913 ON CAREER INQUIRY FORM



# ATTENTION: COMPUTER AND DATA-PROCESSING ENGINEERS

## HERE ARE THE TYPES OF MEN NCR NEEDS:

### COMPUTER ENGINEERS:

#### SENIOR CIRCUIT & LOGICAL DESIGNER

experienced in the design, development and analysis of transistorized computer circuits, including application of magnetic cores to high-speed memories. Plus evaluating and debugging arithmetic and control areas of computer systems.

**Your Work at NCR**—design responsibilities in the areas noted above.

#### SENIOR MECHANICAL ANALYST

must be versed in dynamics, and familiar with analysis of forces involved with bodies in motion, stress and strain with bodies of complex shape. Working knowledge of Laplace transforms, theory of complex variables, matrix algebra and vector or tensor analysis. Experienced in programming of digital or analog computers. Graduate degree required.

**Your Work at NCR**—perform mathematical analyses and relate to the design and development of high-speed input output devices.

#### CIRCUIT AND DEVICE ENGINEER

experienced in the design and development of solid state computer circuits. Strong background in solid state physics and magnetics is necessary.

**Your Work at NCR**—extend the knowledge of new research materials and components in circuits and seek new functions based on this knowledge.

### DATA-PROCESSING ENGINEERS:

#### E.D.P. APPLICATIONS ANALYST

advanced degree in science with systems and/or materials experience in the field of electronic data processing. Should have special interests in pursuing the applications aspects of new technology.

**Your Work at NCR**—preparation of technical-economic evaluations of existing and proposed research projects for research management.

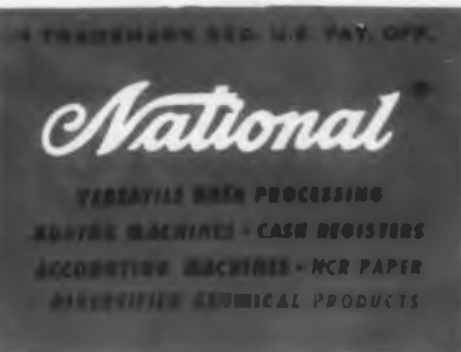
#### SENIOR ELECTRONIC DESIGN ENGINEER

experienced in the development of logical design using standard computer elements.

**Your Work at NCR**—to evaluate and design transistorized circuits including voltage regulated power supplies and circuitry related to decimal to binary coding.

#### HOW DO I APPLY?

Simply send your résumé to: Mr. K. H. Ross, Professional Personnel Section G, The National Cash Register Company, Dayton 9, Ohio.



THE NATIONAL CASH REGISTER COMPANY, DAYTON 9, OHIO

ONE OF THE WORLD'S MOST SUCCESSFUL CORPORATIONS

75 YEARS OF HELPING BUSINESS SAVE MONEY

Plan to discuss career opportunities with our representatives during WESCON.

CIRCLE 905 ON CAREER INQUIRY FORM

PROFESSIONAL  
GROWTH  
IN A NEW FIELD:



## DATA SYSTEMS IN UNDERWATER RESEARCH

Work is expanding at IBM on the design of new information-handling techniques required to explore the depths of the ocean. These investigations in oceanography are expected to have far-reaching scientific and military implications. Original and basic work will be needed in acoustics, information theory, advanced network theory, delay lines and cross-correlation techniques. Work will include systems design, real-time data processing, analysis of experimental equipment, and hybrid analog-digital techniques in unique data processing configurations. All phases of these varied projects will provide excellent career opportunities for Data Processing Systems Engineers.

### DATA PROCESSING SYSTEMS ENGINEERS

B.S., M.S. or Ph.D. in E.E. Experience desirable in development of one or more of these areas: Navy sonar, fire control, ASW, or navy navigational data processing systems. Experience desired in analog and digital special-purpose instrumentation, conversion equipment, electronic correlation devices, displays and delay lines.

You will enjoy unusual professional freedom and the support of a wealth of systems knowledge. Comprehensive education programs are available—plus the assistance of specialists of many disciplines. Working independently or with a small team, your individual contributions are quickly recognized and rewarded.

Write, outlining your qualifications and experience, to:

Mr. R. L. Lang, Dept. 55H3  
IBM Corporation  
Owego, New York

**IBM**

INTERNATIONAL BUSINESS MACHINES CORP.

Please write direct to advertiser  
mentioning ELECTRONIC DESIGN



# Sampling Papers from Soviet Universities

J. George Adashko

In our July 22 issue we presented a cross section of the "Scientific Report of the Higher Schools," a new scientific periodical published by the Ministry of Higher Education. In this issue we present condensations from "News of the Higher Institutions of Learning," Radio Engineering, No. 4, July-August, 1958. This periodical, unlike the "Scientific Reports of the Higher Schools," is more academic in character. In addition to the 15 main articles, there are short chronicles of university life.

**Analysis of Parameters of a Transistor Stage by the Method of Conformal Mapping,** by L. Ya. Nagornyy, L'vov Polytechnic Institute (pp 402-410, 7 figs.).

If a transistor is considered as a linear two-port network (small signals), it can be described by 18 systems of equations. If the parameters of one system of equations are known, it is easy to deter-

mine all the remaining parameters of the equivalent two-port network. The choice of the particular parameters and connection to employ is dictated essentially by the ease with which the characteristic parameters of the transistors can be determined at high frequencies. At high frequencies the internal feedback of a transistor (particularly a junction transistor) is a complex quantity, and this complicates considerably the analysis of this type of amplifier. If all the parameters of the transistor and the load and source impedances are complex (Fig. 1), it is possible to simplify the analysis by recalling that any two variables in the circuit can be expressed in terms of the parameters by means

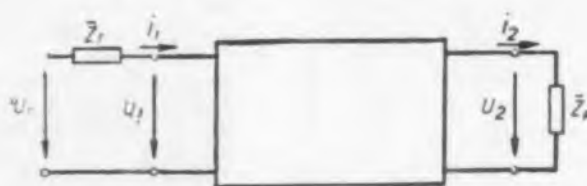


Fig. 1. Two-port representation of transistor.

of the fraction

$$\bar{W} = \frac{\bar{A} + \bar{B}\bar{X}}{\bar{C} + \bar{D}\bar{X}} = \bar{F} + \frac{\bar{G}^2}{\bar{H} + \bar{X}}$$

where  $\bar{W}$  is the dependent parameter and  $\bar{K}$  is the independent variable, while  $\bar{A}$ ,  $\bar{B}$ ,  $\bar{C}$ , and  $\bar{D}$  are the parameters of the two-port network.

The author has taken one Russian transistor (PIZh) connected in a grounded-emitter circuit. The average characteristic admittances, plotted in the frequency range from 0.2 to 1.6 mc, are drawn in the complex plane in Fig. 2.

Figs. 3, 4, 5, and 6 show the variation of the

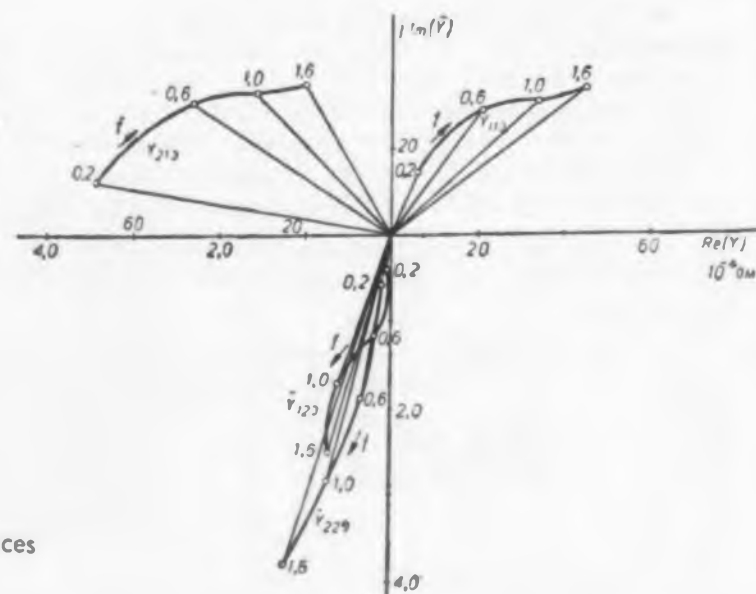


Fig. 2. (right) Average characteristic admittances plotted in complex plane.



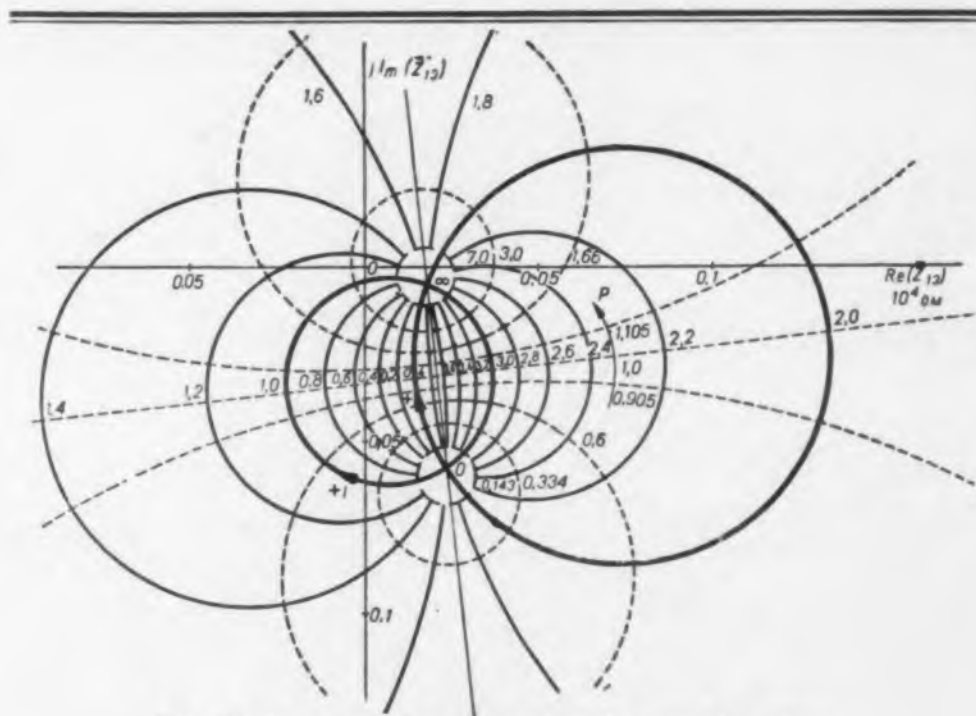


Fig. 3. Input impedance  $Z_{1e}$  plotted in complex plane.

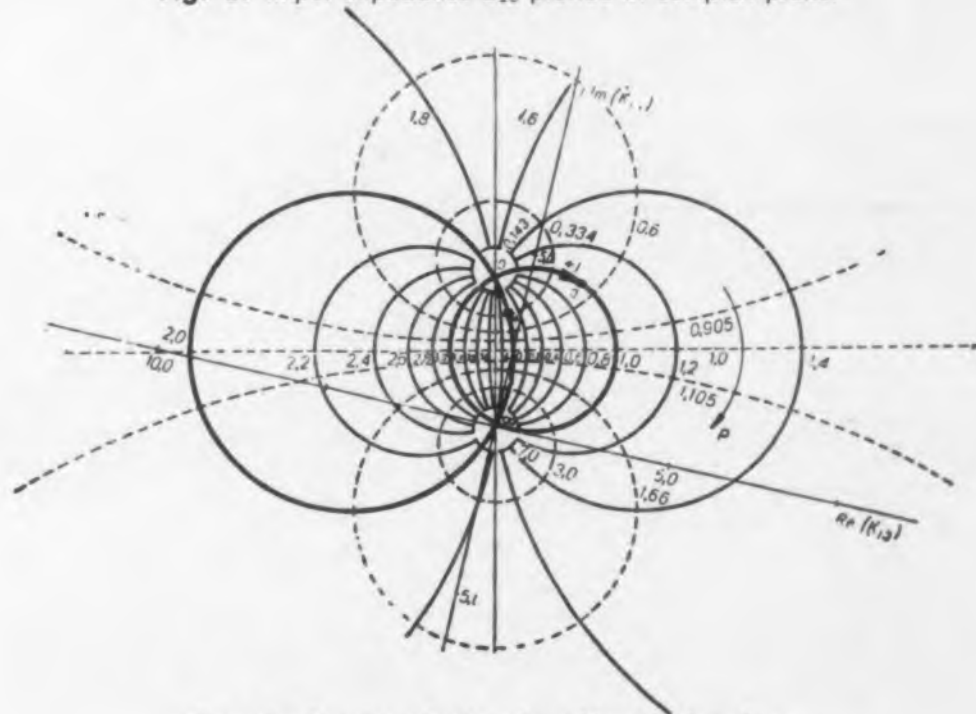


Fig. 4. Current gain  $K_{1e}$  plotted in complex plane.

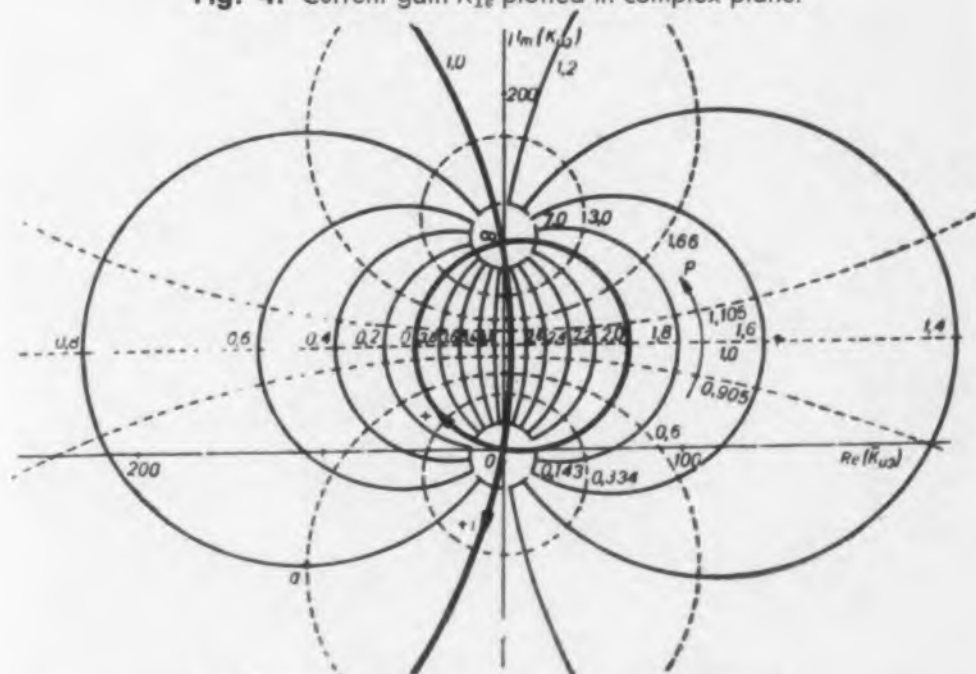
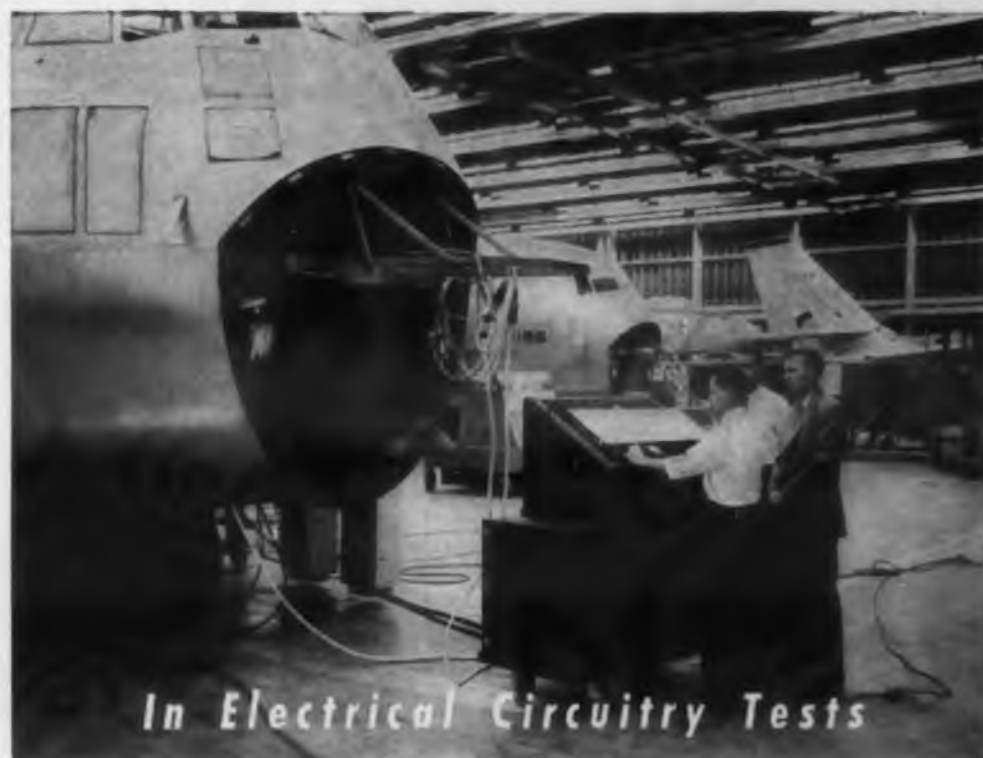


Fig. 5. Voltage gain  $K_{ve}$  plotted in complex plane.



In Electrical Circuitry Tests

## DIT-MCO Is Faster and More Reliable Than Other Methods

Take tape read-out tests, for example. This method requires extra machines to translate test information or a genius to remember the code used on the tape. Either way, it's a costly process. Compare this to the DIT-MCO Automatic Circuit Analyzer and its exclusive Matrix Chart.

The DIT-MCO Circuit Analyzer performs the entire test itself. There's no need for complex machines to translate test information. All data concerning errors, circuit numbers, type of flaws, etc., appears on the Matrix Chart, so there's no need for complicated wiring diagrams or charts! And, the DIT-MCO Circuit Analyzer checks one circuit against all others... over 2,000 in about three minutes... with accuracy never before possible in any test system.

Some testers are a maze of colored, flashing lights. Operators of such test machines must refer to 100, 500 or even 1,000 miniature lights to try and locate errors. Charts and diagrams must also be used... with a resultant high number of human errors.

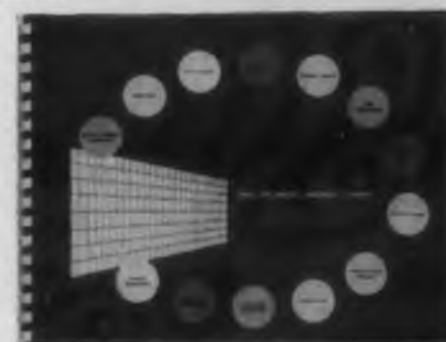
The DIT-MCO Circuit Analyzer injects human decision into every test but in such a way that chances of human errors are nil. The easy-to-read Matrix Chart employs only two lights to quickly pinpoint every circuitry flaw. Yet, anyone, with less than one hour's instruction, can operate the DIT-MCO Automatic Circuit Analyzer and perform test functions once thought impossible!

These are just a few reasons why DIT-MCO is faster and more reliable than other methods in electrical circuitry tests. Why not get the complete story? Write today for free Matrix Chart booklet.

## DIT-MCO, INC.

ELECTRONICS DIVISION

Box 08-20, 911 Broadway  
Kansas City 5, Missouri



### Partial List of DIT-MCO Users

Aircraft Radio Corp. • AirResearch Manufacturing Co. • American Bosch Arms Corp. • American Machine & Foundry Co. • American Motors • Amphenol Electronics Corp. • Autonetics, A Division of North American Aviation, Inc. • Bell Aircraft Corp. • Bendix Aviation Corp. • Boeing Aircraft Co. • Cessna Aircraft Co. • Chance Vought Aircraft, Inc. • Chrysler Corp. • Convair • Douglas Aircraft Co., Inc. • Dukane Corp. • Electronic Products Corp. • Fairchild Aircraft Division • Farnsworth Electronics Co. • Frankford Arsenal • General Electric Co. • General Mills, Inc., Mechanical Division • General Precision Laboratory, Inc. • Goodyear Aircraft Corp. • Grumman Aircraft Engineering Corp. • Hazeltine Electronics Division, Hazeltine Corp. • Hughes Aircraft • International Business Machines Corp. • Jefferson Electronic Products Corp. • Lockheed Aircraft Corp., Missile Systems Division • Martin, Baltimore • Minneapolis-Honeywell, Aeronautical Division • Motorola, Inc. • Northrup Aircraft, Inc. • Pacific Mercury Television Mfg. Corp. • Radio Corp. of America • Radioplane Co. • Raytheon Manufacturing Co. • Servomechanisms, Inc. • Sikorsky Aircraft • Sperry Gyroscope Co. • Summers Gyroscope Co. • Sun Electric Co. • The Swartwout Co., Autronic Division • Temco Aircraft Corp. • Thompson Products • Topp Industries Inc. • Trans World Airlines • U. S. Naval Air Station Overhaul and Repair Depots • U. S. Naval Ordnance Laboratory, White Oak • Vertol Aircraft Corp. • Western Electric Co. • Westinghouse Electric Corp.

CIRCLE 55 ON READER-SERVICE CARD

# Sampling Papers from Soviet Universities

J. George Adashko

In our July 22 issue we presented a cross section of the "Scientific Report of the Higher Schools," a new scientific periodical published by the Ministry of Higher Education. In this issue we present condensations from "News of the Higher Institutions of Learning," Radio Engineering, No. 4, July-August, 1958. This periodical, unlike the "Scientific Reports of the Higher Schools," is more academic in character. In addition to the 15 main articles, there are short chronicles of university life.

**Analysis of Parameters of a Transistor Stage by the Method of Conformal Mapping,** by L. Ya. Nagornyy, L'vov Polytechnic Institute (pp 402-410, 7 figs.).

If a transistor is considered as a linear two-port network (small signals), it can be described by 18 systems of equations. If the parameters of one system of equations are known, it is easy to deter-

mine all the remaining parameters of the equivalent two-port network. The choice of the particular parameters and connection to employ is dictated essentially by the ease with which the characteristic parameters of the transistors can be determined at high frequencies. At high frequencies the internal feedback of a transistor (particularly a junction transistor) is a complex quantity, and this complicates considerably the analysis of this type of amplifier. If all the parameters of the transistor and the load and source impedances are complex (Fig. 1), it is possible to simplify the analysis by recalling that any two variables in the circuit can be expressed in terms of the parameters by means

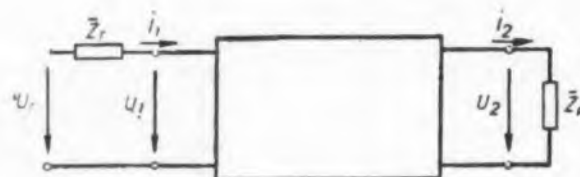


Fig. 1. Two-port representation of transistor.

of the fraction

$$\bar{W} = \frac{\bar{A} + \bar{B}\bar{X}}{\bar{C} + \bar{D}\bar{X}} = \bar{F} + \frac{\bar{G}^2}{\bar{H} + \bar{X}}$$

where  $\bar{W}$  is the dependent parameter and  $\bar{X}$  is the independent variable, while  $\bar{A}$ ,  $\bar{B}$ ,  $\bar{C}$ , and  $\bar{D}$  are the parameters of the two-port network.

The author has taken one Russian transistor (PIZh) connected in a grounded-emitter circuit. The average characteristic admittances, plotted in the frequency range from 0.2 to 1.6 mc, are drawn in the complex plane in Fig. 2.

Figs. 3, 4, 5, and 6 show the variation of the

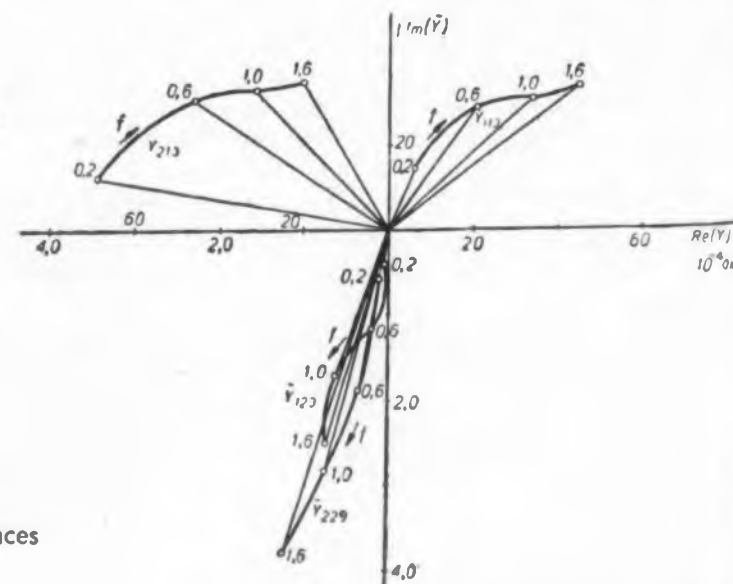


Fig. 2. (right) Average characteristic admittances plotted in complex plane.

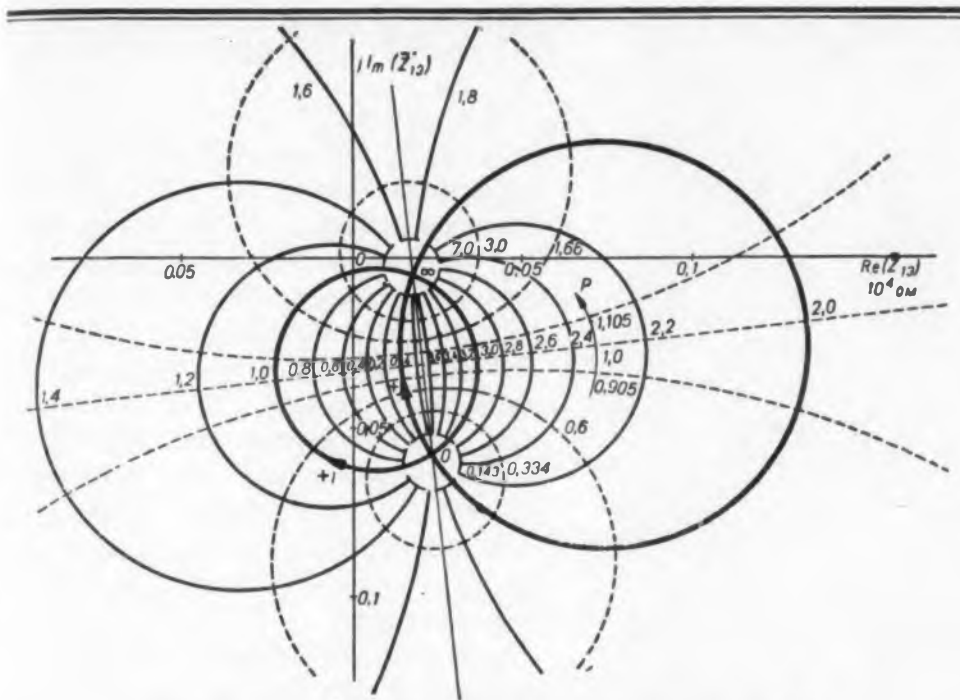


Fig. 3. Input impedance  $Z_{1e}$  plotted in complex plane.

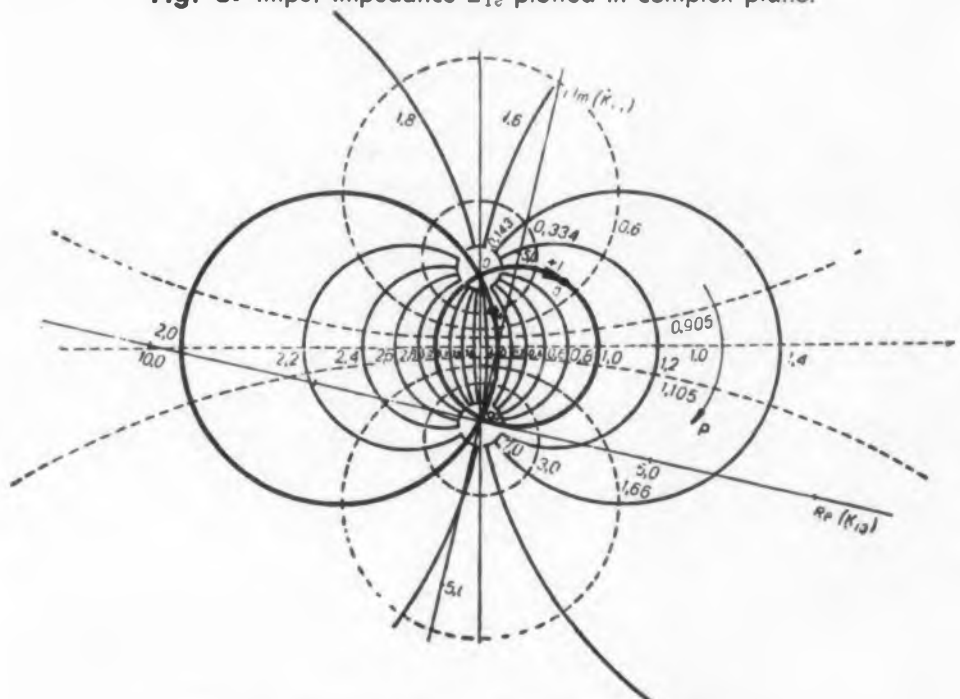


Fig. 4. Current gain  $K_{1e}$  plotted in complex plane.

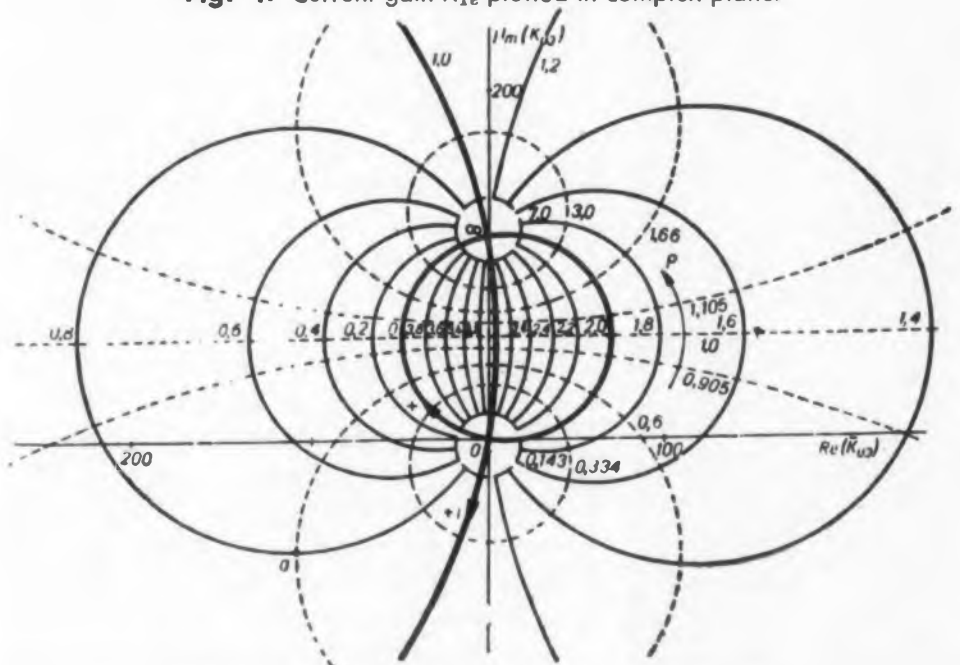
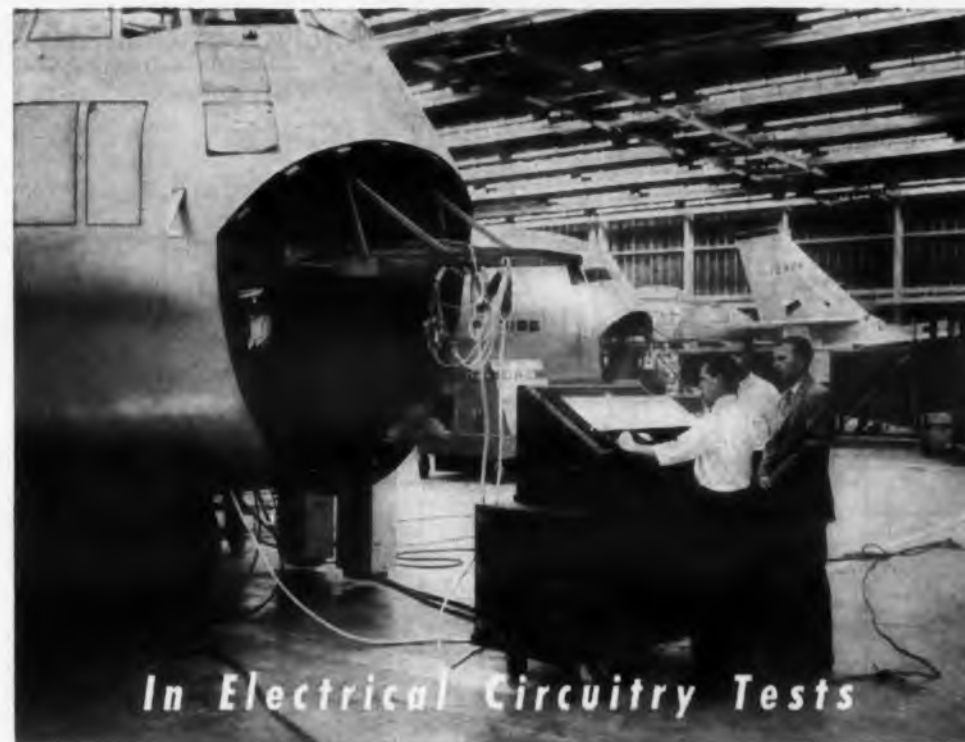


Fig. 5. Voltage gain  $K_{ve}$  plotted in complex plane.



## DIT-MCO Is Faster and More Reliable Than Other Methods

Take tape read-out tests, for example. This method requires extra machines to translate test information or a genius to remember the code used on the tape. Either way, it's a costly process. Compare this to the DIT-MCO Automatic Circuit Analyzer and its exclusive Matrix Chart.

The DIT-MCO Circuit Analyzer performs the entire test itself. There's no need for complex machines to translate test information. All data concerning errors, circuit numbers, type of flaws, etc., appears on the Matrix Chart, so there's no need for complicated wiring diagrams or charts! And, the DIT-MCO Circuit Analyzer checks one circuit against all others... over 2,000 in about three minutes... with accuracy never before possible in any test system.

Some testers are a maze of colored, flashing lights. Operators of such test machines must refer to 100, 500 or even 1,000 miniature lights to try and locate errors. Charts and diagrams must also be used... with a resultant high number of human errors.

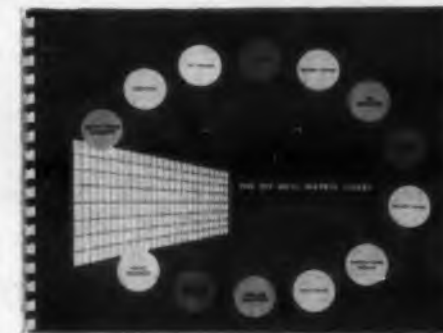
The DIT-MCO Circuit Analyzer injects human decision into every test but in such a way that chances of human errors are nil. The easy-to-read Matrix Chart employs only two lights to quickly pinpoint every circuitry flaw. Yet, anyone, with less than one hour's instruction, can operate the DIT-MCO Automatic Circuit Analyzer and perform test functions once thought impossible!

These are just a few reasons why DIT-MCO is faster and more reliable than other methods in electrical circuitry tests. Why not get the complete story? Write today for free Matrix Chart booklet.

## DIT-MCO, INC.

ELECTRONICS DIVISION

Box 08-20, 911 Broadway  
Kansas City 5, Missouri



### Partial List of DIT-MCO Users

Aircraft Radio Corp. • AiResearch Manufacturing Co. • American Bosch Arma Corp. • American Machine & Foundry Co. • American Motors • Amphenol Electronics Corp. • Autonetics, A Division of North American Aviation, Inc. • Bell Aircraft Corp. • Bendix Aviation Corp. • Boeing Airplane Co. • Cessna Aircraft Co. • Chance Vought Aircraft, Inc. • Chrysler Corp. • Convair • Douglas Aircraft Co., Inc. • Dukane Corp. • Electronic Products Corp. • Fairchild Aircraft Division • Farnsworth Electronics Co. • Frankford Arsenal • General Electric Co. • General Mills, Inc., Mechanical Division • General Precision Laboratory, Inc. • Goodyear Aircraft Corp. • Grumman Aircraft Engineering Corp. • Hazeltine Electronics Division, Hazeltine Corp. • Hughes Aircraft • International Business Machines Corp. • Jefferson Electronic Products Corp. • Lockheed Aircraft Corp., Missile Systems Division • Martin, Baltimore • Minneapolis-Honeywell, Aeronautical Division • Motorola, Inc. • Northrup Aircraft, Inc. • Pacific Mercury Television Mfg. Corp. • Radio Corp. of America • Radioplane Co. • Raytheon Manufacturing Co. • Servomechanisms, Inc. • Sikorsky Aircraft • Sperry Gyroscope Co. • Summers Gyroscope Co. • Sun Electric Co. • The Swartwout Co., Autronic Division • Temco Aircraft Corp. • Thompson Products • Topp Industries Inc. • Trans World Airlines • U. S. Naval Air Station Overhaul and Repair Depots • U. S. Naval Ordnance Laboratory, White Oak • Vertol Aircraft Corp. • Western Electric Co. • Westinghouse Electric Corp.

CIRCLE 55 ON READER-SERVICE CARD

## Derivations for Analysis of Transistor Parameters

$W$	$\bar{F} + \frac{\bar{G}^2}{H + \bar{X}}$	$Z_{1\epsilon} = \frac{1 - Z_n Y_{22\epsilon}}{Y_{11\epsilon} - Z_n \Delta Y}$	$Z_{2\epsilon} = -\frac{1 + Z_r Y_{11\epsilon}}{Y_{22\epsilon} + Z_r \Delta Y}$	$K_{1\epsilon} = \frac{Y_{21\epsilon}}{Y_{11\epsilon} - Z_n \Delta Y}$	$K_{2\epsilon} = \frac{Y_{12\epsilon} Z_n}{1 - Y_{22\epsilon} Z_n}$
$F$	$ F   \bar{F} $	$F_{1\epsilon} = \left  \frac{Y_{21\epsilon}}{\Delta Y} \right   \bar{F}_{1\epsilon} $	$F_{2\epsilon} = \left  \frac{Y_{12\epsilon}}{\Delta Y} \right   \bar{F}_{2\epsilon} $	-	$F_{U\epsilon} = \left  \frac{Y_{21\epsilon}}{Y_{22\epsilon}} \right   \bar{F}_{U\epsilon} $
$\bar{G}$	$ \bar{G}^2   \bar{G} $	$\bar{G}_{1\epsilon}^2 = \left  \frac{Y_{11\epsilon} Y_{22\epsilon}}{(\Delta Y)^2} \right   \bar{G}_{1\epsilon} $	$\bar{G}_{2\epsilon}^2 = \left  \frac{Y_{22\epsilon} Y_{11\epsilon}}{(\Delta Y)^2} \right   \bar{G}_{2\epsilon} $	$\bar{G}_{1\epsilon}^2 = \left  \frac{Y_{21\epsilon}}{\Delta Y} \right   \bar{G}_{1\epsilon} $	$\bar{G}_{U\epsilon}^2 = \left  \frac{Y_{21\epsilon}}{Y_{22\epsilon}} \right   \bar{G}_{U\epsilon} $
$\bar{H}$	$ \bar{H}   \bar{H} $	$H_{1\epsilon} = \left  \frac{Y_{11\epsilon}}{\Delta Y} \right   \bar{H}_{1\epsilon} $	$H_{2\epsilon} = \left  \frac{Y_{22\epsilon}}{\Delta Y} \right   \bar{H}_{2\epsilon} $	$\bar{H}_{1\epsilon} = \left  \frac{Y_{21\epsilon}}{\Delta Y} \right   \bar{H}_{1\epsilon} $	$\bar{H}_{U\epsilon} = \left  \frac{1}{Y_{22\epsilon}} \right   \bar{H}_{U\epsilon} $
$\bar{X}$	$ \bar{X}   \bar{X} $	$Z_n =  Z_n   \bar{Z}_n $	$Z_r =  Z_r   \bar{Z}_r $	$Z_n =  Z_n   \bar{Z}_n $	$Z_n =  Z_n   \bar{Z}_n $
$\bar{W}_R$	$\bar{F} + \frac{\bar{G}^2}{H} \cdot \frac{ \bar{H} ^2}{ \bar{H} ^2 -  \bar{X} ^2}$	$\bar{F}_{1\epsilon} + \frac{\bar{G}_{1\epsilon}^2}{H_{1\epsilon}} \cdot \frac{ H_{1\epsilon} ^2}{ H_{1\epsilon} ^2 -  Z_n ^2}$	$\bar{F}_{2\epsilon} + \frac{\bar{G}_{2\epsilon}^2}{H_{2\epsilon}} \cdot \frac{ H_{2\epsilon} ^2}{ H_{2\epsilon} ^2 -  Z_r ^2}$	$\frac{\bar{G}_{1\epsilon}^2}{H_{1\epsilon}} \cdot \frac{ H_{1\epsilon} ^2}{ H_{1\epsilon} ^2 -  Z_n ^2}$	$\bar{F}_{U\epsilon} + \frac{\bar{G}_{U\epsilon}^2}{H_{U\epsilon}} \cdot \frac{ H_{U\epsilon} ^2}{ H_{U\epsilon} ^2 -  Z_n ^2}$
$\bar{F}_R$	$ \bar{G}^2  \frac{ \bar{X} }{ \bar{H} ^2 -  \bar{X} ^2}$	$ \bar{G}_{1\epsilon}^2  \frac{ Z_n }{ H_{1\epsilon} ^2 -  Z_n ^2}$	$ \bar{G}_{2\epsilon}^2  \frac{ Z_r }{ H_{2\epsilon} ^2 -  Z_r ^2}$	$ \bar{G}_{1\epsilon}^2  \frac{ Z_n }{ H_{1\epsilon} ^2 -  Z_n ^2}$	$ \bar{G}_{U\epsilon}^2  \frac{ Z_n }{ H_{U\epsilon} ^2 -  Z_n ^2}$
$\bar{W}_\varphi$	$\bar{F} + \frac{\bar{G}^2}{2H} [1 + j \operatorname{ctg}(\bar{\varphi} - \gamma)]$	$\bar{F}_{1\epsilon} + \frac{\bar{G}_{1\epsilon}^2}{2H_{1\epsilon}} [1 + j \operatorname{ctg}(\bar{\varphi}_n - \gamma_{1\epsilon})]$	$\bar{F}_{2\epsilon} + \frac{\bar{G}_{2\epsilon}^2}{2H_{2\epsilon}} [1 + j \operatorname{ctg}(\bar{\varphi}_r - \gamma_{2\epsilon})]$	$\frac{\bar{G}_{1\epsilon}^2}{2H_{1\epsilon}} [1 + j \operatorname{ctg}(\bar{\varphi}_n - \gamma_{1\epsilon})]$	$\bar{F}_{U\epsilon} + \frac{\bar{G}_{U\epsilon}^2}{2H_{U\epsilon}} [1 + j \operatorname{ctg}(\bar{\varphi}_n - \gamma_{U\epsilon})]$
$\bar{P}_\varphi$	$\frac{ \bar{G}^2 }{2 H  \sin(\bar{\varphi} - \gamma)}$	$\frac{ \bar{G}_{1\epsilon}^2 }{2 H_{1\epsilon}  \sin(\bar{\varphi}_n - \gamma_{1\epsilon})}$	$\frac{ \bar{G}_{2\epsilon}^2 }{2 H_{2\epsilon}  \sin(\bar{\varphi}_r - \gamma_{2\epsilon})}$	$\frac{ \bar{G}_{1\epsilon}^2 }{2 H_{1\epsilon}  \sin(\bar{\varphi}_n - \gamma_{1\epsilon})}$	$\frac{ \bar{G}_{U\epsilon}^2 }{2 H_{U\epsilon}  \sin(\bar{\varphi}_n - \gamma_{U\epsilon})}$

The Russian subscript  $\epsilon$  represents common-emitter circuit.

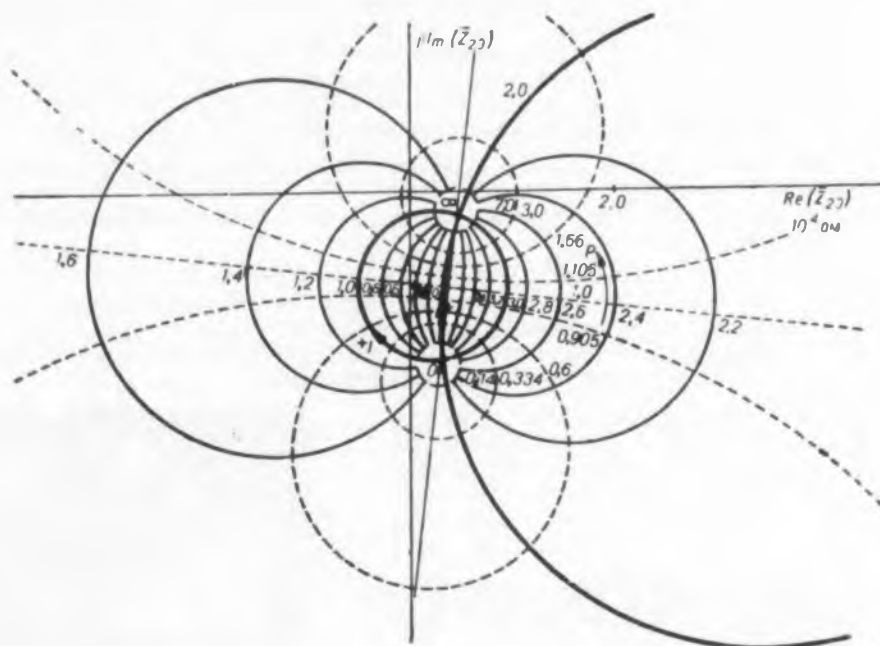


Fig. 6. Output impedance  $Z_{2\epsilon}$  plotted in complex plane.

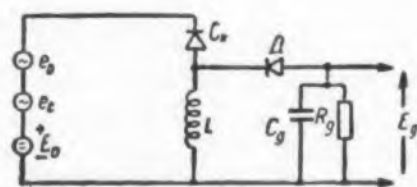


Fig. 7. Diagram of a parametric amplifier without feedback.

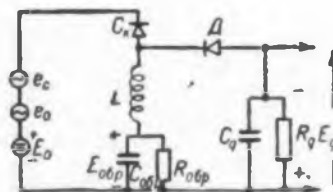


Fig. 8. Parametric amplifier with feedback ( $\beta < 0$ ).

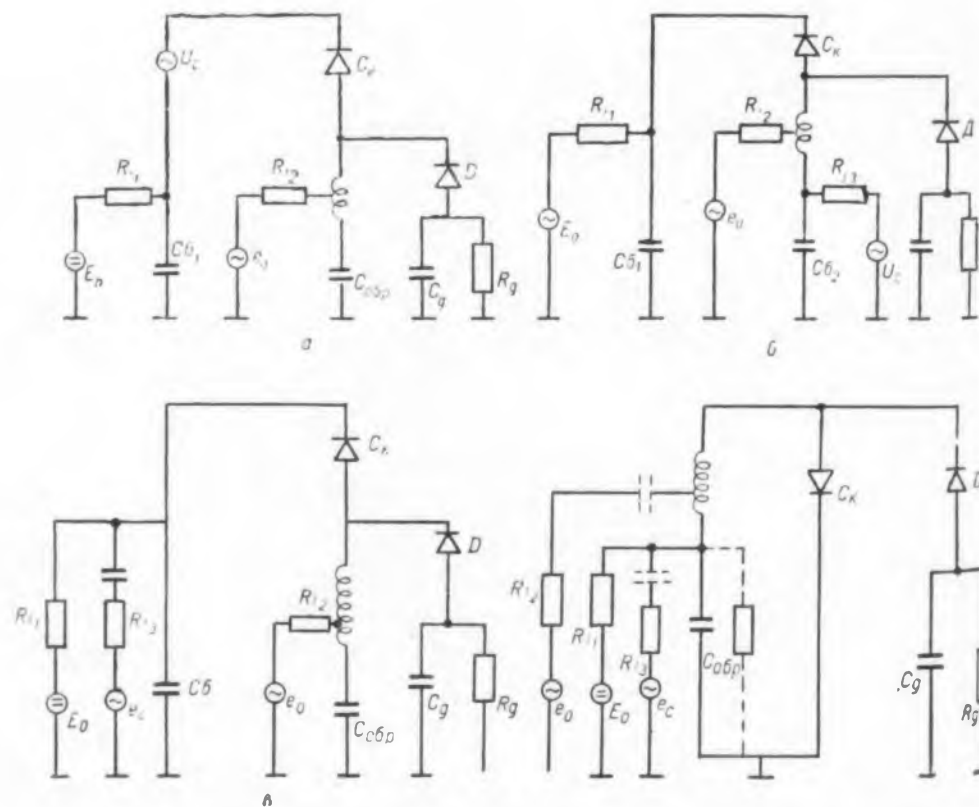


Fig. 9. Several versions of parametric amplifiers and their power supplies.

## RUSSIAN TRANSLATIONS

input impedance  $Z_{1\epsilon} = U_1/I_1$ , the current gain  $K_{1\epsilon} = I_2/I_1$ , the voltage  $K_{2\epsilon} = U_2/U_1$ , and the output impedance  $Z_{2\epsilon} = U_2/I_2$ . The first three curves are plotted as functions of the load impedance  $Z_H$ , and the last one as a function of the source impedance  $Z_r$ . The necessary computations are summarized in a table.

If such nomograms are prepared for various transistors beforehand, the labor involved in calculation of the response of an amplifier stage will be considerably reduced. Furthermore, it is possible to trace directly on this nomogram the character and magnitude of the variation of any one parameter due to simultaneous changes in several other parameters.

**Parametric Amplification Employing the Capacitance of a PN Junction, by V. I. Samoylenko, Moscow Aviation Institute (pp 451-458, 9 figs.).**

Theoretical and experimental investigations show that the capacitance of a pn junction can be used in various circuits as a controllable reactance. Experiments have shown that the value of this capacitance depends very little on the temperature and can be used at frequencies up to 500 mc. This means that pn junctions may be used over a greater temperature and frequency range than transistors.

The principal diagram of a parametric amplifier without feedback is shown in Fig. 7. The input signal  $e_c$  is in series with a dc bias voltage and a

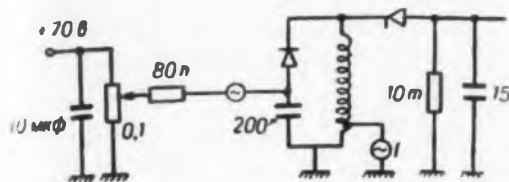


Fig. 10. Experimental model of parametric amplifier.

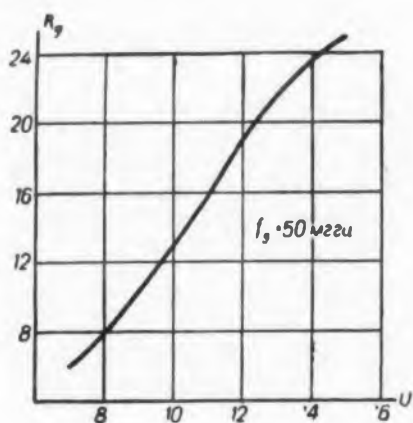


Fig. 11. Experimental plot of gain vs. amplitude of hf oscillations.

high frequency voltage  $e_o$  of frequency  $f_o$ . Since the capacitance  $c_k$  of the pn junction is a function of the voltage applied to the junction, a change in this capacitance will cause a change in the auxiliary frequency  $f_o$ .

The high frequency component is detected, and by suitable choice of the  $Q$  of the circuit and of the bias  $E_o$  it is possible to obtain across the detector load a voltage increment greater than the applied signal. It is also possible to employ feedback, as shown in Fig. 8.

Fig. 9 shows other connections, which are used if the internal impedances of the three generators  $E_o$ ,  $e_o$ ,  $e_o$  are small compared with the circuit impedances.

Fig. 10 shows an experimental model of a parametric amplifier operating at 50 mc, and Fig. 11 shows the experimentally plotted voltage gain as a function of the amplitude of the high voltage oscillation across the tank circuit.

A companion article by the same author, "Amplitude Modulation Employing the Capacitance of an NP Junction" was reviewed in the July issue of *ED*.

Among the other articles there is an analysis of the operation of a watt-meter with a cavity resonator, using the Hall effect in semiconductors (F. T. Skorik, Kiev Polytechnic Institute, pp 393-401, 5 figs.).

We also note with interest some arguments in one of the reports, approved by the staff of the Chair of Electronics of the Moscow Engineering-Physics Institute, in favor of abolishing the Russian term "semiconductor triode" and finally calling a transistor a "transistor." ■ ■



## he's back on the job because...

someone like *you* gave him a helping hand after his discharge as a mental patient. Help thousands like him find friends, a job, a home by giving *your* welcoming hand and by supporting *your*

### MENTAL HEALTH ASSOCIATION



***With Your Help,  
the Mentally Ill  
Can Come Back!***



# AMPERITE

## THERMOSTATIC DELAY RELAYS



AMPERITE  
DELAY  
RELAY



### 2 to 180 Seconds

Actuated by a heater, they operate on A.C., D.C., or Pulsating Current.

Hermetically sealed. Not affected by altitude, moisture, or climate changes.

SPST only—normally open or closed.

Compensated for ambient temperature changes from  $-55^{\circ}$  to  $+70^{\circ}$  C. Heaters consume approximately 2 W. and may be operated continuously. The units are rugged, explosion-proof, long-lived, and—inexpensive!

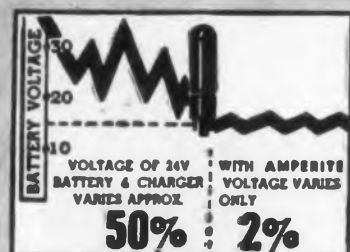
TYPES: Standard Radio Octal, and 9-Pin Miniature . . . List Price, \$4.00. Standard Delays

Also—Amperite Differential Relays: Used for automatic overload, under-voltage or under-current protection.

PROBLEM? Send for Bulletin No. TR-81

# AMPERITE BALLAST REGULATORS

Amperite Regulators are designed to keep the current in a circuit automatically regulated at a definite value (for example, 0.5 amp.) . . . For currents of 60 ma. to 5 amps. Operate on A.C., D.C., or Pulsating Current.



Hermetically sealed, they are not affected by changes in altitude, ambient temperature ( $-55^{\circ}$  to  $+90^{\circ}$  C.), or humidity . . . Rugged, light, compact, most inexpensive . . . List Price, \$3.00.

Write for 4-page Technical Bulletin No. AB-51

# AMPERITE

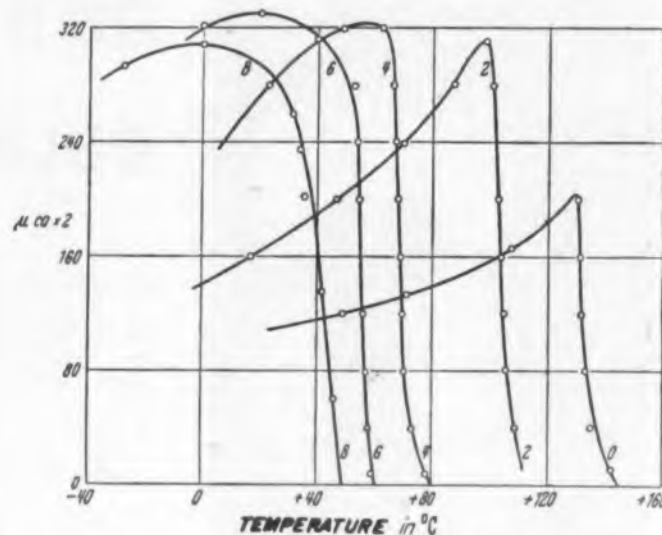
561 Broadway, New York 12, N. Y. . . CAnal 6 1446  
In Canada: Atlas Radio Corp., Ltd., 50 Wingold Ave., Toronto 10

CIRCLE 57 ON READER-SERVICE CARD

## GERMAN ABSTRACTS

E. Branner

# Ferrites As Temperature Transducers

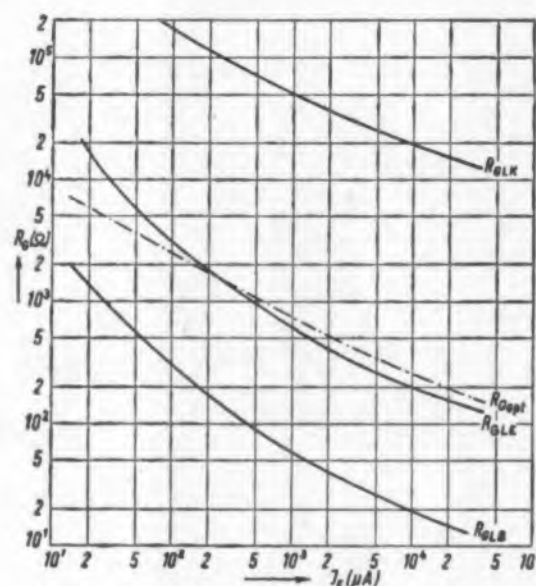


**M**ANGANESE-ZINC ferrites as "soft" magnetic materials have a Curie point,  $T_c$ , which is determined by the proportion of zinc as illustrated in Fig. 1. The steep slope of the initial permeability-temperature curve near  $T_c$  makes the material suitable for transducer and control applications. In such applications, a "soft Iron" ferrite, with an appropriate Curie point as chosen from Fig. 1, is used together with a "hard" iron material whose Curie temperature is of the order of 550 C.

An example of such application is a thermostat

Fig. 1. (left) Initial permeability of a Mn-Zn-Ferrite as a function of temperature.

# Design of Low-Noise Transistor Amplifier



Comparison of the value of  $R_G$  for minimum noise figure ( $R_{Gopt}$ ) to the values for power match in the collector, emitter and base configurations  $R_{GC}$ ,  $R_{GE}$  and  $R_{GB}$  respectively. Emitter current is the independent variable, base resistance is 100 ohms,  $I_S = 1 \mu\text{a}$ ,  $\alpha = 0.99$ ,  $R_G = 1$  megohm, the temperature is 25 C.

**F**IVE FREQUENCY independent noise sources in a transistor amplifier circuit are: emitter and collector diode, base and generator resistance and current division noise. The noise factor of an amplifier can be shown to be for the common emitter or base configuration,

$$F_{B,E} = 1 + (2R_B + R_E)/2R_G + a(b + R_G)^2/cR_G$$

and for the collector configuration

$$F_C = 1 + (2R_B + R_E)/2R_G + a(R_B R_G)^2/2R_E R_G$$

where  $I_S$  is the collector saturation current and

$$a = I_S/I_E + \alpha(1 - \alpha)$$

$$b = R_E + R_B$$

$$c = 2R_E \alpha^2$$

As a function of generator (source) resistance  $R_G$  or emitter current  $I_E$ , the noise factors have a minimum. Denoting the value of  $R_G$  for which  $F$  is a minimum by  $R_{Gopt}$ , it can be shown that

$$(R_{Gopt})^2_{BE} = b^2 + c(2R_B + R_E)/2a$$

$$(R_{Gopt})^2_C = R_B^2 + R_E(2R_B + R_E)/a$$

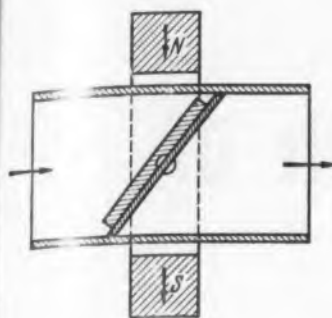


Fig. 2. Thermostat for coolant of internal combustion engine.

for internal combustion engines shown in Fig. 2. The soft-iron ferrite is mounted on the flap which is closed at temperatures below  $T_c$ . As the maximum initial permeability is passed with increasing temperature, the magnetic torque drops rapidly so that the flap opens, permitting the coolant to circulate. Control precision within 2 C is obtained.

In the original paper further applications are cited. A water valve for diffusion pumps, a gas regulator for distillation apparatus, a pyrometer and a switch for liquid air are described.

Abstracted from an article by H. Straubel, Zeitschrift fuer Angewandte Physik, Vol. 11, No. 5, May 1959, pp. 172-174.

## Amplifiers

Exactly as is the case for the value of  $F$  in Eqs. 1 and 2, the value of  $R_{Gopt}$  as given by Eqs. 4 and 5 is markedly different only for very small emitter currents and very small current amplification factors.

Comparing the values of  $R_G$  for minimum noise factor with the values for power matching in the corresponding connections, it can be shown that for the common emitter configuration approximately the same value of  $R_G$  is suited to both purposes (provided that neither base resistance nor emitter current is excessively large). In the collector configuration,  $R_G$  for minimum noise is less than the value of power match while in the base configuration the opposite is true. In Fig. 1 these differences are illustrated in a numerical case.

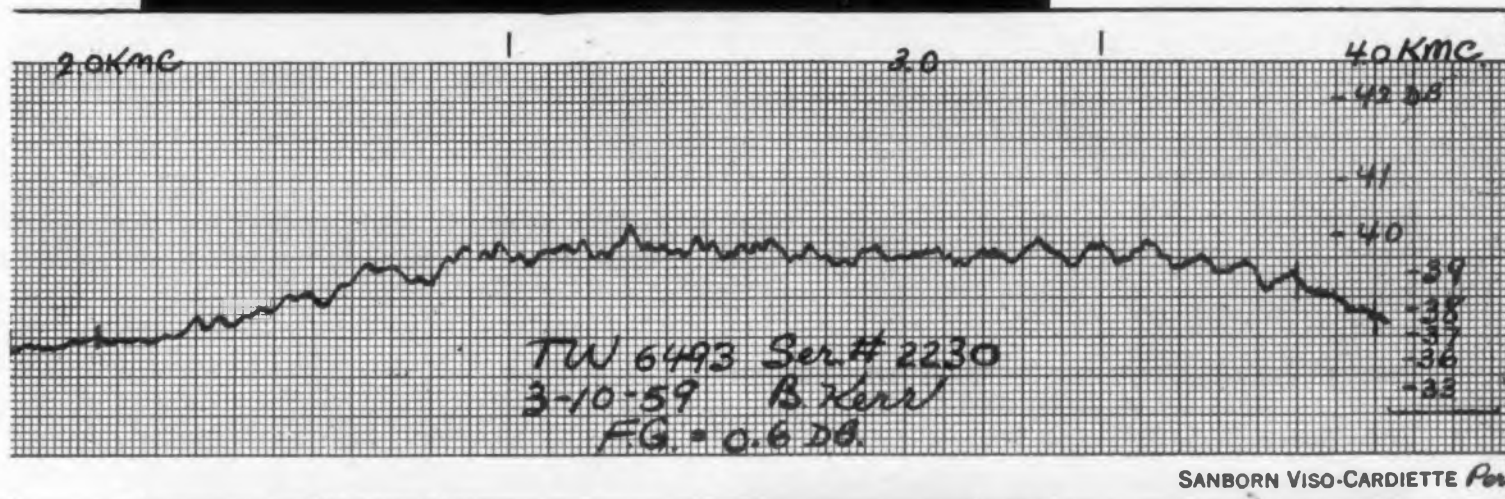
In the original paper, the combined optimization problem as well as temperature effects are discussed. Detailed experimental confirmation is cited.

Abstracted from an article by K. Spindler, Nachrichtentechnische Zeitschrift, Vol. 12, No. 5, May 1959, pp. 250-256.

## Microwave Component News

from SYLVANIA

# Now available—a wide range of traveling wave tubes



SANBORN VISO-CARDIETTE Pen

### ONLY SYLVANIA CAN OFFER YOU

**AVAILABILITY**—now in production, 16 types of traveling wave tubes covering the microwave spectrum from 1 to 11 kmc, and milliwatts to kilowatts. Backward wave oscillators are also available. Modifications and new designs for your special requirements are part of Sylvania's service.

**HIGHEST GAIN**—Sylvania's traveling wave tubes deliver 2 to 5 times the gain of competitive types. For example, TW-4002 delivers a minimum gain of 37 db over its full 2 to 4 kmc band.

**GUARANTEED UNIFORMITY**—Sylvania guarantees gain variations one-half those of other tubes; i.e. 2 to 3 db narrower limits. Other test limits are correspondingly more rigid.

**PROVEN RUGGED DEPENDABILITY**—Sylvania traveling wave tubes have proved their performance by meeting tough military standards and by being specified and used in modern supersonic aircraft.

For more information write your nearest Sylvania tube sales office or Sylvania Electric Products Inc., Special Tube Operations, 500 Evelyn Ave., Mountain View, Calif.

**SYLVANIA**  
Subsidiary of  
GENERAL TELEPHONE & ELECTRONICS

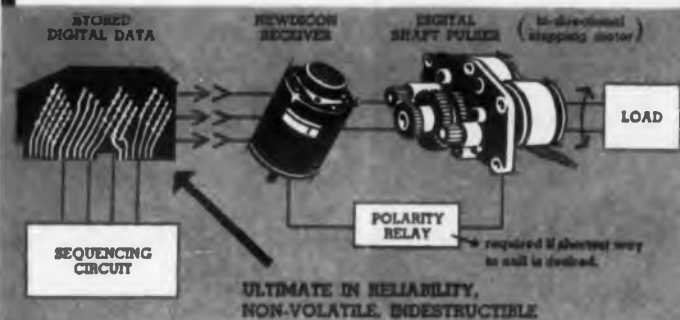


CIRCLE 58 ON READER-SERVICE CARD

ANOTHER ACHIEVEMENT IN OPERATIONAL DIGITAL BY **NEWTON**

## NEW NEWTON PROGRAMMER...

programming stored servo action



The Newton Programmer is a remote shaft positioning system operating from stored digital data. Newton-made components make up this system which requires no tubes or transistors, performs on a wide range of D.C. Voltages. The "key" component is the *Newdicon*—essentially a decimal counter with electrical read-out—designed to form a positioning loop from a pure decimal number input. Applications include programming of servomechanisms, missile control systems, machine tools or any remote shaft positioning application.

Write for complete data, stating your particular requirements if possible.



THE  
NEWTON  
COMPANY

MANCHESTER, CONNECTICUT

CIRCLE 506 ON READER-SERVICE CARD

## a full line of PRECISION STAMPED GEARS

**FASTEX\***  
STAMPED  
GEARS



**FREE!**

Write today for this comprehensive catalog. Contains the full line of Fastex Precision Stamped Gears... plus useful tips on their use and application.

**FASTEX** 195 Algonquin Road,  
Des Plaines, Illinois  
Division of Illinois Tool Works



CIRCLE 507 ON READER-SERVICE CARD

# ABSTRACTS

## Thermal Equivalent Circuit Of a Transistor

A practical approach is presented for determining the instantaneous value of the collector junction temperature of an operating transistor as a function of time.

**B**Y ESTABLISHING an electrical analogue, in the form of a lumped RC network, to the thermal system of a transistor, collector junction temperature can be conveniently determined. Previous methods, making use of the thermal resistance K factor, do not adequately indicate temperature variation resulting from changes in applied power; boundary-value solutions require exact knowledge of internal geometry and physical constants of the semiconductor in addition to rather lengthy computations.

From the electrical circuit developed, voltage response to an applied current corresponds to the response of collector junction temperature to applied power dissipation. The validity of the equivalent circuit is based on the treatment of two physical quantities, heat capacity and thermal conductivity, according to the theory that any network of RC elements has a driving point im-

pedance that can be constructed of a single series string of parallel RC pairs. The mathematical analysis presented leads to a thermal equivalent circuit of precisely such form. See Fig. 1.

### Thermal Equivalent Circuit

For the condition of no applied-power dissipation at the collector junction, the temperature decay at the junction is given by

$$T_J(t) = \sum_{n=1}^{\infty} A_n \exp(-t/\tau_n)$$

where constants  $\tau_n$  and  $A_n$  depend on the geometry, materials, and initial conditions of the system.

By setting up differential equations for a thermal system, the product of thermal resistance  $R_n$  and thermal capacitance  $C_n$ , a solution results such that

$$T_n(t) = T_n(0) \exp(-t/R_n C_n)$$

where  $T_n(0)$  is the value of  $T_n(t)$  at the time  $t$  equals zero.

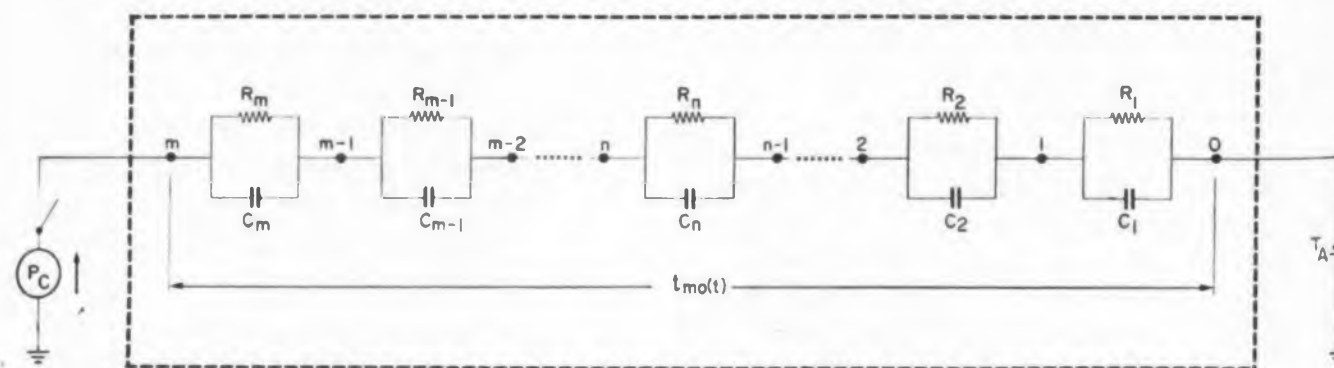
If  $m$  such parallel RC networks are placed in series, the total temperature drop along the string would be

$$T_J(t) = \sum_{n=1}^m T_n(t) = \sum_{n=1}^m T_n(0) \exp(-t/R_n C_n)$$

Assuming a source of constant power dissipation

### A list of analogous quantities between thermal and electrical systems.

Electrical	Thermal
V voltage (v)	T temperature (C)
I current (amp)	P power dissipation (w)
R electrical resistance ohms	R thermal resistance C/w
C electrical capacitance (f)	C thermal capacitance w = sec/C



The thermal equivalent circuit for the collector junction of a transistor, along with the analogous circuit elements necessary to produce the cooling curve,  $T_{m0}(t)$ , is the temperature difference between collector junction and ambient as a time function.  $T_A$  is a battery representing constant ambient temperature.  $P_c$  is constant applied power for  $t < 0$ .



$P_o$  were applied to the terminals of the thermal equivalent circuit, the temperature drop after a sufficient time interval would be constant and given by

$$T_{J_s} = P_o \sum_{n=1}^m R_n$$

Since  $T_J$  will be a constant for some finite value, then  $\sum_{n=1}^m R_n$  must also be finite and, as  $m$

increases,  $R_n$  must approach zero. In a practical sense it will always be possible to find a value for  $m$  such that  $P_o \sum_{n=m+1}^{\infty} R_n$  will be essentially zero.

It will be noted that  $\sum_{n=1}^{\infty} R_n$  is identical to the K factor of the transistor.

#### Determining Circuit Parameters

Circuit parameters were determined experimentally from measurements of temperature decay of the collector junction. A constant power dissipation,  $P_o$ , was applied to the collector junction of a transistor operating in a grounded-base configuration for a period of time sufficient to insure thermal equilibrium.

At a time designated as zero, the power dissipation was completely removed and the temperature decay of the junction to the ambient recorded. The cooling curve was shown to agree with the analytical solution predicted by equations in the paper. The details of test setup and procedures are fully described.

An example is given illustrating the analysis for a switching transistor subjected to periodic power pulses. Also included is an explanation of valid assumptions which can be made to simplify the solution of heat-conduction equations.

Examination and use of the equivalent circuit enables the circuit designer to determine the extent of the temperature problem to be encountered at the collector junction. Temperature response prediction is possible with periodic pulsing and single pulses, as well as sinusoidal inputs.

One further application suggested is the possibility of checking uniformity of manufactured transistors by determination of variation in thermal circuit parameters from unit to unit. Defects such as poor thermal bonds between germanium wafers and base tabs could be rapidly detected.

Abstracted from IBM Journal, Jan. 1959, *The Thermal Equivalent Circuit of a Transistor* by P. I. Strickland.



Comparison of area required to mount new Mallory TAM capacitor versus metal cased unit of same rating.

Actual size Mallory TAM capacitor.

## NEW Encapsulated Tantalum Capacitor Saves Space, Weight and Cost

The first commercially available solid electrolyte tantalum capacitor *without* a metal case, the Type TAM is the latest in the wide line of Mallory tantalum capacitors. Its flat, rectangular design gives you new compactness and light weight especially useful in printed circuits . . . at a cost substantially below metal can types.

The TAM takes only about one-third the chassis space of its metal counterpart, and weighs about 30% less. It is fully insulated from the chassis and from adjoining components. Grid-spaced leads are dimensioned to EIA printed circuit standards; negative lead is rectangular for identification.

To protect the new TAM capacitor against moisture, Mallory engineers developed, and exhaustively tested, a new special coating com-

pound. Overall size is  $\frac{5}{16}$ " square by .175" thick. Temperature range is  $-55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ . Seven ratings are currently available: 56 mfd., 6 VDC; 39 and 33 mfd., 10 VDC; 22 mfd., 15 VDC; 15, 10 and 6.8 mfd., 25 VDC. Write today for complete data and prices, and for a consultation on your circuit application.

#### See Mallory for the most complete line of Tantalum Capacitors

Pioneer in tantalum capacitors, Mallory makes 15 different types:

HAT: microminiature size	XTL: 200°C rating
TAP: miniature, 100°C rating	XTH: 200°C, small diameter
TAP2: miniature, wide range of ratings	XTK: 175°C, smaller case
TAS: solid electrolyte	XTO: 200°C, shorter shape
TNT: miniature, axial leads	XTV: high capacity, 175°C
STNT: subminiature	M2: miniature, 150°C
XTM: miniature, 175°C rating	TAF: tantalum foil
	TAM: encapsulated

P. R. MALLORY & CO. Inc.  
**MALLORY**  
P. R. MALLORY & CO. Inc., INDIANAPOLIS 6, INDIANA

CIRCLE 60 ON READER-SERVICE CARD

## REPORT BRIEFS

### Pulsed Oscillators

The build-up time of pulsed oscillators has been observed often to exceed greatly that which is classically expected. The cause of this delay is investigated. Methods of calculating the delay are developed for situations where: (a) the oscillator builds up from the circuit noise level because there is a negligible frequency component of the applied pulse at the oscillator frequency, (b) the oscillator builds up from the shock-excited level in the tuned circuit caused by the applied pulse, and (c) both of the effects (a) and (b) are important. *Build Up Time of Pulsed Oscillators*, James B. Woodford, Jr., and Leslie C. Hale, Carnegie Inst. of Tech., Pittsburgh, Pa., Apr. 1957, 39 pp, Microfilm \$3.00, Photocopy \$6.30, Order PB 135257 from Library of Congress, Washington 25, D. C.

### Tantalum Electrolytic Capacitors

The electron diffraction work on tantalum oxide films is summarized in this report. Good anodic films cannot be distinguished from poor films by means of electron diffraction techniques. Anodic films formed in phosphoric acid have been compared with those made in Glycolonitrile by life test data. The electrical characteristics of Glycolonitrile films are superior in all respects to those formed in phosphoric acid solutions. The Glycolonitrile-formed anodic films are more stable and show lower electrical losses. Concentrated HF or NaOH 30% at 100 C appear to be suitable for cleaning tantalum prior to anodizing. Lift test data is given for a number of test capacitors made with Dexter paper and LC-141 and rated at 150 v dc, 125 C; 200 v dc, 125 C; 250 v dc, 125 C; 300 v dc, 85 C; and 350 v dc, 85 C. All of these units show excellent electrical characteristics. The 150 v dc, 125 C units and the 300 v dc, 85 C units are indicative of the type of unit which can be made commercially. The data for test capacitors constructed with a one-mil-thick fiber-glass cloth spacer are given. Teflon bushings have been compared with butyl rubber bushings in test capacitors rated at 85 C and 125 C. All of the butyl rubber units failed at 125 C and the failure rate at 85 C was excessively high. An examination of the filter used in the butyl rubber shows that over 1% NaCl is present. The presence of this salt is probably the reason for the failures. *Investigation and Research Pertaining to the Development and Design of Tantalum Electrolytic Capacitors*, D. Mohler, General Electric Co., Hudson Falls, N.Y., Sept.-Nov. 1956, 44 pp, Microfilm \$3.30, Photocopy \$7.80, Order PB 139618 from Library of Congress, Washington 25, D. C.



**350°C. ST resistors** Highest wattage to volume ratio in metallic oxide field. 2½, 5, and 10 W at 25°C., derating to 350°C. Achieves its specs through new resistance film and insulation coating developed at Corning. 2% and 5% tolerances.



**High temperature capacitor** New high temperature dielectric. Up to 10,000 uuf, DCWV of 300 V at 300°C. Q better than 500 at 300°C. Especially suitable for missiles and aircraft. Highly resistant to nuclear radiation.



**Micro miniature capacitors** 1 to 10,000 uuf. DC working voltage is 300 V over -55 to +125°C. range. Suitable for micro miniature work, lumped constant delay lines, missiles, nuclear equipment, and similar high reliability systems.



**Epoxy coated resistors** Exceptional moisture resistance. 1.5% max. resistance change after military moisture tests. Beats demands of MIL-R-10509C, Char. B. Tin oxide film fused to glass. ¼, ½, 1 W. 10 ohms to 1 megohm at 70°C., derating to 150°C.



**FOTOCERAM,® an unusual new printed circuit board** We've resoldered more than fifty times on this board without damage to circuit runs or through-plate holes. No adhesives needed to bond copper to board. Bond strength between Fotoceram and metal is 15 to 20 lbs., when 1" strip is pulled perpendicular to board. Takes over 60 g vibration shock. All electrical properties equally outstanding.



**Fusion-sealed resistors** For ultra specs. Glass-enclosed, tin oxide resistance element. Impervious to moisture because of fusion seal. 10 ohms to 360 K at 70°C., derating to 160°C. Well in excess of MIL-R-10509C, Char. B.

# ALL NEW



## CORNING ELECTRONIC COMPONENTS

CIRCLE 61 ON READER-SERVICE CARD

Write for data sheets for complete specs on these components. Address: Corning Glass Works, 540 High Street, Bradford, Pa. Or sales offices in New York, Chicago, Los Angeles.

See them at WESCON Show All items on display along with data at Booths 506-508, August 18-21.

## Feedback Control

This research is concerned with multi-dimensional systems having the particular structure in which the desired functional relation is specified parametrically in terms of one of the variables, and in which the functional errors are used to control all the variables. The major aspects of the system considered in this work are: a) mathematical description: the differential equations describing the system are derived and represented rather simply in vector matrix notation; b) stability: the proper performance requirements of the overall system are identified with the stability properties of a "reduced system." Three stability theorems are then proved, two of which are applicable to two dimensional systems and one to the n-dimensional case; c) dynamic behavior and synthesis: the linearized equations in the vicinity of equilibrium are derived, and a synthesis procedure is suggested which combines the non-linear methods required to establish stability in the large with linear designs for good dynamic behavior. *Cross-Coupled Multi-Dimensional Feedback Control Systems*, Philip E. Sarachik, Columbia University, School of Engineering, New York, May 1958, 122 pp, Microfilm \$6.30, Photocopy \$19.80, Order PB 137446 from Library of Congress, Washington 25, D. C.

## Conversion of Carbonaceous Fuels to Electrical Energy

This report summarizes the results of the three years work on the project. Detailed results obtained during the twelfth quarter are also presented, since they have not been reported elsewhere. A procedure has been worked out for the preparation of magnesia electrolyte plates of adequate strength and porosity for use in the fuel cell. The cell has been operated for several relatively long periods of time up to nine days in duration. The problem of cracking of the electrolyte plates in cell operation has been solved. A stable power output has been achieved over a long operating period on continuous current drain at a relatively low current density, i.e., 11.3 ma/cm<sup>2</sup>. The cell did not, however, give a stable power output at high current densities, i.e., at 28.3 ma/cm<sup>2</sup> or higher. The general level of cell performance was not as high as in some runs reported previously. A slow deterioration of cell performance occurred with time. The deterioration is thought to be due to a slow corrosion process particularly at the air electrode. *Conversion of Carbonaceous Fuels to Electrical Energy*, Everett Gorin and Howard L. Recht, Pittsburgh Consolidation Coal Co., Library, Pa., April 1957, 47 pp, Microfilm \$3.30, Photocopy \$8.00, Order PB 136014 from Library of Congress, Washington 25, D. C.

electric motion  
control facts



for IDEA MEN

# Warner brake, clutches, team with tape, control high-speed forward-reverse drive

## Automatic film printer, with dual motor drive, speeds production, eliminates human errors

Here is an example of how 6-millisecond operation through overexcitation of the electromagnetic coils makes Warner electric brakes and clutches ideally suited for ultrasensitive tape-controlled servo-systems.

The problem was to design a robot printer which would reduce motion picture film processing time and eliminate human judgment in determining light exposure. Here is how that problem was solved.

First, a servodrive (Fig. 2) was designed to control light values automatically in accordance with the degree of negative exposure. This simple device, which provides two-directional movement of the selector arm over adjustable light value contacts, consists of two 1725 rpm motors, two flange-mounted Warner electric clutches, a Warner electric brake, and worm gearing.

A tape-controlled computer is an important part of the system. It transforms punched data into electrical signals which actuate the Warner electric brake and clutches.

Exposure values are compared by the computer with settings punched in the

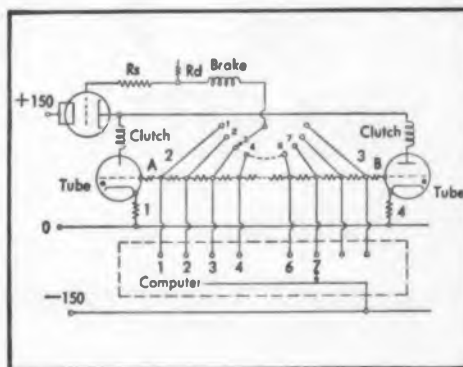


Fig. 1—Magnetic clutch circuit shows point resistance circuit, two thyatron tubes (A&B), computer, and power source hookup.

tape. A difference in values causes a bias—through a resistance network—on the grid of a thyatron tube. The tube fires a 200-volt burst (over twice normal magnet voltage) through the electrical circuit to the clutches.

The armature of each clutch is keyed to opposite ends of the worm gear shaft—the rotor to one of the constant-run-

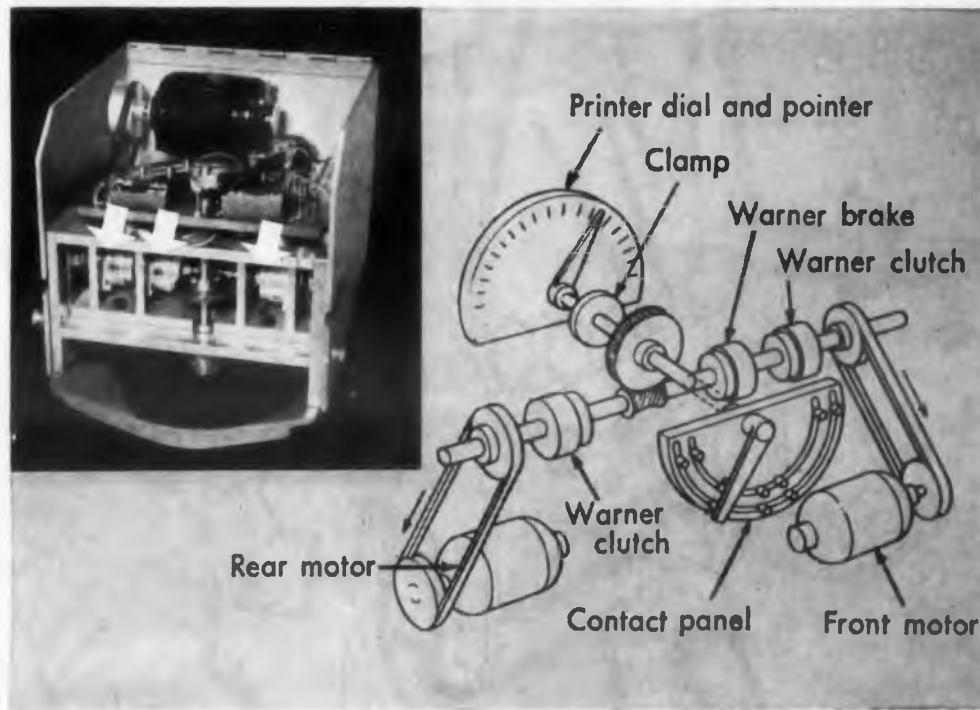


Fig. 2—Tape-controlled servomechanism locks on printer light value selection lever, automatically sets preselected exposure. Inset of servo-unit shows compact design made possible by use of Warner electric clutch-couplings and dual motor drive.

ning power shafts. Actuation locks the armature and rotor of the desired clutch in full couple, transmitting power to the worm gear. This moves the shutter-control pointer in the proper direction. When the pointer reaches its preselected position, it completes a circuit and neutralizes the grid bias at the thyatron tube, cutting out the electric clutch. The brake (also mounted on the worm gear shaft) is actuated automatically when either clutch is de-energized. Required time for complete cycle is 6 milliseconds.

Ability to actuate Warner fractional-

horsepower electric brakes and clutches directly through the operating power circuit may be the key to your space, timing, or cost problem. Complete automation can be achieved simply without complex control hardware—any electro-sensory device may be used to actuate a power drive precisely in a way that minimizes equipment cost and maintenance.

Your Warner sales engineer can help you solve difficult design problems with fast-acting, compact electric brakes and clutches. Contact him or send coupon below.



Originators of electric motion control

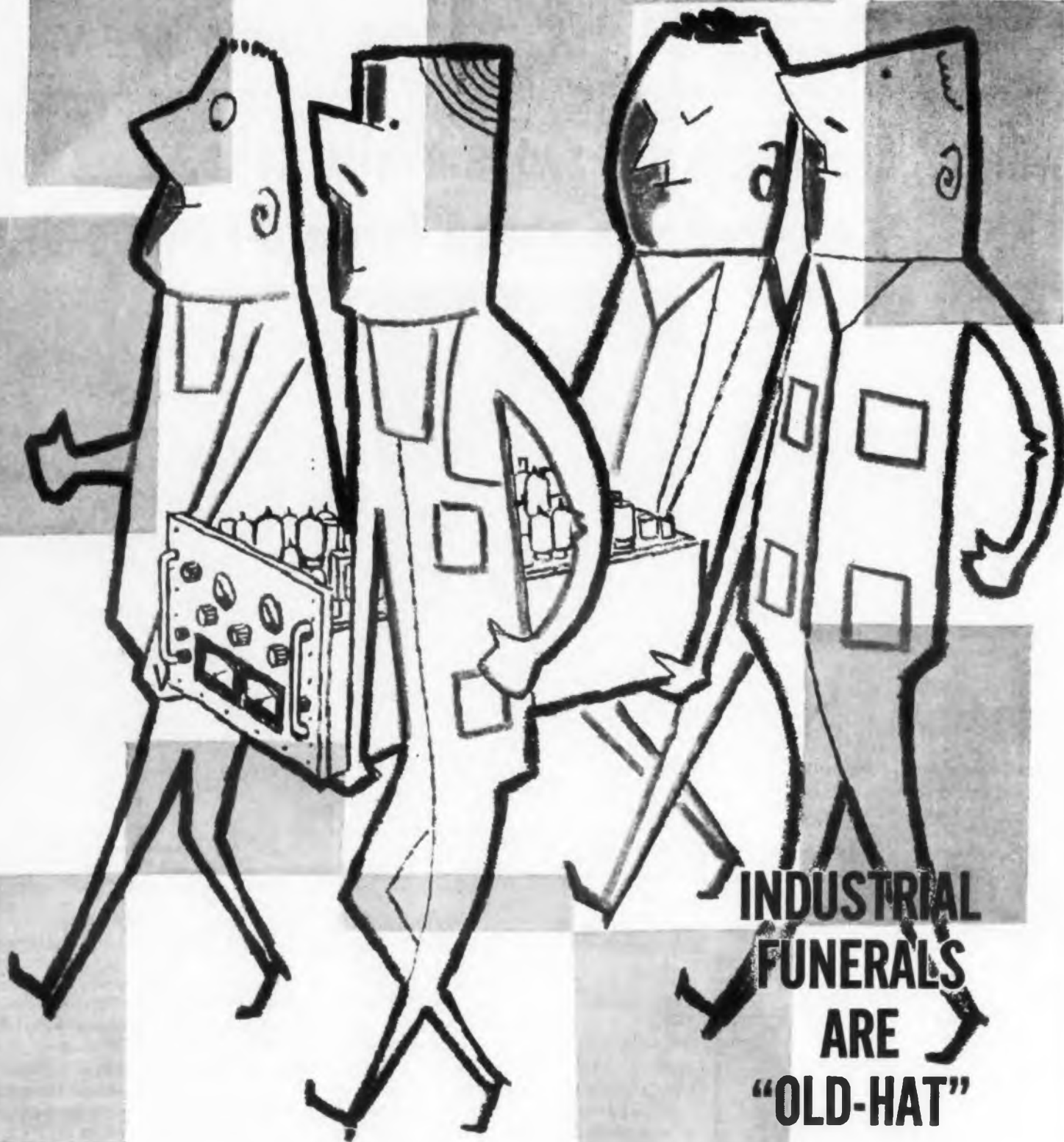
**Warner Electric Brake & Clutch Co.**

Beloit, Wisconsin

Gentlemen: Please send complete information about Warner electric brakes and clutches.

Name \_\_\_\_\_ Title \_\_\_\_\_  
Company \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

CIRCLE 62 ON READER-SERVICE CARD



**INDUSTRIAL  
FUNERALS  
ARE  
'OLD-HAT'**



While we're the first to admit that pallbearers have a definite place . . . we're last to agree that their place is in industry.

Certainly, when time is of the essence, old-fashioned repair and servicing techniques are about as efficient as horse-drawn carriages. Progressive manufacturers are dispensing with equipment-carrying pallbearers . . . turning instead to efficient Grant Slides.

If you've been plagued by down-time, or have been engaged in weight-lifting exercises . . . why not investigate Grant Slides? It's true, we're putting industrial pallbearers out of business . . . but we may help put your company back into business.

*The nation's first and leading manufacturer of slides*

## **GRANT INDUSTRIAL SLIDES**



GRANT PULLEY AND HARDWARE CORPORATION

21 High Street, West Nyack, New York  
944 Long Beach Avenue, Los Angeles 21, Cal.

See the Grant Exhibit at WESCON, Booths 824 and 826  
CIRCLE 63 ON READER-SERVICE CARD

## REPORT BRIEFS

### Linear Sweep Circuit

A simple electronic circuit employing feedback is described that will produce a positive pulse whose amplitude is proportional to the duration of a positive input pulse. The circuit is analyzed using fundamental principles. The theory of propagation of errors is used in comparing the observed and the predicted behavior of the circuit. *Linear Sweep Circuit*, John R. Green and Paul O. Scheie, New Mexico University, Albuquerque, July 1957, 13 pp, Microfilm \$2.40, Photocopy \$3.30. Order PB 135088 from Library of Congress, Washington 25, D. C.

### Quantization in Feedback Systems

The author utilizes the concept of the state of a dynamic system in order to obtain a mathematical formulation which permits an easy determination of the upper bound on the error in the state variables due to quantizers in an otherwise linear sampled-data feedback system. The same formulation in conjunction with the norm of a vector has been used to obtain sufficient conditions for global stability of several classes of non-linear sampled systems, as well as desirable operating conditions for a random quantizer. *The Effects of Quantization in Feedback Systems*, John E. Bertram, Columbia University, School of Engineering, New York, Mar. 1958, 76 pp, Microfilm \$4.50, Photocopy \$12.30. Order PB 137726 from Library of Congress, Washington 25, D. C.

### Impedance Characteristics of Fixed-Length Antennas

Operating activities have consistently reported difficulty in maintaining long-range communications with available equipment and frequency allocations. A project was undertaken for the purpose of improving communications coverage through better understanding of the antenna systems involved and by refinement of equipment tuning procedures. Impedances of long-wire antennas, ranging in length from 20 to 102 ft were measured over the frequency range from 2 to 24 mc. Impedance charts were constructed as aids in selection of operating frequencies on the basis of power transfer by the antenna. Recommendations are made concerning antenna length selection and equipment tuning techniques for improved hf operation. *Impedance Characteristics of Fixed-Length Antennas*, Naval Air Test Center, Patuxent River, Md., May 1955, 34 pp, Microfilm \$3.00, Photocopy \$6.30. Order PB 137920 from Library of Congress, Washington 25, D. C.

### Environmental Requirements for Electronic Parts

This document establishes the research and development objective environmental design requirements for use in current and future electronics planning, in research and development of electronic component parts, as well as appropriate test procedures. *Environmental Requirements Guide for Electronic Component Parts*, Office of the Director of Defense Research and Engineering, Washington, D. C., Mar. 1959, 13 pp, \$0.50. Order PB 131423R from OTS, Washington 25, D. C.

### Trough Waveguide Antenna Arrays

Several new types of linear antenna arrays that use trough waveguide as a transmission line have been investigated. The radiating elements of these fixed beam arrays can be discrete, continuous, or periodic; they can be resonant or nonresonant. Design criteria and mathematical analyses for trough waveguide traveling-wave line sources are presented for arrays with continuously and periodically asymmetric bases and for an array of resonant L-rod radiators. Antenna model studies of representative types show good agreement with theory. These trough waveguide arrays can easily be adapted to parallel-plate systems since the radiation occurs as TEM fields between bounding walls. Their other advantages over antenna systems that use conventional transmission lines, such as rectangular waveguides, include simpler mechanical construction, greater bandwidth, and better radiation characteristics. *The Design of Trough Waveguide Antenna Arrays*, Walter Rotman and Sally J. Naumann, Air Force Cambridge Research Center, Bedford, Mass., June 1958, 49 pp, Microfilm \$3.30, Photocopy \$7.80. Order PB 137064 from Library of Congress, Washington 25, D. C.

### Transistors for VHF and UHF

The recently developed diffused-base germanium transistors have opened the way toward uhf transistor circuitry. While these units are not yet in quantity production, they are being redesigned and fabricated in increasing numbers. This report is an attempt to present the current status of developmental uhf transistors, and emphasize the potential of these devices for oscillator amplifier work. *Developmental Transistors for VHF and UHF*, Victor Boxer, Army Signal (Research and Development Lab.), Fort Monmouth, N. J., Mar. 1957, 31 pp, Microfilm \$3.00, Photocopy \$6.30. Order PB 137301 from Library of Congress, Washington 25, D. C.



## SMALL A. C. MOTORS

Consider the many advantages of using precision miniature a.c. motors. Output performance equals that of larger conventional motors—so you can offer smaller, lighter, more compact designs than your competitor. And you can offer superb reliability. When you design around precision miniature motors, their price in quantity is competitive with larger ordinary motors. Globe is the largest precision miniature motor specialist and is working with people like you right now to gain these benefits.

Get in touch with Globe early in the design stage. Very probably Globe has already made a motor close to your requirements. You'll receive a recommendation for your specific job, and get custom prototypes promptly.

Globe's induction and hysteresis-synchronous a.c. motors provide up to 4.5 oz. in. of torque—up to 200 in. lbs. with a planetary gear reducer! Sizes start at one inch in diameter, and can include such special features as integral brakes, clutches, speed reducers, etc. Please request Bulletin ACM. GLOBE INDUSTRIES, INC., 1784 Stanley Avenue, Dayton 4, Ohio. BAIdwin 2-3741.

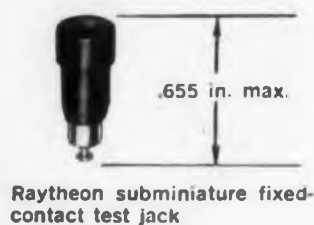
**GLOBE INDUSTRIES, INC.**

PRECISION MINIATURE A.C. & D.C. MOTORS. ACTUATORS.  
TIMERS. GYROS. STEPPERS. BLOWERS. MOTORIZED DEVICES

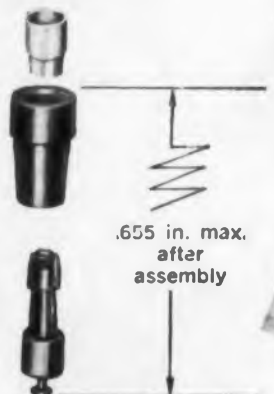
**GLOBE**

CIRCLE 64 ON READER-SERVICE CARD

SAVE TIME — SPACE — MONEY



Raytheon subminiature fixed-contact test jack



Raytheon subminiature snap-in contact test jack

## sub-miniature TEST JACKS



FOR DATA SHEETS



Excellence in Electronics

please write  
RAYTHEON COMPANY  
Mechanical Components  
Sales Department  
Industrial Apparatus Div.  
Waltham 54, Massachusetts

CIRCLE 571 ON READER-SERVICE CARD



## STANDARDS AND SPECS

Sherman H. Hubeibank

### Quality Control

ASA Z1.1-1958, GUIDE FOR QUALITY CONTROL  
ASA Z1.2-1958, CONTROL CHART METHOD OF ANALYZING DATA

ASA Z1.3-1958, CONTROL CHART METHOD OF CONTROLLING QUALITY DURING PRODUCTION

ASA Z1.1 outlines the basic concepts and philosophy of the Shewhart control chart. Z1.2 provides methods for using the control chart in the analysis of data. Z1.3 provides methods for using the chart in the active control of quality during production. Step-by-step procedures are given along with examples of application. The standards also provide a definite criterion for judging the character and quality of information needed to insure that a process is in a state of statistical control. With such control, the quality of the resulting product will have minimum variability and may be predicted with the highest degree of assurance. Copies may be obtained from the American Standards Association, 70 E. 45th St., New York 17, N.Y. Z1.1-1958 and Z1.2-1958 are combined in one volume and cost \$2.25; Z1.3-1958 costs \$2.50.

### Radiation

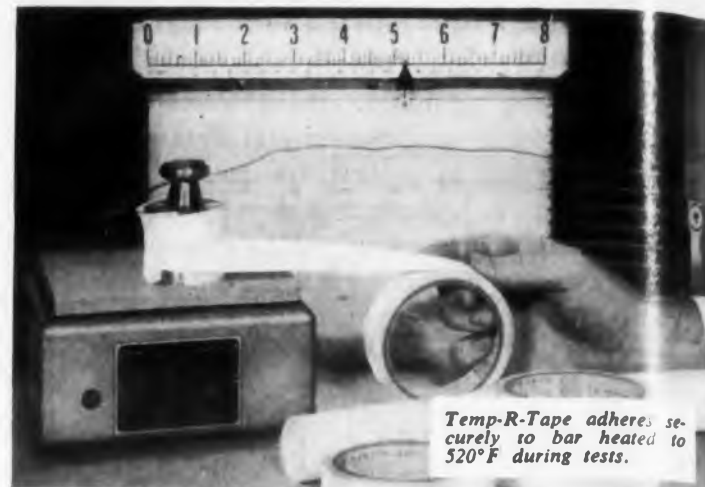
ASTM-STP233, THE EFFECT OF RADIATION ON MATERIALS

This 168-page volume is divided into three parts. The first deals with dosimetry techniques; the second with radiation facilities and techniques; and the third with radiation effects. All the information in this publication is based on new data. This manual may be obtained from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., at \$4.25 each.

### ASTM Proceedings

1958 PROCEEDINGS PUBLISHED BY ASTM

The 1430-page volume, recording the technical accomplishments of the year, includes reports and papers together with discussion offered to the society during the year and accepted by the Proceedings. Copies may be obtained from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., at \$12.00 each.



Temp-R-Tape adheres securely to bar heated to 520°F during tests.

## CHR PRESSURE-SENSITIVE TEFLON® TAPES

- -100°F to 500°F applications
- Class H and Class C insulation
- Non-stick and low friction facing
- Chemical resistant facing
- Easy to apply

Temp-R-Tape is available from stock in rolls and sheets. All four types — Temp-R-Tape T; TH; C and TGV — combine some form of Teflon backing with silicone polymer adhesive to provide easy-to-apply pressure-sensitive and thermal curing pressure-sensitive tapes for electrical and mechanical applications. Designed for extreme temperatures, Temp-R-Tapes possess high dielectric strength, low power factor, high elongation, negligible moisture absorption, are non-corrosive and non-contaminating.

FREE SAMPLES and folder — write, phone or use inquiry service.



CONNECTICUT HARD RUBBER

\*duPont TM

Sold nationally through distributors

Main Office: New Haven 9, Connecticut

CIRCLE 573 ON READER-SERVICE CARD

## New 1959 DIGITAL INSTRUMENTATION CATALOG

CMC

Ready now...

12 PAGES — Featuring

- ★ New transistorized frequency meter
- ★ New digital voltmeter
- ★ New fast digital printer and
- ★ The complete CMC line

Write for your FREE copy today.  
Address Dept 198-A

Computer Measurements  
Company • A Division of Pacific Industries, Inc.

12970 Bradley Ave., Sylmar, Calif.

CIRCLE 572 ON READER-SERVICE CARD

## specify... G-E WET-SLUG TANTALYTIC\* CAPACITORS

for miniaturized high capacitance,  
low-voltage transistor applications

- Completely sealed porous anode provides lowest impedance, per unit volume, of any capacitor.
- Insulated metal cases permit operating temperatures from -55 to +85° C.
- Meet 2000-cycle military vibration requirements.

FOR IMMEDIATE SPECIFYING INFORMATION contact your nearest G-E Apparatus Sales Office or write for free bulletin, GEA-7008, to General Electric Co., Section 449-10, Schenectady 5, N.Y.

\*Registered trademark of General Electric Co.

GENERAL ELECTRIC

CIRCLE 65 ON READER-SERVICE CARD  
ELECTRONIC DESIGN • August 19, 1959

## Capacitors

MIL-C-92A, CAPACITORS, VARIABLE AIR DIELECTRIC (TRIMMER), 2 APRIL 1959

JAN-C-92 is superseded by this new issue. The spec has been modified to provide for the detail spec format. The type designation has been changed and now includes nine characters. A typical designation is CT06E004J. The electrical and environmental tests have been rewritten to be in accord with MIL-STD-202. The test frequency for capacitance measurement has been changed to  $1 \text{ mc} \pm 0.1 \text{ mc}$ . Four new tests have been added: capacitance change versus rotation; contact resistance; low-temperature exposure; and temperature cycling. The low-frequency vibration test has been replaced by a high-frequency test in accord with MIL-STD-202.

MIL-C-10950B, CAPACITORS, FIXED, MICA DIELECTRIC, BUTTON STYLE, AMENDMENT 1, 26 FEBRUARY 1959

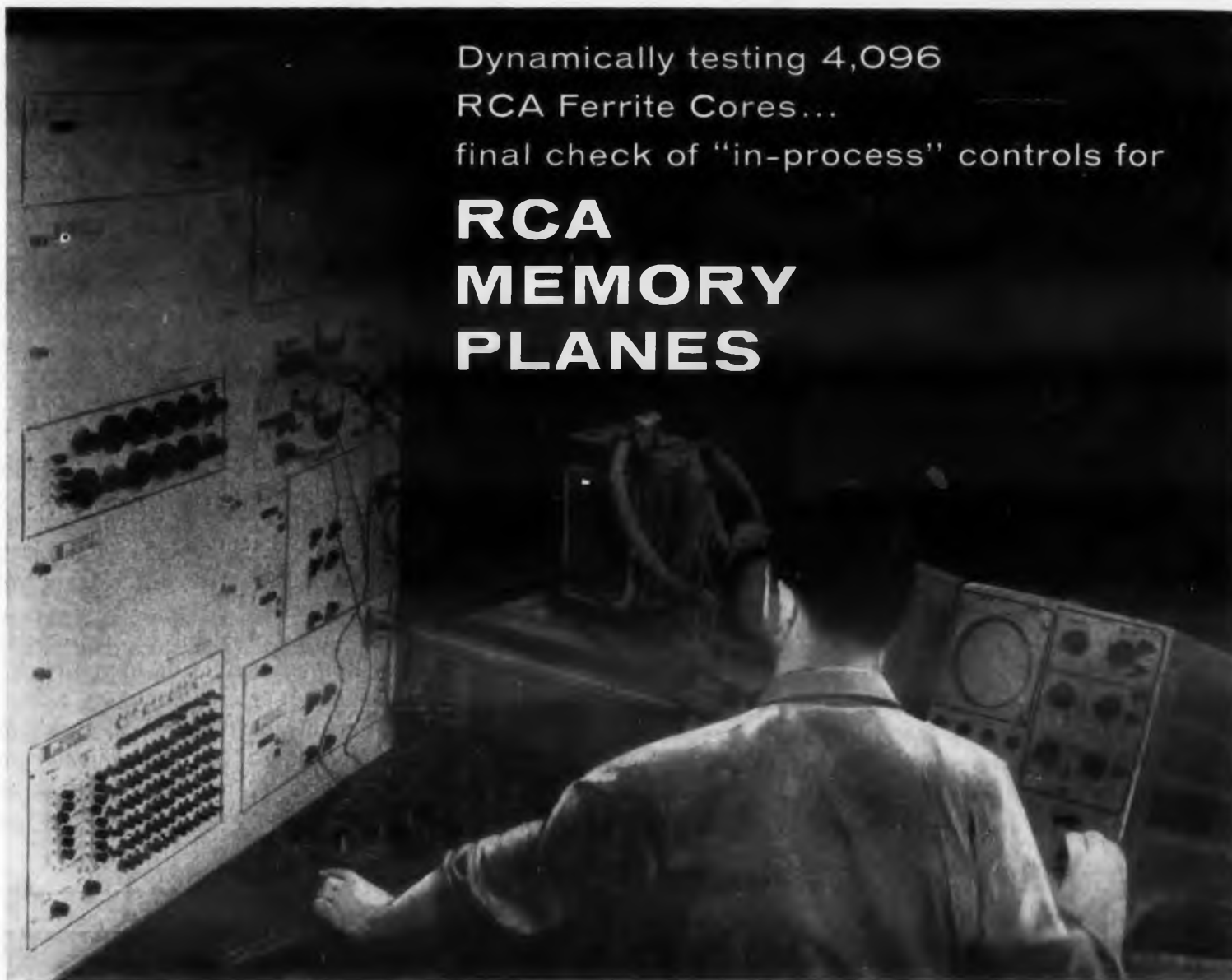
Characteristic E has been added. This characteristic has a temperature coefficient of  $-20$  to  $+100$  parts per million per deg C and a capacitance drift of  $\pm (0.1\% + 0.1 \mu\text{f})$ . The list of referenced publications and specs has been revised as have the requirements for packing, packaging and marking. Six detail specs were revised.

MIL-C-62A, CAPACITORS, FIXED, ELECTROLYTIC (DC, ALUMINUM, DRY ELECTROLYTIC, POLARIZED) AMENDMENT 2, 24 FEBRUARY 1959

The list of referenced specs has been revised. Also revised were sections dealing with responsibility for inspection, acceptance inspection, testing, preparation for delivery, and qualification.

EIA RS-218, METAL ENCASED FIXED PAPER DIELECTRIC CAPACITORS FOR DC APPLICATION, APRIL 1959

Capacitors covered by these standards are intended primarily for filter, by-pass and blocking purposes where the service is nominally dc. Capacitors conforming to the permissible operating voltages and ambient temperatures above  $40 \text{ C}$  are expected to have an operating life of one year of continuous operation. Longer life can be expected by operation at still lower voltages, for example five years at 70% of the values indicated. Capacitors having voltage ratings of 1500 v and below are suitable for use up to altitudes of 50,000 ft. Those rated above 1500 v are suitable for operation at altitudes up to and including 7500 ft. Copies of this standard are available from the Electronic Industries Association, 11 W. 42nd St., New York 36, N.Y., for \$2.50 each.



Dynamically testing 4,096  
RCA Ferrite Cores...  
final check of "in-process" controls for

## RCA MEMORY PLANES

*Unique memory plane and stack tester dynamically tests every RCA core in every RCA plane while the entire stack is being driven ... assures extremely high uniformity from core to core.*

This dynamic Plane and Stack Tester at RCA's Ferrite Plant in Needham Heights, Massachusetts, is one of the most versatile and efficient test apparatus of its type in use today. It evaluates each RCA coincident current type of memory plane and stack *under actual use conditions* and provides 100% testing to your rigid specifications at typical computer frequencies. During tests, two programs are run alternately in the machine: first program 1 and then program 2. Each program is capable of writing all ones, all zeros, the double checkerboard pattern and its complement, or the double complemented checkerboard. Defective cores are immediately

detected and identified...cores with the highest ones or lowest zeros, or early or late peaking characteristics can also be eliminated to further assure uniformity from core to core.

This testing procedure is another example of "in-process" controls employed by RCA in every stage from the selection of raw materials to the inspection of finished product. For Ferrite Cores, Planes, and Stacks to meet your most rigid specifications, contact your local RCA Field Representative. For technical data, write RCA Commercial Engineering, Section H-18-NN-3, Somerville, New Jersey.



**RADIO CORPORATION OF AMERICA**  
Semiconductor & Materials Division • Somerville, N. J.

East: 744 Broad Street, Newark, N. J.  
Humboldt 5-3900  
Northeast: 64 "A" Street, Needham Heights 94, Mass.  
Hillcrest 4-7200  
East Central: 714 New Center Bldg., Detroit 2, Mich.  
TRinity 5-5600  
Central: Suite 1154, Merchandise Mart Plaza  
Chicago, Ill., Whitehall 4-2900  
West: 6355 E. Washington Blvd.  
Los Angeles, Calif., RAYmond 3-8361  
Gov't: 224 N. Wilkinson St., Dayton, Ohio  
BAldwin 6-2366  
1625 "K" Street, N.W., Washington, D.C.  
District 7-1260

CIRCLE 66 ON READER-SERVICE CARD

The NEW Series BH100

# MILLI-V-METER

THE INSTRUMENT  
with the TAPE-SLIDEWIRE



**1/10 THE SIZE ...**  
**10 TIMES THE ACCURACY**  
OF STANDARD INSTRUMENTS!

- Resolution: 1 part in 10,000
- LABORATORY PRECISION for the operating plant.
- COMPATIBLE with any transducer—AC or DC.
- For strain gage, linear differential transformer, thermocouple, thermistor, resistance thermometer, pulse or variable frequency circuits or systems.
- Parabolic or logarithmic functions are linearized for direct digital reading.
- Every scale unit is a calibrated value.

*Produced by the makers of the JETCAL® jet engine Analyzer...  
in worldwide military and airline use!*



Full information is available for the asking!

**B & H INSTRUMENT  
CO., INC.**

3479 West Vickery Blvd., Fort Worth 7, Texas

Sales-Engineering Offices:  
ATLANTA, GA., COMPTON, CAL., DAYTON, OHIO, VALLEY STREAM, L.I., N.Y., WICHITA, KAN.  
TORONTO, ONT. (George Kelt Ltd.), MITCHAM, SURREY, ENGLAND (Bryans Aeroequipment Ltd.)

Visit us at Booth No. 847—ISA Show—Chicago

CIRCLE 67 ON READER-SERVICE CARD

## BOOKS

### Circuit Theory of Linear Noisy Networks

Hermann A. Haus, Richard B. Adler, *The Technology Press of M. I. T.*, and John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y., 79 pp, \$4.50.

This study, based on a single hypothesis concerning the essential function of an amplifier, leads to a characterization of amplifier spot-noise performance that avoids pitfalls previously associated with the effect of feedback upon noise performance.

The problem of noise-performance optimization leads to a search for the properties of linear noisy networks that are invariant under lossless network transformations. These invariants are determined for multi-terminal-pair networks. Their physical interpretations are pre-

sented in terms of a generalized "available power." A "canonical" form is also developed which exhibits all the invariants in a particularly simple way.

The invariants are then considered for the special case of a linear two-terminal-pair amplifier, and are shown to establish a lower limit on its noise performance. Various ways of achieving this limit are presented for all classes of such amplifiers, including those with negative resistance.

### Servomechanisms and Regulating System Design, Vol. 1, Second Ed.

Harold Chestnut, Robert W. Mayer, John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y., 680 pp, \$11.75.

Although the text has been altered ex-

CURTISS WRIGHT

## TIME DELAY RELAYS

Instant reset—Voltage compensated



Curtiss-Wright "IR" thermal time delay relays reset the instant they are de-energized. The second cycle will always provide the same delay as the first cycle. Variations from 22 to 32 volts will not affect the time delay of the "IR" Series.

**SPECIFICATIONS**  
Time delay . . . . . Preset 20 to 180 seconds  
Contact arrangement . SPST, DPDT or SPDT  
Temperature compensation . -65°C to +125°C  
Weight . . . . . 4½ ounces  
Terminals . . . . . Hooked solder type  
Mounting . . . . . Bracket or stud

Variations of the above relay characteristics available upon request.

*The Components Department also manufactures digital (stepping) motors, ultrasonic delay lines, and other units for electronic systems.*

WRITE FOR  
COMPLETE  
COMPONENTS  
CATALOG  
159

ELECTRONICS DIVISION  
**CURTISS-WRIGHT**  
CORPORATION • WEST CALDWELL, N.J.

CIRCLE 68 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 19, 1959



tensively, the object of this second edition remains the same as the first—to train design and application engineers in the basic principles of feedback control.

Major additions include a new chapter on the application of root-locus to the analysis and synthesis of control system design and a chapter on the use of an analog computer for the solution of control systems problems.

Among the other new features are: updating of feedback nomenclature and definitions in accordance with current practice, modification in presentation of transfer function material to emphasize the loading effect of one element on another, and addition of supplemental ways of relating open-loop frequency response to approximate closed-loop transient response. The material discussing error coefficients has been completely rewritten. Problems have been revised and new ones added.

#### Programming Business Computers

Daniel D. McCracken, Harold Weiss, Tsai-Hwa Lee, John Wiley & Sons, Inc.,

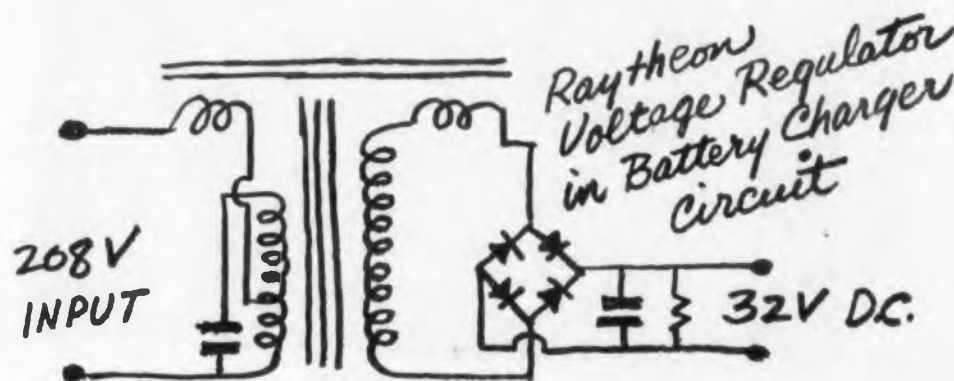
440 Fourth Ave., New York 16, N.Y., 510 pp, \$10.25.

The person who is involved or expects to be involved in day-to-day application of electronic computers to business data processing problems will be interested in this book.

Such fundamental topics as the nature of the data processing problem, the central concept of the file, flow charting, and the general characteristics of electronic computers are discussed in the early chapters. Numerous examples are then used to explain standard techniques of coding. These examples are written in terms of a hypothetical computer called DATAC, which is a compilation of the features of many machines.

An examination of such advanced techniques as the principles of sorting, re-run, timing estimates, file organization, automatic coding, and large random access storage devices is also included. The final chapters summarize the steps involved in establishing a computer application, and examine the accounting and auditing problems associated with electronic data processing.


## IS CONSTANT VOLTAGE POSSIBLE IN THESE CHANGING TIMES?



...Basically, the problem is a classical one of semantics. Higher minds than ours have pondered this question for centuries.

As a practical exercise, let us examine the case of voltage regulation reference source in the power supply circuit shown above. This passive network corrects input voltage changes of more than  $\pm 15\%$  of rated outputs and controls them to within  $\pm \frac{1}{2}\%$ ...a feature that is highly important in keeping storage batteries alive longer.

The point is that constancy is a relative term understood only against a background of change. The answer then to the initial question is "yes"...constant voltage is possible.

You can get the  about voltage

regulators from the higher minds at Raytheon by writing to:

VOLTAGE REGULATOR MAN  
Raytheon Company  
Magnetic Components Department  
Section 6120  
Waltham 54, Massachusetts



CIRCLE 70 ON READER-SERVICE CARD

## Shatterproof, Clear Plastic Containers

for packaging individual components!



- For individual packaging or kits • Wide range of sizes • 1/5 the weight of glass • Lower shipping costs • Can be printed or decorated • Low cost • Reusable • Also Available in Color.

Write for complete prices and literature

**LERMER PLASTICS, INC.**

572 South Avenue, Garwood, N. J.

PIONEERS AND SPECIALISTS IN PLASTIC CONTAINERS SINCE 1919

CIRCLE 69 ON READER-SERVICE CARD

Where only the **best**  
is good enough . . .



MODEL UHR-240

## Krohn-Hite power supplies are used

In basic electronic instruments for lab or test work, *less than the best* may be a dangerously bad bargain. Unexpected limitations — of reliability, range, precision — can throw out weeks of work on today's jobs, and can make tomorrow's tougher jobs untouchable.

The *best* instrument of its type is probably a bit more expensive, but it's worth buying . . . because you can believe in it today, and will rely on it tomorrow. An example is the Krohn-Hite Model UHR-240 ultra-high-regulation power supply. Here are some facts about it.

**MAIN DC OUTPUT:** zero to 500 volts, continuously adjustable, at zero to 500 milliamperes.

**REGULATION:** less than 0.001% plus 0.002 volt from no load to full load.

**LINE STABILIZATION:** less than 0.003% plus 0.003 volt, for 10% change.

**OUTPUT IMPEDANCE:** DC — less than  $(0.005 + 0.00002 \times \text{output volts})$  ohm; AC — less than 0.05 ohm plus 0.1 microhenry.

**RIPPLE:** less than 0.1 millivolt rms.

**DC BIAS OUTPUT:** zero to minus 150 volts, continuously adjustable, at zero to 5 ma; regulation less than 1%.

**DC HEATER OUTPUTS:** 5 to 12.6 volts, adjustable, at zero to 2.5 amperes.

**AC HEATER OUTPUTS:** two, each 6.3 volts at 10 amperes.

There's a lot more you should know about the UHR-240 . . . and about the other Krohn-Hite power supplies, oscillators, tunable electronic filters and amplifiers. In all of them, you'll find the same far-ahead engineering, design and construction. Because K-H instruments *are* good enough even for tomorrow's most critical work, they are increasingly chosen today where true reliability and precision are needed.



Write for your free copy of the new Krohn-Hite Catalog.

**Krohn-Hite CORPORATION**

580 Massachusetts Avenue, Cambridge 39, Mass.

CIRCLE 71 ON READER-SERVICE CARD

## NEW LITERATURE

### Electrohydraulic Servoactuator 72

Catalog 170, six pages, illustrates and describes the firm's line of electrohydraulic servoactuators. Included is a detailed cutaway photograph and schematic diagram of the unit in a typical systems application. Schematic drawings of eight auxiliary devices which can be incorporated in these servoactuators and a glossary of servoactuator terminology also appear in the catalog. Several typical production servoactuators with their applications are pictured. Moog Servocontrols, Inc., Proner Airport, E. Aurora, N.Y.

### Relay Catalog 73

This illustrated catalog is composed of individual catalog sheets which describe the firm's line of relays. Included are open and plug-in 5, 10 and 15 amp general purpose relays, polystyrene plug-in enclosures, miniature telephone type relays, and multiple leaf relays. Technical specifications and diagrams also appear. Line Electric Co., 271 S. Sixth St., Newark 3, N.J.

### Titanium Fasteners 74

This 12-page, illustrated technical bulletin describes standard titanium aircraft fasteners. General properties and advantages of titanium are covered. In addition, the compositions of the most generally used titanium alloys are given. Included is a table of comparative mechanical properties for both steel and titanium bolts. Graphs show the comparative fatigue strengths for both tension and shear bolts made of the two metals. Standard Pressed Steel Co., Box 202, Jenkintown, Pa.

### Solid State Power Supplies 75

Four-page, illustrated catalog 114A describes the firm's line of solid state regulated power supplies, which combine the features of magnetic and transistor regulators. Included are graphs, specifications, and physical data, in addition to information on several new intermediate current units and high current models. Electronic Research Associates, Inc., 67 Factory Place, Cedar Grove, N.J.

### Resistance Thermometer 76

Complete data on a standard line of the company's resistance thermometer elements can be found in this six-page catalog. Also included are instrumentation techniques, applications, diagrams and a price list. Arthur C. Ruge Associates, Inc., Hudson, N.H.

### Fractional HP Motor 77

Universal dc, induction and shaded pole motors, with ratings from 1/2000 to 1 hp, are described in this eight-page catalog. Motor parts sets, blowers and gear reduction units are also listed. Specifications are given for all motors shown. Howard Industries, Inc., 1760 State St., Racine, Wis.

### Breadboard Parts 78

Catalog 575, 24 pages, describes standard electromechanical breadboard parts, which are necessary for the assembly of complicated gear trains and servomechanisms. Included in the catalog are typical schematics and specifications, basic synchro transmitter and receiver systems, potentiometer transmitter and receiver systems, and a mechanical resolver system. Beckman Instruments, Inc., Helipot Div., 2500 Fullerton Rd., Fullerton, Calif.

### Ball Bearings 79

Bulletin 110, 12 pages, provides complete information on the firm's deep-groove ball bearings. Dimensions, loads and other application data for these deep-groove bearings are included in this illustrated brochure. Hoover Ball and Bearing Co., 5400 S. State Rd., Ann Arbor, Mich.

### Wattmeter 80

Mobile rf loads and wattmeters for use with aural or visual transmitters operating on any assigned frequency from 54 to 216 mc, including fm, are described in illustrated bulletin Q-105. Included in this two-page brochure are electrical and dimensional specifications for these items. Radio Engineering Laboratories, Inc., Standard Electronics Div., 29-01 Borden Ave., Long Island City 1, N.Y.

### Capacitor Motors 81

This four-page bulletin SDA 145 presents the firm's line of capacitor motors. Described are 1/2 to 15 hp types in frame sizes from 56 to 286U. Cut-away illustrations of the units are included. Peerless Electric Co., Electric Motor Div., W. Market St., Warren, Ohio.

### Polyphase Motors 82

Bulletin SDA 105, four pages, describes the firm's polyphase motors. These motors are available from 1/2 to 30 hp in frame sizes from 56 to 326U, in open drip-proof or enclosed, fan-cooled, and explosion-proof types. Peerless Electric Co., Electric Motor Div., W. Market St., Warren, Ohio.

### Test Instruments 83

The firm's line of instruments for automatic measurement of sound, vibration and strain is described in catalog ES-8, 24 pages. Electrical and physical data are given for electrical, acoustical and mechanical test instruments and their accessories. B & K Instruments, Inc., 3044 W. 106 St., Cleveland 11, Ohio.

### Clamps 84

Catalog No. 50, 48 pages, provides physical and dimensional information on the firm's complete line of clamps. Covered are split-hub clamps, mounting clamps and screw-type hub clamps. Sterling Precision Corp., Instrument Div., 17 Matinecock Ave., Port Washington, N.Y.

### Synchro Indicators 85

Brochure MDSP 592-16, four pages, gives electrical and dimensional data on military and commercial Autosyn synchro indicators, Autosyn synchro transmitters and aircraft pressure switches. Bendix Aviation Corp., Montrose Div., S. Montrose, Pa.

### Synchros 86

A reference guide to military synchros, brochure MDSP 592-4, four pages, provides electrical and dimensional specifications on MIL-S-20708 sizes, 11, 15, 18, 23, 31 and 37, and MIL-S-2335 types 1, 3, 5 and 6 synchros. Bendix Aviation Corp., Montrose Div., S. Montrose, Pa.

### Industrial Catalog 87

This 176-page catalog contains detailed product listings on a variety of electronic parts and equipment for use in aircraft, automation, computer, missile and research applications. Engineering Supply Co., Dallas, Tex.

### Encapsulation Cups 88

Electrical and physical properties, sizes and dimensions of the firm's line of rectangular, round and diamond-shape encapsulation cups are given in these processing technique sheets and catalog. Electronic Production & Development, Inc., 205 S. Beverly Dr., Beverly Hills, Calif.

### Tantalum Capacitors 89

Two-page bulletin 159C provides electrical, physical and dimensional information on the firm's series of high temperature tantalum slug capacitors. Data on leakage current, series resistance and impedance is given. Ohmite Manufacturing Co., 3639 Howard St., Skokie, Ill.

### Coupling Transformers 90

Two series of wide-band coupling transformers rated at 1 w and 1/2 w are described in bulletin WB-5. These units are used in the audio and radio frequency range in transistorized equipment. Either or both windings may be center-tapped. Write on company letterhead to Aladdin Electronics, Dept. ED, Nashville, Tenn.

### Relays 90

This 44-page illustrated catalog lists and describes the firm's line of relays, stepping switches, solenoids, contactors, rectifiers and related items. Universal Relay Corp., 42 White St., New York 13, N.Y.

### Photorelay 91

This illustrated data sheet describes the R-CH model photorelay. Typical applications, as well as physical, electrical and dimensional specifications are given. Berkeley/Dynamics, 2831 Seventh St., Berkeley, Calif.



# DIEHL\*

## The growing family of instrument servo components

60 cycle Servomotors (1, 3, 5 and 10 watts)  
400 cycle Servomotors (3 and 15 watts)  
60 cycle A.C. Tachometers  
400 cycle A.C. Tachometers  
D.C. Tachometers  
Gear Reducers

Vacuum Tube Servo Amplifiers  
SERVO POT (Combination of: Servomotor,  
gear train, slip clutch and potentiometer)  
Available separately or in any combination

DIEHL Instrument Servo Components have been developed to offer maximum performance, flexibility and reliability at minimum cost. These are the basic servo system building blocks which enable our military and industrial customers to satisfy the demands placed on them for higher over-all response, accuracy and economy. Write for full details concerning any of these components.



**DIEHL MANUFACTURING COMPANY**

A SUBSIDIARY OF THE SINGER MANUFACTURING COMPANY

Somerville, New Jersey

• AC SERVO MOTORS • AC SERVO MOTORS WITH AC TACHOMETERS • DC SERVO SETS  
• AC SERVO MOTORS WITH DC TACHOMETERS • AC AND DC TACHOMETERS • RESOLVERS

\*A Trademark of DIEHL MANUFACTURING COMPANY

CIRCLE 92 ON READER-SERVICE CARD





## TENSOLITE CABLE RIDES THE X-15

It's no small honor to be picked to ride the X-15 — America's first space-craft. All components were carefully selected, then checked and re-checked for top performance and reliability. Tensolite is honored to have its multi-conductor cable included in this tremendous program.

Producing inherently reliable 250 deg. C. cable and cable assemblies is Tensolite's specialty. Cables utilizing the maximum number of conductors in a minimum of area — saving weight and space — are available as ribbon cable or standard round configurations.

"You write the specs — Tensolite does the rest." Or let our experienced cable design engineers assist you. Many leading aircraft and electronic manufacturers are taking advantage of Tensolite's new, expanded design and production facilities in the cable field. We'd like to work with you on your cabling problems. Contact your local Tensolite representative, or write to:



**Tensolite** INSULATED WIRE CO., INC.

A Subsidiary of Carlsle Corporation  
West Main Street, Terrytown, N.Y.  
Pacific Division: 1816 N. Gardner St., Los Angeles, California

HOOK-UP WIRE • AIRFRAME WIRE • COAXIAL CABLE • MULTI-CONDUCTOR CABLE • MAGNET WIRE

See Us At Booth 1412 At The Wescon Show  
CIRCLE 93 ON READER-SERVICE CARD

## NEW LITERATURE

### Slow-Speed Motor 94

One-page bulletin provides electrical, mechanical and dimensional data on a slow-speed gear motor. It has speeds from 6 rpm and torque up to 40 in. lb. Brevet Products Corp., 601 W. 26 St., New York 1, N.Y.

### Voltmeter 95

Electrical and physical specifications of a 1 mv to 1000 v voltmeter are given in this two-page brochure R2-858. Included is a block diagram of the instrument. Southwestern Industrial Electronics Co., 2831 S. Post Oak Rd., P.O. Box 13058, Houston 19, Tex.

### Footswitch 96

This one-page bulletin gives electrical and dimensional data on a general-purpose footswitch with a 7 in. treadle. Linemaster Switch Corp., 432 Woodstock Terrace, Woodstock, Conn.

### Thermistor Controller 97

Two-page brochure MC-179 contains electrical and mechanical specifications, and applications of a transistorized thermistor controller. Also described are the principle of operation and available modifications. Fenwal Inc., Pleasant St., Ashland, Mass.

### Capacitors 98

Computer-grade aluminum electrolytic capacitors, 3 to 450 v dc, 300 to 150,000  $\mu$ fd, are described in four-page bulletin GEA-6819A. Performance characteristics, dimensions, and rating tables are given. General Electric Co., Schenectady 5, N.Y.

### Microwave Equipment 99

Dual-Beam microwave equipment is described in bulletin ECM 91. Cross-polarization of antennas makes continuous parallel operation of two sets of rf equipment possible, increasing reliability. G-E Communication Products Dept., Lynchburg, Va.

### Synchro Transmitter 110

Data sheet 801-T4 describes size 8 synchro transmitter line. Included are dimensioned and schematic drawings, photos, and tables of electrical and mechanical specifications. Daystrom, Inc., Daystrom Transicoil, Worcester, Montgomery County, Pa.

### Electronic Symbols Chart 111

Electronic symbols approved by the ASA, IRE, NEMA are listed on this wall chart. Included are symbols for devices, circuit elements, wiring, intercom, and plugs, jacks and outlets. Dukane Corp., St. Charles, Ill.

### Fluorocarbon Resins 112

"Teflon Fluorocarbon Resins for Electrical and Electronic Systems," 24 pages, provides electrical and physical characteristics of fluorocarbon resins. Specific applications and design considerations are also given in this illustrated booklet. E. I. Du Pont de Nemours & Co., Wilmington 98, Del.

### Transistor Circuits 113

Four-page brochure No. 1-03159 contains 16 transistor circuit diagrams, including power pack, modulator and 300 v dc regulated supply. Semiconductor Products, Red Bank Div., Bendix Aviation Corp., Long Branch, N.J.

### Tape Reader 114

This illustrated two-page data sheet describes the model PR-2 paper tape reader. Used in combination with the G-15 digital computer the photoelectric reader accepts paper tapes punched in any numeric code. Bendix Computer Div., 5630 Arbor Vitae St., Los Angeles 45, Calif.

### Digital Control System 115

Two-page bulletin 350-2 describes a punched-card-programmed digital control system. Included are short descriptions of the system components, as well as a block diagram showing the component functions. Also given are system electrical and physical specifications. Datex Corp., 1307 S. Myrtle Ave., Monrovia, Calif.

### Semiconductor Devices 116

Eight-page bulletin TE-1340A describes a line of semiconductor devices. Included are electrical specifications and illustrations of transistors, diodes, rectifiers, regulators, references, capacitors, and packaged assemblies. Dimensional diagrams are also given. Transitron Electronic Corp., Wakefield, Mass.

### Shipping Cases 117

Two-page illustrated bulletin "Reusable Shipping Cases" describes and illustrates vulcanized fibre containers which are used in transporting delicate instruments and electronic equipment. A table of sizes and specifications is included. Continental-Diamond Fibre Corp., Newark, Del.

### Mercury Bulb Elements 118

Bulletin 851 provides a technical description of different types of mercury bulb elements and temperature ranges. Designations and markings, various element plunger types, and a chart on sample element specifications are also given. Partlow Corp., 528 Campion Road, New Hartford, N.Y.

### Recorders 119

Specification sheets 51-1202W-1 and 51-1212W-1 describe four-inch strip chart miniature recording and recording control stations for process variables. Electrical and physical specifications, illustrations, dimensional diagrams, and typical installation diagrams are given. Fischer & Porter Co., 217 Jacksonville Road, Hatboro, Pa.

### Studio Equipment 120

This six-page illustrated bulletin describes the Telefunken line of studio equipment and professional products. Electrical and physical specifications are given for capacitor microphones, power amplifiers, attenuators, equalizers, general purpose amplifiers, and oscillators. Audio Fidelity, Inc., 770 Eleventh Ave., New York 19, N.Y.

### Phase Sensitive Detector 121

Bulletin No. 91411 describes the theory and operation of a visual phase sensitive detector. Applications, block diagrams, waveforms, and test setups are given, as well as a chart illustrating the demodulation of various carrier signals of different

phase relationships. Boonshaft and Fuchs, Inc., Hatboro Industrial Park, Hatboro, Pa.

### Cycle Controller 122

Bulletin C311, 12 pages, describes an impulse-sequence time-cycle controller and its applications. Detailed information is given on the controller, its operation, and attachments. Bristol Co., Waterbury 20, Conn.

### Fluorescent Lamps 123

This six-page illustrated catalog describes a line of miniature fluorescent lamp fixtures. Included are fluorescent illuminated magnifiers, hand lights, hand magnifiers, and microscopic illuminators. Stocker & Yale, Inc., 77 Green St., Marblehead, Mass.

### Transistor Chart 124

This transistor characteristics chart, eight pages, lists all of the firm's commercially available transistors, grouped as to type of construction or general field of application. The 20 most important parameters of each transistor and JEDEC case designations are given. Lansdale Tube Co., Lansdale, Pa.

### Autopots 125

This four-page brochure describes the applications, operation, and specifications of a line of self-balancing potentiometers. Block diagrams show the operating principles of both the pyrometer and millivoltmeter applications. Daystrom Pacific, 9320 Lincoln Blvd., Los Angeles 45, Calif.

### Nickel Alloys 126

"A Quick Guide to the Nickel-Containing Casting Alloys," 27 pages, presents condensed data on the major nickel-containing casting alloys, including the range of properties offered, industries served, and general applications for each of the alloys. A six-page fold-out briefly summarizes the important properties of each alloy and its uses. International Nickel Co., Inc., Readers Service Section, 67 Wall St., New York 5, N.Y.

### Mica Insulation 127

Catalog M59, 14 pages, describes the firm's line of bonded mica insulation. It provides complete information on the properties, tolerances and composition of all the grades of mica. Continental-Diamond Fibre Corp., Newark, Del.

## in step with tomorrow!



## FERRITE CIRCULATORS your choice of advanced designs

HIGH POWER  
LOW POWER  
BROAD and NARROW BANDS  
LOW INSERTION LOSS  
HIGH ISOLATION  
SMALL SIZE  
LIGHTWEIGHT

Kearfott Ferrite Circulators—a complete line especially designed to meet the growing need for reliability, precision and performance in the space age. In the broad range of sizes and types, there is a circulator to fit your exact requirement. Our engineers will be pleased to offer application assistance.

Engineers: Kearfott offers challenging opportunities in advanced component and system developments.

TYPICAL SPECIFICATIONS				
MODEL	FREQ. RANGE	ISOLATION	INSERTION LOSS	V.S.W.R.
W-169-7B-5	8500-9600 MC	25 DB Min.	0.3 DB Max.	1.10 Max.
W-163-1C-1	9.2-9.4 KMC	20 DB Min.	0.5 DB Max.	1.25 Max.
W-117-2A-1	9200-9400 MC	18 DB Min.	0.3 DB Max.	1.30 Max.
W-269-2A-1	5.975-6.425 KMC	20 DB Min.	0.7 DB Max.	1.25 Max.
W-569-1B-2	16.0-17.0 KMC	I-III 30 DB Min. II-I 20 DB Min.	0.5 DB Max.	1.20 Max.

THESE ARE ONLY A FEW OF THE MANY AVAILABLE MODELS



**Kearfott**

A  
GENERAL  
PRECISION  
COMPANY

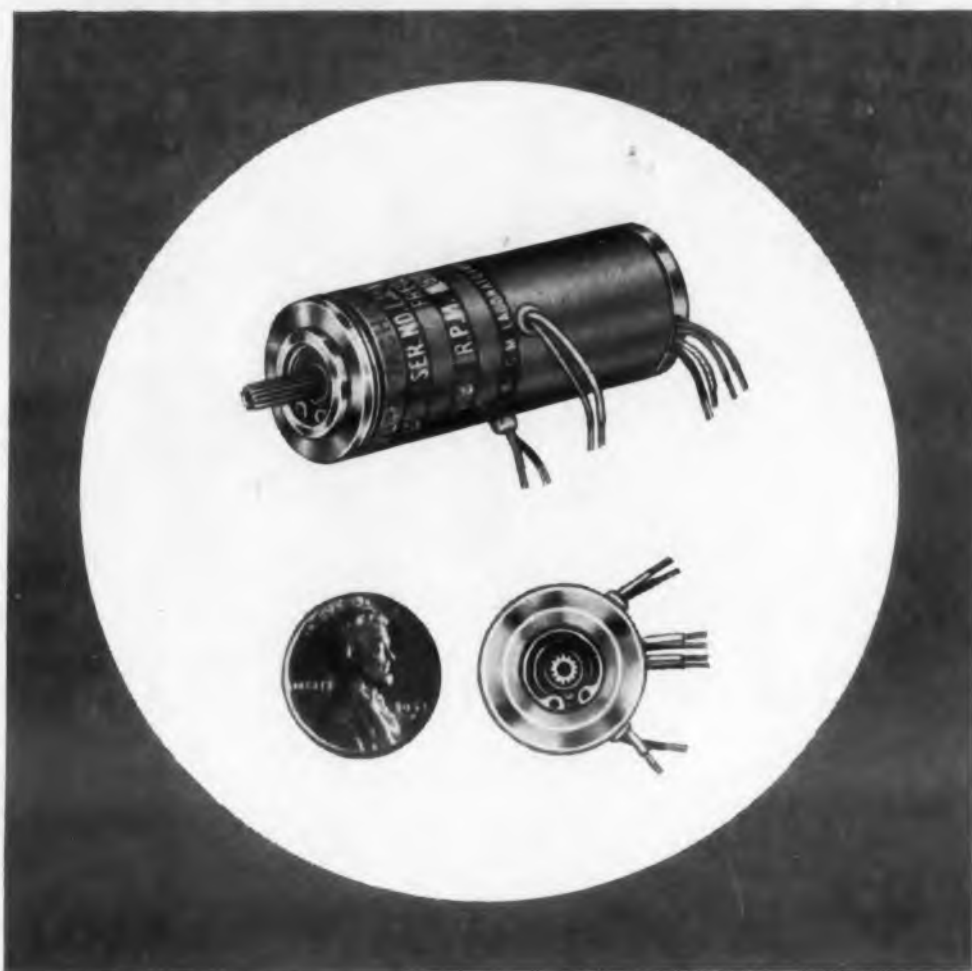
KEARFOTT COMPANY, INC.  
Microwave Division  
A Subsidiary of General  
Precision Equipment Corporation  
14844 Oxnard Street  
Van Nuys, California

#### SALES OFFICES

SEATTLE, WASH. VAN NUYS, CALIF. PHOENIX, ARIZ. DAYTON, OHIO CLIFTON, N. J.  
PALO ALTO, CALIF. SAN DIEGO, CALIF. DALLAS, TEXAS CHICAGO, ILL. WASHINGTON, D.C.

CIRCLE 128 ON READER-SERVICE CARD

# Spotlight on Space!



## NEW SIZE 8 MOTOR GENERATOR

*for transistor operation*

Tested to conform to all applicable Government Specifications for humidity, salt-spray, temperature, altitude, vibration! Promptly available in prototype and sample quantities.

- Outside Diameter: 0.750 inches.
- Weight: 2.9 ounces maximum.
- Tachometer-generator operates on 18 volts, 400 cycles.
- Gradient: 0.23 volts per 1000 RPM.
- Maximum null voltage: 0.015 RMS.
- Both fixed and control phase of motor wound for 18 volts, 400 cycles.
- Stall Torque: 0.3 ounce-inch, with no-load speed of 5400 RPM.
- Pinion Data: Precision Class 2, 13 tooth, 120 pitch, 20° pressure angle.



Write for full information, G-M Recommended Procurement Specification No. 665 and Catalog.

CIRCLE 129 ON READER-SERVICE CARD

## NEW LITERATURE

### Measurement Techniques 130

Time-saving measurement techniques with the use of a coaxial switch are the subject of this four-page Technical Newsletter. The bulletin, Vol. 1, No. 1, with the aid of pictures, charts, and diagrams, describes how the coaxial switcher, model FD-30, can be used for comparison measurements in the frequency range from dc to 250 mc. Jerrold Electronics Corp., Industrial Products Div., 15th and Lehigh Ave., Philadelphia 32, Pa.

### Subminiature Paper Capacitors 131

Two four-page bulletins, A-110 and A-115, describe the firm's subminiature glass-to-metal sealed tubular capacitors, types AQF and TQF respectively. Illustrated with pictures and diagrams of two optional bracket styles and screw-base and standard mountings, the bulletins contain a complete list of military and commercial ratings, performance characteristics, and test specifications. Astron Corp., Newark, N.J.

### Accessories Catalog

132

More than 1500 different electronic items are listed in this 72-page parts and accessories catalog. In addition to listings and illustrations of picture and receiving tubes, batteries, speakers, stereo record changers, antennas, bases and stands, the catalog contains a 20-page section devoted to cross-reference information on universal replacement parts. Admiral Corp., 3800 Cortland St., Chicago 47, Ill.

### Quartz Crystal

This paper covers instruments and techniques for the precise measurement of quartz crystal characteristics in accordance with IRE standards. Entitled "Measuring Instruments for Determination of Electrical Characteristics of Quartz Over the Range from 0 to 300 Mc," this paper was delivered at the symposium on frequency control sponsored by the Signal Corps. Write on company letterhead to Rhode & Schwarz Sales Co., Inc., Dept. ED, P.O. Box 275, Passaic, N.J.

## DO YOU KNOW A SUPERIOR SALES ENGINEER?

### A MAN WITH A GOAL BEYOND ENGINEERING?

... a man with imagination, sales potential, a broad marketing outlook, and engineering background, the man qualified by versatility and ambition to sell space on **ELECTRONIC DESIGN**. Here is an unusual opportunity for an east coast engineer with dash, brains, vitality to grow in a broader and more lucrative field than straight engineering.

*If you know the man, we'd like to, too!*

Mrs. Cynthia Cooper  
**ELECTRONIC DESIGN**  
830 Third Avenue  
New York 22, New York  
or call: PLaza 1-5530

## Temperature Cabinets 134

This 32-page catalog describes 14 types of constant temperature cabinets including ovens and special purpose models. The wide-range cabinet is used for testing electrical and physical properties of semiconductors or other electrical components. Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

## Chemical Catalog 135

Revised and expanded, this 200-page catalog lists over 4500 of the firm's items including organic chemicals, laboratory reagents, spectroquality solvents, and biological stains. The formula is given for each item. Matheson, Coleman and Bell, 2909 Highland Ave., Cincinnati 12, Ohio.

## Silicon Diodes 136

"Silicon High Reliability Glass Diodes," a four-page bulletin, provides electrical characteristics of general purpose and fast switching silicon diodes. Included are typical reverse and forward characteristic curves. Silicon Transistor Corp., 150 Glen Cove Rd., Carle Place, Long Island, N.Y.

## Airborne Power Supplies 137

Specifications, operational characteristics, and design features of airborne strain-gage power supplies appear in the four pages of bulletin 201. Graphs illustrate load regulation, temperature stability, and line regulation. Neff Instrument Corp., 2211 E. Foothill Blvd., Pasadena, Calif.

## Indicators and Indicating Controllers 138

Four-page bulletin No. 65 discusses thermo-electronic self balancing indicators and indicating controllers, which indicate any process variable convertible to an electrical quantity such as dc potential, current, or resistance. Potentiometer and bridge type units are described and specifications for the exclusive high-gain servo-amplifier, which combines extreme sensitivity with exceptional stability, are given. Illustrations show the design of these instruments, the 34 in. scale, the quick-set control points, and the double slidewires. Thermo Electric Co., Inc., Saddle Brook, N.J.

## ANOTHER FIRST...



BASIC MOTOR

## THE ONLY *Electro-Reliable* A.C. TIMING MOTOR

*Thinner... Quieter...  
More Reliable... More Versatile*

### FINGER-THIN...

Only 9/16 Inches Short... Only 1 3/4 Inches in Diameter... very compact... reduces the size of your equipment.

### WHISPER-QUIET...

Strictly an electrical motor... practically noiseless... no rattling of gears or ratchets.

### HIGH TORQUE...

1/4 oz. inch at the rotor with an instantaneous start and stop... requires only 2 1/2 watts... can replace larger motors in recorders, controls and telemetering equipment.

### HIGHEST RELIABILITY...

Longer life... no one-way gears or ratchets to fail... provides millions of operations without any trouble.

### SPECIFICATIONS

Standard Voltage Ratings:  
6, 12, 24, 115, 230 Volts  
Frequency:  
60 CPS Standard  
25, 50 CPS Available  
Power Input: 2.5 Watts  
Maximum (60 CPS)

#### BASIC MOTOR

Weight: 4 ounces  
Speed: 300 RPM  
Torque: 1/4 oz.-in.  
Length: 9/16 inch

#### WITH INTEGRAL GEAR TRAIN

Weight: 5 ounces  
Speed: 300 RPM to 1/6 RPH  
Torque: 30 oz.-in. @ 1 RPM  
Length: 7/8 inch



WITH INTEGRAL GEAR TRAIN

© 1959



The **A.W. HAYDON Company**

227 NORTH ELM STREET  
WATERBURY 20, CONNECTICUT

Custom Design & Manufacture Of Electronic  
And Electro-Mechanical Timing Devices

CIRCLE 139 ON READER-SERVICE CARD

1959 ELECTRONIC DESIGN • August 19, 1959



**MAKES YOUR LOAD  
A REFLECTIONLESS  
TERMINATION**

## PRECISE COAXIAL TUNERS TUNE TO VSWR 1.000

200-4000 MCS.

DESIGNED FOR USE whenever extremely accurate RF power terminations are required. This laboratory type Coaxial Tuner will tune out discontinuities of 2 to 1 in coaxial transmission line systems or adjust residual VSWR to 1.000 of loads, antennas, etc. May also be used to introduce a mismatch into an otherwise matched system.

M. C. Jones Coaxial Tuner is designed for extreme ease of operation, with no difficult laboratory techniques involved. Reduces tuning time to a matter of seconds. Graduations on carriage and probe permit resetting whenever reusing the same termination.

AT IRE SHOW  
SEE US AT BOOTH 3224  
MICROWAVE AVENUE

### SPECIFICATIONS

Impedance	50.0 ohms
Frequency Range	Model 151N 200-1000 Mcs. Model 152N 500-4000 Mcs.
RF Connectors	E1A 7/8" 50.0 ohm Flange plus adapters to N female connector
Power Rating	100 watts
Range of Correction	VSWR as high as 2 may be reduced to a value of 1.000

For more information on Tuners, Directional Couplers, R. F. Loads, etc., please write for 68-page Catalog No. 12 or see Electronics Buyers Guide or Electronic Engineers Master.

## M. C. JONES ELECTRONICS CO., INC.

SUBSIDIARY OF

## BENDIX AVIATION CORPORATION

BRISTOL, CONNECTICUT

CIRCLE 140 ON READER-SERVICE CARD



**ETCHED METAL PARTS?  
TOLERANCES CRITICAL?**

call **buckbee mears**

Micron range tolerances are standard practice with B.M.C. photomechanical techniques. Storage tube, mesh, transistor evaporation masks, intricate metal parts, mechanical filter screens, etched shaver combs, etched orifice plates, all are produced more perfectly by electroforming or mechanical etching.

**advantages:**

1. No tool distortion and burrs.
2. Processing of parts too small or intricate for stamping or machining.
3. Ease of handling.
4. Parts or sheets of parts furnished pre-tooled for final processing.

**BUCKBEE MEARS CO.** ST. PAUL, MINNESOTA — Capital 7-6371

*Etching on metal and glass, electroforming, manufacturers of fine mesh for storage and image tubes, micron sieves, shadow masks for color T.V., evaporation masks for transistors.*

CIRCLE 596 ON READER-SERVICE CARD

*deep drawn aluminum boxes and covers*

**11,600  
Standard  
Sizes  
and  
Shapes**

**WITH NO TOOLING COST!**



Choose from more than 11,600 sizes, shapes and heights of square, round, rectangular boxes and covers — pay no tooling charge! All can be trimmed and modified to your specification . . . brackets and fasteners can be installed, holes and louvers punched, etc. Complete facilities for welding and painting too! Send print or contact your Zero Representative for quote on custom deep drawn parts using the exclusive Zero-Method tooling.



**ZERO  
MANUFACTURING CO.**  
1121 Chestnut Street, Burbank, California  
Telephone Victoria 9-5521 • TWX 9862

representatives in 26 key cities covering the U.S.  
factories in Burbank, California and Palmer, Massachusetts

**WRITE FOR  
NEW ZERO STOCK  
BOX CATALOG**



CIRCLE 141 ON READER-SERVICE CARD

**NEW LITERATURE**

**Vernier Variable Resistor 142**

One-page, illustrated data sheet 174 gives electrical and mechanical specifications of a vernier carbon variable resistor with 15/16 in. diameter. Chicago Telephone Supply Corp., Elkhart, Ind.

**Flight-Path Computer 143**

Complete details of model 500 jet aircraft flight computer and its applications are discussed in four-page bulletin 500. Colorado Research Corp., Broomfield, Colo.

**Readout System 144**

Illustrated catalog 30B1000, 12 pages, describes the firm's multiple pressure readout system. This system measures and records hundreds of different pressures simultaneously using a single high accuracy transducer. Fischer & Porter Co., 225 Jacksonville Rd., Hatboro, Pa.

**Cartoon Booklet 145**

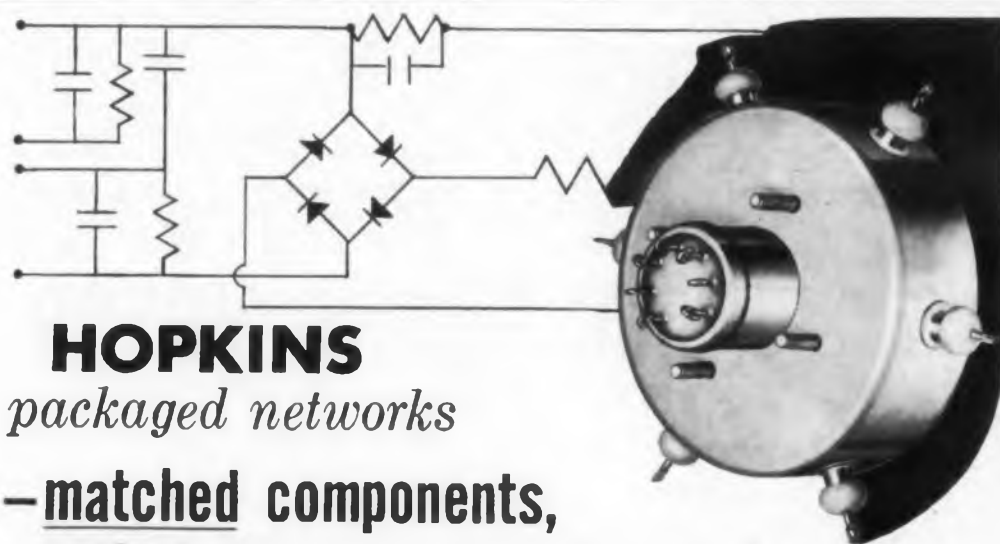
This collection of cartoons satirizes the effect of advanced electronics on man. It is titled "A Study of the Unique Influence of Space-Automation Technology on the Present Day Environment with Special Attention to its Implications for the Behavioral Sciences." Audio Devices, Inc., 444 Madison Ave., New York 22, N.Y.

**Photoelectric Scanners 146**

Bulletin 659, two pages, describes and illustrates the components of miniature photo-electric scanners. Included are physical dimensional information on light sources, photocell housing and photo relays. Farmer Electric Products Co., Inc., 2300 Washington St., Newton Lower Falls, Mass.

**Control System 147**

Eight-page brochure K-2 describes the firm's K-2 electronic control system. Included are illustrations and physical and electrical information. Eaton Manufacturing Co., Dynamatic Div., Kenosha, Wis.



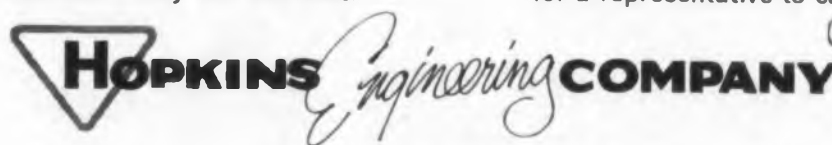
**HOPKINS**  
*packaged networks*  
**—matched components,  
built to your specs, at a saving**

**We do the matching**, so you're not stuck with the job, or with capacitors, inductors and resistors left over after matching.

**Save time**—you purchase only one unit instead of many . . . test and assemble only the one unit.

**Save space**—a Hopkins packaged network usually saves more space than a unit of your own design.

**Let us analyze your circuit problems**, and offer network recommendations and samples for your approval. Write for a representative to call.



12900 Foothill Blvd., San Fernando, Calif. Tel. EMpire 1-8691  
CIRCLE 148 ON READER-SERVICE CARD

CIRCLE 149 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 19, 1959



# SIO-SYN

## SYNCHRONOUS MOTORS

### AUTOMATIC MACHINES AND APPARATUS

needing a simple, efficient, maintenance-free synchronous motor

### NUMERICAL CONTROL SYSTEMS

requiring continuous, constant-speed traverse and/or incremental stepping for positioning

### REMOTE CONTROL SYSTEMS

using either manually-operated or remote positioning control

### SERVOMECHANISMS

calling for instant starting, stopping and reversing characteristics without slip or chatter



**72 RPM**  
*shaft speed*

**STARTS**  
*instantly!*

**REVERSES**  
*instantly!*

**STOPS**  
*instantly!*

*can be used as a stepping motor!*



**THE SUPERIOR ELECTRIC COMPANY**

Bristol, Connecticut, U.S.A.

# SYNCHRONOUS MOTORS

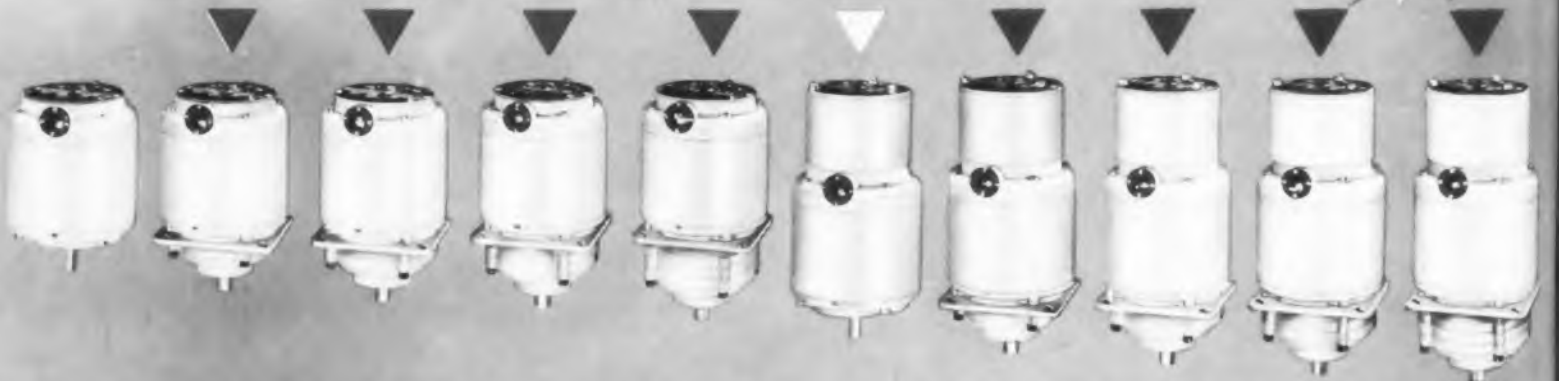
A SLO-SYN is an enclosed, permanent magnet type a-c motor with a slow basic shaft speed of 72 RPM. A single-pole, three-position switch can give complete forward, reverse and "off" control because the motor has three leads only. The SLO-SYN Motor will start or stop in less than 0.025 seconds or approximately 1.5 cycles. No need for electrical or mechanical braking because the motor will stop in less than 5° of shaft rotation. Maximum moment of inertia of a load rigidly attached to the shaft is 1.5 pound-inches<sup>2</sup>. Loads with higher inertia can be started by using a coupling method which allows 5° freedom. Types having specially-designed planetary gear assemblies are available to provide speeds of 3.323, 0.665, 0.133 or 0.027 RPM. Torque on all planetary gear types is 2500 ounce-inches.



TYPE SS150

## AS A D-C STEPPING MOTOR

The SLO-SYN Synchronous Motor can be adapted for use as an incremental stepping device by the use of a d-c power source and a suitable switching arrangement. When used as a control system stepping or "inching" motor, d-c electrical impulses are converted into either 200 or 400 precise increments of one revolution of the motor shaft. The motor will maintain its rated torque for any stepping position. Each step is made instantly without slip or clatter because no ratchets are used.

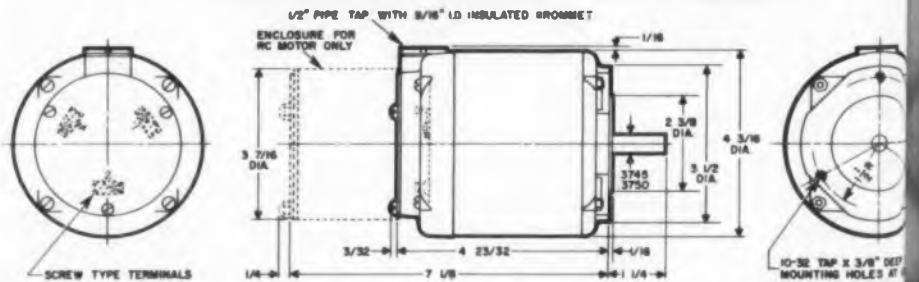


▼ Available with speed reducing planetary gears
▼ Available with enclosed capacitor and resistor
▼ Available with both enclosed capacitor and resistor and planetary gears

## RATINGS AND SPECIFICATIONS

**INPUT** ..... 120 volts, 40/70 cycles, 1 phase  
**OUTPUT SPEED** 72 RPM at 60 cycles  
**MAX. CURRENT** 0.3 ampere at 60 cycles  
**TORQUE** ..... 150 ounce-inches  
**WEIGHT** ..... 6.5 pounds

## OUTLINE DIMENSIONS - TYPE SS150



THE SUPERIOR ELECTRIC COMPANY, Bristol, Connecticut

Please send SLO-SYN Synchronous Motor Bulletin
  Please have your representative call.

name \_\_\_\_\_  
 company \_\_\_\_\_  
 address \_\_\_\_\_  
 city \_\_\_\_\_ zone \_\_\_\_\_ state \_\_\_\_\_

... FOR YOUR FILES

Request SLO-SYN Bulletin giving full technical information, ratings and specifications.



THE SUPERIOR ELECTRIC COMPANY  
Bristol, Connecticut, U.S.A.

Comp  
First H  
ELI  
the av  
It will  
into  
product  
during  
uct is li  
tiating  
with th  
page an  
publishe  
specifie  
almost  
page in  
830 Thi  
Plastics  
Plastic  
and flat  
catalog.  
table of  
cal prop  
ranges, t  
tions. Ca  
15111 Se

... ELE 140  
ELECTRON

**Complete List of New Products,  
First Half of 1959 150**

**ELECTRONIC DESIGN** announces the availability of its New Products Index. It will convert your back copies of **ED** into a quick reference file of all the new products and materials announced by **ED** during January to June, 1959. Each product is listed by category; a short differentiating description of each is given, along with the manufacturer's name, plus the page and issue in which it appeared. **ED** publishes descriptions of all new products specified by electronic design engineers—almost 2000 items are listed in this 30-page index. **ELECTRONIC DESIGN**, 830 Third Ave., New York 22, N.Y.

**Plastics Catalog 151**

Plastic sheets, rods, tubes, films, blocks and flat tubings are listed in this 64-page catalog. Information includes comparison table of chemical, electrical and mechanical properties, available sizes, color ranges, textures, and purchasing specifications. Cadillac Plastic & Chemical Co., 15111 Second Ave., Detroit 3, Mich.

**Industrial Catalog 152**

The "Industrial Catalog," 274 pages, contains product descriptions on a variety of electronic parts and equipment. Included are listings for high fidelity and service products, and a supplement covering amateur radio equipment. Harrison Radio Corp., 225 Greenwich St., New York 7, N.Y.

**Power Supplies 153**

This 16-page catalog C-59 gives electrical and physical specifications on precision calibrated, high-voltage power supplies. Also included is data on dc potentiometric and dc-ac differential voltmeters. John Fluke Mfg. Co., Inc., 1111 W. Nickerson St., Seattle 99, Wash.

**Molding Equipment 154**

This illustrated catalog shows how to develop and produce a wide variety of molded items (from subminiature to 1.5 oz) in all thermoplastics. Performance data, specifications, applications, and a price list on the firm's plastic injection molding machine and accessories are included. Newbury Industries, Inc., Newbury, Ohio.

**EXTENSIVE  
MOLD - ENCAPSULATION  
FACILITIES**

available for reliable environmental protection of  
**TRANSFORMERS • TOROIDS • MAGNETIC AMPLIFIERS • FILTER NETWORKS**



MOLDED



ENCAPSULATED



POTTED-SHELL

TYPICAL KEYSTONE TREATED UNITS

**KEYSTONE FEATURES:**

1. Minimum cost molds.
2. Meet difficult thermal shock, immersion and salt-spray tests.
3. Pass applicable portions of MIL-T-27A; MIL-I-16923; MIL-E-5272A.
4. High operating temperatures, 130°, 155°, 170° C.
5. Weight reduction through use of high thermal conductivity modified resins.
6. Complete choice of materials: epoxys, polyesters, silicone rubber, etc.

KEYSTONE'S continuous evaluation program of resin and processes it at your disposal. SPECIFY your resin and processing procedure, if you so desire.

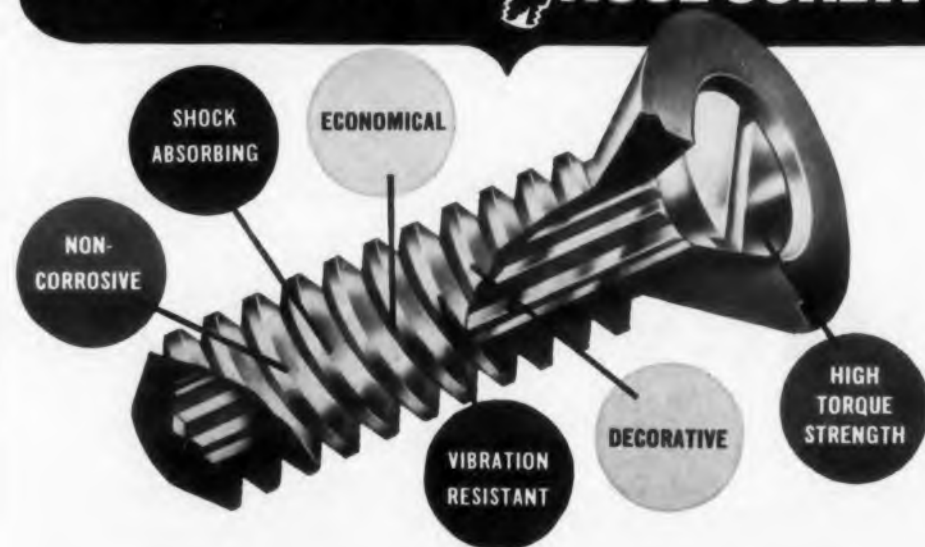
**keystone** PRODUCTS COMPANY  
SPECIALISTS IN PRECISION MAGNETIC COMPONENTS

904-6 TWENTY-THIRD STREET UNION CITY, NEW JERSEY  
Union 6-5400

CIRCLE 155 ON READER-SERVICE CARD

CIRCLE 149 ON READER-SERVICE CARD  
**ELECTRONIC DESIGN • August 19, 1959**

**NYLON + STEEL = INSUL-SCREW**



**A Scientifically New, Thoroughly Tested Plastic Screw with Metal Core!**

Insul-Screw is a composite plastic-metal screw consisting of a serrated metal core with a plastic exterior. The two materials blend their properties to form as an integral fastening unit which eliminates these common fastener problems: insulation requirements, corrosion, vibration hazards. Insul-Screw reduces weight, size and number of components and simplifies assembly. FREE SAMPLES! Our engineering representative will be pleased to call on you.

**INSUL-SCREW**  
4873 West Armitage Avenue • Chicago 39, Illinois

A product of  
**AUSTIN SCREW  
PRODUCTS COMPANY**



FREE ILLUSTRATED BROCHURE!  
Write TODAY for your copy of this complete and factual presentation!

CIRCLE 156 ON READER-SERVICE CARD

**HEATHKIT**

**NEW! An  
ELECTRONIC  
ANALOG  
COMPUTER  
for \$199<sup>95</sup>**



FREE CATALOG describes over 100 easy-to-build Heathkit products including test equipment, ham radio gear, marine equipment and hi-fi components.



**HEATHKIT EC-1 COMPUTER KIT**

- Simulates Mechanical Problems, Processes and Conditions
- Solves Mathematical Problems (Add, Subtract, Divide, Multiply, Integrate, Differentiate, get Transfer Functions)
- In a Class by Itself, but Compares in Functions to Computers Costing Over \$1000.00

Complete information is available; mail the coupon — or see your nearest authorized Heathkit dealer.

**HEATH COMPANY**

a subsidiary of Daystrom, Inc.  
Benton Harbor 60, Michigan

Please send complete information on the EC-1 Computer and your latest Free Heathkit Catalog.

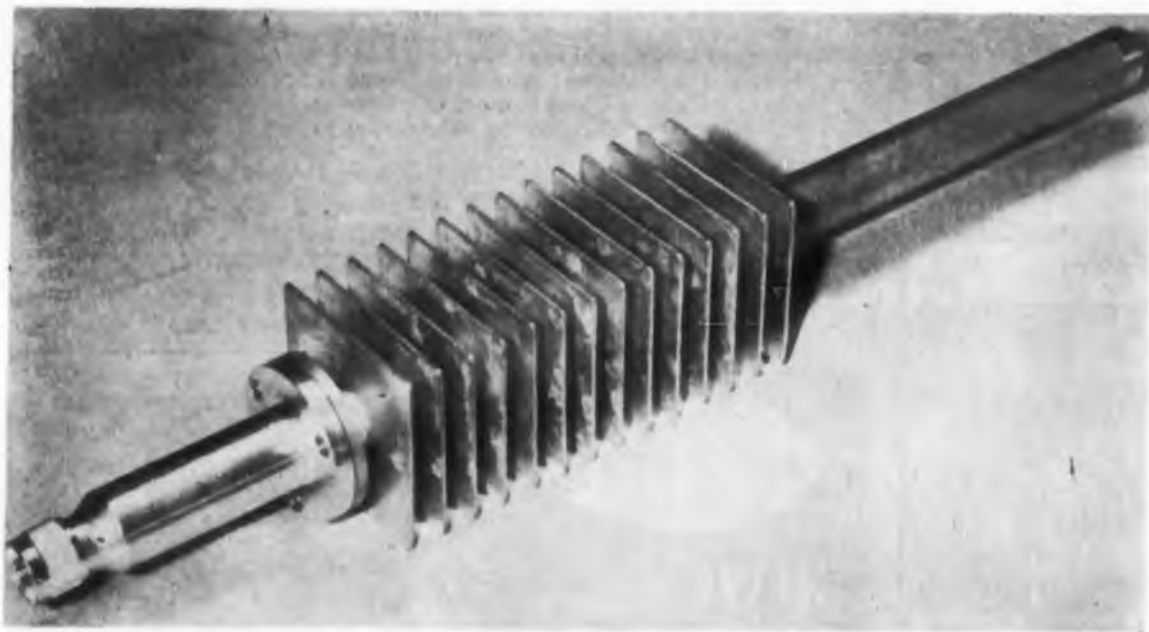
NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

All prices F.O.B. Benton Harbor, Mich. Prices and specifications subject to change without notice.

CIRCLE 157 ON READER-SERVICE CARD

# NEW PRODUCTS

*Covering all new products that might generally be specified by an electronics engineer engaged in the design of original equipment.*

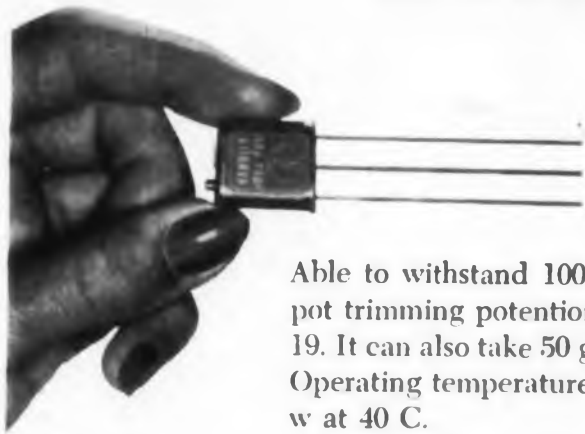


## Microwave Terminations Rated at 300 w

Rated at an average power of 300 w, these microwave terminations have a maximum vswr ratio of 1.2 from 0.9 to above 8 kmc. The new line have type LT, N, 7/8 in. and 1-5/8 in. connectors. Models RDL-6-7/8, RDL-6 1-5/8 (H), RDL-6LT (H), RDL-6LC-(H) can handle a peak power of 50 kw.

Radar Design Corp., Dept. ED, Pickard Dr., Syracuse 11, N. Y.

CIRCLE 158 ON READER-SERVICE CARD

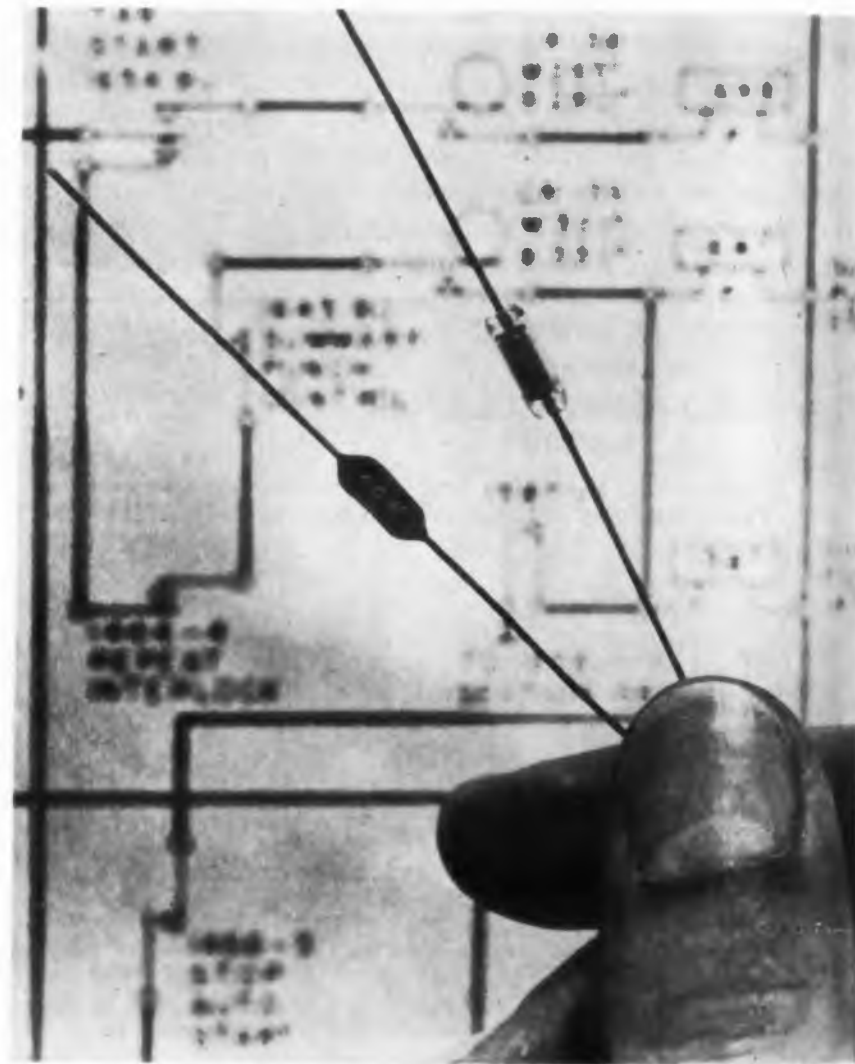


## Trimmer Pot Takes 100 g

Able to withstand 100 g of acceleration, the model 1-WO Wee-pot trimming potentiometer exceeds the requirements of MIL-R-19. It can also take 50 g of shock and 30 g of vibration to 2000 cps. Operating temperature range is  $-55$  to  $+140$  C. It is rated at 1.3 w at 40 C.

Handley Inc., Dept. ED, 14758 Keswick St., Van Nuys, Calif.

CIRCLE 159 ON READER-SERVICE CARD

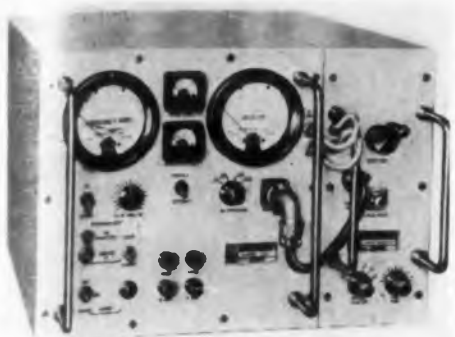


## Film Resistors Rated at 1/8 w

Both these 1/8 w resistors have ratings of 10 to 100,000 ohms at 250 v and 70 C, and are derated to 150 C. They are oxide film units and measure about 3/8 in. in length and 1/8 in. in diam. The epoxy-coated N-60 unit and the glass-enclosed NF-60 unit conform to MIL-R-10509C, characteristic B.

Corning Glass Works, Electronic Components Dept., Dept. ED, Bradford, Pa.

CIRCLE 160 ON READER-SERVICE CARD



### Microwave Tester Checks Stability

Designed to check the stability of radar systems components the Series 800 stalo tester operates in the frequency band of 1100 to 10,000 mc. An indicator unit, model 800, houses the measuring circuitry and power supplies. Two interchangeable units, models 801 and 802, are used to heterodyne the signal down to the input range of the indicator.

Pitometer Log Corp., Dept. ED, 237 Lafayette St., New York, N. Y.

CIRCLE 161 ON READER-SERVICE CARD



### Memory Stack Has 0.05 in. Cores

This memory stack has 0.05 in. memory cores and a density rate of about 3.5 million cores per cu ft. It consists of 2048 cores in a unit measuring 1 x 1.4 x 1.4 in. The unit is shown next to a conventional stack that is 50 times larger.

General Ceramics Corp., Applied Logics Div., Dept. ED, Kenilworth, N. J.

CIRCLE 162 ON READER-SERVICE CARD

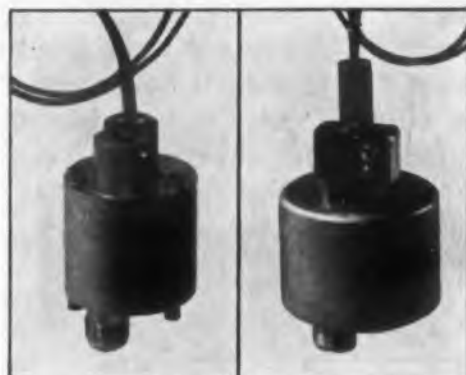
Circle 720-724 on Reader Service Card ▶

# Creative Microwave Technology

Published by MICROWAVE AND POWER TUBE DIVISION, RAYTHEON COMPANY, WALTHAM 54, MASS., Vol. 1, No. 5

## NEW RAYTHEON MICROWAVE TUBE DEVELOPMENTS

Miniature pulsed magnetrons for missile beacon applications are ruggedly constructed with integral magnets. The RK-7461 is tunable from 9,300 to 9,500 mc and has minimum peak power output of 60 watts. It is 1½" in diameter and 2½" long, and weighs only 6 ounces.



RK-7461

QK-735

The QK-735 is tunable from 5,400 to 5,900 mc with minimum peak power output of 400 watts. 1½" in diameter and 3¼" long, it weighs 8 ounces.

CIRCLE 720  
Reader Service Card

\* \* \*

Designed for electronic countermeasures and FM/CW operations, the QK-625 BWO provides a minimum CW power output of 180 watts and a nominal CW power output of 250 to 350 watts over the 2,500 to 3,000 mc band. The tube is voltage tunable over the entire range with tuning sensitivity of approximately 0.4 mc/volt. Liquid-cooled, the QK-625 BWO is equipped with an integral



permanent magnet, and can be mounted in any position.

CIRCLE 721  
Reader Service Card

\* \* \*

Small-signal gain of up to 35 db in microwave relay links is achieved by means of a new compact traveling wave tube amplifier -- the QK-542. This permanent-magnet focused CW tube has nominal saturated power output of 5 watts over 5,900 to 7,400 mc. An integral UG 344/U waveguide-type flange is supplied as standard. With an optional coaxial output coupler the QK-542 covers 4,000 to 8,000 mc.

CIRCLE 722  
Reader Service Card



Ideal for linear accelerators and high-power radar systems. The QK-783 and QK-622 Amplitrons operate over the 2,700-2,900 mc and 2,900-3,100 mc bands, respectively, at a peak power of 3 megawatts and a typical efficiency of 75%. Because no heater is required, these tubes are capable of exceptionally long life. RF gain is 8 db under rated conditions, and as high as 12 db at lower peak power outputs. Phase pushing figure is less than 0.5 degrees for a 1% variation of anode current.

CIRCLE 723  
Reader Service Card



\* \* \*

Compiled as a Raytheon service to the field, new Consolidated Data Booklet contains comprehensive information about principal unclassified magnetrons, klystrons, backward wave oscillators and special purpose tubes manufactured by Raytheon. Characteristics presented include maximum ratings, typical operating values, band or frequency ranges and other essential data for microwave engineers and purchasing departments.

CIRCLE 724  
Reader Service Card

A Leader in Creative Microwave Technology



RAYTHEON AT WESCON—BOOTHS 2131-2134

# Modular Antenna Pedestals

## Afford Rapid Interchangeability and Maintenance

**B**Y APPLYING the concept of modular design to pedestals used with radar antenna systems, parts replacement and inventory are greatly simplified for the user and lower cost with faster delivery are offered to the systems manufacturer.

The basic modular pedestal, developed by the Special Products Division of the I-T-E Circuit Breaker Co., Philadelphia, Pa., can

be adapted to support and drive antenna reflectors ranging in size from 12 to 60 ft for either land-based or sea-based operation.

### Module Construction

Basically, the pedestal consists of seven major components or modules—the base, rotary joint, gearbox, main turntable housing, motor, oil sump and junction box and synchro mechanism.

In addition, roll or pitch drives can be added to the pedestal to stabilize it in either or both planes for shipboard duty.

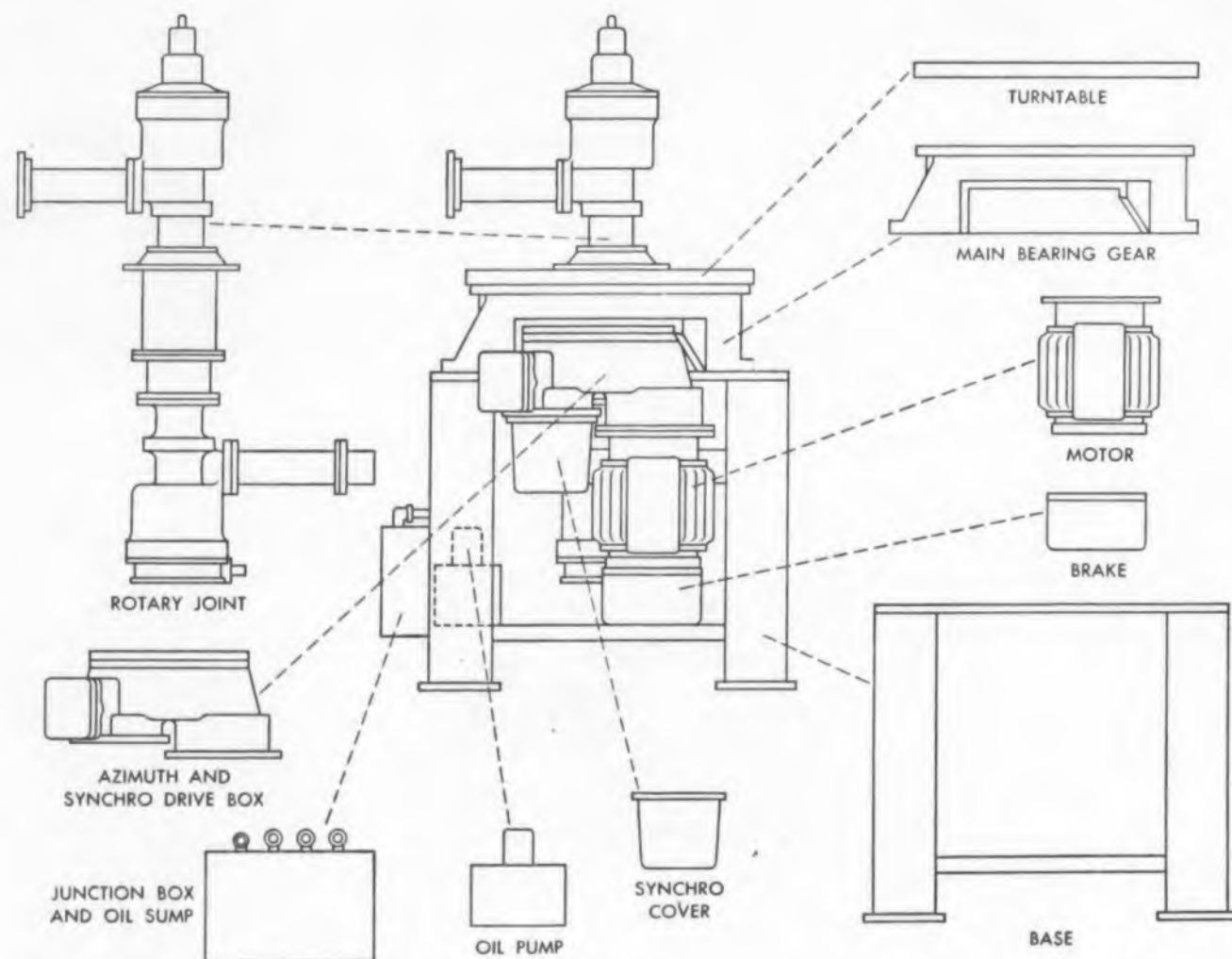
The modular pedestal differs from conventional pedestals in that each module is designed as a separate component to be fitted with other modules to form a working pedestal.

Since each module is a complete unit, any one can be easily replaced to change the pedestal to conform

to the needs of a new reflector. Either size or speed of rotation may be easily changed.

In each antenna system one pedestal module—the rotary joint which transmits radio frequency energy from the stationary waveguide supplying the antenna to the feed horn which illuminates the moving reflector—must be changed to match system frequency.

Each rotary joint is a self-con-



**Fig. 1.** One basic pedestal design can support and drive antenna reflectors ranging in size from 12 to 60 feet, cutting antenna system cost and delivery time. Shown is an exploded view of pedestal and modules, all independent units which can be removed without disturbing any other part of the pedestal.



**Fig. 2.** Basic simplicity of modules, illustrated by this compact, weatherproof gearbox, eliminates the large and difficult castings and intricate component design required to adapt conventional pedestals for a new antenna system.



**Fig. 3.** Rotary joint is changed easily by removing the four bolts which attach it to the antenna turntable flange.

lined weatherproof unit which can be removed by taking out the four bolts that attach it to the flange of the antenna base, making changes simple.

#### Advantages of Modular Pedestal Design

- Lower cost—Design and production problems are reduced by modular design, particularly when the pedestal must be adapted to fit a new reflector, providing savings of up to 10 per cent in the original cost of complete radar systems.

- Quick delivery—Adaptations of the basic pedestal do not have to be resubmitted for extensive life testing because they are made up of standard, proven components. This eliminates a three-month testing delay and \$50,000 in testing costs.

- Simple inventory—Most modules can be used interchangeably in any I-T-E modular pedestal, regardless of the differences in the radar, allowing a drastic cut in replacement parts stock without affecting availability.

The modular concept also aids maintenance personnel because they only need learn one basic design to become proficient in repairing and maintaining a wide variety of antenna pedestals.

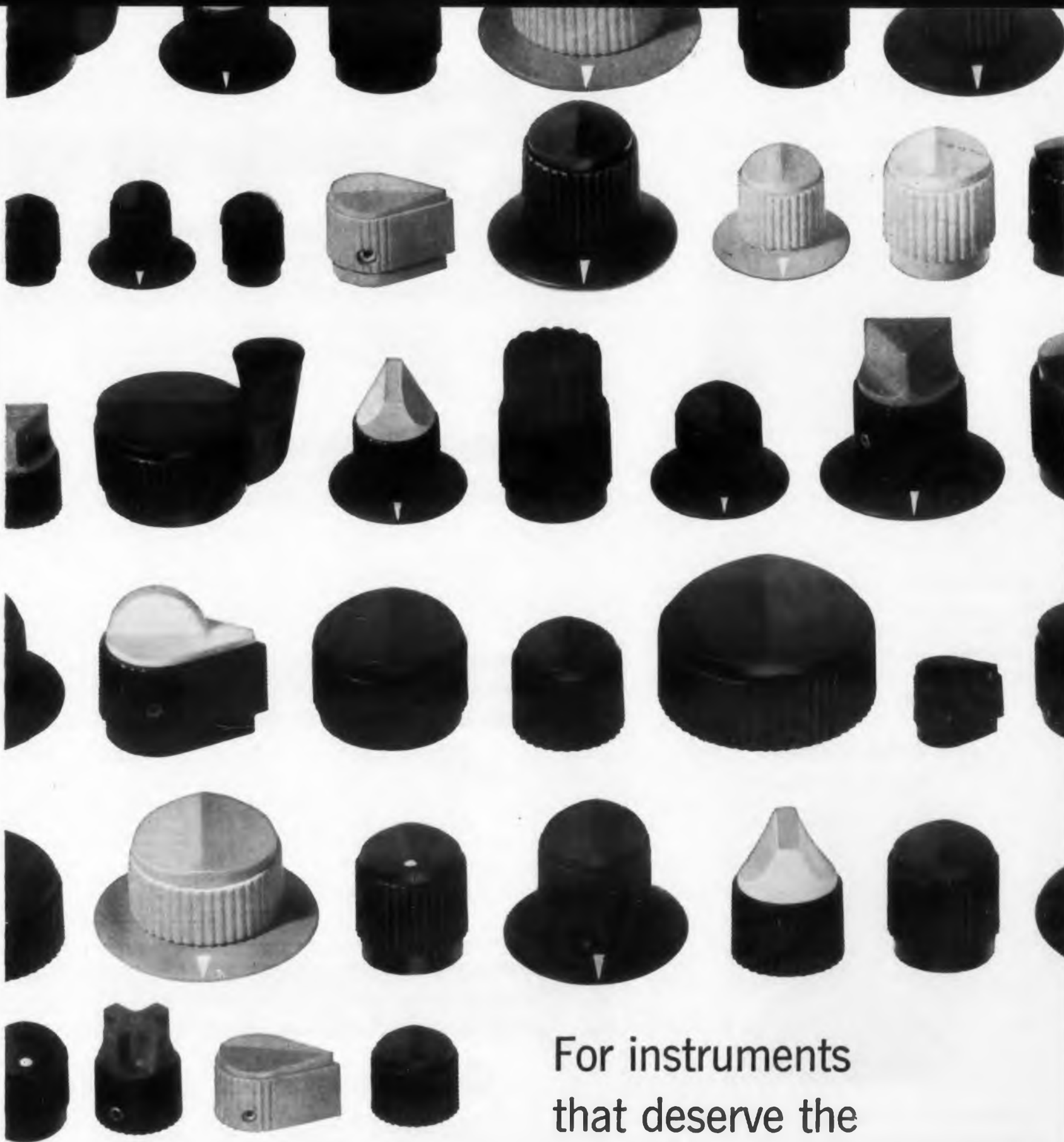
- Rapid maintenance—All modules can be removed without disturbing any other part of the pedestal, simplifying replacement of worn components or changeover to a new reflector.

Shipboard pedestals can be stabilized to compensate for the ship's roll which may be as high as 30 deg in heavy seas.

The modular pedestal serves another important function by cutting down topside weight. The I-T-E stabilization units add only 600 lb as opposed to 3000 lb needed for stabilization of conventional pedestals. The weight saving reduces the moment of inertia of the antennas which is extremely important since they are located on high positions on a ship.

For more information on this modular pedestal, turn to the Reader-Service Card and circle 103.

CIRCLE 164 ON READER-SERVICE CARD ➤  
ELECTRONIC DESIGN



*\*Seven styles in six sizes — tactile shapes, color and color caps—plus hundreds of modifications on special order.*



*Excellence in Electronics*

For instruments that deserve the precision engineered look—specify Raytheon knobs

194 styles\* in stock for immediate delivery.

Military or commercial applications. For further facts, write Dept. 6477, Raytheon Company, Industrial Apparatus Division, Waltham 54, Massachusetts.

RAYTHEON AT WESCON—BOOTHS 2131-2134

## NEW PRODUCTS

### Six-Channel Amplifier

For vibration test systems



Model 6006, a six-channel amplifier, consists of six independent amplifiers mounted on one chassis. Each amplifier is electrically identical with model 6000. Input impedance is 1600 meg and output impedance is 150 ohms. Variable gain is 100 max and noise level is 40  $\mu$ v max. The unit offers coarse and fine adjustment of gain, and a calibrator to normalize accelerometer sensitivities.

Columbia Research Laboratories, Dept, ED, MacDade Blvd. and Bullens Lane, Woodlyn, Pa.

CIRCLE 165 ON READER-SERVICE CARD

### Radar Antenna

Operates in X band



Designed for mobile use, the model 8340 X-band radar antenna can handle 300 kw of peak power. It operates over a frequency range of 8750 to 10,500 mc. The unit can accommodate reflectors up to 3 ft in diam and thus provides about 37 db gain at mid-band frequencies. It has one moving part. Standard polarization of the antenna feed is linear and is adjustable to any orientation. Models with circular polarization are also available.

Underwood Corp., Canoga Div., Dept. ED, 15330 Oxnard St., Van Nuys, Calif.

CIRCLE 166 ON READER-SERVICE CARD

# 5 EXCITING NEW SILICON TRANSISTOR

## 1. HI-POWER STUD-MOUNTED SILICON TRANSISTOR



Type	V <sub>cb</sub> Max. Volts	I <sub>c</sub> max. Amps	B Typical	R <sub>cs</sub> Typical (Ohms)
2N1208	60	5	35	1.5
2N1209	45	5	40	1.5
2N1212	60	5	25	2.5

**APPLICATIONS** Regulated Power Supplies . . . High Current Switching . . . High Frequency Power Amplifiers

Send for Bulletin No. 1355M

## 2. CORE SWITCH



Type	V <sub>cb</sub> Max. Volts	(B) Min.	Typ. Input Voltage (Volts)	Typ. Saturation Resistance (Ohms)	Switching Characteristics ( $\mu$ sec)
ST4100	60	15	2.5	10	t <sub>r</sub> .2
					t <sub>b</sub> .2
					t <sub>f</sub> .2

**APPLICATIONS** . . . magnetic core memory . . . high level multivibrators . . . buffer amplifiers . . . clock source

Send for bulletin 1355X

## 3. 150mc VERY HIGH FREQUENCY TRANSISTOR



TYPE  
2N1139

		Min.	Typical	Max.	Test Conditions
D.C. Current Gain	h <sub>FE</sub>	20	40	—	I <sub>C</sub> = 10ma, V <sub>CE</sub> = 10V
D.C. Collector Saturation Voltage	V <sub>CE</sub>	—	.5	0.7V	I <sub>C</sub> = 10ma, I <sub>B</sub> = 1ma
Collector Cutoff Current	I <sub>CO</sub>	—	2	5 $\mu$ a	V <sub>CB</sub> = Rating
Output Capacitance	C <sub>ob</sub>	—	8	12 $\mu$ af	V <sub>CB</sub> = 10V, I <sub>E</sub> = 0 mA
High Frequency Current Gain	h <sub>fe</sub>	5	7.5	—	F = 20mc, V <sub>CE</sub> = 10V I <sub>E</sub> = 10 mA
Delay Time	t <sub>d</sub>	—	6	—	m $\mu$ sec.
Rise Time	t <sub>r</sub>	—	12	—	m $\mu$ sec.
Fall Time	t <sub>f</sub>	—	10	—	m $\mu$ sec.

Send for bulletin TE1355 B2

## 4. UNIVERSAL 50mc LOGIC TRANSISTOR



Type	Typ. Alpha Cutoff (Mc)	Beta Typical	C <sub>D</sub> (Typical) ( $\mu$ af)	Max. (Volts)	Typ. Saturation Resistance (ohms)
ST3031	70	50	2	20	40

**APPLICATIONS** . . . flip-flops . . . IF and video amplifiers . . . transistor logic . . . pulse amplifiers

Send for bulletin 1353X

## 5. STABISTOR COUPLED LOGIC TRANSISTOR



Type	Beta Typical	V <sub>c</sub> max. (Volts)	Typical Saturation Resistance (ohms)	Typ. Alpha Cutoff (Mc)	Switching Characteristics ( $\mu$ sec)
ST3030	12	15	40	50	t <sub>r</sub> .05
					t <sub>b</sub> .20
					t <sub>f</sub> .10

**APPLICATIONS** . . . designed specifically for SCTL and DCTL circuits (write for descriptive paper on SCTL)

Send for Bulletin 1357



# DEVELOPMENTS FROM TRANSITRON... added to

**THE INDUSTRY'S  
MOST COMPLETE  
LINE**

## SILICON TRANSISTORS

JAN TRANSISTOR	Minimum Current Gain (β)	Maximum Collector Voltage (Volts)	Typical Cut-off Frequency (Mc)	Maximum $I_{CO}$ @ 25°C and $V_C$ Max. (μa)	FEATURES
JAN-2N118	10	30	10	1	• Only Jan Silicon Transistor

SMALL SIGNAL	Minimum Current Gain (β)	Maximum Collector Voltage (Volts)	Typical Cut-off Frequency (Mc)	Maximum $I_{CO}$ @ 25°C and $V_C$ Max. (μa)	FEATURES
2N333	18	45	7	50	• Low $I_{CO}$ • Operation to 175°C • 200 mw Power Dissipation
2N335	37	45	10	50	
2N480	40	45	11	.5	
2N543	80	45	15	.5	
ST905	36	30	10	10	

HIGH SPEED SWITCHING	Typical Cut-off Freq. (Mc)	Maximum Collector Voltage (Volts)	Maximum Collection Saturation Resistance (ohms)	Max. Power Dissipation @ 100°C ambient (mw)	FEATURES
ST3030	50	15	60	50	• High Frequency Operation • Low Saturation Resistance • Low $I_{CO}$
ST3031	70	20	65	50	
2N1139	150	15	70	500	
2N337	20	45	150	50	
2N338	30	45	150	50	

MEDIUM POWER	Max. Power Dissipation @ 25°C Case (Watts)	Maximum Collector Voltage (Volts)	Minimum DC Current Gain (β)	Typical Rise Time (μsec)	Typical Storage and Fall Time (μsec)	FEATURES
ST4100	5	60	15	.2	.4	• Fast Switching • High $V_C$ • Rugged Construction
2N545	5	60	15	.3	.5	
2N547	5	60	20			
2N498	4	100	12			
2N551	5	60	20			
2N1140	1	40	20	.2	.2	

HIGH POWER	Maximum Power Dissipation @ 25°C Case (Watts)	Minimum DC Current Gain (β)	Typical Collector Saturation Resistance (Ohms)	Maximum Collector Voltage (Volts)	FEATURES
ST400	85	15 @ 2 Amps	1.5	60	• High Current Handling Ability • Low Saturation Resistance • Rugged Construction
2N389	85	12 @ 1 Amp.	3.5	60	
2N424	85	12 @ 1 Amp.	6.0	80	
2N1208	85	15 @ 2 Amps	1.5	60	
2N1209	85	20 @ 2 Amps	1.5	45	
2N1212	85	12 @ 1 Amp.	2.5	60	

Write for Bulletins: TE-1353 and TE-1355

Your local authorized TRANSITRON DISTRIBUTOR now carries in-stock inventories for immediate delivery.

# Transitron

electronic corporation • wakefield, massachusetts



"Leadership in Semiconductors"

VISIT OUR WESCON BOOTHS, NOS. 3002 — 3004

## Shunt Motor

Has speeds up to 25,000 rpm

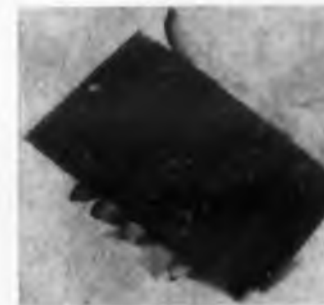


Model 74-015 reversible shunt motor is available at speeds up to 25,000 rpm and torques up to 2000 oz-in. Under varying loads, there is a change in motor speeds of less than 1% through the temperature range from -65 to +450 F. This motor has three lead connections and rapidly responds to varied torque loading.

Hydro-Aire Co., Dept. ED, 3000 Winona Ave., Burbank, Calif.

CIRCLE 168 ON READER-SERVICE CARD

## Inverters Transistorized



These three types of transistorized inverters are available: the gate driven inverter, GDI, driven from gating circuitry and providing total output current of 16 to 26 ma depending on driving currents; the power driven inverter, PDI, driven by a gate driven inverter or other power source and providing 33 ma output with 3.5 ma drive; and the heavy duty inverter, HDI, driven from a power source and providing 77 ma output with 13 ma drive. 75 to 80% of the output current drives gating AND circuits; the balance drives OR circuits. The printed circuit logic cards use germanium diodes and transistors rated to operate at ambient temp up to 65 C. The circuits operate at nominal input signal levels of 0 and -6 v, with passive diode logic. Operating frequency is from dc to 500 kc.

Digitronics Corp., Dept. ED, Albertson Ave., Albertson, L.I., N.Y.

CIRCLE 169 ON READER-SERVICE CARD

CIRCLE 167 ON READER-SERVICE CARD

# DOES <sup>specialized</sup> BUSINESS PUBLICATION ADVERTISING HELP SALESMEN?



Jack Hegarty  
Texas Instruments  
Incorporated  
sells to industry

says Mr. Hegarty:

No one is in a better position to give a hard-boiled, practical answer to this question than the men who spend their working lives on the sales front...the men the ads are supposed to help...the men who sell.

Here is the statement of a salesman who knows what advertising does for him when it appears in the industrial, trade or professional publications that serve the specialized markets to which he sells:

"I sell semiconductors and other components to original equipment manufacturers in the electronics field. With the tremendous expansion in the electronic industry today, one of our problems is prompt coverage of the market when a new or improved device is announced. I can contact all my larger accounts within a few days, but it takes considerable time to cover the many smaller accounts.

"That's one of the reasons I think our advertising in business publications is so important. It covers all my prospects, large and small, and gets the story of our products to all three groups that can influence purchases—the engineers, the purchasing agents and top management. In some accounts 50 or 60 engineers will attend a meeting. However, there are still many decision-making personnel who can't attend because of other demands on their time. But I know that they will get our story from our advertising.

"On cold calls, many times my selling effort is greatly assisted by the 'pre-selling' of our advertising and it seems to me that advertising often gets me an entree at a higher level than I can usually get on cold calls.

"It helps in other ways, too. For instance, we get inquiries for applications and devices that haven't been developed by our company. Prospects read the advertising, get clues, then contact us. In one case we ran an ad that basically showed a specification sheet on a new component. On one inquiry I followed up, the engineer had the magazine open on his desk right at our ad. He asked me, 'Can you meet this spec?' It was different—but, by some specialized design work, something we could do. I secured a first release order for over \$70,000 just from this one inquiry.

"While my division of our corporation had first established its name in the industry on the basis of its work in semiconductors, we also manufacture many other components. They are in competition with units of companies longer established than we are. Here our advertising helps establish our name as a progressive company with a dependable reputation, good to deal with."

Ask your own salesmen what your company's business publication advertising does for them. If their answers are generally favorable, you can be sure that it is really helping them sell. If too many answers are negative, it could well pay you to review your advertising objectives—and to make sure the publications that carry your advertising are read by the men who must be sold.

## How salesmen use their companies' advertising to get more business

Here's a useful package of ideas for the sales manager, advertising manager or agency man who would like to get more horsepower out of his advertising. Send for a free copy of the pocket size booklet which reports the successful methods employed by eleven salesmen who tell how they get more value out of their companies' business publication advertising.

HOW  
SALESMEN  
USE  
BUSINESS  
PUBLICATION  
ADVERTISING  
IN THEIR  
SELLING

You can be sure that more of your salesmen will use your advertising after they read how others get business through these simple methods.

The coupon is for your convenience in sending for your free copy.

## NATIONAL BUSINESS PUBLICATIONS, INC.



... each of which serves a specialized market in a specific industry, trade or profession.

### NATIONAL BUSINESS PUBLICATIONS, INC.

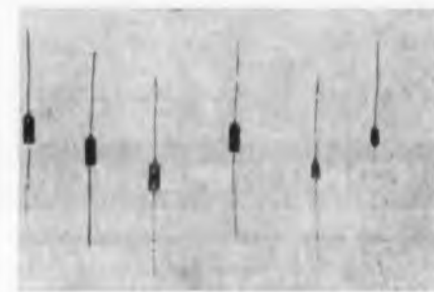
Department 12D  
1413 K Street, N. W.  
Washington 5, D. C. STerling 3-7533  
Please send me a free copy of the NBP booklet  
"How Salesmen Use Business Publication  
Advertising in Their Selling."

Name \_\_\_\_\_  
Title \_\_\_\_\_  
Company \_\_\_\_\_  
Street Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

## NEW PRODUCTS

### Electrolyte Tantalum Capacitors

Ratings of 0.68 to 22  $\mu$ f



This line of solid electrolyte tantalum capacitors has ratings of 0.68 to 22  $\mu$ f, 6 to 50 v dc. Tolerance is  $\pm 20\%$  in uninsulated cases and  $\pm 10\%$  in insulated cases. Two case sizes are available: 0.125 x 0.25 in. and 0.175 x 0.438 in. Made for use in military electronic equipment, they also have television and computer applications.

General Electric, Dept. ED, Schenectady 5, N. Y.

CIRCLE 170 ON READER-SERVICE CARD

### Rotary Transducer

Linear range is  $\pm 45$  deg



Having a linear range of  $\pm 45$  deg, the model RMT-11504 rotary transducer features 3-wire, half-bridge, variable reluctance construction. Its linearity is 0.5%. Specifications include: excitation, 24 v at 400 cps; output, 5.45 mv per v per deg; null voltage, 1 mv per v; phase shift, less than 5 deg; operating temperature range,  $-65$  to  $+225$  F. The unit weighs 7 oz and measures 1.75 x 1.313 in. It can be had in a wide variety of packages and with various electrical specifications.

G. L. Collins Corp., Dept. ED, 2820 E. Hullett St., Long Beach 5, Calif.

CIRCLE 171 ON READER-SERVICE CARD

### Logic Circuit

On plug-in cards



Series 2010, a complete and compatible set of transistor operated, digital logic circuits on plug-

in cards, operates at data rates in the 200 kc range. The circuits include flip-flops, gating circuits, pulse generators, power amplifiers, and multivibrators which operate over a temperature range of -30 to +55 C and are mounted on glass-epoxy base material. Types 2010-LO, opaque, and 2010-LT, translucent, standard wiring layout sheets are available for laying out the intercard wiring diagram. Made for use with the circuits, model 2010-SU power supply can operate up to 125 plug-ins. It is fused for both line and load.

Rese Engineering, Inc., Dept. ED, 731 Arch St., Philadelphia 6, Pa.

CIRCLE 172 ON READER-SERVICE CARD

### Circulator

Operated at 1 megawatt peak



Model CXL 200 four-port circulator operates at a power level of 1 megawatt peak, 1000 w avg over the frequency range of 8.5 to 9.6 kmc, and provides isolation greater than 20 db with an insertion loss of less than 0.5 db. Ambient temperature range is -55 to +100 C; pressurization is -30 psi gage; and waveguide length is 12-7/8 in. with a weight of 3-3/4 lb. Provision for liquid cooling is provided for operation at maximum rated power level.

Rantec Corp., Dept. ED, Calabasas, Calif.

CIRCLE 173 ON READER-SERVICE CARD

### Pulse Generator

Transistorized



This completely transistorized pulse generator has less than 2 w power drain. Short circuit proof 15 v positive and negative pulse outputs are provided with separately controlled amplitudes. Pulse width can be varied from 0.5 to 100  $\mu$ sec with a rise time less than 0.1  $\mu$ sec. Repetition rate can be continuously varied between 20 and 5000 pps and provision for an external synchronization source is included. Output pulse delays of up to 100  $\mu$ sec and anticipation up to 10  $\mu$ sec are also provided.

Solidyne, Dept. ED, 7460 Girard Ave., La Jolla, Calif.

CIRCLE 174 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 19, 1959

## Developing capacitors for unusual situations your job...and Centralab's

# Centralab

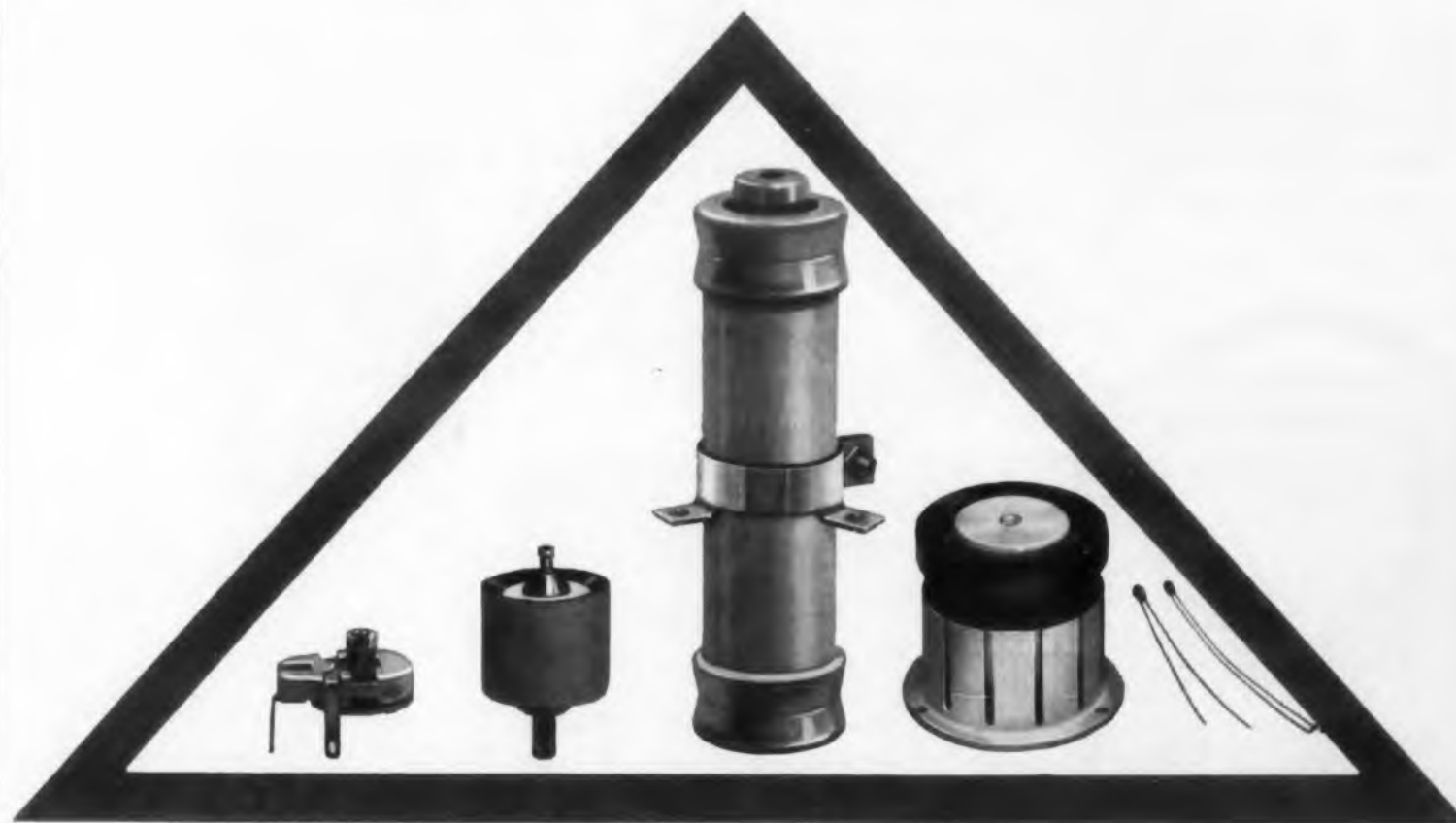
## CERAMIC CAPACITORS

### for difficult applications

Ceramic capacitors have almost unlimited capabilities... but utilizing their full potential demands expert knowledge *not bound to conventional approaches*. Creative engineering, involving new concepts and new techniques, can broaden your design horizons.

That kind of creative engineering is a CENTRALAB specialty. As specialists in ceramic capacitors, CENTRALAB engineers have developed units to

meet an enormous variety of difficult size and rating requirements beyond the scope of oil, mica or vacuum capacitors. The unusual designs illustrated here are typical of CENTRALAB's answers to the problems no-one else could solve. A representative group of additional specialized units are described in Bulletin #42-719. Request your free copy of this bulletin today; it will stimulate your thinking towards making full use of the design potential of ceramic capacitors.



**Variable Capacitors**  
600VDCW, capacity ranges to 250 mmf. Compact construction, 1 1/8" wide, 1 1/8" long, 1/8" deep overall. Temperature compensating units NPO, N650 are standard. Other temperature characteristics available on special order.

**Precision Temperature Compensating Capacitors**  
Hermetically sealed, T.C.  $\pm$  10 PPM, capacity tolerance  $\pm$  1%. Outer shell grounded. Available in 50-3500 mmf range in NPO. Other T.C. ratings proportional.

**High Voltage Capacitor**  
12KVDCW, 2000 mmf; 30 amps at 30 mc. Unit is 6" long, 2" O.D. Extremely flexible design—can be made to a wide range of dimensions and ratings. Units that operate at 125°C. without derating can be designed.

**DC Blocking Capacitor**  
10KVDCW, 1700 mmf  $\pm$  10%; 12 amps at 4 mc, 80 amps at 30 mc. Measures only 4" high and 4" O.D. at base. Ideal for restricted space, high reliability applications. Can be used in parallel to handle large loads.

**Ultra-Miniature Capacitor**  
3VDCW, .01 mmf G.M.V. Capacity change  $\pm$  10% to  $\pm$  85°C., 25% maximum. Approximately 1/8" diameter. For transistor, coupling, by-pass, cathode and other low voltage, high capacity applications.

# Centralab

D-5947

A Division of Globe-Union Inc.  
960 H.E. KEEFE AVE. • MILWAUKEE 1, WIS.  
In Canada: 669 Bayview Ave., Toronto 17, Ont.

VARIABLE RESISTORS • ELECTRONIC SWITCHES • PACKAGED ELECTRONIC CIRCUITS • CERAMIC CAPACITORS • ENGINEERED CERAMICS

CIRCLE 175 ON READER-SERVICE CARD

R.F.I.

SCHUYLERNIT

End RFI Shielding problems with SCHUYLERNIT Standard RFI Shielding Strips and gaskets. These strips are available in continuous lengths and meet the exact requirements of most RFI gasketing problems. SCHUYLERNIT Shielding Strips come in Monel, Aluminum, and Silver-plated Brass. Ask our technical department for engineering assistance on other than Standard Shielding Strips. RFI Shielding Strips are made of a resilient metallic structure with maximum conductivity for continuous contact between uneven mating surfaces. Write today for SCHUYLERNIT complete illustrated RFI Shielding Manual.

\*Radio Frequency Interference  
specialists in RFI shielding

FOR QUICK  
REFERENCE:  
SEE PAGE 477  
EM CAT. (1959)

SCHUYLER

SCHUYLER MANUFACTURING CORP. 84 Porete Ave., No. Arlington, New Jersey  
CIRCLE 176 ON READER-SERVICE CARD



### NEW... DIRECT-READING TRANSISTOR TEST SET MEASURES

$\beta$  in ranges of 0 to 30/100/300  
 $\left. \begin{matrix} h_{11} \\ h_{1e} \end{matrix} \right\} 0.5 \text{ to } 20 \text{ K at } 1 \text{ KC}$   
 $I_{co}$  0 to 50 microamperes  
 $I_e$  0 to 3/10/30 milliamperes

Quickly and accurately the new Metronix Model 545-B Transistor Test Set measures all the essential parameters of transistor performance and gives a direct presentation of the test data.

This versatile instrument can be operated either on its own 5.2-volt collector voltage supply or on any externally supplied potential up to 50 volts DC... can accommodate a wide test frequency range of from 200 cps to 50 kc... has an output jack to permit oscilloscope display of AC collector waveforms. And it's fully protected against meter overload.

Price \$225.00, f.o.b. factory.  
Call or write for Specification Sheet No. 545-B

Metronix INC

A SUBSIDIARY OF  
**ASSEMBLY PRODUCTS, INC.**  
Chesterland 17, Ohio

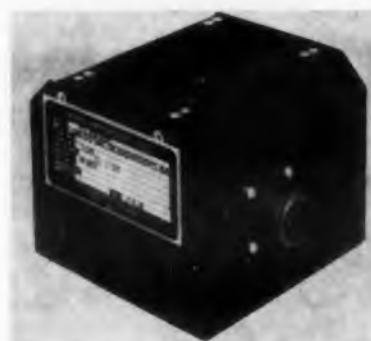
api  
S.A. 2088

CIRCLE 177 ON READER-SERVICE CARD

## NEW PRODUCTS

### Transformer Rectifier

Weighs less than 3 lb



Weighing less than 3 lb, the W-1401 transformer rectifier can deliver 8 amp with an input of 108 to 122 v, single phase, at 400 cps. The output voltage is between 21 and 29 v. Maximum ripple is 5% and the efficiency is 85%. The unit will operate continuously for more than 5000 hr. Silicon diodes are used.

Electrosolids Corp., Dept. ED, 13745 Saticoy St., Panorama City, Calif.

CIRCLE 178 ON READER-SERVICE CARD



### Digital Systems Modules

Operate to 300 kc

The 300 series of transistorized digital systems modules operate to 300 kc in ambient temperatures from 0 to +135 F. The module is a 5 x 6 in. glass-epoxy printed circuit board, with an 18 pin printed circuit tab having nickel-plated contacts. Modules include: crystal controlled pulse generators, pulse delays, one-shot multivibrators, flip-flops, shift registers, binary counters, reversible binary counters, pulse sorters, pulse amplifiers, pulse standardizers, and amplifiers.

Navigation Computer Corp., Dept. ED, 1621 Snyder Ave., Philadelphia 45, Pa.

CIRCLE 179 ON READER-SERVICE CARD

### Solder-Clad Stampings

For ohmic junctions

These solder-clad stampings are used in making ohmic junctions for germanium or silicon junction transistor triodes. These stampings consist of a layer of solder alloy bonded to a base

# GUARD YOUR FAMILY



# FIGHT

# CANCER WITH A CHECKUP AND A CHECK

Send your gift to "CANCER"  
In care of your local post office  
**AMERICAN CANCER SOCIETY**

**RAPID,  
ECONOMICAL,  
NON-DESTRUCTIVE  
TESTING OF  
COMPONENTS  
AND INSULATION**

Two MEGPOT® models offer a choice of instruments: a high potential test set and megohm-meter, or the high potential test set alone. The combination unit quickly and efficiently tests components and insulation... provides non-destructive testing with current limiting circuit, voltage range 0-3000V AC, 0-5000V AC, or other if specified. Voltage read directly across output leads. As megohm-meter, Megpot features 10 million megohms at 100, or 200 and 500V DC.



MEGPOT MODEL 573 provides all the efficiency, convenience and speed for high potential testing of components or complete assemblies, but without the megohm-meter, resulting in even more compactness and economy. Both models are self-contained, attractively housed and easily portable.



The MEGPOT substantially reduces the cost of testing components and complete assemblies!  
Write for Megpot specifications now

**GENERAL  
HERMETIC  
SEALING**  
ELECTRONICS FOR  
LAND, SEA AND SPACE CORPORATION  
Valley Stream, N. Y. • Valley Stream 5-6363

CIRCLE 181 ON READER-SERVICE CARD  
ELECTRONIC DESIGN • August 19, 1959

tab conductor such as nickel or nickel-iron alloys. They are available in diameters from 0.03 to 2 in. OD, in thicknesses from 0.002 to 0.01 in.

Accurate Specialties Co., Inc., Dept. ED, 37-11 57 St., Woodside 77, N.Y.

CIRCLE 182 ON READER-SERVICE CARD

**Frequency Selective Voltmeter**

300 cps to 400 kc range



Model 2174A voltmeter makes amplitude measurements through the frequency range of 300 cps to 400 kc. It employs the heterodyne principle with balanced modulation. The instrument is available with a 50 or 100 cycle crystal filter. A 3 kc crystal filter and demodulator are provided for monitoring single sideband speech or tone signals. Amplitude and fm monitoring are also provided. Indicating levels are from -80 to +32 dbm with accuracies of  $\pm 0.5$  db. A portable carrying case is supplied; total weight is 28 lb.

Rycom Instruments, Dept. ED, 9351 E. 59 St., Raytown 33, Mo.

CIRCLE 183 ON READER-SERVICE CARD

**Magnetic Triggers**

Used with silicon controlled rectifiers



Designed for use with the C35 or equivalent silicon controlled rectifiers, the model 410 series of full wave magnetic triggers has an operating range of 50 to 400 cps. Its volume is less than 31.5 cu in. and it weighs less than 43 oz. The unit is insensitive to line transients such as switching surges, commutator noise and capacitance to ground.

ACF Industries, Inc., Avion Div., Dept. ED, 11 Park Place, Paramus, N. J.

CIRCLE 184 ON READER-SERVICE CARD

LEFT: STUD 7/16-11/16  
CENTER: AXIAL LEAD TOP MOUNT  
RIGHT: STUD INSULATED

COLUMBUS ELECTRONICS CORPORATION  
DOUBLE DIFFUSED SILICON RECTIFIERS  
COLUMBUS ELECTRONICS CORPORATION  
DOUBLE DIFFUSED SILICON RECTIFIERS  
COLUMBUS ELECTRONICS CORPORATION  
DOUBLE DIFFUSED SILICON RECTIFIERS  
COLUMBUS ELECTRONICS CORPORATION  
DOUBLE DIFFUSED SILICON RECTIFIERS  
COLUMBUS ELECTRONICS CORPORATION  
DOUBLE DIFFUSED SILICON RECTIFIERS  
COLUMBUS ELECTRONICS CORPORATION  
DOUBLE DIFFUSED SILICON RECTIFIERS  
COLUMBUS ELECTRONICS CORPORATION  
DOUBLE DIFFUSED SILICON RECTIFIERS  
COLUMBUS ELECTRONICS CORPORATION  
DOUBLE DIFFUSED SILICON RECTIFIERS



Now... an extensive line of  
high performance, hermetically sealed,  
silicon power rectifiers UP TO 35 AMPS.  
JEDEC types exceeding MIL specifications.

**NEW**

SINGLE unit VERY HIGH VOLTAGE silicon rectifiers exhibiting these desirable characteristics...

HIGH VOLTAGE  
up to 2000 PIV

LOW FORWARD DROP  
1.5 Volts, DC

EXTREMELY LOW LEAKAGE  
1  $\mu$ A

FORWARD CURRENT  
up to 20 Amps.

**NEW**

INSULATED STUD silicon rectifiers offering these quality features...

- Simplify mounting
- Save assembly parts & costs
- Obtain efficient heat transfer
- Give greater design flexibility

AVAILABLE UP TO 10 AMPS PER UNIT AND UP TO 2000 VOLTS PIV.

WRITE FOR FULL DETAILS

**COLUMBUS ELECTRONICS CORP.**

1010 SAW MILL RIVER RD., YONKERS, N. Y.  
YONKERS 8-1221 • TWX-Yonkers, NY-1369

CIRCLE 185 ON READER-SERVICE CARD

# FIRST

## Miniature 10 amp relay

Only the new 1.1 oz. Babcock BR-7 Relay permits contact loads from dry circuit conditions to 10 amperes, satisfying virtually all MIL-SPEC aircraft and missile requirements for DPDT relays. One miniature size, with 0.2" grid spaced header for interchangeability. Over 300,000 miss-free operations at 10 amps, 25° C. Complete header arrangements, mounting methods and special mountings available. For technical bulletin, write BABCOCK RELAYS, INC., 1640 Monrovia Ave., Costa Mesa, California.

### BR-7 SPECIFICATIONS:

Meets Mil R5757C and Mil R25018.

VIBRATION: 30g. 10-2000 cycles • SHOCK: 50g. 11 millise. • DIEL. STR.: 1250 V • INSUL. RES.: 10,000 MΩ. • LIFE: 100,000 operations min. @125° C to Mil R5757C • TEMP. RANGE: -65° C to +125° C • DUTY: Continuous

CONTACT RATING: BR-7X: 10 amp. resistive, 28 V DC or 110 V AC; Derate 50% for inductive loads. cuit to 2 amp. Derate 50% for inductive loads.

OVERLOAD RATING: 25 amp. min. for BR-7X • CONTACT ARRANGEMENT: DPDT or SPDT • MAX. COIL DISSIPATION: 3 watts • MIN. PULL-IN POWER: 80 mw to 500 mw • OPERATE & RELEASE TIME: 7 millise. max. • NORMAL ADJUSTMENT (Max. Diff.): Drop-out, 10% of pull-in • SPECIAL ADJUSTMENT: (Min. Diff.): Drop out, 40% of pull-in • WEIGHT: 1.1 oz.

Available for AC or DC coil operation.

Other miniature Babcock Relays include the versatile, reliable BR-3 crystal can and BR-1, BR-3 series. Write for complete details.

BABCOCK RELAYS, INC., Costa Mesa, California

CIRCLE 186 ON READER-SERVICE CARD

## NEW PRODUCTS

### Transistor Transformers

Are 0.6 in. in diam and 13/16 in. high

Supplied with glass seal turret terminals, these transistor transformers are 0.6 in. in diam and 13/16 in. high. They are hermetically sealed and meet MIL-T-27A, Grade 4, Class R, 10,000 hr life. Designed for clamp mounting, they may also be obtained with a 4-40 stud.

Microtran Co., Inc., Dept. ED, 145 E. Mineola Ave., Valley Stream, N.Y.

CIRCLE 187 ON READER-SERVICE CARD

### RF Voltage Calibrator

Accuracy is 0.3%



The model RFVC true rms rf voltage calibrator has an accuracy of 0.3% of full scale. It can be used to check vtvm's, oscillators, signal generators and similar apparatus at frequencies from dc to 10 mc. The unit provides four true rms voltage output ranges for vtvm calibrations between 2 mv and 3 v. Power required: 90 to 130 v ac, 25 va.

Sensitive Research Instrument Corp., Dept. ED, 310 Main St., New Rochelle, N. Y.

CIRCLE 188 ON READER-SERVICE CARD

### Voltage Comparator

Weights 10 oz

Using a combination of silicon and germanium transistors, this go/no-go voltage comparator measures 1-7/8 x 1-7/8 x 4 in. Go conditions result in the closure of a relay with dpdt contacts available for external connection. Its input impedance is 1 meg; detectable differences are 8 mv dc and 3 mv ac rms. Connections are by a 14-pin miniature plug. It requires 115 to 125 v ac, 60 or 400 cps.

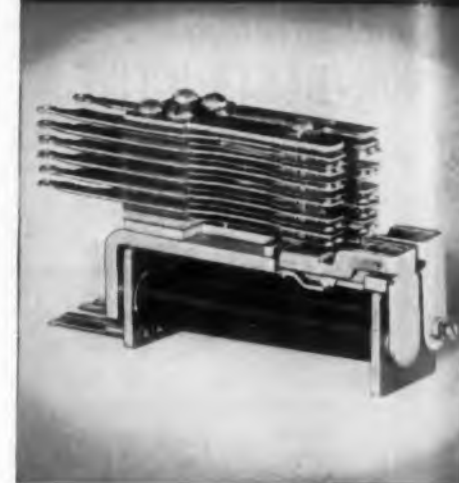
Optimized Devices, Inc., Dept. ED, 864 Franklin Ave., Thornwood, N.Y.

CIRCLE 189 ON READER-SERVICE CARD

## Stromberg-Carlson

"TELEPHONE QUALITY"

## Relays



... available immediately for any part of your operation that depends on electromechanical switching.

Proven by many years of meeting the exacting requirements of the telephone industry, these twin-contact relays of unsurpassed reliability are available in many types. The following are representative:

**Type A:** general-purpose relay with up to 20 Form "A" spring combinations. This relay is excellent for switching operations.

**Type B:** a gang-type relay with up to 60 Form "A" spring combinations. **Type BB** relay accommodates up to 100 Form "A" springs.

**Type C** (illustrated): two relays on the same frame. A "must" where space is at a premium.

**Type E:** has the characteristics of Type A relay, plus universal mounting arrangement. Interchangeable with many other makes.

Complete details and specifications on all Stromberg-Carlson relays are contained in our *new relay catalog*. Contents include: spring combinations, table of equivalents, contact data, variations and special features, plus complete mounting and cover information.

The catalog is available on request.

## STROMBERG-CARLSON

A DIVISION OF GENERAL DYNAMICS CORPORATION

Telecommunication Industrial Sales  
116 Carlson Rd. • Rochester 3, N. Y.



CIRCLE 190 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 19, 1959

## Resistance Network

Used with ac analog computer



This resistance network is designed for ac analog computer applications. A typical unit contains 6 ac matched resistors, up to 2 meg each, in less than 2.5 cu in. and weighs less than 2.5 lb. Resistors of approximately equal value can be matched to better than 0.005% over a temperature range of -15 to +65 C. The reactive match at 400 cps can be held as close as 20  $\mu$ v per volt for a six-resistor network. The unit is fully encapsulated.

The Daven Co., Dept. ED, Livingston, N.J.

CIRCLE 191 ON READER-SERVICE CARD

## Latch Relays

Open and enclosed types



Designed for use in circuits where a sustained relay closure is required, this series of latching relays is available with up to 6pdt contacts for the RL open types and up to 5pdt for the RLP enclosed type. Operating voltages are from 6 to 230 v ac and from 2 to 110 v dc. Coil wattage is 2.7 to 4 w; coil resistance is 2.1 to 5000 ohms for ac and 200 to 2000 ohms for dc. Models with silver contacts are rated at 5 amp and silver cadmium oxide contacts, 10 amp. All loads contacts are gold flashed.

Line Electric Co., Dept. ED, 271 S. Sixth St., Newark 3, N.J.

CIRCLE 192 ON READER-SERVICE CARD

CIRCLE 193 ON READER-SERVICE CARD

# THE BIG LOOK



2½-inch size

**ACTUAL SIZE**—Although they look bigger, these a-c and d-c units are actually 2½- and 3½-inch sizes. Mounting is interchangeable with JAN, MIL and ASA (round) specifications. *Widest range of scales and face-plate colors are available.*



3½-inch size

## General Electric small panel meters

BIG LOOK styling of General Electric's new small panel meters adds *functional beauty* to your products and equipment. Distinctive design creates the illusion of bigness, yet these new meters fit into the same panel space as old style meters. You get big border-to-border scale . . . *modern, clean-line design* . . . *your choice of seven attractive colors* . . . and widest selection of scales.

Up to 28% longer scales allow accurate readings. Tough neoprene gaskets provide *complete protection* of internal parts and movements from dirt, dust or water. Best of all, General Electric BIG LOOK meters are *competitively priced*. And you can plan on *fast delivery*, too, from a national network of authorized stocking distributors and G-E Apparatus Sales Offices.

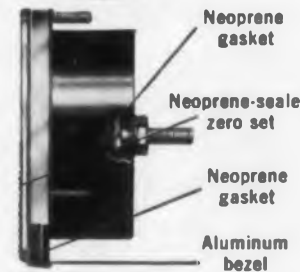
Let G.E.'s BIG LOOK in panel meters help you improve the appearance and reliability of your equipment at low cost. Get the full story. Just contact your G-E Apparatus Sales Engineer, or write for bulletin GEA-6678, Sect. 593-303, General Electric Co., Schenectady, N. Y.



**SELF-SHIELDED CORE-MAGNET**, used in d-c milliammeters below 5 MA and all microammeters, permits mounting of meters on magnetic or non-magnetic panels without special calibration.



**ALL A-C METERS** utilize moving-iron mechanisms—plus magnetic damping to settle the pointer quickly and accurately.



**COMPLETELY SEALED CASES** protect internal parts of instrument from harmful contaminants. Even zero-set is sealed with a neoprene O-ring.

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

# Editorial Critique



*Electronic Design* is getting a thorough going over . . . The scene above is typical of the editorial conference held after each issue goes to press. These special meetings, called by Edward E. Grazda, Editor, help to improve editorial standards by constructive self-criticism. Editors exchange points of view, make suggestions, comment on clarity and conciseness; discuss technical points. These discussions are aimed, as always, toward making your magazine more interesting, useful, and informative. Your own reactions, ideas, and comments are often mentioned here—all helping to keep the magazine more closely tuned to the main current of reader needs and interests.

## NEW PRODUCTS

### Coaxial Termination

Rated at 1 w



The center conductor of model TE-80 coaxial termination is a precision film resistor rated at 1 w. Impedance is 50 ohms. Vswr is less than 1.07:1 from dc to 4 kmc and less than 1.15:1 from 4 to 10 kmc. Overall length is less than 1.5 in., including the connector. The unit is designed for both field and laboratory use.

Empire Devices Products Corp., Dept. ED, Amsterdam, N.Y.

CIRCLE 194 ON READER-SERVICE CARD

### Mercury Plunger Relays

Single and double pole



Two types of mercury plunger relays are available in the plug-in MiniRelay series. Model MR-10PL, shown here, is a single pole unit with normally open or normally closed contacts. It measures 4 x 2.25 x 2.25 in. and is rated at 20 amp at 115 v ac. The model MR-14PL relay, a two pole unit, comes in combinations of normally open and normally closed contacts. All contacts are hermetically sealed. The relays are suited for power supplies, motor controls, and circuits requiring a plug-in unit.

Ebert Electronics Corp., Dept. ED, 212-31P Jamaica Ave., Queens Village 28, N.Y.

CIRCLE 195 ON READER-SERVICE CARD

### Resistance Thermometer

Probe weighs 2 oz

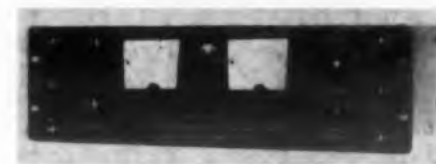
This miniature tungsten resistance thermometer weighs 2 oz, less connector. Its temperature range is  $-450$  to  $+2000$  F, and it features a body rotation independent of leads for ease of installation. The unit is capable of withstanding high vibration and shock.

Astra Technical Instrument Corp., Dept. ED, 1132 Mission St., S. Pasadena, Calif.

CIRCLE 196 ON READER-SERVICE CARD

### DC Power Supply

Provides 0 to 36 v dc



This magnetic amplifier-transistor regulated dc power supply, model MTRO36-5, provides a 0 to 36 v dc output at load capacities up to 5 amp from an ac input of 105 to 125 v, single phase, 60 cps. It has a dynamic line regulation of  $\pm 10$  mv and load regulation of  $\pm 0.2$  v with no load to full load and full load to no load changes. Typical static regulation is  $\pm 3$  mv at 10 v output. Ripple is 1 mv rms.

Perkins Engineering Corp., Dept. ED, 345 Kansas St., El Segundo, Calif.

CIRCLE 197 ON READER-SERVICE CARD

### Terminal Boards

Lengths from 2 to 12 in.

Available in lengths from 2 to 12 in., type 3101 terminal board assemblies can be furnished with any number of terminals required for the specific application. The paperbase phenolic insulation plate is supplied in thicknesses of 1/16, 3/32, and 1/8 in. The spacing between terminals is 5/16 in. and the distance between terminal rows is 1 in. Requirements of MIL-P-3115B type PBE-P are met.

National Tel-Tronics Corp., Dept. ED, 52 St. Casimir Ave., Yonkers, N.Y.

CIRCLE 198 ON READER-SERVICE CARD



## EIR Meter

### Has 26 measuring ranges

Designated ELAV 12, this EIR meter offers 26 measuring ranges. Currents from 0.3 ma to 1.5 amp and voltages from 0.15 v, or 6 v ac, up to 600 v can be measured. The instrument has two resistance measuring ranges from 0 to 1000 and 0 to 100 ohms. The frequency range for ac measurements is 15 cps to 10 kc. The instrument has germanium diodes. Its moving coil system with core magnet and strip suspension is insensitive to external magnetic fields. The meter is built for telecommunication systems for both field and laboratory use. It weighs 2 lb and measures 7.5 x 4 x 2.5 in.

EPIC, Inc., Dept. ED, 154 Nassau St., New York 38, N.Y.

CIRCLE 199 ON READER-SERVICE CARD

## Power Supply

### Rated at 60 v dc, 10 amp



Model ME 60-10 transistorized power supply is rated at 60 v dc, 10 amp, and can be operated at approximately 120% of rated current continuously. The transistor regulator circuit permits a recovery time under 50  $\mu$ sec with a maximum overshoot of 1% of the voltage setting. Output is floating and continuously variable over the range of 0 to 60 v dc at 0 to 10 amp. Ripple is 1 mv rms max. The supply has a 0.5% regulated ac output from rear terminals. The unit is remotely programmable over a narrow voltage range. An axial blower with front panel air intake is provided and the mounting panel is for a standard 19 in. relay rack.

Mid-Eastern Electronics, Inc., Dept. ED, 32 Commerce St., Springfield, N.J.

CIRCLE 200 ON READER-SERVICE CARD

CIRCLE 201 ON READER-SERVICE CARD

Vital equipment in this Jupiter missile is protected 24 hours a day, month after month, by a specially designed Ellis and Watts refrigerated-type Dehumidifier. In the various compartments of the Jupiter missile this E-W Unit constantly maintains perfect environmental conditions during long periods of standby and storage. Without this specialized Dehumidification Unit, moisture and condensation could cause deterioration of vital equipment and one of our most important weapons would never even get off the ground!

Designing and building specialized dehumidification units for electronic or mechanical gear is our business at Ellis and Watts. Units of any capacity, configuration, control requirements or functions can be designed and built to any applicable military or commercial specifications. And, Ellis and Watts units will function perfectly in any climate conditions on earth.

For additional information on specialized dehumidification units for electronic or mechanical gear, write for bulletin 135-D.



*E-W refrigerator-type Dehumidifier, developed especially to protect vital equipment in the Jupiter missile.*

# without E-W dehumidifiers, the Jupiter would drown in its own sweat!



**ELLIS AND  
WATTS  
PRODUCTS, INC.**

P. O. Box 33-DD, Cincinnati 36, Ohio.

*Jupiter missile developed by the Army Ballistic Missile Agency for operational use by U. S. Air Force. Photo courtesy U. S. Army.*

## NO TEMPERATURE OVERSHOOT



## WHEN SIMPLYTROL MINDS THE POT



## TIME-PROPORTIONING CONTROL HAS UNIQUE ANTICIPATING ACTION

The new A.P.I. *Simplytrol* brings an extremely high degree of precision to low-cost temperature control. On most applications, this meter-relay-actuated controller will hold temperature accurately to within  $\pm 1^\circ\text{F}$ . of a desired set point.

An ingenious anticipating circuit aids in the "pot minding." When the measured temperature approaches the set point, an electrostatic attraction is created between the contacts on the indicating and adjustable pointer-arms. This electrostatic force increases rapidly as the contacts move closer together and causes premature closing of the circuit, thereby avoiding temperature overshoot by early shut-off.

Built around the well-proven A.P.I. meter-relay design, *Simplytrol* is a complete controller package which uses no amplifying circuits or vacuum tubes: it is perfectly stable, thoroughly reliable. And it costs much less than comparable temperature controls.

Available in thirty ranges from  $-400^\circ\text{F}$ . to  $+3000^\circ\text{F}$ ., *Simplytrol* is packaged in an attractive case that converts in minutes from table-top enclosure to panel-mounting rack. Special models offer an adjustable time-proportioning band.

For complete information, request Data Sheet 9-B.



**ASSEMBLY PRODUCTS, INC.**  
Chesterland 17, Ohio

CIRCLE 202 ON READER-SERVICE CARD

D.A. 1004

## NEW PRODUCTS

### Leak Detection Unit

Uses argon gas

This argon differential-sorption leak test station has high sensitivity, but needs no mass spectrometer. It uses inert argon as well as helium; the sensing element detects all inert gases without modifications. This unit has a sensitivity of  $5 \times 10^{-9}$  std. cc per sec. The leak output meter is portable.

Vacuum Instrument Corp., Dept. ED, 132 Broadway, P.O. Box 48, Huntington Sta., N.Y.

CIRCLE 203 ON READER-SERVICE CARD

### Low-Pass Filter

Covers range of 200 to 1000 mc



Type TLP-4A low pass rf filter covers from 200 to 1000 mc with cut-off frequencies in 5 mc increments. The cut-off frequency is where the insertion loss exceeds 1.5 db. Made for use with oscillators and other rf sources, the unit is available in lengths from 1.5 to 2.5 in., depending on cut-off frequency. Diameter is less than  $3/8$  in. A variety of end connections are available.

Telonic Engineering Corp., Dept. ED, Laguna Beach, Calif.

CIRCLE 204 ON READER-SERVICE CARD

### Tantalum Capacitors

Measure  $0.125 \times 0.25$  in.

These miniature solid electrolyte tantalum capacitors are 0.125 in. in diam and 0.25 in. long. Electrical leakage is less than  $0.1 \mu\text{a}$  per  $\mu\text{f-v}$  for 6 to 20 v units and  $0.04 \mu\text{a}$  per  $\mu\text{f-v}$  at 35 v. Capacitance range is 0.22 to 6.8  $\mu\text{f}$ . Operating temperature range is  $-80$  to  $+125$  C and dissipation factor is less than 6%.

Magnavox Co., Dept. ED, 2131 Bueter Rd., Fort Wayne, Ind.

CIRCLE 205 ON READER-SERVICE CARD

### Miniature Counter

Has 0.01 oz-in. torque



This miniature counter offers 0.01 oz-in. torque max at 25 C. Operating speed is 1000 rpm max. Having  $1/2$  in. wheels which display  $1/8$  in. white characters on black, the counter weighs  $1/4$  oz. It meets military aircraft instrument shock and vibration requirements. Its applications include altimeters, navigation instruments, integrators, and other airborne and ground control missile and radar systems.

Veeder-Root, Inc., Instrument Div., Dept. ED, Hartford 2, Conn.

CIRCLE 206 ON READER-SERVICE CARD

### Time Delay Relays

Have adjustable timing ranges



These time delay relays are available in six models having the following time ranges in seconds: 0.05 to 1, 0.15 to 3, 0.75 to 15, 3 to 60, 9 to 180, and 15 to 300. A stable fixed resistor wired directly across the terminals provided on the unit, or a precision potentiometer remotely situated, allows adjustment. Input is from 18 to 31 v dc over a temperature range of  $-55$  to  $+125$  C. Vibration is 20 g max to 2000 cps and shock is 50 g max for 11 msec. Acceleration is 20 g max. The control relays can be either 2 pdt, rated at 2 amp, or 3 pdt, rated at 10 amp. Requirements of MIL-E-005272B, MIL-E-5400B, MIL-R-5757C, MIL-R-6106, and MIL-R-25018 are met.

Tempo Instrument, Inc., Dept. ED, P.O. Box 338, Hicksville, N.Y.

CIRCLE 207 ON READER-SERVICE CARD

## Variable Inductor Coils

Available in five sizes

This series of variable inductor coils and coil forms is available in five sizes. Vibrationproof tuning is obtained through use of a high temperature Teflon torque washer which is inserted into the brass mounting housing. These coils are pretuned. The terminals do not come in contact with the form to prevent damage to the coil winding during many soldering cycles. All metal parts are nickel-plated brass to meet 50 hr salt spray and government tests.

Delevan Electronics Corp., Dept. ED, 77 Olean Rd., E. Aurora, N.Y.  
CIRCLE 208 ON READER-SERVICE CARD

## Data Transmission System

Speeds up to 1000 wpm

This completely transistorized system converts a standard paper tape reader output to an error-reducing format for transmission over relatively narrow band communication links. Model SE-1 encoder drives the tape reader at speeds up to 1000 wpm. Model SD-2 decoder converts the serial words back to parallel form and provides signals for driving a standard punch.

Kauke and Co., Dept. ED, 1632 Euclid St., Santa Monica, Calif.  
CIRCLE 209 ON READER-SERVICE CARD

## Forced Draft Oven

Temperatures to 535 F

This forced draft oven produces temperatures up to 535 F, and is suitable for diode age cycling, drying of transistors and printed circuits, encapsulation, and short heat tests. Temperature uniformity is maintained by means of a hydraulic thermostat and horizontally-directed air movement generated by a blower. Standard equipment includes a thermostat, wattage selector heat switch and thermometer.

Electric Hotpack Co., Inc., Dept. ED, Cottman & Melrose, Philadelphia 35, Pa.

CIRCLE 210 ON READER-SERVICE CARD  
CIRCLE 211 ON READER-SERVICE CARD ➤

# ALLIED'S

# New

# CRYSTAL CAN

# 5 amp Relay

## GENERAL FEATURES

### Contact Arrangement:

Two pole double throw.

### Contact Rating:

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

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

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

### Initial Contact Resistance:

.05 ohms maximum.

### Minimum Operate Sensitivity

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

### Ambient Temperature:

-65°C to +125°C.

### Dielectric Strength:

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

### Insulating Resistance:

10,000 megohms minimum.

### Vibration:

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

### Shock: 50 g operational. 100 g mechanical.

### Operate Time:

10 milliseconds or less at rated voltage at 25°C.

### Release Time:

5 milliseconds or less at rated voltage at 25°C.

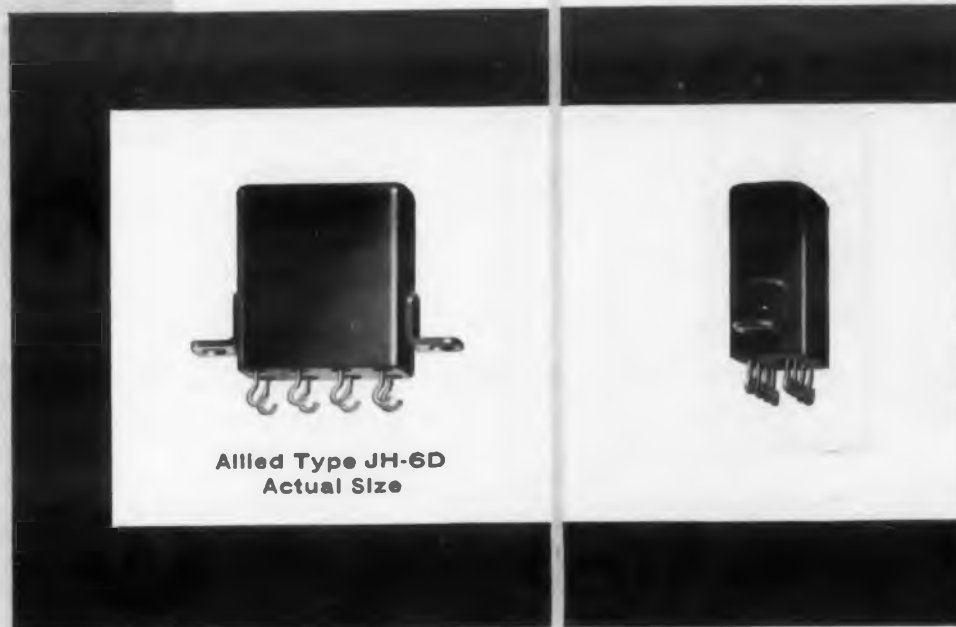
### Maximum Over-all Dimensions:

height 1.0" length 0.8" width 0.4".

### Terminals:

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

### Weight: 0.8 ounces maximum.



Write  
for  
Bulletin  
JH-6D



# ALLIED CONTROL



ALLIED CONTROL COMPANY, INC., 2 EAST END AVENUE, NEW YORK 21, N.Y.

# A VITAL 100 MINUTES!

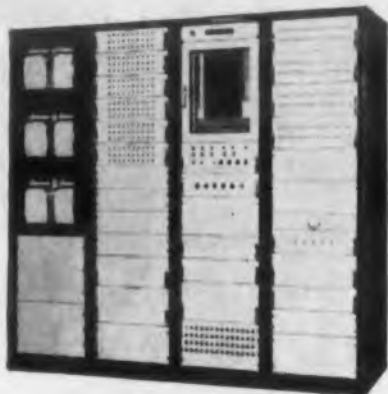
## *Firing Sequencer with 762 CLARE RELAYS gives automatic control*

Automatic control of the countdown at the Air Force's Cape Canaveral Missile Test Center—from X minus 90 minutes to 10 minutes after a missile is fired—is in the hands of a Milgo Model III Sequencer.

The Sequencer, built by Milgo Electronic Corporation, Miami, Fla., automatically controls the myriad operations which must be performed before any missile can be launched. It is preprogrammed to recognize the precise condition that must exist during each of the operations it controls. When any other condition is detected, it will automatically hold fire until the condition is corrected. In a recent instance, it saved a Titan prototype which developed a malfunction after firing but before actual takeoff.

Another of these sequencers is being built by Milgo for installation at the Pacific Missile Range, Vandenberg Air Force Base, Calif.

Milgo engineers selected 762 Clare Type J and Type HG Relays for this supremely important device, and not one has ever malfunctioned. Here is convincing proof that, where the safety of personnel and of valuable equipment is at stake and the utmost accuracy is demanded, a designer who rides with Clare relays can rest assured that he has chosen wisely and well,—not necessarily the cheapest relays but certainly the very best.



Front view of Model III Sequencer which uses 762 CLARE Type J Relays and 14 CLARE Type HG Relays. Made by Milgo Electronic Co., Miami, Fla.

View of control rack of Model III Sequencer showing 56 CLARE Type J sealed relays.



## CLARE RELAYS

C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Ill.  
In Canada: C. P. Clare Canada Ltd., P. O. Box 13, Toronto, Ontario.  
Cable Address: CLARELAY

## NEW PRODUCTS

### Power Isolator

Delivers 300 va

Model 30 power isolator delivers up to 300 va of isolated power at 115 v at 60 cps. The isolation permits currents in the millimicroampere range to flow from the output to line ground when used on a 60 cps line. The loading of the output to ground is less than 2  $\mu$ f capacitance and greater than 50,000 meg which enables off-ground operation of line-operated equipment. The unit may be used with oscilloscopes, voltmeters, amplifiers, signal generators, power supplies, and recorders. The isolator is portable; its dimensions are 12 x 11 x 6 in.

Moeller Instrument Co., Electronics Div., Dept. ED, 132nd St. and 89th Ave., Richmond Hill 18, N.Y.

CIRCLE 212 ON READER-SERVICE CARD

### Power Supplies

Half-rack construction



The half-rack construction of models TR-18-2 and TR-36-1 power supplies permits their use for both bench work or, in pairs, for rack installation. For model TR-18-2, voltage range is 0 to 18 v dc and current range is 0 to 2 amp; for model TR-36-1, voltage range is 0 to 36 v dc and current range is 0 to 1 amp. For both models, rms ripple is 1 mv; load regulation for 0 to 100% is  $\pm 0.05$  or  $\pm 2$  mv; line regulation for  $\pm 10\%$  is  $\pm 0.1\%$  or  $\pm 3$  mv; and internal impedance for dc to 20 kc is 0.1 ohms max. Each unit measures 5 x 8.25 x 14.5 in. and weighs 20 lb.

NJE Corp., Dept. ED, 345 Carnegie Ave., Kenilworth, N.J.

CIRCLE 213 ON READER-SERVICE CARD  
CIRCLE 214 ON READER-SERVICE CARD

## Potentiometer

Linearity to 0.25%

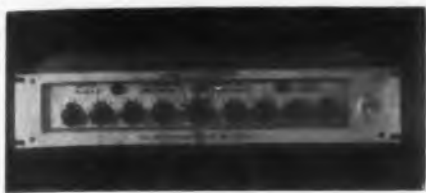
This split winding potentiometer has independent linearity to 0.25% and continuous rotation to 1000 rpm. The unit is available in a wide range of resistance values with resolution dependent on size which is 1-1/16 to 3 in. diam. Ambient operating temperature is  $-50$  to  $\pm 100$  C. Mil specs for salt spray, humidity, vibration, and shock are met.

Precision Line, Inc., Dept. ED, 63 Main St., Maynard, Mass.

CIRCLE 215 ON READER-SERVICE CARD

## Voltage Comparator

For go/no-go indication



Model 50 go/no-go voltage comparator accurately determines whether an input voltage is within prescribed limits. It will check any voltage from  $\pm 0.001$  to  $\pm 999.9$  v. The instrument has a detection threshold of 500  $\mu$ v, and a sensitivity of 0.005%. Its limit settings are precise to  $\pm 0.01\%$ . Semiconductors are used in all electronic functions. A go or no-go indication is given 90 msec after the voltage under test is applied.

Non-Linear Systems, Inc., Dept. ED, Del Mar, Calif.

CIRCLE 216 ON READER-SERVICE CARD

## Gate-Pulse Generator

Readout is from 1 to 88 channels

This gate-pulse generator is adaptable to the firm's Decommulator, or any system requiring sequential timing pulses. Its operation is continuous, even with one or several information gates removed. Active readout capability is from 1 to 88 channels, operating on all standard IRIG sampling rates of 30, 45, 60, or 90 channels at from 75 to 900 cps.

Arnoux Corp., Dept. ED, 11924 W. Washington Blvd., Los Angeles 66, Calif.

CIRCLE 217 ON READER-SERVICE CARD

CIRCLE 218 ON READER-SERVICE CARD

# cooling avionic systems

During World War II, Eastern Industries pioneered cooling systems for aircraft electronic systems. Now, thousands of installations later, and as the leader in this challenging field, Eastern is still pioneering.

Experience has been a springboard to new developments . . . compactness, simplification, refrigeration cycles. Research and development continue to play their vital parts in perfecting systems to overcome the new problems as expanded aircraft performance produces fantastic rises in temperatures.

If you have a challenging problem, come to the leader in the field for complete and creative engineering help.



COOLING UNIT



REFRIGERATION-TYPE

## ELECTRONIC TUBE COOLING UNITS

Custom-made units, with or without refrigeration cycles, provide a method of maintaining safe operating temperature limits in electronic equipment. Standard sub-assemblies and components normally are used to create a custom-made design to fit your exact needs. Costs are minimized for these completely self-contained units by combining heat exchangers, fans or blowers, liquid pumps, reservoirs, flow switch, thermostat, and other common components.

Write for Eastern AVIONICS BULLETIN 340

PIONEER OF THE THERMAL FRONTIER

EASTERN  
AVIATION PRODUCTS

**EASTERN**

**INDUSTRIES, INC.**

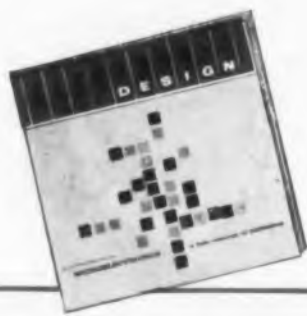
100 Skiff St., Hamden 14, Conn.

West Coast Office: 1408 Centinela Avenue • Inglewood 3, California



## the new products

To keep you informed, *Electronic Design's* editors strive to include every new product item that is pertinent to electronic design work. Last year this magazine ran 3,527 new product items, 1,743 more than "Electronics" magazine, our nearest competitor. Whether you need to keep in touch with new materials, test equipment, components, or production machinery, you can depend on finding them all through *Electronic Design*.



a HAYDEN publication

## NEW PRODUCTS

### Voltage Regulators

For aircraft dc generators

Designed for aircraft dc generators, these two transistorized voltage regulators offer about 10,000 hr operational life. Model 50-029 weighs 1.45 lb, including 0.2 lb adapter plate; model 50-066 is an integral unit weighing 1.5 lb. Both units are solid state devices and are encapsulated. Regulation is provided to undergo less than 0.3 voltage change from 0 to full load at 28 v. The voltage regulators may be set to any value between 26 and 30 v in increments of 0.05 v. Temperature range is  $-55$  to  $+71$  C.

Hydro-Aire Co., Electronics Div., Dept. ED, 3000 Winona Ave., Burbank, Calif.

CIRCLE 219 ON READER-SERVICE CARD

### Frequency Counter

Transistorized



Model 100T transistorized frequency counter is made for use as a tachometer, a flowrate indicator, or an indicator for pressure, temperature, acceleration, velocity of force. The input amplifier, squaring amplifier, gate and beam switching tube drivers are located on a 5 x 9 in. modular printed-circuit card. The power supply uses silicon rectifiers and two independent, bridge-rectified dc sources. A series regulator tube and neon tube reference element regulate the beam switching tube high voltage supply, used for the counter tubes and Nixie indicators.

Erie Pacific Div. of Erie Resistor Corp., Dept. ED, 644 W. 12th St., Erie 6, Pa.

CIRCLE 220 ON READER-SERVICE CARD

### Time Delay and Repeat Cycle Timers

Have accuracy of 0.5%



The 600 series of electronic time delay and repeat cycle timers is used in ground support equipment for preflight missile testing. The illustrated WC-601 timer, operating from 24 to 30 v dc, gates a power output for a period of  $60 \pm 0.25$  sec. A 400 cps input serves as reference. These units have potted modular construction and transistorized circuitry and an accuracy of 0.5%. They are unaffected by extremes of shock and vibrations in temperatures ranging from  $-55$  to  $+71$  C.

Webcor, Inc., Dept. ED, 816 N. Kedzie Ave., Chicago 51, Ill.

CIRCLE 221 ON READER-SERVICE CARD

### Tone Telemetry System

Contains 11 sine-wave oscillators



Silicon transistorized tone telemetry system, model T-108, is a high temperature, ruggedized tone generating system capable of operation within associated fm-fm telemetry systems. It indicates the precise occurrence and sequence of remote functions through extreme environmental conditions. The standard unit contains 11 sine-wave oscillators. Tone frequencies may range from 25 cps to 100 kc. It requires 28 v dc supply at a nominal 20 ma.

Solid State Electronics Co., Dept. ED, Orion Ave., Van Nuys, Calif.

CIRCLE 222 ON READER-SERVICE CARD

## Transistorized Converters

Output of 200 w

The TS series transistorized dc-dc converters supply a continuous output of 200 w. They have high heat dissipation to size ratio and an efficiency of better than 85%. Input voltage is 6 to 110 v dc, output voltage as specified. Reversal of input polarity or a short across the output will not damage the units. They serve as replacements for the dynamotor and vibrator-type power supplies.

Electrodynamic Instrument Corp., Dept. ED, 2508 Tangley Rd., Houston 5, Tex.

CIRCLE 223 ON READER-SERVICE CARD

## Vane Axial Blower

Output is 760 cfm max

Model FV7-1 vane axial blower has an output of 600 cfm, at water SP of 1 in., and 760 cfm at free air. It is a six-pole, 7300 rpm unit and is designed for 2000 hr life. The input is 200 v, 400 cps, three-phase at 1.2 amp. It weighs 4.74 lb and has a noise level of 78 db overall. The envelope diameter shell is 7.5 x 6 in. Specifications of MIL-M-7969A are met.

Western Gear Corp., Electro Products Div., Dept. ED, 132 W. Colorado Blvd., Pasadena, Calif.

CIRCLE 224 ON READER-SERVICE CARD

## Cam Switch

Solenoid operated

Model C-3837, a hermetically sealed, miniaturized, solenoid operated cam switch provides at least 10,000 cycles of operation and 800,000 contact breaks. Operation is from 24 to 30 v dc at 125 C ambient temperature. Current rating is 1 amp. The unit is designed for 7-pole, 18 position-shorting with interrupter and homing features. Over-all dimensions are 1-3/4 x 1-21/32 x 2-3/4 in. The unit has been shock and vibration tested in accordance with MIL-E-5272A.

Tech Laboratories, Inc., Dept. ED, E. Edsall Blvd., Palisades Park, N.J.

CIRCLE 225 ON READER-SERVICE CARD

CIRCLE 226 ON READER-SERVICE CARD >



## HOTLINE: ANOTHER VITAL COMMUNICATIONS SYSTEM POWERED BY EIMAC KLYSTRONS

Maintaining hundreds of miles of multi-channel communications over rugged, mountainous, arctic terrain is a big job. Add the requirement of extreme reliability demanded in a SHAPE system vital to the defense of free Europe and the task is doubly difficult.

That's the kind of job being done by Project HOTLINE, a three-hop tropo-scatter system stretching from above the arctic circle to Oslo, Norway. HOTLINE is the first link in a network that will ultimately tie European defenses together from the arctic to Eastern Turkey.

Tropo-scatter propagation was chosen for HOTLINE because of its exceptional reliability under tough conditions. Eimac power amplifier klystrons were chosen for the same reason — years of field-proved service in tropo-scatter systems throughout the world. DEW Line, Pole Vault and White Alice head the list.

Many exclusive design features make possible the excellent reliability and performance of Eimac klystrons. External-cavity design permits wider tuning range and bandwidth. It significantly reduces system operating cost since tuning circuitry is not repur-

chased when tubes are replaced. Long-life, efficient cathodes and the exclusive Eimac modulating anode (available in many klystron types) offer additional operating advantages.

If you have a tough systems design job that requires large quantities of reliable UHF power, investigate the many advantages of Eimac power amplifier klystrons.

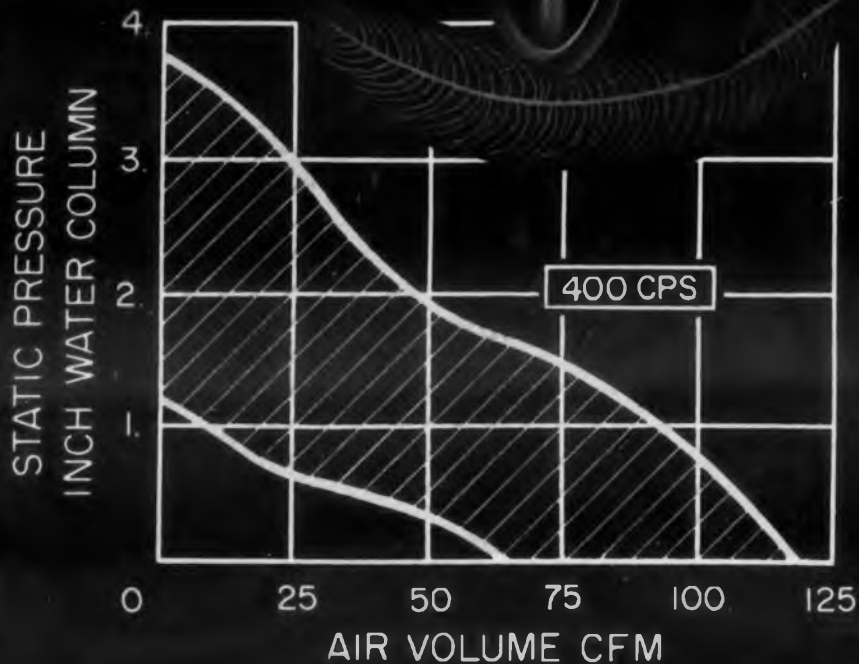
**EITEL-McCULLOUGH, INC.**



San Carlos, California

See Eimac's newest klystrons, negative grid tubes, TWT's and rectifiers at WESCON, San Francisco

**120 CFM  
FAN WEIGHT  
ONLY 6½ oz.!**



## PROPIMAX 2®

Air delivery of 120 cfm is obtained from a fan only 3" in diameter by 1.4" in depth and weighing only 6½ ounces. The Propimax 2 is the perfect answer for 400-cps airborne or missile applications where maximum cooling with a minimum of space and weight loss is mandatory.

Variation in driving motors includes constant speed 21,000-rpm, 11,500-rpm and Altivar® versions. The latter automatically vary their speeds directly with altitude and thereby approach constant cooling with a minimum of power drain and noise.

Simplicity of mounting is achieved by provision of "servo" type rims at either end of venturi. Airflow is reversible by turning fan end-for-end. Electrical connections made to compact terminal block. Power requirement is 400 cps, 1 or 3 phase, sinusoidal or square wave.

Write for complete technical information . . .



Pat. Pend.



**ROTRON** mfg. co.,  
inc.

WOODSTOCK • NEW YORK

In Canada: The Hoover Co., Ltd., Hamilton, Ont.

CIRCLE 227 ON READER-SERVICE CARD

## NEW PRODUCTS

### Frequency Converter

Has  $\pm 0.01\%$  frequency regulation

Made to convert variable to constant frequency power, this converter has  $\pm 0.1\%$  frequency regulation. Output voltage is 115 v ac  $\pm 5\%$  for all load and input voltage variations. Input voltage is 95 to 135 v ac and input frequency range is 360 to 980 cps. Harmonic distortion is less than 5% and efficiency is 78%. The unit features short circuit protection and variable power factor load capability. It may be used with computers, autopilots, servo systems, and gyro motors.

Power Supplies, Inc., Dept. ED, Highland, Ill.

CIRCLE 228 ON READER-SERVICE CARD

### Miniature Delay Lines

Have time delays to 12  $\mu$ sec



This series of miniature delay lines has delay times as long as 12  $\mu$ sec. These lines are of the completely encapsulated or embedded circuit type, and are suitable for either pulse or cw applications. They are available in a range of delays spanning a ratio of 240 to 1, and have a rise time of 1/4 of the delay time. Bandwidths range from 0.26 to 63 mc. Rated at 300 wvdc, these units are 1/2 in. thick and 2 in. long.

Artronic Instrument Co., Dept. ED, 11232 Triangle Lane, Silver Spring, Md.

CIRCLE 229 ON READER-SERVICE CARD

### Modulation Test Set

For aircraft and ground power systems

Model T97 modulation test set provides direct frequency and voltage modulation readings on 400 cps systems. It measures modulation, stability characteristics, and transients of aircraft and ground power systems. Voltage modulation is

$\pm 0.05\%$  on  $\pm 0.5\%$  scale and  $\pm 0.13\%$  on 2.5% scale. Frequency modulation is  $\pm 0.025\%$  on 0.25% scale and  $\pm 0.062\%$  on 1.25% scale. It measures 15 x 15-1/2 x 9-3/8 in. and weighs 41 lb.

Avtron Manufacturing, Inc., Dept. ED, 10409 Meech Ave., Cleveland 5, Ohio.

CIRCLE 230 ON READER-SERVICE CARD

### Miniature Rotary Switches

Have dual concentric shafts



This series of miniature rotary switches, designed for use in instruments and computers, have dual concentric shafts. A total of 8 switch decks may be ganged, with the inner shaft controlling up to 4 of the 8 decks. In a typical combination, one shaft may control one or several 1-pole decks; the other shaft, 4-pole decks. One set of decks may have 11.25 deg indexing, the other 22.5 or 30 deg indexing. One set may be shorting, the other non-shorting.

Shallcross Mfg. Co., Dept. ED, Selma, N.C.

CIRCLE 231 ON READER-SERVICE CARD

### Transistor Chopper

Operates from 50 to 5000 cps



This transistor chopper, type 6025, has a spdt switching action for operation from 50 to 5000 cps. The drive may be 6.3 v, sine or square wave. It consumes less than 20 mw. At frequencies above 14 v, the drive may be as high as 14 v. The output is linear within 2% over a range of signals from about 10 times the noise level up to 100 v with a



signal current that does not exceed 10 ma.

Airpax Electronics, Inc., Cambridge Div., Dept. ED, Cambridge, Md.

CIRCLE 232 ON READER-SERVICE CARD

## Coaxial Choppers

Three types available



These three coaxial choppers may be used for continuous or asynchronous switching of coaxial signals. Models C-2099, C-1755 and C-1760 have a driving frequency range of dc to 150 cps. The switching frequency is from dc to 500 mc, for all units. Having a vswr of 1.1:1 at 50 ohms, they can stand a shock of 50 g. Contact arrangement for the units is dpdt.

James Vibrapowr Co., Dept. ED, 4050 N. Rockwell St., Chicago 18, Ill.

CIRCLE 233 ON READER-SERVICE CARD

## Analog Scanner

Switches 1000 10  $\mu$ v signals

Model 453M analog signal scanner has high input capacity, flexible operating modes, and a method of indicating the channel being scanned. It is capable of switching up to 400 one-wire, 200 two-wire, or 100 four-wire units. When used with Model 453S slave unit, the capacity is upped to 1000 single-wire or 300 four-wire signals. With properly shielded input and output connections, it can switch signals as low as 10  $\mu$ v. Both start channel number and stop channel number may be preset from 0 to 999 by six selector switches.

Kin Tel Div. of Cohu Electronics, Inc., Dept. ED, 5725 Kearny Villa Rd., Box 623, San Diego 12, Calif.

CIRCLE 234 ON READER-SERVICE CARD

CIRCLE 235 ON READER-SERVICE CARD

# Multi-Circuit Switching Problems?

Here are quick solutions  
with **ELECTROSNAP**  
**BASIC SNAP-ACTION SWITCHES**

- quality engineered and designed to meet human factors
- over 60,000 switch and actuator variations available
- adaptations can be made to fit your requirements

### double pole



actual size

### D series

DPDT, 4 CKT.

L.W.H. 1 1/4" x 1/2" x 3/8"

Elec. 15 amps @ 125/250 V.A.C.  
Rating: 15 amps Res. @ 30 V.D.C.  
10 amps Ind. @ 30 V.D.C.

Operating Force 23 to 33 oz.  
Amb. Temp. -100 to +375° F.  
Termination D4 series—end solder  
D8 series—side solder

Available in simultaneous, non-simultaneous and reset models. Models available with Military and U.L. approval. Write for details.



### triple pole



actual size

### K series

TPDT, 6 CKT.

L.W.H. 1 1/4" x .491" x 1-5/16"

Elec. 15 amps @ 125/250 V.A.C.  
Rating: 15 amps Res. @ 30 V.D.C.  
10 amps Ind. @ 30 V.D.C.

Operating Force 40 oz.  
Amb. Temp. -100° to +375° F.  
Termination K1 series—end solder  
K3 series—side solder

Available in simultaneous, non-simultaneous and reset models. Models available with Military and U.L. approval. Write for details.



### multi-pole combination actuator assemblies



Any basic switch can be adapted to multi-pole assemblies. Send us your requirements.



### Need a special switch?

Often standard switches can be modified to do the job. If a special switch is required, ElectroSnap engineering can create new switches in any quantity to your specifications. Send us your problem...our answer can save you time and money.

Call or Write for Specific Details on Any Switch Type

**ELECTROSNAP CORPORATION**

SWITCH DIVISION • 4216 W. Lake Street, Chicago 24, Illinois  
Telephone: VAn Buren 6-3100, TWX No. CG-1400



## NEW PRODUCTS

### Refrigeration Cabinet

Temp to  $-95^{\circ}\text{F}$

Model ULT 95-1.5 refrigeration cabinet, adjustable to  $-95^{\circ}\text{F}$ , may be used for laboratory testing, precision tools, seasoning gages, and shrink fits. The storage compartment is 1.5 cu ft and outside dimensions are 38 x 28 x 38 in. This steel constructed cabinet is vaporproof and is insulated with fibre-glass bats. The doors have hard rubber double lids. The unit operates on 110 v, 60 cps single phase current.

Everlast Refrigeration Co., Dept. ED, 654 Henry St., Brooklyn 31, N.Y.

CIRCLE 236 ON READER-SERVICE CARD

### Silver-Zinc Batteries

High energy-to-weight ratios

This line of silver-zinc secondary batteries for missiles and spacecraft have high energy-to-weight ratios compared with ordinary batteries. They are composed of individual cells which may be combined to develop the power required. This SC series has capacities ranging from 0.5 to 450 amp-hr. All cells are rated with a terminal voltage of 1.4 v under load. For an 80 F rise above room temperature, the terminal voltage under typical load increases less than 3%.

Telecomputing Corp., Cook Batteries Div., Dept. ED, 3850 Olive St., Denver 7, Colo.

CIRCLE 237 ON READER-SERVICE CARD

### Servo-Driven Delay Line

Range of 3 to 400  $\mu\text{sec}$

This servo-driven delay line offers a continuously adjustable range of 3 to 400  $\mu\text{sec}$ . The linearity of delay, compared with the indicated position is within 10  $\mu\text{sec}$  of the actual delay. The case contains the motor-driven worm-screw shaft that moves and positions the output coil along the length of the magneto-strictive element in providing the time-delay constant. The instrument is capable of simulating the flight of a missile in terms of time.

Deltine, Inc., Dept. ED, 139 Holt St., Mamaroneck, N.Y.

CIRCLE 238 ON READER-SERVICE CARD

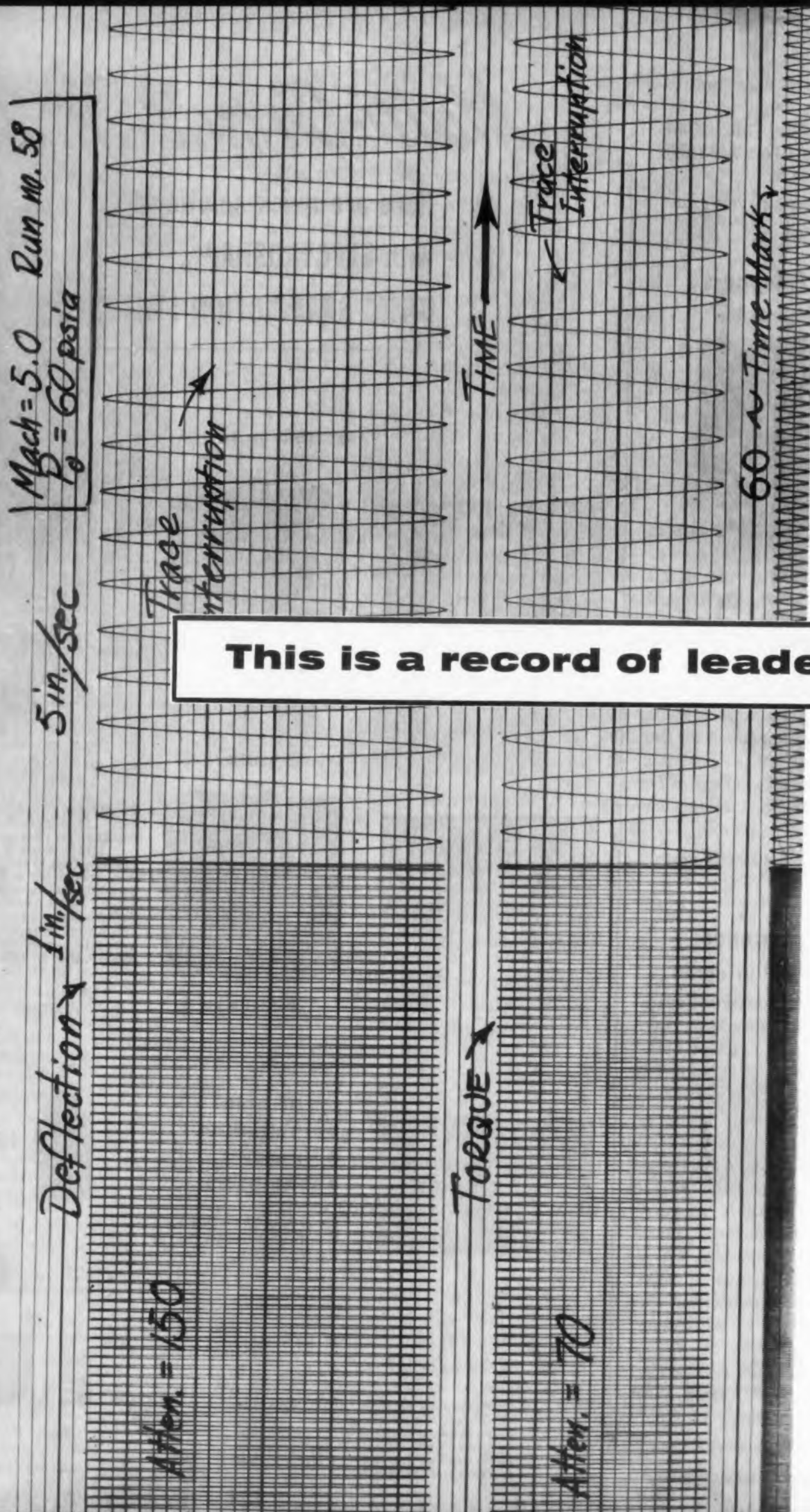
### Vane Axial Blower

Delivers 1200 cfm

Vane axial blower unit SK-2367 delivers 1200 cfm output at 7-in. static pressure while operating at 11,500 rpm. Other speeds obtainable with the 400 cps, three phase motor are 5400 and 7500 rpm. The unit meets MIL-E-5272A, weighs 11 lb, and is 7.44 in. long and 8.50 in. in diam.

Torrington Manufacturing Co., Dept. ED, Torrington, Conn.

CIRCLE 239 ON READER-SERVICE CARD



This is a record of leadership in

Honeywell 906A Visicorder record, actual size. Note longitudinal grid lines and trace identification interruptions.



These studies of aerodynamic damping coefficients on an airframe were made by engineers at ARO, Inc. They were conducted in the Gas Dynamics Facility at the U.S.A.F.'s Arnold Engineering Development Center, Tullahoma, Tennessee, wind tunnel center of the Air Research and Development Command. The studies were directly recorded on a Honeywell 906-A Visicorder.

The problem: To measure damping-in-pitch derivatives for a clipped-delta-wing-body configuration over a Mach number range of 2.0 to 5.0 so that these measurements could be compared with the Mach number trend predicted by theory.

The set-up: A model of the delta-wing body, mounted

on its cross-flexure pivot support, was forced to oscillate through a linkage by an electro-magnetic shaker. Resistance strain gauges were bonded to the input torque member and to one of the pivot supports. These gauges supplied torque and displacement signals through a carrier amplifier to two galvanometers in the Visicorder. An oscillator, driving a third galvanometer, established a time base for the oscillogram.

The values discovered through this forced-oscillation balance system experiment showed some discrepancies from values predicted by theory, because the theory pertained to simpler bodies than that used in the tests. The experiments provided a new set of data which will result in more accurate predictions for future design.

## Tip in aerodynamic research



Z. A. Woodard, Jr., ARO, Incorporated, instrument technician, operates the Visicorder in the measurement of aerodynamic damping coefficients.

The Honeywell Visicorder is the pioneer and unquestioned leader in the field of high-frequency, high-sensitivity direct recording oscillography. In research, development and product testing everywhere, instantly-readable Visicorder records are pointing the way to new advances in product design, rocketry, computing, control, nucleonics . . . in any field where high speed variables are under study.

The new Model 906A Visicorder, now available in 8- and 14-channel models, produces longitudinal grid lines simultaneously with the dynamic traces, time lines, and trace identification by means of new accessory units.

To record high frequency variables—and monitor them as they are recorded—use the Visicorder Oscillograph. Call your nearest Minneapolis-Honeywell Industrial Sales Office for a demonstration.

**Reference Data:** Write for Visicorder Bulletin  
*Minneapolis-Honeywell Regulator Co.,  
Industrial Products Group, Heiland Division  
5200 E. Evans Ave., Denver 22, Colo.*

# Honeywell



Industrial Products Group

CIRCLE 269 ON READER-SERVICE CARD

## Analog Frequency Meter

Available in three ranges



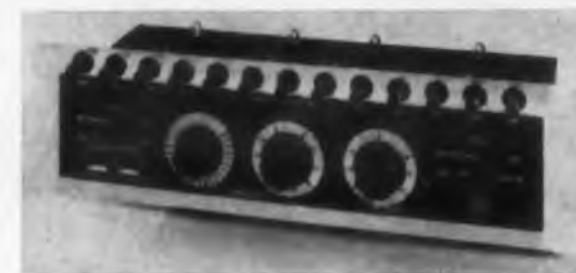
Available in ranges from 0 to 1000 cps, 0 to 10 kc, and 0 to 100 kc, model T-4 displays only 10% of each range to full scale reading. Accuracy is  $\pm 17\%$ ; stability is  $\pm 0.25\%$  with  $\pm 0.005\%$  internal calibration standard based on 100 kc crystal. These units may be operated on 10 mv input or less. From 10 mv to 100 v no change in frequency indication is observed.

Jones-Porter Instrument Co., Inc., Dept. ED, Box 302, Milburn, N.J.

CIRCLE 270 ON READER-SERVICE CARD

## Reference Set

For computers and instruments



Model VRS-105/R voltage-ratio-resistance reference set permits calibration of resistance-ratio devices to 0.0001% at 19 different ratios between 0 and 0.999999. It can be used to standardize dc voltage sources against a standard cell to an accuracy of 0.001%. Voltages of 500, 100, 50, 10 and 5 v may be so calibrated. Resistance standardization from 10 to 100 K, in 10 equal steps, is provided to an accuracy of 0.0015%.

Julie Research Laboratories, Inc., Dept. ED, 556 W. 168th St., New York 32, N. Y.

CIRCLE 271 ON READER-SERVICE CARD

**MINIATURIZED FM TUNER.**—For fm, am-fm, or two-tuner stereo-fm radio sets. Reduces radiation and drift to imperceptible levels.

General Instrument Corp., Dept. ED, 65 Gouverneur St., Newark 4, N.J.

CIRCLE 272 ON READER-SERVICE CARD

**MICROWAVE MATERIAL.**—Available in rods and sheets, Rexolite is low loss, high frequency dielectric material for prototype work. Suitable for construction of complex delay lines and component miniaturization. Hard, mechanically strong, machinable to 0.005 in. tolerances with conventional tools.

Rex Corp., Dept. ED, West Acton, Mass.

CIRCLE 273 ON READER-SERVICE CARD



(NUT SHOWN  
4 TIMES  
ACTUAL SIZE)

THIS  
IS  
A

*Fischer*

JEWEL  
NUT

... FOR MINIATURIZED  
PRECISION EQUIPMENT

This tiny brass nut is mass produced to Class 3 tolerances for use in precision instruments. Typical of the miniature nuts FISCHER supplies to manufacturers of electrical and electronic equipment, it is countersunk both sides, burrless, cleaned and ready to install.

As the leading producer of *turned* nuts, FISCHER can supply standard, special and odd sizes or types of miniature brass nuts having diameters from  $\frac{1}{8}$ " and threads from No. "O". All FISCHER nuts are made to exact customer specifications . . . and are competitively priced with nuts made by less precise methods.

*If you need precision nuts . . . brass or aluminum . . . FISCHER is your best source.*



there's no premium for precision at

***Fischer* SPECIAL MFG. CO.**

422 MORGAN STREET • CINCINNATI 6, OHIO

CIRCLE 274 ON READER-SERVICE CARD

8405-78

## NEW PRODUCTS

### Precision Thermostat

Has 9 F differential



With a differential of 9 F, this high reliability version of the Klixon M1 snap action thermostat provides close temperature control in a 60 to 225 F range. For missile and other critical applications, the miniature, hermetically sealed unit withstands 25 g, 75 to 3000 cps vibration. It is rated 5 amp, maximum at 30 v dc and has gold electroplated contacts for dry circuit applications.

Metals & Controls, Div. of Texas Instruments, Inc., Dept. ED, 34 Forest St., Attleboro, Mass.

CIRCLE 275 ON READER-SERVICE CARD

### Miniature Power Supplies

Have  $\pm 0.05\%$  regulation



Operating from 115 v ac, 50 to 60 or 400 cps, series QM miniature dc power supplies have  $\pm 0.05\%$  line and load regulation and under 0.01% ripple. The 36 models with 50 to 60 cps input cover nine output voltages between 3 and 36 v with output capacities of 2, 4, 8, and 15 w. A like number of models are available for 400 cps input. The units are not damaged by overloads or output shorts.

Sorensen & Co., Inc., Dept. ED, South Norwalk, Conn.

CIRCLE 276 ON READER-SERVICE CARD

# COMPUTER TAPE?



*AMPEX C-1... no other tape that lasts as long performs so well*

## Transistorized Power Supply

Has five regulated outputs

For airborne use, the model PS-25 transistorized power supply has five outputs protected from overloads and short circuits: +17.5 and -17.5 v dc, 5% regulated; +110 and -110 v dc, 1% regulated; and 6.3 v ac, 5% regulated. All voltages have final potentiometer adjustment. Power requirements are 115 v ac  $\pm 10\%$ , 350 to 450 cps, single phase at 4 amp, and 28 v dc at 100 ma. The units are 8 in. high, 5 in. wide, and 17 3/16 in. long.

Southeastern Industrial Electronics Co., Dept. ED, 10201 Westheimer Rd., Houston, Tex.

CIRCLE 278 ON READER-SERVICE CARD

## Solid-State Scanner-Multiplexer

Scanning rate from 15 to 1000 cps

The Monitron solid-state scanner is a modular plug-in unit with fully automatic scanning of 3 to 256 signals of any type which can be reduced to on and off or go and no-go information. Scanning rate ranges from 15 to 1000 cps. It can be used to multiplex many sources of information over one communication channel. Other applications include alarm monitoring, centralized master control facilities and automatic alarm-and-control closed loops.

Moore Associates, Dept. ED, 2600 Spring St., Redwood City, Calif.

CIRCLE 279 ON READER-SERVICE CARD

## Miniature Choppers

Are 1-3/4 in. high, 3/4 in. in diam

These low-noise miniature choppers are available in 8 models including break-before-make and make-before-break designs, in either spdt or 2pdt types. Noise level is less than 10  $\mu$ v across 1 meg at 400 cps, and less at 60 cps. They are 1-3/4 in. high and 3/4 in. in diam. Hermetically sealed, they meet applicable military specs.

Collins Electronics Mfg. Corp., Dept. ED, Stevensville, Md.

CIRCLE 280 ON READER-SERVICE CARD

CIRCLE 281 ON READER-SERVICE CARD

NOW, FROM GENERAL ELECTRIC'S NEW 6L6-GC...

# Power



## 55 WATTS...with only 2% distortion without feedback\*

Power for orchestral climaxes with full concert-hall brilliance... yet mellow in tone, undistorted! You can build this high speaker power into your new equipment at a cost *one-third less* than the cost of other tubes with comparable performance!

With 30 watts plate dissipation, 5 watts screen, General Electric's 6L6-GC beam pentode can take peak power demands in stride. This is a new tube throughout, designed to handle easily the speaker requirements of the finest audio systems. Type 6L6-GC has, among other features:

- Special 5-layer bonded-metal plate, developed by General Electric for improved heat conduction and radiation.
- New large heat radiator on control grid, to minimize grid emission.
- Redesigned screen grid, for higher dissipation.
- New protective slots on micas, to reduce high-voltage interelement leakage.
- New-design bulb, to radiate heat more efficiently.

Top power output—low distortion—completely new design—economy! Four important advantages to *you* of General Electric's 6L6-GC. Ask any G-E Receiving Tube Department office below for further information!

200 Main Avenue, Clifton, New Jersey (Clifton) GREGORY 3-6387 (N.Y.C.) WISCONSIN 7-4065, 6, 7, 8  
3800 North Milwaukee Avenue Chicago 41, Illinois SPRING 7-1600  
11840 West Olympic Boulevard Los Angeles 64, California GRANITE 9-7765, BRADSHAW 2-8566



\* Two 6L6-GC tubes push-pull, Class AB<sub>1</sub> service, with 450 v on the plate.

Key design-max ratings, per tube, of the new General Electric 6L6-GC are:

Plate voltage	500 v
Plate dissipation	30 w
Screen voltage	450 v
(500 v with output transformer taps)	
Screen dissipation	5 w
Cathode current	110 ma

*Progress Is Our Most Important Product*

# GENERAL ELECTRIC

2-211-101



# A RADICALLY NEW LAMINATE

UNIQUE COMBINATION  
of PROPERTIES

## Exclusive New Resin Formulation (Patent Applied For) Developed by the Richardson Research Laboratory

Here is a radically new and different series of laminated insulating materials known as the "MARK TEN" series. This series of laminates has unique properties which are *chemically built-in* and are not degraded during normal manufacturing processes. Rigidity and flexural strength are high as compared with other cold punch laminates. Intricate shapes can be punched at room temperatures and lower.

Now a true cold punch laminate, the first grade in this series and identified as "MARK TEN" 10-01, is available both plain and copper-clad. Exceeding NEMA XXXP and MIL-P-3115B Type PBE-P requirements, "MARK TEN" 10-01 has excellent stability in both dimensions and electrical properties over a wide temperature range.

## Outstanding Combination of Properties for Copper-Clad

As a copper-clad laminate, "MARK TEN" 10-01 introduces the most unusual combination of properties ever known to the laminated plastics field. Besides being a true cold punch material it has unusual resistance to organic cleaning compounds . . . it withstands blistering in solder at 500°F for 40-60 seconds or at 550°F for 10-20 seconds . . . and it averages 7-9 lbs. bond strength.

This "MARK TEN" laminate is chemically engineered with the printed circuit manufacturing process in mind and is designed for most efficient production of printed circuits as well as other products.

"MARK TEN" 10-01 is Richardson's latest addition to its well known line of INSUROK® laminates.

You are invited to request further information and a sample. Write . . . or phone today . . . Chicago phone MA 6-8900.

Typical part punched from "MARK TEN" at 60°F.



\* TRADEMARK OF THE RICHARDSON CO.

## the RICHARDSON COMPANY

LAMINATED AND MOLDED PLASTICS

Founded 1858

DEPT. 41 • 2682 LAKE ST. • MELROSE PARK, ILL. • SALES OFFICES IN PRINCIPAL CITIES

CIRCLE 282 ON READER-SERVICE CARD

## NEW PRODUCTS

**LOW NOISE UHF TRIODE.**—The Genalex A2521, for use as a grounded grid rf amplifier at up to 1 kmc, has a transconductance of 12,000 umhos and a plate dissipation of 2-1/2 w. In normal receiver application, the noise factors are 9 and 12 db at 500 and 900 mc, respectively. At 900 mc for power gains of 6 and 16 db, available bandwidths are 80 and 4 mc, respectively.

British Industries Corp., Dept. ED, 80 Shore Rd., Port Washington, N.Y.

CIRCLE 283 ON READER-SERVICE CARD

**POCKET CIRCUIT TESTER.**—Model AT-101 instantly shows power availability and continuity for any normal voltage circuit through three indicator lights for 24 v, 110 v, and continuity. Other voltages may be substituted. The unit operates on two standard C flashlight batteries, measures 4-1/4 x 2-1/4 x 1-1/4 in., and weighs 12 oz.

Autotron, Inc., Dept. ED, Box 2278, Santa Monica, Calif.

CIRCLE 284 ON READER-SERVICE CARD

**VOLTAGE RESPONSE TEST SET.**—This automatically swept power supply is useful in testing voltage response characteristics over narrow or broad scanning limits. It can be coupled with an X-Y recorder to draw response curves. Sweeping limits may be preset or manually controlled at continuously variable scanning speeds, and typical dual voltage ranges are 2 and 15 kv at 4 ma. Accuracy and linearity are 1%.

Briggs Associates, Inc., Dept. ED, 10 DeKalb St., Norristown, Pa.

CIRCLE 285 ON READER-SERVICE CARD

**PRECISION VERNIER CALIPER.**—The Etalon 17 caliper has flush back jaws and long, fully adjustable vernier plates. Inside, outside, and depth measurements are read from the same scale. Available in English, or English and metric combination; it is packaged in a contour case.

Alina Corp., Dept. ED, 122 E. Second St., Mineola, N.Y.

CIRCLE 286 ON READER-SERVICE CARD

**LOCKING ADAPTERS.**—Adapt coaxial connectors to instruments equipped with binding posts on standard 3/4 in. spacing. Approximately 1/2 turn of lock screw expands plated steel banana pin within binding post, securely locking adapter in place. Models 100 BS and 100 B are for shielded and unshielded BNC connectors; models 100 US and 100 U are for shielded and unshielded UHF connectors.

Highland Electric Co., Dept. ED, 1130 Mission St., South Pasadena, Calif.

CIRCLE 287 ON READER-SERVICE CARD

**SEALED RELAYS—unmatched for reliability**



**1951—Miniature sealed relay**



**1953—Sub-miniature sealed relay**



**1955—Micro-miniature sealed relay**

**1959**



**NEW 4-pole micro-miniature relay  
NEW Unimite relay**



**GENERAL ELECTRIC ANNOUNCES . . .**

**Two new, ultra-small relays**

From the company which first introduced the revolutionary micro-miniature relay in 1955 come two more important new developments in sealed-relay miniaturization.

General Electric has added the world's smallest one-amp relay, the single-pole Unimite, and a new four-pole micro-miniature to its sealed-relay line. Both new relays incorporate an important advance in relay manufacture. No solder and no solder flux are used anywhere in either relay's structure. A new inert-arc welding process seals headers to cans, eliminating a major cause of contact contamination.

The new Unimite and four-pole relays lend themselves admirably to printed-circuit-board work. The Unimite relay can be soldered into the board or is available for stud, lug, or bracket mounting. Its flexible leads can be formed or fanned for any circuit requirement. The four-pole relay terminations are on 0.2 inch centers in accord with the popular grid-spaced pattern.

These new relays, combined with a full line of miniature and double-pole micro-miniatures, offer equipment designers a new dimension in relay flexibility. Both new relays meet or exceed

applicable requirements of MIL-R-5757 and MIL-R-25018.

All General Electric sealed relays combine minimum size with unmatched reliability under severe shock, vibration, and temperature conditions. For complete information on G.E.'s full line of sealed relays, contact your G-E Apparatus Sales Office or mail coupon at the right. General Electric Co., Specialty Control Dept., Waynesboro, Va.

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**



**Unimite is world's  
smallest 1-amp relay**

The slim cylindrical shape of the new Unimite relay saves space in the important vertical dimension. Its high-speed operation—operates in 1.5 milliseconds max., release time 3.5 milliseconds max.—offers a new approach to automatic switching. Its welded, totally isolated contact capsule eliminates organics from switching chamber, provides lifetime freedom from contact contamination. Every Unimite is a dry-circuit relay.



**4-Pole micro-miniature  
suited for 160C ambient**

New micro-miniature provides four-pole configuration and exceptionally long life performance—minimum of 10 million low-level operations, test units have run over 50 million operations. Suitable for continuous operation in a 160C ambient, the relay provides a valuable safety factor in application to 125C equipments. Vibration performance is excellent; it withstands 55 to 2000 cycles at 30G acceleration without contact opening. Operate power is only 400 mw.

General Electric Company  
Section D792-12  
Schenectady, New York

Please send me a free copy of the  
1959 Sealed Relay Catalog.

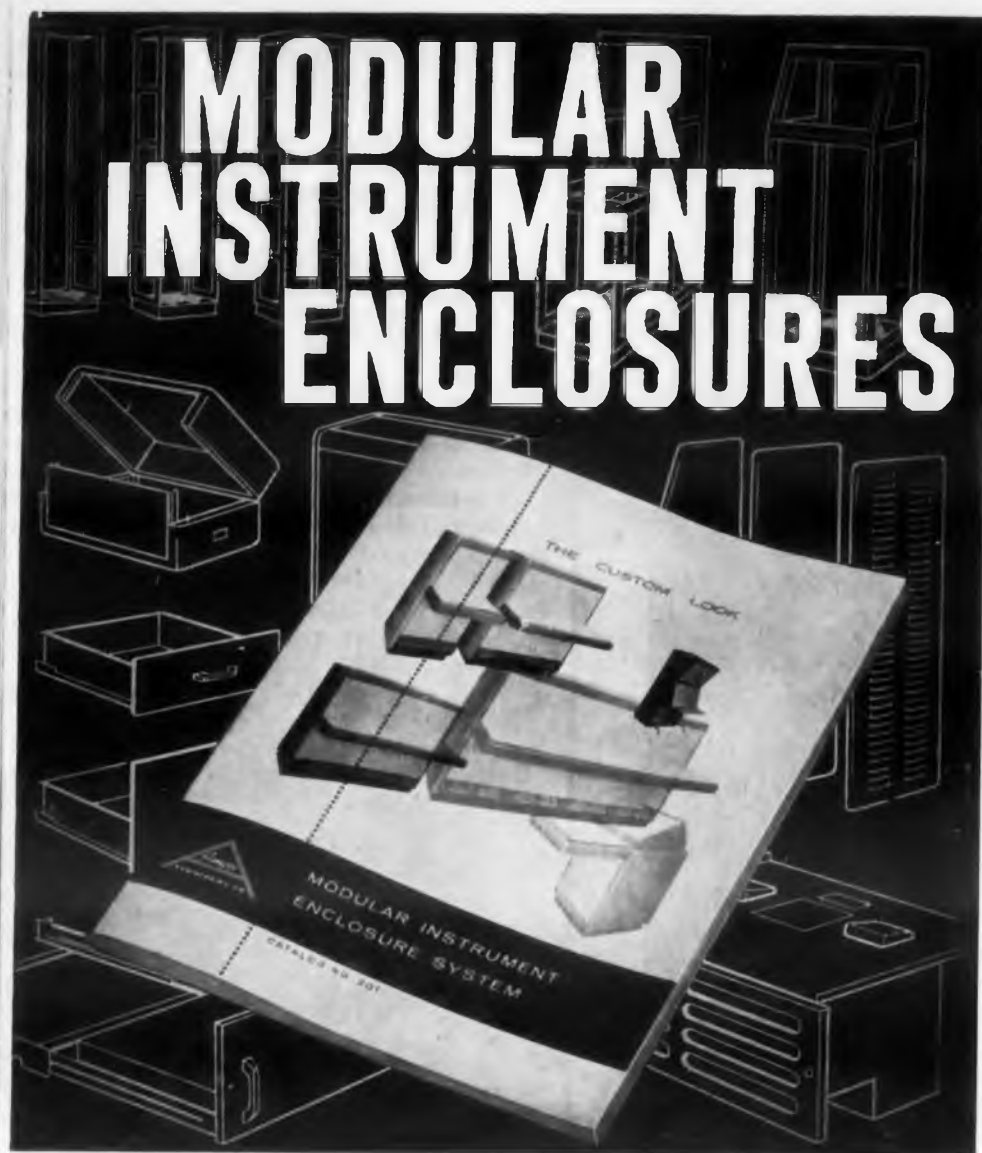
Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

**GENERAL ELECTRIC**



Everything needed for top-quality, custom-appearance enclosures is made by AMCO...and shown in this new catalog!

The multi-width panels, cowlings and writing surfaces, unique with Amco, retain custom quality appearance of single unit construction. Amco's electronics know-how and wide experience in the manufacture of equipment enclosure and relative mounting and cooling accessories assure your complete satisfaction in the appearance, strength and durability of every unit. Amco cabinets and enclosures are designed to accommodate the most complex systems and provide complete service accessibility and operator convenience.

All Amco frames are direct floor-bearing.

A complete selection of basic frames can be arranged in endless variety, all chassis and equipment is mounted directly off of frame members for maximum support. Blowers, chassis slides, heavy-duty dollies and many other parts and accessories, *all made by Amco, are supplied under a combined discount rate with other components—a big savings.*

These are a few of the reasons more and more engineers depend on Amco for all enclosure needs. They find real convenience, quality and economy by doing it. If you don't have your copy of the new catalog yet, send for it now.

Realistic 3 week delivery



**AMCO ENGINEERING CO.**  
7335 W. AINSLIE STREET • CHICAGO 31, ILLINOIS  
Factory-trained representatives in all principal U. S. cities and Canada  
CIRCLE 289 ON READER-SERVICE CARD

## NEW PRODUCTS

### AC Voltmeter Panel mounted



Panel mounted model 311 ac electronic voltmeter has a 5 meg input impedance paralleled by 25  $\mu$ f. Frequency range is 20 cps to 250 kc, accuracy is  $\pm 2\%$  of full scale, and full scale sensitivity is 10 mv to 300 v rms. The multirange unit has a 6 in. meter and a built-in power supply.

Metronix, Inc., Dept. ED, Chesterland, Ohio.

CIRCLE 290 ON READER-SERVICE CARD

### Angle Measuring System

Provides continuous decimal display

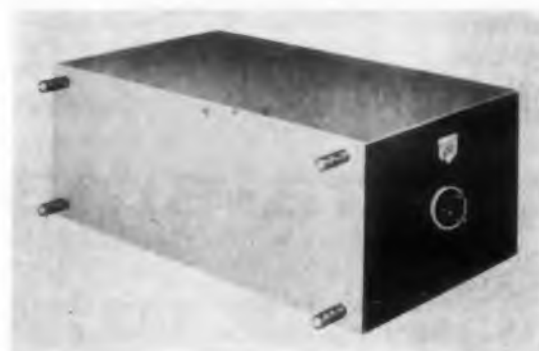
Type BRL-5 electro-mechanical angle measuring system provides continuous information of shaft angle to resolution of 360,000 parts in a single turn, and decimal display of the measured angle in degrees and thousandths of degrees. Output is in decimal and 8-4-2-1 binary coded decimal form.

United Aircraft Corp., Norden Div., Dept. ED, Wiley St., Milford, Conn.

CIRCLE 291 ON READER-SERVICE CARD

### Delay Network

For analog computers



This analog computer delay network has a 700  $\pm 7$   $\mu$ sec overall delay tapped at 70  $\mu$ sec  $\pm 1\%$  intervals. Characteristic impedance is 3 K at  $\pm 5\%$ ; delay linearity,  $\pm 1\%$  from 300 cps to 25 kc; ripple,  $\pm 1\%$ ; insertion loss, 1 db maximum; frequency response,  $\pm 1$  db from 300 cps to 10 kc. Dimensions are 9 x 5-3/8 x 4-7/8 in.

ESC Corp., Dept. ED, 534 Bergen Blvd., Palisades Park, N.J.

CIRCLE 292 ON READER-SERVICE CARD

**Malco** IS YOUR  
**BEST SOURCE**  
FOR  
SOLDERING LUGS  
TERMINALS  
PRINTED CIRCUIT  
HARDWARE



### HERE'S WHY:

- Specialized high production techniques afford lowest possible unit cost.
- Precision tooling, rigid quality control assure tolerances to critical specifications.
- Ample stocks of over 1000 different parts permit prompt delivery.
- Malco specializes in a complete line of small stampings for Radio-TV, electrical/electronic and automotive industries.

- Our line includes terminals and printed circuit hardware in loose or in chain form for automatic insertion.

Let Malco show you how you can save on production time and costs. Contact us today.

REQUEST  
BULLETIN  
552



**Malco** MANUFACTURING COMPANY

4027 W. LAKE ST. • CHICAGO 24, ILL.  
CIRCLE 293 ON READER-SERVICE CARD



## Pulse Height Analyzers

Have no double pulsing or threshold shift

These pulse height analyzers use a linear amplifier with overload characteristics that eliminate double pulsing or threshold shift. Model SC-76 contains a pulse height analyzer and a high voltage regulator with high reliability. Model SC-77 contains a pulse height analyzer and a precision 2000 v high voltage power supply of high stability.

Tracerlab, Inc., Dept. ED, 1601 Trapelo Rd., Waltham, Mass.

CIRCLE 294 ON READER-SERVICE CARD

## Magnetic Amplifier

Has built-in, all-magnetic modulator

Model DM-4 magnetic amplifier consists of types 3W and 6W for servo applications. It has a built-in, all-magnetic demodulator and does not require tube preamplifier. Hermetically sealed and built to MIL-T-27A specs, the unit operates from 400 cps power with a minimum input impedance of 15 K. The operating temperature range is -55 to +85 C.

Westbury Electronics, Inc., Dept. ED, Westbury, N.Y.

CIRCLE 295 ON READER-SERVICE CARD

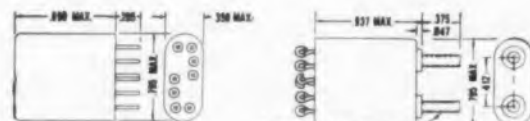
## X-Band Waveguide Twist Section

Available in  $\pm 45$ ,  $\pm 60$ ,  $\pm 90$  deg units

This X-band waveguide twist section is available in models X45, X60, and X90, having 45, 60, and 90 deg twists, respectively. Typical specifications include an insertion loss of less than 0.2 db, vswr of less than 1.1, bandwidth of 8.2 to 12.4 kmc. Its weight is 18 oz; it is 2.1 in. long and has a diameter of 2.5 in. The unit has no gears or flexible linkages to wear and has a large bearing area.

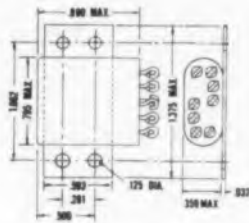
Wiley Electronics Co., Dept. ED, 2045 W. Cheryl Drive, Phoenix, Ariz.

CIRCLE 296 ON READER-SERVICE CARD  
CIRCLE 297 ON READER-SERVICE CARD

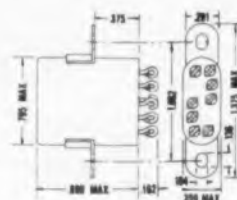


SC11D  
6, 12, 24, 36 Volts

SC11DK  
6, 12, 24, 36 Volts

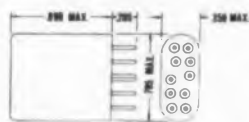


SC11DB  
6, 12, 24, 36 Volts



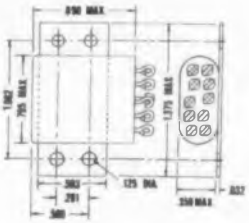
SC11DA  
6, 12, 24, 36 Volts

2 TYPES • 4 MOUNTINGS • 4 VOLTAGES

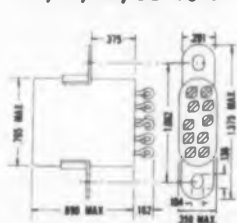


SL11D  
6, 12, 24, 36 Volts

SL11DK  
6, 12, 24, 36 Volts



SL11DB  
6, 12, 24, 36 Volts



SL11DA  
6, 12, 24, 36 Volts

# SC

# SL



Off the shelf delivery FROM YOUR P & B DISTRIBUTOR

# 32 STANDARD P & B CRYSTAL CASE RELAYS

Prototype or small-production-run quantities of P&B's micro-miniature relays are now available from your local electronic parts distributor. Choose from 2 types, 4 mountings, 4 coil voltages—32 models in all.

P&B's dual coil, permanent magnet, crystal case relays remain operative under 100g shock, 30g to 2000 cps vibration. Modern White Room production facilities assure

highest possible reliability.

The SC conforms to standard dimensions and circuitry, and can replace ordinary relays of the same size.

The SL, a latching relay, utilizes the dual-coil, permanent magnet principle to provide a highly efficient, tenacious latch, assuring high contact pressure.

Order today from your local electronics parts distributor.

#### SC and SL SPECIFICATIONS:

Shock: 100g for 11 millise.

Vibration: 30g from 55 to 2000 cps  
.195" max. excursions from 10 to 55 cps

Ambient Temperature Range:  
-65°C. to +125°C.

Contact Arrangement: dpdt

Contact Load: 2 amps at 30 vdc  
1 amp at 115 vac, 60 cycle

Sensitivity:  
SL—230 milliwatts at 25°C. with  
630 ohm coil  
SC—260 milliwatts at 25°C. with  
550 ohm coil



## POTTER & BRUMFIELD

DIVISION OF AMERICAN MACHINE & FOUNDRY COMPANY, PRINCETON, INDIANA  
IN CANADA: POTTER & BRUMFIELD CANADA LTD., GUELPH, ONTARIO

## NEW PRODUCTS

**PRINTED CIRCUIT BOARD CLIP.**—One-piece Speed Clip designed to serve as spacer and fasten boards to chassis. Provides 1/2 in. clearance.

Tinnerman Products, Inc., Dept. ED, P.O. Box 6688, Cleveland, Ohio.

CIRCLE 298 ON READER-SERVICE CARD

**RECTIFIER TUBES.**—Full-wave types 604, 604L, 606, 606L and half-wave types 615, 623, 635, 635L, and 635P are rated from 10 to 77 amp peak current, 500 to 2000 peak inverse v. Applications include induction heating, dielectric heating and motor speed control.

Raytheon Mfg. Co., Industrial Products Dept., Dept. ED, 55 Chapel St., Newton 58, Mass.

CIRCLE 299 ON READER-SERVICE CARD

**TEMPERATURE INDICATOR.**—Is used with any 100 ohm resistance probe or thermometer using CP nickel wire. The PI-3 is portable, battery operated, has a low range of -60 to +140 F and a high range of 0 to 500 F. It is 7 x 10 x 5-1/2 in.

Arthur C. Ruge Associates, Inc., Dept. ED, Hudson, N.H.

CIRCLE 300 ON READER-SERVICE CARD

**SET SCREW.**—Flare-Lok set screw will not shake loose from its mounting when not in use. Its point flares out when it is tightened against the bearing surface, and may be removed without damaging mating thread. It is available in hex, slabbed or slotted heads.

Set Screw & Mfg. Co., Dept. ED, Bartlett, Ill.

CIRCLE 301 ON READER-SERVICE CARD

**TRANSIT CASE.**—Protects delicate and critical missile and electronic components. It is lined with precisely molded Stanfoam to fit irregular components.

Standard Plastics, Inc., Dept. ED, Fogelsville, Pennsylvania.

CIRCLE 302 ON READER-SERVICE CARD

**MINIATURE TRANSDUCER.**—Withstands rocket engine blast. Oil-damped, the P285TC withstands the violent pressure transients generated in shock tubes. It measures pressures from 0 to 50 and 0 to 1000 psi. It weighs 3 oz, and is 49/64 in. long. Output is 28 mv full scale open circuit at 7 v excitation.

Statham Instruments, Inc., Dept. ED, 12401 W. Olympic Blvd., Los Angeles 64, Calif.

CIRCLE 303 ON READER-SERVICE CARD

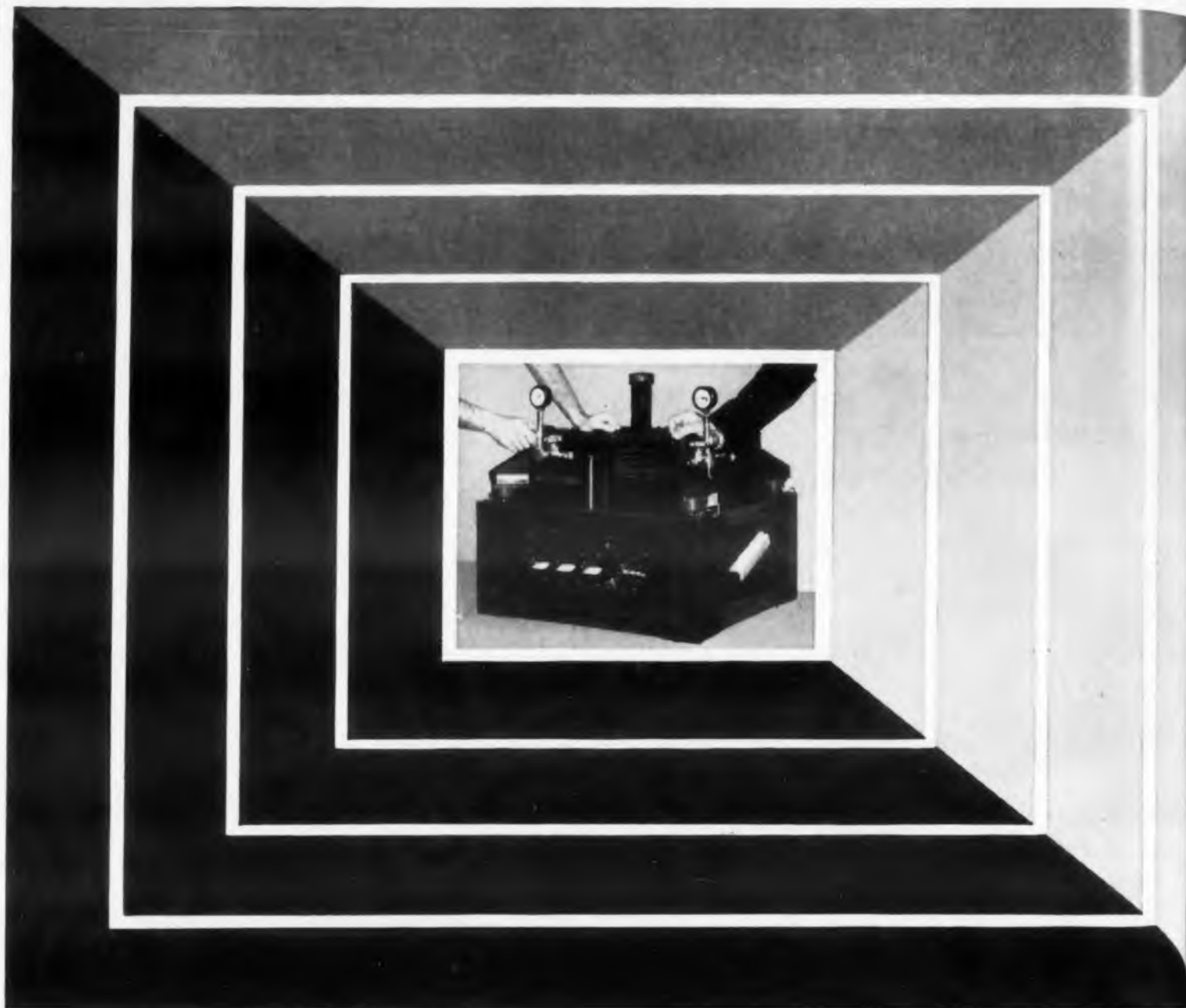
**ELECTRICAL CONNECTORS.**—Single-conductor plugs and receptacles have 50 and 100 amp ratings for use in portable or stationary power and distribution panels. Current-carrying parts are of gold-plated brass; plug wiring can be by soldering or by fastening with two cable screws.

Superior Electric Co., Dept. ED, Bristol, Conn.

CIRCLE 304 ON READER-SERVICE CARD



THE RAW MATERIALS OF PROGRESS



## VHF AMPLIFIER WEIGHT REDUCED

Dramatic results in miniaturization were achieved by The Martin Company on their airborne electronics equipment through use of FC-75 Dielectric Coolant by 3M.

The conventional amplifier, complete with power supply, weighed more than half a ton, required a standard 6 foot high relay rack for installation. Yet elaborate as this system was, it was still not immune to extreme temperature ranges, aircraft speeds and altitudes.

Then, non-corrosive 3M inert fluids were used to help

protect from internally generated heat using the evaporative cooling qualities of FC-75. The result: a new 2-stage VHF amplifier that weighs less than 200 pounds, occupies less than 3 cubic feet of space and operates under all extremes encountered.

Investigate the remarkable properties of 3M inert fluids in terms of your own product design, miniaturization and performance problems. 3M inert fluids are non-flammable, non-explosive, non-toxic and odorless, ideal as evaporative coolants and insulators.

CHEMICAL DIVISION

MINNESOTA MINING AND MANUFACTURING COMPANY

... WHERE RESEARCH IS THE KEY TO TOMORROW



CIRCLE 305 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 19, 1959



3M FLUORO-CHEMICAL FC-75 has a useful liquid range of  $-150^{\circ}\text{F.}$  to  $212^{\circ}\text{F.}$  at atmospheric pressure, with a viscosity of 16 Centistokes at  $-90^{\circ}\text{F.}$  In addition, it offers these other useful properties: High dielectric strength in both liquid and vapor state (37 KV 0.1" gap for liquid) . . . self-healing in high voltage electrical equipment . . . excellent wetting power . . . compatible with materials commonly used in the construction of high temperature equipment . . . thermally stable to temperatures in excess of  $750^{\circ}\text{F.}$  and, even under extreme use conditions, does not form sludge or corrosive products. Heat capacities in liquid and vapor state are approximately equal.

ED BY 80%

See what 3M Chemicals can do for you! For free literature, write on your company letterhead, specifying product interest, to 3M Chemical Division, Dept. KAP-89, St. Paul 6, Minnesota.



3M CHEMICAL DIVISION, MANUFACTURERS OF:  
Acids • Resins • Elastomers • Plastics • Oils,  
Waxes and Greases • Dispersion Coatings  
• Functional Fluorochemicals • Surfactants  
and Inert Liquids

### Miniature DC Motor

Weights 1.4 oz



Type 820 permanent magnet dc motor has an operating speed up to 20,000 rpm and weighs 1.4 oz. The unit operates on any dc voltage between 3 and 30 v. Maximum torque is about 0.5 oz-in. and working torques range from 0.4 to 0.1 oz-in. between the output speeds of 5000 and 20,000 rpm. With constant load, speed is almost a linear function of applied voltage.

Cramer Controls Corp., Dept. ED, Centerbrook, Conn.

CIRCLE 306 ON READER-SERVICE CARD

### Line-Voltage Regulators

Are servo-controlled

These line-voltage regulators are designed to meet military environmental requirements of shock, vibration, temperature and humidity for three-phase service. They are servo-controlled and have no distortion, large power rating and good transient response. Type 1570-ALS25, 115 v, and type 1570-AHS-25, 230 v, have maximum kva in wye connection of 8.6.

General Radio Co., Dept. ED, West Concord, Mass.

CIRCLE 307 ON READER-SERVICE CARD

### Continuously Variable Delay Line

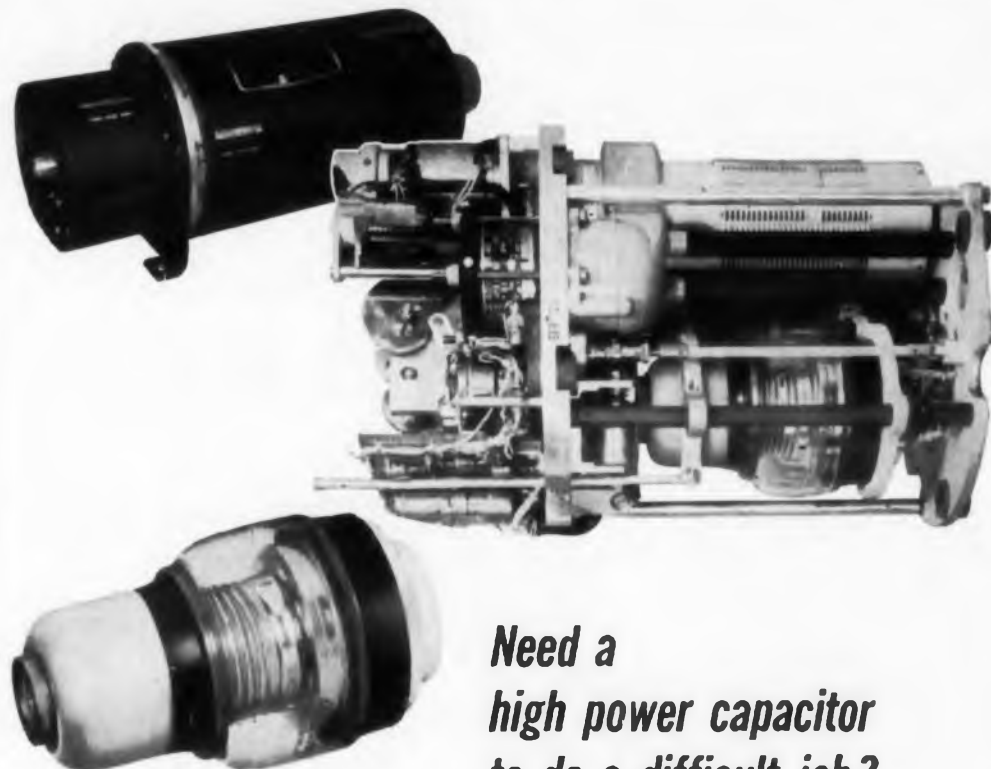
Resolution time less than 1  $\mu\text{sec}$



Having 40 turns and 14400 deg of rotation, this continuously variable delay line measures 1 x 2 x 7 in. Resolution time is less than 1  $\mu\text{sec}$  and rise time is less than 10% of the time delay at any point. Maximum operating voltage is over 300 v. Many types of the unit are available with total delay varying from 1.5 to 10  $\mu\text{sec}$  and the characteristic impedance varying from 50 to 300 ohms.

Ad-Yu Electronics Lab., Inc., Dept. ED, 249-259 Terhune Ave., Passaic, N. J.

CIRCLE 308 ON READER-SERVICE CARD



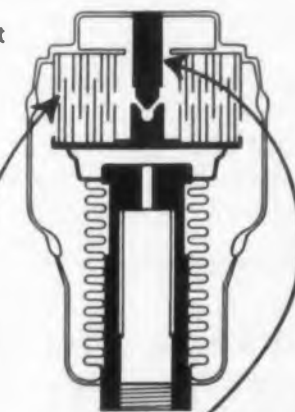
Need a  
high power capacitor  
to do a difficult job?

## JENNINGS VACUUM CAPACITORS

Jennings Vacuum Capacitors combine imaginative engineering with the innate advantages of a vacuum dielectric to accomplish circuit designs impossible to obtain with other capacitive devices.

An example of the creative engineering obtainable at Jennings is our type UCSLPS variable vacuum capacitor. This capacitor was designed for use in Remington Rand's new UNIVAC 3200 Series Automatic Antenna Coupler whose superior performance is achieved through advanced circuit design using the highest quality components.

Apparent requirements, in this application, were for two capacitors and a shorting relay to allow switching from a high voltage capacitor to a low voltage capacitor, or switch both capacitors out of the system completely. Space limitations, however, presented an obstacle. The problem was solved by designing one capacitor with two sets of plates of different lengths which by sliding in and out would meet the different voltage and capacitance requirements. It has a test voltage rating of 5 kv at 750 mmfd increasing to 23.5 kv at 40 mmfd and 30 kv at 10 mmfd. A switch is incorporated inside the vacuum to short out the total capacity under very high frequency operation. This also has the added advantage of having a common starting point, or a pre-set point, for the automatic tuning mechanism.



Jennings capacitors are obtainable either fixed or variable and since there is no dielectric to puncture they are self healing after moderate arc-over.

Catalog literature on over 300 types of vacuum capacitors, switches, and relays is available for more detailed information.

Jennings

RADIO MANUFACTURING CORPORATION  
970 McLAUGHLIN AVE., P. O. BOX 1278, SAN JOSE 8, CALIF.

CIRCLE 309 ON READER-SERVICE CARD

# HETHERINGTON

SWITCHES • INDICATOR LIGHTS • SPECIAL ASSEMBLIES

## ENGINEERING NEWS

### LIMIT SWITCHES

for Heavy Current Jobs



For heavy-duty limit or positioning applications, Hetherington offers a variety of special switches with ratings from 10 to 35 amperes.

Pushbutton types, such as the slim, 9/16" diameter "W100" Series or the 35-amp "D200" Series, feature short, unusually sturdy plungers that afford positive direct operation in minimum space. Threaded aluminum bushings provide easy mounting and positioning.

Where switches must operate against sliding surfaces, the cam-operated "D7000" Series proves ideal for many applications. Flush

CIRCLE 716 ON READER-SERVICE CARD

mounting, and only 2-27/64" long by 3/4" square, this small switch has a polished stainless steel cam which retracts within 1/32" of the switch body. Over-travel is 9/32" minimum.

Like most Hetherington products, Limit Switches use Hetherington's tease-proof, double-break, snap-action mechanism. A variety of single-pole contact arrangements are available on each type. Switch mechanisms are effectively sealed against dust and moisture by integral anodized aluminum housings. Cases are especially rigid to withstand severe service.

### For Lamp Circuits that MUST NOT FAIL

Lamp burn-outs and circuit failures can present real hazards in critical warning light applications. To minimize the danger, the Hetherington L3000 Series allows the lamp and its circuit to be checked at any time merely by pressing on the spring-mounted plastic lens.

An anodized aluminum case seals the L3000 against dust, while a rubber "O" ring and silicone boot fully mois-



tureproof the lens and plunger. Highly reliable AN3140 lamps used in the L3000 series add still further to the dependability.

Details on the L3000 line are in Hetherington Bulletin L-1a. Small quantities of Type L3000R (red lens, 28v) are stocked by many leading electronic parts distributors.

CIRCLE 718 ON READER-SERVICE CARD

### SCREWDRIVER-OPERATED ROTARY

Simplifies Circuit Testing



An aircraft equipment manufacturer needed a small, yet high current switch that could be concealed for use only during installation or routine maintenance testing of his equipment. The answer was the Hetherington Type R1043—a screwdriver-operated version of the popular R1000 Series Rotary Switch.

Accessible, yet readily hidden behind the chassis, the R1043 allowed easy circuit transfer from "Operate" to "Test" with far greater reliability than the space-consuming, jumper-type test fittings previously used.

Only 3/4" in diameter, the R1043 rotary switch breaks 20 amps (resistive) at 28v dc. In spite of its size, the positive snap-action assures adequate leverage to break contact welding from overloads.

No bulletin is available on the R1043, but dimensions, ratings and contact data will gladly be sent.

CIRCLE 717 ON READER-SERVICE CARD

### FAST, STOCK DELIVERIES

... from local Parts Distributors

In many areas you can now get immediate delivery of most popular Hetherington products . . . and at factory prices for less than 50 pieces.

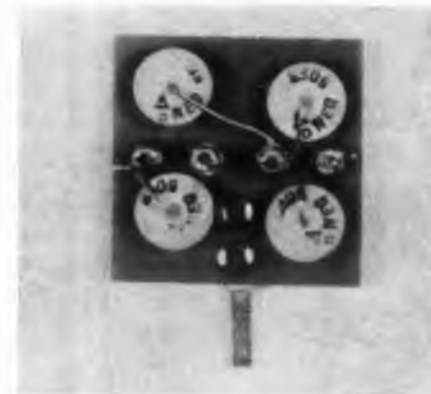
For the name of your nearest electronic parts distributor and bulletins of the Hetherington products he carries, write directly to: *Distributor's Div.*, Hetherington Inc., 26 Rittenhouse Place, Ardmore, Pa.

CIRCLE 719 ON READER-SERVICE CARD

### NEW PRODUCTS

#### Silicon Rectifier Full Wave Bridge

Has 500 piv rating



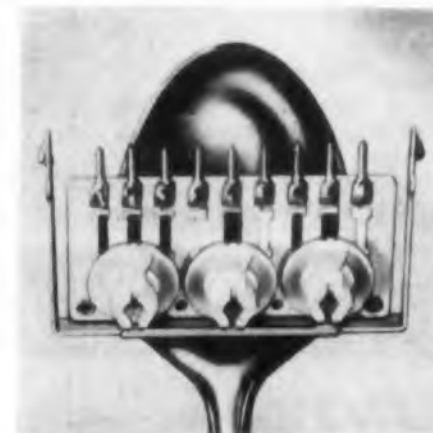
Mounted on Bakelite board, this silicon rectifier full wave bridge has a 500 piv rating and an output of approximately 315 v dc, resistive. Maximum ac input is 350 v, resistive-inductive, and 175 v, capacitive. Rectified forward current is 1.5 amp, resistive and 1 amp, capacitive, and maximum reverse current, full cycle average, is 0.25 ma. The unit weighs about 4 oz.

Gates Electronic Co., Dept. ED, 2090 Barnes Ave., Bronx 62, N.Y.

CIRCLE 311 ON READER-SERVICE CARD

#### Resistor Network

For printed circuits



Designed for printed circuit applications, this self-supporting snap-in two or three-section variable and fixed resistor network has a mounting bracket which secures the network to a printed circuit panel before solder dipping. Resistive elements are bonded to steatite ceramic for maximum stability. Variable resistor parts have a resistance range of 500 ohms to 5 meg (linear taper), wattage rating of 1/4 w with 250 v dc max across end terminals, and full load rating at 70 C derated to no load at 90 C. Type X-153, three-section unit, measures 1-29/32 in.; type X-152, two-section unit, measures 1-25/64 in.

Chicago Telephone Supply Corp., Dept. ED, Elkhart, Ind.

CIRCLE 312 ON READER-SERVICE CARD

HETHERINGTON INC. DELMAR DRIVE, FOLCROFT, PA. • 139 Illinois St., El Segundo, Calif.

NOW IN LARGER FACILITIES TO SERVE YOU BETTER

A Controls Company of America Subsidiary

CIRCLE 716 THROUGH 719 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 19, 1959

## Numeric Readout

One input per character



Model SGS-401 numeric readout uses only one input per character and needs no external segment switching devices. Input voltage is 230 to 300 v dc or 160 to 200 v ac, rms. The display screen size is 1-3/8 x 2 in. and the characters are 1-1/8 x 1-3/4 in. The standard model displays 26 letters and 10 digits; other combinations or additional characters are available.

I.D.E.A., Inc., Dept. ED, 7900 Pendleton Pike, Indianapolis 26, Ind.

CIRCLE 313 ON READER-SERVICE CARD

## 4PDT Relay

Takes 20 g to 2000 cps

Type HG 4DM relay is a double-ended 4pdt relay using two parallel, magnetically isolated structures and one common coil. The two armatures are of the balanced rotary type, making it suitable for use under vibration of 20 g to 2000 cps. Contacts are rated at 2 amp resistive at 28 v dc or 115 v ac. The diameter is 5/8 in.; case length is 1-1/2 in.

Hi-G, Inc., Dept. ED, Bradley Field, Windsor Locks, Conn.

CIRCLE 314 ON READER-SERVICE CARD



## Acceleration-Sensitive Switch

5 g to 60 g range

For missiles and aircraft, series 5 I-S switch responds uni- and bi-directionally to axial acceleration from 5 to 50 g. Accuracy is within 5% and actuating time is 20 msec. The service life is 100,000 cycles. The only moving part is a precision ground ball held by a uniform magnetic field. The switch is factory preset, with nominal setting specified by the user. It meets MIL-E-5272-A.

Inertia Switch, Inc., Dept. ED, 311 W. 43rd St., New York 36, N.Y.

CIRCLE 315 ON READER-SERVICE CARD

## Outstanding

### New Performance ... Flexibility

in automatic noise figure measurement



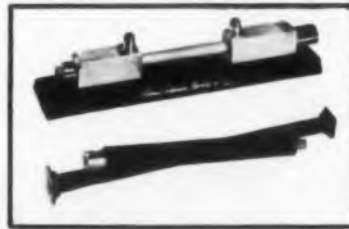
## Only THE NEW AIR TYPE 74 Offers These Advantages

- **Noise Figure Range, RF or IF** ... High Scale—23 to 36 db with extension to infinity  
Low Scale—0 to 25 db
- **Accuracy** ..... Automatic: Low Scale— $\pm 1/2$  db  
High Scale— $\pm 1$  db  
Manual:  $\pm 0.1$  db with AIR Type 30 Attenuator
- **Automatic Operation** ..... AGC range—65 db minimum
- **Manual Operation** ..... Front panel IF gain control
- **Input Frequency** ..... 30 or 60 MC standard plug-in units.  
Other frequencies available
- **Sensitivity** ..... 50 microvolts at 30 MC  
100 microvolts at 60 MC
- **Bandwidth** ..... 6.0 MC minimum
- **Recorder Outputs** ..... Noise figure and AGC

All these features at a new, low price ..... **\$765.00**

The AIR Type 74 provides continuous, automatic noise figure measurements. Its design permits the adjustment of receiver parameters

to minimize noise figure. No special training is required for use on the production line, in the laboratory, or in the field.



Ten AIR Type 70 Noise Generators provide continuous coverage from 30 MC to 40,000 MC ... most complete line of noise generators available for automatic noise figure measurements.



## AIRBORNE INSTRUMENTS LABORATORY

1345 NEW YORK AVENUE, HUNTINGTON STATION, L. I., NEW YORK

A DIVISION OF CUTLER-HAMMER, INC.

CIRCLE 316 ON READER-SERVICE CARD

RVG-14-MT10 Multi-Turn  $\frac{7}{8}$ " diam.  
Shown twice size.



## New "Standard" WITH Special Capabilities!

### EXTRA RUGGEDNESS

- Anodized Aluminum Housing for Stability
- Individual, High-Strength Terminals Resist Elevated Temperatures
- High-Temperature Epoxy-Glass Insulation Protects Coil
- Sturdy Shock-Proof Shaft Stops Won't Loosen

### EXTRA PRECISION

- Linearity (Independent) up to  $\pm 0.05\%$
- Close Concentricity between Coil and Wiper
- Wiper Pigtailed to Terminal to Eliminate Sliding Contact
- Exclusive Spring-Pressure Terminal-and-Tap Design Assures Positive Contact

### EXTRA VERSATILITY

- Operation Up to  $150^{\circ}\text{C}$
- 10, 5, or 3 Turn Units
- Resistance Range from 250 ohms to 300 K ohms
- Tap Locations Limited Only by Physical Spacing
- 5.5 watts @  $85^{\circ}\text{C}$  (derated to 0 @  $150^{\circ}\text{C}$ )

### EXTRA SMOOTHNESS

- Stainless-Steel Class 7 Ball Bearings
- Wear-Compensating Slider for Zero Backlash
- Wiper Pigtailed to Terminal to Eliminate Sliding Contact
- Meets applicable sections of MIL-E-5272A and NAS-710. Write for detailed RVG-14-MT10 specifications.

A glance at the performance characteristics of this new Gamewell precision potentiometer tells the story! It fully meets applicable MIL specs — and much more. In addition, it gives you important *extras* that permit you to do *more* with a *standard potentiometer*. In many cases you can save the cost of a "special."

Of course, Gamewell supplies special pots — both linear and non-linear whenever necessary. Extensive facilities for their design, development, and production are constantly at your disposal.

Meet the challenge of shrinking component space . . . tougher environmental demands . . . tighter limits of precision . . . *economically* with Gamewell Precision Potentiometers. Bring your pot problems to THE GAMEWELL COMPANY, Dept. 14C, Newton Upper Falls 64, Massachusetts.

**Gamewell**

PRECISION POTENTIOMETERS

"Integrals of High Performance"

CIRCLE 317 ON READER-SERVICE CARD

## NEW PRODUCTS

### X-Y Recorder

Has writing speeds over 2500 in. per sec



Model 670 x-y recorder uses optical galvanometers, a light beam trace and immediate-developing direct print paper charts. Charts are 8 x 8 in. Writing speeds over 2500 in. per sec are attained. The over-all frequency response is 3 db down at 130 cps and is independent of amplitude. Linearity is 1% of full scale; sensitivity is as high as  $62.5 \mu\text{v}$  per in.

Sanborn Co., Industrial Div., Dept. ED, 175 Wyman St., Waltham 54, Mass.

CIRCLE 318 ON READER-SERVICE CARD

### Silicon Rectifiers

Piv range is 600 to 10,000 v



Types 1N2373 through 1N2381 high altitude silicon cartridge rectifiers cover the piv range from 600 to 10,000 v. The rectifiers are ceramic encased to minimize problems encountered in high altitude operation. They provide dc output currents from 75 to 250 ma at 25 C. Operating temperature range is from  $-55$  to  $+150$  C. Maximum reverse current at rated piv is  $10 \mu\text{a}$  at 25 C.

International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif.

CIRCLE 319 ON READER-SERVICE CARD



### Servo Amplifier

Drives either 3.5 w or 6 w servo motors

Model 130 servo amplifier drives either 3.5 w or 6 w servo motors from low level 400 cps signals. Maximum gain is 2000 and may be adjusted by external resistor. Gain stability of the transistorized unit is 3 db over temperature range. Input impedance is 100 K min at all gains. It operates on 28 v dc with internal protection against dc line transients and meets MIL-E-5272.

Control Technology Co., Dept. ED, 1186 Broadway, New York 1, N.Y.

CIRCLE 320 ON READER-SERVICE CARD

### Flexible RF Coaxial Cable

Operates continuously at 1000 F

Designed for missile, aircraft, and nuclear applications, the cable system consists of a flexible, metal-alloy jacketed rf coaxial cable with series N, C or SC connectors. It will operate continuously at 1000 F. The cable core is semi-solid silica. Nominal impedance is 50 ohms; velocity of propagation is 69.0%.

Amphenol-Borg Electronics Corp., Amphenol Cable & Wire Div., Dept. ED, S. Harlem Ave. at 63rd St., Chicago 38, Ill.

CIRCLE 321 ON READER-SERVICE CARD

### Random Signal Meter

Indicates true rms



Model TBM-2 true rms voltmeter has a peak factor of 10 or more and two selectable time constants of 0.5 and 16 sec. Frequency range is between 1 cycle and 500 kc. There are 18 voltage ranges between 0.5 mv and 250 v. An amplified signal feeds the sensitive thermal device which generates a voltage proportional to input signal power.

Flow Corp., Dept. ED, 85 Mystic St., Arlington, Mass.

CIRCLE 322 ON READER-SERVICE CARD

*Philbrick's USA-3 Amplifier...*  
**"Heart" of Dymec's\***  
**new DY-2210**  
**Voltage-to-Frequency Converter**

**PHILBRICK MODEL USA-3 UNIVERSAL STABILIZED AMPLIFIER**—More performance per dollar than any other amplifier. Highly reliable — no electrolytic capacitors or glow tubes. Designed to prevent self destruction even when output is grounded. Drift, noise, offset under 100 microvolts. Output, 116 vdc. Wide frequency range — dc to 100 kc (attenuation less than 3 db) when connected as gain-of-ten amplifier. Printed circuit board, 7" x 2½", mounts by several convenient methods. **PRICE \$95**



The new DYMEC Model 2210 compares the area under a stable, calibrated pulse train with the average value of an input signal and continuously adjusts the pulse rate for equality. The result: a pulse frequency proportional to input voltage within 0.1% of full scale up to 10 kc.

The summing integrator performing this comparison must have very high reliability and low drift while maintaining low distortion. Furthermore, it must be sufficiently economical to make this product feasible at its low price of \$650.

Only Philbrick's Model USA-3 Universal Stabilized Amplifier met all these exacting needs.

*Have you considered this versatile unit for your new product or system designs?*

Write, wire or phone:

*The analog way is the model way . . . . .* GEORGE A.

**PHILBRICK** RESEARCHES, INC.

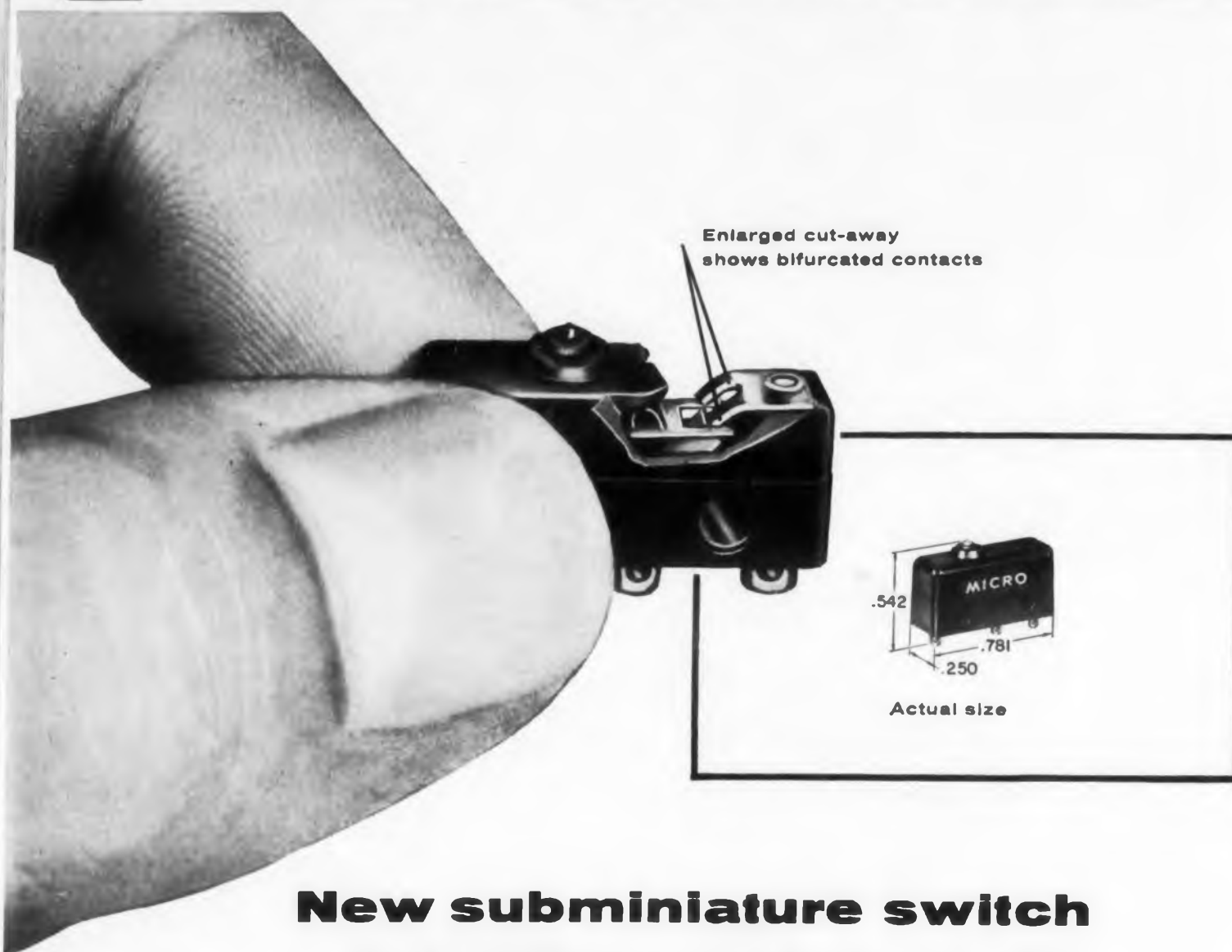
285 Columbus Ave., Boston 16, Mass. Tel. COmmonwealth 6-5375

\* **DYMEC, INC.** Palo Alto, California

CIRCLE 324 ON READER-SERVICE CARD



MICRO SWITCH Precision Switches



## New subminiature switch has bifurcated contacts

Now, for the first time, bifurcated contacts are available in a sub-miniature snap-action precision switch. Two points of contact provide increased reliability of milli-volt, milli-amp circuit control. Contacts are gold. Resistance is constant for the life of the switch. Switches are individually packaged in sealed double thickness plastic envelopes.

The 12SM4 is an addition to the MICRO SWITCH "SM" subminiature series. "SM" switches are available in 260 variations, with hundreds of different actuators and enclosures. For more information on this and other small snap-action switches, send for Catalog 63.

Catalogs, data sheets and application assistance are available on request from the MICRO SWITCH branch office near you. Consult the Yellow Pages.

MICRO SWITCH... FREEPORT, ILLINOIS

A division of Honeywell

In Canada: Honeywell Controls Limited, Toronto 17, Ontario

Visit Booth 2621-23  
at the  
WESCON Show



# Honeywell

MICRO SWITCH Precision Switches

CIRCLE 325 ON READER-SERVICE CARD

## NEW PRODUCTS

### Plug And Receptacle Unit

Handles 60 circuit combinations



This plug and receptacle unit has positive polarity and handles up to 60 circuit combinations. Terminals are automatically crimped to wires and snap-lock into male and female parts. They are removed with an ejector tool. Made of Bakelite, custom made units can be ordered. A unit for 15 circuits measures 1-1/16 in. long and 3/4 in. wide. Contacts are rated at 6.5 amp at either 125 or 250 v ac.

Molex Products Co., Dept. ED, 9515 Southview Ave., Brookfield, Ill.

CIRCLE 326 ON READER-SERVICE CARD

### Indicator Thyatron

Operates on 4.5 v signal



Requiring a 4.5 v signal and negligible grid current to produce a neon glow, the type WC-23 indicator thyatron measures 0.2 in. in diam and 0.75 in. long. Filament voltage is 1.25 v and current is 220 ma. Anode supply voltage is either 65 v ac or 85 v dc. The tube is designed for use in transistor circuitry in computers, data processors, signal systems and keyboard equipment.

Wiltec Electronics, Inc., Dept. ED, 53 Water St., South Norwalk, Conn.

CIRCLE 327 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 19, 1959



## Insulated Mounting Studs

For transistor bases



These insulated brazed mounting studs are designed for use as transistor bases in power rectifiers. They consist of a high alumina ceramic disc sandwiched between an oxygen free copper tab and a copper mounting stud.

Mitronics, Inc., Dept. ED, 1290 Central Ave., Hillside, N. J.

CIRCLE 328 ON READER-SERVICE CARD



## Tube Stems

Made in 8, 9,  
and 14 pin  
configurations

Made in 8, 9, and 14 pin configurations, these tube stems have Kovar metal conductors sealed, for high vacuum, in 7052 borosilicate glass. The pins are hydrogen fired before assembly to occlude residual gasses. The entire assembly is annealed and descaled after completion of construction. All sizes provide for vacuum tabulation; stems are individually wrapped and packaged.

Diamond Power Specialty Corp., Electronics Div., Dept. ED, Box 415, Lancaster, Ohio.

CIRCLE 329 ON READER-SERVICE CARD

## Dual Trimmer Potentiometer

Has 3/4 in. diam



Model 75-M28 dual trimmer potentiometer has a 2/4 in. diam and comes with wirewound resistance elements from 25 to 25,000 ohms per cup. Tracking accuracy is 0.5% and the unit is completely sealed for encapsulation. At 105 C it takes 1.5 w. It meets military specifications.

Maurey Instrument Corp., Dept. ED, 7924 S. Exchange Ave., Chicago 17, Ill.

CIRCLE 330 ON READER-SERVICE CARD

## General Electric Improves Heat Dissipation, ups Power in New 6L6-GC Tube



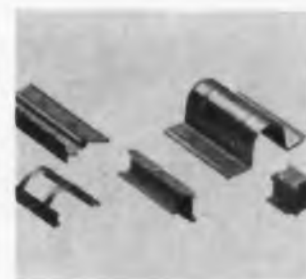
WITH

## General Plate COPPER-CORED ALIRON

Redesigned with improved heat dissipating anode material, General Electric Company's 6L6-GC audio power output tubes now offer important new advantages — maximum anode dissipation — or, rating increased 40 percent — cost one-third lower than comparable tubes — low distortion. And to obtain this improved value for their customers, General Electric Company used General Plate 5-layer copper-cored Aliron strip made available by Metals & Controls Division at the request of the Receiving Tube Department of the General Electric Company.

The copper, when combined with high emissivity aluminum-steel surfaces, results in a clad metal stock with improved heat conductivity . . . allows greater heat dissipation without danger of hot spots developing in tube anodes. The five layers are inseparably bonded together without intermediate brazing materials. Individual layer thicknesses are accurately controlled so that physical properties remain uniform.

Metals & Controls is constantly developing new clad metals which save weight, increase strength, conserve materials, improve performance and offer other advantages not found in single metals or alloys. Write for catalog GP-1 and get acquainted with General Plate Clad Metals.



### OTHER GENERAL PLATE CLAD METALS USED IN TUBES

Copper-base Aliron — Aluminum on low-carbon steel on copper  
Aliron<sup>®</sup> — Aluminum clad to both sides of low-carbon steel  
Nifer<sup>®</sup> — Nickel clad to both sides of low-carbon steel  
Alnifer<sup>®</sup> — Aluminum on low-carbon steel on nickel

## METALS & CONTROLS

707 FOREST STREET, ATTLEBORO, MASS., U.S.A.

A DIVISION OF TEXAS INSTRUMENTS INCORPORATED

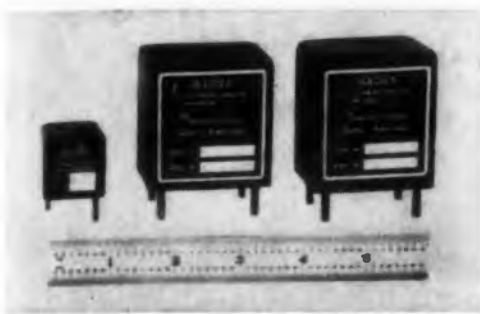
GENERAL PLATE PRODUCTS: Clad Metals • Electrical Contacts • Truflex<sup>®</sup> Thermostat Metal • Platinum Metals • Reactor Metals • Radio Tube & Transistor Metals

CIRCLE 331 ON READER-SERVICE CARD



## Servo Amplifiers

Operate from  $-55$  to  $+125$  C



Transistorized and fully potted, model AMP-576, AMP-424-6, and AMP-424-12 servo amplifiers operate from  $-55$  to  $+125$  C and meet MIL-E-5400A and MIL-E-5272A specifications. Respectively, they have 3.5, 6, and 12 w power outputs, size 11, 15, and 18 motors; 1000, 1500, and 1000 fixed voltage gains; and 10, 25, and 50 K input impedances. The 3.5 w unit is 1 cu in. and the other two are  $1-7/16 \times 1-7/8 \times 2$  in. All three amplifiers provide 40 v rms output signals.

Bulova Research and Development Labs, Inc., Dept. ED, 62-10 Woodside Ave., Woodside 77, N.Y.

CIRCLE 337 ON READER-SERVICE CARD

**LAMINATING RESIN.**—For continuous use at 400 to 600 F, Thermalam 1255 has a tensile strength of 51,000 psi at 77 F and 21,000 psi at 500 F. Coefficient of linear thermal expansion is  $12 \times 10^{-6}$ .

Hastings Plastics, Inc., Dept. ED, 1551 12th St., Santa Monica, Calif.

CIRCLE 338 ON READER-SERVICE CARD

**VTVM.**—Portable unit designed to read from 1 mv to 1 kv with 2% accuracy. Suited for use as high gain amplifier, it operates from 110 to 120 or 220 to 440 v, 50 to 420 cps lines at 30 w. Equipped with front panel mounted fuse and mirrored scale.

Elsin Electronics Corp., Dept. ED, Eileen Way, Syosset, N.Y.

CIRCLE 339 ON READER-SERVICE CARD

**LOW WING NUTS.**—Zinc alloy, die cast line in thread sizes No. 5 through  $3/8$  in. and wing spreads of  $13/16$  through  $1-7/8$  in. For portable tools, instruments, air filters, and other devices where low height is needed.

Cries Reproducer Corp., Dept. ED, 125 Beechwood Ave., New Rochelle, N.Y.

CIRCLE 340 ON READER-SERVICE CARD

**CRYSTAL OVEN.**—Improved miniature model BM-100 maintains a crystal at its designed operating frequency with accuracies to  $\pm 1$  C over a 100 C ambient range. Conforms to government specification HD/54U.

Federated Electronics, Inc., Dept. ED, 139-14 Jamaica Ave., Jamaica 35, N.Y.

CIRCLE 341 ON READER-SERVICE CARD



## BELDSOL\* Magnet Wire

105C (Class A), solderable Polyurethane

### Engineered Wire for Engineered Products Supported by Complete Factory Stocks

1. Solderable—eliminates costly stripping operations.
2. High "cut-through" values reduce shorted turns.
3. Uniformly soft copper for windability and handling.
4. Excellent electrical properties for best winding performance.
5. Resists impregnating varnish solvents—for better end products.

### Other Magnet Wires—For Every Requirement

105C (Class A), solderable Cellulose acetate—CELENAMEL\*

105C (Class A), oleoresinous, P. E.—BELDENAMEL\*

180C-130C-105C (Classes H, B, and A)—SQUARES & RECTANGULARS

105C (Class A), Vinyl Acetal-Nylon—NYLCLAD\*

130C-155C (Class B-F), Polyester—BELDTHERM\*

\*Belden Trademark  
Reg. U. S. Pat. Off.

One Wire Source for  
Everything Electrical and Electronic

**Belden**  
WIREMAKER FOR INDUSTRY  
SINCE 1902  
CHICAGO

Magnet Wire • Lead Wire • Power Supply Cords,  
Cord Sets and Portable Cord • Aircraft Wires  
Electrical Household Cords • Electronic Wires  
Welding Cable • Automotive Wire and Cable

1-5-8

# Oster<sup>®</sup>

to  
the  
Outside

## MISSILE QUALITY SERVOS

For trouble-free systems, missile designers specify Oster reliability. Choose from the Complete Line for Missile, Aircraft & Ground Support Applications.

- Sizes 8, 10, 11, 15, 18, 23, 29 in 400 cycle. Sizes 15, 18, 23 in 60 cycle.
- -55° to +125°C temperature range. Higher temperature servos available for special applications.
- Meet MIL-E-5272A & MIL-E-5400.
- Available with leads & terminals to your requirement.
- Immediate delivery from stock of many types in sample quantities.



BURTON BROWNE ADVERTISING

### NEW 24-page SERVO MOTORS CATALOG No. 5000

Lists 40 basic servo types for military, scientific and industrial applications. Write for your free copy on company letterhead today.

#### OTHER PRODUCTS INCLUDE:

Synchros	Computers
Resolvers	Indicators
Motor Tachs	Servo Mechanisms
DC Motors	Servo Torque Units

*John Oster*

#### MANUFACTURING CO.

Your Rotating Equipment Specialist

Avionic Division

Racine, Wisconsin

#### NEW YORK OFFICE

237 North Main Street  
Hempstead, L.I., New York  
Phone: IVanhoe 3-4653  
TWX Hempstead N. Y. 705

#### NEW JERSEY OFFICE

517 Lyons Avenue  
Irvington, New Jersey  
Phone: ESsex 3-2361

#### WESTERN OFFICE

5333 So. Sepulveda Blvd.  
Culver City, California  
Phone: EXmont 1-5742  
TEXas 0-1194  
TWX S. Mon 7671

Engineers For Advanced Projects:

Interesting, varied work on designing transistor circuits and servo mechanisms.  
Contact Mr. Robert Burns, Personnel Manager, in confidence.

CIRCLE 343 ON READER-SERVICE CARD

## NEW PRODUCTS

### Magnetron Pulse Transformer

Delivers 1.3 megawatts at 28 kv



Designed to provide 1.3 megawatts at 28 kv, this pulse transformer has a plug-in magnetron receptacle and pulse cable connection. Step-up ratio is 1 to 3.5; primary impedance, 50 ohms; pulse duration, 0.9 μsec; pulse repetition frequency, 1300 pps; filament supply, 3.5 amp. The 30 lb unit measures 13 x 5-1/2 x 8-1/4 in.

Stavid Engineering, Inc., Dept. ED, Plainfield, N.J.

CIRCLE 344 ON READER-SERVICE CARD

**ADD-SUBTRACT REVOLUTION COUNTER.**—Weatherproof, 7-digit, nonreset model CM-1A127 adds 10 counts per forward shaft revolution, subtracts same ratio per reverse revolution. Speeds to 10,000 cpm; dimensions, 2-19/32 x 1-3/4 x 1-13/64. Available top coming or top going shaft revolution; right or left shaft extension.

General Controls Co., Dept. ED, 8078D McCormick Blvd., Skokie, Ill.

CIRCLE 345 ON READER-SERVICE CARD

**SERVO AMPLIFIER.**—Transistorized, 6 w, 400 cps model 907-0010 is 9 cu in., plugs into standard octal socket, meets MIL-E-5272. Voltage gain, 4500; impedance, 70 K at 27 C.

Belock Instrument Corp., Dept. ED, 112-03 14th Ave., College Point, N.Y.

CIRCLE 346 ON READER-SERVICE CARD

**HEAVY DUTY ULTRASONIC CLEANERS.**—For continuous use and difficult operations such as cleaning waveguides. Line includes models GU 150, GU 420, and GU 720 with 150 to 700 w average output power and 3 to 8 gal tank capacity.

Acoustica Associates, Inc., Dept. ED, 26 Windsor Ave., Mineola, N.Y.

CIRCLE 347 ON READER-SERVICE CARD

**TORQUE ADJUSTABLE WRENCH.**—For tightening hex socket screws in electronic instruments. Hexco wrench has interchangeable blades that screw into head. Torque is adjusted from 5 to 18 lb with screw at top of head. Wrench sizes: 1/16, 5/64, 3/32, 1/8, and 5/32 in. Blades are 3 in. long or to order.

Herrmann Engineering & Sales Co., Dept. ED, 15942 Minnesota St., Paramount, Calif.

CIRCLE 348 ON READER-SERVICE CARD

## Encoder

Has built-in buffer amplifier



Model PH-VII-1 Optisyn encoder has a built-in buffer amplifier and four signal leads. It meets MIL-STD-202A and has high readout rate, small size and long life. Designed for a resolution of 2048 per revolution and a maximum speed of 3000 rpm, its applications include servo positioners, machine tool control and telemetry. No slip rings, brushes or gears are used in this encoder.

Dynamics Research Corp., Dept. ED, 44 Winn St., Woburn, Mass.

CIRCLE 349 ON READER-SERVICE CARD

**TRANSISTORIZED SCALER.**—Model SG-10A Serviscaler, for training and classroom use, has maximum count capacity of 99,999 counts. Its high voltage is continuously variable between 600 and 1600 v, connectors for detector input, timer output and remote control; power consumption is 20 w.

Technical Measurement Corp., Dept. ED, 441 Washington Ave., North Haven, Conn.

CIRCLE 350 ON READER-SERVICE CARD

**CARRYING CASES.**—Protective, functional containers for any of the firm's six Pocketscope models, plus line cords, probes and instruction manuals. Laminated texon construction makes them light and rugged.

Waterman Products Co., Dept. ED, 2445 Emerald St., Philadelphia 25, Pa.

CIRCLE 351 ON READER-SERVICE CARD

**MINIATURE SIREN.**—Produces a tone of 1100 cps at 80 db and 11,000 rpm. Less than 2 in. in diam it is powered by a 115 v ac, 400 cps motor.

Western Gear Corp., Electro Products Div., Dept. ED, 132 W. Colorado Blvd., Pasadena, Calif.

CIRCLE 352 ON READER-SERVICE CARD

**TRIODE TRANSMITTING TUBE.**—Has high grid current rating and high stability. Used for fm and TV, type 7459 triode has an amplification factor of 32 and a transconductance of 15,000  $\mu$ mhos.

Amperex Electronic Corp., Transmitting Tube Dept., Dept. ED, 230 Duffy Ave., Hicksville, N.Y.

CIRCLE 353 ON READER-SERVICE CARD

Engineers/Designers! Ask for this G-C

# MICROWAVE FERRITE APPLICATION CHART

## MICROWAVE FERRITE APPLICATION CHART

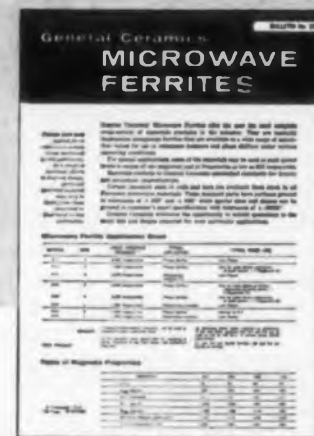
MATERIAL	BAND	LOWEST OPERATING FREQUENCY**	TYPICAL APPLICATION	TYPICAL POWER LEVEL
R-1	X	8,500 megacycles	Phase Shifter	Low Power
R-4	X	7,000 megacycles	Phase Shifter	Can be used above resonance at peak power > 1 Megawatt (2)
R-4	S	2,500 megacycles	Resonance Isolator (1)	Low Power
R-5*	C	5,000 megacycles	Phase Shifter	Can be used above or below resonance at peak power > 1 Megawatt (2)
R-5*	S	2,500 megacycles	Phase Shifter	Can be used above resonance at peak power > 1 Megawatt (2)
R-5*	L	1,000 megacycles	Resonance Isolator	Low Power
R-6*	S	2,500 megacycles	Phase Shifter	Similar to R-5
R-6*	L	1,000 megacycles	Resonance Isolator	Low Power

### \*NEW PRODUCT

#### REMARKS:

- (1) R-4 saturates more rapidly than R-1 resulting in faster reduction at low field losses. See hysteresis loop data.
  - (2) Operating power levels reported by customers. It has also been reported that R-5 and R-6 can be used as low as 500 Mc/s in certain phase shifter applications.
- R-1 and R-4 are Mg-Mn ferrites. R-5 and R-6 are Mg-Mn-Al ferrites.

\*\*Lowest Recommended Frequency—can be used at frequencies above published value.



## — it's included in the new General Ceramics Data Bulletin on Microwave Ferrites

This new comprehensive bulletin contains technical data on the most complete cross-section of materials in the industry, including two grades introduced for the first time. Included are hysteresis loops, magnetic and dielectric properties vs. frequency, and magnetic induction vs. temperature curves on ferrite materials R1, R4

and newly-developed R5 and R6. Application data, magnetic properties tables, and drawings and dimensions of available stock parts are also contained in new Bulletin 259. Request your copy of this informative literature, today; please address inquiries to General Ceramics Corporation, Keasbey, New Jersey—Dept. ED.

## GENERAL CERAMICS

The World's Largest Producer of Microwave Ferrites



TV and Radio Cores



Magnetic Memory Cores



General Purpose Cores



Recording Head Cores



Microwave Ferrites

CIRCLE 354 ON READER-SERVICE CARD

**Montrose**  
DIVISION

**Bendix**  
AVIATION CORPORATION

# SYNCHROS

MIL-S-20708 | MIL-S-2335



Your complete source for all military type synchros with  
"off the shelf" delivery

SIZE 11	CT4c, 26V-CT4c, CX4c, 26V-CX4b, CDX4a, 26V-CDX4b, TR4b, 26V-TR4b, TX4b, 26V-TX4b
SIZE 15	CT4b, CX4b, CDX4b, TR4c, TX4b, TDX4b, CT6b, CX6b, CDX6b, TR6a
SIZE 18	CT4b, CX4b, CDX4b, TR4b, TDX4b, CT6b, CX6b, CDX6b, TX6a, TRX6a
SIZE 23	CT4, CT4a, CT4b, CX4, CX4a, CX4b, CDX4, CDX4a, CDX4b, TR4, TR4a, TR4b, TX4, TX4a, TX4b, TDX4, TDX4a, TDX4b, TDR4, TDR4a, TDR4b, CT6, CT6a, CT6c, CX6, CX6a, CX6c, CDX6, CDX6a, CDX6b, TR6, TR6a, TX6, TX6a, TX6b, TDX6, TDX6a, TDX6b, TDR6, TDR6a, TRX6a
SIZE 31	TR4d, TX4a, TX4d, TDX4b, TDR4b, TR6b, TX6b, TDX6b, TDR6b
SIZE 37	TR4a, TX4b, TDX4a, TDR4a, TR6b, TX6b, TDX6a, TDR6a
TYPE 1	1D, 1F, 1HCT, 1HDG, 1HG
TYPE 3	3D, 3F, 3HCT, 3HDG, 3HG
TYPE 5	5D, 5F, 5HCT, 5HDG, 5HG, 5N
TYPE 6	6HDG, 6HG

## WRITE FOR FREE

Rapid Reference Guide to  
Military Synchros. →

Write on company letterhead  
for Synchro Engineering Catalog.



West Coast Sales and Service Office—117 East Providencia Avenue, Burbank, California  
Canadian Sales Office—Aviation Electric Limited, 200 Laurentien Blvd., Montreal, Quebec, Canada  
Export Sales and Service—Bendix International, 205 East 42nd St., New York 17, New York

**Montrose Division**  
SOUTH MONTROSE, PA.



CIRCLE 355 ON READER-SERVICE CARD

## NEW PRODUCTS

**Voltage Standards**  
Output stability better than 0.1%



For most types of Refvolt voltage standards the output stability is better than 0.1% for input or load variations of 20%. All types pass the shock and vibration requirements of MIL-E-5272A. Units are available for dc inputs from 18 to 30 v, and for 60 and 400 cps from 90 to 130 v. Input power requirements range from 0.4 to 2 w and output impedance for all units is 20 ohms.

Consolidated Controls Corp., Dept. ED, Bethel, Conn.

CIRCLE 356 ON READER-SERVICE CARD

**MINIATURE MAGNETIC DRUM HEAD.**—Model MHDM-35-328 for use where many tracks or re-circulating registers are needed. Diameter is 0.216; length, 1.062. Can be mounted 0.15 apart circumferentially. Available with shielded and jacketed cable.

General Transistor Western Corp., Dept. ED, 6110 Venice Blvd., Los Angeles 34, Calif.

CIRCLE 357 ON READER-SERVICE CARD

**VIDEO AMPLIFIERS.**—Housed two to a cabinet with power supply and front panel connections, models M-630 or M-680 can be operated separately or in cascade, parallel, or push-pull. Separately they have 90 ohm input and output impedance, 2 v rms output, and 20 and 60 db respective gains.

Instruments for Industry, Inc., Dept. ED, 101 New South Rd., Hicksville, N.Y.

CIRCLE 358 ON READER-SERVICE CARD

**ELECTROLYTIC CAPACITORS.**—Nonpolarized, ac, tubular series IHTAC for cross over audio circuit networks. Units have high current carrying capabilities, low power factor, and provide virtually uniform capacitance over full audio spectrum with flat characteristics from 30 cps to 15 kc.

Illinois Condenser Co., Dept. ED, 1616 N. Throop St., Chicago 22, Ill.

CIRCLE 359 ON READER-SERVICE CARD

**HIGH VOLTAGE THYRATRON.**—Model WL-7269 permits design of 20 kv, 10 amp, 3-phase, full-wave, bridge type rectifier. Rated 3.2 amp and 21 kv inverse voltage.

Westinghouse Electric Corp., Electronic Tube Div., Dept. ED, P.O. Box 284, Elmira, N.Y.

CIRCLE 360 ON READER-SERVICE CARD

# KLYSTRON POWER SUPPLY



with a

# MEMORY

No more fiddling with reflector voltage adjustments when you switch between cw and square wave...because of just one of the typically advanced features of this low-medium voltage Klystron Power Supply.

Ever double-mode a Klystron? Not with our model 809! Again, the thoughtful engineering that goes into every PRD product assures the user of self-protection against errors.

Even little things like the built-in beam voltage and current meter prevent guessing and doubt during runs. And when it comes to 'scoping the Klystron...compare the CRT display of a tube powered by the 809 and you'll see for the first time what a really sharp trace looks like!

For complete details, send for our data sheet F-10.

P.S. In case you don't have our latest catalog, E-8...160 pages, chock-full of useful data...dash off a note on your company letterhead.



**POLYTECHNIC RESEARCH  
& DEVELOPMENT CO., INC.**  
202 Tillary St., Brooklyn 1, N.Y.  
ULster 2-6800

CIRCLE 361 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 19, 1959

## TWEEZER WELD

Precision  
Resistance Welding  
Equipment

**NOW** produce up to 6,000 welds  
per hour . . . automatically  
. . . with one operator.

model  
DC 80



**BENCH MOUNTED  
STORED ENERGY WELDER**

- New TW5 low friction welding head
- Stored energy panel of 80 Watt second capacity
- Discharge time of 0.0008 to 0.0012 second
- Permits welding of difficult materials, i.e.: copper, silver, tungsten, etc.
- Reliable welds without discoloration, deformation, metallurgical change



COMPACT  
SYNCHRONOUS  
WELDING  
TIMER  
6" wide  
10½" high  
8½" deep

model T-3

**TRANS-SYNC  
WELD-TIMER**

- 1 KVA capacity-utilizing semi-conductors.
- Also ideally suited with high speed automatic machinery.
- Operates at a rate up to 1200 welds per minute . . . welds partially oxidized materials with ease.
- Welding time: ½ cycle (8 milliseconds) to 10 cycles (160 milliseconds).

**FEDERAL TOOL ENGINEERING CO.**  
1400 Pompton Ave.  
Cedar Grove, New Jersey

**WRITE FOR  
INFORMATION**

CIRCLE 362 ON READER-SERVICE CARD

## Constant Current Source Programmable



Designed for precision gyro measurements, the model CS-117 constant current source is programmable. It has a range of 0.1  $\mu$ a to 150 ma from 0 to  $\pm 100$  v dc. Current is set to six places by decade divider knobs, and line and load regulation are better than 0.0025%. The current may be programmed or modulated by remote control. Measuring 19 x 12-3/4 x 18 in., the unit weighs 45 lb.

North Hills Electric Co., Inc., Dept. ED, 402 Sagamore Ave., Mineola, L. I., N. Y.

CIRCLE 363 ON READER-SERVICE CARD

**CONNECTORS.**—Single conductor Supercon plugs and receptacles have a wide color range for circuit coding, a positive grip design, gold plated current carrying metal parts, and a choice of soldered or solderless connections. Dub-L-Plug dual connectors, for making rapid connections to binding posts, are offered in both insulated and shielded-insulated types. Insulated types come in six colors.

Superior Electric Co., Dept. ED, Bristol, Conn.

CIRCLE 364 ON READER-SERVICE CARD

**MINIATURE TETRODE.**—Model 6FV6 is a sharp cutoff, 7-pin unit for use as an rf amplifier tube in vhf tuners of TV receivers. It has a transconductance of 8000  $\mu$ mhos and a plate to grid No. 2 current ratio of 7 to 1.

Radio Corporation of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 365 ON READER-SERVICE CARD

**IMPRESSIONABLE NAMEPLATES.**—Anodized aluminum foil Quik-Plates are self-bonding, take imbedded imprint from standard or electric typewriters, and meet MIL-N-25076, MIL-P-6906, and MIL-E-5272A. Bond holds from  $-6$  to  $+325$  F.

W. H. Brady Co., Dept. ED, 727 W. Glendale Ave., Milwaukee 9, Wis.

CIRCLE 366 ON READER-SERVICE CARD

**MINIATURE CLUTCH AND BRAKE.**—Controls potentiometers, counters, servos, and computer integrators. Minimum torque, 10-oz.-in.; engagement time, under 7 msec. In coil voltages from 3 to 100 v.

Norman Hardy Associates, Dept. ED, P.O. Box 97, Wyncote, Pa.

CIRCLE 367 ON READER-SERVICE CARD



## He is looking at the conquest of space

The man above is studying the vibration reaction of a Union 6 PDT miniature relay, at the reliability laboratory of Convair-Astronautics, San Diego, Calif.

**Result:** These Union Switch & Signal relays were chosen by Convair for the guidance of their Atlas missile, launched into orbit December 18, 1958.

Extreme reliability was needed in the Atlas guidance system, to insure precise control of flight. And the Union relay subjected to thorough testing, answered that need.

Part of the 6 PDT relay reliability can be laid to its small size and its clean, simple, rotary design which gives it fewer inherent problems than other relays. In tests at Union Switch & Signal, it has proved its ability to give outstanding performance in critical dry-circuit control applications—was absolutely solid to 2,000 C.P.S. at 15 G!

The relay used in the Atlas is just one of a complete line of dependable relays designed by Union Switch & Signal. Write today for complete technical details.

*"Pioneers in Push-Button Science"*



**UNION SWITCH & SIGNAL**

DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY

PITTSBURGH 18, PENNSYLVANIA

CIRCLE 368 ON READER-SERVICE CARD

## HOLTZER -CABOT



R-24 Motor

### Synchronous and Induction Capacitor Type Motors



R-25 Motor

**R-24.** Typical applications for this reversible, 4-pole induction motor are in servo mechanisms, as a balancing motor in recording instruments or as a control motor for voltage regulators. It has low rotor inertia for fast response applications. When operated 2 phase, it can be controlled electronically; or operated single phase as a permanent split capacitor motor.

**R-25.** Typical uses are for recording instruments, dictating and adding machines. Approximately 2 1/2" in diameter, it is available in either induction or synchronous construction with reversible rotation.

Both the R-24 and R-25 are available with gear case speeds from 1/2 to 3600 RPM, torque ratings up to 75 oz. inches or higher, and single phase, 2 or 3 phase.



HOLTZER-CABOT MOTOR DIVISION  
NATIONAL PNEUMATIC CO., INC.

125 Amory Street, Boston 19, Mass.

GENTLEMEN: Please send me data sheets on the Holtzer-Cabot R-24 and R-25 Size Motors.

Please have representative call \_\_\_\_\_ (date)

Name \_\_\_\_\_

Company \_\_\_\_\_

Street \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

CIRCLE 369 ON READER-SERVICE CARD

## The Second Annual INSTRUMENT MOTOR SYMPOSIUM

sponsored by

### Holtzer-Cabot Motor Division

National Pneumatic Co., Inc. will be held in Chicago during the week of the ISA Instrument-Automation Conference and Exhibit.

**Theme:** "Today's Trends — Tomorrow's Motors"

**Speakers:** Nationally-known instrument and motor design specialists. Open discussion will follow the prepared remarks.

**When:** 8:00-10:00 p.m., Tuesday, September 22.

**Where:** Palmer House, Chicago

**How to Register:** Members and guests of the ISA may register at Holtzer-Cabot's exhibit (#368) at the International Amphitheatre on Monday or Tuesday or by writing earlier to the Symposium Chairman: R. H. Matthews, Chief Engineer, Holtzer-Cabot Motor Division, National Pneumatic Co., Inc., 125 Amory Street, Boston, Massachusetts.

## NEW PRODUCTS



### Variable RF Inductors

Have range of 0.1 to 10,000  $\mu$ h

Produced through a special epoxy resin encapsulating technique, VE(RG)I coils cover a range of 0.1 to 10,000  $\mu$ h. The standard series has an insulation resistance of 100,000 meg min and a temperature range of -55 to +125 C. Temperature coefficient of inductance is -50 to +100 ppm per deg C. Terminal arrangement is standard 90 deg. Terminals are gold-plated.

Coil Winders, Inc., Dept. ED, New York Ave., Westbury, L.I., N.Y.

CIRCLE 370 ON READER-SERVICE CARD

**BATTERY CHARGER SYSTEM.**—Model MIL-28-200 charges 12 24 v, 24 12 v, or 48 6 v batteries at once. Power unit is 28 v, 200 amp dc supply with under 1% ripple. Input is three-phase, 200 to 253 v ac, 60 cps.

Sorensen & Co., Dept. ED, Richards Ave., South Norwalk, Conn.

CIRCLE 371 ON READER-SERVICE CARD

**HEAVY DUTY COMMUNICATION TOWER.**—Model 50 for mounting microwave, radio communication, TV reception antennas. Stays rigid in heights to 450 ft when properly guyed. In 10 ft sections.

Rohn Mfg. Co., Dept. ED, 116 Limestone, Bellevue, Peoria, Ill.

CIRCLE 372 ON READER-SERVICE CARD

**ELECTRONIC TACHOMETERS.**—For measuring speed of any rotating, reciprocating, or oscillating shaft or mechanism, Tach-Paks have 0.25% accuracy, require 5 mv input signals. Standard 0 to 5 v output drives 3000 ohm loads, is directly proportional to speed or rpm of device measure.

Airpax Electronics Inc., Seminole Div., Dept. ED, Fort Lauderdale, Fla.

CIRCLE 373 ON READER-SERVICE CARD

**THYRATRON INDUSTRIAL CONTROL TUBES.**—Rated from 2 to 77 amp peak current, 1250 to 5000 peak inverse v. They are argon and mercury filled. Types 3C23, 710/60A, 710L, 715, 740, 7402, 740P, 760, 760L, and 760P are used for resistance welding and motor speed control applications.

Raytheon Mfg. Co., Industrial Products Dept., Dept. ED, 55 Chapel St., Newton 58, Mass.

CIRCLE 374 ON READER-SERVICE CARD

## TUBE PROBLEM:

When the 6AF4 tube was replaced in UHF TV tuners, servicemen sometimes got a big surprise. Reason: the tubes were not standardized, and a replacement was likely to bring in one channel where another should have been.

## SONOTONE SOLVES IT:

First, Sonotone set up extremely tight controls on all materials going into the 6AF4 components. Second, Sonotone used a more thorough exhaust process.

## RESULT:

The Sonotone AF4 family of reliable tubes has been accepted by the industry as standard for initial production and replacement.

Let Sonotone help solve your tube problems, too.

## Sonotone

Electronic Applications Division, Dept. TGG-89

ELMSFORD, NEW YORK

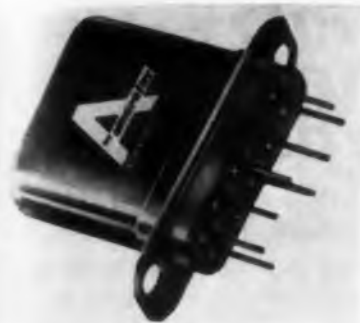
Leading makers of fine ceramic cartridges, speakers, microphones, electronic tubes.

In Canada, contact Atlas Radio Corp., Ltd., Toronto

CIRCLE 375 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 19, 1959





### Miniature Relay

Eliminates contact contamination

Dualseal type A relay eliminates contact contamination with operating coils in a separate hermetically sealed enclosure. The unit may be used for both 2 amp 26.5 v dc resistive load service and for low level or dry circuit operation. Specifications include: vibration, 5 to 55 cps at 0.06 in. max excursions and 55 to 2000 cps at 20 g; shock, 50 g for 11 msec; contact arrangement, dpdt; temperature range, -65 to +125 C. Operating time is 5 msec max at rated load and release time is 3 msec max at continuous duty.

Amerelay Corp., Dept. ED, 13 County Court House Rd., New Hyde Park, L.I., N.Y.

CIRCLE 376 ON READER-SERVICE CARD

**RF TRANSMISSION CABLE.**—Teflon insulated coaxial type RG-117U for radar and other installations with high power, high temperature requirements.

Times Wire and Cable Co., Inc., Dept. ED, Wallingford, Conn.

CIRCLE 377 ON READER-SERVICE CARD

**PRODUCTION SOLDERING UNIT.**—Model 3374 is built for heavy duty, has 100 w input, provides selectable temperature from 500 to 750 F, and maintains constant tip temperature.

Eder Engineering Co., Inc., Dept. ED, 1568 S. First St., Milwaukee 4, Wis.

CIRCLE 378 ON READER-SERVICE CARD

**FLUTTER METER.**—Provides fast, accurate indication of wow and flutter content of all types of tape recorders and playback equipment. Has built-in limiter and 3000 cps oscillator. Filter isolates three ranges: 0.5 to 6 cps for wow, 5 to 250 cps for flutter, and 0.5 to 250 cps for both.

Amplifier Corporation of America, Dept. ED, 398 Broadway, New York 13, N.Y.

CIRCLE 379 ON READER-SERVICE CARD

**MINIATURE TWIN TRIODE.**—Medium mu, 9-pin type 7044 is designed for use in pulse amplifier, inverter, frequency divider, cathode follower, and multivibrator circuits in computers and other equipment. It has separate terminals for each cathode and a mid-tapped heater to permit operation from a 6.3 or 12.6 v supply.

Radio Corporation of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 380 ON READER-SERVICE CARD

# FIELD-PROVED HONEYWELL COMPONENTS

for measuring, balancing and positioning applications

## CONVERTERS



These synchronously driven choppers handle d-c signals as small as  $10^{-8}$  volt. Sensitive, stable performance. Available with special features such as fungus proofing, grounded housing, mica-filled base, various contact percentages. Weight: 10 oz. Prices from \$39.

ELECTRICAL CHARACTERISTICS					
Part No.	354210-2	354210-3	354210-1	354210-4	355081
Modulation Frequency	20-30 cycles	40-45 cycles	50-65 cycles	50-65 cycles	360-440 cycles
Switching Action (SPDT)	(Make-before-break) Each contact closed 55% of each cycle ( $\pm 2\%$ ) Other actions, as specified			(Break-before-make). Each contact closed 47% of each cycle	Each contact closed 57% of each cycle ( $\pm 7\%$ )
Driving Coil Requirements	6.3 v, 60 ma at rated frequency				18 v, 94 ma at rated frequency
Contact Rating	100 microwatts at 6 v max.; 1.0 ma max.				
Electrostatic Stray Pickup	$2 \times 10^{-8}$ volts per ohm of input circuit impedance				$2 \times 10^{-10}$
Electromagnetic Stray Pickup	Less than $2 \times 10^{-6}$ volts, constant to within $2 \times 10^{-7}$				$2 \times 10^{-2}$ volts constant to $2 \times 10^{-6}$
Phase Shift	Output voltage lags driving phase by $17^\circ \pm 5^\circ$				Lags driving phase by $45^\circ$ to $50^\circ$
Symmetry	Within 2%				Within 7%
Shielding	Frame and coil shield, grounded through pin No. 2				Shell and coil shield, grounded through pin No. 2
Load Characteristics	Resistive or Inductive				
Vibration Resistance	Output voltage varies less than 2% with rates of vibration from 0 to 10g				

## MOTORS



Designed for chart drives, servos and balancing circuits, these motors are available in three general types: Stack type, with easily maintained sectional housing; self-lubricated, oil-sealed type; and fungus-proofed, oil-sealed military motors. Prices from \$40.

Nominal No Load R.P.M.*	R.P.M.*	Gear Ratio	Intermittent Rated Load (oz.-in.)	Max. Starting Torque (oz.-in.)	Pull-In Torque Min. (oz.-in.)	Continuous Torque (oz.-in.)	Power (Watts) Loaded	Current (amps.) Loaded	Temp. Rise of
<b>Two Phase Induction Motor</b>									
330		44:1	4	10			11.5	0.11†	70
144		10:1	5	20			11.5	0.11†	70
48		30:1	15	60			11.5	0.11†	70
23		60:1	30	110			11.5	0.11†	70
<b>Synchronous</b>									
	180	10:1			12	12	24	0.21	100
	180	10:1			2.0	2.0	11.5	0.11	65
	90	20:1			14	12	11.5	0.11	65
	60	30:1			21	18	11.5	0.11	65
	30	60:1			42	36	11.5	0.11	65

\*1/6 less at 50 cycles †Field winding 11.0 watts, balance in amplifier winding  
Note: Some speeds available at 25 cycles  
All motors are available in two phase and synchronous models

## AMPLIFIERS



They amplify a d-c or a-c microvolt input signal sufficiently to drive one field of a two-phase balancing motor. Three stages of voltage amplification are followed by the power-output phase discriminator stage, which supplies power for the motor. Extremely low stray pickup . . . adjustable sensitivity . . . fast response. Priced from \$110 to \$250.

Gain	Sensitivity (Microvolts)	Nominal Input Impedance (Ohms)
$10^4$	4.0	400, 2,200, 50,000
$4 \times 10^4$	1.0	400, 7,000, 50,000
$12 \times 10^4$	0.4	400, 2,200, 7,000
$40 \times 10^4$	0.1	2,200

**POWER SUPPLY**—115 v., 60 cycles (fused power line)

**OUTPUT**—2 to 18 ma. into 12,000 ohm load

**SENSITIVITY**—Continuously variable screwdriver adjustment. Recessed slot protects setting

**MOUNTING**—Operation unaffected by mounting position

**OPTIONAL FEATURES**—(a) thermocouple burnout protection, (b) without desensitizing adjustment, (c) parallel T feedback, (d) velocity damping, (e) special connecting cables and plugs, (f) without tubes, shields, and converter, (g) for 25 cycles.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Aves., Phila. 44, Pa.

# Honeywell



*First in Control*

CIRCLE 381 ON READER-SERVICE CARD

## When Top Quality Capacitors Are Required Specify Pyramid Mylar® or Tantalum

UP TO 1000 MFD-VOLTS IN LESS THAN 2/100  
OF A CUBIC INCH

...PYRAMID TANTALUM CAPACITORS

Miniaturized to provide maximum space economy.

New Pyramid Tantalum slug capacitors have cylindrical cases and contain a non-corrosive electrolyte. Due to the special construction of materials used in the manufacture of Pyramid Tantalum slug capacitors, these units are both seep and vibration proof. In addition, this type of capacitor assures long service life and corrosion resistance—made to meet MIL-C-3965 Specifications.

Commercially available immediately, these new Pyramid Tantalum capacitor units have an operating range between  $-55^{\circ}\text{C}$  to  $100^{\circ}\text{C}$  for most units without any de-rating at the higher temperature.

PYRAMID MYLAR...  
... $-30^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ...  
SMALLEST FILM CAPACITORS MADE!

Pyramid new Mylar capacitors have extremely high insulation resistance, high dielectric strength and resistance to moisture penetration.

Commercially available immediately, Pyramid Mylar capacitors have an operating range between  $-30^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  with voltage de-ratings above  $+85^{\circ}\text{C}$ . Pyramid wrapped Mylar capacitors—Series nos.: 101, 103, 106 and 107 have the following characteristics:

Construction Styles:	Basic No.	Type Winding	Shape
	101	Inserted Tabs	Flat
	103	Extended Foil	Flat
	106	Inserted Tabs	Round
	107	Extended Foil	Round

**Tolerance:** The standard capacitance tolerance is  $\pm 20\%$ . Closer tolerances can be specified.

**Electrical Characteristics:** Operating range for Mylar capacitors—from  $-55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  and to  $+125^{\circ}\text{C}$  with voltage de-rating.

**Dissipation Factor:** The dissipation factor is less than 1% when measured at  $25^{\circ}\text{C}$  and 1000 CPS or referred to 1000 CPS.

Insulation Resistance:	Temperature	IR x mfd	Maximum IR Requirements
	$25^{\circ}\text{C}$	50,000	15,000 megohms
	$85^{\circ}\text{C}$	1,000	6,000 "
	$125^{\circ}\text{C}$	50	300 "

Pyramid Mylar capacitors are subject to the following tests:

**Dielectric Voltage Test—**Mylar capacitors shall withstand 200% of rated D.C. voltage for 1 minute at  $25^{\circ}\text{C}$ .

**Life Test—**Mylar capacitors shall withstand an accelerated life test of 250 hours with 140% of the voltage rating for the test temperature. 1 failure out of 12 is permitted.

**Humidity Test—**Mylar capacitors shall meet the humidity requirements of MIL-C-91A specifications.

Complete engineering data and prices for Pyramid Mylar and Tantalum Capacitors may be obtained from Pyramid Research and Development Department.

DU PONT REGISTERED TRADEMARK

WESCON BOOTH 1401

CAPACITORS—RECTIFIERS  
FOR ORIGINAL EQUIPMENT—  
FOR REPLACEMENT

ELECTRIC CO.  
NORTH BERGEN, N. J.

EXPORT: 458 Broadway, N.Y. 13, N.Y. • CANADA: Wm. Cohen, Ltd.—7000 Park Ave., Montreal

CIRCLE 383 ON READER-SERVICE CARD

## NEW PRODUCTS

### Multiplier Phototube Counts low level radioactivity



Multiplier phototube type K1758 is a 3 in. diam unit designed to count very low levels of radioactivity. It is made of materials which are low in radioactive contaminants so that its inherent radioactivity does not override the radiation levels to be counted. The faceplate is quartz. Other tube sizes can be provided on a custom basis.

Allen B. Du Mont Labs, Inc., Electronic Tube Div., Dept. ED, 750 Bloomfield Ave., Clifton, N.J.

CIRCLE 384 ON READER-SERVICE CARD

**PRECISION MECHANICAL COUNTER.**—Series 2500 operates from  $-65$  to  $+160^{\circ}\text{F}$  at speeds to 1350 rpm, has digits 0 to 9 with vernier graduations, measures  $3\text{-}3/8 \times 1\text{-}7/8 \times 2$  in.

Chicago Dynamic Industries, Inc., Precision Products Div., Dept. ED, 1725 Diversey Parkway, Chicago 14, Ill.

CIRCLE 385 ON READER-SERVICE CARD

**MECHANICAL REFRIGERATION SYSTEM.**—Model U-522477 fractional tonnage system for TV cameras used with radar systems. Heat dissipation, 275 w; weight, 26 lb.

United Aircraft Products, Inc., Dept. ED, 1116 Bolander Ave., Dayton, Ohio.

CIRCLE 386 ON READER-SERVICE CARD

**EXPLOSION-PROOF PRESSURE CONTROL.**—Pressure ranges of type H98 are 10 to 1700 psi with a proof pressure of 2500 psi and a maximum pressure of 3500 psi. Switches are rated 15 and 20 amp at 115 or 230 v ac and operate at ambients to  $180^{\circ}\text{F}$ .

United Electric Controls Co., Dept. ED, 79 School St., Watertown, Mass.

CIRCLE 387 ON READER-SERVICE CARD

**EPOXIDE RESIN SHELLS.**—Wide variety of shapes for encapsulating all types of components. In diameters from  $1/8$  to 1 in. and heights from  $1/4$  in.; rectangular, other shapes to specifications. Units have high tensile strength, withstand  $150^{\circ}\text{C}$ .

Thor Ceramics, Inc., Dept. ED, 225 Belleville Ave., Bloomfield, N.J.

CIRCLE 388 ON READER-SERVICE CARD

## HOW ABOUT YOU?

Do you know that many cancers can be cured if detected early? That an annual health checkup is your best protection against cancer?

Are you giving yourself this big advantage? Or are you taking chances with your life because of foolish attitudes about cancer like these?



**DON'T  
EVEN  
MENTION  
THAT  
WORD!**

Fear keeps some people from even learning cancer facts that can save their lives.

**NEVER FELT  
BETTER!**



Checkups help to detect cancer in its "silent" stage before you notice any symptom.



**COSTS  
TOO  
MUCH!**

Dollars you spend for the protection of your health can mean years of life.

Millions of Americans have made an annual checkup a habit...for life. How about you?

AMERICAN CANCER SOCIETY

## Incremental Shaft Encoder

Has 100 pulse output

Model ES-100 incremental shaft encoder provides a 100 pulse output for 360 deg shaft rotation. Pulses are read out by two heads phase 180 deg pulse period with respect to each other. This permits determination of rotation direction as well as angle. The unit uses magnetic, non-contacting readout which makes it immune to the effects of contact wear, dirt and dust, humidity and other environmental conditions.

Applied Science Corp. of Princeton, Dept. ED, P.O. Box 44, Princeton, N. J.

CIRCLE 390 ON READER-SERVICE CARD

## Selenium Rectifiers

Offer fixed or variable dc output

These selenium rectifiers have ratings from 40 to 100 w, at 100 v dc output. There are five models with fixed dc output, and three with variable dc output. Each model is supplied with its own enclosure and fuse holder. Those with variable output have a rheostat. Units are available for operation on: 115 v, 60 cps; 550 v, 60 cps; or 220 and 440 v, 60 cps.

Stearns Electric Corp., Dept. ED, 120 N. Broadway, Milwaukee 2, Wis.

CIRCLE 391 ON READER-SERVICE CARD

## Magnetic Shield

Increases backward wave tube versatility

This shock-insensitive non-retentive Netic Co-Netic shield diverts magnetic fields from reacting on backward wave tubes. By making negligible the tube's sensitivity to low intensity magnetic fields, the tube can be used in many more radar and other high frequency applications. The shield has eight covers and encloses the entire special focusing coil assembly.

Perfection Mica Co., Magnetic Shield Div., Dept. ED, 1322 N. Elston Ave., Chicago 22, Ill.

CIRCLE 392 ON READER-SERVICE CARD

CIRCLE 393 ON READER-SERVICE CARD >

WESCON: BOOTH 1509



BURTON BROWNE New York



50 G'S VIBRATION—3000  
250 G'S SHOCK

THE FIRST PREMIUM QUALITY MICRO-MINIATURE RELAY

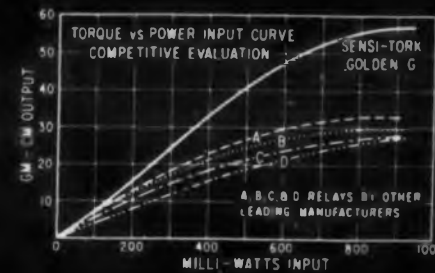
# FILTERS' NEW GOLDEN G

Filter's Golden G is the only relay that will meet 50 G vibration to 3,000 CPS and 250 G shock.

Each Premium Quality Golden G—precision made to provide the finest overall performance characteristics of any relay available—is expertly tested by Filter's Reliability Test Center to the most exacting standards in use in the industry.

The exclusive new "Sensi-Tork" rotary relay motor makes the Golden G unmatched for ruggedness and efficiency. Filter's newly developed RELAY MOTOR ANALYZER, which can continuously measure magnetic fields, force, armature travel and flux density, was used to plot the actual curves of Torque vs. Input Power, illustrating the great superiority of the Golden G vs. micro-miniature relays from other leading manufacturers.

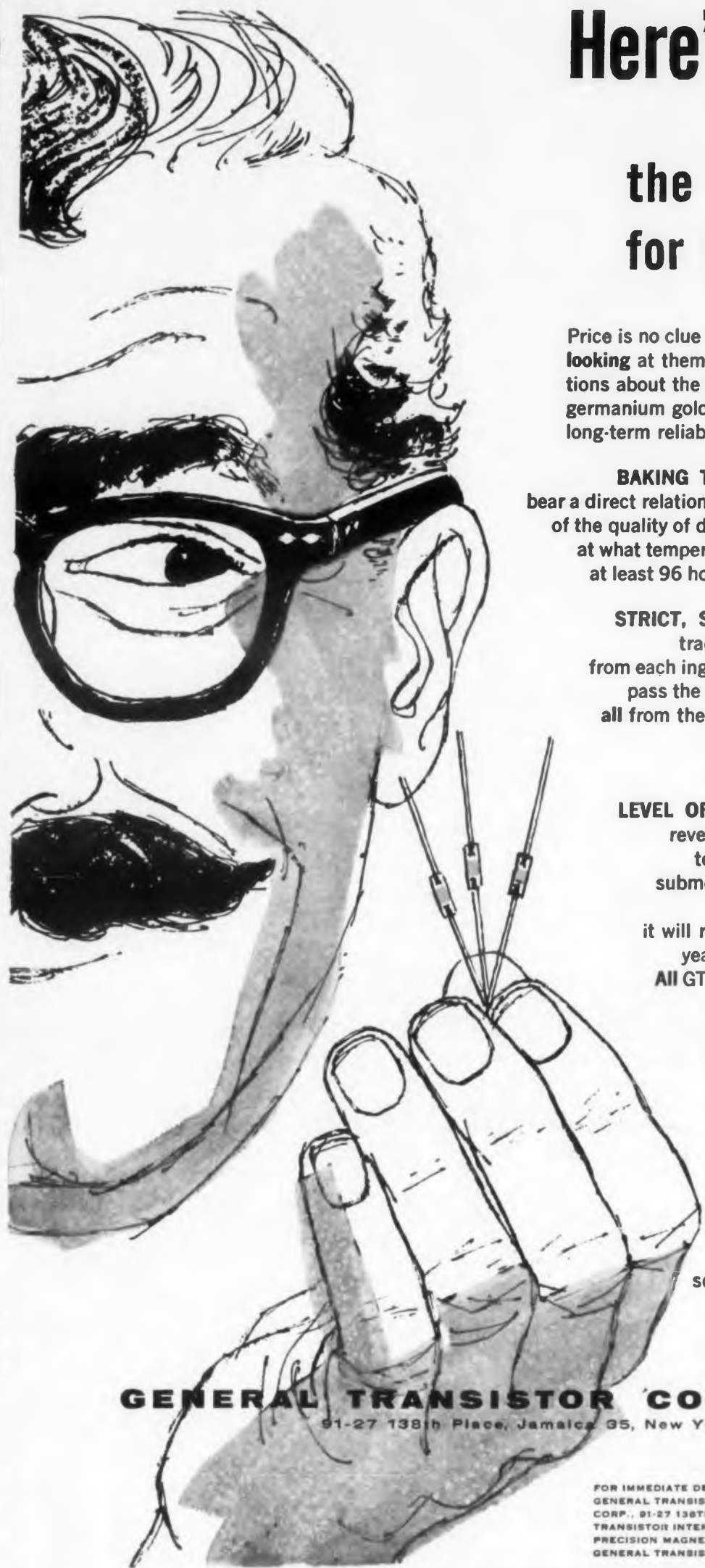
For more details and specifications of the Premium Quality Golden G call your Filter's representative or write:



Leading manufacturer of hermetically sealed rotary sub- and micro-miniature relays.

FILTERS, INC.

Main office and plant: Port Washington, N. Y. POrt Washington 7-8220  
West coast office: 13273 Ventura Blvd. Studio City, Calif. STanley 3-2770



# Here's how to pick the best **DIODES** for your money

Price is no clue when diodes sell for about the same, and just looking at them tells nothing. But if you ask the right questions about the three key factors in the production of quality germanium gold bonded diodes, you have your clues to more long-term reliability for your money. Here they are:

## BAKING TIME AND TEMPERATURE

bear a direct relationship to long-term stability. You get a measure of the quality of diodes by asking: "How long do you bake, and at what temperature?" (All GT diodes are baked at 140°C for at least 96 hours—the highest and longest in the industry!)

## STRICT, STATISTICAL, HISTORY LOGGING

traces the progress of every single wafer made from each ingot of germanium. At GT, if a few wafers fail to pass the stringent GT quality tests along the way, then all from the ingot are suspect and can be identified and pulled out. There are no "stowaways" in a shipment of GT quality diodes.

## LEVEL OF TESTING STANDARDS

reveals the level of quality. Ask about "everyday" test standards. (In the GT Seal Test, diodes are submerged in a penetrant-dye solution for 24 hours under 75 psi. This test is so sensitive that it will reveal a leak so small it would take over 300 years for 1 cc of gas to diffuse through the case.) All GT quality tests—100% electrical, 100% shock and vibration, and 100% temperature cycling—are at the highest industry level... and as a final mark of quality, the color bands on GT Germanium Gold Bonded Diodes are baked on to stay.

GT is equipped to supply diodes tested to individual customer requirements, such as JAN Qualification Inspection Tests and many others.

To get the full measure of quality in Germanium Gold Bonded Diodes, see your GT representative; or write directly to the company with know-how **NOW**.

**GENERAL TRANSISTOR CORPORATION**

91-27 138th Place, Jamaica 35, New York



FOR IMMEDIATE DELIVERY FROM STOCK, CONTACT YOUR NEAREST AUTHORIZED GENERAL TRANSISTOR DISTRIBUTOR OR GENERAL TRANSISTOR DISTRIBUTING CORP., 91-27 138TH PLACE, JAMAICA 35, NEW YORK. FOR EXPORT: GENERAL TRANSISTOR INTERNATIONAL CORP., 91-27 138TH PLACE, JAMAICA 35, NEW YORK. PRECISION MAGNETIC RECORDING HEADS AVAILABLE FROM GENERAL TRANSISTOR WESTERN CORP., 6110 VENICE BLVD., LOS ANGELES, CALIF.

CIRCLE 394 ON READER-SERVICE CARD

## NEW PRODUCTS

### Electronic Multicoder

Samples 88 channels



Model 1208D-2 electronic multicoder measures 4 x 4 x 4 in. and samples 88 instrument channels. It simultaneously produces pdm and pam output waveforms. The pdm output will drive a standard magnetic record head and the pam output will drive a standard SCO. It operates directly from a 28 v supply and draws 3 w. All necessary auxiliary power supplies, blanking and keying circuitry are contained within the unit.

General Devices Inc., Dept. ED, P.O. Box 253, Princeton, N.J.

CIRCLE 395 ON READER-SERVICE CARD

**PROPORTIONAL COUNTER TUBE.**—Model WL-7243 detects thermal neutrons in  $8 \times 10^{-2}$  to  $8 \times 10^0$  neutrons per  $\text{cm}^2$  per sec range, operates in any position at ambients to 175 F. Operating at 2000 v, tube has sensitivity of about 13 counts per neutrons per  $\text{cm}^2$ .

Westinghouse Electric Corp., Electronic Tube Div., Dept. ED, P.O. Box 284, Elmira, N.Y.

CIRCLE 396 ON READER-SERVICE CARD

**SYSTEM ERROR BRIDGE.**—Redesigned model SSB-11C has phase-sensitive null meter, can measure outputs of synchros and resolvers that are sealed in a system. Range, 360 deg continuous; readability, 3.6 sec; accuracy, 10 sec. Unit meets MIL-D-8512 and MIL-T-945A, needs no auxiliary equipment.

Theta Instrument Corp., Dept. ED, 48 Pine St., East Paterson, N.J.

CIRCLE 397 ON READER-SERVICE CARD

**HIGH TEMPERATURE TERMINAL.**—Single-piece, self-insulated unit for aircraft, missiles, and electronic wiring. Withstands 500 F for indefinite periods, 600 F for short periods.

Thomas & Betts Co., Dept. ED, 36 Butler St., Elizabeth, N.J.

CIRCLE 398 ON READER-SERVICE CARD

**DC SOLENOID CONTACTOR.**—Standard NEMA size 4, 150 amp, spdt unit for general purpose and machine tool controllers and for switching lamp, battery, and other dc loads. Standard coils for 115 and 230 v dc operation.

Ward Leonard Electric Co., Dept. ED, 115 MacQuesten Pkwy. S., Mt. Vernon, N.Y.

CIRCLE 399 ON READER-SERVICE CARD



**Variable Resistor**  
Motor driven

For TV and other remote control applications, the type MD10 motor driven variable composition resistor is available in ranges from 250 ohms to 10 meg and in 1/4 to 1/2 w ratings. The assembly incorporates a 6 v, bidirectional dc motor-gear-train that rotates the resistor contact arm at about 5 rpm. Voltage rating across the control end terminals is 500 v dc. Standard tolerance is  $\pm 30\%$  for 250 ohms to 5 meg and  $\pm 40\%$  for 5 to 10 meg.

Chicago Telephone Supply Corp., Dept. ED, 1142 W. Beardsley Ave., Elkhart, Ind.

CIRCLE 400 ON READER-SERVICE CARD

**PRECISION GEARS.**—Solid hub type available in standard diametral pitches 48 through 200 with 20 through 120 teeth. Bore sizes are 0.12, 1/8, 3/16, and 1/4 in. In stainless steel and anodized aluminum to AGMA Class 1 and 2 tolerances.

U. S. Gear Corp., Dept. ED, 81 Bay State Rd., Wakefield, Mass.

CIRCLE 401 ON READER-SERVICE CARD

**MEDIUM-MU TWIN TRIODES.**—Models 5BK7-A and 6BK7-B are 9-pin miniature units for use in cathode drive rf amplifier circuits in vhf television receiver tuners. They have a low plate-to-cathode capacitance and a transconductance of 9300  $\mu$ mhos obtained at a plate current of 18 ma. The 5BK7-A has a 4.7 v, 600 ma heater and the 6BK7-B a 6.3 v, 450 ma heater.

Radio Corporation of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 402 ON READER-SERVICE CARD

**TV CAMERA CABLE.**—Accommodates signal and control circuits between camera and associated equipment. Contains specified number of hookup wires and several coaxial cables. Conductors are color coded; overall shield and jacket prevent radiation and cross-talk.

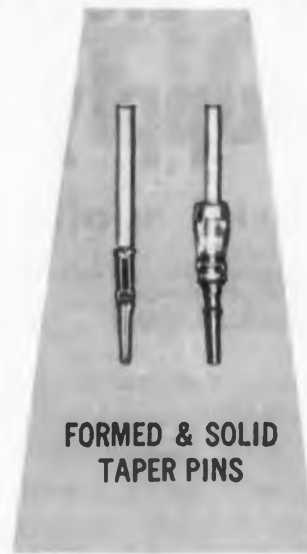
Times Wire and Cable Co., Inc., Dept., Wallingford, Conn.

CIRCLE 403 ON READER-SERVICE CARD

**HOLLOW SHAFT DIFFERENTIALS.**—Miniature, flange type units in 1/8 and 3/16 in. bore sizes designed to fit specifications of many existing instruments.

Superite Instrument Corp., Dept. ED, 7 Mayflower Place, Floral Park, N.Y.

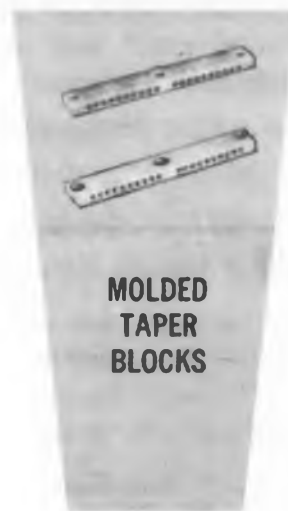
CIRCLE 404 ON READER-SERVICE CARD



FORMED & SOLID  
TAPER PINS



FOR A TIGHT FIT IN A TIGHT SPOT...



MOLDED  
TAPER  
BLOCKS



INSERTION &  
CRIMPING  
TOOLS



If miniaturization has put your circuits in a tight spot, you can build reliability right into them with the AMP Taper Technique . . . formed taper pins or new solid, pre-insulated taper pins . . . two-piece or molded one-piece stackable blocks . . . plus a wide assortment of taper receptacles.

The AMP Taper Technique offers the most complete line of taper products available plus many extra features. A three-and-a-half degree taper assures the firmest fit of pin in block. A-MP Pull-Test Insertion Tools assure the proper seating of pins. Hand and Automachine crimping tools assure uniformity of pin attachment to your circuit leads.

And—with the addition to the AMP Taper Technique of the new Solid Pre-Insulated Diamond Grip Taper Pin and the new one-piece warp-free block, you can have the greatest flexibility of product choice for your circuit design and manufacturing operations.

You can concentrate more circuits in a smaller space—and be sure of reliability when you use the AMP Taper Technique. Send for our new catalog today.

# AMP INCORPORATED

**GENERAL OFFICES: HARRISBURG, PENNSYLVANIA**

A-MP products and engineering assistance are available through subsidiary companies in: Australia • Canada • England • France • Holland • Japan

CIRCLE 405 ON READER-SERVICE CARD

# Here's how General Electric solves typical DC power-supply problems

for computers and special applications

## PROBLEM

"We need to devote our engineering time to designing our electronic circuitry . . . not the power components."



## SOLUTION

This is a frequent problem facing computer manufacturers. General Electric's Rectifier Department has complete engineering and manufacturing capability not only to design and apply all types of power supplies, but also to incorporate power supplies into completely integrated systems.

These systems could include load distribution, supply sequencing, protection for power supply and load, and complete power distribution. Let General Electric tackle your DC power problems such as those associated with load IR drop, "cross talk," and other nuisance-type problems plaguing your engineers.

## PROBLEM

"It's always a problem making sure transistorized equipment is safe from its power supply."

## SOLUTION

To alleviate this problem, General Electric has developed several methods of making transistorized equipment safer in this respect. With G-E protective circuits, shorting a plus high-voltage bus to a plus or minus low-voltage bus would not cause the low-voltage bus to exceed a small percentage of nominal rated value.

General Electric power supplies protect completely transistorized pieces of equipment from large losses due to over-voltage failures.

## PROBLEM

"My power supply requirements fluctuate so much . . . big jobs, little jobs, all in between."

## SOLUTION

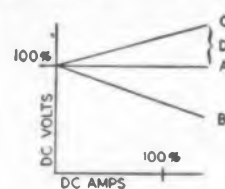
G.E. has built individual power supplies and complete systems ranging from less than one watt up to 35,000 kilowatts. These power supplies span the complete range of DC power—regulated and unregulated—applying all types of components. G-E experience includes completely transistorized supplies, and supplies with the new controlled rectifier, magnetic amplifiers, voltage stabilizing transformers, and motor-alternator "brute force" systems.

## PROBLEM

"We have a real low-voltage power distribution problem with our computer."

## SOLUTION

Low-voltage distribution problems can be handled easily through load compensation. Curve "A" is net desired no-load to full-load regulation at load point. "B" is regulation at load without remote sensing or load compensation. "C" represents IR compensation in power supply itself. "D" is amount of IR or load compensation.



**NO MATTER WHAT** your computer and other special power-supply problems are, General Electric can help you economize—economize by helping you free your engineers of these problems. For more information on power-

supply products and services, contact your nearest General Electric Apparatus Sales Office or write to Section C 535-2, General Electric Company, Schenectady, New York.

*Progress Is Our Most Important Product*

**GENERAL  ELECTRIC**

CIRCLE 406 ON READER-SERVICE CARD

## NEW PRODUCTS

### Frequency Meter

400 cps



This Amelco frequency meter is for the precise measurement of 400 cps. It is completely transistorized and conforms to MIL-T-945, MIL-E-4158, and MIL-T-27 specifications. It has a 4 w operating power from an ac line, a 394 to 406 cps frequency range, and a 3-1/2 in. round meter. Accuracy is  $\pm 0.1$  cps at center frequency and 0.25 cps at the ends of the range. The hermetically sealed control unit is 5-1/2 x 4 x 3 in.

Joslyn-Hudson Corp., Dept. ED, 2040 Colorado, Santa Monica, Calif.

CIRCLE 407 ON READER-SERVICE CARD

**FLEXIBLE COAXIAL CABLE.**—Designed to extend range of high frequency induction heating. Attaches to induction heater at one end and a work coil at the other. For brazing, spot annealing, forming, other applications. In 2 to 20 ft lengths.

L. C. Miller Co., Dept. ED, 5005 E. Slauson Ave., Los Angeles 22, Calif.

CIRCLE 408 ON READER-SERVICE CARD

**HIGH SPEED MICROFILM PRINTER.**—Model 4020 for graph plotting, tabular printing, design engineering, and computer monitoring. For on- or off-line operation, unit is compatible with wide variety of data processing systems and records computer output data at rate of 15,000 characters per sec.

Stromberg-Carlson, 1895 Hancock St., Dept. ED, San Diego 12, Calif.

CIRCLE 409 ON READER-SERVICE CARD

**PRESSURE-TO-FREQUENCY SYSTEM.**— Model PFS-4 combines a reactance-controlled subcarrier oscillator and a variable reluctance type pressure transducer in one cylindrical package. It is suited to airborne telemetry systems for instrumenting missiles, rockets, and aircraft.

Ultradyn, Inc., Dept. ED, P.O. Box 3308, Albuquerque, N. Mex.

CIRCLE 410 ON READER-SERVICE CARD



### Trimmer Capacitors

Six units available

Designed to meet MIL-C-81A, type 833 trimmer capacitors are available with 180 deg rotation in six different units having these capacity ranges: 1.5 to 7  $\mu\text{f}$  MIL CV11A070; 2 to 6  $\mu\text{f}$ , CV11A060; 3 to 12  $\mu\text{f}$  CV11A120; 4 to 30  $\mu\text{f}$ , CV11A300; 4.5 to 25  $\mu\text{f}$ , CV11A250; 7 to 45  $\mu\text{f}$ , CV11A450. All are rated at 600 v dc with a power factor of less than 0.2% at 1 mc. These trimmer capacitors measure 41/54 x 27/43 in. and have mounting holes for No. 4 machine screws.

Centralab, Div. of Globe-Union, Dept. ED, 900 E. Keefe Ave., Milwaukee, Wis.

CIRCLE 411 ON READER-SERVICE CARD

**S-BAND BEACON.**—Model 19SC has 2850 to 2950 mc range,  $\pm 2$  mc stability,  $-40$  dbm triggering sensitivity. Receiver-transmitter is 6-1/4 in. long and 2-1/2 in. in diameter. Power supply is 5 in. long and 2-1/2 in. in diameter with 6.5 v dc input at 2.5 amp and 150 v dc output.

Telerad Mfg. Corp., Dept. ED, Flemington, N.J.

CIRCLE 412 ON READER-SERVICE CARD

**TOGGLE SWITCH.**—Heavy duty series 4102-JV7 units have maintained and momentary action, are available in ten different circuit combinations. Ratings: 20 amp, 30 v dc, resistive; 15 amp, 30 v dc, inductive; 15 amp, 125 or 250 v ac. UL and CSA approved.

Sargent Electric Corp., Dept. ED, 630 Merrick Rd., Lynbrook, N.Y.

CIRCLE 413 ON READER-SERVICE CARD

**LOW PRESSURE TRANSDUCER.**—Model 155 for vibrational g loadings from 10 to 25 g in all axes in the range scale from 0 to  $\pm 1$  to 0 to 150 psi. Maximum errors including all resonant points are 2%.

Rahm Instruments, Div. of American Machine and Metals, Inc., Dept. ED, 65 Rushmore St., Westbury, N.Y.

CIRCLE 414 ON READER-SERVICE CARD

**IGNITRON INDUSTRIAL CONTROL TUBES.**—Are rated from 600 to 1200 kva, 54 to 140 amp peak current. Models 1051A, 1052A, 1053A and 10550 are particularly suited for resistance welding applications.

Raytheon Mfg. Co., Industrial Products Dept., Dept. ED, 55 Chapel St., Newton 58, Mass.

CIRCLE 415 ON READER-SERVICE CARD

# Swift, sure DISTORTION READINGS



-hp- 330B/C/D Distortion Analyzer

20 cps  
to  
20 KC

Measure distortions as low as 0.1%  
Measure noise on voltages as small as 100  $\mu\text{v}$   
High sensitivity, high stability  
Wide band 20 db gain amplifier  
Oscilloscope terminals; built-in VTVM

-hp- 330B Distortion Analyzer is a basic instrument universally used to measure total audio distortion, voltage level, power output, gain, total AM carrier distortion, noise and hum level and audio signal frequencies.

Model 330B consists of a frequency selective amplifier, a regulated power supply and a VTVM. The amplifier operates with a resistance-tuned circuit to provide almost infinite attenuation of the fundamental while passing harmonic frequencies at normal gain. Negative feedback minimizes distortion and insures uniform response and stability. The VTVM is used to set the load and measure the value of harmonic voltages, thus providing a direct reading of total distortion. The VTVM may also be used separately.

For FM broadcasters, -hp- 330C is offered. Similar to 330B, this instrument has a meter with VU ballistic characteristics meeting F.C.C. requirements and a VTVM frequency range of 10 cps to 60 KC.

For FM-AM broadcasters, -hp- 330D is available. This instrument is similar to -hp- 330C except for addition of an AM detector covering 500 KC to 60 MC.

Details from your -hp- representative, or write direct

**HEWLETT-PACKARD COMPANY**

4819K PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U.S.A.

CABLE "HEWPACK" • DAVENPORT 5-4451

Field Engineers in all Principal Areas

### SPECIFICATIONS

**Distortion Measurement:** 20 cps to 20 KC.

**Dial Calibration Accuracy:**  $\pm 2\%$  full range.

**Elimination Characteristics:** Reduces fundamental frequency more than 99.9%.

**Accuracy:**  $\pm 3\%$  full scale at distortion levels of 0.5%.

**Sensitivity:** Distortion levels of 0.3% are measured full scale. Accurate readings on 0.1% levels.

**Input Impedance:** 200,000 ohms, 40  $\mu\text{f}$  shunt.

**Required Input:** 1 v RMS.

**Voltmeter:** Nine 10 db ranges, 0.03 to 300 v. Full scale sensitivity all ranges.

**Noise Measurement:** 300  $\mu\text{v}$  full scale. Coverage 10 cps to 20 KC.

**Oscilloscope Terminals:** 75 db max. gain from AF input to terminals.

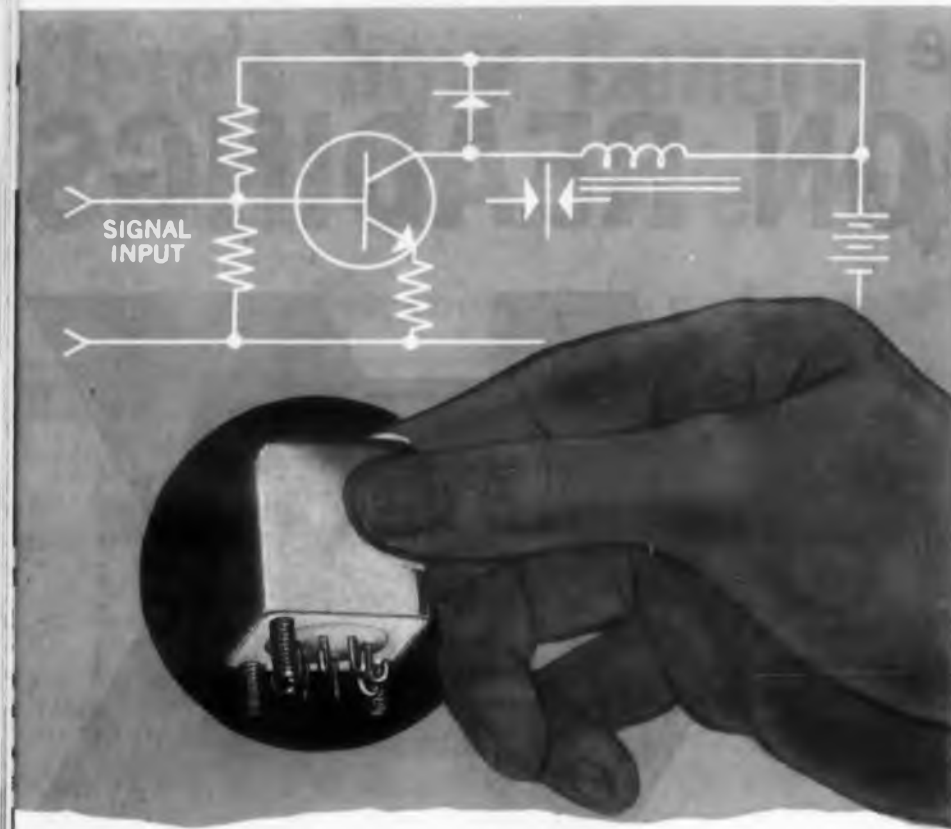
**Price:** -hp- 330B, \$410.00 (cabinet), -hp- 330C, \$440.00 (cabinet), -hp- 330D, \$500.00 (cabinet), (Rack models \$15.00 less).

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



now has a 200 KC 'scope for \$435! Seen it?

CIRCLE 416 ON READER-SERVICE CARD



## ADVANCE VGS

### MINIATURE ROTARY RELAY

*—high sensitivity and  
high contact rating in  
less than 1 cubic inch space*

**125 milliwatts** is all that's needed to operate this relay. Even a single transistor supplies enough power for fast, positive switching of the unit.

**5 amps** for 100,000 operations is the minimum rating.

You get all this power in a unit measuring only  $\frac{7}{8}$ " square x  $1\frac{1}{8}$ " high, and weighing only 1.5 ounces.

**50 G's** shock rating is standard for the Advance VGS. Unit operates under vibration of 15 G's from 55 to 2000 cps...is fully operational for use in exacting military systems.

**125°C** high-temperature operation...down to  $-65^{\circ}\text{C}$ .

**Hermetically sealed** and Radiflo tested to meet MIL-R-5757C test specifications. Available with two-pole, double-throw contact combination, and in many resistances and mounting arrangements.



### ADVANCE RELAYS



A PRODUCT OF ELECTRONICS DIVISION  
ELGIN NATIONAL WATCH COMPANY  
2435 N. NAOMI ST., BURBANK, CALIFORNIA



See us at Booth #1701 at the WESCON SHOW.  
CIRCLE 417 ON READER-SERVICE CARD

## NEW PRODUCTS

**INSULATION MATERIAL.**—Aluminum-Teflon AM-Foil for use as insulated flat conductor in electronic components, as gasketing material, or as separator and mold release film in plastics manufacture. Consists of aluminum foil with Teflon resin cast on one or both sides and fused at 900 F. Foil thicknesses are 0.0002 to 0.12 in.; Teflon coatings are 0.00006 to 0.001 in.

American Machine & Foundry Co., Dept. ED, 261 Madison Ave., New York 16, N.Y.

CIRCLE 418 ON READER-SERVICE CARD

**TELEMETERING SYSTEM.**—For sampling and telemetering remote measurements in power distribution systems and industrial processes. Transmits and receives up to 30 data points with 99% accuracy and provides output signal suitable for computer control. Hinged front provides instant access to plug-in circuitry.

Applied Science Corp. of Princeton, Dept. ED, P.O. Box 44, Princeton, N.J.

CIRCLE 419 ON READER-SERVICE CARD

**SLIDE GAGE PEN.**—Ball point Fend-Truxa 111 has scale for inches and centimeters, pushbutton for pen, and sliding combination pocket clip and measuring device.

Designs Modern, Dept. ED, 4082 El Bosque Dr., Pebble Beach, Calif.

CIRCLE 420 ON READER-SERVICE CARD

**FILM CARD READER.**—Model KG 15 has 18 x 24 in. plastic crystal screen for reading engineering drawings on 35 mm microfilm and built-in provision for making full size photo prints. Adapter for reading roll film can be furnished.

Eugene Dietzgen Co., Micro-Fax Div., Dept. ED, 218 E. 23rd St., New York 10, N.Y.

CIRCLE 421 ON READER-SERVICE CARD

**DEEP SEA PULSE TRANSFORMER.**—Delivers 8 kv pulse energy to sonar transducers, withstands 15,000 psi pressure or depths of 36,000 ft. Diameter, 2-1/2 in.; length, 11 in.

Edgerton, Germeshausen & Grier, Inc., Dept. ED, 160 Brookline Ave., Boston, Mass.

CIRCLE 422 ON READER-SERVICE CARD

**ELECTRICAL ENCLOSURES.**—Floor mounted NEMA 12 single and double door models MEK-8170 and MEK-8171 are heavy duty, free standing units providing sealed protection against dust, dirt, oil, water, and coolants. Single door sizes: 30 x 60 to 36 x 90; double door sizes: 42 x 60 to 72 x 90.

Machinery Electrification, Inc., Dept. ED, 56 Hudson St., Northboro, Mass.

CIRCLE 423 ON READER-SERVICE CARD

**5-IN. OSCILLOSCOPE.**—Wideband model ES-550B has two improvements: a camera mount bezel and an edge-lighted acrylic graticule.

Precision Apparatus Co., Inc., Dept. ED, 70-31 84th St., Glendale 27, N.Y.

CIRCLE 424 ON READER-SERVICE CARD

# 55

temperature & millivolt ranges



with 1 Speedomax<sup>®</sup> H Recorder

Yes, a single Speedomax H Recorder enables you to measure practically any temperature or millivoltage encountered in research activities. Simply pick the stocked range card and scale you need from 50 thermocouple or 5 millivolt ranges . . . substitute them in your Speedomax H Recorder . . . insert matching chart paper . . . and you're ready to record.

The specifications listed below are for the Speedomax H Strip Chart Recorder with a widely used range of 0 to 10 millivolts. For information on other ranges, contact your nearest L&N Office, or write to address below.

**List No.—3-32-000-044-6-120-5 Speedomax H Model S Recorder**, available for delivery in less than four weeks.

**Record**—Single-point continuous line.

**Measuring Circuit**—D-c potentiometer.

**Electrical Range**—0 to 10 millivolts.

**Accuracy Rating**— $\pm 0.3\%$  of span.

**Dead Band**—0.2% of span.

**Chart Number**—600006: 50 uniform divisions in  $6\frac{1}{2}$ ". Chart tear-off included.

**Chart Speed**—120 inches per hour.

**Span Step Response Time Rating**—1 second nominal.

**External Circuit Resistance Rating**—Up to 2500 ohms for normal performance.

**Current Standardization**—Automatic, every 48 minutes.

**Power Supply**—Operates on 120v, 60~.

**Optional Feature**—Carrying handle and feet available. Add (-9) to List No.

**Price**—\$585.00 f.o.b. Philadelphia or North Wales, Pa. (subject to change without notice). Add \$12.00 to price for (-9) suffix if desired. Use List No. 3-32-000-044-6-120-5 when ordering from L&N, 4908 Stenton Ave., Phila. 44, Pa.



CIRCLE 577 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 19, 1959



## Cathode Ray Tube

is used as a flying-spot scanner

Type 5ZP16 5 in. cathode ray tube can be used as the flying spot scanner in a video signal generator. It has a metal-back aluminized phosphor and uses magnetic deflection and electrostatic focus. A small deflection angle of 40 deg minimizes deflection defocusing. The P16 phosphor has a decay time of 9  $\mu$ sec.

Westinghouse Electronic Tube Div., Dept. ED, P.O. Box 284, Elmira, N.Y.

CIRCLE 425 ON READER-SERVICE CARD

## Actuator Switches

Side plunger type

Designed for use with the company's series LS and 200LS switches, these oil tight actuators are made to lie flat under cams and slides. The 3LS1 and 203LS1 side roller plunger versions are for actuation by fast cams and slides, while the 4LS1 and 204LS1 plain side plunger units are for use with slow moving cams and slides or where actuating motion is in line with plunger travel. The actuator heads may be mounted in four positions 90 deg apart, and the rollers may be rotated 360 deg, positively locking in any position.

Micro Switch, Div. of Minneapolis-Honeywell Regulator Co., Dept. ED, Freeport, Ill.

CIRCLE 426 ON READER-SERVICE CARD

## Insulation Leakage Current Tester

Provides 5000 v dc

Dc Hypotr model 5205 test set measures insulation leakage current as low as 0.05  $\mu$ a and up to 2000  $\mu$ a. Dc test potentials are continuously variable from 0 to 5000 v. It is used for production and performance testing of electronic components, servos, generators, cables, and harnesses. It weighs 24 lb and is 13-1/2 x 13 x 7 in.

Associated Research, Inc., Dept. ED, 3777 W. Belmont Ave., Chicago 18, Ill.

CIRCLE 427 ON READER-SERVICE CARD

CIRCLE 428 ON READER-SERVICE CARD

# CLEVITE

# DIFFUSED SILICON RECTIFIERS

### TECHNICAL DATA:

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

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

Check these features:

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

*For details, write for Bulletin B217A-3*

### OTHER CLEVITE DIVISIONS:

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

A DIVISION OF

**CLEVITE**

# CLEVITE

## TRANSISTOR PRODUCTS

241 CRESCENT ST., WALTHAM 54, MASS.

Twinbrook 4-9330

# Good-All

## CAPACITORS

### Two SPACE SAVERS and a Classic

Good-All Type 663UW SPACE-SAVING  
Sub-Miniature with a SKIN-TIGHT Case

SPACE  
SAVER

Type 663UW is an ideal choice for miniaturized and transistorized products. The space-saving possibilities are amazing.

SPECIFICATIONS.....	Voltage Range...100-1000 VDC
Dielectric.....Mylar® Film	I.R. at 25°C 100,000 Meg. x Mfd.
Case.....Plastic Wrap	Temp. Range -55°C to +125°C
End Fill.....Thermo-Setting Plastic	Humidity Resistance...Superior

SLIM  
LINE

#### 601PE — Tailored for transistors

Wafer-thin shape is ideal for upright mounting in tight spaces. An excellent replacement for ceramic discs where stability is important.

SPECIFICATIONS.....	Temp. Range...Full to +85°C...
Dielectric.....Mylar® Film	Derate 50% at +125°C
Case.....Dipped Epoxy	I.R. at 25°C.....
Voltage Range...50 VDC only	.....75,000 Meg. x Mfd.
	Humidity Resistance Superior

#### METAL ENCLOSED Tubulars per MIL-C-25A and MIL-C-0025B (U.S.A.F.)

CLASSIC

These capacitors are well-known classics... from the standpoint of broad usage in military electronics. Good-All specializes in CP tubular styles CP04, CP05, CP08, CP09, CP10 and CP11. \*DuPont's trademark for polyester film.

A LEADING MANUFACTURER OF TUBULAR,  
CERAMIC DISC AND  
ELECTROLYTIC CAPACITORS

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

CIRCLE 429 ON READER-SERVICE CARD

## NEW PRODUCTS

### Current Drivers

For testing computer components



Designed for testing computer components, negative current driver model 50 and positive current driver model 60 can be used independently or in conjunction to provide both polarities of pulses. Special features of these drivers are: 1 amp max current pulses; 0.1  $\mu$ sec rise time; regulated filaments; and three quick-select current levels. Both models have three pairs of coarse and fine amplitude controls. There is also a three-position switch to select one of these pairs of amplitude controls, as well as a rise time control.

Digital Equip. Corp., Dept. ED, Maynard, Mass.

CIRCLE 430 ON READER-SERVICE CARD

**ACTUATORS.**—Corrosion-resistant steel auxiliary actuators that absorb side thrust which a cam or slide might exert on switch plunger. Type JX-40 has leaf actuator for use with low angle or slow moving cams or slides. Type JX-45 has roller leaf actuator to allow rapid cam or slide operation. Actuators and type 1SX1-T miniature switches are for aircraft relays, computers, rocket equipment.

Micro Switch, Div. of Minneapolis-Honeywell Regulator Co., Dept. ED, Freeport, Ill.

CIRCLE 431 ON READER-SERVICE CARD

**GLASS SCRIM PAPER.**—For electronic and other laminates where high shock resistance and rigidity are needed. Consists of the company's Grade 101 paper with integral glass screen. Lengthwise tensile strength is 60 lb for 1 in. strip.

Knowlton Brothers, Dept. ED, Watertown, N.Y.

CIRCLE 432 ON READER-SERVICE CARD

**INDUSTRIAL FOOT SWITCHES.**—Heavy duty Clipper switches with wide treads. Available in both momentary and maintained contact types with spdt or dpdt circuits. Two mounting holes can be provided for rigid mounting.

Linemaster Switch Corp., Dept. ED, 432 Woodstock Terrace, Woodstock, Conn.

CIRCLE 433 ON READER-SERVICE CARD

**MIXER PREAMPLIFIER.**—Model MMX combination microwave and if preamplifier assembly. Each unit is tested at X band for gain and selectivity and is adjusted for minimum noise figure. Standard units have output frequencies of 30 or 60 mc.

LEL, Inc., Dept. ED, Oak St., Copiague, N.Y.

CIRCLE 434 ON READER-SERVICE CARD

When you want 'em ... you've got 'em

# Good-All

## CAPACITORS

### AUTHORIZED INDUSTRIAL DISTRIBUTORS

ARLINGTON, VIRGINIA  
Industry Services, Inc.  
Key Electronics Division

BALTIMORE, MARYLAND  
Kann-Elliott Electronics, Inc.

BATTLE CREEK, MICHIGAN  
Electronic Supply Corp.

BUFFALO, NEW YORK  
Radio Equipment Corp.

CAMBRIDGE, MASSACHUSETTS  
Electrical Supply Corp.

CAMDEN, NEW JERSEY  
General Radio Supply Co.

CHICAGO, ILLINOIS  
Laska Sales Corporation  
Newark Electric Co.

CLEVELAND, OHIO  
Pioneer Electronics Supply Co.

CLIFTON, NEW JERSEY  
Eastern Radio Corporation

DALLAS, TEXAS  
Engineering Supply Co.

DAYTON, OHIO  
Srepro, Inc.

FT. WAYNE, INDIANA  
Ft. Wayne Electronics Supply, Inc.

HOUSTON, TEXAS  
Harrison Equipment Co., Inc.

INDIANAPOLIS, INDIANA  
Graham Electronics Supply, Inc.

KANSAS CITY, MISSOURI  
Burlison Appliances Co.

LOS ANGELES, CALIFORNIA  
Radio Product Sales Corp.

MIAMI, FLORIDA  
Electronic Equipment Co., Inc.

MINEOLA, NEW YORK  
Arrow Electronics, Inc.

NEW YORK, NEW YORK  
Electronics Center, Inc.

PHILADELPHIA, PA.  
Philadelphia Electronics, Inc.

POUGHKEEPSIE  
Higgins & Sheer Electronic Distributors

SAN DIEGO  
Radio Parts

SAN FRANCISCO, CALIF.  
Fortune Electronics  
Television Radio Supply Co.

SCRANTON, PA.  
Fred P. Purcell Co.

SEATTLE, WASHINGTON  
C. and S. Radio Supply Co.

SOUTH BEND  
Radio Distributing Co.

SPRINGFIELD, MASSACHUSETTS  
T. F. Cushing, Inc.

ST. LOUIS, MISSOURI  
Interstate Supply Corp.

ST. PAUL, MINN.  
Northport Electronics, Inc.

TULSA, OKLAHOMA  
Oil Capital Electronics Corp.

WATERBURY, CONNECTICUT  
Bond Radio Supply Co., Inc.

**GOOD-ALL ELECTRIC MFG. CO.**  
Distributors' Div.  
26 Rittenhouse Pl. Ardmore, Pa.

CIRCLE 435 ON READER-SERVICE CARD

## Motor Driven Switch

For missiles



Designed for switching functions on missiles, the model M-172-4 motor driven switch has 5pdt power circuits, a position indication circuit and ruggedized terminals. The power circuits are rated for currents ranging from microamperes to 22 amp. Tested successfully at 40 g to 2000 cps of vibration and from -65 to +165 F, the unit maintains positive position stability without control power. It measures 1.94 x 2.56 x 2 in.

Kinetics Corp., Dept. ED, 410 S. Cedros Ave., Solana Beach, Calif.

CIRCLE 436 ON READER-SERVICE CARD

**TELEPHONE RELAY.**—A stainless steel hinge pin and riveted contact pusher pins have extended the useful life of the type LS relay to hundreds of millions of operations. The 4pdt unit measures 2-3/8 x 1-5/32 x 1-1/2 in., weighs about 3 oz. Sensitivity is 65 mw per movable arm for standard units, 35 mw for special units. Bifurcated contacts are rated 4 amp, 115 v, 60 cps, resistive. Units can be equipped with up to 20 contact springs.

Potter & Brumfield, Inc., Dept. ED, Princeton, Ind.

CIRCLE 437 ON READER-SERVICE CARD

**CAPACITORS.**—Improved type OF Glasscaps have lower power factor, higher resistance, lower temperature coefficient. Life expectancy, 5000 hr at 85 C; voltage range, 2000 to 60,000 dc.

Plastic Capacitors, Inc., Dept. ED, 2620 N. Clybourn Ave., Chicago 14, Ill.

CIRCLE 438 ON READER-SERVICE CARD

**TINNED COPPER STRANDING.**—"No Fray" conductors are heavy tinned copper stranded wires with the strands fused. Strandings are approved for UL appliance wiring material in sizes AWG 16 through 26, and for CSA types TR and TEW wire.

Phalo Plastics Corp., Dept. ED, Shrewsbury, Mass.

CIRCLE 439 ON READER-SERVICE CARD

**MAGNETIC SHAKER TABLE SHIELD.**—Nonre-tentive, shock insensitive Co-Netic shields designed to enclose any shaker table configuration and allow mechanical positioning of shaker with minimum of interference. Field levels can be reduced to 1 or 2 gauss at distance of 3 in. from shield surface.

Perfection Mica Co., Magnetic Shield Div., Dept. ED, 1322 N. Elston Ave., Chicago 22, Ill.

CIRCLE 440 ON READER-SERVICE CARD

.005  $\mu$ sec. to 5,000  $\mu$ sec.

# ESC DELAY LINES TAKE GIANT STEPS!



From the smallest to the largest— .005  $\mu$ sec. to 5,000  $\mu$ sec.—ESC's research staff has custom-designed delay lines for virtually every military and commercial application! And with every delay line prototype comes a comprehensive laboratory report, which includes submitted electrical requirements, photo-oscillograms (which indicate input and output pulse shape and output rise-time), the test equipment used, and an evaluation

of the electrical characteristics of the prototype.

In addition, an extensive factory rep organization spans the nation, ready to provide on-the-spot assistance in specification and installation.

For complete technical data, write to ESC—America's leading manufacturer devoted to the design, development and production of custom-built and stock delay lines!



# ESC

WRITE TODAY FOR COMPLETE TECHNICAL DATA.

*exceptional employment opportunities for engineers experienced in computer components... excellent profit-sharing plan.*

**CORPORATION** 534 Bergen Boulevard, Palisades Park, New Jersey

Distributed constant delay lines • Lumped-constant delay lines • Variable delay networks • Continuously variable delay lines • Pushbutton decade delay lines • Shift registers • Pulse transformers • Medium and low-power transformers • Filters of all types • Pulse-forming networks • Miniature plug-in encapsulated circuit assemblies

CIRCLE 441 ON READER-SERVICE CARD

# NOW DROP TUBE TEMPERATURES




AS MUCH AS 130°C

prolong tube life—increase reliability

**atlee** FULL-CONTACT TUBE COOLING SHIELDS  
provide MAXIMUM tube cooling through

- FULL CONTACT with tube
- FULL CONTACT with shield
- FULL CONTACT with chassis

The new **atlee** FULL-CONTACT tube-cooling shield, with exclusive "delta-wave"  insert and flat-mounting shield base, provides a spectacular reduction of envelope temperatures even under extreme operating conditions. Tests prove a drop of 130°C below bare-bulb temperatures, and 80°C below levels reached with JAN shields and standard N.E.L. inserts.

Here is a significant advance in the fight against equipment failure even under conservative operating conditions. Further, where tubes must operate close to maximum ratings, it means a real reduction in the inevitable penalty of shorter tube life.

DESIGN FOR RELIABILITY WITH **atlee** — a complete line of dependable heat-dissipating holders and shields of all types, plus the experience and skill to help you solve unusual problems of holding and cooling electronic components.

## ATLAS E-E

CORPORATION

47 PROSPECT STREET • WOBURN, MASS.

CIRCLE 442 ON READER-SERVICE CARD

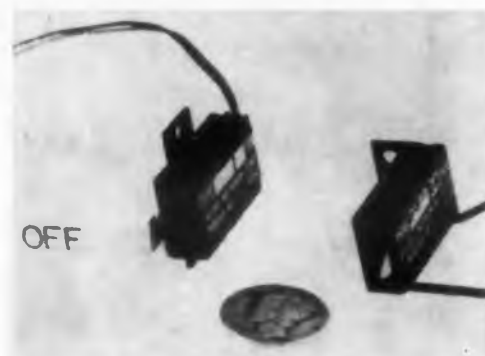


Get the complete story  
in your free copy of  
this fact-filled Bulletin!

## NEW PRODUCTS

### Shutter Indicators

Mask Instruments



Designated type 109, these miniature electro-magnetic shutter indicators provide simple and positive on-off masking of dial counters and similar devices in compact instrument panels. Measuring 15/16 x 9/16 x 0.270 in. and weighing 9 g, they operate on voltages up to 50 v. Input power is under 1.5 w. The units operate over temperatures from -65 to +80 C and conform to applicable sections of MIL-E-5272A.

Allard Instrument Corp., Dept. ED, 146 E. 2nd St., Mineola, N. Y.

CIRCLE 443 ON READER-SERVICE CARD

PRECISION MOLDED HOLES.—In type G-10 and G-11 epoxy glass laminates for terminal and printed wiring boards. Sizes down to 0.012 in. with  $\pm 0.001$  in. tolerances, smooth walls, and no crazing, wicking or burrs. Irregular shapes available.

Sandymac Corp., Dept. ED, P.O. Box 505, Traverse City, Mich.

CIRCLE 444 ON READER-SERVICE CARD

MINIATURE SOLDERING TIP.—Type PL340 Micro-Needle Tiptet for soldering miniature toroids, diodes, and other electronic components. Tip is 3/4 in. long with 3/64 in. OD and bevelled point, fits the company's 4045, 1235, and 535 heating units. Suited for soldering miniature eyelets to printed circuit boards.

Ungar Electric Tools, Inc., Dept. ED, 4101 Redwood Ave., Los Angeles 66, Calif.

CIRCLE 445 ON READER-SERVICE CARD

SWITCHING TRANSISTORS.—Type 2N1090 and 2N1091 npn germanium alloy junction transistors provide switching times of 0.3 and 0.25  $\mu$ sec, respectively, at collector current levels of 200 ma. Respectively, they have minimum dc current gain of 30 and 40 at 20 ma collector current, minimum alpha cutoff frequency of 5 and 10 mc, and maximum stored base charge of 1600 and 1000 micromicrocoulombs.

Radio Corporation of America, Semiconductor and Materials Div., Dept. ED, Somerville, N.J.

CIRCLE 446 ON READER-SERVICE CARD

### METAL FILM RESISTORS



NEW! This precision low noise metal film resistor meets and exceeds requirements with temperature coefficient of plus or minus 50 ppm/°C independent of resistance value. Standard tolerance plus or minus 1 per cent. Type WHM-1.125" long x .406" diam. — is equivalent to MIL Style RN 75, maximum voltage rating 500V. Type WFH-.781" long x .250" diam. — equivalent to MIL Style RN 70, maximum voltage rating 350V.

Enclosed in specially designed hermetically sealed plastic casing (patent pending) to protect precision resistor element.



RESISTANCE PRODUCTS  
COMPANY

914 S. 13 St.

Harrisburg, Pa.

Specialists in manufacturing quality resistors: Precision Wire Wound — High Voltage — High Megohm — High Frequency. Our test equipment and standards for checking and calibrating are matched only by leading laboratories. Write for more information.

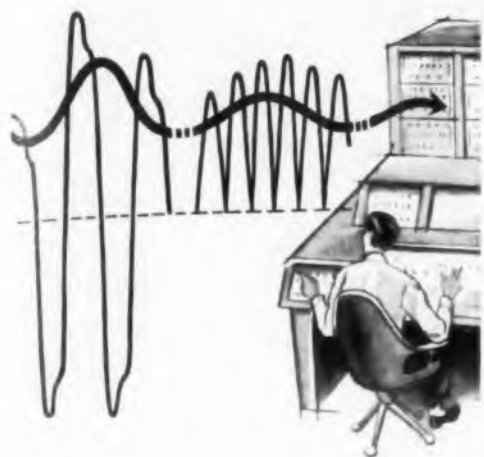
### HIGH MEGOHM RESISTORS

Type H. For electrometer circuits, radiation equipment and as high resistance standards. Resistance available to 100 million megohms. Voltage rating to 15,000 volts. Low temperature and voltage coefficient. Seven sizes, from 3/4" to 3" long, of which 2 meet requirements of MIL-R-14293A. Standard resistance tolerance 10%. Tolerance of 5% and 3% available. Also matched pairs with 2% tolerance.



CIRCLE 528 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 19, 1959



## NOW — AC TO DC CONVERSION UNAFFECTED BY HARMONICS

IN PRODUCTION, LABORATORY  
OR IN THE FIELD

North Atlantic  
Phase Sensitive AC to DC Converter

makes available, for the first time, the precision and flexibility that permits DC instruments to be used for measurement of complex AC signals. Freedom from harmonic effects, plus variable phasing control, allow accurate DC readout of total, fundamental, in-phase and quadrature component of any signal.

Broad dynamic response, excellent linearity and choice of single- or double-ended output make the Model 401 readily applicable to digital voltmeters, DC ratiometers, electronic analog to digital converters and data handling systems. Available for specified frequencies from 30 to 5000 cps, in portable, bench or rack-mount models—or as a module for automated checkout systems. For full specs, write for Bulletin 401.



Model 401  
5 1/4" x 19" x 8 1/2"

**NORTH ATLANTIC**  
industries, inc.  
603 Main Street, Westbury, N.Y.  
EDgewood 4-1122

See us at WESCON—Booth 3224

CIRCLE 452 ON READER-SERVICE CARD



### Miniature Variable Delay Line

Has 3 in. diam,  
1 in. height

Measuring 3 in. in diam and 1 in. in height, type V-397 delay line can be motor driven and has been life tested for over 10,000 hr. Made to meet all applicable mil specs, this unit has an impedance of 1000 ohms, a rise time of less than 0.1 msec, a delay time from 0 to 1.2 msec, and less than 1 db attenuation. Contacts are rhodium plated. Other delays and impedance are available.

Control Electronics Co., Inc., Dept. ED, 10  
Stepar Place, Huntington Station, L.I., N.Y.

CIRCLE 447 ON READER-SERVICE CARD

**NPN JUNCTION TRANSISTOR.**—Germanium type 2N649 for use with its pnp counterpart, type 2N408, in class B complementary-symmetry power output stages of transformerless, battery operated portable radio receivers, phonographs, and audio amplifiers with supply voltages to 9 v.

Radio Corporation of America, Semiconductor and  
Materials Div., Dept. ED, Somerville, N.J.

CIRCLE 448 ON READER-SERVICE CARD

**DRIFT TRANSISTORS.**—Germanium pnp units for am broadcast band applications in automobile receivers. Type 2N640 is for rf amplifier service; type 2N641, for 262.5 or 455 kc if amplifier service; type 2N642, for converter service.

Radio Corporation of America, Semiconductor and  
Materials Div., Dept. ED, Somerville, N.J.

CIRCLE 449 ON READER-SERVICE CARD

**POWER TRANSISTORS.**—Type 2N456 and 2N457 germanium pnp alloy junction transistors for use in power switching, voltage regulator, multivibrator, dc-to-dc converter, and power supply circuits. May also be used as relay actuating devices and in large signal class A or B push-pull audio frequency oscillator service. Maximum collector current rating, —5 amp; maximum collector-to-base voltage rating, —40 and —60 v, respectively; maximum transistor dissipation, 50 w.

Radio Corporation of America, Semiconductor and  
Materials Div., Dept. ED, Somerville, N.J.

CIRCLE 450 ON READER-SERVICE CARD

**INSTRUMENT CASES.**—King-Size models, up to 30 in. high, are designed to meet MIL-STD-108C and MIL-T-945A. Shock-mounted, they are made of reinforced aluminum, and have relief valves to protect contents from pressure changes.

TA Manufacturing Corp., Dept. ED, 4607 Alger  
St., Los Angeles 39, Calif.

CIRCLE 451 ON READER-SERVICE CARD



ELECTRONIC DESIGNERS:

**choose from  
325 MODELS**

**OF JOY BLOWERS . . .**

OVER 325 MODELS with 1300 designs available to meet your requirements . . . from 1/500th hp up . . . efficiency ratings up to 86% . . . pressures as high as 70" WG.

MEET MILITARY SPECS . . . accepted for airborne and ground installations by RCA, Boeing, Douglas, Motorola, Lockheed, Raytheon and many others.

VANEAXIAL DESIGN . . . motor mounted inside the fan . . . provides more air more efficiently than any other type fan.

RUGGED . . . because of simple design . . . vibration free, the outer casing, the vanes, and motor mounts are cast in one piece.

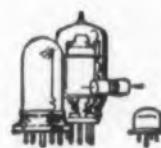
SPECIAL DESIGNS . . . We can furnish project engineers with any specially engineered fan to meet the toughest requirements and the tightest project deadlines.

WANT PROOF? Write Joy Manufacturing  
Company, Oliver Building, Pittsburgh 22,  
Pennsylvania.

W8W 17378-270

**JOY**

AIR MOVING EQUIPMENT FOR ALL INDUSTRIES



ELECTRONIC  
COOLING



MISSILES  
AND GSE



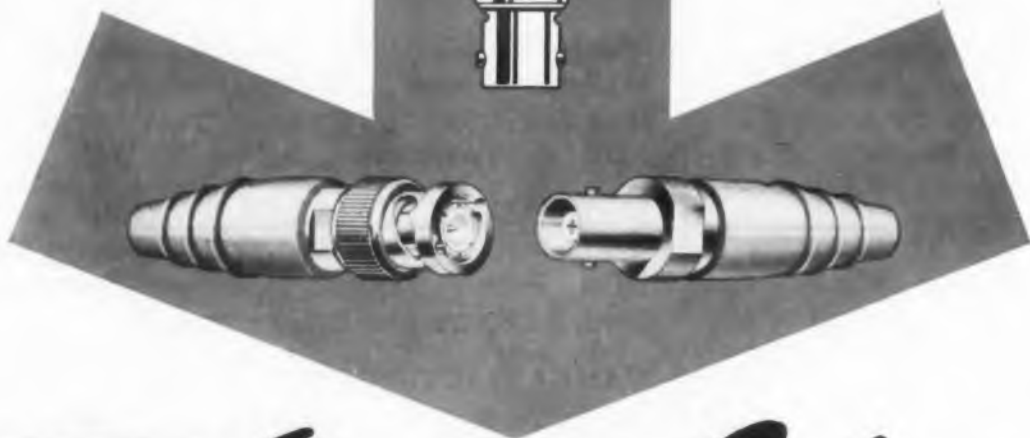
CABIN  
VENTILATION



DEFOGGING  
DE-ICING

CIRCLE 453 ON READER-SERVICE CARD

**CUT RE  
ASSEMBLY  
TIME  
IN  
HALF!**



**AMPHENOL** *Quick-Crimp*<sup>\*</sup>  
**BNC CONNECTORS**

Assembly-time savings of 50%, measurable increase in systems reliability—these are the clearcut advantages of AMPHENOL's new Quick-Crimp BNC connectors! Because there are only 3 basic parts plus an optional boot to assemble (compared with as many as 10 in a standard BNC) Quick-Crimps are prepared in half the usual time, even by inexperienced personnel! Because critical pre-assembly work has already been done the finished Quick-Crimp assembly is highly reliable. Let Quick-Crimps solve your RF assembly problems!

*Available Now! Write for Complete Cataloging*



CONNECTOR DIVISION 1830 S. 54th Ave., Chicago 50, Illinois  
Amphenol-Borg Electronics Corporation

<sup>\*</sup>U.S. Patent Pending

CIRCLE 454 ON READER-SERVICE CARD

**NEW PRODUCTS**

**Magnetic Ferrite**

For recording heads

Nickel ferrite type CN-20, for use in recording heads, operates most effectively in the 10 to 750 kc range. Initial permeability at 100 kc is 800 and saturation magnetization at 16 oersteds is 3680. Recording heads made of the material show negligible inductance deviations at temperatures to 160 F.

Kearfott Co., Inc., Dept. ED, 1500 Main Ave., Clifton, N.J.

CIRCLE 455 ON READER-SERVICE CARD

**Pulse Current Transformer**

Has rise time of 20  $\mu$ sec

Model PCT 325 pulse current transformer allows precision monitoring of both pulse amplitude and waveshape. It has a rise time of 20  $\mu$ sec, droop of 0.1% per  $\mu$ sec, and an accuracy of 0 to +1%. This transformer is able to monitor currents at high voltages: 300 kv pulse in oil; 30 kv ac, dc, or pulse in air.

Pearson Electronics, Inc., Dept. ED, 707 Urban Lane, Palo Alto, Calif.

CIRCLE 456 ON READER-SERVICE CARD

**Triple Chamber Refrigerator**

For multiple testing

Designed for multiple testing, the model SV3-75-5 low temperature and environmental chamber is equipped with three stainless steel, 14 cu in. test cells with adjustable temperature ranges. One cell has a 0 to -20 F range, the second, -35 to -45 F, and the third, -60 to -75 F. A cascade refrigeration system with 3/4 and 1 hp motor compressors cools all three cells. Operation of the individually controlled compartments is charted by separate recording thermometers. The outside cabinet is equipped with casters and measures 46 x 58 x 37 in.

Cincinnati Sub Zero Products, Dept. ED, 3932 Reading Rd., Cincinnati 29, Ohio.

CIRCLE 457 ON READER-SERVICE CARD

one  
word  
more  
about  
the

**Amperex**  
**6CA7/EL34**  
OUTPUT  
PENTODE



**NOW ITS  
RATED POWER OUTPUT  
IS 60 WATTS**  
(Class AB<sub>1</sub>)

We are pleased to announce that as a result of the further exploration of the 6CA7's capabilities... its power output rating has been raised to 60 watts in a distributed load circuit. This was achieved by increasing the screen grid voltage to 500V. The screen voltage rating now equals the plate voltage rating, thus greatly simplifying the design of power supplies.

Class AB<sub>1</sub> Audio Amplifier  
Distributed Load Connection  
Typical Operation

(Fixed Bias—Two Tubes Push Pull)

Plate Supply Voltage.....500 V  
Grid No. 2  
Supply Voltage.....(See Note) 500 V  
Grid No. 1 Bias.....(approx.) -44.5 V  
Plate to Plate Load Resistance....7000 Ω  
Plate and Grid No. 2 Current  
(Zero Signal).....2x57 mA  
Plate and Grid No. 2 Current  
(Max. Signal).....2x112 mA  
Input Signal Voltage (rms).....32 V  
Power Output.....60 W  
Harmonic Distortion.....2.5%

NOTE: Screen voltage is obtained from taps located at 43% of the plate winding turns. An unbypassed resistor of 1KΩ in series with each screen grid is necessary to prevent screen overload.



ask **Amperex**  
about detailed data and  
applications engineering  
assistance on hi-fi tubes  
for hi-fi circuits.

AMPEREX ELECTRONIC CORP.  
290 Duffy Avenue, Hicksville, L. I., N. Y.

CIRCLE 459 ON READER-SERVICE CARD

### Panel Meters

Maximum width is 3.5 in.



These panel meters have a maximum width of 3.5 in. and are accurate to 2%. Model 1035 is available in dc ranges from 20 μamp to 3000 amp, and 10 mv to 750 v. Model 1036 is for ac use from 6 ma to 600 amp and from 5 to 600 v. Dials are fadeproof and lithographed directly on metal. The meters are interchangeable with all comparable 3.5 in. diam round meters.

Hoyt Electrical Instrument Works, Inc., Dept. ED, 42 Carleton St., Cambridge 42, Mass.

CIRCLE 460 ON READER-SERVICE CARD

**SILICONE RUBBER WIRE.**—Lead and hookup, aircraft and circuit wire insulated with silicone rubber for -55 to ±200 C use. Type F, for 600 v service, meets MIL-W-16878C; type FF, for 1 kv service, meets MIL-W-8777A. In AWG 4 through 28.

American Super-Temperature Wires, Inc., Dept. ED, W. Canal St., Winooski, Vt.

CIRCLE 461 ON READER-SERVICE CARD

**TAPE HEAD DEMAGNETIZER.**—Universal model AR-294 has three full sets of interchangeable pole-pieces for easy access to any tape head. For 110 v, 60 cps operation.

Argonne Electronics Mfg. Corp., Dept. ED, 165-11 South Rd., Jamaica 33, N.Y.

CIRCLE 462 ON READER-SERVICE CARD

**ADHESIVE PREFORMS.**—Die-cut or preformed shapes of dry adhesive, 2 mil film for lamination of cold rolled steel, brass, galvanized iron, aluminum, phosphor bronze, chrome steel, and phenolic. Uses include lamination of copper to phenolic board in printed circuit construction.

Auburn Mfg. Co., Dept. ED, Middletown, Conn.

CIRCLE 463 ON READER-SERVICE CARD

**PRINTED CIRCUIT DRAFTING TAPE.**—Narrow, black, pressure sensitive photographic tape for printed circuit master layouts. Available in 15 and 60 yd rolls with precision tolerance widths from 1/64 to any fraction of an inch; also in rolls 3 in. wide and 5 yd. long. Nonstaining.

By-Buk Co., Dept. ED, 4314 W. Pico Blvd., Los Angeles 19, Calif.

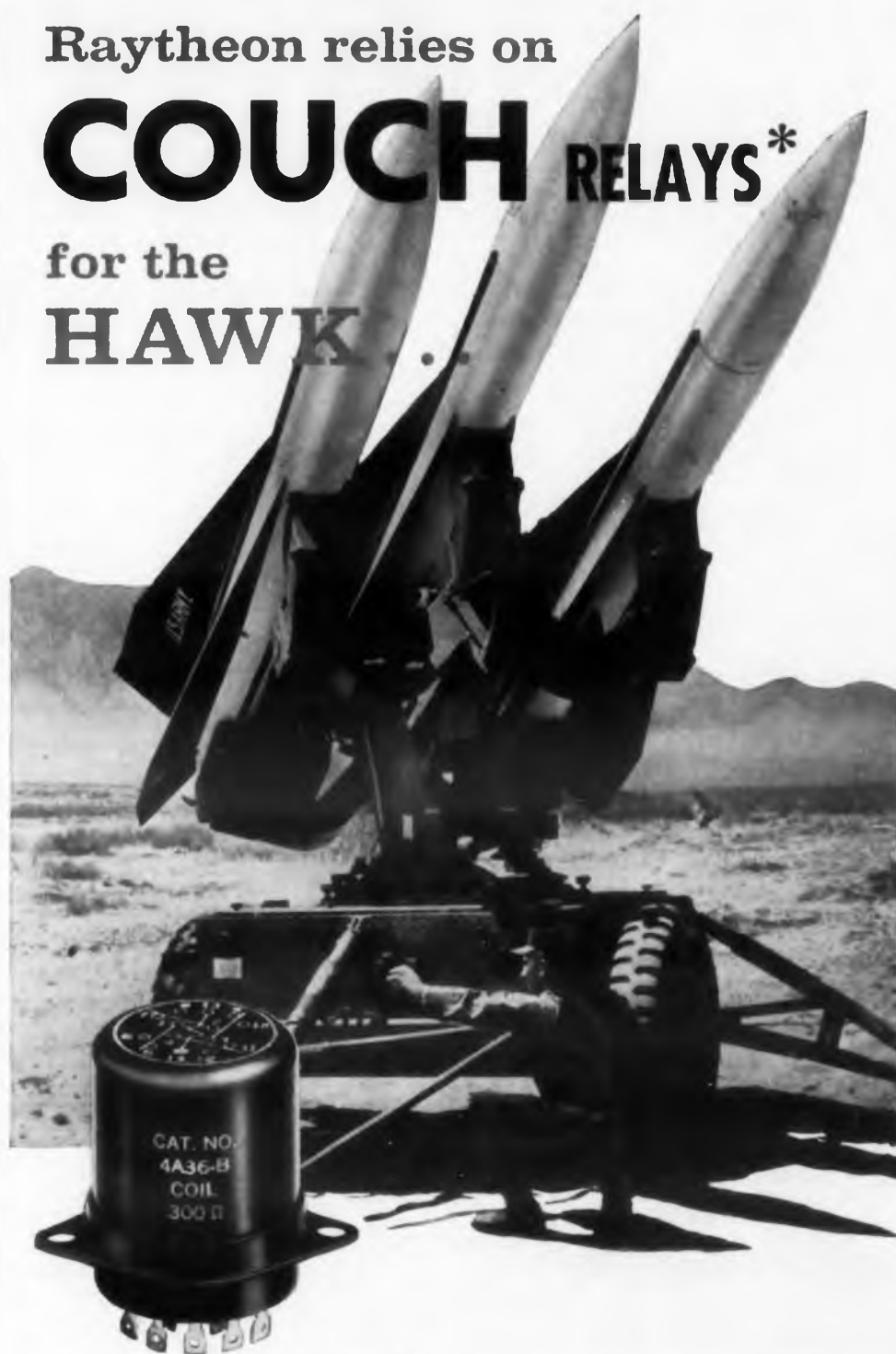
CIRCLE 464 ON READER-SERVICE CARD

Raytheon relies on

# COUCH RELAYS\*

for the

# HAWK



### IMPORTANT SPECIFICATIONS

Contacts: 4PDT - Dry circuit to 3 amperes

Size: 1 1/2" D x 1 1/2"

Weight: 3.2 oz.

Pull-in power: 1/2 watt

Ambient Temperature: -65°C to +125°C

Vibration Resistance: 20G, 5 to 2000 cps

Shock Resistance: 75G operating

200G non-operating

Couch Relays are used in the successful Hawk missile now being produced by Raytheon Company for the U.S. Army. Designed primarily to attack low flying aircraft from mobile launchers at a battle front, or from fixed installations in populated areas of the United States, the Hawk's mission leaves no room for error or unreliability of its systems. The production quantities of Couch Relays used in these systems measure up to this required reliability.

Write for our new catalog on the full Couch line of rugged rotary relays.



**ORDNANCE INC.**

A subsidiary of S. H. Couch, Inc.

\*CVE TYPE

3 Arlington Street

North Quincy, Mass.

CIRCLE 465 ON READER-SERVICE CARD

## NEW PRODUCTS

### Power Supply

Operates from -65 to +165 F

Model A200-VF is a closely regulated encapsulated power supply for test and checkout equipment. Input is 115 ±10 v ac, at 50 ±2 cps, 60 ±2 cps; and 400 ±40 cps. Output is 350 v dc at 200 ma, 7 v ac rms at 8 amp, -50 v dc at 1 ma. The unit weighs 20 lb and has a temperature range of -65 to +165 F.

ACF Industries, Inc., Avion Div., Dept. ED, 11 Park Place, Paramus, N.J.

CIRCLE 466 ON READER-SERVICE CARD

### Terminal Boards

Have molded-in conductors

This line of terminal boards has molded-in conductors which eliminate the need for saddle plates, and a solid insulating back to reduce breakage and guard against moisture. These solid block boards have high current carrying capacity, long creepage path, and thick, high barriers for increased insulation.

General Products Corp., Dept. ED, Union Springs, N.Y.

CIRCLE 467 ON READER-SERVICE CARD

### Temperature Data Recording System

Measures 0 to 1200 F

For process monitoring and other applications where periodic temperature recording is required, this temperature data recording system measures and records up to 75 iron constantan thermocouple inputs. Its digital output is automatically presented on an electric typewriter. The unit has three ranges: -30 to +120 F, 250 to 600 F, and 0 to 1200 F. Accuracy is ±5 F on the last range and +1 F on the other two, and scanning rate is 3 sec per data point. The scan cycle is 225 sec long and can be initiated manually or automatically 1/2 to 3 min after completion of the last logging cycle.

Datex Corp., Dept. ED, 1307 S. Myrtle Ave., Monrovia, Calif.

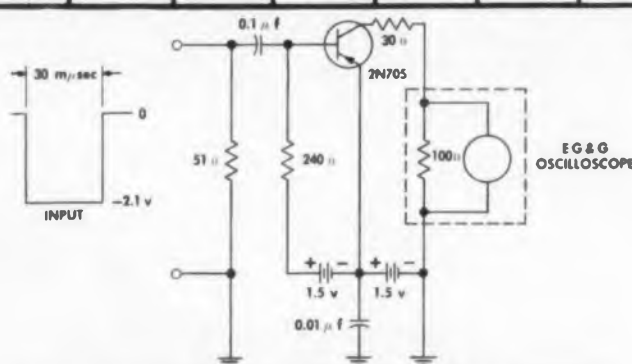
CIRCLE 468 ON READER-SERVICE CARD

# For high-reliability switching

## APPLICATION NOTES

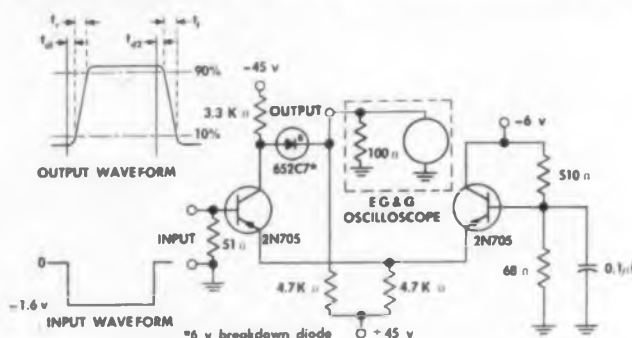
### VOLTAGE SWITCHING CIRCUIT

$t_d$	$t_r$	$t_s$	$t_f$	$V_{BE(0)}$	$V_{BE(1)}$	$V_{BE(2)}$
5 mμsec	7 mμsec	7 mμsec	7.5 mμsec	1.5 v	-0.6 v	1.5 v



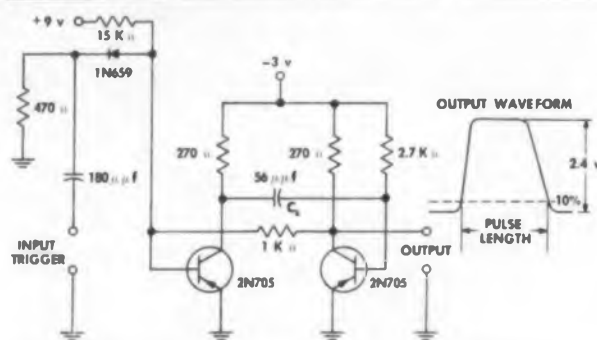
### NON-SATURATING CURRENT MODE SWITCH

$t_{d1}$	$t_r$	$t_{d2}$	$t_f$
4 mμsec	3.6 mμsec	5.5 mμsec	10.4 m sec



### MONOSTABLE MULTIVIBRATOR

$t_r$	$t_f$	Pulse length (depends on $C_1$ )
20 mμsec	40 mμsec	120 mμsec



5 times actual size

Exact product uniformity and reproducibility is another benefit to you from TI's diffused-base production process. Maximum mechanical strength and high heat transfer characteristics are a direct result of mounting the wafer directly to the header.



FROM THE WORLD'S LARGEST SEMICONDUCTOR PLANT

Highest inherent reliability provided by diffused-base 'mesa' process

- Higher reliability because of lower operating junction temperature from the industry's highest dissipation germanium ultra-high speed switcher.
- Increased protection against surge voltages provided by diffused junction (rugged emitter-base junction) permits greater design freedom.
- Maximum resistance to shock and vibration is designed into all TI diffused-base products by fusing the semiconductor wafer directly to the header.



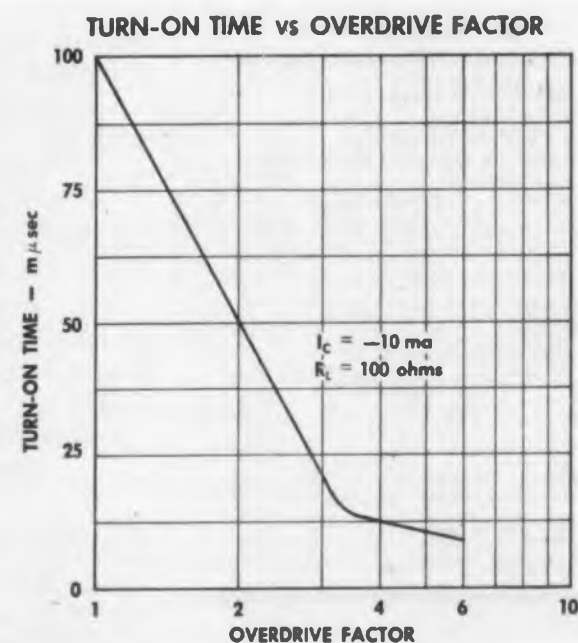
Actual Size

Now utilize the combination of maximum reliability and ultra-high speed switching furnished by TI 2N705's. Reliability is determined largely by device operating junction temperature. 2N705 300-mw dissipation at 25°C case temperature and operation to 100°C junction temperature gives you three times greater power handling capacity plus typical total switching times of 25 mμsec!

### TRUE SWITCHING SPEED

A transistor's true switching speed in any circuit is dependent on the amount of over-drive designed in the circuit:  $Overdrive = \frac{I_{bFE}}{I_{CS}}$

Below is the speed-up of 2N705's as a function of overdrive characteristics.

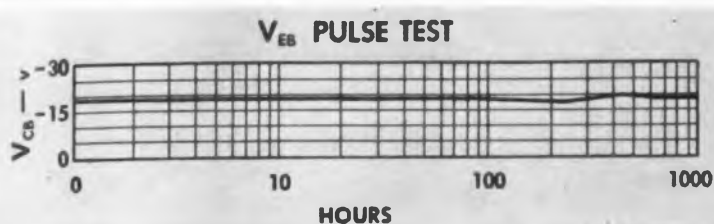
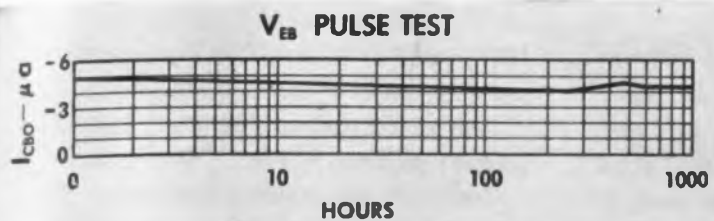


TEXAS





# TI 'mesa' transistors!



## RELIABILITY INSURED BY RUGGED DESIGN, TEST

5000-hours life test data! Check the curves on the right for yourself and see how TI's 2N705  $h_{FE}$  and  $I_{CBO}$  proved-performance characteristics apply to your high speed switching requirements. Also, for absolute assurance of conformance to specifications, all units are stabilized at 100°C for 100 hours and then 100% production tested!

### Rugged Emitter-Base Junction

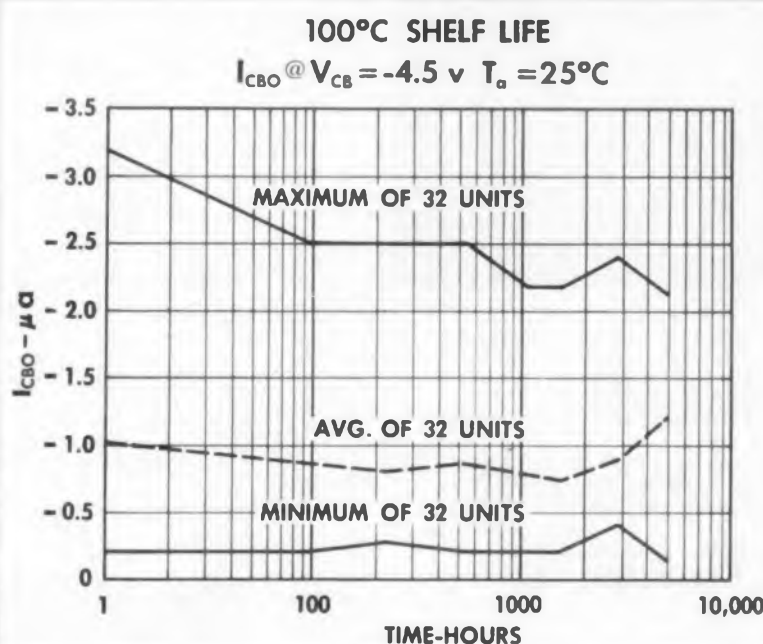
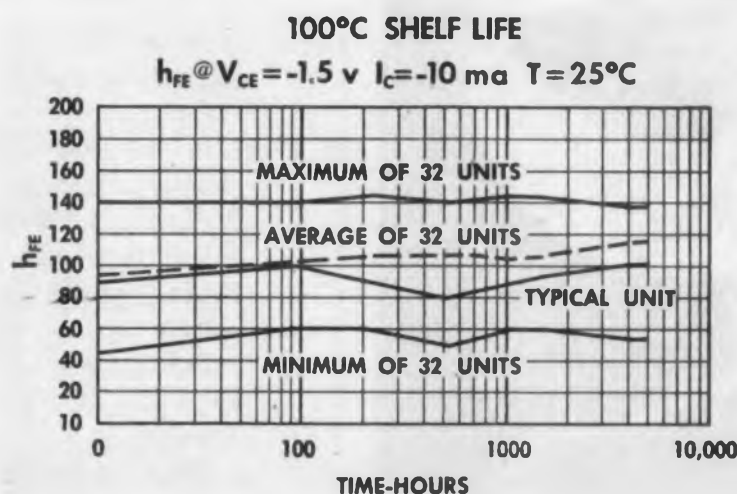
For an added design safety factor, consider the voltage surge tests shown above from which the graphic data on this page was obtained. In a circuit utilizing 2N705's a voltage pulse was applied to the emitter base diode in sufficient magnitude that it resulted in breakdown of the emitter base diode, causing flow of a 1, 5 and 10 ma current in each of three separated device groups. This test was continued for 1000 hours and all test data indicated that device characteristics  $I_{CBO}$ ,  $h_{FE}$ ,  $V_{EB}$ , and  $V_{CB}$  were unaffected by this 1000 hour pulse test.

Like all other TI semiconductors, the new 2N705 series is guaranteed for one full year.

### absolute maximum ratings at 25°C case temperature (unless otherwise specified)

	2N705	2N710
Collector-Base Voltage	-15 v	-15 v
Emitter-Base Voltage	-3.5 v	-2.0 v
Collector-Emitter Voltage	-15 v	-15 v
Storage Temperature Range	-65 to +100°C	
Emitter Current	-50 ma	-50 ma
Collector Current	-50 ma	-50 ma
Collector Junction Temperature	+100°C	+100°C
Total Device Dissipation	300 mw*	300 mw*

\* Derate at 4 mw/°C. This is equivalent to a maximum power rating of 300 mw at a case temperature of 25°C. The power rating in free air at 25°C is 150 mw.



Evaluate the data on these pages for your requirements and call your nearby TI sales office for complete price and delivery information... or contact your authorized TI distributor for off-the-shelf overnight delivery!

Write on your company letterhead describing your application for specific details on TI products.

CIRCLE 469 ON READER-SERVICE CARD

ONE ORDER TO

# ALLIED

FILLS THE WHOLE BILL

... for All your  
ELECTRONIC  
SUPPLY  
NEEDS

## SAME-DAY SHIPMENT

... next-day delivery  
(by air where required)

ON  
TEXAS  
INSTRUMENTS  
SEMICONDUCTORS

# O. E. M.

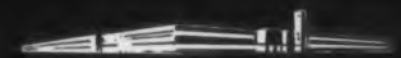
PRICES ON

Silicon Transistors: 1-999  
Germanium Transistors: 1-999  
Silicon Diodes and Rectifiers: 1-999  
Carbon Film Resistors: 1-999  
sensistor Silicon Resistors: 1-499  
tan-TI-cap Tantalum Capacitors: 1-99

CIRCLE 470 ON READER-SERVICE CARD

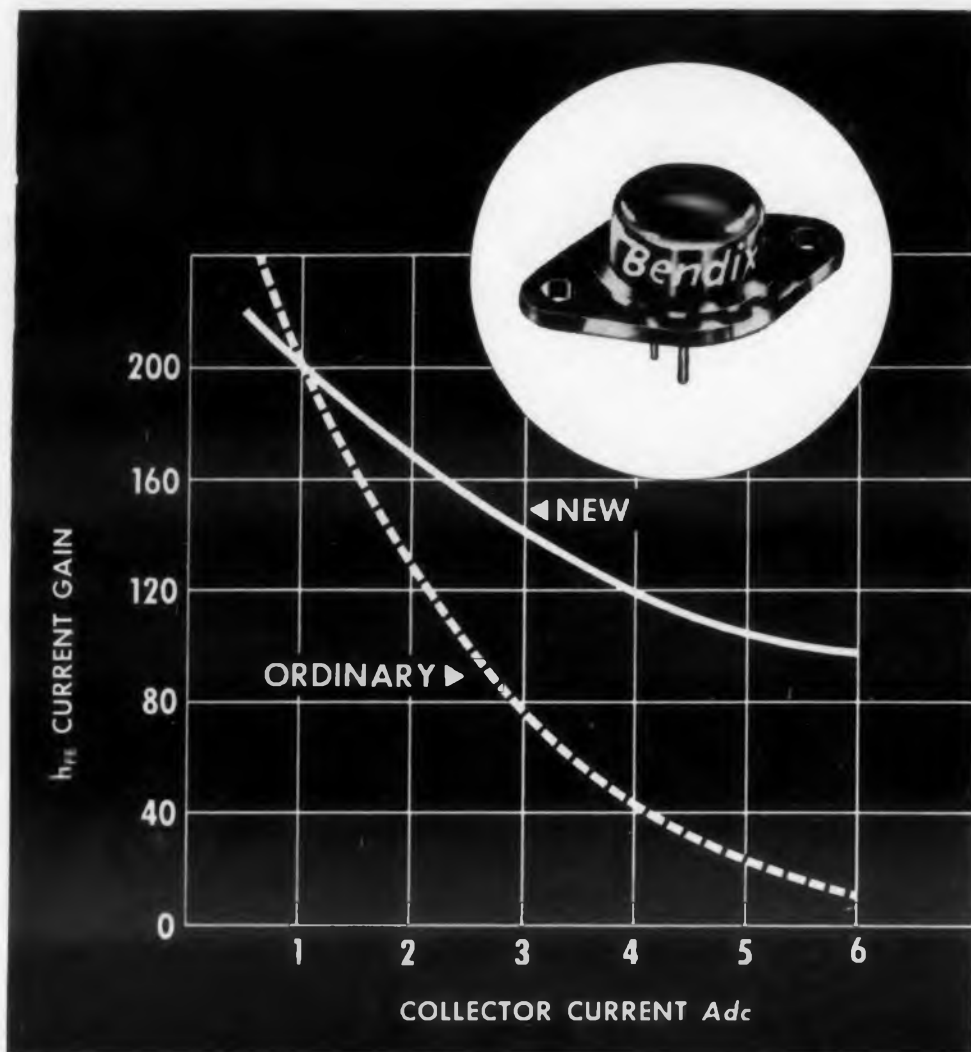
## ALLIED RADIO CORP.

100 N. WESTERN AVE.  
CHICAGO 80, ILLINOIS  
HAYmarket 1-6800  
TWX: CG - 2898



# INSTRUMENTS

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



Solid line indicates the low beta fall-off of one of the new Bendix transistors as compared to that of an ordinary transistor.

## NEW BENDIX HIGH GAIN INDUSTRIAL POWER TRANSISTORS OFFER FLATTEST BETA CURVE

Now available—a new series of power transistors with the flattest beta curve in the industry, made possible by an exclusive Bendix process. This new series has very high current gains—up to 200 at 3 Adc—and a 10 ampere peak current rating.

Featuring ten-amp performance at a five-amp price, the 2N1136,A,B; 2N1137,A,B; and 2N1138,A,B series provide:

LOW BETA FALL-OFF	→	LESS DRIVE AND LESS DISTORTION
LOW SATURATION RESISTANCE	→	GREATER CIRCUIT EFFICIENCY
VOLTAGE BREAKDOWN RATINGS	→	ELIMINATION OF BURN-OUT
CURRENT GAIN MATCHING	→	OPTIMUM CIRCUIT PERFORMANCE

Ideally suited for use in static convertors and regulators, these powerful transistors also have numerous applications in relay replacements and drivers for relays, magnetic clutches, solenoids and other loads requiring high current. In addition, their extremely high current gain and excellent hFE linearity make them the most practical and efficient television vertical output amplifiers.

For complete information, contact SEMICONDUCTOR PRODUCTS, BENDIX AVIATION CORPORATION, LONG BRANCH, NEW JERSEY.

West Coast Sales Office: 117 E. Providencia Avenue, Burbank, California  
 Midwest Sales Office: 4104 N. Harlem Avenue, Chicago 34, Illinois  
 New England Sales Office: 4 Lloyd Road, Tewksbury, Massachusetts  
 Export Sales Office: Bendix International Division, 205 E. 42nd Street, New York 17, New York  
 Canadian Affiliate: Computing Devices of Canada, Ltd., P. O. Box 508, Ottawa 4, Ontario, Canada.

**Red Bank Division**



CIRCLE 471 ON READER-SERVICE CARD

## NEW PRODUCTS

### Silicon Rectifiers

Rated at 2000 piv

These double diffused silicon rectifiers are rated at 2000 piv. They are available in axial lead top hat, 7/16 in. stud and insulated stud mounts and are hermetically sealed. Piv ratings range from 1400 to 2000 v and they carry up to 10 amp. Leakage at 25 C is 1  $\mu$ amp; forward voltage drop at 25 C is 2 v.

Columbus Electronics Corp., Dept. ED, 1010 Saw Mill River Rd., Yonkers, N. Y.

CIRCLE 472 ON READER-SERVICE CARD

### Magnetic Tape Tester

Is fully transistorized

Model 3298 magnetic tape tester, fully transistorized, locates and indicates tape flaws that may be classified as noise or drop-out. Parallel checking facilities are included to

CIRCLE 473 ON READER-SERVICE CARD

simultaneously check for each class of tape flaw. Tape speed up to 150 in. per sec and pulse densities to 550 per in. can be accommodated with tape widths from 1/2 to 1 in. on 10-1/2 in. reels. Tape for both IBM and Remington Rand computer use may be evaluated by this tester.

Potter Instrument Co., Inc., Dept. ED, Plainview, N.Y.

CIRCLE 474 ON READER-SERVICE CARD

### Aluminum Coaxial Connectors

Lighter than brass connectors

The TNC series now include aluminum coaxial connectors. Made of a high strength aluminum, these connectors are as much as 65% lighter than the standard brass TNC connectors. Configurations, dimensions, and electrical and mechanical qualities are the same as in the standard brass series.

General RF Fittings, Inc., Dept. ED, 702 Beacon St., Boston 15, Mass.

CIRCLE 475 ON READER-SERVICE CARD

## NEW, LOW FREQUENCY RELIABILITY IN GLASS-ENCLOSED CRYSTAL



Precision components of the new RHG-DP crystals are enclosed and hermetically sealed in glass holders to assure maximum internal cleanliness and most reliable evacuation. The result is a series of sturdy, miniature, low frequency units having excellent long-term stability and higher Q.

#### TYPICAL VALUES FOR 2 KC UNIT\*

Frequency range	1 to 15 kc
Holder	TS 1/2 glass bulb —Noval Base
Temperature range	—55 to +100°C
Frequency tolerance	±.015%
Effective resistance	75,000 ohms max.
Aging 8 hours—100°C	±.001% max.
Meets MIL specifications for vibration stability	

\*Reeves-Hoffman manufactures a broad line of crystals in the range from 1 to 1000 kc.



WRITE FOR BULLETIN RHG-DP

DIVISION OF  
DYNAMICS CORPORATION OF AMERICA  
CARLISLE, PENNSYLVANIA

CIRCLE 476 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 19, 1959

## Magnetic Amplifier Controls

### Fully regulated

These fully regulated magnetic amplifier controls are temperature and voltage compensated and have no tubes, transistors, or moving parts except for a controlled dpdt relay. With an input resistance of 45 ohms, they can be used in series with an ordinary meter. Sensitivity is 15  $\mu$ a adjustable over a 0 to 1 ma range or 0.5 mv adjustable over a 0 to 0.05 v range.

Controlomag Labs, Dept. ED, Box 16, Ottsville, Pa.

CIRCLE 477 ON READER-SERVICE CARD

## Recording System

### Operates above 500,000 numbers per sec

This high density magnetic tape recording system, for use with computers, transfers data at rates in excess of 500,000 numbers per sec. With the use of this system, magnetic tape files can be reduced by a

CIRCLE 478 ON READER-SERVICE CARD

factor of 7 to 1; errors are virtually eliminated in the transfer of data from magnetic tape to computer. This recording system may be built into equipment made to customer specifications.

Potter Instrument Co., Inc., Dept. ED, Sunnyside Blvd., Plainview, N.Y.

CIRCLE 479 ON READER-SERVICE CARD

## Terminal

### Is shakeproof

Vibrapruf terminal for etched circuit and terminal boards has a unique countersunk and knurled shank which provides good electrical and mechanical contact. This insures protection against loosening. The terminal uses less surface area on the top side of the plated board, but more contact surface area in the countersunk portion of the plated hole. An increase of g loads is possible.

Hu-Bar Terminals, Inc., Dept. ED, 8721 Rindge Ave., Playa Del Rey, Calif.

CIRCLE 480 ON READER-SERVICE CARD

Engineers! Designers!

**THERE IS NO SUBSTITUTE FOR RELIABILITY!**

Specify —

**PERFORMANCE PROVEN "MAG MOD"**

# MAGNETIC MODULATORS

Actual Size



For complete specifications and application data on "Mag Mod" Miniature and Standard Components, call or write.

Miniaturized design permits engineers to employ these new components in transistorized printed circuit assemblies and wafer type structures. All models offer maximum reliability, fully ruggedized construction and conform to MIL-T-27A specifications.

- COMPLETE RELIABILITY
- INFINITE LIFE
- FASTER RESPONSE TIME
- NEGLIGIBLE HYSTERESIS
- EXTREME STABILITY (Ambient Temp. Range from  $-75^{\circ}$  to  $+135^{\circ}$ C)
- COMPACT SIZE
- LIGHTWEIGHT

Typical circuit applications for Magnetic Modulators are algebraic addition, subtraction, multiplying, raising to a power, controlling amplifier gains, mechanical chopper replacement in DC to fundamental frequency conversion, filtering and low signal level amplification.

## GENERAL MAGNETICS • INC

135 BLOOMFIELD AVENUE  
BLOOMFIELD, NEW JERSEY  
Telephone: Pilgrim 8-2400

CIRCLE 481 ON READER-SERVICE CARD



## -and now the vibration test!

Shock — testing on the rocks? If vibration and shock are your headache, you could build your own pots to lick this problem! But look out for foul play in the shaft and bushings, under shock — you can lose your accuracy right there! And make sure your pet design includes a contact with no resonances, minimum mass, low wiper pressure — yet with excellent linearity! Oh, you'll be plenty busy!

But the easy way is to come to Ace! Our shockless pots incorporate, through exclusive precision production methods, fantastically close bearing fit. And our own specially balanced contacts place extremely low mass at the edge-wipe end, under low brush pressure, for steady contact under shock. Tempered precious metals and low contact resistance mean long, corrosion-free wear. Tested to 50 G's at 2000 cycles.



Our complete pot line incorporates all these anti-shock design features. Under extreme servo applications, this 1/2" servo-mount Series 500 Acepot delivers 0.3% linearity.

See us at WESCON  
Booth 3414

**ACE** ELECTRONICS ASSOCIATES, INC.  
99 Dover Street, Somerville 44, Mass.  
SOMerset 6-5130 TMX SMVL 181 West. Union WUX

Acepot® Acotrim® Acesel® Aceohm® \*Reg. Appl. for  
CIRCLE 482 ON READER-SERVICE CARD

# put your finger on

# PROFIT



*This magnified minuscule electrical part is another Advance Stamping which saved production costs.*

Yes—bigger profits from smaller parts are very possible when you engineer in Stampings—especially *Advance Stampings*. As Specialists in Small Stampings, Advance has been helping metal working industries of various kinds attain higher production at lower cost for over 35 years.



Here are typical Advance Stampings which have been fabricated in different materials to meet tolerance specifications, delivery and price.

Send us your blue prints or samples for quotations. Advance engineers are available to consult on ways to improve your competitive position.

Write for Small Stamping Specialists Brochure

## ADVANCE STAMPING CO.

12023 Dixie Ave., Detroit 39, Michigan

CIRCLE 483 ON READER-SERVICE CARD

## NEW PRODUCTS



### Crystal Filter

Has center frequency of 10.7 mc

Universal crystal filter for communication receivers on emergency frequencies, model CF-1, increases selectivity to permit reception of adjacent channels without interference. It fits standard 10.7 mc if transformer chassis cutout. It will match from the plate of one tube to the grid of the following tube with no external matching device.

I.D.E.A., Inc., Monitoradio Div., Dept. ED, 7900 Pendleton Pike, Indianapolis 26, Ind.

CIRCLE 484 ON READER-SERVICE CARD

**SOLDER MICROFORMS.**—Are made to individual specs to provide exact amount of solder needed. Made for the semi-conductor industry, they are available as discs, pellets, washers, wire, ribbon, and sheets.

Anchor Metal Co., Inc., Dept. ED, 966 Meeker Ave., Brooklyn 22, N.Y.

CIRCLE 485 ON READER-SERVICE CARD

**LACING TAPES.**—Made of Dacron and nylon, these flat-braided lacing tapes are used for wire harnessing. They are available in 250 and 500 yd spools or 1/4 lb tubes, in five tape widths from 3/64 to 1/4 in.

Bentley, Harris Mfg. Co., Dept. ED, Conshohocken, Pa.

CIRCLE 486 ON READER-SERVICE CARD

**TUNING DIAL.**—Has slow motion drive. The movement is gear-driven and flywheel loaded, giving a reduction ratio of 110 to 1 without backlash. The pointer has a horizontal travel of 7 in. A circular vernier 100 division scale rotates five times for one traverse of the pointer, giving 500 divisions. It is 9-3/16 x 3-11/16 in.

British Radio Electronics, Ltd., Dept. ED, 1833 Jefferson Pl., N.W., Washington 6, D.C.

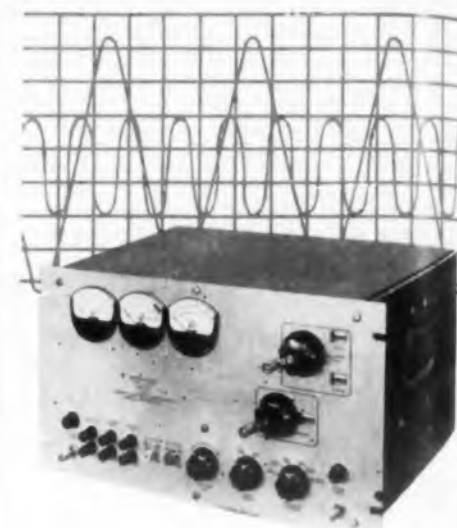
CIRCLE 487 ON READER-SERVICE CARD

**NOISE CHOPPERS.**—Generate noise less than 3  $\mu$ v across 1 meg at 400 cps. Spdt and dpdt types are available in both make-before-break and break-before-make models, 60 or 400 cps. They are hermetically sealed and dry-gas filled.

Collins Electronics Mfg. Corp., Dept. ED, Stevensville, MD.

CIRCLE 488 ON READER-SERVICE CARD

## WIDE RANGE POWER OSCILLATOR



a reliable  
signal source  
for microwave  
measurement

The AIL Type 124C Power Oscillator is applicable as a signal source over the wide range of 200 to 2500 Mc. Its range, power and stability make it an essential element of microwave component test systems. It is often used in measurements relating to antenna design. Facilities for both internal and external modulation are provided. Relative power output is indicated directly on panel meter.

Detailed literature is available on request.



CIRCLE 489 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 19, 1959

## THRUST SENSING FOR LIQUID ROCKET ENGINES



### \*STATHAM PA324 Pressure Transducer

Because of its outstanding performance in severe missile environments, the Statham Model PA324

Absolute Pressure Transducer has been chosen to play the key role in important new thrust control systems based on accurate measurement of thrust chamber pressure.

For further information write for Data File ED-600-2.

STATHAM INSTRUMENTS, INC.  
12401 West Olympic Boulevard  
Los Angeles 64, California

*Statham*

CIRCLE 490 ON READER-SERVICE CARD  
ELECTRONIC DESIGN • August 19, 1959

**SPECTRUM ANALYSIS DISPLAY ADAPTER.**—“Sonagram” adapts output of the company’s 30 channel model 30 spectrum analyzer for three dimensional display on any conventional cathode ray oscilloscope with long persistence screen. Model 30 provides immediate visible display of complex waveforms from 100 cps to 20 kc.

Kay Electric Co., Dept. ED, Maple Av., Pine Brook, N.J.

CIRCLE 491 ON READER-SERVICE CARD

**TRANSPORTABLE TRACKING ANTENNA.**—Easily towed by light truck or station wagon, unit has folding 28 ft reflector, hand operated elevation and azimuth drive system, self-contained trailer mount and tower.

D. S. Kennedy & Co., Dept. ED, Cohasset, Mass.

CIRCLE 492 ON READER-SERVICE CARD

**PREAMPLIFIER.**—Model 458 handles small dc or ac signals from 30 to 2000 cps, is packaged to serve as accessory for precision measuring instruments. Used with the company’s digital voltmeters, it extends sensitivity down to 1  $\mu$ v dc and 10  $\mu$ v ac. Gain, 100; linearity, 0.01%; drift, below 2  $\mu$ v per 24 hr. Front panel control permits selection of different standard bandwidths.

Kin Tel, Div. of Cohu Electronics, Inc., Dept. ED, 5725 Kearny Villa Rd., San Diego 12, Calif.

CIRCLE 493 ON READER-SERVICE CARD

**MINIATURE VHF BEACON.**—For use as aircraft or drone crash locator. Also for signaling, control, telemetering. Crystal controlled unit incorporates modulator power supply and three subminiature tubes providing carrier output to 100 mw in 300 mc band. Input, 6 v at 660 ma; output impedance, 50 ohms; modulation, 1000 cps.

LEL, Inc., Dept. ED, 380 Oak St., Copiague, N.Y.

CIRCLE 494 ON READER-SERVICE CARD

**CORE LAMINATIONS.**—High permeability Supermu 30 and 40 are mechanically and thermally processed to close limits. Supermu 40 provides permeability ratings beyond 40,000 on 1 DU laminations.

Magnetic Metals Co., Dept. ED, Camden, N.J.

CIRCLE 495 ON READER-SERVICE CARD

**DIODE CARTRIDGE AND CONDUCTOR MATRIX.**—In this pluggable assembly, the cartridge provides a triggering device which can be inserted at any intersecting coordinates in the two sided etched wiring matrix to give yes or no answers. Cartridges, 3/16 in. in diameter and 3/4 in. long, can be placed in matrix spacings of 1/4 in. Matrix with 10,000 individual positions occupies 26 x 26 in.

Method Mfg. Corp., Dept. ED, 7447 W. Wilson Ave., Chicago 31, Ill.

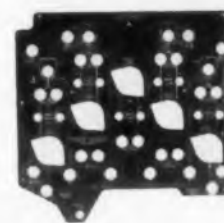
CIRCLE 496 ON READER-SERVICE CARD

**EXTRUSIONS AND FABRICATED PARTS.**—Thermoplastic Delrin in strips, rods, tubes, or special shapes. Strips are up to 7 in. wide and 0.02 to 0.093 in. thick; rod diameters are 1/2 to 2 in. Tubing and special shapes to order. Variety of precision parts are produced from basic extruded forms.

National Vulcanized Fibre Co., Dept. ED, 1059 Beech St., Wilmington 99, Del.

CIRCLE 497 ON READER-SERVICE CARD

# PRODUCT DIGEST from U.S. RADIUM



## EDGE-LIGHTED PANELS

Special-purpose panels and dials accurate to MIL spec are available from United States Radium Corporation. Standard edge-lighted and integral edge-lighted products by Lackon<sup>®</sup> provide optimum legibility and contrast, with high resistance to humidity, surface abrasion.

CIRCLE 579 ON READER-SERVICE CARD

## DIALS, PANELS AND NAMEPLATES

Metal dials and panels include a greater variety of finishes, colors and processes than ever before.

New lithographed nameplates and panels featuring special hard, abrasion-resistant finish are available with or without adhesive backing in various thicknesses.



CIRCLE 580 ON READER-SERVICE CARD



## CATHODE-RAY TUBE PHOSPHORS

USR offers a variety of phosphors for TV and industrial cathode-ray tube applications.

CIRCLE 581 ON READER-SERVICE CARD

## RADIATION SOURCES FOR ELECTRON TUBE IONIZATION

Specially-fabricated isotope sources—Ni<sup>63</sup> plated electrodes and radium foil—are now being produced as ionization sources for electron tubes.



## ISOLITE LIGHT SOURCES

New 360° light source and high-brightness one-way lamps use luminescent bulbs energized by Kr<sup>85</sup> gas. Units visible at 500-2000 ft., depending on model, size, color; service life to 10 years. New Isolite markers, signs and placards now available.

CIRCLE 582 ON READER-SERVICE CARD



## RADIATION SOURCES

Sealed beta, gamma and neutron sources for research, gauging, radiography and related applications are available with varying intensities and energies.



CIRCLE 583, 584, 585 ON READER-SERVICE CARD



# UNITED STATES RADIUM CORPORATION

MORRISTOWN, N. J. | Offices: Chicago, Illinois and North Hollywood, Calif. Subsidiaries: Radelin Ltd., Port Credit, Ont., Canada and U. S. Radium Corp. (Europe), Geneva, Switzerland.

CIRCLE 579 THROUGH 585 READER-SERVICE CARD

Here's  
data  
on the  
*New*

## DIAL HEAD AGASTAT® time/delay/relays

These relays have recently been re-designed—improved in performance and appearance. So you'll want up-to-date specs.

This free folder gives complete details on all models. In it you'll find operating specs, timing ranges, contact capacities, dimensions, diagrams of contact and terminal arrangements, and data on mounting and installation accessories.

For your copy, write: Dept. A34-824

AGA

ELASTIC STOP NUT CORPORATION OF AMERICA

Elizabeth, New Jersey

CIRCLE 504 ON READER-SERVICE CARD

## MOBILE-IZE YOUR ELECTRONIC EQUIPMENT



MODEL OC-2 WITH FORMICA SCOPE TRAY

PRICE ONLY \$54.50  
f.o.b. Glendale, Calif.

**TECHNIBILT**  
CORPORATION  
905 AIR WAY, GLENDALE 1, CALIFORNIA

CIRCLE 505 ON READER-SERVICE CARD

## NEW PRODUCTS

### C Band Load Isolator

Has 300 w average power level



Load isolator model IC-400 covers 4.6 to 6 kmc and provides 12 db minimum isolation with 1 db maximum insertion loss. At center frequency, isolation is 18 db and insertion loss is 0.6 db. Power level is 300 w average and 300 kw peak in the presence of an ionizing source with a 2 to 1 variable phase load impedance. Constructed in UG49/U waveguide with UG-149A/U flanges, the unit is 4 in. long and weighs 4-3/4 lb.

Rantec Corp., Dept. ED, Calabasas, Calif.

CIRCLE 499 ON READER-SERVICE CARD

**POWER SUPPLY.**—Delivers 200 ma at 100 kv dc. Model 100-200-1, designed for use on a 208 v, 3 phase, 60-cycle line, has an output ripple of less than 0.1%. The high voltage unit is 41 x 25 x 34 in.; the control cabinet is 27 x 24 x 67 in.

Del Electronics Corp., Dept. ED, 521 Homestead Ave., Mount Vernon, N.Y.

CIRCLE 500 ON READER-SERVICE CARD

**CABLE INSULATION.**—Silastic 1601, a silicone rubber compound for use as wire and cable insulation, maintains its electrical properties at high temperatures and remains flexible over a wide temperature range. Silastic 1602 may be pigmented for color coding.

Dow Corning Corp., Dept. ED, Midland, Mich.

CIRCLE 501 ON READER-SERVICE CARD

**MINIATURE RUBBER BUSHINGS.**—Are as small as 0.05 in. OD, 0.05 in. high with a center hole of 0.012 in. in diam. These bushings are used as end seals for microminiature tantalum capacitors.

Industrial Electronic Rubber Co., Dept. ED, 31945 Aurora Rd., Solon, Ohio.

CIRCLE 502 ON READER-SERVICE CARD

**UHF SOCKET.**—For 2C39 series of tubes, it has low capacitance from cathode to ground and from anode to ground. This CD-7620 socket prevents undue strain on the tube.

Jettron Products, Inc., Dept. ED, 56 Route 10, Hanover, N.J.

CIRCLE 503 ON READER-SERVICE CARD

### Low Frequency Oscillator

Crystal controlled



Model TO-402 Decalator oscillator is a decade switched crystal controlled sonic-ultrasonic signal generator. Frequencies are selected in 9000 discrete steps of 0.1, 1 and 10 cps. Frequency range is from 100 cps to 100 kc and accuracy is 0.05% or better. Among the applications are: tele-metering ground stations; digital instrumentation systems; filter calibrations; and communications testing.

Systems Research Corp., Dept. ED, 18323 Parthenia St., Northridge, Calif.

CIRCLE 586 ON READER-SERVICE CARD

**INDICATORS, INDICATING CONTROLLERS.**—These self-balancing potentiometer and bridge type instruments feature a high-gain servo-amplifier and have a sensitivity of 1  $\mu$ v, power gain of 135 db. Calibration is accurate within  $\pm 0.25\%$  of full scale.

Thermo Electric Co., Inc., Dept. ED, Saddle Brook, N.J.

CIRCLE 587 ON READER-SERVICE CARD

**OVERLOAD RELAY.**—B-145A provides time delay overload protection and also signals motor contactor at first sign of trouble. Inverse time delay allows for starting inrush and transient currents, but senses locked rotor, overloads, winding to winding, or turn to turn faults. The B-145 series of load protectors are available for currents of 5 amp up, 115 to 140 v, 60 to 400 cps and over.

Hartman Electrical Mfg. Co., Dept. ED, 175 N. Diamond St., Mansfield, Ohio.

CIRCLE 588 ON READER-SERVICE CARD

**MULTI-FIT LATCH HINGE.**—Part of Kwik release hinge line. Applicable in electronic cabinets, equipment, release boards and panels.

Burklyn Co., Dept. ED, 3429 Glendale Blvd., Los Angeles 39, Calif.

CIRCLE 589 ON READER-SERVICE CARD

**CABLE CLAMP.**—The wedge lock band clamp prevents slipping with ratchet teeth and a wedge. The clamp may be used as a temporary or permanent lock and will handle cable diameters from 1/8 to 1-3/4 in. More bands can be combined in series to handle larger diameters.

Weckesser Co., Dept. ED., 5701 Northwest Hwy., Chicago 46, Ill.

CIRCLE 590 ON READER-SERVICE CARD

For remote control switching jobs . . .  
stepping, counting, programming,  
circuit selecting, sequencing and homing



I specify  
**LEDEX SELECTOR SWITCHES**

because . . . sizes from sub-miniature, with  
switch positions for all requirements . . . voltages from 3 to  
300 volts DC . . . variety of models stocked for immediate  
delivery . . . hermetically sealed models offered . . . compactness  
eliminates "bulk" . . . silver alloy contacts give  
long life . . . the economical solution to multiple circuit  
switching . . . experienced LEDEX engineers available . . .  
LEDEX means dependability.

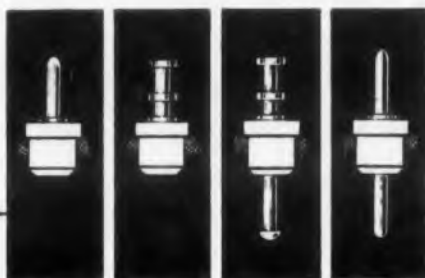


write for descriptive literature today!

**G. H. LELAND, INC.**  
DAYTON 2, OHIO, U.S.A.

In Canada: Marsland Engineering, Ltd., Kitchener, Ontario  
In Europe: NSP Ltd., 31-32 Alfred Pl., London, England; NSP, GmbH, Nürnberg, Germany

CIRCLE 508 ON READER-SERVICE CARD



**TAURUS**  
Terminals of Teflon\*

We are specialists in manufacturing STANDOFF and  
FEEDTHRU TERMINALS insulated with TEFLON®.  
Simplest terminal to install by forcing into undersize  
chassis hole.

Taurus Terminals are accepted and approved by  
major users. Taurus is a completely integrated, ex-  
perienced and quality minded manufacturer of ter-  
minals.

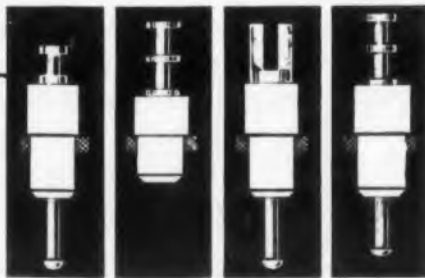
Taurus also produces Punched Card Sensor.

\*Trademark of E. I. DuPont de Nemours Co.



**TAURUS CORPORATION**

8 Coryell Street, Lambertville, N. J.



CIRCLE 509 ON READER-SERVICE CARD

ELECTRONIC DESIGN • August 19, 1959

**EPOXY POTTING COMPOUNDS.**—Series 500  
epoxy liquids for potting and encapsulating trans-  
formers, capacitors, resistors, other electronic de-  
vices. General purpose Cerox 501 is rigid, has low  
viscosity. Cerox 502 has high impact resistance for  
applications involving temperature cycling and me-  
chanical shock. Both cure without heat or pressure.

Chemical Development Corp., Dept. ED, Dan-  
vers, Mass.

CIRCLE 510 ON READER-SERVICE CARD

**CABLE MOLDING COMPOUND.**—Polyurethane  
Pro-Seal 793 has good electrical properties, good  
fluid resistance, -65 to +300 F temperature range,  
2000 psi tensile strength, 500% elongation. Two-part  
compound cures at room temperature, can be used  
for general purpose molding encapsulation, and  
coating.

Coast Pro-Seal & Mfg. Co., Dept. Ed, 2235 Bev-  
erly Blvd., Los Angeles 57, Calif.

CIRCLE 511 ON READER-SERVICE CARD

**MAGNETIC RECORDING TAPE.**—Mylar based  
DataTape for analog or digital data recording. Avail-  
able in 1/2, 1, and 1-1/4 in. widths; 1 or 1.5 mil  
thicknesses; 2000 to 7200 ft lengths; 9-1/2, 10-1/2,  
and 14 in. reel diameters. Designed to MIL-T-21029.

Consolidated Electrodynamics Corp., Dept. ED,  
360 N. Sierra Madre Villa, Pasadena, Calif.

CIRCLE 512 ON READER-SERVICE CARD

**LINEAR MOTION TRANSDUCER.**—Model 102A-  
120 displacement transmitter measures linear motion  
with 0.0001 in. accuracy in ranges to 0.12 in.

Daytronic Corp., Dept. ED, 216 S. Main St.,  
Dayton 2, Ohio.

CIRCLE 513 ON READER-SERVICE CARD

**ELECTRIC COUNTER PANEL ASSEMBLY.**—  
Preassembled Panel-Strip with four electric counters  
integrally mounted with all wiring connected to  
terminal block at counter base. Fits any standard  
vertical or console type control cabinet 18 in. wide.  
Available with the company's Y or YE counters.

Durant Mfg. Co., Dept. ED, 1993 N. Buffum St.,  
Milwaukee 1, Wis.

CIRCLE 514 ON READER-SERVICE CARD

**DESK COMPUTER.**—Transistorized Sirius digital  
computer weighs 560 lb, measures 7 x 3.5 x 4 ft, in-  
cluding desk. Input and output are punched paper  
tape.

Ferranti Electric Inc., Dept. ED, 95 Madison  
Ave., Hempstead, N.Y.

CIRCLE 515 ON READER-SERVICE CARD

**ALKYD MOLDING COMPOUND.**—Glass fiber re-  
inforced Glaskyd 2051 for circuit breakers, switch  
 housings, terminal boards, connectors, fuse holders,  
and rotary switches. Supplied in continuous ropes  
with 1/2 to 1-1/4 in. diameters.

Glaskyd, Inc., Dept. ED, Perrysburg, Ohio.

CIRCLE 516 ON READER-SERVICE CARD

**DIE CAST WING SCREWS.**—Zinc alloy fasteners  
in No. 6 through 1/2 in. thread sizes, 27/32 to  
1-7/8 in. wing spreads, 1/4 to 1-3/4 in. screw  
lengths.

Gries Reproducer Corp., Dept. ED, 125 Beech-  
wood Ave., New Rochelle, N.Y.

CIRCLE 517 ON READER-SERVICE CARD

**ANNOUNCING**



The new **CRATEX**

**TOOL & DIE MAKERS KIT**

The world's finest rubberized abrasives  
for deburring, smoothing and polishing  
tools, dies, patterns, molds, models, instru-  
ments and component parts.

Kit contains 80 wheels and points in the most  
popular sizes and shapes, equally assorted in  
four grit textures, coarse (C), medium (M),  
fine (F), extra fine (XF) . . . plus four mandrels  
for 1/2" chuck . . . packaged in plastic box, com-  
partmented for fast selection. \$7.50 complete.

Order your new Cratex Tool & Die Makers Kit  
#777 through your distributor—or, send your  
order to us for delivery by the Cratex distrib-  
utor nearest you.

**CRATEX** Free 8-page catalog available on request.  
**MANUFACTURING CO., INC.**

1600 ROLLINS ROAD, BURLINGAME, CALIFORNIA  
CIRCLE 518 ON READER-SERVICE CARD



Type 1230-A D-C Amplifier  
and Electrometer: \$440

In  
**ONE**  
Instrument

- MILLI-VOLTMETER
- MICRO-MICROAMMETER
- MEGA-MEGOHMMETER
- and D-C AMPLIFIER

**DIRECT-READING RANGES**

Voltage: ±30 mv, 100 mv, 300 mv, 1 v, 3 v and 10 v dc, full-scale; accuracy  
±4% full scale on 30 mv range, ±2% on others

Current: ±1 milliampere to ±300 milli-microamperes d-c, full scale,  
in 20 ranges

Resistance: 300 kilohms to 10 mega-megohms — full scale — in 16 ranges

Very Low Drift: less than 2 mv per hour after warmup

Terminals for graphic recorder

Line voltage changes: temperature and humidity effects negligible

Write for Complete Information

**GENERAL RADIO COMPANY**


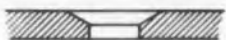
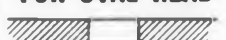
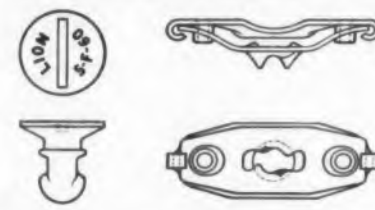
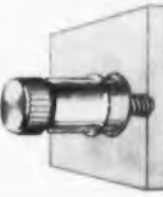
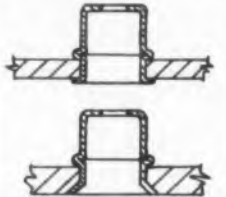
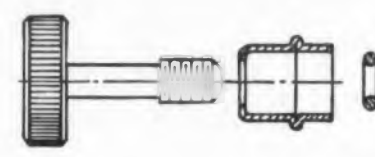

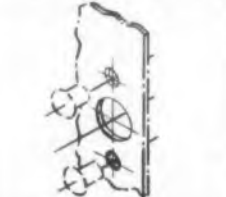
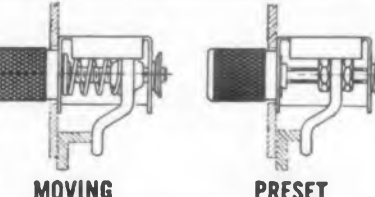

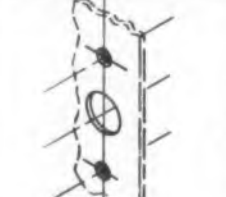
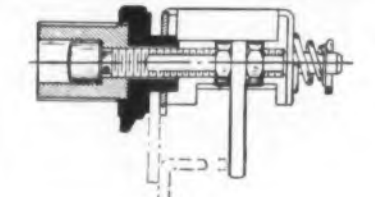

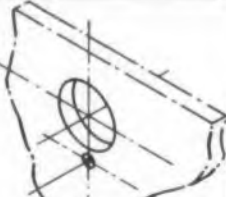
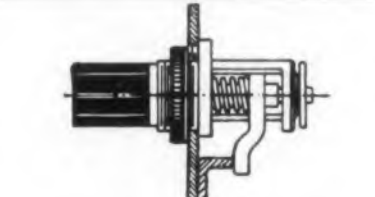


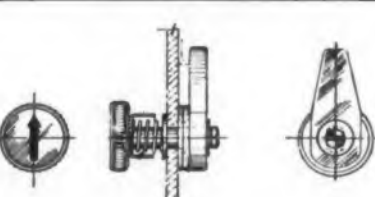
WEST CONCORD, MASSACHUSETTS

Broad Avenue at Linden, Ridgefield, N. J. NEW YORK AREA 1000 M. Seward St. LOS ANGELES 38  
8055 13th St., Silver Spring, Md. WASHINGTON, D. C. 1150 York Road, Abington, Pa. PHILADELPHIA  
1182 Los Altos Ave., Los Altos, Calif. SAN FRANCISCO 6605 W. North Ave., Oak Park, Ill. CHICAGO  
In CANADA: 99 Floral Parkway, TORONTO 15

CIRCLE 519 ON READER-SERVICE CARD

# Captive Quick-Opening Fasteners:

*Southco standards provide many benefits at low cost for access through doors, covers, panels and into drawers*

	<p><b>LION 1/4 TURN FASTENERS</b> Quick, positive locking, by fractional turn. Tight seal formed by compression of leaf spring. Alignment and stack height not critical. Approved for aircraft use. Rugged. Extra strength provided by swaged nose. Vibration resistant.</p>	<p><b>FOR COUNTERSUNK</b> </p> <p><b>FOR OVAL HEAD</b> </p>	
	<p><b>RETRACTABLE SCREW FASTENERS</b> Stand-off thumb screws from stock to eliminate costly, special fasteners. Installed quickly without special tools. Accommodate misalignment. Complete range of standard sizes.</p>		
	<p><b>ADJUSTABLE PAWL FASTENERS</b> Pre-assembled, quickly installed. Accommodate variations in frame thickness up to 1/2 inch. One-quarter turn closes, additional turns increase grip pressure. Attractive appearance, long life. Moving or pre-set pawl. Miniature, intermediate and large sizes.</p>		 <p><b>MOVING</b>      <b>PRESET</b></p>
	<p><b>ADJUSTABLE PAWL FASTENER</b> Has twin-knob control. One knob controls pawl, pointer shows pawl position. Other knob controls amount of pressure to seal closure with uniform pre-set compression. Easily installed.</p>		
	<p><b>ADJUSTABLE PAWL FASTENER</b> Compact and rugged. Eliminates rivets or bolts to save installation time. Three types cover grip range up to 3/4". Supplied either with integral metal and plastic knob, plastic knob or for your knob.</p>		
	<p><b>ARROWHEAD DOOR LATCH</b> Requires only one hole to install. Operates on quarter turn. Holds under spring tension. Arrow shows pawl position; no pawl stops required. Uses minimum inside space.</p>		

## Free Fastener Handbook

Send for your complete Southco Fastener Handbook, just printed. Write to Southco Division, South Chester Corporation, 235 Industrial Highway, Lester, Pa.



**SOUTHCO FASTENERS**  
© 1959 **LION**

CIRCLE 520 ON READER-SERVICE CARD

## PRODUCTION PRODUCTS

### Coil Winding Machine

Provides fast setup

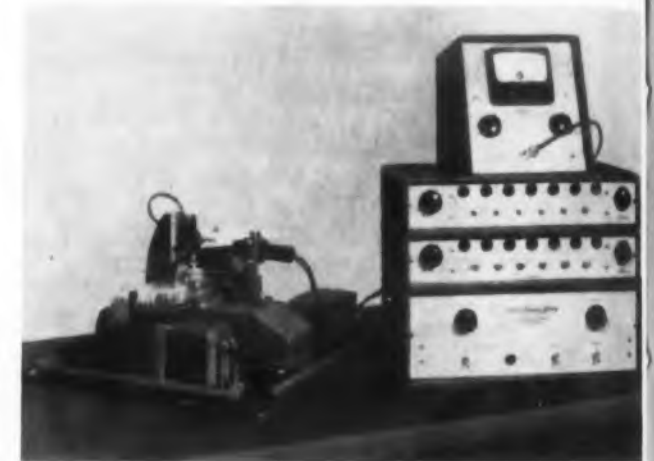
Series S coil winding machines have a shuttle speed of 1200 rpm and a minimum shuttle cross section which allows the winding of coils with small inside diameters. Setup time is reduced to a minimum with a lever that effects the change from one winding head to another. The unit has a mechanical footage counter that controls the loading of the wire and an electronic counter which registers the windings. Both counters stop the machine when a preset number of turns is reached.

Universal Mfg. Co., Inc., Dept. ED, 1168 Grove St., Irvington, N.J.

CIRCLE 521 ON READER-SERVICE CARD

### Automatic Dice Sorter

High speed



Designed to handle light, fragile germanium and silicon dice, this sorter automatically measures and sorts small delicate parts on the basis of thickness. The dice are transported from the hopper, positioned, gaged, classified, and sorted into one of 13 grades of thickness. The machine handles almost 3600 dice or wafers an hour and gages sizes from 0.04 x 0.04 x 0.0015 to 0.19 x 0.19 x 0.01 in.

Airborne Instruments Lab., Dept. ED, 160 Old Country Rd., Mineola, N.Y.

CIRCLE 522 ON READER-SERVICE CARD

### Injection Molding Machine

Air powered

For producing a variety of thermoplastic sub-miniature to 3/4 oz parts, the Mini-jector model 60PC85 molding machine uses air power for both injection and mold closing. Clamp pressure is about 10 with 100 lb air line pressure.

Newbury Industries, Inc., Dept. ED, Newbury, Ohio.

CIRCLE 523 ON READER-SERVICE CARD



## Automatic Dryers

For semiconductor assembly use

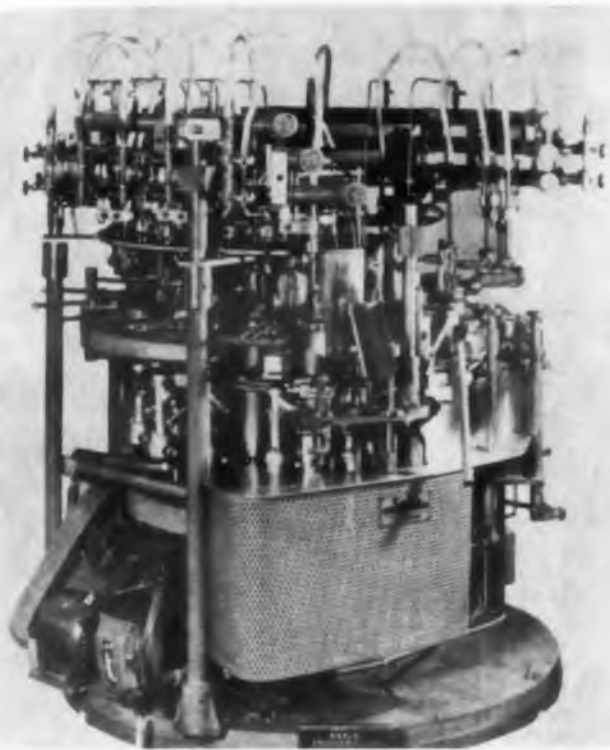
These automatic, heatless desiccant dryers are designed for use in the manufacture of semiconductor and other electronic devices requiring dry-box assembly techniques. The Heat-Les units produce dry air to  $-200$  F dewpoint and eliminate bottled gas systems.

Trinity Equipment Corp., Dept. ED, Cortland, N.Y.

CIRCLE 524 ON READER-SERVICE CARD

## Sealing-Exhaust Machine

For automatic tube production



For miniature radio receiving tubes, the Seal-Ex model 2187 sealing-exhaust production machine has 16 sealing heads and 16 exhaust heads which handle up to 1200 units per hr. It is also available for production of standard and miniature lamps, and it may be fitted with automatic transfer from sealing to exhaust port positions. In operation, miniature receiving tubes with button stem and top tubulation are sealed, inverted, and inserted into the exhaust port.

Kahle Engineering Co., Dept. ED, Union City, N.J.

CIRCLE 525 ON READER-SERVICE CARD

## Cleaning Machine and Compound

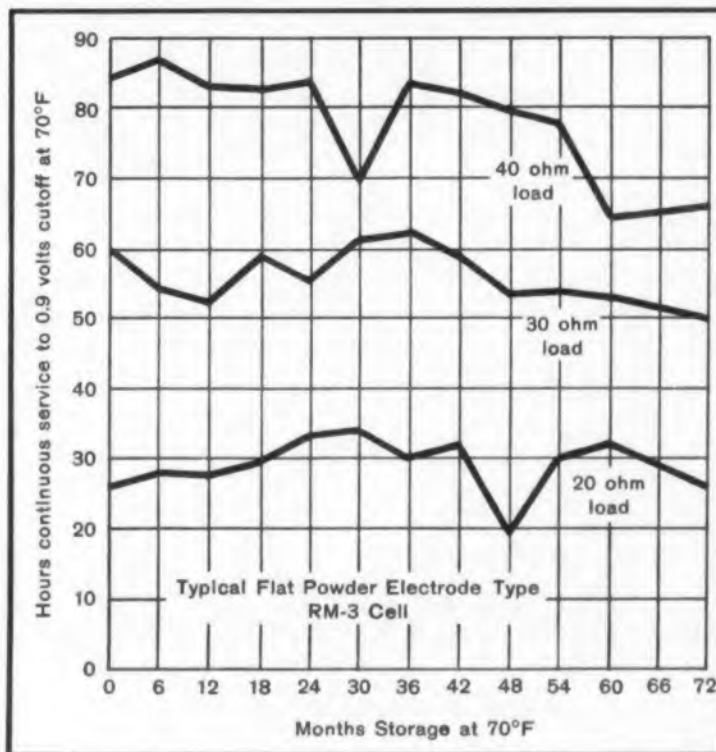
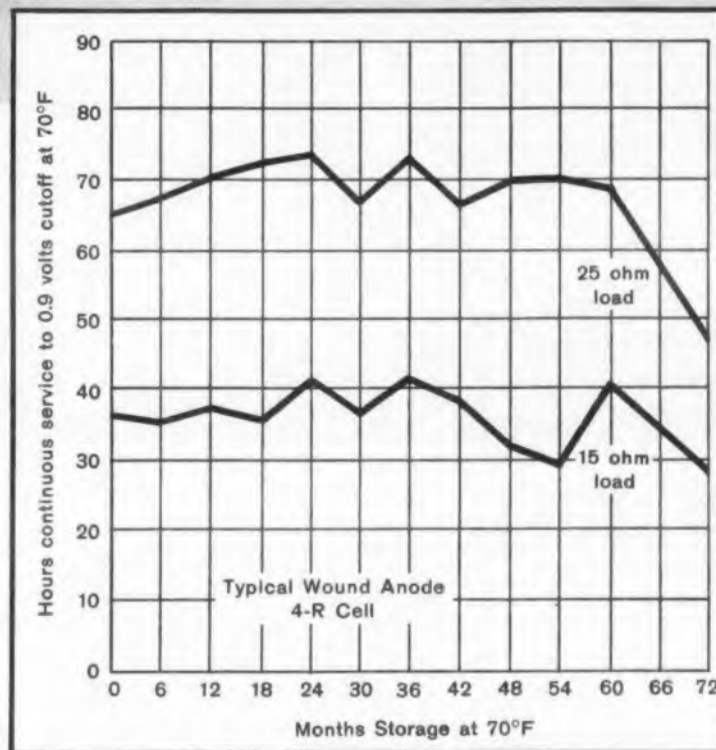
Remove epoxy fill and rosin flux

The Miji-Lif cleaning machine and the 751 cleaning compound can clean up to 75 lb of small glass or metal electronic parts in about 10 min. They remove epoxy fill and rosin flux as well as light oils and airborne dirt.

Magnus Chemical Co., Inc., Dept. ED, South Ave., Garwood, N.J.

CIRCLE 526 ON READER-SERVICE CARD

# Still "FRESH" After 6 Years Storage - Mallory Mercury Batteries



An extensive series of storage tests, now well past the six-year mark, proves that Mallory Mercury Batteries can take extremely long storage far past the point where ordinary batteries become useless.

Some typical test curves are shown here. Note that even at the end of six years, Mallory Mercury Batteries remain close to their "newly-made" capacity.

This extraordinary stability is one of the unique characteristics of the mercury battery system, pioneered and constantly refined by Mallory. During periods of storage, the system does not deteriorate. And during discharge, output voltage stays practically constant out to the limit of battery life. This is an ideal discharge for providing fade-free performance in transistor circuits.

The long service and storage life you get from Mallory Mercury Batteries mean unmatched convenience and dependability to users of your battery powered products. Their high energy content in compact size makes possible new feats of miniaturization. And their precise, stable output offers opportunities for use in instrument circuits, calibration and voltage reference applications.

A consultation with one of our engineers will help you apply our standard models in your product, or will start us on development of special battery packs for your requirements.

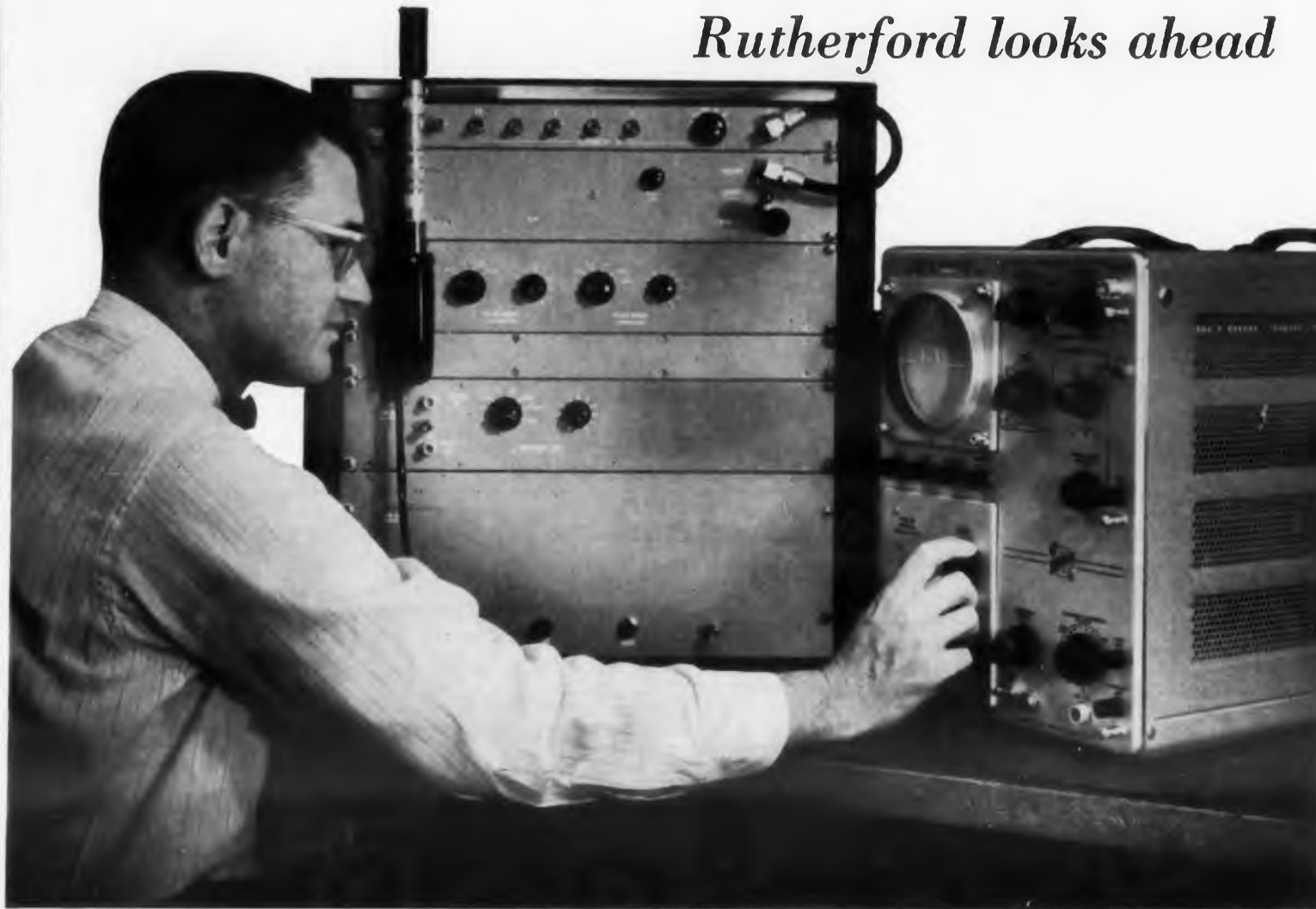
Mallory Battery Co., Cleveland, Ohio  
a division of

P. R. MALLORY & CO. Inc.  
**MALLORY**

P. R. MALLORY & CO. Inc., INDIANAPOLIS 6, INDIANA

CIRCLE 527 ON READER-SERVICE CARD

## Rutherford looks ahead



## FASTER RISE TIME RUTHERFORD GENERATORS REQUIRE FASTER SCOPES

*First* in electronics means a lot of things. To be first in its field, Rutherford must be ahead in research, ahead in development, ahead in quality.

Being first also means recognizing achievement in others. Tektronix' new oscilloscope, capable of reading a rise time of only 3.5 millimicroseconds allows Rutherford to continue its advanced research into generators with faster rise times.

That's why Charles E. Rutherford proudly purchased the *first* Type 581 oscilloscope from Tektronix. That's why Rutherford will continue to hold its position as *first* in the pulse generator field.

*pulse generators • pulse systems*  
*accurate time delay generators*

**Engineers:** If your field is pulse circuitry design, a brighter future awaits you at Rutherford Electronics Company. Send resume to Charles E. Rutherford, president.

THE  
RUTHERFORD  
**B-5-A**  
PULSE  
GENERATOR



Another example of Rutherford superiority. The B-5-A ten-megacycle pulse generator features a rise time of less than 8 millimicroseconds. It has an electronic pulse delay that can be set to zero or is continuously variable from 0.030 microseconds to 500 microseconds in five ranges. Pulse width is continuously variable from .02 to 12.5 microseconds in four ranges.

# Rutherford

**ELECTRONICS CO.**

8944 LINDBLADE STREET, CULVER CITY, CALIFORNIA

CIRCLE 528 ON READER-SERVICE CARD

## PRODUCTION PRODUCTS

### Wire Processing Equipment

Eliminates retwisting

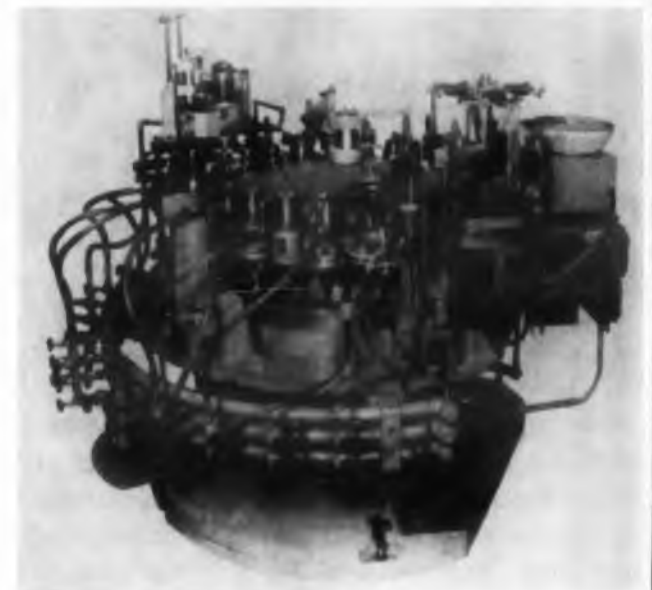
Designed to eliminate retwisting in stranded wire processing, the Reevelec induction reflow machine melts the tin on wire strands at the stripping point. Located between a standard reel or spool and any automatic or semiautomatic wire stripper, it fuses strands together without affecting insulation. The equipment incorporates the company's model L4D-TR 1 kw induction heating generator.

Reeve Electronics, Inc., Dept. ED, 609 W. Lake St., Chicago 6, Ill.

CIRCLE 529 ON READER-SERVICE CARD

### Button Stem Machine

24-head



The model 3017 button stem machine is a fully automatic, 24-head unit designed to make up to 1000 nontabulated miniature electronic tube stems an hour.

Kahle Engineering Co., Dept. ED, Union City, N.J.

CIRCLE 530 ON READER-SERVICE CARD

### Wire Stitcher

Installs Solder Lugs

This stitching machine forms solder lugs from flat roll wire, perforates the insulating strip and permanently fastens the terminal in one operation. A bench mounting unit, model IBM-1234, and a floor mounting unit are available. A variety of forming tools are available as well as flat, oval

ELECTRONIC DESIGN • August 19, 1959

and round stitching wires to provide terminals of shapes and sizes for attachment of very fine wires on the heaviest conductors. Electrically driven, it makes 20,000 terminals without reloading.

Ideal Stitcher Co., Dept. ED, 2323 N. Knox Ave., Chicago, Ill.

CIRCLE 531 ON READER-SERVICE CARD

### Environment Chamber

Conditions diodes and rectifiers



Environment chamber model WF-12-90+240C is a front opening, mechanically operated, self-contained unit that conditions 90 lb of diodes and rectifiers in a range from +355 to -85 F in 30 min, and from -85 to +355 F in 30 min. These cycles can be repeated as many times as required, depending upon the program setting of the instrumentation. Inside capacity is 12 cu ft.

Webber Corp., Dept. ED, P.O. Box 217, Indianapolis 6, Ind.

CIRCLE 532 ON READER-SERVICE CARD

### Ultrasonic Welder

For small parts



Ultrasonic welder model W-100-TSL-58-6 is designed to handle small parts and delicate assemblies. It makes ohmic contacts between silicon or germanium and aluminum or gold wire and welds fine bridge wire assemblies with high resistance wire less than 0.001 in. thick. Power capacity is 100 w.

Aeroprojects Inc., Dept. ED, West Chester, Pa.

CIRCLE 533 ON READER-SERVICE CARD

# 3.5-millimicrosecond risetime

with these

## TWO NEW OSCILLOSCOPES



### TYPE 581

The Tektronix Type 581 is a new laboratory oscilloscope with many of the capabilities needed in the current rapid advancement of the electronic art. Its 3.5- $\mu$ sec risetime, 0.1-v/cm sensitivity, and 0.01- $\mu$ sec/cm sweep time are excellent features for modern high-speed pulse applications. In addition to these unique features, the Type 581 also has the slow sweeps, versatile triggering, and dc-coupled vertical-deflection system needed for most general-purpose laboratory work. A new series of Tektronix plug-in preamplifiers promises outstanding signal-handling versatility for an oscilloscope with a vertical passband of dc to approximately 100 mc.

With the Type 80 Plug-In Preamplifier and Type P80 Probe the basic vertical-deflection factor is 0.1 v/cm with input impedance of 10  $\mu$ f paralleled by 100 kilohms. Five snap-on probe attenuator heads provide deflection factors of 0.2, 0.5, 1, 2, and 5 v/cm at input impedances ranging up to 1.5  $\mu$ f paralleled by 5 megohms. A fixed balanced delay line is incorporated in the main vertical amplifier.



The cathode-ray tube is a lumped-constant traveling-wave type with 10-kv accelerating potential.

The wide sweep range of the Type 581 includes sweeps fast enough to take advantage of its risetime capabilities. Calibrated range is 0.05  $\mu$ sec/cm to 2 sec/cm in 24 steps, with 5-x magnifier to increase calibrated range to 0.01  $\mu$ sec/cm. Sweep time is continuously adjustable between steps. Versatile triggering includes amplitude-level control, and preset stability for operating convenience. Lockout-reset circuitry provides for one-shot sweep operation.

### TYPE 585

The Tektronix Type 585 has, in addition to the identical general specifications of the Type 581, a second time base generator. This time-base generator, designated TIME BASE B, acts as a delay generator, providing a wide range of calibrated sweep delay. Two modes of sweep delay are available—triggered (delayed sweep is started after the

delay period by the signal under observation), and conventional (delayed sweep is started at the end of the delay period by the delayed trigger). Calibrated sweep delay is continuously variable over the range of 1  $\mu$ sec to 10 sec. Color-correlated controls eliminate confusion, making this new high-performance oscilloscope easy to operate.

TYPE 581, without plug-in units . . . . .	\$1375
TYPE 585, without plug-in units . . . . .	1675
TYPE 80 Plug-In Preamplifier . . . . .	50
TYPE P80 Probe, with 5 attenuator heads . . . . .	100

(Both Preamplifier and Probe are needed to operate the Type 581 and Type 585.)

Other Plug-In Preamplifiers are currently in development.

Prices f.o.b. factory.

ENGINEERS—Interested in furthering the advancement of the oscilloscope? We have openings for men with creative ability in circuit and instrument design, cathode-ray tube design, and semiconductor research. Please write Richard Rapiequet, V.P., Eng.

## Tektronix, Inc.

P. O. Box 831 • Portland 7, Oregon

Phone CYpress 2 2611 • TWX-PD 311 • Cable TEKTRONIX

TEKTRONIX FIELD OFFICES: Alhambra, I. I., N.Y. • Albuquerque • Atlanta, Ga. • Bronzville, N.Y. • Buffalo • Cleveland • Dallas • Dayton • Elmwood Park, Ill. • Endwell, N.Y. • Houston Lathrup Village, Mich. • East Los Angeles • West Los Angeles • Minneapolis • Mission, Kansas • Newtonville, Mass. • Orlando, Fla. • Palo Alto, Calif. • Philadelphia • Phoenix • San Diego • St. Petersburg, Fla. • Syracuse • Towson, Md. • Union, N.J. • Washington, D.C. • Willowdale, Ont.

TEKTRONIX ENGINEERING REPRESENTATIVES: Hawthorne Electronics, Portland, Oregon • Seattle, Wash.; Hytronic Measurements, Denver, Colo.; Salt Lake City, Utah.

Tektronix is represented in 20 overseas countries by qualified engineering organizations.

SEE THIS AND OTHER NEW TEKTRONIX INSTRUMENTS AT WESCON, BOOTHS 1801 AND 1802

CIRCLE 534 ON READER-SERVICE CARD



## Catalog Information

### .. Right at Your Finger Tips

Here is a valuable new information service to augment your data files. Manufacturer's catalogs are now being accepted — one each issue — for binding directly in *Electronic Design's* center fold. The catalog may be easily removed, or if you wish, filed with the magazine (all catalogs will be listed in the semi-annual index of articles).

This unique service is one more step in providing our readers with the latest, complete, product information obtainable in a single reference source. Up-to-the-minute product data can break design bottlenecks, create additional time for more important work, speed the completion of your project.

If there is a particular type of product for which you would like to have information on a regular basis, let us know about it, we will relay your requests to the appropriate manufacturer.

### How to Request Additional Catalogs

If you need extra catalogs for other engineering groups or for central files, use your Reader Service card to request additional copies.



CIRCLE 535 ON READER-SERVICE CARD

## ADVERTISERS INDEX August 19, 1959

Advertiser	Page
ACDC Electronics, Inc. (Formerly NYT)	54
AGA Div. of Elastic Stop Nut Corp.	164
AMP, Inc.	147
Ace Electronics Associates	161
Advance Relays	150
Advance Stamping Co.	162
Aeronutronic Systems, Inc.	48
Airborne Instrument Lab., Inc.	131, 162
Allied Control Co.	113
Allied Radio Corp.	159
Amco Engineering Co.	126
Amperex Electronic Corp.	157
Amperite Co.	78
Ampex Corp., Magnetic Tape Div.	122
Amphenol Borg Electronics Corp.	156
Assembly Products, Inc.	112
Atlas E-E Corp.	154
Audio Devices, Inc.	16
Austin Screw Products Co.	97
B & K Instruments, Inc.	50
B & H Instrument Co., Inc.	88
Babcock Relay, Inc.	108
Belden Mfg. Company	137
Bendix Aviation Corp., Montrose Div.	140
Bendix Aviation Corp., Red Bank Div., Transistors	160
Berkeley, Div. of Beckman Instruments, Inc.	8
Bomac Laboratories, Inc.	172
Buckbee Mears Co.	96
Burdy Corporation	26
Burnell & Co. Inc.	5
Burroughs Corp., Electronic Tube Div.	15
Centralab, Div. of Globe-Union, Inc.	105
Clare, C. P. & Company	114
Clevite Transistor Products	151
Columbus Electronics Corp.	107
Computer-Measurements Co.	86
Connecticut Hard Rubber Co., The	86
Consolidated Electrodynamics Corp.	32
Convair Astronautics	63
Cornell-Dubilier Electric Corp.	33
Corning Glass Works	82
Couch Ordnance, Inc.	157
Cratex Mfg. Co., Inc.	165
Curtiss-Wright Corp.	88
D & R Limited	10
Dale Products, Inc.	13
Daven Co., The	18
Deutsch Company, The	53
Diehl Mfg. Co.	91
DIT-MCO, Inc.	75
Douglas Aircraft Co.	64
ESC Corporation	153
Eagle Signal Company	14
Eastern Industries, Inc.	115
Eitel-McCullough, Inc. (Eimac)	117

51  
164  
147  
161  
150  
162  
48  
131, 163  
113  
150  
126  
157  
78  
Div. 122  
orp. 156  
112  
154  
16  
97  
50  
88  
108  
137  
ose  
140  
nk  
160  
stru-  
8  
172  
96  
26  
5  
ube  
15  
t, Inc. 105  
114  
151  
107  
86  
The 86  
Corp. 32  
63  
33  
82  
157  
165  
88  
10  
13  
18  
53  
91  
75  
64  
153  
14  
115  
117

Advertiser	Page
Electro Instruments	Cover III
Electro-Measurements, Inc.	27
Electrosnap Corp.	119
Elgin Metalformers Corp.	56
Ellis & Watts Products, Inc.	111
Fairchild Semiconductor Corp.	22, 23
Fastex Div., Illinois Tool Works	80
Federal Tool & Engineering Co.	141
Filtors, Inc.	145
Fischer Special Mfg. Co.	122
G-M Laboratories, Inc.	94
G-V Controls, Inc.	1
Gamewell Company	132
Garrett Corp.	69, 71
General Ceramics Corp.	139
General Electric Co., Light Military Div.	59
General Electric Co., Panel Instruments	109
General Electric Co., Power Supplies	148
General Electric Co., Receiving Tubes Dept.	123
General Electric Co., Specialty Control	125
General Electric Co., Tantalum Capacitors	86
General Hermetic Sealing Corp.	107
General Magnetics, Inc.	161
General Mills, Inc.	73
General Motors Corp., AC Spark Plug Div.	65
General Plate Div., Metals & Controls Corp.	135
General Radio Co.	165
General Transistor Corp.	146
Globe Industries, Inc.	85
Good-All Electric Mfg. Co.	152
Grant Pulley & Hardware Corp.	84
Haydon, A. W. Co., Inc.	95
Heath Co.	97
Heiland Div. of Minneapolis-Honeywell	120, 121
Helipot Div. of Beckman Instruments	42
Hetherington, Inc.	130
Hewlett-Packard Company	47, 149
Hi-Temp Wires, Inc.	171
Holtzer-Cabot Div., National Pneumatic Co.	142
Hopkins Engineering Co.	96
House Adv.	68, 73, 94, 104, 110, 116, 170
Hughes Aircraft Co., Culver City	70
I T & F Components Div.	17
International Business Machines Corp.	72
International Nickel Co., Inc.	46
Jennings Radio Mfg. Co.	129



## MCDONNELL VOODOO

Above 1200 mph, it isn't enough to put just mechanical "muscle" at the pilot's command; he needs an assist with "mental" aerobatics, too.

Teaming-up with McDonnell engineers, the specialists of the Aeronautical Division at Minneapolis-Honeywell Regulator Company turned out a mechanical co-pilot specifically for the F-101B. For nerves and sinews in this M-H Autopilot, they specified Hitemp Teflon\* coated wire and cable.

As the leading specialist in high temperature insulated wires and cables, Hitemp Wires, Inc. is proud to stand among those devoted to safeguarding our country.

## HITEMP WIRES, INC.

1200 SHAMES DRIVE, WESTBURY, NEW YORK

\*Registered trademark for Du Pont fluorocarbon resins.

CIRCLE 536 ON READER-SERVICE CARD





TR, ATR, PRE-TR TUBES  
SHUTTERS  
REFERENCE CAVITIES  
SILICON DIODES  
MAGNETRONS  
KLYSTRONS  
DUPLEXERS  
PRESSURIZING WINDOWS  
SURGE PROTECTORS  
SPARK GAP TUBES

**THE MOST  
COMPLETE  
LINE  
OF MICROWAVE  
TUBES AND  
COMPONENTS**

Bomac offers you *the* widest choice of performance-proven microwave tubes and components from which to choose.

And when it comes to adaptations, or totally new designs, there's no substitute for Bomac's 12 years' experience in this specialized, complex, fast-changing field.

Whatever your problem in microwave, check Bomac *first*.

*Bomac*

**LABORATORIES, INC.** Salem Road, Beverly, Massachusetts  
a subsidiary of VARIAN ASSOCIATES

VISIT US AT THE WESCON  
SHOW — BOOTH 1622-1624

Offices in major cities — New York • Chicago • Los Angeles • San Francisco • San Carlos, Calif. • Kansas City • Dallas • Dayton • Washington • Seattle • Fort Wayne • Phoenix • Camden, N.J. • Decatur, Ga. • Towson, Md. • Canada: R-O-R Associates Limited, 1470 Don Mills Road, Don Mills, Ontario • Export: Maurice I. Parisier, 741-745 Washington St., N.Y. 14, N.Y.

Advertiser	Page
Jones, M. C. Electronics Co., Inc. . . .	95
Joy Mfg. Co. . . . .	155
Kearfott Co., Inc., Microwave Div. . .	93
Keystone Products Co. . . . .	97
Krohn-Hite Corp. . . . .	90
Lafayette Radio Corp. . . . .	106
Lambda Electronics Corp. . . . .	20
Leach Corp. . . . .	45
Leeds & Northrup Co. . . . .	150
Leland, G. H., Inc. . . . .	165
Lerner Plastics, Inc. . . . .	89
Linde Co. . . . .	25
Lockheed Aircraft Corp., Missile Systems Div. . . . .	66
Magnetics Inc., Components Div. . .	12
Malco Mfg. Co. . . . .	126
Mallory, P. R. Co. . . . .	81, 167
Marion Instrument Div., Minne- apolis-Honeywell Regulator Co. . .	56
Melpar, Inc. . . . .	71
Metronix, Inc. a Subsidiary of As- sembly Products, Inc. . . . .	106
Mica Insulator Co. . . . .	24
Micro Switch, Div. of Minneapolis- Honeywell . . . . .	134
Minneapolis-Honeywell Co., Boston Div. . . . .	24, 25
Minneapolis-Honeywell Co., Indus- trial Div. . . . .	143
Minnesota Mining & Mfg. Co., Mag- netic Div. . . . .	136
Minnesota Mining & Mfg. Co., Chemical Products Div. . . . .	128, 129
Monsanto Chemical Co. . . . .	48
Motorola, Inc., Western Military Electronics Center . . . . .	60
National Cash Register Co. . . . .	72
New England Instrument Co. . . . .	38
Newton Co., The . . . . .	80
North Atlantic Industries, Inc. . . . .	153
Oak Mfg. Co. . . . .	52
Oster, John Mfg. Co. . . . .	138
Pacific Semi-conductors, Inc. . . . .	12, 13
Philbrick Research, Inc. . . . .	134
Philco Corp., Landsdale Tube Div. . .	7
Polarad Electronic Corp. . . . .	48-49
Polytechnic Research & Develop- ment Co., Inc. . . . .	140
Potter & Brumfield . . . . .	127
Potter Instrument Co. . . . .	6
Power Sources, Inc. . . . .	31
Pyramid Electric Co. . . . .	144
Radio Corp. of America, Designers' Entertainment . . . . .	Cover IV
Radio Corp. of America, Designers' Entertainment Picture Tube . . . . .	19

◀ CIRCLE 537 ON READER-SERVICE CARD

Page	Advertiser	Page
95	Radio Corp. of America, Semiconductor & Materials Div.	87
155	Radio Corp. of America, Employment Div.	62
93	Raytheon Mfg. Co., Distributor Products	49
97	Raytheon Mfg. Co., Industrial Apparatus Div.	86
90	Raytheon Mfg. Co., Magnetic Components	89
106	Raytheon Mfg. Co., Microwave & Power Tube Div.	99
20	Raytheon Mfg. Co., Mechanical Components	101
45	Raytheon Mfg. Co., Semiconductor Div.	2
150	Raytheon Mfg. Co., Special Microwave Devices	4
165	Raytheon Mfg. Co., Personnel	67
89	Reeves-Hoffman Div., Dynamics Corp. of America	160
25	Republic Aviation	60
66	Resistance Products Co.	154
12	Richardson Co., The	124
126	Rotron Mfg. Co.	118
81, 167	Rutherford Electronics Co.	168
56	Schuyler Mfg. Co.	106
71	Shell Chemical Corp.	Cover II
108	Simpson Electric Co.	43
24	Sonotone Corp.	142
134	Southco, Div. of South Chester Corp.	166
24, 25	Sprague Electric Co.	9
143	Stathem Instruments, Inc.	163
Mag-	Stromberg-Carlson Co., Div. of General Dynamics	108
136	Superior Electric Co.	96, 97
128, 129	Sylvania Electric Products, Inc. Mt. View Labs.	73
46	Sylvania Electric Products, Inc. Special Tubes	79
ary	Taurus Corp.	165
69	Technibilt Corp.	164
72	Tektronix, Inc.	169
30	Tensolite Insulated Wire Co., Inc.	92
81	Texas Instrument, Inc., Employment	69, 71, 73
155	Texas Instruments, Inc.	158, 159
52	Times Wire & Cable Co.	57
136	Transitron Electronic Corp.	102, 103
12, 13	Tung-Sol Electric, Inc., Electron Tubes Div.	21
131	Union Switch & Signal Div., Westinghouse Air Brake Co.	141
Div.	U. S. Radium Corp.	163
48-49	United Shoe Machinery Corp.	51
pp-	Vickers, Inc.	55
140	Voltron Products	54
127	Warner Electric Brake & Clutch Co.	83
6	Western Devices, Inc.	57
31	Wheelock Signals, Inc.	11
144	Worthington Mfg. Co.	96

CIRCLE 538 ON READER-SERVICE CARD >

# Martin picks Electro Instruments D.C. Amplifiers



Plug-in attenuators of the A12 provide convenience, flexibility, economy. Special variations, gain settings, etc., can be tailored to your system at no extra cost.

## for TITAN ground support equipment



Totally transistorized—dissipates only 7 watts.  
 Drift less than 2 microvolts for 200 hours.  
 .01% linearity and stability.  
 100 megohms input impedance—40 milliohms output impedance.  
 1 db DC to 10 KC.  
 Noise less than 10 microvolts wideband.  
 Single ended or differential input.  
 Operates to specifications from 0° to 50°C.  
 Self-contained power supply—operates on any line frequency from 50-400 cps.  
 Mil-type chopper gives unmatched reliability for the life of the instrument.  
 7" x 19" panel accommodates 8 instruments.

**Model A12's pass rugged military environmental tests for altitude, shock, temperature, humidity and electro interference.**

Design and construction techniques used in the Model A12 amplifier are fully two years ahead of the field! These advanced techniques enabled the Model A12 to meet stiff environmental qualification tests which resulted in their being selected by Martin engineers for use in the *Titan* ground support equipment.

Use of totally transistorized circuits gives the A12 unmatched reliability and performance, and minimizes heat dissipation problems inherent in vacuum tube instruments. Plug-in etched circuit boards and modular internal construction make servicing and maintenance checks easy—the amplifier can be disassembled and reassembled in less than 10 minutes. *Your E-I representatives can give you complete information.*

**Electro Instruments, Inc.** 3540 AERO COURT SAN DIEGO 11, CALIF.

HAYDEN PUBLISHING COMPANY, INC.  
830 Third Avenue, New York 22, N.Y.

ELECTRONIC  
DESIGN



Developmental type A-2346, world's most powerful electron tube. Only 17" high; only 14" in diameter.

Adjusting an A-2346 Super-Power Tube in an rf power amplifier utilizing experimental cavities.

# 5 MEGAWATTS OF LONG-PULSE POWER

## —at 450 Megacycles

Revolutionary new RCA developmental Super-Power Tube delivers tremendous RF Power with a pulse duration of 2000 microseconds and a duty factor of 0.06

Innovator in super-power tube development and manufacture for almost two decades, RCA takes another bold step into high-power rf generation with the new developmental type A-2346—the most powerful UHF electron tube on earth.

Here, within the geometry of a single tube no bigger than a nail keg, lies the potential ability to generate the rf power it takes for outer-space communications...scatter transmission on a global scale...super-range radar and missile guidance...industrial rf applications on a mass-production basis.

Developmental type A-2346 is just one among a number of RCA Super-Power types now available to research, industry, and the military. RCA Super-Power Tubes have been serving in major projects and are being incorporated in other major defense projects.

For more information on both commercial and developmental types of RCA Super-Power Tubes—and application assistance—talk to your RCA Field Representative.

Typical data on RCA Super-Power Tubes in plate-pulsed service

TYPE	USEFUL POWER OUTPUT (Kw) <sup>1</sup>	DUTY FACTOR	FREQ. (Mc)	MAX. FREQ. FOR FULL INPUT (Mc)	UPPER USEFUL FREQ. (Mc) <sup>2</sup>
RCA-2041	300	0.003	450	600	1500
	250	0.05	250	600	1500
A-15049*	1100	0.003	500	1000	1250
	500	0.06	500	1000	1250
RCA-2039	1500	0.06	200	200	250
RCA-6952	2000	0.0018	425	600	1000
A-2344*	5000	0.003	1000	1000	1250
A-2349*	8000	0.003	200	200	250
A-2346*	10000	0.01	450	450	600
	5000	0.06	450	450	600
A-15025*	27500	0.003	425	600	600

<sup>1</sup>RCA Developmental Type      <sup>2</sup>For Prototype Design  
■ At Peak of Pulse

Typical data on RCA Super-Power Tubes in hard-tube pulse-modulator service

TYPE	MAX. SWITCHED POWER (Kw)	DUTY FACTOR
A-15030*	22,000	0.05
A-15034*	11,000	0.05

\*RCA Developmental Type



**RADIO CORPORATION OF AMERICA**

Electron Tube Division

Harrison, N. J.

Visit the RCA Booth at WESCON

Your RCA Field Representatives are here to help you

GOVERNMENT SALES

NEWARK 2, N. J.  
744 Broad St., HUmboldt 5-3900  
DAYTON 2, OHIO  
224 N. Wilkinson St., BALdwin 6-2366  
WASHINGTON 6, D. C.  
1625 "K" St., N.W., DIstrict 7-1260

INDUSTRIAL  
PRODUCTS SALES

NEWARK 2, N. J.  
744 Broad St., HUmboldt 5-3900  
DETROIT 2, MICHIGAN  
714 New Center Building, TRinity 5-5600  
CHICAGO 54, ILLINOIS  
Suite 1154, Merchandise Mart Plaza  
Whitehall 4-2900  
LOS ANGELES 22, CALIF.  
6355 E. Washington Blvd., RAYmond 3-8361