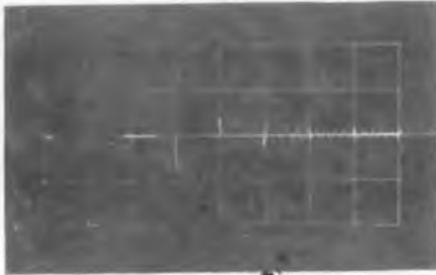


# ELECT D



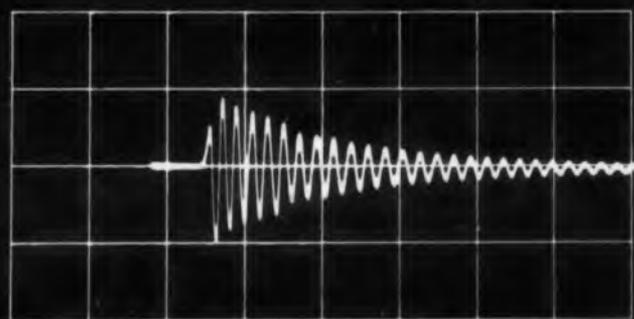
THE LIBRARY OF  
CONGRESS  
SERIAL RECORDS

SEP 15 1959

**Transients  
Invisible to Eye  
Recorded by  
New Polaroid Film  
... page 22**

# RONIC E S I G N

SEPTEMBER 2, 1969



*advanced*  
**PRECISION COMPUTING RESOLVERS**  
for  
**Cascaded Resolver Systems**

**SIZE 8 FEEDBACK WINDING RESOLVERS**

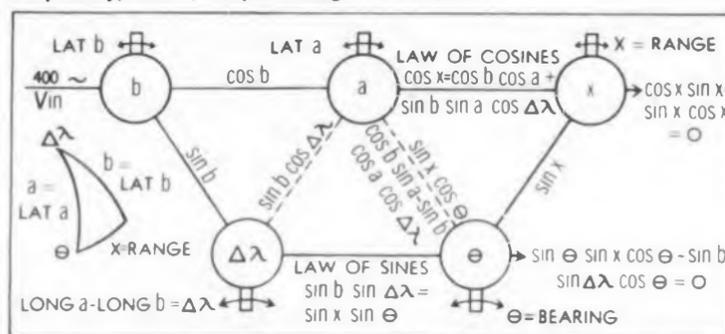


These resolvers are designed for use with transistorized amplifiers and permit the solution of spherical triangles in a size 8 cascaded resolver chain.

Functions of the spherical triangle which can be produced are indicated in the schematic below. More complex trigonometric functions, as well as systems involving coordinate axis transformation, can be generated with the use of these resolvers.

Accuracy: Functional error .1% or less; winding perp.  $\pm 5'$ . Electrical

characteristics: Input voltage 15v400~ (stator); output voltage 13.7v (rotor); phase shift (stator as primary) 20.5°; output voltage 13.7v (compensator); Zro 234 + j596; Zso 244 + j548; Zcompensator 237 + j553; max. null voltage 1 mv/v.



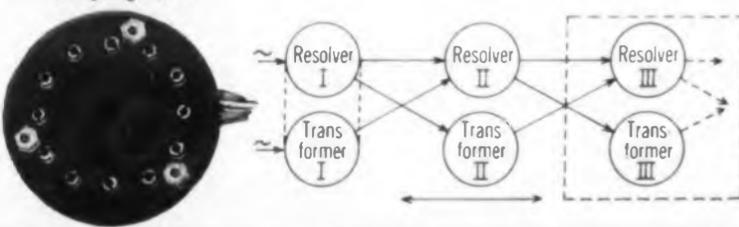
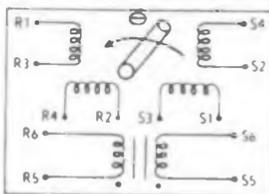
**SIZE 11 AMPLIFIERLESS RESOLVER FOR ANGULAR DATA TRANSMISSION**



These size 11 resolvers incorporate an integral transformer which simulates a resolver function at maximum coupling. They are used in the typical chain application indicated below for angular data transmission. In this particular application, the output information can be served at either end of the chain.

Quick disconnect allows ease in harnessing.

Accuracy:  $\pm 5'$  of arc or less; winding perp.  $\pm 5'$ . Electrical characteristics: Input to EITHER rotor or stator. Input voltage 115v1600~; output voltage 110v both stator and rotor as primary; phase shift (stator primary) 1.1°; phase shift (rotor primary) 1.9°; Zso (nom.) 990 + j13500; Zro (nom.) 1150 + j13500.



**SIZE 11 RESOLVER TRIMMED FOR ZERO PHASE SHIFT CONTAINS ALL COMPENSATION IN 2 1/4" LENGTH**



The YZC-11-E-1 precision computing resolver has been developed for use in a cascaded, amplifierless resolver system at 900~.

These units have been trimmed to provide zero phase shift and compensated for transformation ratio stability, under temperature, when working into their iterative impedance.

Accuracy: Functional error .1% or less; winding perp.  $\pm 5'$ . Electrical characteristics: Input voltage (stator) 40v900~; output voltage (rotor) 33.2v; phase shift 0; max. null voltage 1 mv/v.

Also ready for delivery is an equivalent, compatible pancake resolver. By its use, differential information from an inertial platform may be obtained and introduced into the system.

ENGINEERS — Join the leader in the rotating components field. Write David D. Brown, Director of Personnel, Dept. 59

**cppe CLIFTON PRECISION PRODUCTS Co., INC.**  
CLIFTON HEIGHTS, PENNSYLVANIA

Sales Office: 9014 W. Chester Pike, Upper Darby, Pa.—Hilltop 9-1200, TWX Flanders, Pa. 1122—or our Representatives

CIRCLE 285 ON READER-SERVICE CARD

HIGHLIGHTS OF ISSUE



**A Film That's Quicker Than the Eye (Cover) . . . . 22**

New horizons in oscilloscope-trace photography have been opened with Type 47 Land film. It has photographed writing rates exceeding 3000 centimeters per microsecond. This figure can be raised to 8000 with special techniques. Fine detail of transients is also possible.

**Building-Block Circuits for Digital Computers . . . . . 18**

Reliable Navy-designed transistor building-block circuits are available to engineers. They include a gated blocking oscillator, gated exclusive-OR circuit, monostable multivibrator and others.

**Mechanical Checklist: Key To Reliable Equipment . . 24**

Many reliability problems in electronic equipment are caused by poor mechanical design. A checklist that covers representative mechanical hazards is covered in this article. It was developed from experiences with missiles and complex military electronic equipment.

**How to 'Spec' a Career . . . . 38**

What are the most important values for an engineer in a job? Money? Responsibility? Many engineers would favor these two. But they would be overlooking more vital, long-range goals, according to one engineer. He outlines the alternatives in suggesting ways to "Look Before You Leap into That Job."

TK7800  
E427

CON

ELEC

ELEC

## NEWS

- CADF Direction Finder Details Revealed 3

## EDITORIAL

- Is Our Management Letting Us Down? 17

## FEATURES

- Building-Block Circuits For Transistorized Digital Computers 18  
*Reliable Navy designs available to engineers ..... A. Demmerle*

- High-Speed Photo Film Records Invisible Scope Traces 22  
*New horizons open in recording waves and transients*

- Mechanical Check List: A Key To Reliable Electronic Equipment 24  
*Based on experiences with complex military electronic equipment ..... H. I. Dwyer, Jr.*

- How To Choose The Right Indicator 28  
*Factors in selecting the three basic kinds of symbolic indicators are covered ..... H. L. Williams*

- Look Before You Leap Into That Job 38  
*A guide to designing a career ..... R. N. DeFloria*

- Millimicrosecond Sampler Makes Any Scope High Speed 73  
*A millimicrosecond sampling unit permits extremely high frequency displays on almost any oscilloscope*

- Dimension PC Board Holes This Easy Way 30  
*Ideas For Design*

- Solar Batteries In Sputniks 52  
*Soviet approach to improve efficiency in solar batteries*

- DC Stabilization Of Transistors 60  
Double Push-Pull Modulator  
*German Abstracts*

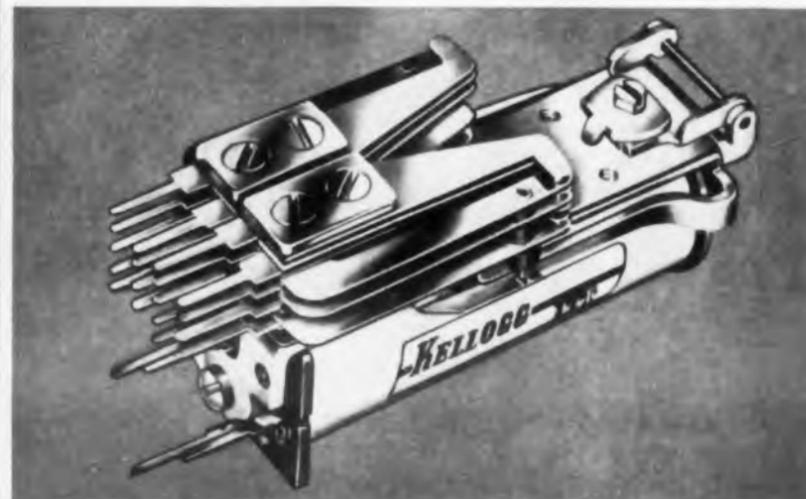
## DEPARTMENTS

- |                   |    |                      |    |
|-------------------|----|----------------------|----|
| Washington Report | 12 | Russian Translations | 52 |
| Meetings          | 14 | German Abstracts     | 60 |
| Ideas for Design  | 30 | Report Briefs        | 62 |
| Patents           | 36 | Standards and Specs  | 66 |
| Careers           | 38 | New Literature       | 68 |
| Career Brochures  | 45 | New Products         | 74 |
| Books             | 48 | Letters              | 96 |

Advertisers' Index 99

**NOW!** A telephone type DC relay  
for industrial application

# Kellogg AK relay



**Highly sensitive:** adaptable for marginal operation

**Long coil construction:** permits use of high resistance coils

**Low current:** operates on as little as .002 amps

**Slow operate (Type AKSO), or slow release (Type AKSR) models also available**

**Coil Characteristics:**

operating voltage—up to 230 volts D.C.  
single or double wound

**Contact Assembly:**

single or double pile up  
forms A to E  
14 springs maximum in each pile-up  
alternative: single or double microswitch  
standard terminals also available

**Operate and Release Time:**

.002 sec. minimum operate  
.100 sec. maximum operate delay  
.400 sec. maximum release delay

**Weight:** 8-12 oz. net (approx.)

Inquiries are invited. Send for a free catalog  
on relays, components.



Kellogg Switchboard and Supply Company, 6650 South Cicero Avenue,  
Chicago 38, Ill. Communications division of  
International Telephone and Telegraph Corporation.  
Manufacturers of: Relays • Hermetically Sealed Relays • Switches  
Miscellaneous Telephone Type Components

CIRCLE 286 ON READER-SERVICE CARD

when it  
comes to  
**REVERSE  
RECOVERY**



Raytheon *Diffused Junction* Silicon Rectifiers provide the precise junction gradient necessary for many applications. Operating temperature range is from minus 65° C to plus 165° C.

Available in stud and wire-in types having a wide range of characteristics, meeting MIL specifications.

Available in production quantities.

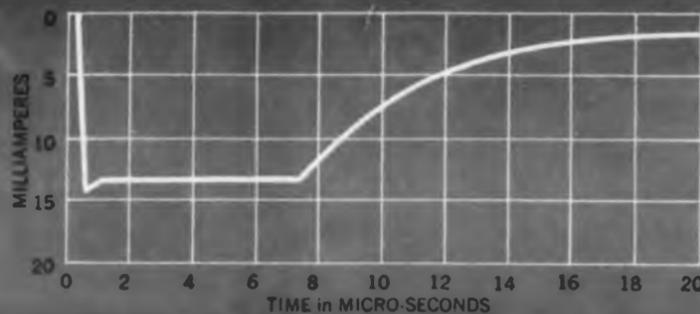


**SEMICONDUCTOR DIVISION**

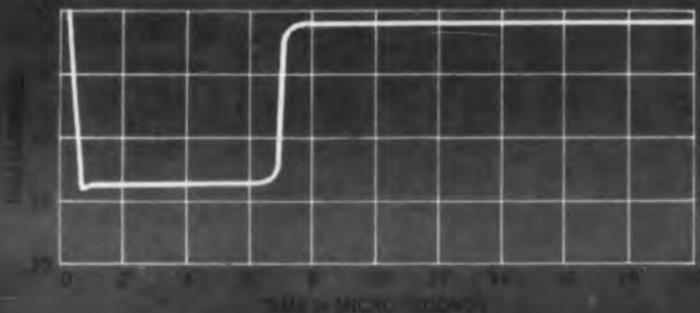
SILICON AND GERMANIUM DIODES AND TRANSISTORS  
SILICON RECTIFIERS • CIRCUIT-PAKS

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

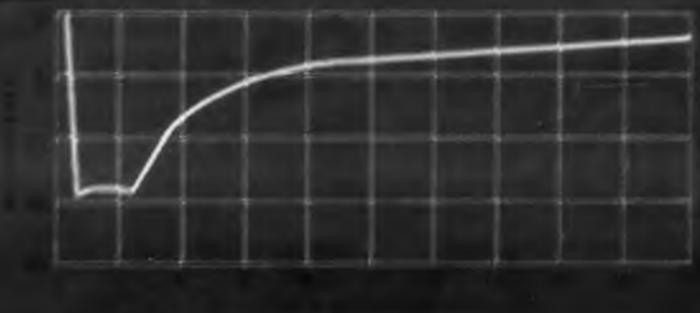
SOME silicon rectifiers give you slow start — slow rise



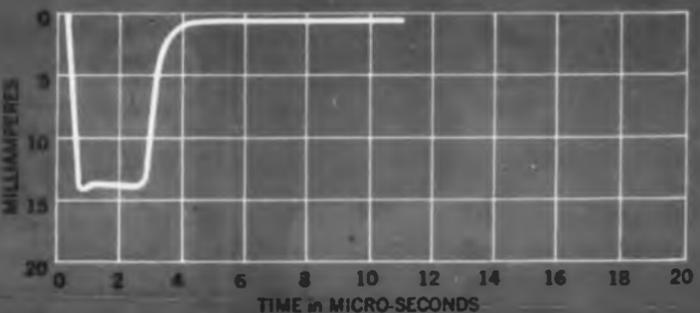
SOME silicon rectifiers give you slow start — fast rise



SOME silicon rectifiers give you fast start — slow rise



**BUT** RAYTHEON Reliable SILICON RECTIFIERS give you  
fast start — fast rise



**STAFF**

EDITOR: Edward E. Grazda; MANAGING EDITOR: J. A. Lippke; ASSOCIATE EDITORS: L. D. Shergalis, G. H. Rostky, H. Bierman; ASSISTANT EDITORS: T. E. Mount, D. S. Viebig, L. N. Tolopko, A. Corneretto, F. Muehleck, A. Caprioglio; CONTRIBUTING EDITORS: S. H. Hubelbank, E. Brenner, B. Bernstein, E. Kahn, 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, C. E. Moodhe; 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 RESTATEMENT OF THESE QUALIFICATIONS. Subscription rate for nonqualified 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.

CIRCLE 287 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 2, 1959

## CADF Direction Finder Details Revealed

**A** BRITISH-DEVELOPED wide-aperture direction finder, said to display bearing readings accurate to one degree, is stirring interest in this country.

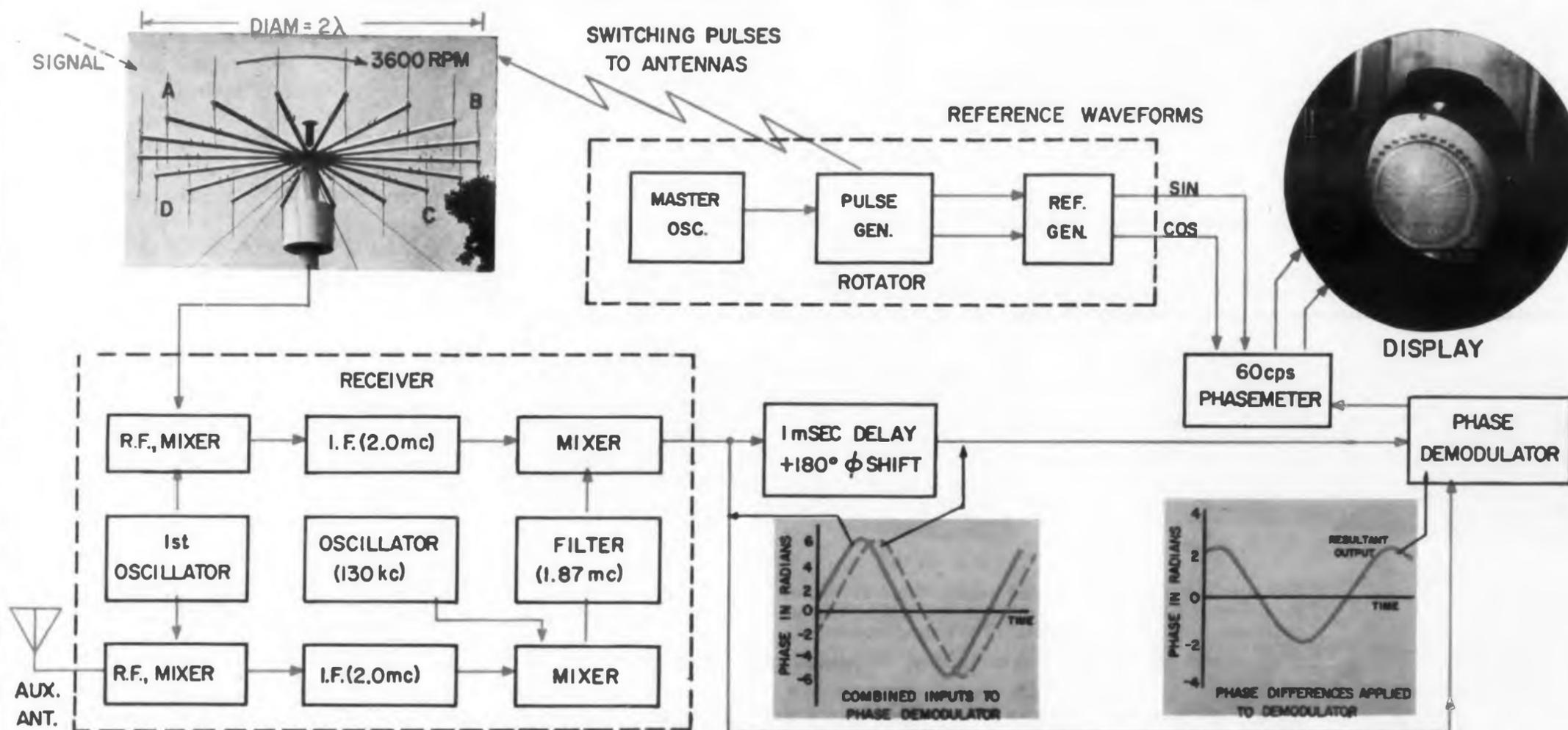
The equipment incorporates novel design features that are reported to eliminate disadvantages of narrow-aperture direction finders and to improve on Doppler and Wullenweber wire-aperture systems.

The new device, called the Commutated Antenna Direction Finder (CADF), was developed by Standard Telephones and Cables, Ltd., a

British subsidiary of the International Telephone and Telegraph Corp. A number of overseas air-traffic control centers have already installed the equipment. Details of its operation were disclosed recently at a showing in Atlantic City for the Federal Aviation Agency.

The basic operating principle is standard: the times that a signal arrives at different antenna elements are compared and fed to a display device to indicate bearing of a target.

(Continued on p. 4)



Antenna array feeds signals to twin-receiver direction finder for comparison of times signals arrive. Twin receivers simplify processing.

Display unit shows direction of signal as a radial line on compass-marked cathode-ray tube face. Bearings can be accurate to one degree.



## Specialized laboratory and production test instruments for your advanced requirements

EH Model Number	Item	Description	EH Model Number	Item	Description
101N	Coincidence Unit	Multi-channel (4) coincidence circuitry. Ultimate resolution: 3 millimicroseconds. Operates directly from photomultiplier outputs.	201C	Electrometer Amplifier	Measures currents between $10^{-6}$ and $10^{-15}$ ampere. Ultra-high sensitivity with ultra-low noise. Response time: 250 microseconds for $10^{-11}$ ampere full scale.
120B	Pulse Generator	Ultra-fast hard tube pulse circuitry. Rise time $< 2.5$ millimicroseconds. Repetition rate 10 cps to 10 Mc continuous. Pulse widths 2.5 to 25 millimicroseconds.	202	Electrometer for Automatic Control	Measures current with specifications identical to EH model 201C, but has presettable high limit control for actuation of external devices. Extremely stable; zero drift less than 3% per week.
130	Pulse Generator	Fast general purpose pulse circuitry. Pulse widths 100 millimicroseconds to 1 second. Rise time $< 10$ millimicroseconds. Pulse amplitude: 50 volts.	203 series	Constant Impedance Micromicroammeter	Constant impedance instrument for automatically measuring very low currents. Measures transistor $I_{c0}$ , diode back current, capacitor leakage current. Fast response time, even with large overloads. Provisions for remote control.
140	Transistor Rise, Storage, and Fall Time Meter	Semi-automatic measurement of rise, storage and fall time of NPN and PNP transistors. 10 millimicroseconds to 10 microseconds full scale, each channel. Readout time: less than 50 milliseconds. Linearity: $\pm 7\%$ , $\pm 5$ millimicroseconds.	213	Microvoltmeter	Measures potentials below 1 microvolt. Response time $< 50$ milliseconds. Chopper stabilized; ultra-low drift. Accuracy: 3% of full scale.
161	Binary	50 Mc scale of 2 unit. Element for fast pulse systems. Extends ranges of present cycle counters.	215 series	Multimeter • Millivoltmeter • Micromicroammeter • Megmegohmmeter • Current Integrator	Basically a very stable millivoltmeter, the EH 215 series offers easy conversion to micromicroammeter, megmegohmmeter, and current integrator. As millivoltmeter, range is 10 millivolts to 10 volts full scale with fast response. Measures current to $< 10^{-14}$ ampere. Measures resistance to $> 10^{16}$ ohms. Measures integrated current $< 10^{-13}$ coulomb.
301B	Analytical Balance	Automatic analytical balance. Measurement time: 1 second. Accuracy: 0.2%. Range: 1 milligram to 200 grams.	401	Microwave Signal Generator	Precision microwave signal generator for frequencies from 500 to 11,000 megacycles. Readout to 7 significant figures. 1 watt power output, 1 to 11 kMc. Extremely stable 1 part in $10^7$ short term.

EH Model Number	Item	Description
ZT	Pulse Transformer	Impedance matching pulse transformer for pulse inversion or straight reproduction. Features 0.5 millimicrosecond rise time. For various impedances and connector matching. Extremely compact small size.



Model 120B



Model 201C

EH instruments are designed and manufactured to the high quality standards necessary for the most advanced work. All over the world, these superb instruments are making important contributions at research and testing centers.

Write or wire EH for additional information. Our staff is ready to assist you.



**EH RESEARCH LABORATORIES, INC.**  
1922 PARK BLVD. • GLENCOURT 2-1314 • OAKLAND 6, CALIFORNIA

CIRCLE 288 ON READER-SERVICE CARD

## NEWS



Portable version of CADF direction-finding system functions in both vhf and uhf. Roof of shelter is part of uhf counterpoise.

### Key Features Listed

But the design details show that:

- All-electronic means are used to switch the antenna into the receivers for sampling.
- A 180-degree linear-phase detector rather than an fm discriminator is used.
- Stages of a second receiver are included to pick up a reference signal from a fixed antenna.

The direction finder is designed for a wide variety of signals and propagation conditions in the bands between 1 and 400 mc. Antennas are available for it in arrays of 12, 18 or 24 elements. The antenna in the block diagram above is a combination of uhf counterpoise, 18 uhf unipoles and 18 vhf dipoles.

The cathode-ray tube display is capable of handling two bearings simultaneously: a solid radial line can represent a trace of a vhf signal, a dotted trace can represent a uhf signal.

The 1-kc master oscillator controls electronic switching of the antennas by triggering sharp pulses to a ring counter, consisting of three pulse-generator units in cascade.

Interaction from antennas not in use is minimized by diodes that break up the antennas' electrical length. A single switch-box, mounted midway up the mast (see photo) switches all the antennas.

Phase resolving is also all-electronic. A novel multiplier circuit provides wide-band bearing information by converting the phase modulation to a low-frequency amplitude waveform and comparing its phase with that of a reference waveform.

### Extra Channel Speeds Processing

The second-receiver stages provide another receiving channel, which is used to transfer bearing information to a constant-frequency, crystal-controlled carrier. This extra channel makes further signal processing easier, eliminates automatic frequency control and improves the handling of short signal transmissions down to 50 milliseconds.

Twin-receiver technique also makes possible the low 3600 rpm commutation rate without restriction of selectivity.

In the entire CADF, there are no mechanically operated parts. ■ ■

### Etched Reticle Offered For Video Pick-Up Tubes

A reticle in a cathode-ray pick-up tube—described as the first such for television—is being produced. The maker, Grimson Color, Inc., of New York, says the reticle lines are etched on the vidicon face plate and are therefore in the exact focal plane. They are transmitted simultaneously with the televised scene, appearing superimposed in correct relationship to the subject shown on the monitor.

### Tiny Transmitter to Guide Mower

Available in Britain next year will be a radio-controlled power lawn mower. The unit will be guided by a twin-switch miniature transmitter and a multi-stage receiver with integral relays. Audio frequencies imposed on a 27 mc carrier will actuate the receiver.

### AEC Asks Atomic User Reports

The Atomic Energy Commission has issued for public comment a proposal that would require semi-annual reports from licensed users of special fissionable materials.

These materials are uranium 233 and 235 and plutonium. Reports would include data on receipts, transfers and inventories of the materials. Written comment must be submitted to the AEC by Oct. 6.

CIRCLE 289 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

#### 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.

*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*

A DIVISION OF

**CLEVITE**

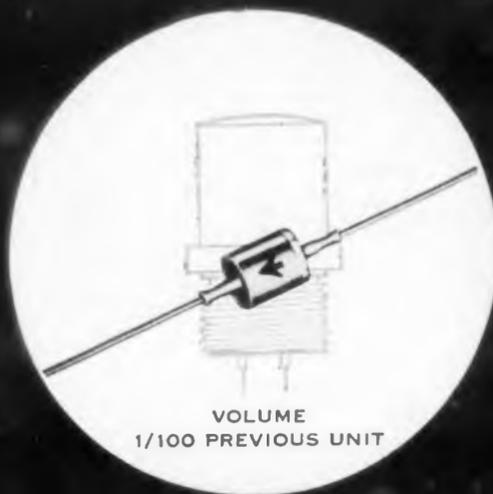
**CLEVITE**  
**TRANSISTOR PRODUCTS**  
241 CRESCENT ST., WALTHAM 54, MASS.  
Twinbrook 4-9330

# THE SYMBOL OF ACCURACY!

VOLTAGE  
REGULATING  
DIODE

TEMPERATURE COMPENSATED 1N2.53 1N2.71A SERIES

US SEMCOR



$T_c \leq .0005\% \text{ PER } ^\circ\text{C FROM } -55^\circ\text{C TO } +185^\circ\text{C}$

This tiny Reference Element is the outstandingly successful . . . most-in-demand . . . diode produced by U. S. SEMCOR! It has become a new symbol of reliable accuracy, comparable to the navigator's North Star. Wherever superior voltage regulation is required . . . in computers, measuring instruments, controls . . . U. S. SEMCOR's tiny voltage regulating diode provides unmatched accuracy, high performance, and complete reliability through repeated temperature cycling . . . at low cost, in the smallest package yet!

$T_c \leq .0005\% \text{ per } ^\circ\text{C, from } -55^\circ\text{C to } +185^\circ\text{C}$  . . . a range 35° higher than others ■ Rating: 9.0 to 9.8 volts at 10 ma, or 9.2 to 9.6 volts ■ Zener Impedance: 15 ohms ■ Not position-sensitive ■ Triple diffused silicon wafer ■ Stainless steel case ■ .250" diameter x .290" long ■ Ends hermetically welded and glass-sealed ■ Crimped and welded nickel leads ■ Axial leads for automatic machine insertion.

ASK for New Catalog . . . or, for a call from our nearest Field Engineering Representative, write or wire collect to Sales Engineering Department.



**U. S. SEMICONDUCTOR PRODUCTS**  
3540 West Osborn Road • Phoenix, Arizona • BRowning 2-1341

A Division of  
**TOPP**  
Industries, Inc.



CIRCLE 290 ON READER-SERVICE CARD

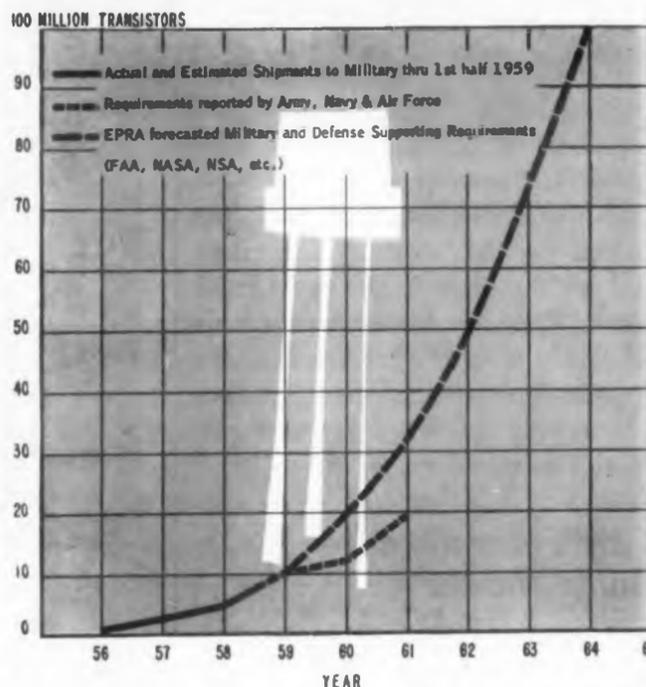
## NEWS

### New Mobile Radio Antenna Patent

Antenna authority Ira Kamen of General Bronze Corp. has developed a concealed antenna that eliminates protruding aerials from autos.

The patent was awarded for a "unique configuration of magnetic materials in the proximity of an electrostatic component." The magnetic material is a ferrite. The configuration produces an omnidirectional high gain with low noise, according to the inventor. The antenna is designed for frequencies below 5 mc.

### Military to Need 100 Million Transistors by 1965



A five-year rise in military needs for transistors should bring a 1965 requirement for 100 million units, according to estimates made by the Electronic Production Resources Agency of the Department of Defense. EPRA's forecast ties in with that of the Electronic Industries Association for the total 1965 transistor market, which EIA predicted would grow 10 times larger in the next five years and be valued at \$1 billion. Of the 565 types represented in EPRA's data, 32 account for about 80 per cent of the total military requirement. Roughly half of the transistors included in this estimate are for equipment currently in pre-production or R & D. The seven most significant types for the next 30 months as measured by specific military requirements are: 2N396, L5129, 2N501, 2N559, 2N1135, 2N1103, and 2N1104. Four of these have not been announced as commercially available; L5129 and 2N1135, both Philco, and 2N1103 and 2N1104, both reported to be Texas Instruments, Inc. types.

## Study Contract Let for Sky Ship



Sky station, scheduled for study by Raytheon under Air Force contract, will be powered by microwaves beamed from earth. (See ED of June 10, 1959, p 3.) Microwaves picked up by craft's antenna and fed through waveguides to a heating element could develop the 1000 rotor hp necessary to keep the platform aloft. Raytheon also calculates that over-all efficiency of 9.6 per cent would require generation of about 10,000 hp of microwave energy. This power would mean an electrical generating capacity of about 20,000 hp—the amount developed by a DC-8 airliner. Raytheon reports tubes are now available that generate 20 hp at 3,000 mc, that 100-hp tubes will be available in two years, and that 500-hp tubes can be expected after three years of development.

## U. S. Offers Technical Papers And Soviet Journal Abstracts

Among the latest publications available from the Office of Technical Services (Dept. of Commerce, Washington 25, D. C.) are these:

■ "A Multi-field Electronic Tachistoscope," PB 151689.

■ "An Image Orthicon with Narrow Range of Electron Energy in the Scanning Beam," PB 151589.

■ "A Military Color Television System," PB 151586.

■ "English Abstracts of Russian Technical Journals," which lists some 100 technical journals that are summarized regularly.

Some of the Soviet publications of particular interest to electronic designers are *Automation, Automatics and Telemechanics, Electricity, Electrical Communications, Radio Engineering, Radio Engineering and Electronics, Herald of the Electrical Industry, Measurement Techniques, and Instruments and Experimental Techniques.*

# POWER

handling capacity  
of the new  
Westinghouse  
Silicon



transistor!

**Greater than 99% efficiency** when used to handle 1.5 kw of power in a low-frequency DC switch! Power loss is only 10-15 watts when handling 1.5 kw. That's just one of the impressive specifications established by a remarkable new semiconductor device—the Westinghouse Silicon Power Transistor.

This Power Transistor is remarkable in other ways, too . . .

● It is the first power transistor available in voltage ranges above 100 volts.

● It has power dissipation capability of 150 watts made possible by the low thermal resistance of  $.7^{\circ}\text{C}/\text{watt}$ .

● It can operate at higher temperatures than germanium ( $150^{\circ}\text{C}$ ., compared to  $85^{\circ}\text{C}$ ).

● It has astonishingly low saturation resistance—less than .5 ohms at 5 amperes and .75 ohms at 2 amperes, an achievement made possible through extensive research and development of hyper-pure Siemens-Westinghouse Silicon.

● It is 100% power-tested under actual maximum rated specifications before leaving the plant.

● It is encapsulated in a rugged, all-welded case.

#### HERE ARE A FEW OF THE APPLICATIONS . . .

● Inverters and converters ● Data processing circuits ● Servo output circuits ● Series regulated power supplies ● As a low frequency switch ● In class A amplifiers.

Available in 2 and 5 ampere collector ratings in production quantities now. For complete specifications and details, contact your local Westinghouse representative.

**YOU CAN BE SURE...IF IT'S** **Westinghouse**

Westinghouse Electric Corporation, Semiconductor Department Youngwood, Pa.

CIRCLE 291 ON READER-SERVICE CARD

## NEWS

### Explorer VI Satellite Loaded With New Communication Gear

The 142-pound Explorer VI satellite, now transmitting data to earth from a peak distance of 25,000 miles, carries in addition to a novel paddle-wheel array of solar cells a dense load of advanced equipment for space-communication research.

Miniaturized by American scientists into the 26-inch-diameter moon are:

- A television scanner weighing two and a half pounds, designed to pass a rudimentary picture, dot by dot, to a counter. The dots are formed into lines and frames after transmission. The device gives a rough, snowy picture of the earth and its cloud cover.

- A "teletbit" system for gathering, storing and calculating data to be telemetered. Developed by Space Technology Labs, this system collects and

While the attention of most designers was focused on the Explorer VI communication satellite, another rocket, Discoverer V, was polar-orbited. Planned recovery of Discoverer's instrument package was not successful, however. But the perfect launching marked a big step forward for the lagging Discoverer program.

Within a fortnight, Discoverer VI was orbited. But as this page went to press, recovery of its instrument capsule seemed improbable, too, because of apparent failure of a radio beacon.

tallies data while the satellite's transmitters are inoperative, then automatically releases the information to the transmitter at predetermined times, thereby saving telemetering power.

- A new memory technique for the satellite's command system. This system made installation of a tape recorder unnecessary.

- A coil-operated temperature control. In this device a heat-sensitive coil rotates a heat-reflecting, stubby propeller over a black patch on the vehicle's surface. When temperature drops in the satellite's interior, the coil relaxes and rotates the propeller, exposing the heat-absorbing black patch.

Other equipment includes two receivers—one for command signals, the other for 15.5-kc signals being transmitted to test dispersion of vlf waves by the ionosphere—and three transmitters—two for low-power telemetering on 108.06 and 108.09 mc, and one high-powered, primary transmitter operating in a classified uhf band. The high-powered transmitter draws 40 watts and is cycled



**ST 73K BULOVA**

**CRYSTALS**  
Available for any frequency from 1 KC thru 100 mc to meet and exceed all military specifications.

**CRYSTAL FILTERS**  
Center frequencies from 10 KC thru 20 mc, band widths of 0.1% to 8% of center frequency.

**OVENS**  
Complete from multi-purpose AM 100 to the specific BHC series, temperature stabilization to 1 C.

**PACKAGED OSCILLATORS**  
30 cps thru 70 mc frequencies available as tube type or transistorized oscillators.

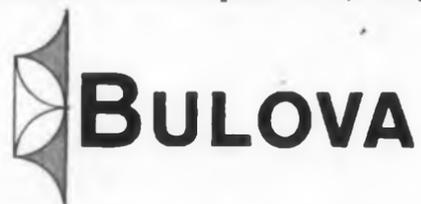
# BULOVA

## NUMBER ONE SOURCE in frequency control—components and systems

Today, an increasing number of electronic systems demand a degree of reliability heretofore unobtainable. That is why more and more manufacturers are specifying Bulova.

Bulova crystals, filters, ovens, packaged oscillators, and Bulova frequency control systems, custom-designed for either limited or mass production, meet and exceed military and industrial specifications.

Bulova's experience in mastering many of the most difficult problems involving component and system reliability has made it the *number one source* for frequency control devices. This experience can prove of immense value in your particular program. For more information write Dept. A-1183, today.



ELECTRONICS DIVISION • WOODSIDE 77, NEW YORK  
CIRCLE 292 ON READER-SERVICE CARD

to operate only one and a half hours in every six. Also carried by the satellite are three radiation-measuring devices for gaging energy of atomic particles in the Van Allen Radiation Belts, two magnetometers to map the earth's magnetic field, and a micrometeorite counter that uses microphones to transduce hits into signals.

The paddle-wheel array of silicon solar cells charges the satellite's chemical batteries. Each of the 210 modules, housing a total of 21,000 cells, develops three-quarters of a watt of electricity under direct sunlight.

The paddle wheels were folded against the satellite's sides during launching and were sprung into position in space. The same system will be used in future satellites if the present equipment proves satisfactory.

Altogether 15 major experiments are under way in Explorer VI. The satellite is designed for a lifetime of one year.

### Silicon-Carbide Emission Studied for Solid-State Tube

Westinghouse is developing a tube that gets its electron supply from a crystal of silicon carbide acting as an emitter.

The level of emission in the tube ranges up to one microampere, equal to that of a typical vacuum-tube cathode.

According to Westinghouse researchers, the instant, steady emission from a silicon-carbide crystal in an electron tube should simplify beam focusing and eliminate much complicated tube construction. Power requirements and heat generation should also be greatly reduced in a device combining the advantages of solid-state and vacuum-tube units.

So far, the company's investigators say, silicon carbide has proved to be the only semiconductor material that exhibits steady electron flow at densities usable in tubes.



Experimental Westinghouse tube, with pinhead-size silicon-carbide crystal for emitter, could be forerunner of semiconductor electron tubes.

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



Only the  
**WESTON  
VAMISTOR®**  
offers performance like this!

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

- **VAMISTOR HANDLES HIGHER WATTAGES.** Up to 8 full watts at 40 C for Model 9849-2.
- **VAMISTOR OFFERS HIGHEST RESISTANCE RANGES.** For example, 1.5 megohms in ¼-watt size . . . 5 megohms, ½-watt.
- **VAMISTOR HAS OUTSTANDING THERMAL CHARACTERISTICS.** Runs cooler . . . resists thermal shock. Standard temperature coefficient doesn't exceed 50 ppm/°C.—lower than Nichrome wire. Also available with maximum of 25 ppm/°C. Temperature coefficients don't vary over the resistance range.
- **VAMISTOR OFFERS UNUSUALLY LONG SHELF LIFE, STABILITY.** Exclusive process of fusing element to inside of steatite tube assures long life, improved resistance to all environmental conditions.
- **VAMISTOR IS MORE RELIABLE; HAS GREATER MEAN-TIME-TO-FAILURE.**
- **VAMISTOR PRODUCES NO CORONA; IS AS NOISE-FREE AS BEST WIRE-WOUND RESISTORS.**
- **VAMISTOR OFFERS EXCEPTIONAL PERFORMANCE UNDER RADIATION.**
- **VAMISTOR ACCOMMODATES HIGHER MAXIMUM CONTINUOUS WORKING VOLTAGES.**
- **VAMISTOR IS VIRTUALLY NON-INDUCTIVE.** Capacitance characteristics are superior to all other existing resistors.
- **VAMISTOR IS SUBJECTED TO STRICTER QUALITY CONTROL THAN ANY OTHER RESISTORS.**
- **THE VAMISTOR LINE CONFORMS TO MIL-R 10509C CHAR. C. Styles RN-65, RN-70, RN-75 and RN-80.**

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

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

# WESTON

*Instrument*



WORLD LEADER IN MEASUREMENT AND CONTROL

CIRCLE 293 ON READER-SERVICE CARD

# NEW MICROWAVE LIMITER

*protects receivers  
against overload  
and burnout*

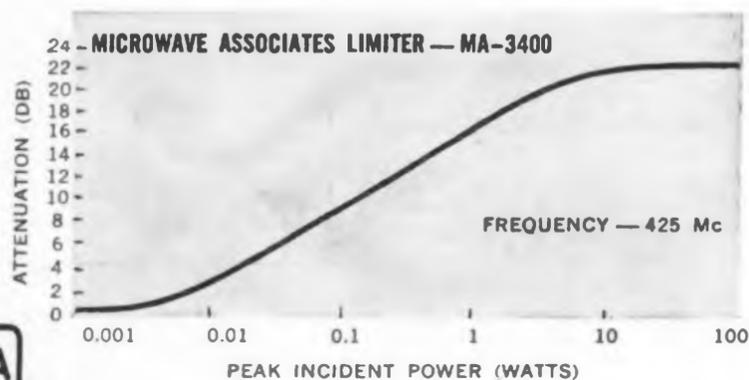
Another unique "first" from Microwave Associates, Inc., is this family of all-new solid state devices, which require no external bias and are self-limiting devices. It is the simplest way yet to give radar and communication receivers needed protection.

The specifications chart and performance curve below tell you all you need to know to evaluate its capabilities. The two models are typical of units which can be designed for your applications at other frequencies. The package has female Type N coaxial connectors, for input and output.

Today for UHF . . . tomorrow for higher frequencies.

## SPECIFICATIONS

	MA-3400	MA-3401
Frequency (center)	425 $\pm$ 5%	600 $\pm$ 5%
Low Level Insertion Loss	0.3 db	0.5 db
Peak Power	400 watts	200 watts
Duty Cycle	.002	.002
High Level Insertion Loss	20 db	20 db



**MICROWAVE ASSOCIATES, INC.**

BURLINGTON, MASSACHUSETTS • Telephone: BRowing 2-3000

CIRCLE 294 ON READER-SERVICE CARD

## NEWS

# Major Design Advances Revealed at WESCON



"Flameless fusion," part of ITT method for combining rust and other oxides into near-flawless ferrite monocrystals.

New developments in electronics—some with far-reaching effects on the future of designing—took the spotlight for the first time at the 1959 Western Electronics Show and Convention in San Francisco.

Demonstrations of major advances in designing included:

- An International Telephone and Telegraph Corp. technique for producing nearly perfect ferrite crystals from ferric oxide, a form of common rust, and other oxides.

- A compensated avalanche diode developed by Shockley Transistor Corp., a division of Beckman Instruments, Inc., of Palo Alto, Calif.

- A 50-cent general-purpose germanium transistor of Texas Instruments.

Among the newer products available were deposited-carbon resistors made by the International Resistance Co. of

Philadelphia and paramistors built by TDK Electronics Co., Ltd., of Tokyo (see ED, Aug. 19, 1959).

WESCON drew some 30,000 representatives of the electronics industry to its sessions Aug. 18 to 21 in the Cow Palace. They viewed nearly 1000 exhibits by more than 800 companies.

"Firsts" of the show included a design competition, in which 18 outstanding products were chosen for display from 140 that competed, and a panel of 29 specialists, who commented on papers presented at 42 technical sessions. (Editor's Note: Highlights of technical papers and panel sessions will be covered in a forthcoming issue of ELECTRONIC DESIGN.)

Exhibition space, displaying a total of \$20 million worth of equipment, was sold out, the show's manager, Don Larson, reported.



Dr. William Shockley (left), president of Shockley Transistor Corp., discusses merits of compensated avalanche diode with its principal developer, Dr. G. Smoot Horsley, assistant director of the corporation. Three-layer diode is said to allow simultaneous reduction of noise, temperature coefficient and dynamic resistance.

## ... And Youth Joins Show



Youth, too, was represented at WESCON this year. Thirty-seven students competed for scholarships in a Future Engineers Show, and their exhibits drew favorable comment. The prospective engineers demonstrated a variety of electronic and scientific equipment that they designed and built. Typical were, above, an accelerometer by John Frank of Reseda (Calif.) High School and, below, an atomic particle precipiton chamber, constructed by Douglas Smith (left) and Lewis Hamilton, both of Petaluma (Calif.) High School.



## New Precision in Stereo Control

We have developed a new approach to a one-knob control for dual stereo amplifiers. It gives far greater precision of match and track than you may have thought possible. On typical systems we have developed control packages based on a db or voltage conception which deliver matching and tracking coinciding in volts throughout the useable range of the control.

This is equivalent to approximately 5% resistance match and track. In contrast, "standard" 20% tolerance controls when ganged may be 40% out of track between match points, while the matching and tracking of the Mallory units is tailored to the individual requirements.

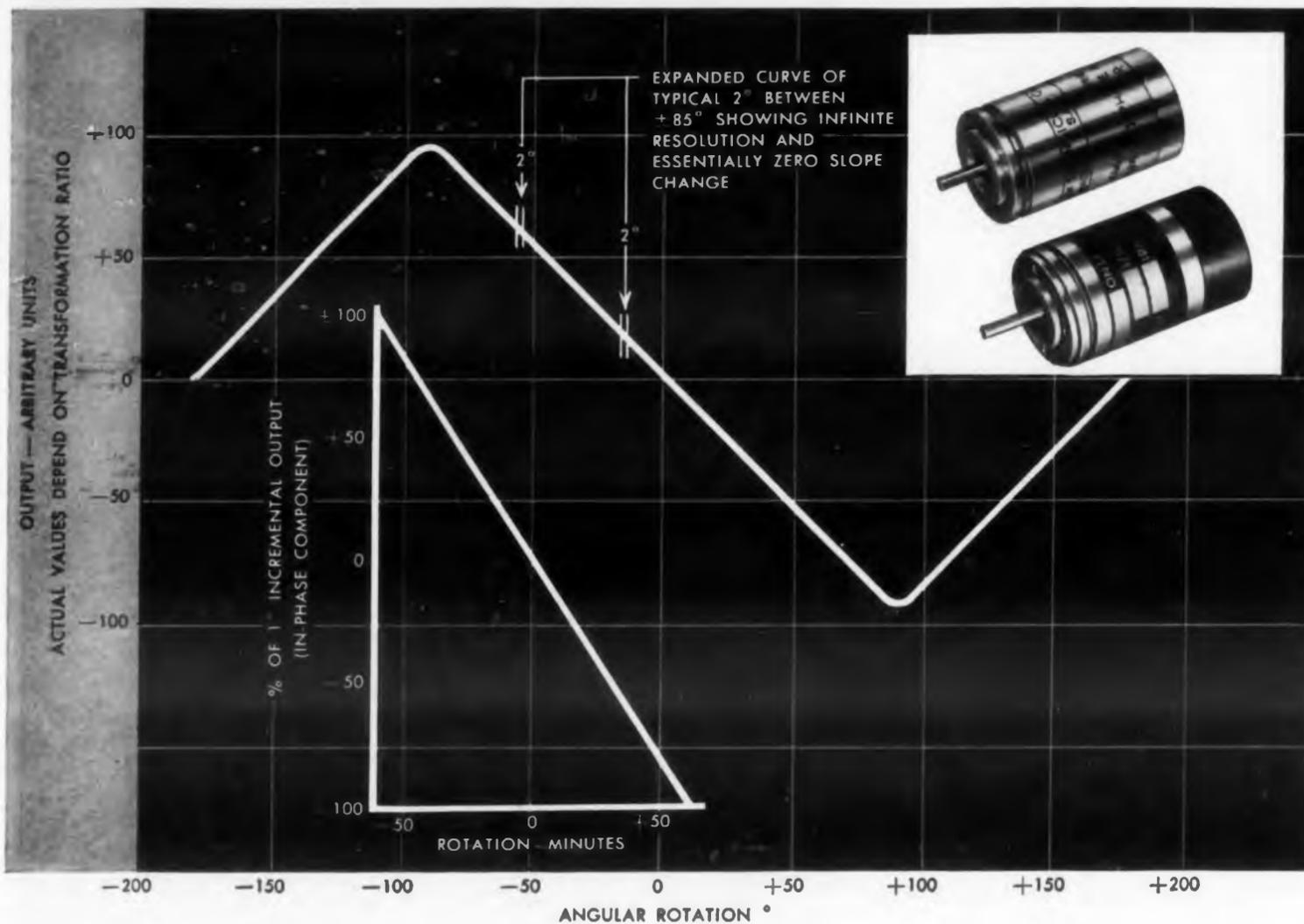
We welcome the opportunity to discuss this new idea . . . to engineer a control package for your system . . . to develop new match and track specifications with you.

P. R. MALLORY & CO. Inc.  
**MALLORY**

Mallory Controls Company  
Frankfort, Indiana



CIRCLE 295 ON READER-SERVICE CARD



## Inductive pots give accurate noiseless output with infinite resolution

Weapons systems... analog computers... proportioning circuits—wherever the limitations of wirewound potentiometers can not be tolerated, these precision linear pots are the answer.

The Daystrom Transicoil Size 8 and 11 Inductive Pots provide extreme angular accuracy for applications requiring linear output and high gain amplification. There are no brushes wiping over turns of resistance wire to generate noise. Grounding problems are eliminated since each phase is electrically insulated from the other. When operated into the correct load, output is linear to within  $\pm 0.25\%$  over the  $170^\circ$  ( $\pm 85^\circ$  from null) operating range. Output phase is dependent on direction of shaft displacement from null.

Write for complete specifications. Daystrom Transicoil, Division of Daystrom, Inc., Worcester, Montgomery

County, Penna. Phone: JUNO 4-2421. In Canada: Daystrom, Ltd., 840 Caledonia Rd., Toronto 19, Ontario. Foreign: Daystrom International Division, 100 Empire Street, Newark 12, New Jersey.

TYPICAL CHARACTERISTICS

	Size 8		Size 11		
	26	26	26	26	115
Excitation	Power (watts)	.16	.16	.15	.15
	Current (ma)	27	27	30	30
	Frequency (cps)	400	400	400	400
Sensitivity (v/°)	.107	.346	.107	.346	.620
Null Volts (mv)	7	20	7	20	40
Transformation Ratio	.350	1.130	.350	1.130	.458

**DAYSTROM TRANSICOIL** DIVISION OF DAYSTROM, INC.  
Representatives in Canada and Other Foreign Countries

CIRCLE 296 ON READER-SERVICE CARD

## WASHINGTON REPORT



Ephraim Kahn

### AF to Buy Electron Tubes for 3 Military Services

Electron tubes for common use by the three military services will soon be bought by the Air Force as the purchasing agent for all. This action was ordered by the Pentagon after industry protests had failed to convince military officials that procurement by individual services was preferable to unified buying.

The impact of this decision, which probably will not be completely translated into action before next March, is going to be important for electron-tube makers. In fiscal 1959, which ended last June 30, the military bought about \$48 million worth of tubes of types used by all services. The Air Force accounted for \$26 million, with the Army and Navy splitting the remainder.

Of the approximately 3,300 types of electron tubes in military use, logistics experts have found about 1,100 suitable for common use by the services. They will be bought by the Air Force under the single-service procurement.

Plans call for buying electron tubes both by negotiation and by advertised competitive bidding. Negotiated purchases are supposed to be held to a minimum. They will be made only when the tubes are of types put out by only one or two manufacturers. When there is a wide choice of suppliers, competitive bidding will be the rule.

The Defense Department plans to keep a sharp eye on the Air Force's administration of the new plan, so that necessary changes can be made to smooth over possible irritations to the Army and Navy.

One consequence of single-service procurement is likely to be bigger single orders. This means, of course, that loss of a bid may hurt an electronic company more than it has in the past. It seems clear that bidders will have to compute their estimates quite sharply to stay in the running.

### Weapons Buying Attacked Again

Another sharp attack has been leveled by the Senate Small Business Committee at the weapons system method of defense buying. A report made

by the committee on "Small Business Participation in Defense Contracting" repeats a number of charges made before the government procurement subcommittee.

Senator George Smathers, chairman of the subcommittee, has already introduced legislation designed "to break the monopoly of military defense dollars by large prime contractors." The odds are that no action on this measure will be taken by Congress. But the attacks have already led to numerous changes in subcontracting rules by the military, and there may be more to come.

The committee's report says, for example, that "the declared small-business policy of the Congress is not being adequately implemented by present procurement regulations" and that the military's present subcontracting regulations "fail to insure to small business a fair proportion of defense subcontracts."

### Company 'Pirating' Charged

The report also notes that the "one most serious charge that ran like a thread through the testimony of the small-business witnesses" was that large, prime contractors were "pirating" the technical information, engineering know-how and design ingenuity of small companies. The committee also observed that big companies were building up their own facilities with the help of government-furnished equipment and then reducing the amount of subcontracted work as they produced more and more in their own plants.

The report states that "weapon system contracting, in the absence of firm subcontracting laws and regulations, will continue to contribute to an unhealthy concentration in the defense industry."

Remedial steps proposed include:

- Strengthening of subcontracting provisions of the Armed Services Procurement Regulation to make the regulation conform, in general, to the Air Force's subcontracting program. The Air Force program calls for government approval whenever prime contractors decide to make any component they have once subcontracted.

- Formation of a "break-out" committee for each large weapon-system contract to survey the pact and to recommend direct purchase by the government of components, under open competition.

- Greater emphasis on purchase of weapon system components directly by the military services rather than including all of them in all-embracing package contracts.

- Limitation of profits to prime contractors for work they have subcontracted to other concerns. Profits would be based upon consideration of the extent to which the prime contractor directly contributed to the performance of the subcontracts.

after routing,  
clip and save

a continuing series on technical topics  
of specific interest to engineers

Folio 59-6

REFERENCE  
DATA FILE



## the significance of envelope delay in communication networks ...

The design of electronic wave filters is an exact science requiring painstaking attention to even the most minute detail. Of no less importance is the preparation of filter performance specifications. The transmission of pulsed sinusoids, steep-front modulation envelopes and other complex wave forms in modern telemetry, speech and facsimile systems has made the preparation of adequate component specifications an absolute necessity. The omission of a single required performance detail can lead to serious malfunctioning of the component in the completed system.

Envelope delay is one of the important characteristics in filter applications requiring minimum distortion of the transmitted signal. The systems engineer must give proper attention to this requirement. Mathematically, envelope delay may be defined as:

$$T_d = - \frac{d\beta}{d\omega}$$

Where:  $T_d$  = envelope delay in seconds  
 $\beta$  = phase shift in radians  
 $\omega$  = angular frequency in radians per second

To hold distortion to a minimum, the envelope delay must be nearly constant over the entire frequency spectrum of the transmitted signal. It is the constancy of envelope delay rather than the actual magnitude of the delay which governs a network's ability to transmit a complex wave form without introducing objectionable distortion. The distortion arising from non-constant envelope delay is termed envelope delay distortion. From the above equation it is apparent that  $T_d$  is constant as long as phase shift varies linearly with frequency. Unfortunately, the realization of a filter network with perfectly linear phase shift over its entire pass band is not always practical or even possible. For this reason, the systems engineer should carefully evaluate the degree of constancy of  $T_d$  which his system requires as well as the range of frequencies over which  $T_d$  must be maintained nearly constant.

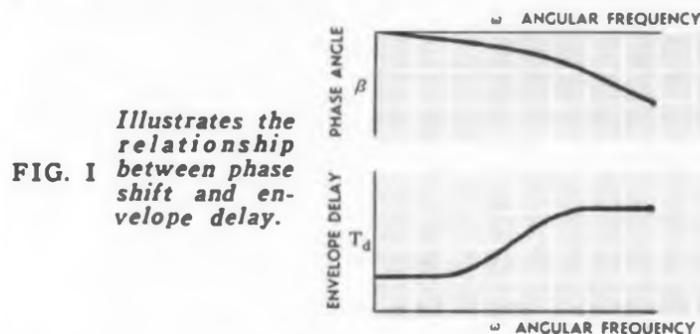
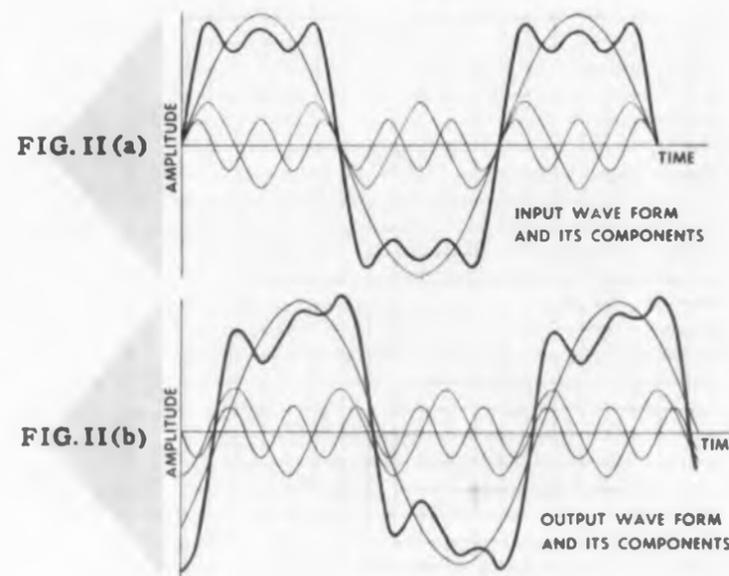


FIG. 1  
Illustrates the relationship between phase shift and envelope delay.

The effect of envelope delay distortion on a transmitted signal is illustrated in figure 2. Figure 2 (a) shows the input signal. It is composed of a fundamental frequency plus the third and fifth harmonics. Figure 2 (b) shows the output signal. The network has shifted the fundamental frequency by 45°, the third harmonic by 90° and the fifth harmonic by 180°. The net result of such non-linear phase shift is a highly distorted output signal. If components of the wave had been shifted 45°, 135° and 225° respectively, the signal would have been transmitted without distortion.



Since envelope delay is defined as the derivative of phase with respect to frequency, exact measurement of envelope delay is difficult. In practice, however, envelope delay may be approximated by the following definition:

$$T_{\Delta d} = - \left( \frac{\theta_2 - \theta_1}{f_2 - f_1} \right) \frac{1}{360}$$

Where:  $\theta_2$  = phase angle in degrees at  $f_2$   
 $\theta_1$  = phase angle in degrees at  $f_1$   
 $f_2$  = frequency in cycles per second at which phase shift equals  $\theta_2$   
 $f_1$  = frequency in cycles per second at which phase shift equals  $\theta_1$

$T_{\Delta d}$  is the average envelope delay between  $f_2$  and  $f_1$ . By convention,  $T_{\Delta d}$  is assumed to be the envelope delay at a frequency equal to  $\frac{1}{2}(f_1 + f_2)$ . When the approximate formula is used to calculate envelope delay from empirical phase shift versus frequency data, it should be remembered that the approximation holds only for small differences between  $f_1$  and  $f_2$ .



The IBM "650" computer services maintained at Sangamo materially aid our design engineers in solving complicated networks for envelope delay, phase shift and attenuation characteristics.

Write for Inductive Component Bulletin Series IC-260

SC-59-7

SANGAMO ELECTRIC COMPANY, Springfield, Illinois

--designing towards the promise of tomorrow

CIRCLE 297 ON READER-SERVICE CARD



...a world of ideas... that work



## **BOEING NEEDED SPECIALTY ENGINEERING... AND GOT IT...FROM BORG**

### A FEW BORG DEVELOPMENTS

FREQUENCY STANDARDS

AIRCRAFT INSTRUMENTS

PRECISION POTENTIOMETERS

MULTI-TURN COUNTING DIALS

FRACTIONAL H. P. MOTORS

Boeing Airplane Co. needed special potentiometers for the guidance systems of their deadly Bomarc surface-to-air missiles. The necessary potentiometers had to withstand severe vibration and shock and still retain uncanny accuracy within extreme tolerances. The solution to this difficult reliability problem? The design, development and production facilities of the Borg Equipment Division of the Amphenol-Borg Electronics Corporation. The result? Specially designed potentiometers exceeding all required specifications. Many industry leaders have found that they can depend on Borg engineering skill and cooperation. Call on Borg when you are faced with difficult design, development or production problems. Chances are you'll save a good deal of time and money and find it makes good sense to call on Borg. Write for our new facilities brochure.



**BORG EQUIPMENT DIVISION**  
AMPHENOL-BORG ELECTRONICS CORPORATION  
JANESVILLE, WISCONSIN

CIRCLE 298 ON READER-SERVICE CARD

# MEETINGS

## Calendar of Events

### September

- 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 Telemetering IRE, Civic Auditorium and Whitcomb Hotel, San Francisco, Calif.

### October

- 30-1 Industrial Electronics Symposium, Mellon Institute, IRE, AIEE, Pittsburgh, Pa.
- \* Includes meetings described herewith.
- 5-7 Fifth National Communications Symposium, IRE Professional Group on Communications System, Hotel Utica, Utica, N. Y.
  - 5-9 Eleventh Annual Convention and Professional Equipment Exhibit, Audio Engineering Society, Hotel New Yorker, N. Y.
  - 6-7 Value Engineering Symposium, EIA, University of Pennsylvania, Pa.
  - 6-8 Fifth Conference on Radio Interference Reduction, U. S. Army Signal Research and Development Labs. in cooperation with the IRE Professional Group on Radio Frequency Interference, Chicago, Ill.\*

### 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: "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.

#### 14th Annual ISA Conference and Exhibit, September 20-25

Chicago will be the scene of this "Instrumentation Show" sponsored by the Instrument Society of America. Arrangements are being made for from five to seven presentations from abroad. Plans for the program include: (1) emphasis on the use of computers in process control and in sizing control valves as well as sessions on data handling and feedback control systems, (2) sessions on photo instrumentation, (3) action to help alleviate the shortage of instrument men and other technicians. The exhibit will be held in the Chicago amphitheater, while technical sessions of the conference will take place in downtown hotels. Henry C. Frost, 313 Sixth Ave., Pittsburgh, Pa., is president of the ISA.

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

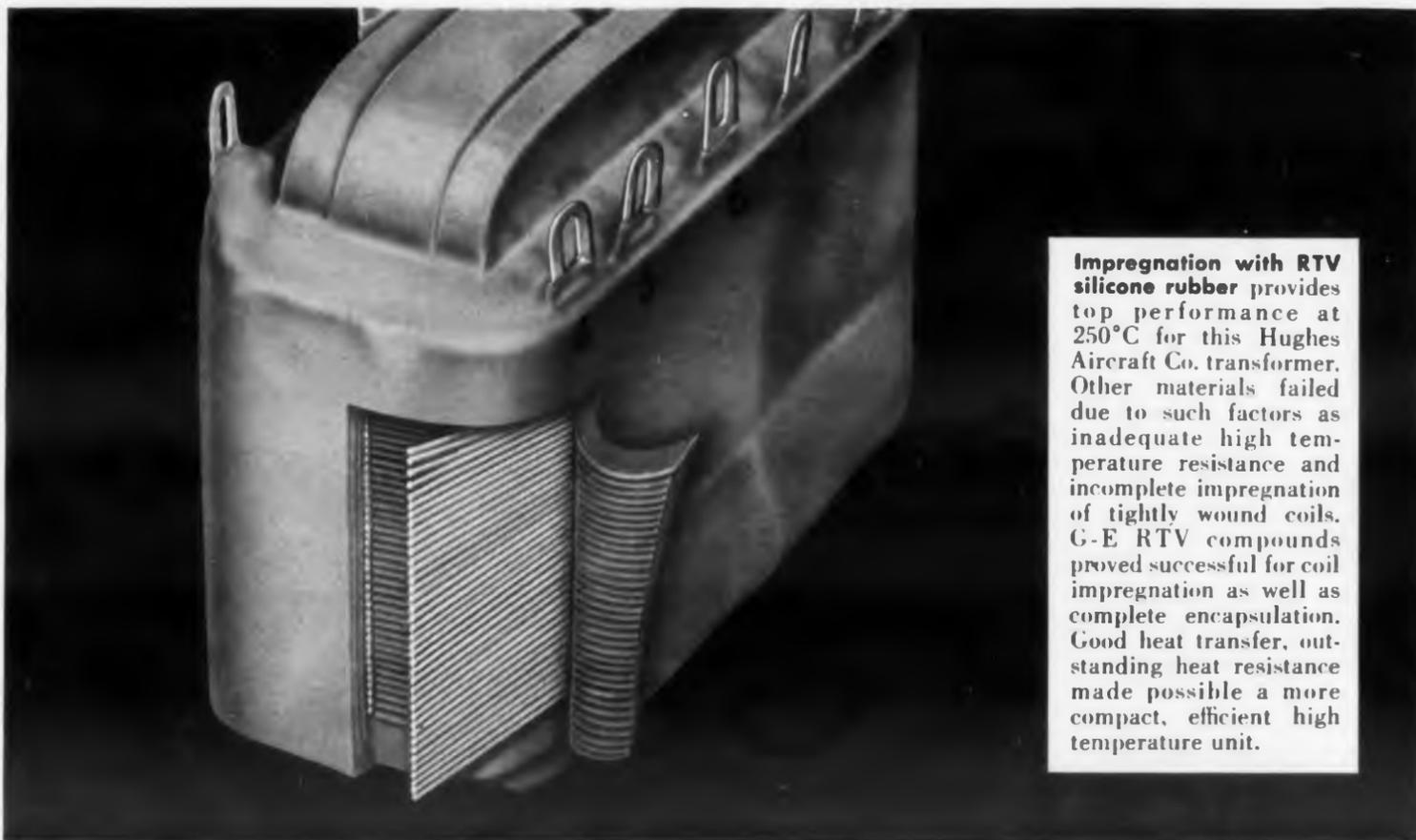
To be sponsored by the AIEE and IRE and will be held at the Shoreham Hotel, Washington, D.C. The technical program will consist of sessions devoted to the theory, design, and application of: (1) magnetic amplifiers and similar saturating core devices, (2) magnetic amplifiers and semiconductor devices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

#### 5th Conference on Radio Interference Reduction, October 6-8

The U. S. Army Signal Research and Development Labs will sponsor this conference in cooperation with the IRE Professional Group on Radio Frequency Interference. A feature of this year's conference will be a one-day session at which classified papers will be presented. Conference chairman is S. I. Cohn of the Armour Research Foundation, 10 W. 35 St., Chicago 16, Ill.

### 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.*



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

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

*Outstanding heat resistance and electrical properties combined with room temperature cure*



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



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



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

For application data and samples of General Electric RTV silicone rubber, write General Electric Company, Silicone Products Department, Section L108, Waterford, New York

# GENERAL ELECTRIC

Silicone Products Department, Waterford, New York  
CIRCLE 299 ON READER-SERVICE CARD

A unique combination of engineering and scientific skills, coupled with production ability... plus more than two decades of continuous development and production of newer and better airborne instruments — over 400,000 reliable guidance controls delivered — these are the reasons why Whittaker Gyro instruments are operational on many of the nation's major missile programs. From a simple gyro to complete stabilizing systems... Whittaker can provide the latest in design.



*Check These Advantages In The New Whittaker Sub-Miniature Rate Gyro!*

- reliable performance from — 65 F to 400 F
- only 3/4 inch diameter — 2 inches long
- non floated — eliminates fluid expansion problems
- quick start — no heater necessary

For additional information on the Sub-Miniature Gyro — on any specialized control components or systems... write today for technical data.

Floated rate gyros / Directional gyros  
Vertical gyros / Spring energized gyros  
Auto-pilots / Stable platforms / Rate switches

# 400,000

## REASONS WHY WHITTAKER GYRO IS FIRST IN ADVANCED CAPABILITIES

"A Guide To Better Flight Controls"



**WHITTAKER GYRO**  
DIVISION OF TELECOMPUTING  
CORPORATION

16217 LINDBERGH ST. VAN NUYS, CALIF. PHONE TRIANGLE 3-1950

divisions and subsidiaries of  
**TELECOMPUTING  
CORPORATION**



915 North Citrus Avenue, Los Angeles 38,  
California • Phone: HOLlywood 4-0181



**WHITTAKER GYRO DIVISION**

has manufactured more than 400,000 gyros for installation in a wide variety of military products, including advanced aircraft and missiles.



**WHITTAKER CONTROLS DIVISION**

(formerly Wm. R. Whittaker Co., Ltd.) is the world's largest exclusive custom producer of valves and controls for aircraft and missiles.



**BRUBAKER ELECTRONICS DIVISION**

is a leader in research and development of advanced radar, IFF equipment, video processing equipment, radar beacons and navigational aids.



**DATA INSTRUMENTS DIVISION**

develops and manufactures proprietary instruments for data processing, including automatic plotting devices, oscillogram and film readers, digital counters, and other specialized devices.



**TELECOMPUTING SERVICES DIVISION**

is a technical service and developmental organization skilled in the engineering, instrumentation and operation of data processing and communications centers, primarily for government and military agencies.



**NUCLEAR INSTRUMENTS DIVISION**

is engaged in design and manufacture of maximum reliability equipment for testing nuclear weapons and missile instrumentation.



**COOK BATTERIES DIVISION**

Proven specialists in the design, development, and manufacture of miniaturized automatically and manually activated silver zinc primary batteries, rechargeable batteries and cells. Ultimately reliable electric power sources of highest energy-to-weight ratio.

# EDITORIAL

## Is Management Letting Us Down?

Are managers failing engineers? Many engineers seem to think so.

One such engineer, incensed over our June 24 editorial, which asked for an increased college enrollment in engineering, told us that his company used only 20 per cent of his time at engineering tasks. He is convinced that engineers are not being used properly, and that there is in reality an oversupply of engineers.

Engineers from southern California, according to a survey by Hirsch, Milwitt, Oakes and Pelton (IRE Trans. on Engineering Management, Sept. 1958), are being utilized only 35.8 per cent effectively on the basis of technical training and experience. The average engineer polled by Hirsch and his colleagues felt that 65 per cent of the work he performed was beneath his capabilities.

Certainly many managements have failed if companies *can* be properly organized to use engineers for engineering more than one-third of the time. Granted the unlikely possibility that the 35 to 65 ratio of engineering to non-engineering time is most efficient, management certainly has failed when its engineers *feel* they spend the majority of their time in ignominious labor.

In view of the heavy demand for engineers, effective use should mean that an engineer is engaged in work particularly suited to him because of his special training, experience and ability. Conceivably the non-technical or routine contribution of an engineer is as valuable as his engineering contribution. If this is so, management should make this point clear.

If management thinks that time spent with a soldering iron is as important as that spent with a slide rule; if time spent in a conference serves objectives; if writing reports is of value—management should be able to demonstrate it to its engineers.

Job objectives are not easy to spell out, but they are vital to good management. The engineer should want them to know what is expected of him and to decide if this is what he really wants to do. Management fails if it does not provide this direction.

If management fails, engineers should take the initiative in defining their jobs.

*James G. Kopp*

## — — — — AC POWER — — — —

### COMPLETELY ELECTRONIC

### The Behlman INVERTRON®

is available  
in a choice of  
power and  
frequency ranges . . .



### FROM PORTABLE TO MULTI-KVA MODELS

*The Behlman Invertron is a completely electronic A.C. Power Source widely used in research and development, production testing, test consoles, electronic systems or wherever A.C. Power other than that obtainable from the 60 cycle line is required.*

## INVERTRON®

*Models are available with single phase, two phase or three phase output and with either fixed and variable frequencies.*

## INVERTRON®

*A wide range of power ratings are available in standard models with other power ratings on special order.*

## INVERTRON®

*The Invertron features extreme frequency accuracy and stability, exceptional regulation against both line and load, and low harmonic distortion and noise.*

## INVERTRON®

*Specifications for all standard models include 1% maximum distortion, 1% regulation no load to full load, extremely low output impedance, and essentially zero response time.*

*For further information  
write or call*

Modular construction techniques  
employed to provide low cost  
custom as well as standard units.

**BEHLMAN**  
ENGINEERING COMPANY  
ELECTRONICS • MECHANICS • OPTICS  
DESIGN • DEVELOPMENT • REPROTYPE  
2911 WINONA AVENUE  
BURBANK, CALIFORNIA

*Representatives in all principal cities and Canada*



# Building-Block Circuits for Transistorized Digital Computers

Staff Group of The Electronics Division

U.S. Naval Research Laboratory, Washington, D.C.

C. J. Creveling, E. D. Harris, A. M. Demerle,  
F. C. Hallberg, J. M. Hovey, H. H. Levy, J. L. Tinsley.

Building-block circuits for digital computers are relatively difficult to design but simple to assemble. To aid the computer design engineer, several key circuits are presented which have been tested and proved in field use.

Although these circuits were specifically designed for a unit computing at a 500 kc rate with logic performed in one  $\mu$ sec wide sync pulse positions, they can be used as a guide for the design of other speed computer systems.

ENGINEERS engaged in computer design can save valuable time and effort by making use of several tried and proven transistor building block circuits developed by the U. S. Naval Research Laboratory. The circuits included are:

- A gated blocking oscillator which can be used as a dynamic shift register, storage register, or

delay line when used with a two-phase clock.

- A gated exclusive-OR circuit for precise coincidence applications.
- A monostable multivibrator featuring quick recovery.
- A synchronous "not" circuit which yields no output when input is present and delivers output when no input is present.
- A stable 8.0 mc crystal oscillator for operation from  $-70$  to  $+85$  C.

### Gated Blocking Oscillator

A gated blocking oscillator, such as shown in Fig. 1, can be used in conjunction with a two-phase clock as a dynamic shift register, storage register or delay line.

Operation of a gated blocking oscillator depends on regenerative feedback in the same manner as a blocking oscillator. If transistor  $T_1$  is enabled by a clock pulse, a negative trigger to transistor  $T_2$  will cause its collector to rise toward ground. This rising voltage, transferred through

the transformer, drives the base of  $T_2$  further negative, thus holding  $T_2$  in a bottomed condition until  $T_1$  is shut off. When  $T_1$  is shut off, current can no longer flow through the transformer primary; thus, as in the standard blocking oscillator, the collector voltage swings negative which, coupled through the transformer, causes  $T_2$  to cut off.

Circuit parameters are such as to permit satisfactory operation over the temperature range from  $-65$  to  $+85$  C coincidentally with supply and trigger voltage variations of  $\pm 20$  per cent.

Fig. 1 is a schematic of the gated blocking oscillator along with waveforms showing the relationship between its inputs and outputs.

Fig. 2 shows a cascade of these units with alternate stages energized by alternate clocks which are  $\pi$  radians out of phase. The arrangement shown can be used as a synchronous delay line where the delay is an integral multiple of the clock half-period. If the input and output were connected, such a closed loop could be used as

dynamic storage. A versatile shift register can be made by discriminate gating of this cascaded arrangement.

The component values shown in the schematic were chosen to satisfy these system restrictions:

1. A clock pulse of one  $\mu\text{sec}$  width, 500 kc frequency, direct pulse magnitude of two volts, rise time = 0.02  $\mu\text{sec}$ .

2. Output suitable to drive a similar succeeding stage.

3. Only silicon transistors to be used.

The parameters can obviously be varied to suit any particular application. For example, if a clock of lower frequency is used (and all else held constant), the primary inductance of the transformer should be increased to preserve the waveshape shown.

#### Specifications

- Minimum trigger = 1.5 v
- Output impedance = 90 ohms
- Output amplitude = 2.5 v (direct pulse), 5 v overshoot
- Output rise time = 0.02  $\mu\text{sec}$
- Output fall time = 0.05  $\mu\text{sec}$

#### Gated Exclusive—OR

Often in sequential logic circuits, some pulse paths inadvertently produce more delay than do others. For this reason, it is sometimes difficult to build circuits to perform sequential functions that depend on precise coincidence. The exclusive-or circuit, shown in Fig. 3, is able to compensate for slightly delayed or inaccurate input timing by virtue of a supplementary clock input. It is the enabling gate action of this clock, which led to the name "Gated Exclusive-Or."

Logically, an exclusive-or function can be written as  $F = A \cdot B' + A' \cdot B$ , where  $F$  is the output and  $A$  and  $B$  are the two inputs. This clock gating action changes the expression to  $F = (A \cdot B' + A' \cdot B)C$ .  $A$  and  $B$  are nominally one  $\mu\text{sec}$  long and in phase; however, due to system and circuit anomalies they can vary slightly in length and phase.  $C$ , however, is derived from the prime timing source of the system, and so maintains the reference phase. It is made to begin later, but end at the same time as the clock source from which  $A$  and  $B$  were derived.

Fig. 4a shows the nominal phase and length of  $A$ ,  $B$ , and  $C$ . Fig. 4b shows, in reference to  $C$ , the dislocation and distortions which  $A$  or  $B$  might suffer due to non-ideal circuitry. Fig. 4c shows the output to a non-gated exclusive-or whose inputs are the  $A$  and  $B$  of Fig. 4b. These pulses, appearing at  $F$  when there should be no pulse, can cause gross system errors.

In explanation of the schematic, Fig. 3: Diode pair No. 2 forms an "or" gate whose output will cause  $T_3$  to conduct.  $T_2$  will conduct, rendering an

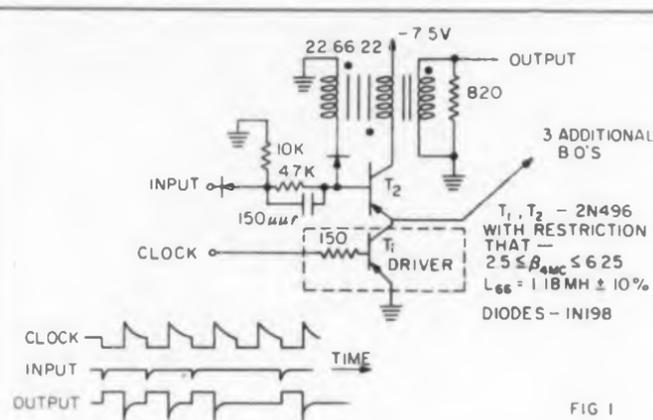


Fig. 1. Gated blocking oscillator circuit with waveforms of clock and input pulse plus output signal.

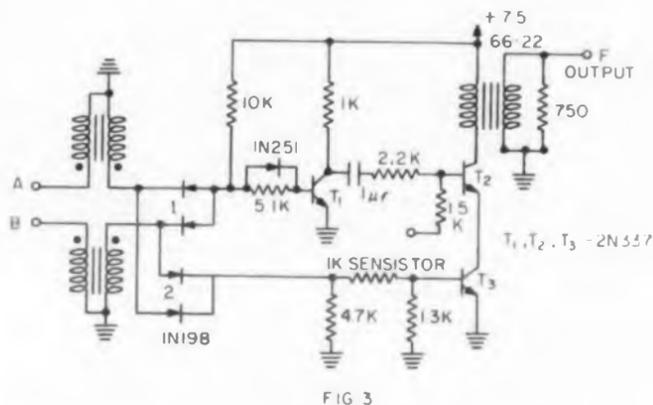


Fig. 3. Gated exclusive-OR circuit can compensate for slightly delayed or inaccurate input timing by means of a supplementary clock input.

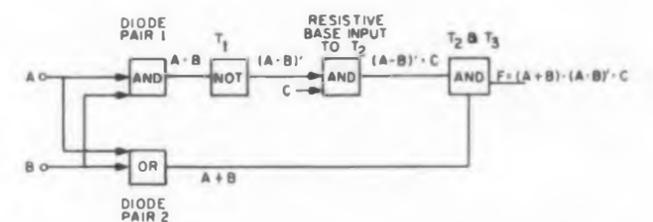


Fig. 5. Block diagram form of gated exclusive-OR circuit showing path of  $A$  and  $B$  input signals.

output only if  $T_3$  is conducting, clock pulse  $C$  is present, and there is no negative pulse output from  $T_1$ .  $T_1$  will have a negative output pulse if  $A$  and  $B$  are both present, which is sensed by the "and" gate formed by diode pair No. 1. Fig. 5 is this circuit, in logical block diagram form. The output  $(A + B) (A \cdot B)' \cdot C$  is equivalent to  $(A \cdot B' + A' \cdot B)C$ .

This circuit is operable over the temperature range of  $-65$  to  $+85$  C with concurrent variations in supply voltage of  $\pm 20$  per cent.

#### Specifications

- Minimum trigger = 1.8 v for ( $A$  and  $B$ ), and = 1.5 v for  $C$
- Input ( $C$ ) minimum impedance = 1.5 K

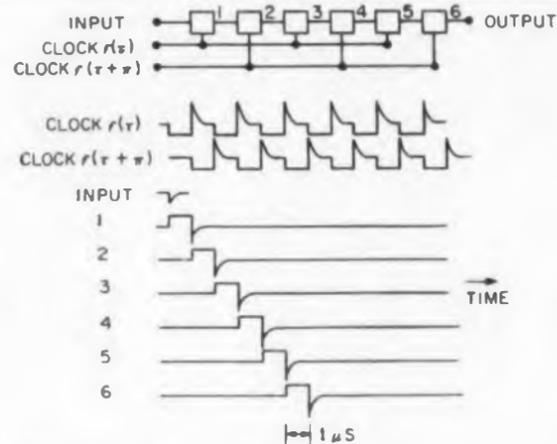


Fig. 2. Cascaded gated blocking oscillators shown with alternate stages energized by alternate clocks which are  $\pi$  radians out of phase.

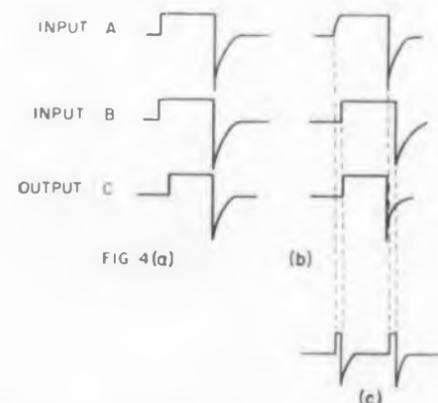
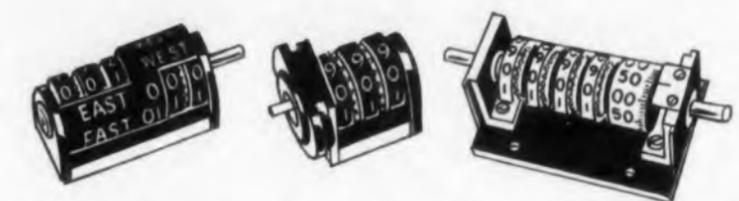


Fig. 4. (a) Nominal phase and length of inputs  $A$  and  $B$  and output  $C$ . (b) Distortions and dislocations which  $A$  or  $B$  might suffer due to non-ideal circuitry. (c) Output pulses which could appear due to distorted  $A$  and  $B$  signals; these pulses can cause gross system errors.

- Input ( $A$  and  $B$ ) impedance = 1 K
- Output impedance = 500 ohms
- Output amplitude = 2.5 v
- Output rise time = 0.1  $\mu\text{sec}$
- Output fall time = 0.1  $\mu\text{sec}$

#### Monostable Multivibrator Featuring Quick Recovery

This circuit, shown schematically in Fig. 6, when triggered by a positive pulse at point  $A$  will generate a positive gate, a negative gate, and a blocking oscillator pulse delayed by an interval of time fixed by  $R$  and  $C$ . It may reset to produce short gates and a short delay on the blocking oscillator pulse at any time within the interval set by  $RC$  by applying a positive pulse at point  $B$ .



# P R E C I S I O N C O U N T E R S



ALL TYPES • ALL SIZES  
ALL QUANTITIES

# B Y B O W M A R

Bowmar designs and produces all kinds of precision counting and indicating devices to all specifications for all indicating applications. A few general types offered include heading and azimuth, latitude-longitude, decimal and impulse counters as well as unlimited special designs. Although Bowmar has standardized dozens of counting devices, all may be modified for new requirements. Counting configurations, light weights, small sizes, high speeds and special mounting hardware are among many factors which can be varied to accommodate new needs.



ANGLE COUNTER 1503. Counts from 000.0° to 359.9° and returns to 000.0; Input speed: 1800 rpm max. int., 500 rpm cont.; Weight: 2.5 oz.; O.D.: 1.310 in. Typical of many Bowmar designs currently being manufactured.



LONGITUDE COUNTER 2216. Provides true indication of longitudinal position; Input speed: 1000 rpm max. int., 300 rpm cont.; Weight: 6.1 oz.; Length: 2.87 in. Typical of many Bowmar designs currently being manufactured.



MINIATURE LATITUDE COUNTER 2417. Counts from 00°00'N to 90°00'N or S, with permissible overrun of 10°; Input speed: 1500 rpm max. int., 500 rpm cont.; Weight: 1.5 oz.; Length: 1.59 in. Typical of many Bowmar designs currently being manufactured.



MINIATURE DECIMAL COUNTER 2416 (with servo type mounting). Counts from 000 to 999 with return to 000. Input speed: 1500 rpm max. int., 500 rpm cont.; Weight: .5 oz.; Length: .685 in. Typical of many Bowmar designs currently being manufactured.



SPECIAL DECIMAL COUNTER 2660. Counts from 000000 to 999950 with return to 000000, in 50-unit increments. Input speed: 1000 rpm max. int., 300 rpm cont.; Weight: 3 oz.; Length: 2.33 in. Typical of many Bowmar designs currently being manufactured.

SEND NOW FOR DATA PACKAGE NO. 1258, WHICH DESCRIBES COUNTING DEVICES ABOVE IN DETAIL



REPRESENTATIVES IN PRINCIPAL U. S. AND CANADIAN CITIES  
CIRCLE 18 ON READER-SERVICE CARD

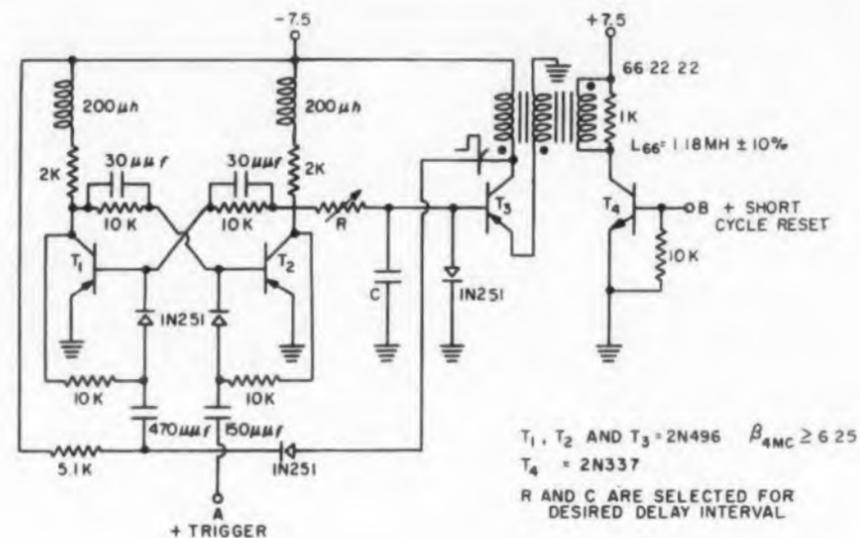


Fig. 6. Monostable multivibrator featuring quick recovery and short cycle reset to within one  $\mu$ sec initial trigger.

This device is essentially a flip-flop ( $T_1$  and  $T_2$ ) and a parallel triggered blocking oscillator ( $T_3$  and  $T_4$ ) connected by an RC circuit. A positive pulse at A turns off  $T_2$  causing its collector to swing negative; this charges capacitor C through resistor R, and, when this voltage becomes sufficiently negative, the blocking oscillator fires. This discharges C through the base-emitter circuit of  $T_3$ .

The blocking oscillator pulse is fed back to the base of  $T_1$  to reset the flip-flop. This completes the cycle and the device is set for another trigger. If this device starts in the wrong state, the action described above will automatically reset it to the proper state.

The gate lengths and blocking oscillator pulse delay may be cut short at any time by a positive pulse applied at B. This causes  $T_4$  to conduct with a resultant negative waveform on its collector. This is inverted through the transformer causing the blocking oscillator to fire with the result that C is discharged and the flip-flop is reset and the device is set for another trigger.

The circuit is operable over the range in temperature from  $-65$  to  $+85$  C with concurrent changes in supply voltage of  $\pm 20$  per cent. All waveforms have rise times  $\leq 0.02$   $\mu$ sec.

While the choice of the product RC determines the delay, it should be noted that C should be kept small, so that the base current of  $T_3$  can completely discharge it, and R varied to change the delay.

The power is consumed primarily by the flip-flop section of this circuit. This can be calculated by knowing that one transistor or the other is always bottomed, and thus one of the  $R_L$ 's is always dissipating power equal to

$$\frac{(\text{supply voltage})^2}{R_L} = \frac{(7.5)^2}{2K} = 28 \text{ mw.}$$

### Synchronous "Not" Circuit

This pulse circuit, shown schematically in Fig. 7.

whose input is in synchronism with a clock, yields no output when an input is present, but does yield a pulse output when no input is present. It can also be called a "complementor."

If there is no input, the clock pulse fed to the emitter turns on the transformer-loaded transistor. The output then is a pulse similar in form to the clock pulse.

A positive input pulse on the base of the transistor, however, holds the transistor from conducting and no output pulse will appear. Note that the input pulse need be slightly wider and greater in amplitude than the clock pulse in order to insure that it will inhibit the clock.

This circuit, designed for an 0.8  $\mu$ sec, a low impedance (15 ohms) clock pulse, and a one  $\mu$ sec input pulse, is operable over the temperature range  $-65$  to  $+85$  C, with concurrent voltage variations of  $\pm 20$  per cent.

It was designed to drive a 1 K external load, with a 25 v direct pulse. Thus it can deliver 6.25 mw of pulse power. It dissipates 8.35 mw in the 750 ohms damping resistor during the time of the direct pulse (calculated by the same method shown for the case of the gated blocking oscillator) and an average of 9.0 mw of power is stored in the core and dissipated during the overshoot.

Thus there is a total average power of  $6.25 + 8.35 + 9.0 = 23.6$  mw dissipated per clock cycle if there is no input trigger, and negligible power dissipated if there is an input coincident with the clock.

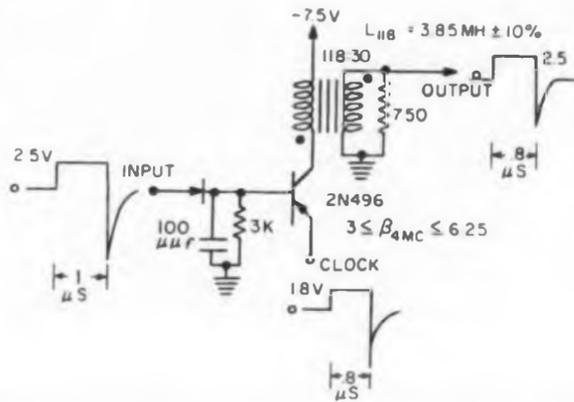
### Specifications

- Minimum trigger = 1.5 v
- Output impedance = (clock) 100 ohms
- Input impedance = 200 ohms
- Output amplitude = 2.5 v
- Output rise time = 0.1  $\mu$ sec
- Output fall time = 0.1  $\mu$ sec

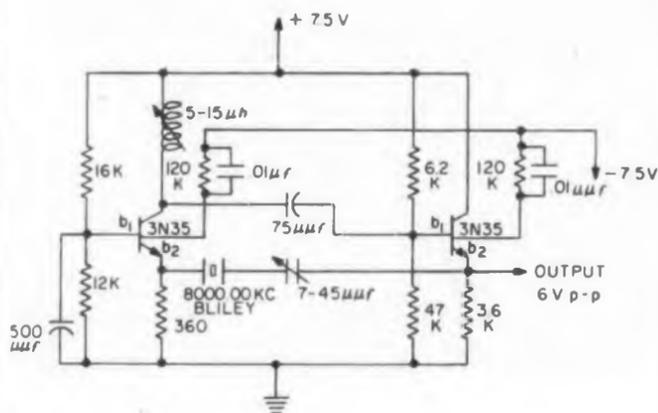
### 8.0 Mc Crystal Oscillator

Fig. 8 schematically shows a transistorized

stable oscillator designed primarily for stable operation over a large range of temperature and voltage variation. It maintains an accuracy of 0.008 per cent over a temperature range of from  $+70$  to  $+85$  C and  $\pm 20$  per cent voltage variation, varying to these extremes the voltages both individually and collectively. The nominal frequency can be varied over a large range by replacing the crystal with one of the desired frequency.



**Fig. 7.** Synchronous "not" circuit, or complementor, yields a pulse output only when no input is present.



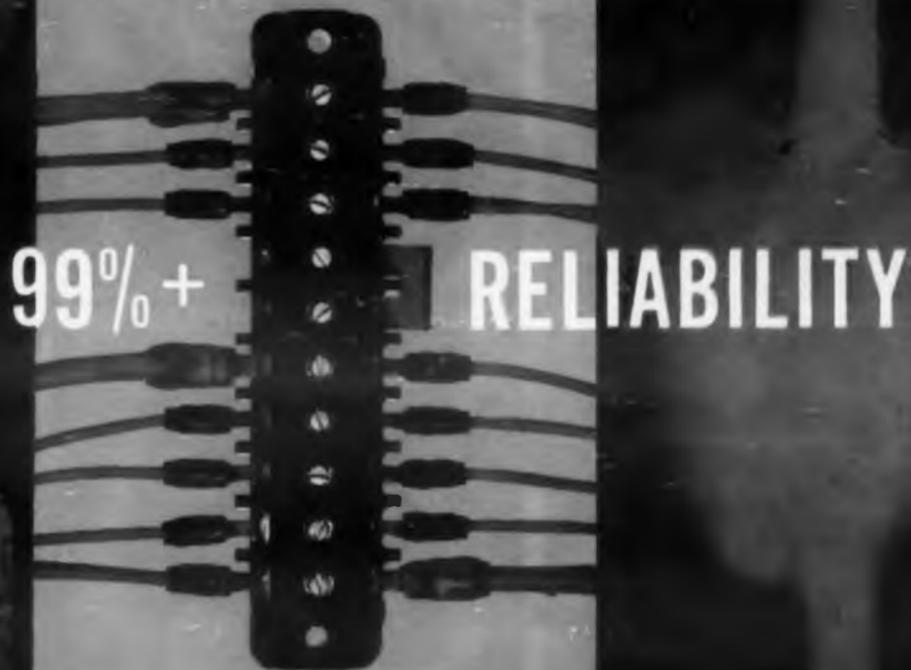
**Fig. 8.** Transistorized eight mc crystal oscillator designed for stable operation from  $-70$  to  $+85$  C.

The particular values shown are optimal for the 3N35 transistor; however, the general configuration can be made to perform equally well with many high frequency transistors both of the small signal and switching types.

The inductance serves to tune out the capacitance appearing at the collector of the grounded base stage, and is made variable for peak output voltage adjustment for any transistor pair. The variable ceramic capacitor serves to pad the series resonant crystal from the changes in capacitance that the transistor exhibits with temperature and voltage changes. It is adjusted for the nominal frequency of oscillation for a given transistor pair.

The circuit draws 45 mw supply power, and delivers a 6 v p-p output into an external load of 2 K. ■ ■

Now—the  
TERMINAL BLOCK  
with...



99%+ RELIABILITY

What makes a good terminal block?  
Two things. One is quick connection.  
The other is absolute dependability.  
You get both in a Twin Lock Terminal Block.

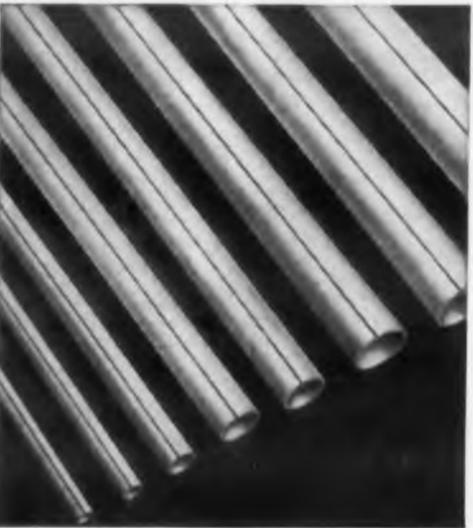
Plug in the terminal lug and the connection is made and locked. One twist of the set screw and it's double locked. Fast? It's done in seconds. Strong? It takes a hundred pounds of force to pull a lug out of its socket. Positive? It has the least resistance of any mechanical connection.

Write for complete engineering data.



1024 West Hillcrest Blvd. Inglewood, California  
Telephone: Oregon 8-4773 • TWX INCL 8194  
Coliseum Tower, 10 Columbus Circle New York 19, N.Y.  
Telephone: Circle 5-8170 • TWX NY 14987

# LOOK TO R/M TO MEET ALL YOUR TEFLON\* NEEDS



R/M—headquarters for "Teflon" products. R/M "Teflon" products include sheets, rods, tapes, tubes, thin-wall tubing (available with color striping) and bondable "Teflon." Molded, machined and extruded parts can also be supplied to your exact specifications.

"Teflon's" many remarkable properties have established it as an important material for use in electronic and electromechanical components and assemblies. Yet, when you select "Teflon" for a particular job, you solve only part of your problem. Equally important is the selection of a source of supply you can depend on for both competent engineering assistance and the production capability needed to meet your exact specifications and quantity requirements. This service—

a complete "Teflon" service—is yours from R/M.

A pioneer in "Teflon" application and fabrication research, R/M offers design guidance that can help assure maximum part performance, and its ample production facilities can supply "Teflon" in the form best suited to your needs. Learn more about R/M's complete "Teflon" service—and how it can benefit you—by contacting your nearest R/M district office. Or write Plastic Products Division, Manheim, Pa.

\*A Du Pont trademark



## RAYBESTOS-MANHATTAN, INC.

PLASTIC PRODUCTS DIVISION FACTORIES: MANHEIM, PA.; PARAMOUNT, CALIF.

Contact your nearest R/M district office listed below for more information or write to Plastic Products Division, Raybestos-Manhattan, Inc., Manheim, Pa.

BIRMINGHAM 1 • CHICAGO 31 • CLEVELAND 16 • DALLAS 26 • DENVER 16 • DETROIT 2 • HOUSTON 1  
LOS ANGELES 58 • MINNEAPOLIS 16 • NEW ORLEANS 17 • PASSAIC • PHILADELPHIA 3  
PITTSBURGH 22 • SAN FRANCISCO 5 • SEATTLE 4 • PETERBOROUGH, ONTARIO, CANADA

RAYBESTOS-MANHATTAN, INC., Engineered Plastics • Asbestos Textiles • Mechanical Packings • Industrial Rubber  
Sintered Metal Products • Rubber Covered Equipment • Abrasive and Diamond Wheels • Brake Linings  
Brake Blocks • Clutch Facings • Laundry Pads and Covers • Industrial Adhesives • Bowling Balls

CIRCLE 20 ON READER-SERVICE CARD

## High Speed Photo Film Records Invisible Scope Traces

SO FAST THAT it can record scope transients too fast to see, Type 47 Land film opens new horizons in oscilloscope trace photography. Rated at ASA daylight exposure index of 3000, the film can show single transients with rise times of less than one millimicrosecond. It fits standard five-inch scope cameras with

Polaroid Land backs.

Manufactured by Polaroid Corp. of Cambridge, Mass., the new film writes much faster than the fastest Land film previously available for cro trace recording.

Its great sensitivity is apparent in Fig. 1 which shows a single shot 450 mc damped

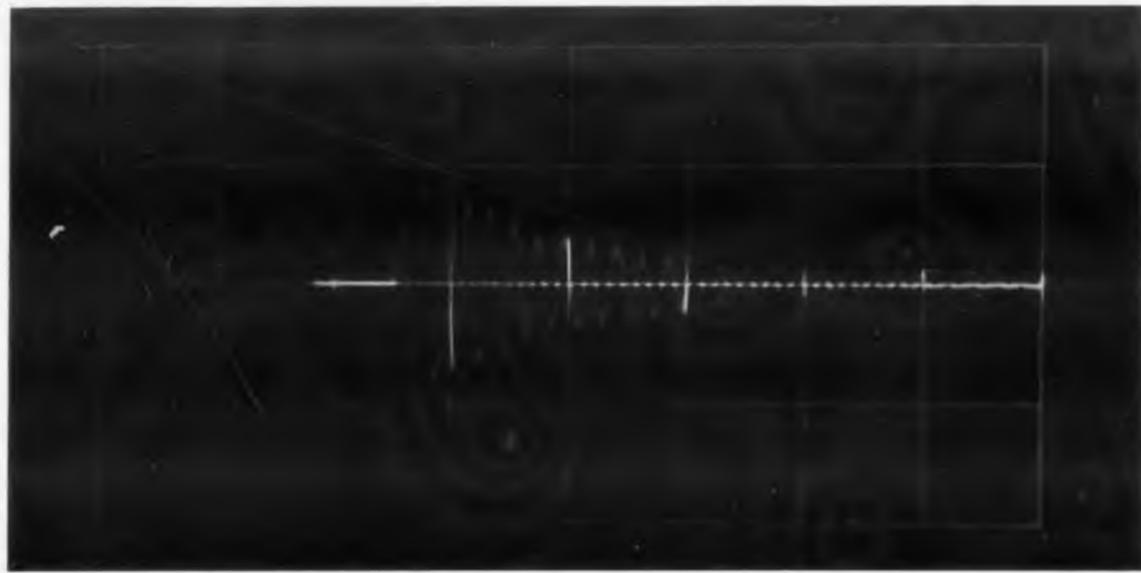


Fig. 1. Photograph of a 450 mc, single-shot, damped sine wave shows writing rate faster than 3000 cm per  $\mu$ sec. Shot was taken with a Hewlett-Packard model 196A camera set at  $f/1.9$ . Scope was a Tektronix 517A. Film was developed for one minute.



Fig. 2. A one millimicrosecond pulse with a 500 mc calibrating sine wave signal. The trace was made on an Edgerton, Germeshausen, & Grier traveling wave oscilloscope with camera model 710. Film development time was 20 seconds.



sine wave. The fastest visible part of the trace shows a writing rate exceeding 3000 cm per  $\mu$ sec.

Reducing the normal one-minute development time to 20 or 30 sec increases the film's capabilities to more than 4000 cm per  $\mu$ sec, while special pre-fogging techniques can yield writing rates greater than 8000 cm per  $\mu$ sec.

A transient, invisible to the eye, is shown in Fig. 2. It is a single pulse, slightly less than one millimicrosecond wide. It has a rise time of a few tenths of a millimicrosecond. Nevertheless, the photograph still reveals the fine detail.

The new high-speed film eliminates many of the headaches associated with photographing transients. For recording transients in the 500 kc to one mc range, one formerly required full intensity settings on scopes with high accelerating potentials, and cameras with wide open lens apertures. Popular scopes with accelerating potentials of 3 kv to 10 kv would lose fine detail because intensity settings had to be turned up so high.

Such brute force techniques resulted in loss of cro sensitivity, large spot size with no detail, and optical distortion. For higher frequency transient recording, it was necessary to provide artificially repetitive traces of naturally transient phenomena. This almost invariably gave blurred images.

The new Land film yields sharper pictures, with more information, even of steady state patterns at lower frequencies. It allows shorter exposures, to eliminate blur due to patterns with drift and jitter; smaller aperture settings for sharper focus; and lower intensity for smaller spot size.

Best pictures result when the crt has a blue P-11 phosphor, but all common tube phosphors yield good results.

For more information on this ultra-fast film, turn to the Reader-Service Card and circle 102.

Announcing Epsco's **NEW**

# DVOM

A MAJOR ADVANCE IN  
**DIGITAL  
VOLT-OHM  
METERS**



**FULLY TRANSISTORIZED**  
No Stepping Switches • No Relays

**Epsco**   
First in data control

• **VERSATILE** accurately measures both resistances and AC-DC voltages and counts external events, too! Directly drives printers, punches and memory storage units and can be directly used as a bi-directional tele-meter.

• **FAST** less than 2 millisecond reading time . . . up to 100 completely independent measurements per second for any system use.

• **EASY TO READ** in-line, in-plane visual display . . . lamp life up to 10,000 hours . . . numerals 1 $\frac{1}{8}$  inch high . . . automatic indication of polarity, decimal point and mode of operation

True dependability and versatility have at long last come to digital volt-ohm meters in EPSCO'S new DVOM. Fully transistorized . . . adjustment-free . . . no stepping switches or relays. Provides precise numerical measurement of AC-DC voltages, resistances . . . fast, accurate visual or printed quality control data . . . high-speed data acquisition for direct print-out or storage . . . remote indication and data transmission over a single line. Compact, lightweight, portable — also for rack-mounting. Write for Bulletin 95801, Epsco, Inc., Equipment Division, 275 Massachusetts Ave., Cambridge, Mass.; in the West: Epsco-West, 240 East Palais Rd., Anaheim, California.

DVOM price . . . . . \$1,475

Ask for a demonstration.

CIRCLE 21 ON READER-SERVICE CARD

Door mechanical design creates many reliability problems with electronic equipment. The check list that follows will help designers nullify Murphy's Law ("In any piece of equipment, if something can possibly be installed wrong, somebody will certainly do it that way."). The list, developed from experiences with missiles and complex military electronic equipment, covers representative hazards.



# Mechanical Check List: A Key To Reliable Electronic Equipment

H. I. Dwyer Jr.  
Reliability Follow-up Group  
Bendix Aviation Corp.  
Mishawaka, Ind.



## Covers and Closures

### Make sure:

- The purpose, compartment or item covered is adequately identified.
- Removable closures, plugs and small covers are permanently attached to prevent loss. The chain or other link should be long enough to place the closure safely out of the way.
- The cover or opening permits, when necessary, easy access to the compartment for the operator's hand or tools.
- The hinges are adequate and the cover is securely held at all necessary positions.
- There are no sharp corners or projections exposed when the cover is opened.
- Interlocks and automatic disconnects are provided for high-voltage areas.
- There is a positive lock to ensure tight closing. The method should permit one to tell at a glance if the cover is locked.
- The seals and gaskets are not damaged by tools or abrading action of the cover.
- The covers and doors used for servicing are easily and quickly opened. They should be keyed or shaped for installation only in the correct position.
- The openings left when regular covers are removed for shipping, testing, etc., are covered by temporary closures to prevent entry of foreign material.
- The caps and plugs that abrade or wear do not introduce foreign material.
- The openings near critical parts are covered to prevent entry of foreign material.



## Tags, Placards and Markings

### Check:

- Stenciled or decal markings. They should be protected from moisture, abrasion, corrosion and fading.
- Service instructions. They should be given and placed near the service area.
- Serial numbers and other markings. Those peculiar to a particular unit should be placed on dust covers or other frequently removed parts.
- Orientation. Markings in any area should be orientated so they can be read comfortably. Shape, size, color or contrast of the marking should be such that they can be read under adverse conditions.
- Sequence instructions. They should be permanently marked on the unit where sequential assembly or disassembly operations are required.
- Warning placards. High-voltage and other potentially dangerous areas need these.
- Circuit reference. Plugs, jacks, resistors, pots, tubes, etc., should be clearly marked on the chassis close to the part for easy trouble-shooting and maintenance.
- Module units. They should be marked with circuit diagrams and identification.



## Cables, Connectors and Clamps

### Look for:

- Cables that are taut—and strain placed on the connector, the cable or the clamps.
- Cables that are loose, or excessive lengths of

cable to be run around a unit. These can result in vibration or interference problems.

- The possibility of more than one cable run with one length of cable. Also, cable runs that require sharp bends or permit such bends.
- Insufficient clearance that causes the cable to chafe or bind on other parts.
- Cables that lie across removable units or across fasteners of any type.
- Potting materials that are susceptible to cracking, absorption of moisture, decomposition, etc. There should be adequate test data to prove environmental resistance.
- Wrong connections that can result from cable layout and connector type.
- Connections that can be made only by sharply twisting the cable.
- Connection points that are not visible due to bulkheads or other interfering units.
- Connectors that are not easily accessible to tools and hands.
- Cable runs that permit contact between cable and moving parts. Clamping that does not provide clearance under all conditions, near moving parts.
- Inadequate protection for cables and connectors near fuel systems, fumes or hydraulic spillage.



## Wiring and Terminal Boards

### Make sure:

- Wires are not taut, placing a strain on the wires or connections.
- Wire lengths are not excessive, causing loops.

■ V  
 ers  
 ■ T  
 mir  
 out  
 ■ T  
 mir  
 ■ T  
 ■ A  
 Gro  
 hig  
 nec  
 ■ S  
 Win  
 to p  
 ■ W  
 thus  
 ■ S  
 corp  
 on v  
 ing  
 ■ H  
 nals  
 ■ A  
 ing.  
 to c  
 ✓  
**Fast**  
**Guar**  
 ■ In  
 prev  
 mov  
 ■ In  
 part  
 both  
 ■ Pl  
 wash  
 rem  
 ■ Us  
 same  
 and  
 comp  
 ■ Fa  
 the a  
 or w  
 ■ Ina  
 ■ Us  
 ing o  
 ■ Ex  
 chass  
 ■ Ins  
 remo  
 ■ Suf  
 a go  
 move  
 ■ Pla  
 must  
 ■ Rec  
 ELEC

- Wires do not lie across removable parts, fasteners or adjustment points.
- There is an adequate clearance around terminal points to allow operations in the area without damage to wires.
- There are not excessive wires on a single terminal.
- There is sufficient sleeving or insulation.
- Adequate grounding for circuits is provided. Grounds are not made through non-conductive or high-resistance paths, or by screw or pressure connections that are not locked or safely tied.
- Sufficient lacing on wire bundles is provided. Wire bundles are tied to the chassis at intervals to prevent vibration and impact problems.
- Wire bundles are formed to a definite shape, thus eliminating extra strain on the outer wires.
- Strain relief boards or other measures are incorporated in connectors to prevent direct stress on wire bundles and connector solder points during assembly and disassembly of the connection.
- Heavy wires are not brought to small terminals.
- A consistent color code is followed for wiring. The code should be compatible from chassis to chassis within equipment or from unit to unit.

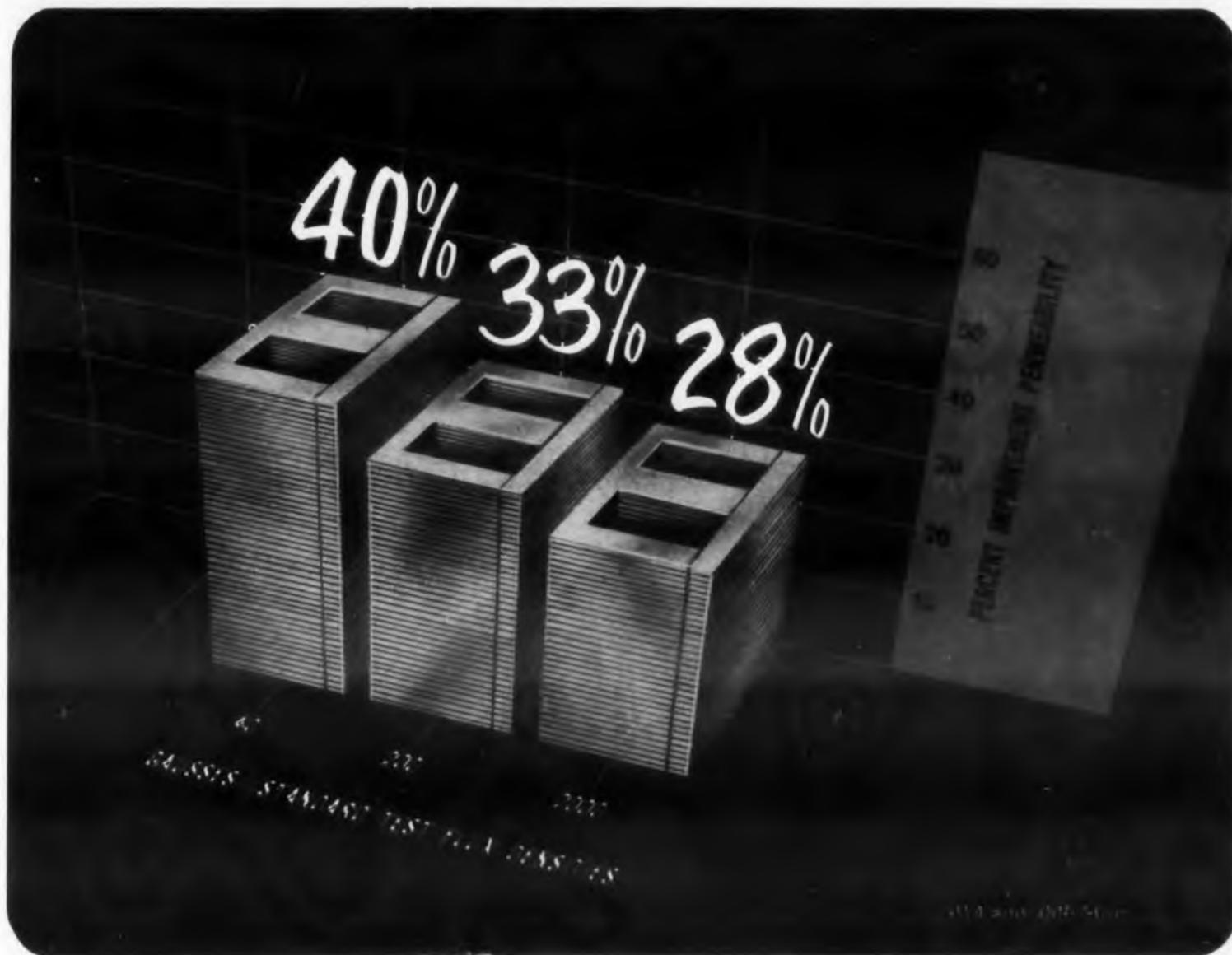


#### Fasteners and Hold Downs

##### Guard against:

- Insufficient clearance around fasteners. This prevents using tools during installation and removal.
- Inaccessible or hard to see fasteners. If two parts must be held—nut and bolt, for example—both ends must be visible from the same location.
- Placing fasteners so that loose parts, such as washers, fall into the unit when the fastener is removed.
- Using more than one type of fastener in the same application. Different head sizes and types, and other differences requiring different tools, complicate installation and removal.
- Fasteners that are too long or too short for the application. Bearing surface or bolt head, nut or washer must be adequate.
- Inadequate locking devices.
- Using dissimilar metals. They will cause galling or electrolytic corrosion.
- Excessive lockwire runs, because of layout of chassis.
- Insufficient clearance above fasteners. During removal this can cause contact with other parts.
- Sufficient room must be provided to permit a good grip on the fastener while it is being removed.
- Placing screw heads so that the screw driver must be tilted to clear other parts.
- Recessed head fasteners unidentifiable as to

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



## Higher permeability values now guaranteed for Allegheny Ludlum's Moly Permalloy

### Means new, consistent and predictable magnetic core performance

Molybdenum Permalloy nickel-iron strip is now available from Allegheny Ludlum, with higher guaranteed permeability values than former typical values. For the buyer, this new high quality means greater uniformity . . . more consistent and predictable magnetic core performance.

This higher permeability is the result of Allegheny Ludlum's intensive research on nickel-bearing electrical alloys. A similar improvement has been made in AL-4750 strip steel. A-L continues its research on silicon steels,

including Silectron, well-known grain-oriented silicon steel, and other magnetic alloys.

Complete facilities for the fabrication and heat treatment of laminations are available from Allegheny Ludlum. In addition, you can be assured of close gage tolerance, uniformity of gage throughout the coil, and minimum spread of gage across the coil-width.

If you have a problem relating to electrical steels, laminations or magnetic materials, call A-L. Prompt technical assistance will be yours. And write for more information on Moly Permalloy. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

Address Dept. ED-21.

WSW 7490

## ALLEGHENY LUDLUM

STEELMAKERS TO THE ELECTRICAL INDUSTRY

Export distribution, Electrical Materials: AIRCO INTERNATIONAL INC., NYC 17

Export distribution, Laminations: AD. AURIEMA, NYC 4

CIRCLE 22 ON READER-SERVICE CARD



are you silicon wait-bait?



avoid unnecessary delays

GT DELIVERS SILICON TRANSISTORS IN 24 TO 48 HOURS!

No need to get hung up with delays or hooked by unkept promises! GENERAL TRANSISTOR delivers sample quantities of GT Silicon Transistors in 24 to 48 hours... production quantities in 2 to 4 weeks!

These are not mere claims, but firm promises on which you can base your design and production schedules.

Quality? Yes—plenty of weight here without waiting. General Transistor is today one of the largest suppliers of highly dependable devices, delivering quality in quantity.

For full information—and fast delivery—call your local General Transistor representative, or contact us directly. Write for Silicon Brochure S-100.

SEE US AT WESCON BOOTHS 3421 & 3423

**GENERAL TRANSISTOR CORPORATION**

91-27 138th Place, Jamaica 35, New York  
Phone: Hickory 1-1000



A Few of the GT Alloyed Junction Silicon Transistors Now Available

- HIGH SPEED SWITCHING
- MEDIUM SPEED SWITCHING
- HIGH VOLTAGE
- HIGH SPEED LINEAR AMPLIFIER
- MEDIUM SPEED LINEAR AMPLIFIER

PNP:	2N1219	2N1220	2N1221	2N1222	2N1223
$V_{cb0}$	30 v	30 v	30 v	30 v	40 v
$V_{ce0}$	25 v	25 v	25 v	25 v	40 v
$V_{eb0}$	20 v	20 v	10 v	10 v	10 v
$I_{co}$	.1 $\mu$ a max.				
$h_{fe}$	18 min.	9 min.	—	—	—
$f_{ab}(mc)$	5 min.	2 min.	5 min.	2 min.	2 typ.
$h_{fe}$	—	—	18 min.	9 min.	6 min.

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., 8110 VENICE BLVD., LOS ANGELES, CALIF.

type and size of recess.

- Unspecified torque requirements.
- Using spring clips and other types of clamps that are too large or too small for the parts to be held.



#### Small Parts

Check for:

- Parts that are exposed to damage because they are too close to places where tools are used.
- Parts that touch the chassis or cover when the cover is installed.
- Inadequate or nonexistent clamps or hold-down for parts.
- Insufficient clearance between parts and other surfaces.
- Solder points that are too close to temperature-sensitive parts.
- Mounted parts that require removal of other parts before being replaced.
- Inadequate marking or identification on each part, or identification not readily determined.
- Lead lengths that are either too long or too short for layout.
- Dirt and moisture traps under or behind a mounted part.
- Clamps or clips that bear against soft or deformable surfaces.
- Part layouts that do not conform as closely as practicable to functional arrangement.
- Polarized parts—electrolytic capacitors for example—that are not identified as to polarity.



#### Brackets and Mounting Pads

Think about:

- Non-symmetric mounts not keyed in some way to prevent reversed installation of the mount.
- Specialized brackets used where not required by function.
- Cantilever mounting of large or heavy hardware on light brackets.
- Flat mounting surface mated to curved surface or vice versa.
- Brackets mounted on brackets.
- Parts mounted on flexible or thin metal bulkheads.
- Sharp bend radius on angle brackets.



#### Test Points and Controls

Remember that:

- Test points and controls should be accessible and easy to see from a normal working position or in poor light.

- Adequate locking provisions are needed on adjustments.
- It is better not to specify special tools for making adjustments or manipulating locking device.
- Points should be clear of all other parts to prevent damage if prods or tools slip.
- Points should be logically placed with respect to function.
- Sufficient identification or operating information should be available for the operator or maintenance man.
- Test points requiring special precautions should be marked.
- Direction of rotation or movement should be consistent for similar functional changes.
- Control knobs, switches and other manual controls should be placed and shaped to permit easy and positive control of movement.
- Controls should not be identified by arbitrary, ambiguous or overly technical terminology.
- "Press to turn" hoods or other devices should not be used to prevent accidental tripping of switches and controls.
- Test points carrying dangerous voltages should be protected against accidental contact.



#### Removable Units

Provide:

- Positive methods for correctly installing and connecting the units.
- Accessible and easy-to-see hold-down provisions.
- Enough hold-down devices.
- Positive identification of the unit's serial number, type, model, modification and purpose.
- "Match fitting" of units to prevent interchange of functionally interchangeable units.
- Adequate clearance between the unit and other units for easy installation and removal.
- Adequate lifting surfaces or handles. In cases where the structure is intended to serve as a gripping surface, provide markings to show where to grip.
- Cabling and wiring that is long enough, when permanently attached, to permit complete removal of the unit. A recess or well into which such cable can be placed when the unit is in position should also be provided.
- Adequate contact between the unit and bearing surface used for ground connection.



Acknowledgement: This check list is based on a paper delivered by the author at the Fifth National Symposium on Reliability and Quality Control.



7372 C

*Arnold Pulse Transformer  
Cores are individually tested*

*under actual pulse conditions*

Here's  
technical data on

**ARNOLD  
SILECTRON  
CORES**

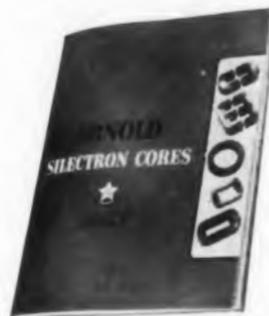
*Bulletin SC-107 A*

... this newly-reprinted 52-page bulletin contains

design information on Arnold Tape Cores wound from Silectron (grain-oriented silicon steel). It includes data on cut C and E cores, and uncut toroids and rectangular shapes. Sizes range from a fraction of an ounce to more than a hundred pounds, in standard tape thicknesses of 1, 2, 4 and 12 mils.

Cores are listed in the order of their power-handling capacity, to permit easier selection to fit your requirements, and curves showing the effect of impregnation on core material properties are included. A valuable addition to your engineering files—write for your copy today.

ADDRESS DEPT. ED-99.



The inset photograph above illustrates a special Arnold advantage: a 10-megawatt pulse-testing installation which enables us to test-prove pulse cores to an extent unequalled elsewhere in the industry.

For example, Arnold 1 mil Silectron "C" cores—supplied with a guaranteed minimum pulse permeability of 300—are tested at 0.25 microseconds, 1000 pulses per second, at a peak flux density of 2500 gauss. The 2 mil cores, with a guaranteed minimum pulse permeability of 600, receive standard tests at 2 microseconds, 400 pulses per second, at a peak flux

density of 10,000 gauss.

The test equipment has a variable range which may enable us to make special tests duplicating the actual operating conditions of the transformer. The pulser permits tests at .05, .25, 2.0 and 10.0 microsecond pulse duration, at repetition rates varying anywhere from 50 to 1000 pulses per second.

This is just another of Arnold's facilities for better service on magnetic materials of all description. ● Let us supply your requirements. *The Arnold Engineering Company, Main Office & Plant, Marengo, Ill.*

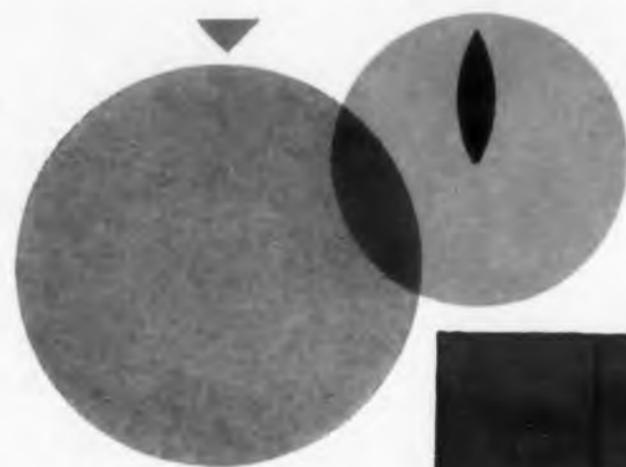


**ARNOLD**  
SPECIALISTS in MAGNETIC MATERIALS

BRANCH OFFICES and REPRESENTATIVES in PRINCIPAL CITIES

Find them FAST in the YELLOW PAGES

CIRCLE 24 ON READER-SERVICE CARD

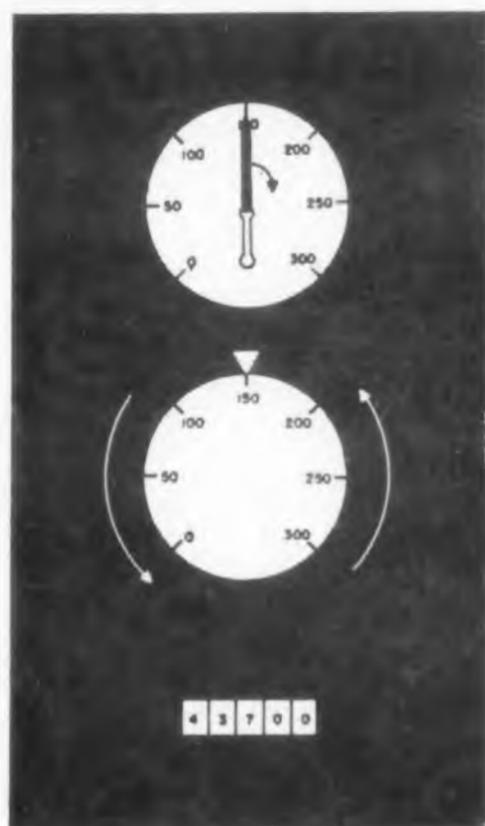


# How To Choose The Right Indicator

In the Nov. 26, 1958, issue of *ELECTRONIC DESIGN* we published an article on "Comparing Illuminated In-Line Readouts" that evoked a letter from a reader disputing the advantages of digital over analog readouts. He tempered his argument with: "In the long run the men who use the instruments most should be served first." Because we agreed we asked an authority to write this article on selecting indicators.

**H. L. Williams**

Supervisor, Human Factors Engineering  
Melpar, Inc.  
Falls Church, Va.



**Fig. 1.** Three basic types of symbolic indicators most commonly used are, from top to bottom: moving pointer on a fixed scale, moving scale behind a fixed pointer, and direct reading counter.

**Table of Recommended Indicators for Various Operator Tasks**

Operator Task	Recommended Indicator	Basis for Recommendations
Reading to an exact numerical value (indicator is stationary)	Counter or illuminated in-line readout	People can read numbers of a counter more accurately than they can interpret the pointer position, numbers and graduation marks of a moving pointer indicator.
Reading to an exact numerical value (indicator is moving)	Moving pointer	Counter-type indicators may be used if the rate of change is not over 2 units per second. For faster rates of change, a moving pointer is best. In either case, readings "on the fly" are not likely to be accurate.
Reading approximate or qualitative, go-no-go, yes or no, good or bad indications	Moving pointer	Qualitative information cannot be obtained readily from a counter or moving scale-type indicator without special color coding. Even with special color coding, a moving pointer indicator is likely to be superior. (Information of this type often can be obtained more easily from simple indicator lights where green represents the positive indication and red the negative.)
Setting values into an indicator (values are large)	Counter or illuminated in-line readout	Counter type indicators can be read more accurately, particularly if more than one rotation of the pointer or more than one pointer would be required.
Setting values into an indicator (values are small)	Moving pointer or counter	For small values requiring less than one rotation of a moving pointer, either a moving pointer or a counter-type indicator is acceptable.
Adjusting an indicator continuously or intermittently to maintain a desired value or to follow a reference marker	Moving pointer	Feedback information of "how well am I doing" type is obtained more easily from the moving pointer.

EACH INDICATOR has its own merits for specific applications and should be selected to present all the information required and no more. This article focuses on factors influencing indicator selection.

Three basic types of symbolic indicators are available:

- Moving pointer with a fixed scale;
- Moving scale with a fixed pointer;
- Direct reading counter.

And there are many variations of each of these basic types. An illuminated in-line readout, for example, is a variation of the counter-type indicator.

Type of information required by an operator governs the choice of an indicator. The rules to follow in selecting the basic type of indicator are numerous. Essential ones relative to the three types under consideration are presented in the table.

After the basic type has been selected, the presentation that is simple, accurate, and capable of being read quickly and easily should be specified. It should give the operator all the information he needs to do the job required of him and no more. Too much information makes the operator's task difficult, since he is forced to extract the information he needs.

#### Moving Circular Scales

Because of ambiguities with moving circular scales and the associated control movement, moving circular scale indicators are recommended only where it is necessary to conserve panel space, since only a small portion of the scale need be exposed. In the design of circular moving scales, however, one of these three recommended design practices will be violated:

- Scale numbers should increase in a clockwise direction around the dial face;
- Direction of movement of the scale should be the same as the control;
- Clockwise rotation of the control should increase the setting. ■ ■

#### References

1. Baker, Charles A., and Grether, Walter F., "Visual Presentation of Information," WADC Technical Report 54-160, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, August, 1954.
2. Bradley, J. V., "Desirable Control-Display Relationships for Moving Scale Instruments," WADC Technical Report 54-423, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, September, 1954.
3. Warrick, M. J., "Counters for Airborne Use," WADC Technical Report 54-266, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, June, 1954.
4. Weldon, Roger J. and Paterson, G. M., University of New Mexico, "Factors Influencing Dial Operation: Three-Digit Multiple-Turn Dials," Sandia Corporation Report SC 3659(TR), Albuquerque, N. Mex., February, 1955.



## Kerite reports: "Tough tapes of MYLAR® help keep costs down, improve cable design"

"We have to use highest-quality materials to maintain the performance people expect from Kerite cables. Tapes of 'Mylar' polyester film help us insure top performance. What's more, 'Mylar' actually costs us less per foot of cable than other tape materials, because it is so tough we can use it in thinner gauges. This helps us offset rising costs in many other cable materials.

"'Mylar' helps by improving production efficiency, too. Its high tensile strength drastically cuts machine downtime due to tape breaks. And our customers benefit from improved performance . . . 'Mylar' makes cable cleaner and easier to strip, provides greater crush resistance, assures longer life."

The control cable shown is only one of a variety of cables made with "Mylar" at the Kerite Company. Kerite, America's oldest cable producer, was a pioneer in the cable field and is still pioneering new concepts in cable design and construction.

Manufacturers of all types of electrical products are replacing conventional materials with thin, tough "Mylar". You, too, can improve performance, cut costs by capitalizing on the unique combination of properties of Du Pont "Mylar":

• High dielectric strength, average of 4,000 volts per mil\*\*, average power factor of 0.003 at 60 cycles.

• Thermal stability from -80° to 300°F.

• Chemical, moisture resistance.

• Resistance to abrasion, aging, tearing, rotting.

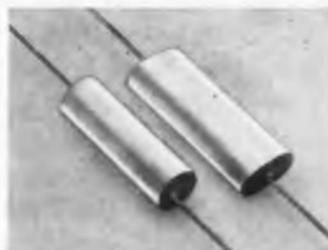
In addition, when figured on an area basis, "Mylar" will often cost you less than your present material. For the full facts on "Mylar", write for free booklet. E. I. du Pont de Nemours & Co. (Inc.), Film Department, Wilmington 98, Del.

\*\*Per ASTM D-149.

#### Consider the advantages of "Mylar" for these applications



HERMETIC MOTORS — 35° F. higher operating temperature.



CAPACITORS — Superior moisture resistance and longer life.



TRANSFORMERS — Reduced size without loss of rating.

CIRCLE 25 ON READER-SERVICE CARD



BETTER THINGS FOR BETTER LIVING  
... THROUGH CHEMISTRY

DU PONT  
**MYLAR**  
POLYESTER FILM

# ANNOUNCING



Model 520 . . . manual range switching AC, DC, OHMS . . . Rack or portable.  
Model 500 . . . automatic range switching DC only . . . Rack or portable.

## The First New Development in Digital Voltmeters

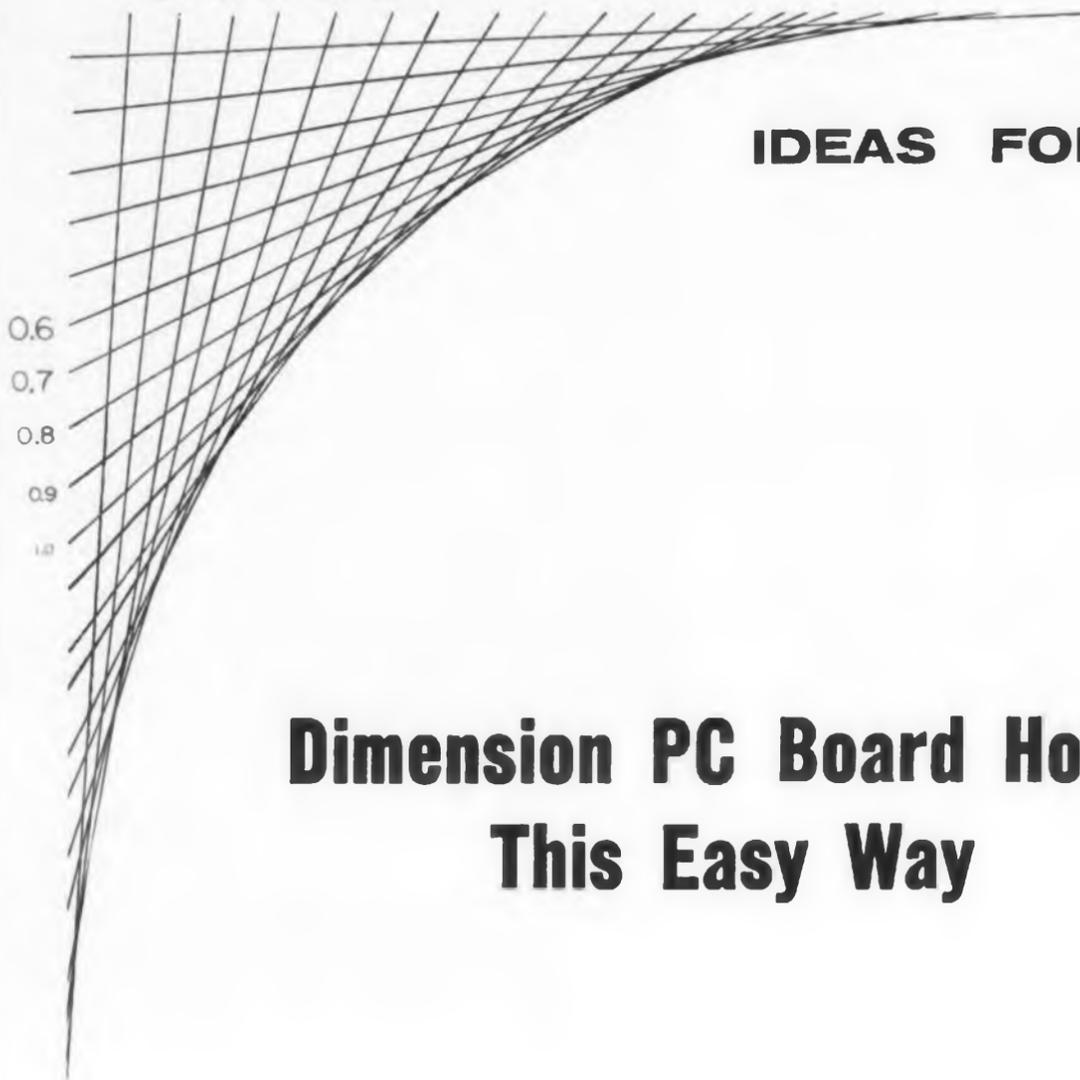
- Absolute dc accuracy . . . 0.1% full scale.
- \*Input impedance (dc) . . . approaching infinity except on 1200 V dc which is 20 megohms.
- Requires no lead switching . . . polarity indication is automatic.
- Requires no range switching on Model 500 . . . range is switched automatically.
- High stability, all-electronic four-digit indication appears in less than 125 milliseconds after step function voltage is applied across test leads.
- 0.001 to 1200 V dc range. Model 520 also reads 0.001 to 1200 V ac and 1 ohm to 1 meg.
- Output provisions for direct drive of printer or tape punch.
- Rack mounting or portable.
- Guaranteed long term stability at least 24 hrs. after 10-minute warmup and internal calibration.

\* May be quickly zeroed for effectively infinite input impedance.



CIRCLE 26 ON READER-SERVICE CARD

0 0.1 0.2 0.3 0.4 0.5



## IDEAS FOR DESIGN

### Dimension PC Board Holes This Easy Way

**T**HE USE of printed wiring panels has brought up some problems not hitherto encountered in drafting. It is very common to find a printed wiring board, say 5 in. x 8 in., with a couple of hundred holes in it.

If the conventional method of dimensioning and locating the holes were used, the drawing would be so full of dimension lines and arrowheads that the result would be a hair scratching problem for the poor fellow responsible for manufacturing the boards.

#### A First Improvement

To alleviate the situation, the following method has been used with success. All the holes on the board are given numbers in orderly fashion, let us say from left to right and progressing in lines from top to the bottom of the board.

Two of the edges are used as reference, and the location of the holes is presented in tabular form, by giving distances from the two reference lines. Hole sizes are also shown on the same tabulation.

This is an improvement over the conventional method, but the following system should prove to be even better when layouts with a great concentration of small holes are to be made.

#### Grid System is Better

The grid system, using increments of tenths of an inch, is the basis of the numbering system in this method.

Two reference lines, perpendicular to each other and normally parallel to two of the sides of the printed wiring board, are arbitrarily selected and shown on the drawing. Each hole is given an identification number, which at the same time determines its location on the board.

As the legend on the drawing explains it, the first two digits locate the hole by giving its distance from the vertical reference line in inches and tenths of an inch. The last two digits give its distance from the horizontal reference line. For example, a hole designated as 2356 is 2.3 in. from the left edge of the board and 5.6 in. down from the top edge.

In case the boards are larger than 10 in. in either or both dimensions, a six-digit code could be used. On the other hand, since it is desirable to minimize the number of digits, and to eliminate most of the zeros which would be necessary for dimensions smaller than 10 in., an acceptable practice would be to put a dot separating the two sections of the designation such as 115.07. This would in-

indicate that the hole is 11.5 in. from the left edge and 0.7 in. from the upper edge.

#### For Special Cases

In cases where no two straight edges perpendicular to each other exist, or where the board is bounded by curved surfaces, arbitrary reference lines outside of the board may be set up. The holes can be dimensioned from these lines which, incidentally may refer to some known or set lines on the jigs holding the boards during drilling or punching.

Tube sockets or other hole clusters can be identified by the locations of their cluster centers. Their details can be shown separately.

If the layout is such that components like resistors and capacitors are oriented vertically or horizontally, and their lead spacing is uniform at say, one inch, the drawings may be further simplified by showing the location of one hole, and joining the hole for the second lead with a line.

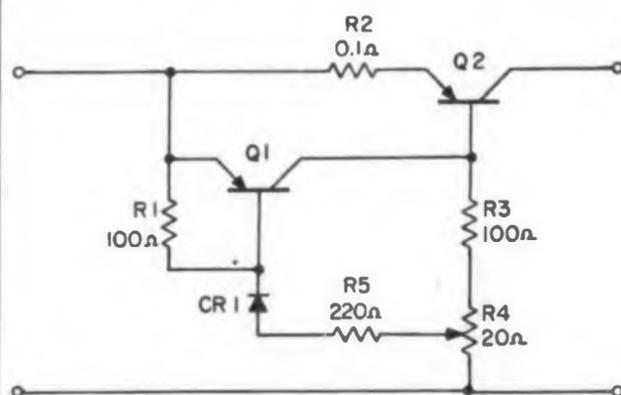
Going one step further, one can code the holes to show their size. This can be done by adding a one-digit suffix, in the form of one letter. For instance, 1294E is an E size hole located at 1.2 in. from reference A and 9.4 in. from reference B.

Ara M. Baltayan, Research Engineer, Automatic Signal Div., Eastern Industries, Inc., East Norwalk, Conn.

#### Surge Limiter Protects Overvoltage Protector

In the May 27th issue of ELECTRONIC DESIGN, this section showed a circuit designed by Victor P. Holvec, Collins Radio, for overvoltage protection. An outstanding shortcoming of this circuit lies in the fact that the transients on the 28 v line can go as high as 80 v. There is nothing in the circuit to limit the current through CR1 and the emitter-base junction of Q1. Excessive currents are possible and they can cause component failure in operation.

The addition of a surge limiting resistor in series with CR1 can limit the current magnitude



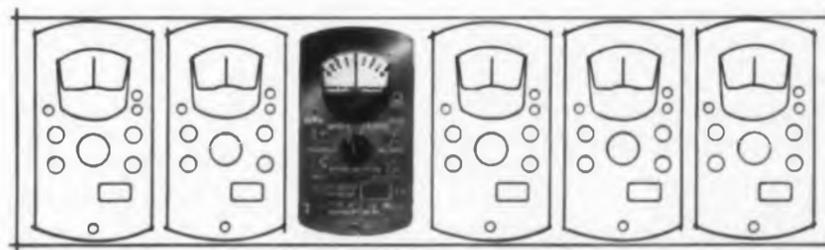
Surge limiting resistor R5 protects this over-voltage protector from surge currents through CR1.

(Continued on page 32)

# TRANSISTORIZED PHASE-LOCK FM-FM GROUND STATION:

# 1/6<sup>TH</sup>

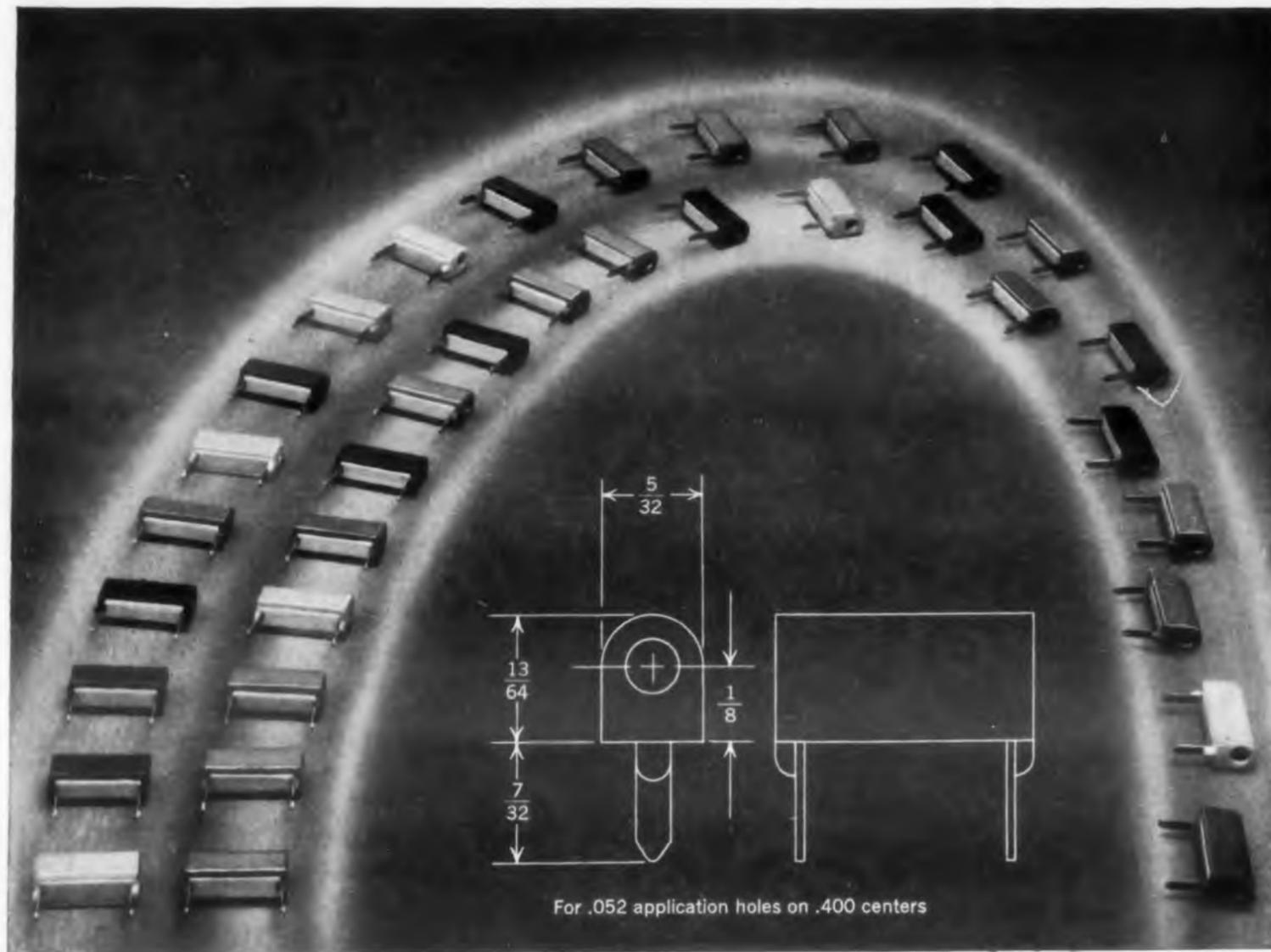
# THE SIZE, AND



Low power consumption, less heat dissipation, increased reliability, low threshold. Six discriminators in 5¼" x 19" standard rack. For information write Dept. F, Vector Mfg. Co., Southampton, Pa.

Visit our booths 1, 2, 3, and 4 at National Symposium on Telemetering in San Francisco, September 28, 29 and 30.

CIRCLE 27 ON READER-SERVICE CARD



Patent Pending

## New Test Jacks for Printed Circuits

Designed for permanent assembly to printed circuit boards, these new test jacks by Ucinite are easily accessible to standard .080 test probes and eliminate the need for individual adaptor boards.

Simple, economical construction ensures reliability and reasonable cost. Gold-over-silver-plated beryllium copper contacts provide dependable, low-resistance connections. Nylon bodies are available in eleven standard code colors specified as follows: Part number (119437) plus letter suffix . . . A-Opaque

White, B-Red, C-Black, D-Brown, E-Green, F-Orange, G-Blue, H-Yellow, J-Gray, K-Violet, L-White translucent.

With an experienced staff of design engineers plus complete facilities for volume production of metal and plastic parts and assemblies, Ucinite is capable of supplying practically any requirement for fasteners, connectors, switches and other small metal and metal-and-plastics assemblies. Call your nearest Ucinite or United-Carr representative for full information or write directly to us.

Manufactured by

**The UCINITE COMPANY**

Division of United-Carr Fastener Corporation, Newtonville, Mass.



CIRCLE 28 ON READER-SERVICE CARD

## IDEAS FOR DESIGN

(Continued from page 31)

to a value around 0.5 amp, which will not be excessive. The circuit gain is still high enough that the overall performance will not be impaired.

Roy P. Foerster, Baltimore, Md.

### Firing Series VR's

In stabilizing dc voltage by means of voltage regulator tubes, two or more units have to be used in series if more than 150 v regulated output is required.

For a single VR tube, minimum supply voltage must equal or exceed the maximum possible starting voltage (breakdown voltage) of the respective tube type. For two or more VR's in series, without suitable circuitry, supply voltage has to be the sum of starting voltages of all tubes.

In "Ideas for Design" of July 22, 1959, the circuit of Fig. 1 appeared, incorporating a diode and two resistors for easy starting of two series VR's. Actually, the solution can be much simpler: The diode and one of the resistors can be omitted as in Fig. 2. Starting procedure is as follows:

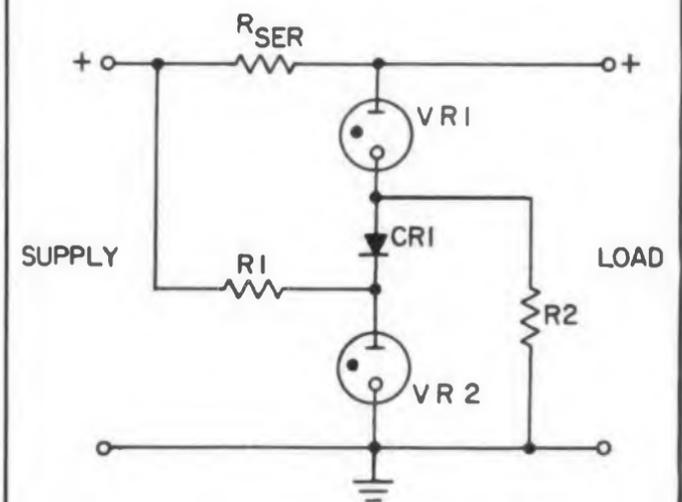


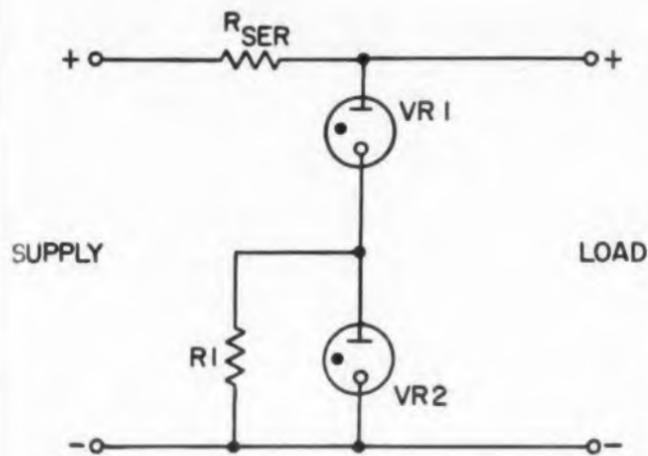
Fig. 1. Original circuit for firing VR's with less than twice the ignition voltage of one.

Before VR's are fired,  $R_1$  is transferring ground potential to VR1. By this means, full supply voltage ignites VR1. After that, supply voltage minus voltage of VR1 is applied to VR2. This balance has to be sufficient to fire VR2.

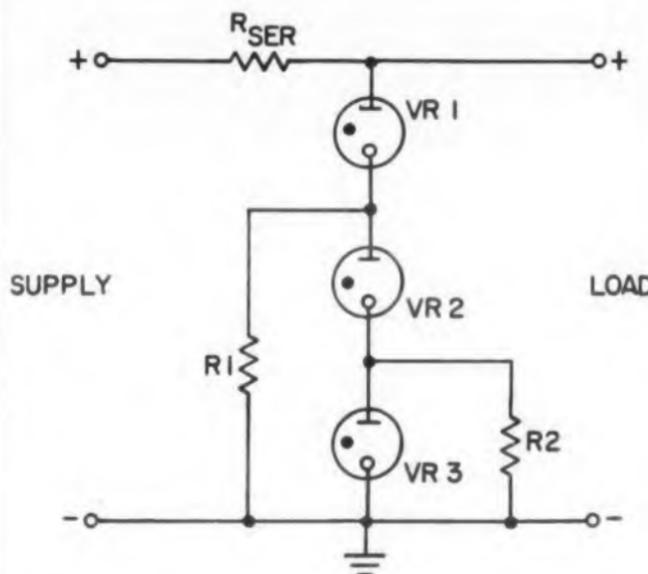
Fig. 3 shows the arrangement for three tubes in series. The sequence of firing is VR1-VR2-VR3. Minimum supply voltage required is the sum of voltages of VR1 and VR2, plus voltage of VR3.

# Electronic Products **NEWS**

by **CARBORUNDUM**  
Registered Trade Mark



**Fig. 2.** Simpler circuit for starting two series VR's on lower voltage.



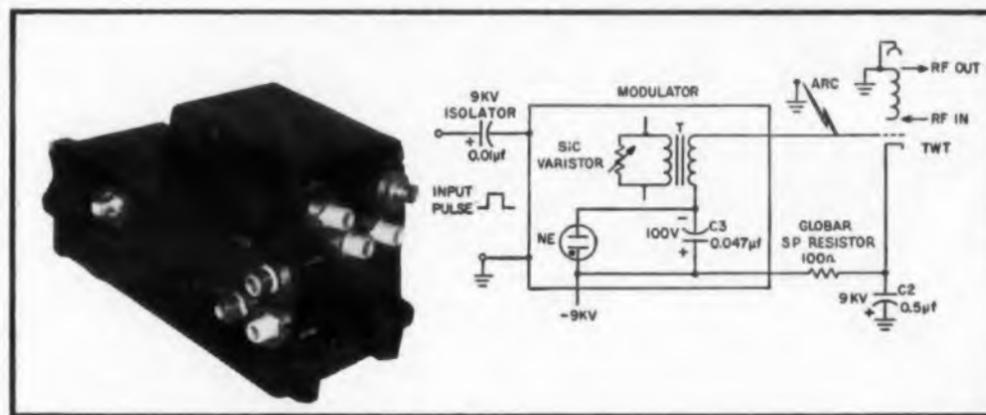
**Fig. 3.** For firing three VR's in series, supply voltage must equal the sum of the operating voltages of VR1 and VR3 and the ignition voltage of VR2.

If considerable load current is expected to flow before the VR's are fired, voltage drop due to this current through  $R_{SER}$  has to be added for minimum supply voltage.

In this latter case, part of the voltage drop on  $R_{SER}$  can be saved for starting VR's by using a tungsten bulb in place of  $R_{SER}$ . Resistance of the bulb with load current only, is lower than during operation with additional VR current. For this reason, voltage drop before VR's are fired is lower than it would be on a fixed resistor  $R_{SER}$ .

Moreover, this bulb improves regulation against supply voltage variations. (For choosing bulb type, see "Light Bulbs for Special Applications" in the August 19th issue of *ELECTRONIC DESIGN*).

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



## MEGAWATT transient handled by GLOBAR® 5 Watt SP Resistor to protect Miniaturized Pulse Generator

A tough problem was recently solved by Ramo-Woolridge, a division of Thompson Ramo Woolridge, Inc. It concerned protection against a transient discharge that caused breakdowns in a miniaturized pulse generator.

The circuitry, as shown above, involved a modulator for a 1-kw grid-controlled traveling wave tube. The grid would often arc to ground, shorting the energy stored in the condenser C2 through the modulator circuit and vaporizing the decoupling resistor R or the bias filter C3.

The answer was found in a GLOBAR Type SP 100Ω resistor, able

to withstand the periodic 8000-v. discharge for several microseconds and to take a temperature of 1000 F. Since this resistor is non-inductive, it works well as decoupling element during normal operation, in addition to giving the protection needed when arcing occurs. 5 watt size 1¼" long, 5/16" diameter, obviates any space problem.

This example may suggest many similar applications. For more details on GLOBAR resistors, write Global Plant, Refractories Division, Dept. EDR99, Carborundum Company, Niagara Falls, N. Y.

CIRCLE 712 ON READER-SERVICE CARD

## CERAMIC DRUM AND END PLATES for radio tuner GROUND TO .001 ACCURACY

The drum coil and end plates shown in the photo are parts of a tuner for the Transport Radio Command and Ground Radio Command. The plate holes are ground to size with an



accuracy of  $\pm .001$  and the hole spacing is held to a tolerance of  $\pm .002$ . The drum with its stainless steel bearing sleeves is a direct ceramic-to-metal assembly. The bearings must withstand a vertical load of 60 lbs. Three of the end holes are tapped. The slot, the pitch and the depth of the spiral winding groove are ground to tolerances of  $\pm .001$ .

This is an example of the accurate specifications that can be met with equipment at Carborundum's Latrobe Plant, which specializes in ceramic, ceramic-to-metal and glass-to-metal assemblies. Facilities are available for small or large production runs. For more information, write Latrobe Plant, Refractories Division, Dept. EDC99, Carborundum Company, Latrobe, Pa.

CIRCLE 714 ON READER-SERVICE CARD

## Vacuum-tight, matched expansion GLASS-TO-METAL WINDOWS



Part No.	F	D	H
95.6006	11/16	.490	.175
95.6009	3/8	.281	.187
95.6010	7/8	.490	.078
95.6011	3/8	.250	1/8
95.6013	.220	.150	.150

Windows of the type shown above have a variety of applications where truly reliable vacuum-tightness or gas-tightness over a considerable temperature range is desired.

The advantage of these windows is that the frame and glass are united to form a chemically bonded, hermetically sealed unit. Use of KOVAR® alloy and borosilicate hard glass, which have practically identical expansion characteristics, eliminates stress and strain.

Large quantities of these windows are manufactured by Carborundum's Latrobe Plant. Bulletin 5133, giving complete information, is obtainable by writing to Latrobe Plant, Refractories Division, Dept. EDS99, Carborundum Company, Latrobe, Pa.

CIRCLE 713 ON READER-SERVICE CARD

## NEW BOOKLET AVAILABLE ON GLOBAR® Type BRN VARISTORS



Non-linear, voltage sensitive resistors are finding many applications for stabilization or voltage control in electronic circuits. This booklet gives full information. For your copy, write Global Plant, Refractories Division, Dept. EDV99, Carborundum Co., Niagara Falls, N. Y.

CIRCLE 715 ON READER-SERVICE CARD



CIRCLE 712 THROUGH 715 ON READER-SERVICE CARD

# HOW TO BUILD A BATTERY BOX WITH RESISTORS...

it's easy with a

## Regatron Programmable Power Supply

Shunt the programming terminals of a Regatron Programmable Power Supply with a resistor, and you've set the output voltage to 1/1000 of the resistor's value. Yet the resistor carries no load current, does not affect regulation or maximum output current capabilities. Several resistors and a multiple-position switch make a compact "battery box" for the voltages you use most often . . . it's as simple as that.

In addition, you'll find that Regatron Programmable Power Supplies have all the other advanced features you would expect in a versatile laboratory instrument; super-regulation, vernier as well as main voltage control, and more. Compare a Regatron Programmable Power Supply with any other d-c power source, batteries included. You'll find you won't settle for less.

Regatron Programmable Power Supplies are available in voltage ranges covering 0-50 V dc, 0-100 V dc, 0-300 V dc, and 0-600 V dc. Current ratings are up to 3A, depending on model. Request Bulletins 350 and 765.

(Various models without the programming feature are also available in voltage ranges up to 1000 V and currents up to 1 ampere.)



### TRANSISTOR TYPES

MODEL NUMBER	OUTPUT		REGULATION				MAXIMUM RIPPLE IN MV
	Voltage	Current	LINE 105-125 V AC 50-60 CPS		NO LOAD TO FULL LOAD		
			%	V	%	V	
212A <sup>1</sup>	0-100 V DC	0-100 MA	0.15	0.05	0.1	0.05	1/2
2-212A <sup>1</sup>	EQUIVALENT TO TWO MODEL 212A's. OUTPUTS MAY BE USED IN SERIES, PARALLEL, OR INDEPENDENTLY.						
224A <sup>1</sup>	0-100 V DC	0-200 MA	0.15	0.05	0.1	0.05	1
220A	0-50 V DC	0-500 MA	0.1	0.05	0.1	0.05	1
221A	0-100 V DC	0-500 MA	0.1	0.05	0.1	0.05	1
213A	0-50 V DC	0-1 AMP	0.1	0.05	0.1	0.05	1
214A	0-100 V DC	0-1 AMP	0.1	0.05	0.1	0.05	1
215A	0-50 V DC	0-3 AMP	0.1	0.05	0.1	0.05	1
218A	0-100 V DC	0-3 AMP	0.1	0.05	0.1	0.05	1

<sup>1</sup> Modulation input provided for measurement of transistor parameters by small signal method.

© REGISTERED U.S. PATENT OFFICE. PATENTS ISSUED AND PENDING.

**ELECTRONIC MEASUREMENTS COMPANY, INCORPORATED**  
EATONTOWN • NEW JERSEY

CIRCLE 30 ON READER-SERVICE CARD

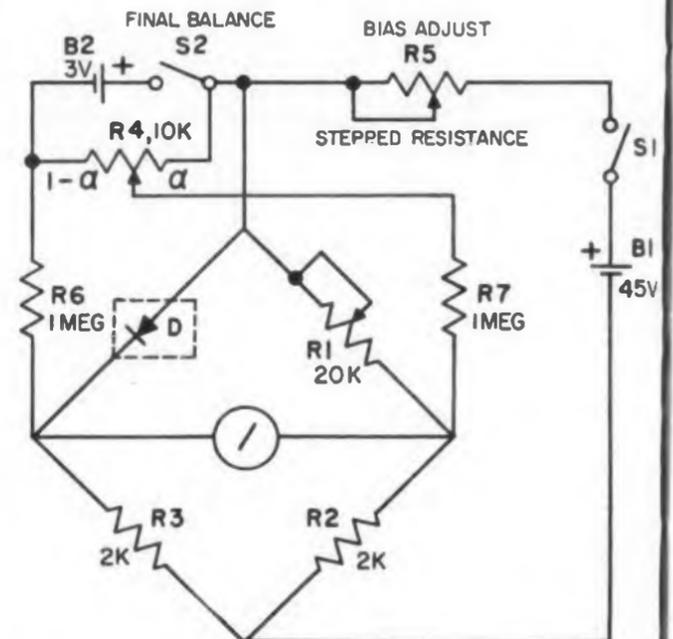
## IDEAS FOR DESIGN

### Simple Dc Tester For Video Crystals

Video crystals can be tested and matched on microwave test setups. But where only a few crystals are to be checked, this can tie up thousands of dollars worth of equipment and the services of highly skilled personnel. Even with the same operator, and especially from operator to operator, the results of rf determination of tangential sensitivity vary widely from measurement to measurement.

The usual dc type tests show no correlation with rf measurements. But the tester shown in the figure gives consistent results, even when used by unskilled operators.

It is essentially a double Wheatstone bridge. Initially, the bias current is set, and one of the Wheatstone bridges is balanced to determine the forward resistance of the crystal.



Double Wheatstone bridge serves for video crystal measurements.

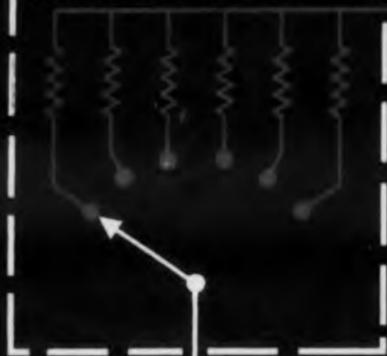
A known increment of current is then sent through the crystal, unbalancing the bridge. Then the second Wheatstone bridge is balanced by forcing a current, equal to a fraction,  $\alpha$ , of the crystal current increment to flow through the balancing resistor,  $R1$ , of the first bridge, to raise its voltage drop to that of the crystal.

If the increment of crystal current is  $i$ , the increment of crystal voltage is  $ri$ , and the increment of voltage across  $R1$  is  $\alpha iR$ . Then

$$ri = \alpha iR \quad \text{and}$$

$$\alpha = r/R = 1/x$$

1.5K 3K 7.5K 22.5K 45K 90K  
1-W 1-W 1-W 1-W 1-W 1-W



REGULATED D-C OUTPUT

1.5V 3V 7.5V 22.5V 45V 90V



This gives two of the crystal parameters: the dc resistance  $R$ , and the nonlinearity  $\alpha$  (or  $x = 1/\alpha$ ). The video resistance is given, simply, by

$$r = \alpha R$$

and the figure of merit by

$$M = \frac{1}{2I} \frac{1 - \alpha}{\sqrt{R} \sqrt{\alpha}}$$

This Video Crystal Paper was the subject of a paper given at the 1959 National Convention of the IRE.

Y. J. Lubkin, Airborne Instruments Laboratory, Mineola, N.Y.

### Low Cost Substitute For Calibrating Meter

A test oscillator should have a calibrating meter. But for a pocket-sized oscillator, the usual meter would be bulky and expensive.

Zener diodes can serve as a simple, yet accurate calibrating device. One oscillator uses back-to-back Zener diodes that clip at 4.25 v. When the oscillator amplitude exceeds 4.25 v, clipping can be observed on a scope.

In use, the oscillator is adjusted to a point slightly below the clipping level, so it yields a sine wave. An external potentiometer sets the maximum output level at 3 v and other amplitudes are obtained from a calibrating attenuator.

L. G. Cowles, Electronic Design Engineer, Superior Oil Co., Bellaire, Tex.

### File Paper Dolls For PC Work

Each time a printed circuit is laid out, it is necessary to make scaled-up cutouts for each component. These "paper dolls" must be drawn over and over again, then cut out by each person developing a circuit layout.

A simple solution requires drawing the scaled-up components on an 8-1/2 x 11 piece of vellum. The drawings may have as many components as size permits. Thus, one sheet may have 1/2 w resistors, another may have one watt resistors, etc.

The master sheet can be filed, and prints can be made at anytime in the future. The pieces can be applied and shifted around by using two-sided adhesive tape like Scotch #400.

Nicholas Scarola, Designer, ITT Labs., Nutley, N.J.



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

Tubes are suited to the job—at SPERRY

## TWO NEW BROADBAND, HIGH POWER CW TWT AMPLIFIERS FROM SPERRY

P-BAND 240-510 mc

L-BAND 500-1000 mc



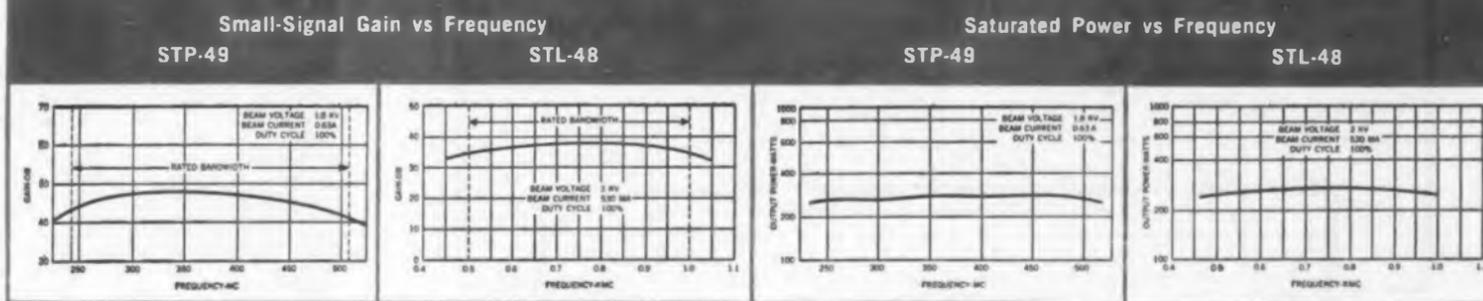
STP-49



STL-48

### SPECIFICATIONS:

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



In these two new TWT's, Sperry brings you the unique combination of high output power, broad bandwidth, and rugged environmental construction for the P and L bands. They are the only tubes of their kind available. Together they offer a frequency range of 250 to 1000 mc for such cw applications as "over-the-horizon" communications, long-

distance TV and radar, tropo-scatter networks, mobile and point-to-point microwave and any other type of amplifier service where high gain, high power and freedom from tuning are desirable. They can be used to transmit narrow-band signals having many channels—or fewer signals requiring wide bandwidth. Both tubes are of all metal-ceramic

construction, ruggedized, reliable and stable in both open and short circuits. Sample quantities available now. Write for complete data.

# SPERRY

SPERRY ELECTRONIC TUBE DIVISION, SPERRY RAND CORPORATION, GAINESVILLE, FLORIDA  
Address all inquiries: Gainesville, Florida, or Sperry Offices in Brooklyn, Boston, Philadelphia, Los Angeles and Montreal, Export Dept., Great Neck, New York

CIRCLE 31 ON READER-SERVICE CARD

Advancing the  
solid-state

art . . .  
NO. 2

# DC POWER

## ...STEADY AS A ROCK!

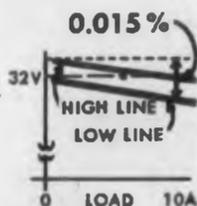
Maintain Tight Regulation  
Despite Combined Effects of  
Time, Dynamic and Temperature,  
Static Line and Load Changes.

You can solve your power supply problems overnight by selecting the appropriate set of our Transistorized Power Supplies, because we think of, design for, and test to all the requirements for truly rock-solid DC power.

A certified report on 17 production tests accompanies each ARMOUR supply. Here is typical performance data:

### TOTAL STATIC REGULATION —

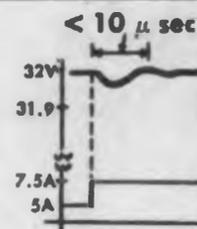
against worst combination of simultaneous static line and load changes.



MODEL 210 B

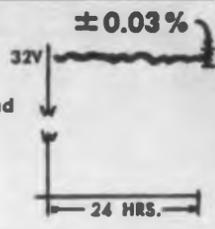
### DYNAMIC RESPONSE —

duration of transient component of output change due to instantaneous load (or line) change.



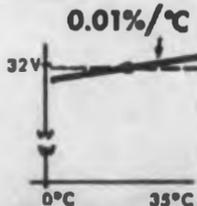
### STABILITY —

after warm up, with constant line, load and ambient conditions.



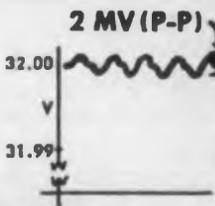
### THERMAL REGULATION —

output variation due to ambient temperature change, at constant line and load.



### RIPPLE —

total of spikes, hash, periodic and h-f aperiodic components of output.



MODEL	OUTPUT RANGE		STATIC REGULATION		RIPPLE MV RMS	PANEL (INCHES)	PRICE
	VOLTS	AMPS	LOAD	LINE			
T-200-B	0-10	0-3	.02% or 3MV	.01%	0.7	3 1/2"	\$395
T-205-B	0-10	0-10	.03% or 6MV	.01%	0.7	3 1/2"	\$495
T-210-B	0-10	0-30	.02% or 6MV	.01%	0.7	5 1/4"	\$725
T-215-B	0-32	0-1	.02% or 3MV	.01%	0.7	3 1/2"	\$450
T-220-B	0-32	0-3	.02% or 3MV	.01%	0.7	3 1/2"	\$525
T-225-B	0-32	0-10	.02% or 5MV	.01%	0.7	5 1/4"	\$695
T-230-B	0-150	0-0.75	.01% or 1MV	.03%	2.0	3 1/2"	\$545
T-235-B	0-150	0-2	.01% or 4MV	.03%	2.0	5 1/4"	\$625



### ARMOUR ELECTRONICS

Division of Cardinal Instrumentation Corporation  
4201 Redwood Avenue - Los Angeles 66, California

TRANSISTORIZED POWER SUPPLIES  
TRANSISTOR TESTERS • LINE REGULATORS

CIRCLE 32 ON READER-SERVICE CARD

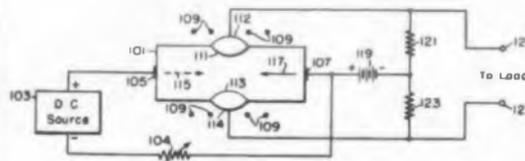
# PATENTS

### Semiconductor Translating Device

Patent No. 2,862,184. Richard L. Lougini.  
(Assigned to Westinghouse Electric Corp.)

A slightly doped semiconductor couples a current consisting of minority carriers to a load. This current is proportional to the magnitudes of a transverse magnetic field and the current flowing through the semiconductor.

The figure shows a thin rectangular n-type semiconductor plate 101 connected to battery 103 through low-resistance terminals 105 and 107 such that minority carriers 115 and majority carriers 117 flow in the directions shown. Terminals 111 and 113 are pn junctions



which offer low impedance to the flow of holes. With an ac magnetic field present, the holes are deflected to the pn junctions and flow through the load depending upon the strength of the magnetic field and the quantity of current from the battery.

### Cathode Ray Tube For Presenting Stored and Non-Stored Displays

Patent No. 2,884,558. George F. Smith.  
(Assigned to Hughes Aircraft Co.)

A storage assembly containing alternate rows of storage slots permits stored and non-stored displays in a multigun electrostatic deflection cathode ray tube.

The non-storage gun 16 is aimed through mesh 30 to pass through the non-storage slots of the control grid 80 and the electron beam is accelerated to the luminescent screen 88. An intensity

where skilled hands  
make the  
difference

For 90 years The Falstrom Company has been fabricating quality cabinets, consoles, housings, chassis, weldments, and custom components to critical specifications, in many metals and alloys.

Starting with your basic design, Falstrom engineers will study your particular problem and suggest ways and means to improve your product while keeping costs low.

Falstrom's extensive fabricating facilities are at your service.

WRITE OR CALL FOR FREE BULLETINS

## FALSTROM COMPANY

169 Falstrom Court, Passaic, New Jersey PRescott 7-0013

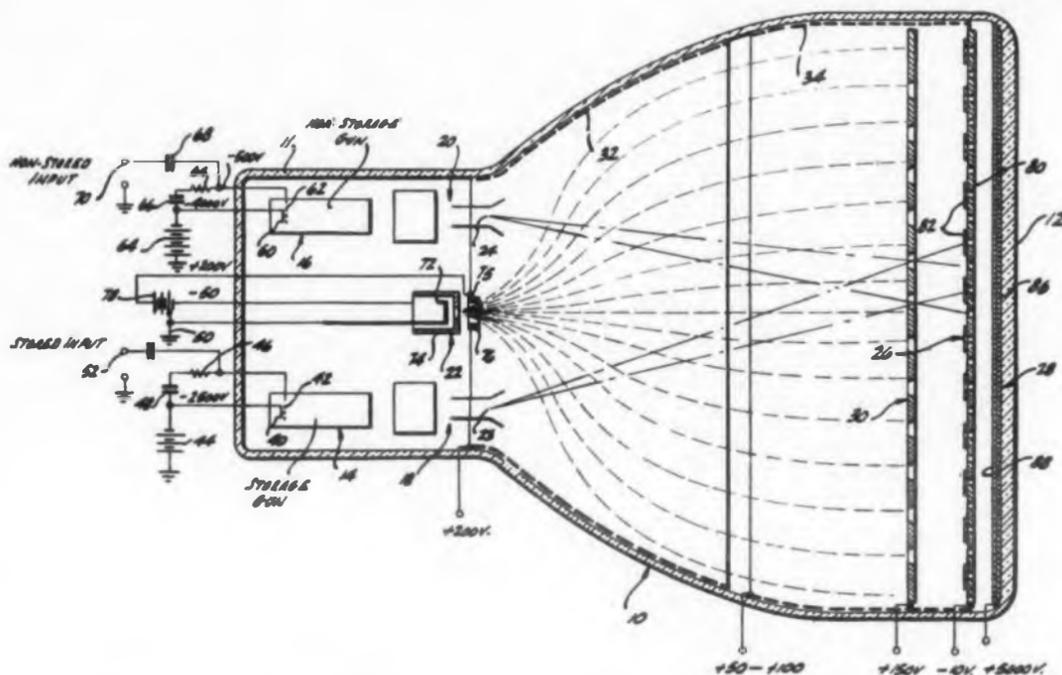
CIRCLE 33 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 2, 1959

modulated display of the signal coupled through capacitor 68 produces a pattern similar to that from a conventional ordinary persistence cathode ray tube.

Electron gun 14 generates a beam directed through mask 30 to strike the insulator 82 (magnesium fluoride) deposited on alternate layers of storage tar-

get 80. A charge pattern is laid down on the insulator according to the signal applied to terminal 52. Thereafter, flood gun 22 illuminates the entire storage surface and the collimated electron beam is gated according to the charge pattern to produce a high-brightness, long-persistence display of the stored signal.



## MICRO-MINIATURE precision wire-wound RESISTORS

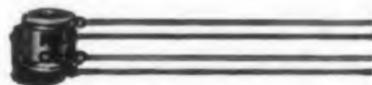
fixed, noninductive

*newly developed Kelvin "RELAXED WINDING" techniques practically eliminate resistance drift with age and "shorts" or "opens" due to thermal shock.*



### PLASTIC ENCAPSULATED SERIES "EP"

The 0.05W micro-miniature type EP-00 is .080" dia. x .325 long, 50K ohms max. resistance. Available with radial and axial lead wires. ALL CONNECTIONS ARE WELDED. High temperature epoxy plastic is used in an exclusive vacuum encapsulation process. Standard resistance tolerances to 0.1% (specials to 0.01%). Environmental temperature range: -65°C to +125°C.



### CERAMIC SERIES "CB"

The 0.15W miniature type CB-05 is 1/8" dia. x 1/4" long, 00 K ohms max. resistance. Available with radial and axial lead wires. Standard resistance tolerances to 0.1% (specials to 0.01%). Environmental temperature range: -55°C to +85°C.

send for complete literature



**KELVIN  
ELECTRIC COMPANY**

TRiangle 3-3430 • SState 2-6662

5907 Noble Avenue, Van Nuys, California

CIRCLE 34 ON READER-SERVICE CARD

## R. F. FILTERS FOR SCREEN ROOMS



Model LP-200

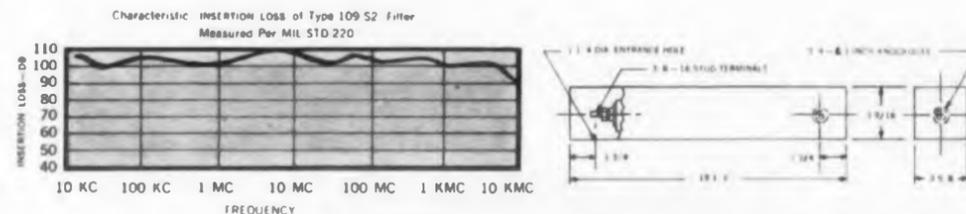
### POWER LINE FILTER

This low-pass Antran unit filters out the interference conducted by power lines entering the screen room. Attenuation is as good as that of the screen enclosure, or better—you get a room free from interference when using this unit.

**Filter is rated at 50 amps**—enough for almost any current requirement. Voltage rating is 250V—0 to 60 cycles. One filter is used for each incoming wire.

**Rugged construction**—unit is built to withstand continuous operation. Case is heavy gage steel, hot tin dipped. Terminals are shielded and enclosed, with removable access plates, and knockouts on three sides.

**Delivery from stock.** Send for complete data.

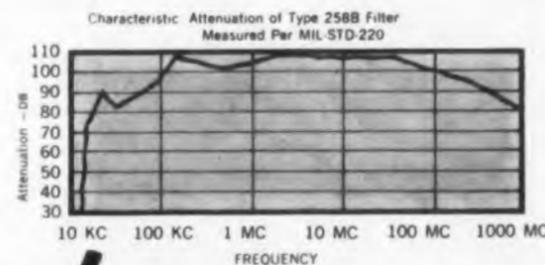


Model LP-201

### TELEPHONE LINE FILTER

—enables you to use telephones, intercoms, or other audio equipment in the screen room. A balanced unit, it can be employed for any audio purpose. The 600-ohm impedance matches that of the telephone line. Unit has a telephone connector block for wiring to 'phone lines. Size: 8 1/2" long x 2 1/2" square. Delivery from stock.

**Other screen room filters.** Antran manufactures a wide variety. Send us your requirements.



**Antran**  
— a division of  
International Electronics Manufacturing Company

2nd Street Extended,  
Greenwood Acres,  
Annapolis, Md.

CIRCLE 35 ON READER-SERVICE CARD



## DESIGNING YOUR FUTURE

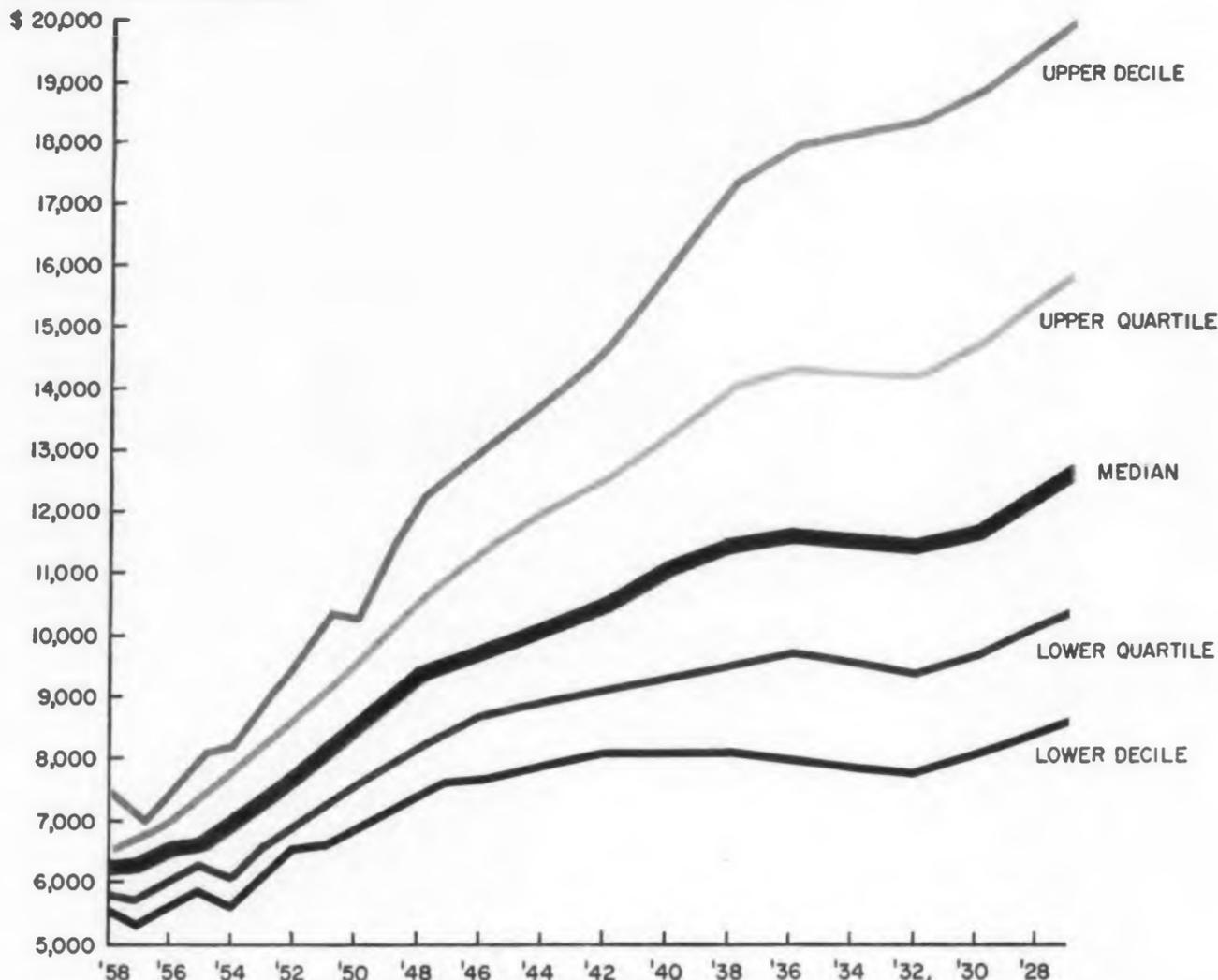
# Look Before You Leap into That Job!



**Robert DeFloria**  
Principal Engineer  
Ford Instrument Co.  
Long Island City, N.Y.

In his work in the last twelve years, Robert N. DeFloria has been in touch with many engineers around the country. He has, he says, been impressed by the variety of careers in the industry. But he has also noticed that many careers seem to be the product of "a series of accidents" instead of careful planning. "Such a state," he says, "is a needless personal tragedy in this dynamic profession, and, in the light of the world situation, constitutes a national waste."

ANNUAL SALARY BY YEAR  
OF ENTRY INTO PROFESSION



Salary plotted as a function of years of experience—from a study by the Engineers Joint Council. This aspect of the study covered 42,643 engineers in the electrical machinery and electronics manufacturing field. Median earnings ranged from nearly \$11,500 for an engineer who entered the field in 1928 to \$6200 for one just out of engineering school. The highest average salary for a 30-year man was \$20,000, against \$8875 for a newcomer. The lowest average: \$8575 for 30 years' experience and \$4250 for the beginner.

IN ANY DESIGN project, the objectives must be specified at the outset. What should be the objectives of the engineer designing a career?

In a recent survey conducted by the advertising firm of Petrik & Stephenson, the two reasons most often given by engineers for changing company affiliation were higher salary (29 per cent) and greater responsibility (27 per cent). By contrast, company reputation and policy were cited as a reason only 3 per cent of the time.

If salary and responsibility are the goals of the majority of engineers on the move, are they also the wisest? Careful analysis suggests that they are not. Let us examine what is wrong with these goals and then present more logical objectives for the career designer.

### Pay Linked to Experience

Higher salary as an objective seems pointless in view of salary statistics. In a survey conducted by the Engineering Manpower Commission of the Engineers Joint Council, engineering salaries last year were plotted as a function of *years of experience*. In a statistical study reported in the IRE Transactions on Engineering Management (June, 1957) engineering salaries correlated highest with years of experience. Such items as class standing in engineering school, patents held and type of degree were much less significant. A West Coast concern is currently reported under fire from a military service because its average engineering salary is twice the industry average, indicating that the salary variation between companies is usually much less than this.

When the average young engineer is on the steep portion of the curve, he is ready to believe the "sky is the limit" help-wanted ads. At the knee of the curve, he begins to wonder if the slowdown in pay rises is not a reflection on his work.

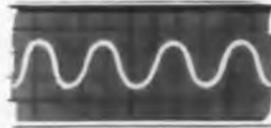
By the time he reaches the flat portion of the curve, he probably realizes that salary differences in the industry are not very great after all. And he will realize, often too late, that he should have had other objectives in planning his career—if indeed it was planned at all. A 10 or 20 per cent salary variation (before taxes) may now seem a poor substitute for the challenging position he passed by.

In many companies there is a real difference between the salary ceiling for

# ON YOUR COMMAND



the satellite reports scientific data back to

earth.  At the ground station, special communications equipments receive and demodulate space telemetry signals.  A data

processing system analyzes findings which are fed in turn to the satellite control network and the computer memory banks, increasing man's knowledge of his newest frontier. 

*The complete system*—from the space communication network of the space vehicles to the complex data-processing equipment of the ground station complex is a product of your team—if you're at Philco in Palo Alto—in the San Francisco Peninsula's new electronic center. A position with this trail-blazing group can be yours—now! Graduate engineers are needed for equipment design and for systems engineering, analysis and integration. Write now, in confidence, to  
Mr. H. C. Horsley, Engineering Placement.



## PHILCO WESTERN DEVELOPMENT LABORATORIES

3875 FABIAN WAY, DEPT. D9 • PALO ALTO, CALIFORNIA  
A PART OF THE GOVERNMENT AND INDUSTRIAL DIVISION OF PHILCO CORPORATION  
CIRCLE 900 ON CAREER INQUIRY FORM

managers and for the technical engineer. The upper end of the salary curve probably represents primarily those engineers who have moved into management. The difference in salary is often accompanied by difference in prestige.

But since, of necessity, only 5 to 10 per cent of engineers are in management posts, the engineer with managerial responsibility as his sole objective faces a high probability of failure. Moreover, many engineers who do enter the ranks of management are not temperamentally suited for the work and cannot feel satisfied in it. Yet they cannot satisfy their need for recognition or salary outside management.

How then does the engineer go about specifying his career objectives? First, he must resolve, as Winston Churchill did: "Never do anything just for the money." He must also resolve not to let his career be the result of chance happenings. He must take the time to decide, realistically and analytically, what is important enough to occupy the rest of his life.

A four point program is suggested to design an engineering career:

1. Analyze the engineering profession.
2. Analyze industrial trends.
3. Analyze yourself.
4. Analyze the prospective company.

Man's greatness has always been evidenced by the engineer's works, from the days long before the Roman aqueducts to the development of instant world-wide communications. But they have never before been so central to the course of history. For the first time, man is about to venture beyond his planet—courtesy of the engineer and scientist. As never before, the nation that dominates the sciences dominates the world.

### Perspective is Essential

Where does this fit in career planning? An engineer aware of his place in the grand scheme of history will have the perspective to align his career with the future. But more than that. It will give him pride in his profession and a sense of contributing that will sustain his enthusiasm for his work far more than a slight difference in salary or fringe benefits. Any student of great men will have learned that it is these drives that are the most effective in inspiring men to accomplish the "impossible." Perspective

The Eclipse-Pioneer Division of Bendix Aviation Corporation

## Announces a Newly Expanded Program

of Advanced Research and Development in

# TRANSISTORIZED AIRBORNE DIGITAL COMPUTING SYSTEMS

We take pleasure in announcing the expansion of our Advanced Research and Development program in solid-state airborne digital computers and digital control systems. Our staff is now interviewing experienced engineers interested in exploring new concepts in digital computation and currently qualified in one of the following areas:

Digital Systems Synthesis	Input-Output Devices
Logical Design	Transistorized Circuitry
High Speed Switching	Pulse Techniques
Logical Implementations	Miniaturization
Magnetic Memory	Micro-Miniaturization

If you are interested in participating in this program, forward a brief resume of your experience and educational background to Dr. Arthur S. Robinson, or telephone Mr. E. Nordstrom at ATlas 8-2000 or BRyant 9-8541.

ECLIPSE-PIONEER DIVISION



AVIATION CORPORATION

Route 46 at 17, Teterboro, New Jersey

(Located in suburban New Jersey, 10 Minutes from New York City)

CIRCLE 901 ON CAREER INQUIRY FORM

## DESIGNING YOUR FUTURE

requires continuing interest in international politics and economics and participation in current developments.

The next step is to analyze industrial trends in engineering. Failure to do this may trap the engineer in a shrinking specialty with low morale and poor prospects. For example, ten years ago a man with foresight might have seen that missiles would take on many of the functions of the manned bomber, that digital computers would cut into the analog market and that transistors have many advantages over vacuum tubes. He could have turned this judgment to advantage by directing his studies and job assignment to these more dynamic fields.

Today there is certainly sufficient indication from the literature and from government and corporate investments that microminiaturization is a field of the future. Courses in solid-state physics and electrochemistry and assignments in this field would be wise moves. This basis for selection is certainly more rational than convenience of classroom schedule or of commuting distance to a plant.

Making correct choices requires a broad knowledge of the military and commercial markets and an informed estimate of future requirements. The study of trade journals and publications of professional societies, and especially the study of reputable financial and economic services, will do more for the engineer's career than technical study in a dying field.

### Personality Must Match

The engineer's specialization must also be in tune with his personality. A mismatch here will considerably reduce his chance for job satisfaction and, therefore, success. There are many activities within the broad classification of engineering—from research, circuit design or production to magazine writing, sales or operations research. One field can surely be found to satisfy every personality. But the engineer must first determine his aptitudes.

There are many services that aid this process of self-analysis—the Veterans Administration, the Young Men's Christian Association and private personnel laboratories with professional analysts. Career planning concerns, advertising

(Continued on p. 43)

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.

18

(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*

<i>College</i>	<i>Dates</i>	<i>Degree</i>	<i>Major</i>	<i>Honors</i>

Recent Special Training \_\_\_\_\_

*Employment History*

<i>Company</i>	<i>City and State</i>	<i>Dates</i>	<i>Title</i>	<i>Engineering Specialty</i>

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

900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924  
 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949

# 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.

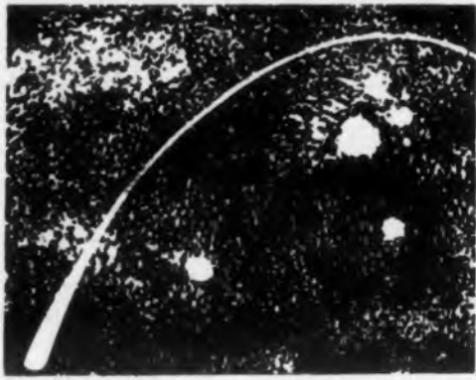
Study the employment opportunity ads in this section, and circle the numbers at the bottom of the form that correspond to the numbers of the ads that interest you.

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.



## **Bendix** YORK

*offers the opportunity  
and the challenge of  
key assignments in...*

### **GUIDED MISSILE ELECTRONICS**

**ELECTRONIC  
ENGINEERS  
MECHANICAL  
ENGINEERS**

Here is your chance to prove your ability doing *important* work on missile fuzing, beacons, guidance, packaging and related test equipment. We have key openings that offer you the opportunity to move ahead rapidly in your profession. At Bendix York, you benefit from the advantages of a small company atmosphere in a growing division of one of the nation's largest engineering and manufacturing corporations. Also, you'll enjoy the "good life" in our beautiful suburban community. Good salaries, all employee benefits.

Drop us a card, briefly stating your education & experience. We'll act immediately to get together with you and talk it over.

ADDRESS:  
PROFESSIONAL  
PLACEMENT  
DEPT. D

**Bendix**  
AVIATION CORPORATION  
**York Division**  
York, Penna. York 47-1951

CIRCLE 902 ON CAREER INQUIRY FORM

# TEXAS



# INSTRUMENTS

## INCORPORATED

DALLAS 9, TEXAS



TI's new semiconductor solid circuits measure less than  $\frac{1}{4} \times \frac{1}{8} \times \frac{1}{32}$  of an inch and incorporate up to 12 integral electronic components. Complete multivibrator circuit shown. In addition to extreme size and weight reduction, reliability also has been greatly increased.

## join TI engineers in such challenging programs as micro-miniaturization

*TI develops new semiconductor solid circuit with component densities up to 34 million per cubic foot!*

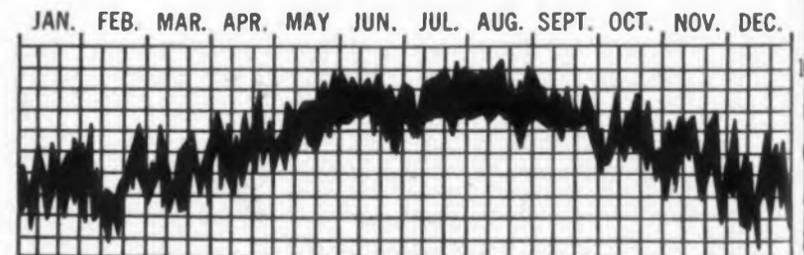
From one of many stimulating research and development programs at Texas Instruments comes another major "first" . . . new semiconductor solid circuits! Born from TI-sponsored research studies, the basic concept was carried through to reality by the Semiconductor-Components division. Utilizing TI developments in semiconductor manufacturing techniques (controlled masking, etching, diffusion), TI has formed diode and transistor elements, as well as passive elements of resistance and capacitance, to provide a complete circuit function normally requiring up to 12 components!

Such significant developments naturally result from TI's great emphasis on creative ability and freedom of professional expression. You'll find many challenging opportunities at Texas Instruments where such technological advances are a frequent occurrence. At the Apparatus division, weight and size are critical factors in its missile and aircraft electronic and electromechanical systems. You may explore new possibilities for making these systems even smaller and more reliable using the new semiconductor solid circuits. Or, with the GeoSciences and Instrumentation division, you may exercise this new concept in circuitry to create new and more compact commercial and industrial instrumentation.

A rewarding opportunity awaits you in one of the many programs now in progress at TI's Central Research Laboratory, Semiconductor-Components, Apparatus, and GeoSciences and Instrumentation divisions.

You will also benefit from TI's up-to-date personnel policies which include profit sharing plan (in 1958, 15% of base earnings), semi-annual salary and advancement reviews, educational assistance, insurance, hospitalization, and retirement programs. You will enjoy the temperate Southwestern climate and the many year-round recreational, amusement and cultural activities.

To join this fast-moving company at the forefront of scientific technologies, please write to activity of interest shown at right enclosing a short resume.



(Graph courtesy of Dallas Times Herald, January 7, 1958)

Dallas' 12-month weather chart shows that temperature averaged 65 in 1958, with humidity at a comfortable low level. Dallas skies are predominantly clear and sunny, devoid of industrial haze or smog.

DE  
effe  
elec  
tion  
dev  
CIR  
equ  
ME

EL  
rac  
mis  
Con  
tion  
ME  
ser  
tur  
tes  
ron  
MA  
tro  
na  
CO  
too  
me  
QU  
and  
ma  
tion  
RE  
mu  
reli  
Eda

MA  
ELE  
EN  
SA  
SE  
IND  
SEM  
ME

HEA  
of t  
mag  
HEA  
abil  
eval  
SO  
sem  
qua  
DE  
tics  
2 to  
SE  
of s  
Met  
THE  
back  
to m  
lati  
PHY  
atur  
desi

# specific career opportunities now open at Texas Instruments

## SEMICONDUCTOR-COMPONENTS DIVISION

**DEVICE DEVELOPMENT** — Develop new semiconductor devices; conduct experimental and theoretical studies on the effects of nuclear radiation on semiconductor materials and devices; evaluate experiments in the analysis of gases and electro-chemistry; conduct physical measurements on semiconductor surfaces; determine the effects of chemical reaction on semiconductor surfaces; studies in device stability, reliability and characterization; materials research and development including crystal growth and crystallography.

**CIRCUIT DEVELOPMENT** — Transistor circuit design and application; design automatic and semi-automatic test equipment.

**MECHANIZATION** — Design and develop high speed automatic machinery.

Please write to H. C. LAUR, Dept. 1102, P. O. Box 312, Dallas, Texas

CIRCLE 915 ON CAREER INQUIRY FORM

## APPARATUS DIVISION

**ELECTRICAL DESIGN AND DEVELOPMENT ENGINEERS (minimum 3 years experience)** To apply technologies of radar, sonar, infrared, magnetics, microwave, telemetry, special-purpose computers, and servos to submarine detection, missile guidance and instrumentation, combat surveillance and reconnaissance, and aerial object detection and tracking. Conduct studies and analyses, and circuit development, electronic and electromechanical component design, transistorization, and miniaturization. Educational requirements: MSEE, BSEE, or BS Physics.

**MECHANICAL DESIGN AND DEVELOPMENT ENGINEERS (minimum 3 years experience)** Design and develop servo systems, X-Y plotters, strip recorders, optical systems, vibration damping and isolation packages, antenna structures and drives, sonar reels, cooling and heating systems and electronics packaging. Guide drafting, environmental testing, and model making; give consultation to manufacturing engineers to solve project production problems. Environmental studies. Educational requirements: MSME or BSME.

**MANUFACTURING ENGINEERS (minimum 1 year experience)** Production planning, tooling, and guidance and control of all phases of general production activity, or of an assigned project. Mechanization for short-run equipment manufacture. Educational requirements: BSME, BSEE, or BSIE.

**COST ESTIMATING ENGINEERS (minimum 3 years experience)** Estimate or supervise estimation of material, labor, tooling, and indirect costing factors on unusual electronic and electronic and electromechanical systems and equipments. Electromechanical manufacturing experience desired. Educational requirements: BSEE or BSIE.

**QUALITY CONTROL ENGINEERS (minimum 3 years experience)** Establish and maintain standards of quality and inspection methods for all raw materials and manufactured products. Three years experience in statistical methods, manufacturing processes, equipment inspection and/or design with minimum of 1 year in electronics industry. Educational requirements: BSEE or BSIE.

**RELIABILITY ENGINEERS (minimum 3 years experience)** Assist project engineers during design phase for maximum electronic or electromechanical reliability. Evaluation, selection, and application of components. Estimate system reliability; analyze and recommend corrective action. Experience in equipment design and component application. Educational requirements: MSEE or BSEE.

Please write to JOHN PINKSTON, Professional Placement, Dept. 1102, 6000 Lemmon Avenue, Dallas 9, Texas

CIRCLE 916 ON CAREER INQUIRY FORM

## GEOSCIENCES AND INSTRUMENTATION DIVISION

**MANUFACTURING ENGINEER**—EE or ME with 2 years or more similar experience in production planning and control.

**ELECTRICAL ENGINEER**—EE with 3 to 5 years experience in electronic design.

**ENGINEER**—EE or Physics sustaining engineering of seismic products.

**SALES ENGINEER, SEISMIC**—Science degree with seismic crew experience, with minimum of 5 years experience.

**SENIOR ENGINEER**—EE with 5 years in electronic circuitry design and development.

**INDUSTRIAL ENGINEER**—IE with 3 to 5 years experience in Industrial Engineering or related work.

**SENIOR ENGINEER**—EE or ME with experience in electrical products, particularly in commercial and industrial areas.

**MECHANICAL ENGINEERS**—ME with instrument field experience.

Please write to DAVE TURNER, Dept. 1102, 3609 Buffalo Speedway, Houston, Texas

CIRCLE 917 ON CAREER INQUIRY FORM

## CENTRAL RESEARCH LABORATORY

**HEAD—PHYSICS SECTION**—4 to 5 years experience in semiconductor physics and proven ability to direct a variety of technical projects. Responsible for directing work on the measurement and understanding of electrical, thermal, magnetic, optical, and transport properties of semiconductors. Educational requirement is PhD in Physics.

**HEAD—DEVICE SECTION**—4 to 5 years experience in semiconductors plus experience in group leadership and proven ability to supervise a variety of technical projects. Will be responsible for directing work on design, fabrication and evaluation of new solid state devices. Educational requirement is MS or PhD in either Physics or EE.

**SOLID STATE THEORIST**—Responsible for the understanding and interpretation of the physical properties of semiconductors and other solid state materials. Educational requirements: PhD in Physics with concentration in quantum mechanics. Solid state experience desirable but not necessary.

**DEVICE THEORIST**—Responsible for the design of new solid state devices and interpretation of their characteristics in terms of physical and fabrication parameters. Educational requirement is PhD in Physics or EE, or MS with 2 to 3 years experience in solid state device theory.

**SEMICONDUCTOR TECHNOLOGY**—Responsible for the design and interpretation of experiments on the technology of semiconductors, including impurity diffusion and alloying. Educational requirement is PhD in Physical Chemistry or Metallurgy. Experience requirement: 3 to 4 years experience in semiconductor technology.

**THEORETICAL PHYSICIST**—2 to 3 years experience in electron or nuclear magnetic resonance with interest and background to perform theoretical analysis of EMR and NMR to develop possible new types of magnetometers or to make significant improvement in present types. Sufficient experimental background and interest to assist in translating theoretical results into experimental projects.

**PHYSICISTS**—Either MS or PhD with 1 year minimum experience in the fields of superconductivity and low temperature physics. Should be acquainted with conventional techniques of transferring and handling liquid helium and designing circuits and instrumentation for studies in this area.

Please write to A. E. PRESCOTT, Dept. 1102, 6000 Lemmon Avenue, Dallas 9, Texas

CIRCLE 918 ON CAREER INQUIRY FORM

## DESIGNING YOUR FUTURE

(Continued from p. 40)

every week in the metropolitan newspapers, specialize in matching careers to personalities. The study of textbooks and other literature on personnel assignment and aptitude will help the engineer interpret results and recognize several specializations he is suited for. Further selection can then be made on the basis of geographical area, salary or any other valid secondary criteria.

In every job interview two simultaneous "hirings" are involved: the corporation is hiring an engineer, and the engineer is hiring a management. The value sought from the corporation in return for engineering competence should be managerial competence first; then projects and people from which the engineer can learn; and, finally, salary.

### Success a Two-Way Street

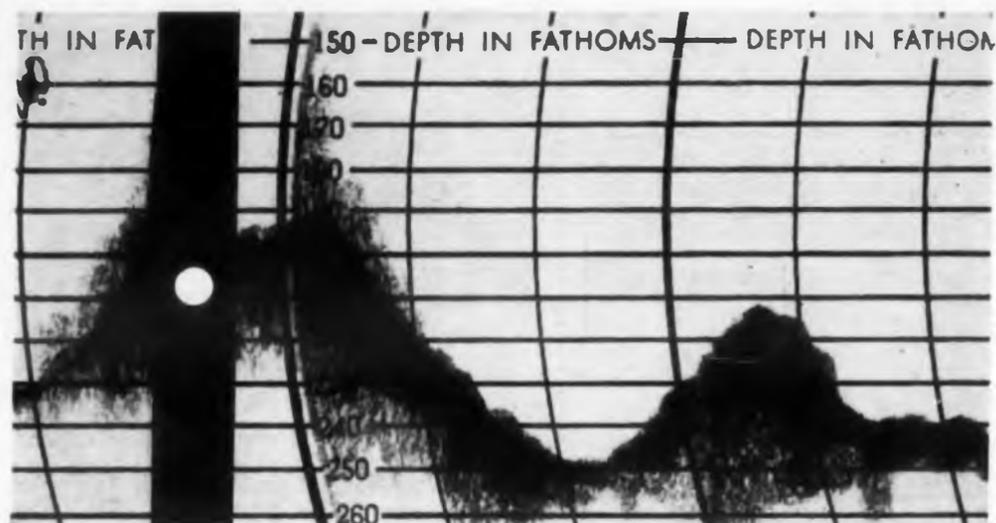
The engineer's success will be governed by the corporation's success. And this in turn depends on management far more than on the engineering department. Engineering, after all, is but one department in the corporation. With proper management, the problems of all the departments will be solved, and without it a business cannot be a success for any extended period.

To assist in "hiring a management," the financial community can again be of great service. Typical sources of aid are Standard & Poor's "yellow sheets," which summarize a corporation's financial vigor and competitive position; Dun & Bradstreet reports, and the engineer's own stockbroker. Unless some insight into the financial side of engineering is gained, the engineer will be blindly dependent on the judgement of others.

To summarize:

Success is not a function of engineering talent alone; nor is it attained by pursuing more dollars, more responsibility or greater job security. It is determined by how well the engineer's career is in tune with world developments, the future trends of engineering developments, the economic realities and the engineers personality. If deliberate, conscious effort is made to achieve this tuning, true success in the form of growth and satisfaction in the job will be assured. Then, more than likely, salary and recognition will come as natural consequences. ■ ■

## 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. They will require major contributions from many fields. 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 qualified engineers and scientists.

IBM is now interviewing personnel for the following specialties:

**COMPUTER ANALYSTS:** M.S. or Ph.D. in Physics or Engineering Science with strong math background. Navy experience in digital techniques for solution of real-time control problems is required. Must be capable of making mathematical analyses of fire and navigational control systems plus math analyses of beam formation, ray tracing and signal cross correlation.

**SONAR SYSTEMS ENGINEERS:** M.S. or Ph.D. in Physics or E.E. Should have extensive experience in Navy sonar systems analysis and design. Experience desired in signal data processing instrumentation, correlation analysis, propagation studies, beam formation and signal analysis.

**SYSTEMS ENGINEERS:** M.S. or Ph.D. in E.E. Navy experience in one or more of these specialties is desired: sonar, fire control, ASW, navigational systems or in applying information theory concepts to signal processing. Experience desirable in signal cross-correlation techniques, statistical data processing, sampled-data control theory, analog-digital data processing techniques, signal propagation and beam formation.

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. This is a unique opportunity for a career with a company that has an outstanding growth record.

Write, outlining your qualifications and experience, to:

Mr. R. L. Lang, Dept. 55511  
IBM Corporation  
Owego, New York

# IBM

INTERNATIONAL BUSINESS MACHINES CORPORATION  
CIRCLE 904 ON CAREER INQUIRY FORM

## ENGINEERS &amp; PHYSICISTS

**Kollsman** is continuing its growth in the field of automatic navigation and flight instrumentation.

### THE RECORD TO DATE:

1. Kollsman has delivered more automatic celestial tracking systems than the rest of the industry combined.
2. Kollsman has delivered more air data computers than the rest of the industry combined.

### KOLLSMAN INVITES YOU TO SHARE IN ITS FUTURE

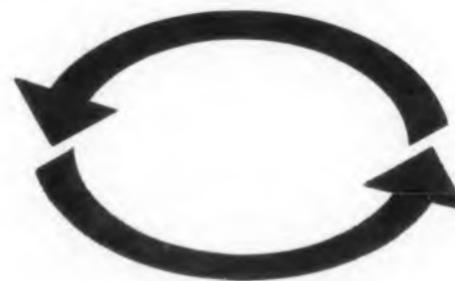
Senior positions in research and development, product engineering, support equipment and services, and sales are presently available. For interview appointment, please send a resume to T. A. DeLuca.



**kollsman** INSTRUMENT CORPORATION

80-08 45th AVENUE, ELMHURST, NEW YORK • SUBSIDIARY OF *Standard* COIL PRODUCTS CO., INC.

CIRCLE 905 ON CAREER INQUIRY FORM



A "communications engineer" at **ELECTRONIC DESIGN** resembles, in part, a communications engineer in the electronic industry. The half that is similar is the engineer—but the other half stands for communicating, clearly and cogently, in print. In fact, cross-communicating practical techniques, ideas for design, new developments, from the working electronic design engineer to the working electronic design engineer.

Our "communications engineers" get out in the field and find out what's going on—then convert technical doings to how-to-do-it articles.

If you have the working combination—use the Career Inquiry Service form to let our Editor know you are interested.

HAYDEN PUBLISHING CO., INC.  
830 THIRD AVENUE,  
NEW YORK 22, N. Y.

CIRCLE 906 ON CAREER INQUIRY FORM

ELECTRONIC DESIGN • September 2, 1959

## CAREER OPPORTUNITIES BROCHURES

Sylvania Electronic Systems



This folder gives brief descriptions of the many-dimensional activities of Sylvania's nine Research and Development Laboratories located in Massachusetts, New York, and California. Community facilities are discussed and complete lists of present Research and Development openings are provided.

E. F. Culverhouse, Sylvania, Amherst Laboratory, Dept. ED, 1101 Wehrle Drive, Amherst 21, N.Y.

CIRCLE 870 ON READER-SERVICE CARD

### Telemeter Magnetics Inc.



Telemeter Magnetics Inc. presents a brief description of its accomplishments including the design and manufacture of ferrite data storage products and the company's contributions to the data processing art. This folder lists the company's products and the various technical activities underway. Present management, benefits and general facilities are listed.

Richard A. Terry, Manager, Telemeter Magnetics, Inc., Dept. ED, 2245 Pontius Ave., Los Angeles, Calif.

CIRCLE 871 ON READER-SERVICE CARD  
CIRCLE 907 ON CAREER INQUIRY FORM ➤

To **ELECTRO-MECHANICAL ENGINEERS**  
who are interested in  
designing and developing

# PROTOTYPE HARDWARE

*The Hughes Systems Development Laboratories have dozens of openings for Electro-Mechanical Engineers... to design hardware to meet the severe environments of space vehicles, missiles and all-weather interceptors. This is an opportunity for design engineers to utilize their ingenuity and creativity in the development of complex precision electro-mechanical devices which must be highly efficient and reliable.*

These positions provide, perhaps uniquely, for individual professional satisfaction through participation in the performance analysis of your own creations.

Some of the areas of assignment are:

- Infra-red Devices
- Digital Computer Devices
- Gyroscopic Guidance Devices
- Inertial Guidance Devices
- Flight Simulator Equipment
- Missile Control Devices
- Antenna Control Devices

Ideally, applicants should have at least two years of practical professional mechanisms experience and an accredited E. E., M. E., or Physics degree.

If you feel that you can contribute, please airmail your resume to:

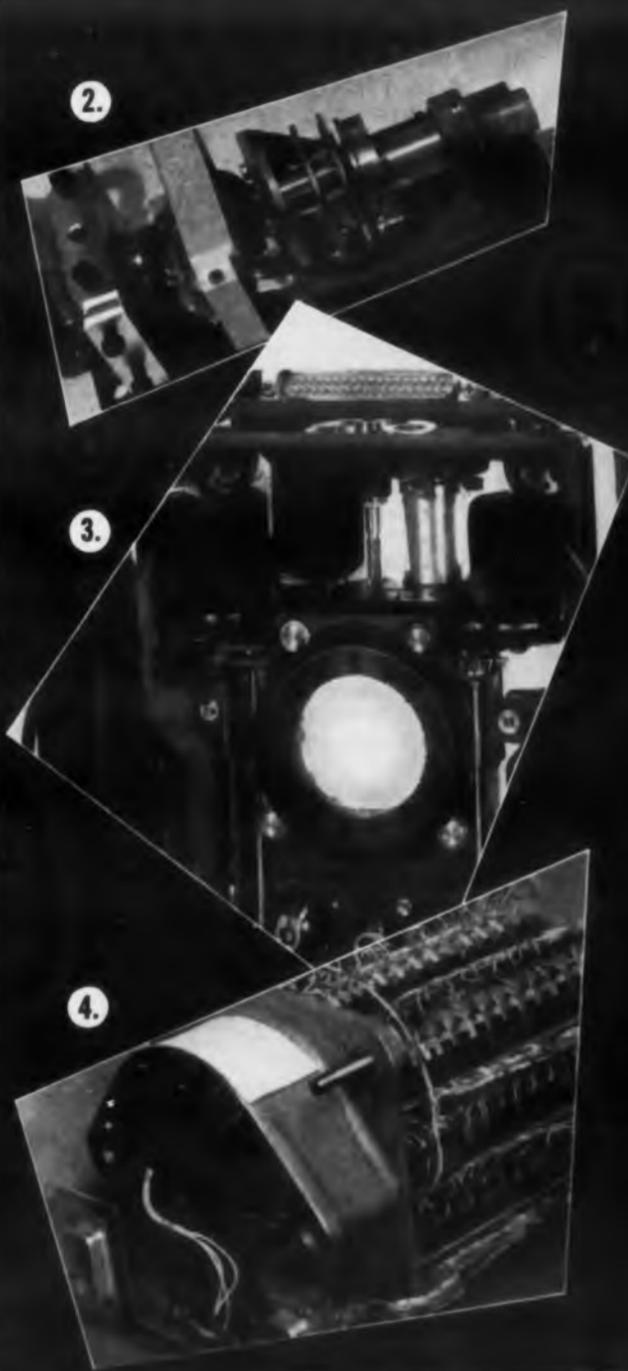
Mr. Robert A. Martin, Supervisor Scientific Employment  
**HUGHES RESEARCH AND DEVELOPMENT LABORATORIES**  
Culver City 70, California

**HUGHES**

© 1959. HUGHES AIRCRAFT COMPANY



1. Portion of Navigational Display Mechanism
2. Flight Interrupter
3. Reticule Frame for Navigational Display
4. Experimental Magnetic Memory Drum



ENGINEERS...PHYSICISTS

# NEW opportunities at Motorola in Chicago

give yourself and your family  
all the big city advantages at a  
relaxed midwest pace, while you  
**ADVANCE YOUR CAREER**

Outstanding career opportunities are waiting at the many Motorola research and development laboratories in the Chicago area. This is your opportunity to advance your career with a swiftly expanding company, working in the most modern and well instrumented laboratories . . . with liberal employee benefits, including an attractive profit sharing plan and association with men of the highest technical competence.

You'll like living in one of the beautiful suburbs of the playground of the midwest, where there are endless social, cultural, and educational activities to choose from the year-round. Exciting life or quiet life—Chicago offers either.



## MILITARY POSITIONS OPEN

- Radar transmitters and receivers
- Radar circuit design
- Antenna design
- Electronic countermeasure systems
- Military communications equipment design
- Pulse circuit design
- IF strip design
- Device using klystron, traveling wave tube and backward wave oscillator
- Display and storage devices

## CIVILIAN POSITIONS OPEN

- 2-WAY RADIO COMMUNICATIONS**
- VHF & UHF Receiver • Transmitter design & development • Power supply
  - Systems Engineering • Selective Signaling • Transistor Applications • Crystal Engineering • Sales Engineers
- PORTABLE COMMUNICATIONS**
- Design of VHF & UHF FM Communications in portable or subminiature development.
- MICROWAVE FIELD ENGINEERS**



Write to:  
**Mr. L. B. Wrenn Dept. B**  
**MOTOROLA, INC.**  
4501 Augusta Blvd., Chicago 51, Ill.

ALSO . . . there are excellent opportunities in  
**PHOENIX, ARIZONA • RIVERSIDE, CALIFORNIA**



# MOTOROLA

CIRCLE 908 ON CAREER INQUIRY FORM

ELECTRONIC ENGINEERS

# Clairvoyant Countermeasures\*

— ONE OF THE MANY EXCITING  
PROJECTS ATTRACTING ENGINEERS  
TO GENERAL ELECTRIC'S LIGHT MILITARY  
ELECTRONICS DEPARTMENT

Engineers at LMED are developing an "Intelligent" ECM System which will instantly analyze radiations from enemy systems, make decisions and immediately respond with counter-radiations to provide continuous protection for our aircraft.

## LIGHT MILITARY DESIGNS ACROSS THE ENTIRE EM SPECTRUM—FROM AUDIO TO INFRARED

The "Clairvoyant" Countermeasures system is typical of LMED's many programs that extend across the entire EM Spectrum. Other diversified programs now under way that offer accelerated career growth and substantial job security include Polaris Fire Control Computers, automated AEW, and a revolutionary Bomb/Nav system.

**FOR PROMPT CONSIDERATION** send a post card containing the following information: your name, home address, home phone, degree(s) and year(s) received plus the technical areas you are particularly interested in to:

Mr. William Gilmore, Dept. 76-MI



LIGHT MILITARY ELECTRONICS DEPARTMENT

# GENERAL ELECTRIC

FRENCH ROAD, UTICA, NEW YORK

\* Attempting to prove the existence of clairvoyance and telepathy, early experimenters used unique "playing cards" developed by Dr. Karl Zener. LMED's ECM will appear clairvoyant to enemy radars by seeming to know beforehand, the precise signal structure to jam.

CIRCLE 909 ON CAREER INQUIRY FORM

ELECTRONIC DESIGN • September 2, 1959

## Air brake for a spaceliner



The earth's atmosphere, one of the biggest obstacles to getting into outer space, can be one of our biggest assets coming back. At Douglas we are investigating how we can use its braking effects on rockets returning from deep space trips at far faster than ICBM speeds. Success will allow us to increase payloads by reducing the weight of soft landing systems. This technique also will aid us in pinpointing landing areas. Current reports show real progress. Douglas is engaged in intensive research on every aspect of space planning, from environmental conditions on other planets to the destroyer-sized space ships necessary to get there. We invite qualified engineers and scientists to join us.

Arthur Shef, Chief, Advanced Design Section, Missiles and Space Systems, irons out a problem with Arthur E. Raymond, Senior Engineering Vice President of **DOUGLAS**



And here's how you can release the brakes on your career.

### **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.

FROM GENERAL INSTRUMENT CORPORATION

**NOW...**

**HIGH  
RELIABILITY  
FOR PENNIES!**

**RADIO RECEPTOR  
SELENIUM DIODES**



PRICED FROM **15¢** TO **35¢** EACH

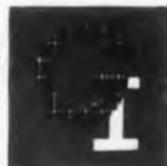
*small size...  $\mu$ a leakage*

TYPICAL  
UNITS

1XH — Half wave — 50 PIV, 12.5 Ma  
2XH — Half wave — 100 PIV, 12.5 Ma  
4XH — Half wave — 200 PIV, 12.5 Ma  
5XH — Half wave — 250 PIV, 12.5 Ma  
8XH — Half wave — 400 PIV, 12.5 Ma

Also available as doubler, center tap, 4-way bridge and special circuits.

For complete information, write today to Section ED-1



**RADIO RECEPTOR COMPANY, INC.**  
Subsidiary of General Instrument Corporation  
240 Wythe Avenue, Brooklyn 11, N. Y.

General Instrument Corporation includes F. W. Sickles Division,  
Automatic Manufacturing Division, Radio Receptor Co., Inc.,  
Micamold Electronics Manufacturing Corporation and  
Harris Transducer Corporation (Subsidiaries)

CIRCLE 36 ON READER-SERVICE CARD



## BOOKS

### Microminiaturization of Electronic Assemblies

Eleanor F. Horsey, Laurence D. Shergalis, Editors, Hayden Book Co., Inc., 830 Third Ave., New York 22, N.Y., 278 pp, \$11.00.

The first of its kind, this is the only reference volume to cover the important new developments and techniques in microelectronics. It offers, in their entirety, the 21 papers presented at the microminiaturization symposium held at Diamond Ordnance Fuze Laboratories on Sept. 30 and Oct. 1, 1958. For men of industry, this is a valuable working tool because the original presentation was restricted to government employees only.

The book opens with chapters on techniques which help overcome limitations

to size reduction of subassemblies composed of conventional components. Sections on semiconductors, components, circuits, and missile systems follow.

The concluding section, written by Laurence D. Shergalis, Associate Editor of ELECTRONIC DESIGN, was not part of the symposium. Entitled "Microelectronics in Industry," it discusses solid circuits or molecular electronics, in addition to surveying recent progress in equipment.

"Microminiaturization of Electronic Assemblies" can be ordered on a ten-day free trial basis. Write to: Hayden Book Co., Inc., 830 Third Ave., New York 22, N.Y.

For more information turn to the Reader Service Card and circle 100.

**NEW** ○○○ handy guide to

## TRANSISTOR COOLER selection!



- \* Forced air-flow models
- \* NEW natural convection models

Modine now offers transistor coolers in two types, seven models . . . all available from stock. These pre-engineered, compact, brazed aluminum units are pre-drilled for the five standard transistor configurations. Choice of two finishes: MIL-C-5541 CHROMATE or MIL-A-8625 BLACK ANODIZED. New Bulletin ID-159 has comprehensive selection data. For your copy write direct.



## Modine Manufacturing Company

1608 DeKoven Ave., Racine, Wisconsin T-1402

CIRCLE 37 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 2, 1959

CIRCLE 38 ON READER-SERVICE CARD

ALCOA ALUMINUM TEAMS NATURALLY  
WITH ELECTRICITY

A NEW CONCEPT

**—first step to better coil design**

Manufacturers of electromagnetic equipment can reduce material and production costs now — by switching to ALCOA® Aluminum strip windings. Equipment designed with ALCOA strip is more compact, lighter in weight, and better able to dissipate heat than conventional wire. For information about recent ALCOA developments in this field and how they benefit you — please turn the page

m-  
ec-  
ts,  
  
by  
or  
of  
ec-  
ir-  
on  
p-  
  
As-  
ay  
ok  
22,  
  
he

## NEW DESIGN CONCEPTS WITH ALUMINUM STRIP

by Robert R. Cope, Aluminum Company of America, Pittsburgh, Pa.

Light weight, better space factor, better heat dissipation, low voltage between turns, less point-to-point contact . . . these characteristics of aluminum strip have long intrigued designers of electrical windings. Today, this aluminum application is a practical reality.

Intensive research and testing by ALCOA have contributed to important technical breakthroughs. New techniques are solving problems relating to edge effect, joining and insulation.

Recently, ALCOA purchased the transformer division of Automation Instruments, Inc., to perfect winding techniques and to produce prototype coils for customers' evaluation. With this added facility, the electrical windings division of ALCOA Research Laboratories is equipped to wind coils from small solenoids up to distribution transformer sizes for testing by manufacturers—an important, new service for the electrical industry.

### ALUMINUM'S NATURAL ADVANTAGES

Aluminum weighs less. In general, an aluminum strip winding weighs only half as much as an equivalent winding of copper. Based on equal current-carrying capacity, 0.48 pounds of aluminum replaces one pound of copper. (Figures are for 61.0 per cent conductivity aluminum, 97 per cent conductivity hard-drawn copper.) ALCOA No. 3 EC alloy has been developed expressly for electrical windings. Space factor of aluminum strip can be 90 per cent and higher; for copper wire, 55 per cent to 65 per cent is typical. Thus, although an aluminum strip requires more conductor volume than a conventional wire winding, the total space occupied by each is about the same. Variations in space factor will depend on the strip-to-insulation thickness ratio.

Aluminum strip windings permit higher current densities because each turn has an outside radiating edge that provides effective heat dissipation. Layer-to-layer temperatures are constant; hot spots are virtually eliminated. The inner turns of a wire-wound coil cannot radiate heat as efficiently as the outer turns.

In most cases, aluminum strip windings can be manufactured at lower cost than equivalent wire windings. Aluminum strip lends itself to automation; new high-speed winding techniques have reduced fabrication costs by eliminating much of the hand labor necessary with wire.

Conventional wire windings require heavier insulations to withstand (1) abrasion during winding, (2) abrasion from point-to-point contact between turns, (3) layer-to-layer voltage, which may be many times the turn-to-turn voltage. Aluminum strip insulation needs to withstand only turn-to-

turn voltage because a single turn occupies the entire width of the coil. Thus, thinner and less abrasion-resistant insulations can be used, such as interleaved sheets of Mylar or Kraft paper . . . coatings of varnish, lacquer or epoxy . . . anodized films or vitreous enamel.

ALCOA has tested every known method of joining aluminum. Some techniques proved impractical or costly. But successful joining has been accomplished with ultrasonic welding, high temperature soldering, shielded inert arc welding, cold pressure welding, resistance welding and mechanical joining. Cold pressure welding is quite practical: joints have high strength and conductivity. Ultrasonic welding requires no heat, precleaning or flux; joints are made quickly between parts of different thicknesses, or of multiple thicknesses—and the weld can be made through many types of insulation.

Where is the best application for aluminum strip windings? In power devices or electronic equipment, the economics of aluminum strip windings are indicated when customary wire sizes are 24 gage or larger. However, in many aircraft and missile applications, where weight is a critical factor, aluminum strip is a natural application regardless of size.

Here, at a glance, are the main areas of comparison:

PROPERTY	COPPER WIRE	ALUMINUM STRIP No. 3 EC
Weight (lb/cu in.)	0.321	0.098
Specific gravity	8.89	2.70
Coefficient of linear expansion (1/°C)	0.000017	0.000023
Thermal conductivity at 20°C ( $\frac{\text{watts/sq in.}}{\text{in./°C}}$ )	9.7 - 10.0	6.0
Electrical conductivity at 20°C, per cent IACS	97 - 100	61.0
Electrical resistance at 20°C (microhms/sq in./ft)	8.40 - 8.14	13.14
Temperature coefficient of electrical resistance at 20°C (1/°C)	0.00392 - 0.00381	0.00409
Modulus of elasticity	17 x 10 <sup>6</sup>	10 x 10 <sup>6</sup>

ALCOA Aluminum Electrical Windings will reduce your costs and improve your product. We'd like to prove it. Send your specifications to us and we will wind sample coils. Then make your own test.

ALUMINUM COMPANY OF AMERICA, 2263-J Alcoa Building, Pittsburgh 19, Pennsylvania.



Interleaving sheet-type insulation with aluminum strip.



Versatile is the word for aluminum strip in electromagnetic equipment. The strip winding technique is applicable to a wide range of coil sizes and dimensions.



Send for Alcoa's new Conductor Selector Chart, a convenient slide rule for converting standard wire sizes to equivalent strip conductor



Digital  
E. M.  
Co., In  
N.Y., 2  
How  
can do  
cal, en  
ing asp  
language  
An  
units,  
ogy, an  
the me  
number  
and the  
input-o  
ming, a  
are also  
The  
eral-pu  
digital  
type. S  
tions ar  
The c  
tuitive,  
the sub  
cal org  
machine

← CIRCLE  
ELECTR

### Digital Computer Primer

E. M. McCormick, McGraw-Hill Book Co., Inc., 330 W. 42 St., New York 36, N.Y., 214 pp, \$7.50.

How digital computers work, what they can do, and their important mathematical, engineering, electronic, and accounting aspects are described in non-technical language.

An introductory discussion of basic units, essential characteristics, terminology, and sequence of operations precedes the more detailed coverage of coding, number systems, the logic of computers, and the control, arithmetic, storage, and input-output units. Instructions, programming, and methods for checking accuracy are also treated.

The author concentrates on the general-purpose stored-program automatic digital computer of the general EDPM type. Specialized machines and applications are not considered.

The chapter on computer logic is an intuitive, non-mathematical approach to the subject. As simple examples, the logical organization of a tick-tack-toe playing machine and other game-playing devices

are described. The value of representing basic logical operations by means of Boolean algebra and the basic manipulations possible appear in the Appendix.

### Linear Network Analysis

Sundaram Seshu, Norman Balabanian, John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 571 pp, \$11.75.

This book develops the foundations of network theory carefully, smoothing out the transitions between (a) steady-state and transient responses, (b) time and frequency responses, and (c) analysis and synthesis. The authors begin with fundamentals, e.g., Kirchoff's laws, the number of independent equations, and direct the reader to the thresholds of some of the most advanced concepts in network theory, including network synthesis, realizability conditions, and feedback and control systems. Almost all results are carefully proved, and all assumptions that are made in the development are clearly explained. Throughout, active and passive networks are treated simultaneously. The book contains numerous illustrations, and problems accompany each chapter.

## HOPKINS

*polystyrene film capacitors*



**—for critical circuits requiring high stability and close tolerances**

In these Hopkins capacitors, you get a typical long-term stability to .1% per year, and a temperature coefficient of 120 PPM per degree C. Tolerances are available down to  $\pm 1\%$ , with guaranteed accuracy.

**High insulation resistance**—1,000,000 megohms is typical. Dielectric absorption is very low—only .05%. Units are manufactured under close quality control to insure utmost reliability.

**Available** as film-wrapped types, and in all case styles in hermetically sealed brass tubes, bathtubs, and decades. Rated .001 to 1.0 mfd., 100 to 600 VDC. Higher values to customer specifications. Send for catalog C-104A.



**HOPKINS** *Engineering* **COMPANY**

12900 Foothill Blvd., San Fernando, Calif. Tel. EMpire 1 8691  
CIRCLE 39 ON READER-SERVICE CARD

← CIRCLE 38 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 2, 1959

## A topper in any language



**It's better than the best XXXP grade, it's lighter and more economical than G-10, it's Taylor XY-1 Paper-Base Epoxy Laminate**

When you want extremely high reliability in printed circuits, with the additional advantages of flame retardance, chemical resistance, good solderability and high bond strength—specify Taylor XY-1 copper-clad laminate. It is self-extinguishing in 1 second, has excellent resistance to alkalis, acids and solvents, has a solder time resistance at 500°F. of 30 seconds in 1-oz. copper and 50 seconds in 2-oz., and a bond strength of 10 lb. in 1-oz. copper and 13 lb. in 2-oz. Sheets available with copper on one or both sides.



Unclad Taylor XY-1 has many advantages, too. It can be substituted for glass-base epoxy laminates to reduce cost and weight. It has excellent electrical, mechanical and machining properties. Contact us for complete technical data and expert guidance in applying this new material. TAYLOR FIBRE CO., Norristown 48, Pa.

**Taylor**  
LAMINATED PLASTICS VULCANIZED FIBRE

CIRCLE 40 ON READER-SERVICE CARD



## Cuppington on Ornithology

Lucius Cuppington (1861-1865), noted authority on the nesting habits of the lesser grebe, put it well: "The dodo was created for the sole purpose of becoming extinct, and achieved its purpose brilliantly." Not that we at HOOVER ELECTRONICS COMPANY would dare to disagree with the eminent Cuppington . . . but isn't *everything*? Look at present FM/FM telemetering systems, for example!

Ah, but HOOVER has done something about *this*, at least. Forgive our blushes, but we've created VERNITEL, a system that prolongs the life of FM/FM systems now in use at missile bases . . . by improving their accuracy by a whole order of magnitude. The cost of space being enough to stagger an oil magnate, we're giving you a peep at a part of it below, greatly reduced, as the encyclopedia boys say.

This is Vernitel, heart of Hoover's new FM/FM telemetering system (maroon box). With its associated transistorized subcarrier oscillator and mixer amplifier. It's a giant step forward, prolonging the life of FM/FM equipment now in use. Ask us for a folder about it.



**HOOVER**  
**ELECTRONICS COMPANY**

SUBSIDIARY OF THE HOOVER COMPANY

110 WEST TIMONIUM ROAD • TIMONIUM, MARYLAND

Field Liaison Engineers  
Los Angeles, California

CIRCLE 41 ON READER-SERVICE CARD

## BOOKS

### The Outlook for Printed Circuits

*The Institute of Printed Circuits, Inc.*, 27 E. Monroe St., Chicago 3, Ill., 23 pp, \$2.00.

Five of the papers presented last October at IPC's Symposium on "The Outlook for Printed Circuits" have been compiled in this booklet.

Of particular interest to design engineers are these papers: "Design Considerations in Industrial Applications of Printed Circuits" by E. J. Lorenz of IBM and "Materials, Methods and Reliability on Printed Wiring Boards" by B. C. Alzua of Motorola, Inc.

Both Mr. Lorenz and Mr. Alzua compare the reliability of eyeletted holes with plated-through holes. In addition, Mr. Lorenz discusses the proper design and application of printed wiring cards, and the prospects for printed wiring in the future.

Also included in the booklet are: "Printed Wiring Board Design Parameters for High Volume Radio Production" by

F. W. Whitford of General Motors Corp., "Printed Wiring in the Commercial Future" by Temple Nieter of Warwick Mfg. Corp., and "Application of Printed Circuits in Industrial Electronics" by James A. Lippke of ELECTRONIC DESIGN.

### Elementary Decision Theory

*Herman Chernoff, Lincoln E. Moses, John Wiley & Sons, Inc.*, 440 Fourth Ave., New York 16, N.Y. 364 pp. \$7.50.

This volume demonstrates the use of decision theory as a means of clarifying basic principles of statistics. Employing simple non-technical examples to suggest fundamental concepts, this book requires only an understanding of high school mathematics. Each chapter includes a summary, exercises, illustrations, and application to statistical problems. Special chapters on utility theory and model building are included. The book is of special value to those interested in the fundamental ideas underlying statistics and scientific method.

## New CANNON XLR plugs for audio and electronic uses



### GREATER VALUE AT NO INCREASE IN PRICE

Improved features illustrated above give you more for your money than any similar plug on the market.

These deluxe audio plugs, in handsome satin nickel finish, give protection against disagreeable interference and mechanical noises. Positive latch holds firmly, yet allows for quick disconnect. Improved strain relief bushings and cable clamps accommodate full range of microphone cables. Series includes wide variety of shell types, with three and four contacts. Mates with Cannon former XL series.

Like all the plugs in the complete Cannon line the XLR series is manufactured of finest quality materials for reliable, long-lasting service. See the distributor nearest you or write for Bulletin XLR-3.

**CANNON**  
**PLUGS**

27,000 kinds to choose from! Call on Cannon for all your plug needs. If we don't have what you want, we'll make it for you. We're ready to help you at any stage—from basic design to volume production—with the largest facilities in the world for plug research, development and manufacturing. Write us today about your problem. Please refer to Dept. 138

**CANNON ELECTRIC COMPANY**  
3208 Humboldt St., L. A. 31, California

Where Reliability for Your Product  
is Our Constant Goal

CIRCLE 42 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 2, 1959

**The Properties, Physics and Design of Semiconductor Devices (Bell Laboratories Series)**

John N. Shive, D. Van Nostrand Co., Inc., 257 Fourth Ave., New York 10, N.Y., 487 pp, \$9.75.

A comprehensive physical theory of semiconductors and device operation is presented. Particular attention is paid to graphic descriptions of the electronic processes occurring in semiconductors as an introduction to more advanced analytical study.

Beginning with the nature, behavior, and uses of thermistors, varistors, photoelectric cells, and transistors, Part One continues with a discussion of fabrication, properties, characteristics, and typical applications. How and why these semiconductor devices work are explained in the text, while diagrams illustrate the basic physical concepts.

Part Two is devoted to the physics of solids and the application of solid-state electronics to the design of practical devices.

**Masers**

J. R. Singer, John Wiley & Sons, Inc., New York, N.Y., 147 pp, \$6.50.

A unified description of microwave amplifiers operating on the induced emission principle is presented. The author approaches masers from both the classical and quantum mechanical points of view. He includes a description of the ammonia maser and a theoretical discussion of a magnetic atomic beam system.

After a short section on an optically pumped frequency standard, electron paramagnetic resonance is considered. Two-level masers are treated with emphasis on their possibilities for millimeter and submillimeter wave generation. Numerical illustrations are then used in an examination of three level cavity masers. The final chapter deals with the theory and experimental results of the traveling wave maser.

Information on two important maser design techniques—the isofrequency plotting and the multiple pumping methods—appears in the appendices.

for maximum reliability

**PREVENT THERMAL RUNAWAY**

Prevent excessive heat from causing "thermal runaway" in power diodes by maintaining collector junction temperatures at, or below, levels recommended by manufacturers, through the use of new Birtcher Diode Radiators. Cooling by conduction, convection and radiation, Birtcher Diode Radiators are inexpensive and easy to install in new or existing equipment. To fit all popularly used power diodes.



with NEW  
BIRTCHER  
**DIODE  
RADIATORS**

**B**

Birtcher Cooling and retention devices are not sold through distributors. They are available only from The Birtcher Corporation and their sales representatives.

**THE BIRTCHER CORPORATION**  
*industrial division*

4371 Valley Blvd. Los Angeles 32, California  
Sales engineering representatives in principal cities.

**FOR CATALOG**  
and  
test data write:



CIRCLE 43 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 2, 1959

**WAVEGUIDE COMPONENTS**  
for microwave applications



**F**OR efficient use of your antenna, let Kennedy engineers design your feed system. Kennedy's line of waveguide components includes dual and linear polarization horns, transitions, duplexers, straight sections and bends. All of the components are designed for high-power use.

ANTENNA EQUIPMENT

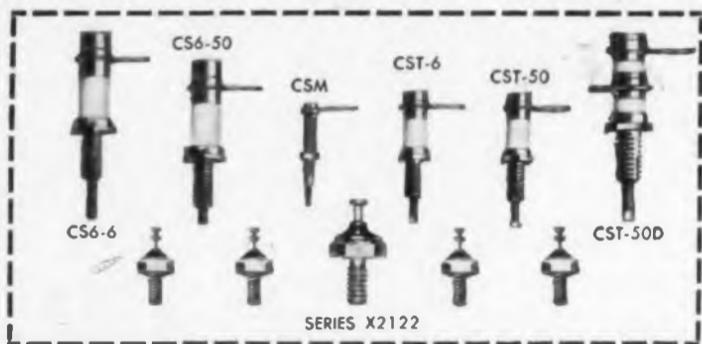
**D. S. KENNEDY & CO.**

COHASSET, MASSACHUSETTS EVergreen 3-1200

West Coast Affiliate . . .  
**SATELLITE KENNEDY, INC. of CALIFORNIA**  
P. O. Box 1711, Monterey, California — FRontier 3-2461

Down-to-earth SOLUTIONS to out-of-this-world PROBLEMS  
Tracking Antennas—Radio Telescopes—Radar Antennas  
"Trans-Horizon" Antennas—Tropospheric Scatter  
Ionospheric Scatter

CIRCLE 44 ON READER-SERVICE CARD



Shown 1/2 actual size

## CAMBION® capacitors ...mighty midgets

CAMBION miniaturized capacitors outperform capacitors several times their size. Their unusual tuning elements practically eliminate losses due to air dielectric and result in wide capacity ranges. Among CAMBION Variable Ceramic Capacitors, Type CST-50 is only 1/32" high mounted, yet its capacity range is 1.5 to 12.5 MMFD's. Ranges of other CAMBION capacitors vary from 0.5 minimum to 25 maximum MMFD's.

CAMBION X2122 Stand-Off Capacitors with ceramic dielectric are exceptionally rugged RF by-pass capacitors for use in high quality electronic equipment. Encapsulating epoxy resin assures rigidity and durability under extreme shock, vibration and humidity. Available in 6 standard values; over-all mounted height under 3/8".

Supplied complete with mounting hardware, all CAMBION capacitors have single mounting studs with locking devices for securing tuning elements. Like all CAMBION components their quality is guaranteed in any quantity ordered. For further details, write to Cambridge Thermionic Corporation, 457 Concord Avenue, Cambridge 38, Massachusetts.

CIRCLE 45 ON READER-SERVICE CARD

# FREE!

## ENGINEERING INFORMATION CATALOG

Shows you how to determine  
which Ring Gives You the  
**ONE BEST ANSWER**  
to Problems of

- ★ REDUCING ASSEMBLED COST
- ★ IMPROVING APPEARANCE
- ★ INCREASING PERFORMANCE



**Spirolox • Circolox**  
ONLY RAMCO MAKES BOTH  
MODERN TYPES OF RETAINING RINGS

40 pages of latest information on both types of modern retaining rings. Explains when and how to use Spirolox, the full 360° "gapless" ring, and when to use the modern conventional Circolox ring. Shows special adaptations, such as the new "Self-Locking" and "Single-Turn" Spirolox Rings, as well as many other specialized rings, materials and finishes available. Write for FREE copy TODAY!

**Retaining Rings by Thompson Products RAMCO DIVISION**

Box 513, Dept. P, St. Louis 66, Missouri

another product of **Thompson Ramo Wooldridge Inc.** automotive group



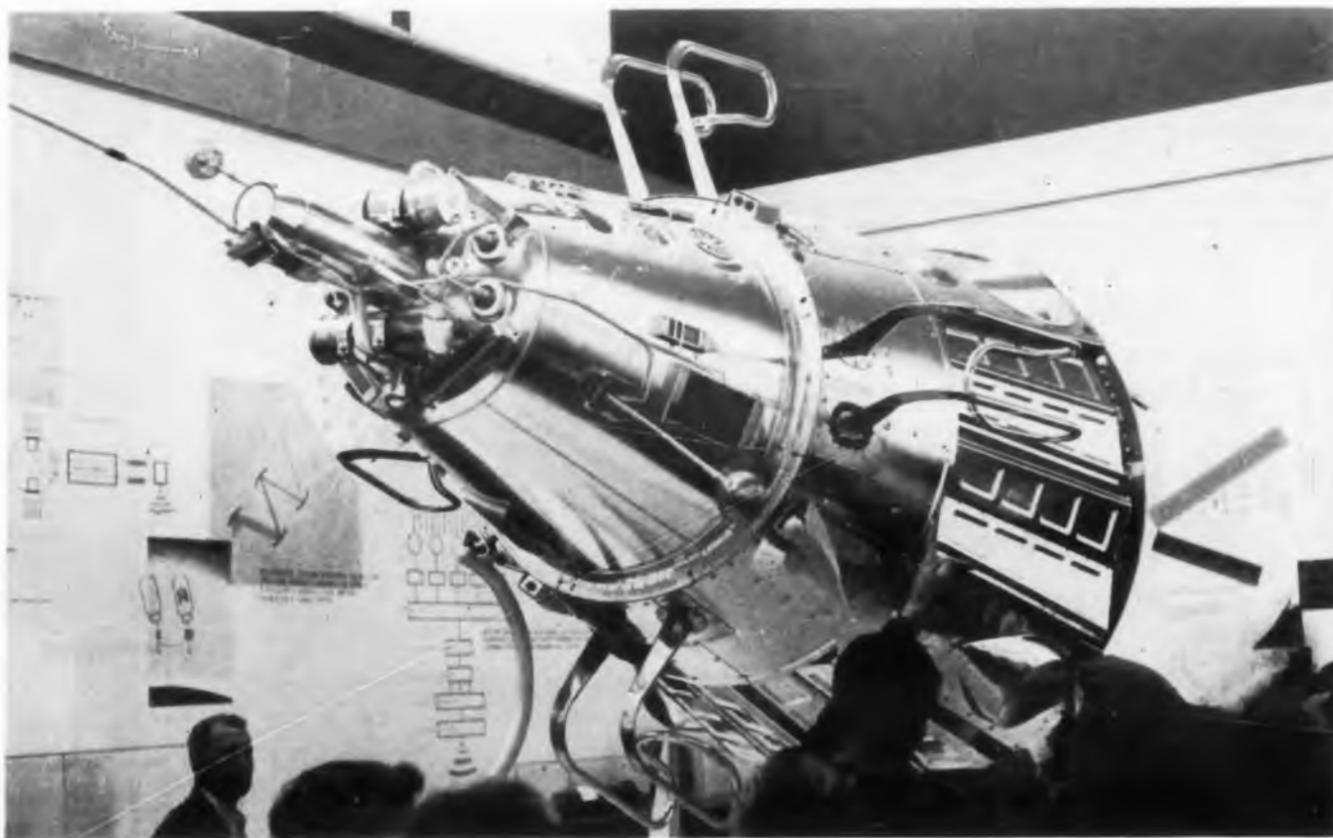
CIRCLE 46 ON READER-SERVICE CARD

## RUSSIAN TRANSLATIONS

J. George Adashko

# Solar Batteries in Sputniks

V. S. Vavilov, A. P. Landsman, and V. K. Subashiev



The solar battery plate is located in the center of the first section of Sputnik III.

**H**IGH-EFFICIENCY semiconductor photocells, the principal components of solar batteries have been described in the literature in detail.<sup>1, 2, 3</sup> In this paper, consideration will be given to recently obtained data on those properties of silicon photocells which render them suitable for use in artificial satellites. Attention will also be given to the possibilities of improving the properties of existing solar batteries.

## Efficiency of Solar Batteries

All the data pertains to silicon photocells since silicon is almost the ideal semiconductor converter of solar energy. It is almost certain that within the next few years the principal efforts of physicists and engineers in this field will indeed be directed towards a study and improvement of silicon devices. It may be that other intermetallic com-

pounds, particularly CaAs, InP, CdTe, and AlSb, may also prove useful in the future, along with silicon. The following problems arise in the operation of solar batteries.

### Operating Stability

Semiconductor transformation of radiation energy is based on a synthetically produced pn junction. It has been shown that pn junctions produced by the diffusion of phosphorus,<sup>4</sup> boron<sup>5</sup> or antimony,<sup>6</sup> even at the highest operating temperatures (200°C), do not change their properties during any conceivable time interval, i.e. hundreds of years. This is due to the fact that the impurity atoms that form the pn junction are introduced at a very high temperature and are therefore strongly bound to the atoms of the single-crystal lattice, in which the light is absorbed.

Another factor contributing to the stability of the silicon photocells is the existence of a protective film of silicon dioxide over the surface of the crystal. This film is totally transparent to light and is very stable. In this respect silicon is superior to germanium, the surface properties of which depend greatly on the pressure of the surrounding atmosphere, on the composition of the gas medium, and on the humidity. It is also superior to selenium and cadmium sulfide.

Experiments performed by the authors of this article show that the characteristics of silicon photocells remain unchanged not only upon prolonged stay in vacuum, but also upon bombardment by electrons with energies up to 30,000 electron-volts (ev).<sup>7</sup> However, ionic bombardment, which destroys the SiO<sub>2</sub> layer and disperses the silicon itself, does influence the operation of the photocell. It increases the rate of surface recombination of the electrons and holes, and reduces the coefficient of utilization  $\alpha^{\circ}$ .

In connection with this, solar battery elements should be protected against collisions with micrometeors.

### Temperature Dependence of Efficiency and Heating Conditions

As expected from theoretical considerations, the efficiency of a solar battery has been found to increase with decreasing temperature.<sup>4</sup>

Of great interest is the possibility of drawing increased amounts of power from the same battery surface area by concentrating the light with

<sup>o</sup>By definition,

$$\alpha = \frac{I}{q N'_{hp}}$$

where  $I$  is the short-circuit photo-current,  $q$  is the charge of the electron, and  $N'_{hp}$  is the number of photons absorbed per unit time.



**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. ⅛, ¼, ½ W. 10 ohms to 1 megohm at 70°C., derating to 150°C.



**FOTOCERAM,<sup>®</sup> an unusual new printed circuit board** We've resoldered more than fifty times on this board without damage to circuit runs or through-hole 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 47 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.

since  
enter  
n the  
icists  
ected  
n de-  
com-

# FREQUENCY STANDARDS

## PRECISION FORK UNIT TYPE 50



Size 1" dia. x 3 3/4" H.\* Wght., 4 oz.  
Frequencies: 240 to 1000 cycles  
Accuracies:—  
Type 50 ( $\pm .02\%$  at  $-65^{\circ}$  to  $85^{\circ}\text{C}$ )  
Type R50 ( $\pm .002\%$  at  $15^{\circ}$  to  $35^{\circ}\text{C}$ )  
Double triode and 5 pigtail parts required  
Input, Tube heater voltage and B voltage  
Output, approx. 5V into 200,000 ohms

\*3 1/2" high  
400 - 1000 cy.

## FREQUENCY STANDARD TYPE 50L



Size 3 3/4" x 4 1/2" x 5 1/2" High  
Weight, 2 lbs.  
Frequencies: 50, 60, 75 or 100 cycles  
Accuracies:—  
Type 50L ( $\pm .02\%$  at  $-65^{\circ}$  to  $85^{\circ}\text{C}$ )  
Type R50L ( $\pm .002\%$  at  $15^{\circ}$  to  $35^{\circ}\text{C}$ )  
Output, 3V into 200,000 ohms  
Input, 150 to 300V, B (6V at .6 amps.)

## PRECISION FORK UNIT TYPE 2003



Size 1 1/2" dia. x 4 1/2" H.\* Wght. 8 oz.  
Frequencies: 200 to 4000 cycles  
Accuracies:—  
Type 2003 ( $\pm .02\%$  at  $-65^{\circ}$  to  $85^{\circ}\text{C}$ )  
Type R2003 ( $\pm .002\%$  at  $15^{\circ}$  to  $35^{\circ}\text{C}$ )  
Type W2003 ( $\pm .005\%$  at  $-65^{\circ}$  to  $85^{\circ}\text{C}$ )  
Double triode and 5 pigtail parts required  
Input and output same as Type 50, above

\*3 1/2" high  
400 to 500 cy.  
optional

## FREQUENCY STANDARD TYPE 2005



Size, 8" x 8" x 7 1/4" High  
Weight, 14 lbs.  
Frequencies: 50 to 400 cycles  
(Specify)  
Accuracy:  $\pm .001\%$  from  $20^{\circ}$  to  $30^{\circ}\text{C}$   
Output, 10 Watts at 115 Volts  
Input, 115V. (50 to 400 cycles)

## FREQUENCY STANDARD TYPE 2007-6



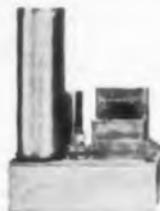
TRANSISTORIZED, Silicon Type **NEW**  
Size 1 1/2" dia. x 3 1/2" H. Wght. 7 ozs.  
Frequencies: 400 — 500 or 1000 cycles  
Accuracies:  
2007-6 ( $\pm .02\%$  at  $-50^{\circ}$  to  $+85^{\circ}\text{C}$ )  
R2007-6 ( $\pm .002\%$  at  $+15^{\circ}$  to  $+35^{\circ}\text{C}$ )  
W2007-6 ( $\pm .005\%$  at  $-65^{\circ}$  to  $+125^{\circ}\text{C}$ )  
Input: 10 to 30 Volts, D. C., at 6 ma.  
Output: Multitap, 75 to 100,000 ohms

## FREQUENCY STANDARD TYPE 2121A



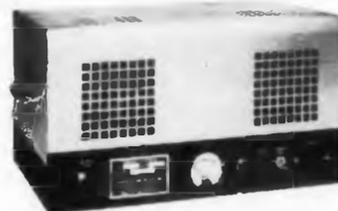
Size  
8 3/4" x 19" panel  
Weight, 25 lbs.  
Output: 115V  
60 cycles, 10 Watt  
Accuracy:  
 $\pm .001\%$  from  $20^{\circ}$  to  $30^{\circ}\text{C}$   
Input, 115V (50 to 400 cycles)

## FREQUENCY STANDARD TYPE 2001-2



Size 3 3/4" x 4 1/2" x 6" H., Wght. 26 oz.  
Frequencies: 200 to 3000 cycles  
Accuracy:  $\pm .001\%$  at  $20^{\circ}$  to  $30^{\circ}\text{C}$   
Output: 5V. at 250,000 ohms  
Input: Heater voltage, 6.3 - 12 - 28  
B voltage, 100 to 300 V., at 5 to 10 ma.

## FREQUENCY STANDARD TYPE 2111C



Size, with cover  
10" x 17" x 9" H.  
Panel model  
10" x 19" x 8 3/4" H.  
Weight, 25 lbs.  
Frequencies: 50 to 1000 cycles  
Accuracy: ( $\pm .002\%$  at  $15^{\circ}$  to  $35^{\circ}\text{C}$ )  
Output: 115V, 75W. Input: 115V, 50 to 75 cycles.

## ACCESSORY UNITS for TYPE 2001-2



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

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

WHEN REQUESTING INFORMATION  
PLEASE SPECIFY TYPE NUMBER

## American Time Products, Inc.

Watch  Master  
Timing Systems

Telephone: PLaza 7-1430

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

CIRCLE 48 ON READER-SERVICE CARD

## RUSSIAN TRANSLATIONS

lightweight mirrors. Available experimental data shows that if the heat is well dissipated, i.e., if the silicon temperature is maintained within  $25^{\circ}\text{C}$ . it is possible to draw from one square meter of operating surface three times the electric power (up to  $180\text{ w/cm}^2$  at an incident power of  $1\text{ kw/cm}^2$ ) at a six-fold concentration of the light. Naturally, the use of concentration is possible only if suitable heat removal is afforded. In the case of non-oriented satellites, the concentration of light by means of mirrors is quite difficult.

### Approach to the Theoretical Efficiency Limit

It is well known that the efficiency of the better individual solar-battery elements does not exceed

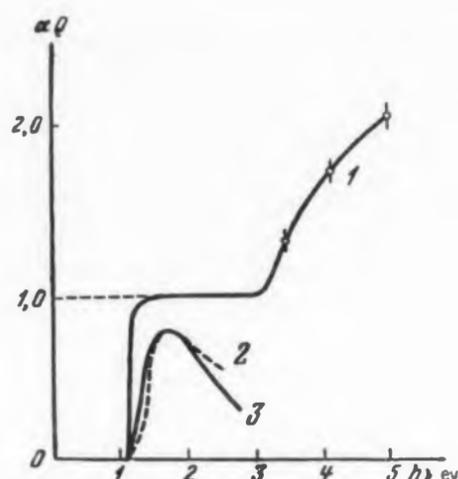
### Number of experimental solar batteries

Date	1	2
May 15	24	25
16	30	25
17	25	26
18	24	27
19	21	25
20	21	24
21	22	23
22	26	25
23	20	18
24	25	23
25	23	25
26	24	28
27	21	23
28	24	26
29	16	27
30	24	21
31	22	22

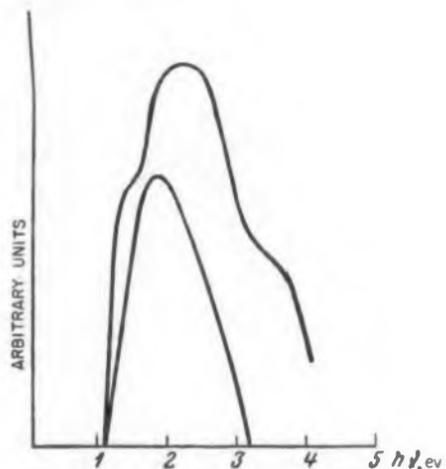
Temperature (averaged over the day) of the surface of solar batteries during the first 17 days of the flight of the satellite, in degrees Centigrade.

13 per cent,<sup>9</sup> and the efficiency of the battery as a whole is still quite low. The physical processes in silicon and on its surface could be used to raise the efficiency substantially, bringing it close to the theoretical limit. This limit, calculated by Prince using certain diffusion assumptions,<sup>2</sup> amounts to approximately 23 per cent for a temperature of 300 K. This is the theoretical equivalent of 300 w of electric power from 1 cm<sup>2</sup> of surface under the conditions prevailing outside the atmosphere. The following possibilities exist.

■ It has been established that the diffusion length of the electrons, which determines the "coefficient of utilization" for the long-wave light ( $h\nu > 2.5\text{ eV}$ ), drops after heat treatment in the presence of phosphorus from the 200 to 800 micron range to the 20 to 50 micron range.<sup>8, 10</sup>



**Fig. 1.** Comparison of spectral characteristics of modern silicon photocells with ideal characteristics: Curve 1—use of photons for ideal silicon photocells (quantum efficiency of photoionization); curve 2—the "bell" photocell; curve 3—experimental photocell of the Physics Institute, Academy of Sciences, USSR.



**Fig. 2.** Comparison of the relative fraction of the photocurrent, arising during absorption of solar radiation in a typical element of a solar battery (lower curve) and in an ideal silicon photocell (upper curve).

It has been shown that phosphorus itself is not one of the recombination impurities that sharply reduce the lifetime and the diffusion length of the carriers. An important problem is the understanding of the causes of the reduction in the diffusion length. If the properties of the silicon are maintained nearly constant, it is possible to increase the utilization of the long-wave light by a factor of several times (Fig. 1).

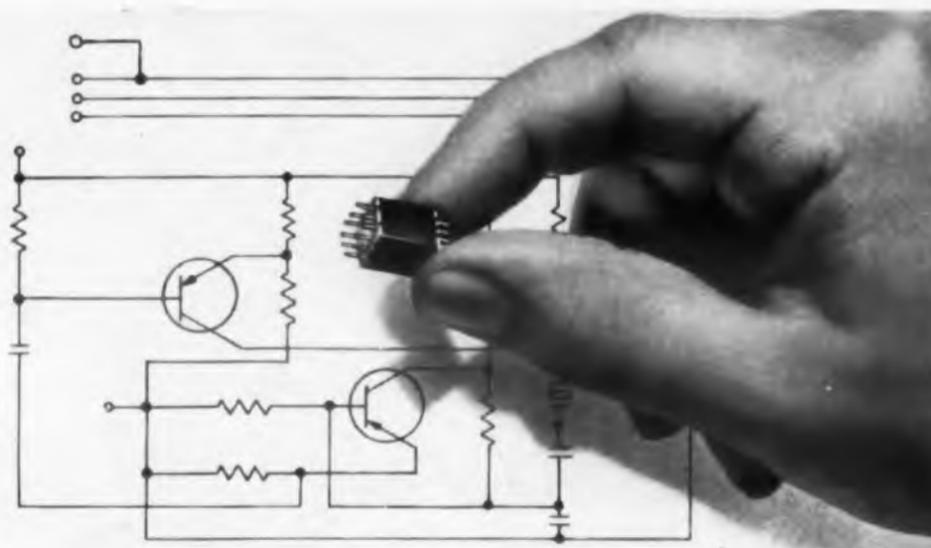
Modern silicon photocells have a relatively low sensitivity in the shortwave portion of the spectrum (wavelengths shorter than that of yellow light). This is indeed characteristic of photocells, but by no means characteristic of the process of photo-ionization in silicon itself. The quantum efficiency, i.e., the number of photoelectrons per

**Status Report on RCA Micromodules—dramatic new semiconductor system for high-density parts packaging**

# Now...600,000 Parts Per Cubic Foot In Low-Power Transistor Circuits with RCA Micromodules

Since our March announcement of the availability of RCA Micromodules, we have been deluged with requests from equipment manufacturers to design their circuits into sample modules...and we are happy to do it, of course. That's the purpose of this first report—to let you know that we'd like to evaluate *your* new or existing circuits for micromodularization. Remember, micromodularized end-equipment for application in military computers, digital devices for missiles and satellites, airborne or portable communication equipment, or submarine electronics is probably only *one design cycle* away. That's why we want you to know *now* what we can do for you.

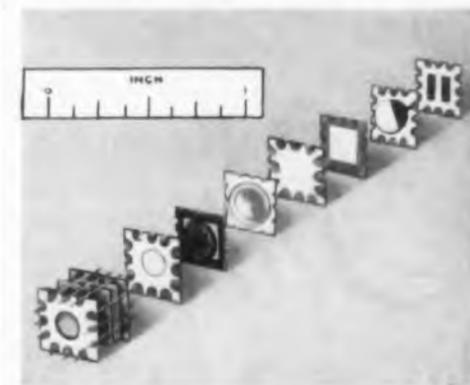
The inherent advantages of micromodularized equipment are among the most exciting in years. Now in pilot production, RCA Micromodules can be made for *any* low-power transistor circuit. The opportunity to design equipment with a modular parts density of 600,000 per cubic foot means dramatic space savings and makes possible an almost unbelievable number of circuits per cubic foot. Result: greater reliability through redundancy, room to improve accuracy, precision, control, sensitivity, and selectivity. RCA Micro-



RCA Micromodules make possible equipment with a modular parts density of 600,000 per cubic foot, achievement of dramatic space savings over existing miniature electronic equipment and an amazing increase in the number of circuit functions per cubic foot. These advantages provide increased reliability through redundancy, room for more circuits to improve accuracy, precision, control, sensitivity.

modules are the design engineer's dream come true.

RCA Applications Engineers are at work now converting equipment designers' circuits into developmental modules. All customers' circuits are treated in strictest confidence, of course. For some we have standard modules, for others we design circuits. And we are currently developing even more standard circuits. We sincerely believe it will be very much to your advantage to prepare your equipment designs for modularization now. Your RCA Field Representative can get you started. Call him today.



Micromodules were developed in cooperation with the U. S. Army Signal Corps. They are units in which several micro-elements are combined to perform specific circuit functions—amplifier, oscillator, or divider for example. The micro-elements are tiny ceramic wafers approximately 3/10th inch square and 1/100th inch thick, on which conducting, semiconducting, and insulating materials are fused to provide the electrical characteristics of basic electronic components such as resistors, capacitors, and transistors. The elements are interconnected and encapsulated to form Micromodules.

Also available at your local RCA Semiconductor Distributor



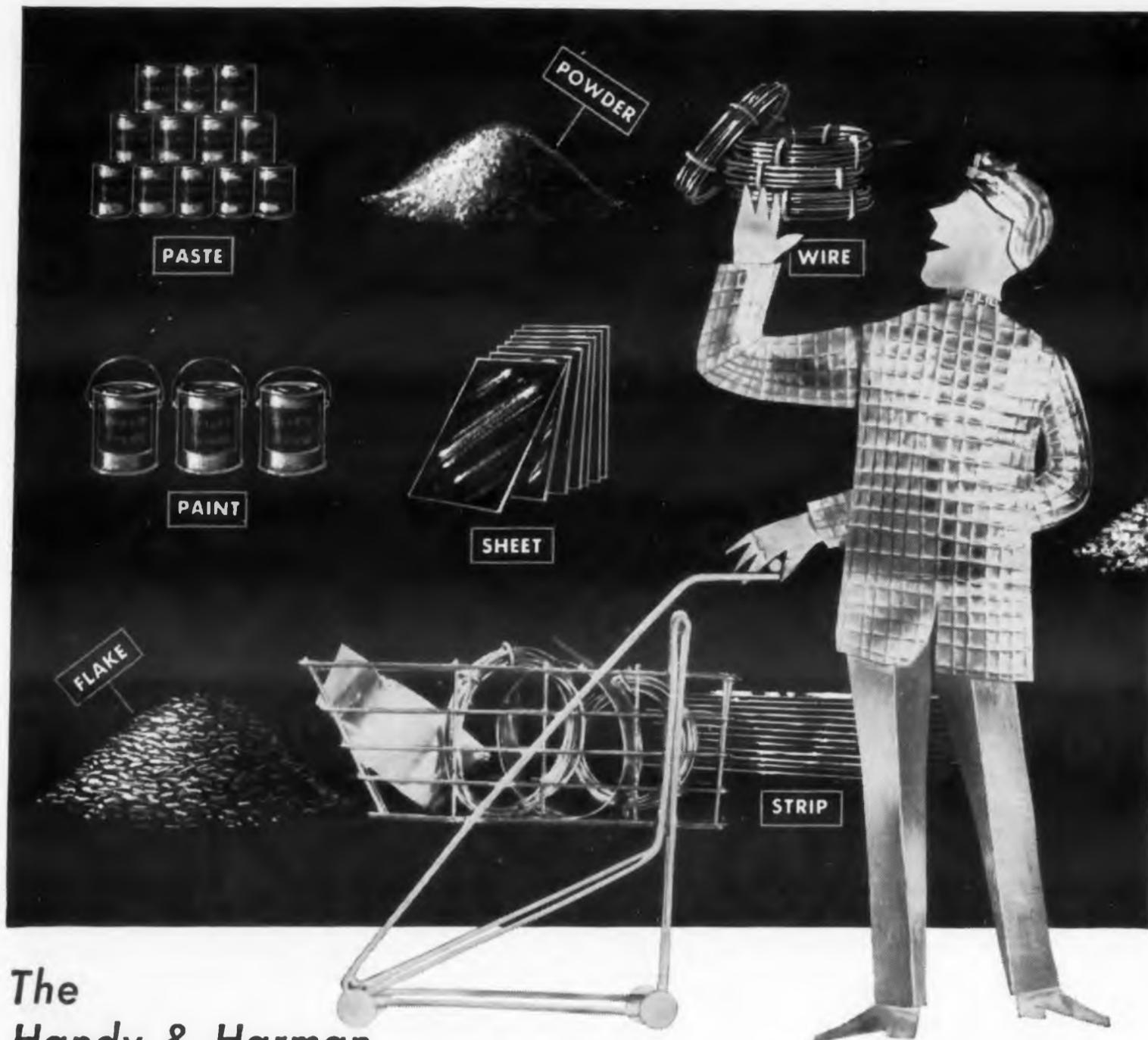
**RADIO CORPORATION OF AMERICA**

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 49 ON READER-SERVICE CARD



The  
Handy & Harman

## Silver Supermarket

Has every form of silver for your electronics applications

Silver, in many forms and alloys, is a necessity in the electronics and electrical industries. To meet this need on a high quality level, Handy & Harman manufactures powder, flake, paint, paste, sheet, strip, wire, etc., for printed circuits, wiring, resistors, condensers, thermistors, contacts, printed terminal strips on glass, ceramics, plastic laminates, etc.

Another "At Your Service" Division of the Handy & Harman Silver Supermarket is our Research and Engineering Department. Always ready to help you with any problem or project you may have involving silver for *any* application.

### VISIT OUR BOOK DEPARTMENT

We have five Technical Bulletins giving engineering data on the properties and forms of Handy & Harman Silver Alloys. We would like you to have any or all of those that

particularly interest you. Your request, by number, will receive prompt attention.

Fine Silver .....	Bulletin A-1
Silver-Copper Alloys .....	Bulletin A-2
Silver-Magnesium-Nickel .....	Bulletin A-3
Silver Conductive Coatings .....	Bulletin A-4
Silver Powder and Flake .....	Bulletin A-5

Your No. 1 Source of Supply and Authority  
on Precious Metal Alloys

**HH**  
**HANDY & HARMAN**

General Offices: 82 Fulton St., New York 38, N. Y.

CIRCLE 50 ON READER-SERVICE CARD

## RUSSIAN TRANSLATIONS

absorbed photon, equals unity in the range of values  $h\nu = 1.1$  to  $3.2$  eV. It was recently shown<sup>11</sup> that when  $h\nu > 3.2$  eV the quantum efficiency increases, due to the impact ionization produced by the excess photoelectron energy. Thus, the use of the shortwave portion of the spectrum is an important problem. Moreover, its solution is made difficult by complicated problems of reducing the depth of the pn junction and reducing the rate of surface recombination.

Fig. 1 shows a comparison of the spectral characteristics of typical modern silicon photocells, and the ideal characteristic for the case of complete collection of the photoelectrons and holes. Fig. 2 shows the relative fractions of the photocurrent, arising in the absorption of solar radiation in a typical solar-battery element (lower curve) and an ideal silicon photo element (upper curve).

■ A third way of increasing the efficiency is to transmit the light through the surface of the silicon. In the region of the silicon wavelengths, i.e., at 1 to 0.25 microns, the coefficient of reflection  $R$  exceeds 30 per cent and increases with diminishing wave lengths (at  $\lambda = 0.25$  microns we get  $R \approx 70$  per cent).<sup>11, 12</sup> By reducing the coefficient of reflection without increasing at the same time the rate of surface recombination, we can increase the efficiency of the photocell.

It has been shown that a considerable transmission of light through the surface of the silicon can be obtained by oxidizing the surface, i.e., by producing a strong and transparent  $\text{SiO}_2$  film of sufficient thickness.<sup>13</sup>

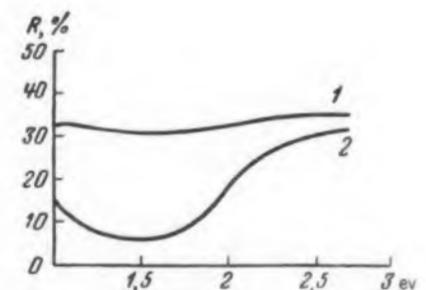


Fig. 3. Coefficients of reflection of pure silicon (curve 1) and of a transmitted-like surface (curve 2).

The thickness of the film, and consequently the position of the minimum coefficient of reflection, can be controlled in accordance with the properties of the photocell and the spectral composition of the light employed. Fig. 3 shows the coefficients of reflection of pure silicon and a transmitted-light surface. The relative increase in the photocurrent for the solar spectrum amounts to 20 to 25 per cent.

## Operation in the Third Soviet Satellite

Prolonged scientific observations by instruments mounted on an artificial earth satellite would make it necessary to increase considerably the weight of the power supplies. The success of experiments with direct conversion of solar energy into electricity outside the earth's atmosphere, carried out in the third Soviet satellite, gives grounds for hoping that the power supply problem for scientific apparatus in satellites has been solved.

When considering the possibility of using solar batteries as sources of supply for artificial earth satellites, one can point to two principal reasons why the apparatus may go out of order or become less efficient when operating in cosmic space:

- High temperatures produced in the solar batteries under prolonged exposure to the sun.
- Erosion of the surface of the solar batteries or of the protective covers by micrometeorites.

Investigations performed under earth conditions cannot give an unequivocal answer to these problems. In addition to providing solar batteries to supply the Mayak beacon radio transmitter, experimental solar transducers were mounted on the satellite to clarify the afore-mentioned basic problems.

They were located on two opposite sides of the housing of the satellite. Each transducer consisted of two solar batteries with different covers and a resistance thermometer on which a plate of single-crystal silicon was glued. Two batteries, covered with ground glass, were placed one in each transducer. They served as standards. Another battery was not protected at all, and the fourth was covered with polished glass.

In the presence of meteoric erosion, the batteries protected with the ground glass should not experience any deterioration of their properties with time. In the battery covered with the plain glass, the current should gradually approach that produced by the battery with the ground glass. The battery without any glass cover should fail completely once its thin surface layer is eroded. The temperature transducers made it possible to measure the effective temperature and to determine the temperature drops.

The interpretation of the films produced after the first two days of operation of the transducers has yielded information on the transducer temperature. The calculated average temperature of the silicon converters fluctuated between 16 and 30 C during the first few days (see table). This was partially due to the specially finished bodies of the solar batteries which resulted in an increased surface radiation coefficient.

Taking into account the very slight thermal con-

# CAN SYNCHROS

# BE MOISTURE-PROOFED?



Thanks to the special materials and construction of improved Ketay synchros, the moisture-resistance standards of Mil Spec 20708 (superseding all previous specifications) can be met or exceeded.

Many of these special materials and design features are exclusive with Ketay . . . the only source currently manufacturing and shipping a wide range of the new Mil-type synchros.

Stainless steel housing, shafts, and bearings . . . stators potted in anti-fungus epoxy resin . . . hermetically sealed windings . . . thru-bore construction for fewer parts and less space where moisture can collect . . . these and a variety of other Ketay features all give extra protection against moisture damage.

For high performance and dependability, despite extremes of humidity and temperature, specify Ketay synchros and other precision components, available in production quantities in sizes from 8 to 23. Sixty cycles per second units are available as small as size 15. Units one or more sizes smaller and lighter than previously required can often be used, because of Ketay's superior accuracy. Units of 3' and 2' accuracy are available for immediate delivery.

Ketay engineers are working with manufacturers whose prototype systems have unusual environmental and accuracy requirements. Call or write for help in solving your special problems.

#### Ketay precision components:

SYNCHROS  
RESOLVERS  
POTENTIOMETERS  
SERVO MOTORS  
TACHOMETERS  
SERVO AMPLIFIERS  
GYROMECHANISMS

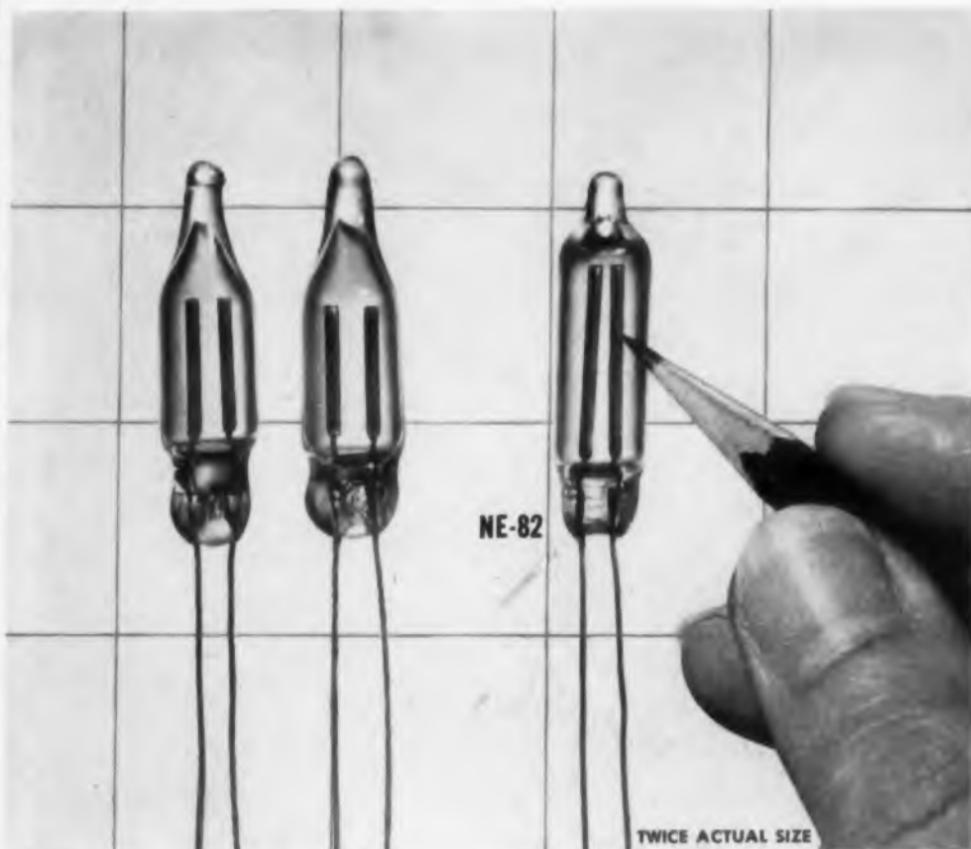
Catalogues available



Division of United Aircraft Corporation

KETAY DEPARTMENT, Commack, Long Island, N.Y.

CIRCLE 51 ON READER-SERVICE CARD



New NE-82 shown with other G-E Glow Lamps

## LONGER ELECTRODES on G-E NE-82 Glow Lamp permit up to 5 times higher current loadings (up to 1.5 m.a.)

The General Electric NE-82 Glow Lamp as controlled characteristics and was specifically engineered for higher current loadings—up to five times higher than most other circuit component glow lamps. Its lengthened electrodes insure longer period of stable operation at higher loadings than glow lamps having shorter electrodes.

Special techniques developed by General Electric bring the G-E NE-82 to a condition of stability; this helps the NE-82 provide uniform performance within established, predetermined limits. The leads of the G-E NE-82 have been plated for soldering ease. The NE-82 also uses the new "formed tip" construction for minimum over-all length.

### DIRECT CURRENT CHARACTERISTICS

Starting Volts . . . . .	62-78-Volts d-c
Operating Volts (up to 1.5 m.a.) . . . . .	50-60-Volts d-c
Extinguishing Volts (in series with .25 megohms or more). . . . .	50-Volts d-c
Design Current. . . . .	1.5 m.a.
Life—Change in Starting and Operating Volts at 1.5 m.a. + 5-Volts in 2,000 hours.	

Select the General Electric Glow Lamp best suited for your circuit requirements. For further information write for "Glow Lamps as Circuit Components", General Electric Co., Miniature Lamp Dept. M-903, Nela Park, Cleveland 12, O.

*Progress Is Our Most Important Product*

**GENERAL  ELECTRIC**

## RUSSIAN TRANSLATIONS

tact between the transducers and the satellite shell, it can be stated, on the basis of material already available, that with careful construction there is no danger of the photoconverter failing through overheating.

Preliminary processing of the data on meteoric erosion still does not allow us to draw any quantitative conclusions. However, judging from the operation of the experimental glass-protected solar battery, the surface erosion is quite slow. To obtain quantitative data obviously calls for a longer time.

A preliminary conclusion can also be drawn concerning the effect of cosmic radiation. The operation of the Mayak radio transmitter for more than six months leads to the conclusion that cosmic radiation presents no danger to the solar battery.\*

Simultaneously with the experiments performed on the satellite to determine the effect of various factors on the operation of silicon converters, a large solar battery was constructed to supply the Mayak transmitter. In the construction of the battery the following factors were taken into account:

- The undesirability of a buffer connection between the solar batteries and the storage batteries
- The rotation of the satellite, particularly the need for providing a power reserve
- The shunting of the illuminated portion of the battery by the unilluminated ones

As a result, the following construction was adopted. The solar battery was built in the form of individual sections and placed on the surface of the satellite shell. Four small sections were mounted on the nose, four sections on the side surface, and one section on the rear cover. All sections were connected in parallel through diodes, which prevented the shunting of the illuminated portion of the battery by non-illuminated ones and assured normal operation regardless of the orientation of the satellite relative to the sun.

The radio transmitter was fed from the solar batteries only when the satellite passed over the side of the earth illuminated by the sun. When the satellite moved in the earth's shadow, the transmitter was fed from electrochemical sources. The switching from one type of supply to another

\*The available data on the damage to the structure of the silicon produced by fast particles, and data on how this damage affects the lifetime of the carriers, the conductivity, and the optical properties also give grounds for assuming that cosmic radiation cannot affect the operation of solar batteries.

for . . . . .  
**PRECISION  
MEASUREMENTS**  
from 50 to  
**10,500 MCS**

# WEINSCHEL

**100% Square Wave  
MODULATED RF SOURCES  
Offer High Amplitude  
and  
Frequency Stability**



Model MS-6

**Output Amplitude Independent of Load**

Feedback circuit maintains constant incident power, allowing use of full generator output without power consuming impedance masking.

**Amplitude Stability**

After one hour warm-up and without feedback circuit:  $\pm 0.1$  db/hr. With regulator and external directional coupler, the incident power will change less than 0.2 db for a change in load of from 25 to 150 ohms. With a voltage probe, the voltage variation is reduced by 10:1 by feedback.

Model No.	Frequency MCS	Minimum Peak Power Output (100% Sq. Wave Modulated)
MS-1	50-250	80MW
MS-2	250-920	200MW
MS-3	900-2000	100MW
MS-4	2000-4200	60MW
MS-5	4000-7300	40MW
MS-6	7200-10,500	30MW

Write for complete specifications.

Weinschel Fixed Coaxial Attenuators cover the frequency range of DC to 12 KMC.

Write for complete catalog,



specifying frequency range of interest.

**Weinschel Engineering**

KENSINGTON, MARYLAND

CIRCLE 53 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 2, 1959

# TOPS'EM ALL



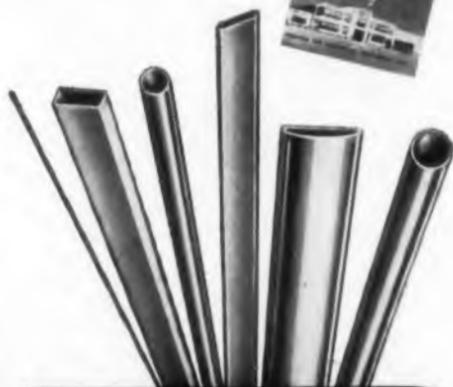
## IN QUALITY OF TUBING

Comparative quality tests by one of America's leading users of tubing proved only Precision Tubing rates excellent in all specifications . . . yet Precision Tubing costs no more.

Precision Tubing is unequalled and unsurpassed in quality tests of accuracy, temper, straightness and roundness. You are sure of extra quality in every size tube at regular mill prices. Available in sizes from .010" to 1.125" O.D. in copper, brass, aluminum, up to 5/8" O.D. in nickel and nickel alloys, Ni-Span "C", phosphor bronze and nickel silver. In straight random lengths, coils or preformed shapes to specifications.

Write for catalog and technical data to Dept. 9, Precision Tube Company, Inc., North Wales, Pa.

GET THIS NEW TUBING DATA CATALOG



**PRECISION TUBE COMPANY**

CIRCLE 54 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 2, 1959

is automatic. After the storage batteries are exhausted, the solar batteries continue to operate when illuminated by the sun.

A substantial shortcoming of such a scheme is that the solar batteries are not operating at their optimum conditions, due to the large variations in the load during the operation of the transmitter. The batteries must therefore be overrated. Later on, when it becomes possible to use batteries with a buffer storage battery, the need for excess capacity will disappear.

Data on the operation of the power supplies of the Mayak transmitters was transmitted over its radio channel by variation of the duration of telegraph messages. The following signal coding was used. If the radio transmitter is operated by the solar batteries, the duration of the first telegraph message, following immediately the 300-msec marker message, is 150 msec. When fed from electro-chemical sources the duration of the signal is 50 msec.

The uninterrupted operation of the Mayak for six months leads to the very important conclusion that solar batteries of high power are already in use efficiently on earth satellites.

*This was translated from "Artificial Earth Satellites," a pamphlet published by the Soviet Academy of Sciences.*

#### References

1. V. K. Subashiev, "Semiconductor Converters of Solar Energy", Earth Science Institute, Academy of Science of USSR, Leningrad, 1956.
2. M. Prince, *Journal of Applied Physics*, 26, 534, 1955.
3. V. S. Vavilov, *Atomic Energy (USSR)*, No. 3, 1956.
4. V. S. Vavilov, V. M. Malovetskaya, G. N. Galkin, and A. P. Landsman, *Progress in Physical Sciences* 63, No. 1a, 123, 1957 (USSR). English translation published by International Physical Index.
5. D. Chapin, C. Fuller, and G. Pearson, *Journal of Applied Physics*, 25, 676, 1954.
6. Yu. P. Maslakovets, G. V. Dubrovskiy, S. A. Poltinnkov, and V. K. Subashiev, *Journal of Technical Physics (USSR)*, 26, 2396, 1956. English translation published by American Institute of Physics.
7. V. M. Patskevich, V. S. Vavilov, and L. S. Smirnov, *Journal of Experimental and Theoretical Physics (USSR)*, 33, 804, 1957. English translation published by the American Institute of Physics.
8. V. S. Vavilov, G. N. Galkin, V. M. Malovetskaya, *Atomic Energy (USSR)*, No. 6, 1958.
9. D. Chapin, C. Fuller, and G. Pearson, *Bell Laboratories Record*, 33, 241, 1955.
10. V. S. Vavilov, G. N. Galkin, and V. M. Malovetskaya, Paper delivered at the All-Union Conference on Photoelectricity, Kiev, 1957.
11. V. S. Vavilov and K. I. Britsyn, *Journal of Experimental and Theoretical Physics*, (USSR), May 1958. English translation by American Institute of Physics.
12. V. S. Vavilov, A. A. Gippius, and M. M. Gorshkov, *Journal of Technical Physics*, (USSR), 28, 254, 1958. English translation by American Institute of Physics.
13. V. M. Malovetskaya, V. S. Vavilov, and G. N. Galkin, *Journal of Technical Physics*, (USSR), 1958. English translation published by the American Institute of Physics.

# SPACE COMMUNICATION ANTENNAS



## Andrew Quad-Helix antenna tracks long and medium-range missiles

Telemetry circuits between missile (or satellite) and ground station are reliably maintained with the ANDREW Quad-Helix Array. This system offers low vswr, high gain, and easy control.

Gain is 17.5 db at 265 mc, 14.5 db at 215 mc. vswr is less than 2.0:1 across this range. Polarization is right hand circular; impedance 50 ohms. Counterbalanced rotator provides 180° elevation and 720° azimuth tracking at speeds from 0° to 30° per second.

Optional remote control unit regulates speed and direction.

#### OTHER ANDREW GROUND-AIR ANTENNAS

##### TRI-HELIX ANTENNA

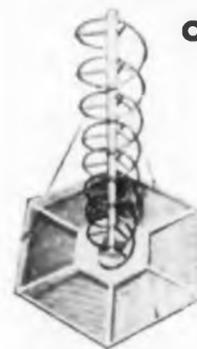
880-990 MC 17.5 DB GAIN TYPE 81068

##### HELIX ANTENNAS

FREQUENCY	GAIN	TYPE NUMBER
108-132 mc	12 db	H 19110 A-1
215-265 mc	10.5 db	H 50140 A
215-265 mc	13 db	H 19110 A-2
260-320 mc	13 db	H 19110 A-3
320-400 mc	13 db	H 19110 A-4
400-500 mc	12 db	H 19110 A-5

##### DISCONE ANTENNAS

FREQUENCY	TYPE NUMBER
25-50 mc	50154
50-108 mc	51150
108-215 mc	19050-1
215-420 mc	19050-2
420-1000 mc	19050-3



**Andrew CORPORATION**

For full information on these and other ANDREW ground-air antennas, write today for Bulletin 8456

363 EAST 75th STREET • CHICAGO 19  
Offices: New York • Boston • Los Angeles  
Washington, D.C. • Toronto

CIRCLE 55 ON READER-SERVICE CARD

## MAMMOTH narda SONBLASTER

America's first mass-produced  
industrial-size ultrasonic cleaner!

**SAVE** 7 ways over costly solvent,  
alkaline or vapor degreasing:

- Clean faster, speed production!
- Cut rejects, eliminate bottlenecks!
- Save on chemicals & solvents!
- Eliminate expensive installation!
- Cut maintenance and downtime!
- Save on floor space!
- Release labor for other work!



G-1501 generator, NT-1505 tank.

**MAMMOTH  
5-GALLON  
TANK  
\$695**

Other models from \$175.

2-year guarantee on all units.

### SPECIFICATIONS

Interior Tank size (in.), 10W x 14L x 9½H. Tank Capacity, 5 gallons.

### Submersible Transducers

Model NT-604 — Hermetically sealed heli-arc welded stainless steel case. Radiating face: 27 sq. in. Effective plane of radiation: 40 to 50 sq. in. (approx. 10" x 5"). Effective cavitation of volumes: up to 1200 cu. in. at 24" tank height (5 gal.) and 2400 cu. in. at 48" tank height (10 gal.). Swagelok tube fitting on side or end for internal tank wiring.

Model NT-605 — Same as NT-604 except for bulkhead fitting on back for external wiring. Eliminates electrical conduits in solutions.

Now you can say goodbye to expensive chemicals, solvents, and degreasing equipment... reclaim valuable floor space... eliminate high installation costs... just by installing a Narda Series 1500 SonBlaster. At the same time, you'll get better, faster cleaning, and you'll need fewer people to do the job!

Get the tremendous activity of the new 200-watt Narda SonBlaster, with the largest transducerized tank ever made, at the lowest price in the industry! Choose from transducerized tanks or submersible transducers for use in any arrangement in any shape tank you desire. Up to 4 submersible transducers can be easily operated from the same generator at one time; load selector switch provided — an exclusive Narda feature.

Simply plug the SonBlaster into any 110-115 V AC line, and flip the switch. In seconds, you'll clean most any mechanical, optical, electrical, medical or horological part or assembly you can think of. Perfect, too, for brightening, polishing, radioactive decontaminating, pickling, quenching and plating; emulsifying, mixing, sterilizing, impregnating, degassing, and other chemical process applications.

Mail the coupon for free help in determining the model that's best for you.

The SonBlaster catalog line of ultrasonic cleaning equipment ranges from 35 watts to 2.5 KW, and includes transducerized tanks as well as immersible transducers. If ultrasonics can be applied to help improve your process, Narda will recommend the finest, most dependable equipment available — and at the lowest price in the industry!

The Narda Ultrasonics Corporation  
625 Main Street  
Westbury, L. I., New York  
Department ED-6

Gentlemen:

Please send me more information about

- Series 1500 SonBlasters  
 The complete Narda line

Name \_\_\_\_\_

Organization \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

Zone \_\_\_\_\_ State \_\_\_\_\_

**the narda** ultrasonics  
corporation  
625 MAIN STREET, WESTBURY, L. I., N. Y.  
Subsidiary of The Narda Microwave Corporation

CIRCLE 56 ON READER-SERVICE CARD

## GERMAN ABSTRACTS

E. Brenner

# Double Push-Pull Modulator

FOR CERTAIN applications of amplitude modulated signals (e.g. the NTSC color system) it is necessary to suppress the carrier. In addition to "ring modulators," which employ diodes and transformers, it is also possible to use electron tube circuits which are easy to balance.

In a tube with two control grids,  $G_1$  and  $G_3$ , the dynamic plate current component is related to the grid signals  $v_{g1}$  and  $v_{g3}$  through the transconductances

$$g_1 = \frac{i_b}{v_{g1}}$$

$$g_3 = \frac{i_b}{v_{g3}}$$

$$g_m = \frac{1}{2} \left( \frac{g_1}{v_{g3}} + \frac{g_3}{v_{g1}} \right)$$

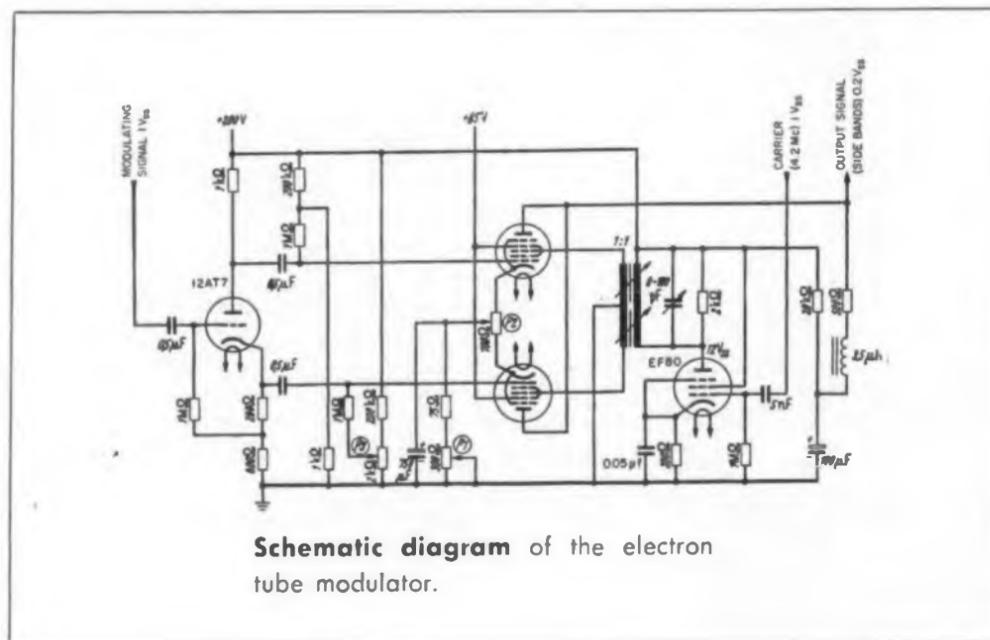
When the carrier,  $v_c$ , is applied to  $G_3$  and the modulating signal,  $v_1$ , is applied to  $G_1$  then  $i_b = g_1 v_1 + g_3 v_c + g_m v_1 v_c +$  negligible terms.

By using two tubes in push-pull, as shown in the Figure with  $g_1$  and  $g_3$  respectively identical, the output voltage has the form

$$v_{out} = R_L (g'_m + g_m'') v_1 v_c$$

Three balancing controls are provided. The potentiometer  $P1$  is used to adjust the operating point of the tubes. This adjustment is not critical and is provided chiefly for use when tubes are changed. The potentiometer  $P2$ , in the cathode circuit, serves to adjust the  $g_1$  values through current feedback. Adjustment of  $g_3$  is made by varying the dc voltage on  $G_1$  and  $P3$ .

Abstracted from an article by W. Beckman  
Zeitschrift fuer Angewandte Physik, Vol. 11, No. 3,  
March 1959, pp 89-91.

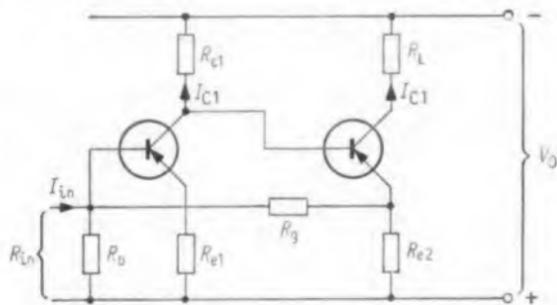


Schematic diagram of the electron tube modulator.

## DC Stabilization of Transistors

DC COUPLING and degeneration over several transistor stages are effective for compensation of drift in dc conditions caused by parameter variation due to temperature changes or due to differences between individual transistors.

In a two stage amplifier (Fig. 1) the collector of the first transistor is tied directly to the base of the second. A resistance of proper value may sometimes be used advantageously in place of the short circuit between these two points. The emitter of the second transistor is coupled to the base of the first through the  $R_g - R_b$  combination. Bypass capacitors which do not influence the dc calculations are omitted from the diagram.



Two stage transistor amplifier with dc coupling and degeneration.

For each transistor

$$I_c = I_{c0} + \alpha I_B$$

where  $\alpha$  is referred to the emitter configuration. If it is assumed that  $R_{c1}$ ,  $R_b$  and  $R_g$  are much larger than either  $R_{e1}$  or  $R_{e2}$  and if  $\alpha + 1$  is replaced by  $\alpha$ , then the two collector currents may be approximated by

$$I_{c1} = \frac{V_o + I_{c01}r_g(1 + r_c/R_{e2}) + I_{c02}r_c}{R_c + r_g + r_cR_{e1}(R_b + R_g)/R_bR_{e2} + r_g r_c/R_{e2}}$$

$$I_{c2} = (V_o - I_{c1}R_c)/R_{e2}$$

where

$$r_g = R_g/\alpha_1; r_c = R_c/\alpha_2'$$

Since  $I_{c01}$ ,  $R_g$  and  $I_{c02}$ ,  $R_c$  are in every case smaller than  $V_o$ , the values  $I_{c01}$ ,  $r_g$  and  $I_{c02}$ ,  $r_c$  are sufficiently small so that  $I_{c1}$  is independent of the parameter  $\alpha$ .

In the original article the choice of individual resistance values is also discussed.

Abstracted from an article by K. Emden, Archiv der Elektrischen Uebertragung, Vol. 13, No. 5, May 1959, pp 219-220.

# check these cost-cutting NEW IDEAS from SETKO

then check the coupon below for full information and free test samples

**IDEA #1** "NU-CUP® POINT GRIPS THINWALL TUBING BETTER THAN ALL OTHERS TESTED!"

42% sharper angle on point cuts deep into the metal in a circular manner!

CONVENTIONAL

An independent manufacturer tested all types of points to find the one that would hold best... and perform most dependably. He chose NU-CUP. Could you use this idea? Check No. 1. (Name of Mfr. on request.)

Set Screw & Mfg. Co.

**IDEA #2** THIS COST-CUTTER TAKES 50% MORE TORQUE BECAUSE OF SLABBED HEAD CONSTRUCTION!

Costs less than comparable hexagon head set screws.

If you are having trouble with stripped heads or insufficient holding power, chances are the Setko Slabbed Head Set Screws are just the idea you need... Available in all points and metals. Check No. 2!

Set Screw & Mfg. Co.

**IDEA #3** IS VIBRATION CAUSING LOOSE SET SCREWS ON YOUR PRODUCTS?... ELIMINATE THIS PROBLEM WITH ZIP-GRIP®!

Slight variation of thread causes locking action on mating surface!

Proven as an outstanding principle in many products, Zip-Grip has found particular acceptance wherever the stress of movement or vibration occur. Makes an outstanding adjusting screw... Can be reapplied many times... Got an idea? Check No. 3.

Set Screw & Mfg. Co.

**IDEA #4** TINY SCREWS DO BIG HOLDING JOB... THEY'RE CALLED "MINI-MITE"

You'll find them perfectly-produced counterparts to their big brothers!

If miniaturization is one of the fields that you're interested in, then you'll see many good ideas in the perfectly-produced, money saving selection of Mini-Mites... Why pay for Specials when these can keep your costs at a minimum... Get the idea? Check No. 4.

Set Screw & Mfg. Co.

**IDEA #5** NEW SELF-LOCKING SET SCREW SELECTOR CHART LISTS OVER 1,001 COMBINATIONS.

Helps you determine available combinations best for your particular application!

Here is another Setko first... A complete listing of locking actions, points, metals, drives, etc., including suggested applications of the complete line of Setko self-locking screws... It's jam packed with ideas for you! Check No. 5.

Set Screw & Mfg. Co.

**IDEA #6** "SETKO HOPPER FEEDER SAVED US \$42,000 IN FIRST YEAR."

Here's the first truly Automated method of hopper feeding Headless Set Screws.

Unique Setko Hopper Feeder design orients headless Set Screws then feeds them to a driving device... Savings like the one shown above are but one of the advantages (name of mfr. on request)... Product quality is consistent, etc. This cost-cutting idea is one you can't miss! Check No. 6.

Set Screw & Mfg. Co.

**IDEA #7** NOW YOU CAN GET COLD FORGED "PERFECT HOLE" CAP SCREWS IN THE NEW '60 SERIES... and in STAINLESS STEEL, TOO!

If you're a user of Cap Screws you'll want to examine these yourself... We know you'll get our idea of trying to produce a perfect product consistently... We're sure you'll appreciate their performance once you've tried them... Would you like test samples? We'll be glad to send them! Check No. 7 and indicate sizes, etc.

Set Screw & Mfg. Co.

**IDEA #8** THERE'S A BARREL-FULL OF IDEAS IN THE NEW 28-PAGE SETKO CATALOG #23.

The complete line of cost-cutting SETKO Socket Screw Products is at your fingertips.

You'll want this compact catalog for your personal use... And you'll particularly like the easy to read manner in which it has been prepared. Want a copy? Check No. 8.

Set Screw & Mfg. Co.

**Set Screw & Mfg. Co.**

265 MAIN STREET, BARTLETT, ILLINOIS

Please send me Idea information on items checked below. (If FREE samples are wanted of any of these products, send your specifications).

<input type="checkbox"/> 1. Nu-Cup	<input type="checkbox"/> 3. Self-Locking Selector Chart
<input type="checkbox"/> 2. Slabbed Head	<input type="checkbox"/> 4. Hopper Feeder
<input type="checkbox"/> 3. Zip-Grip	<input type="checkbox"/> 5. Cap Screw
<input type="checkbox"/> 4. Mini-Mite	<input type="checkbox"/> 6. Catalog

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

CIRCLE 1 THROUGH 8 ON READER-SERVICE CARD



SPECTROL PRECISION POTENTIOMETERS

## Meet the SPECTROL METAL MULTI-TURN



New type  
construction  
provides  
**150°C.  
OPERATION**

The Spectrol Model 590 ten-turn precision potentiometer features all metal construction of machined aluminum with the helical coil placed directly against the case for maximum heat dissipation. Aluminum case provides excellent dimensional stability, is non-hygroscopic and will operate in a relative humidity of 95%. The 1" diameter 590 is available in ranges from 25 to 120,000 ohms with a standard linearity tolerance of  $\pm 0.3\%$ . Tolerances to  $\pm 0.025\%$  on special order.

For complete technical information call your local Spectrol representative or write directly to the factory. Please address Dept. 199

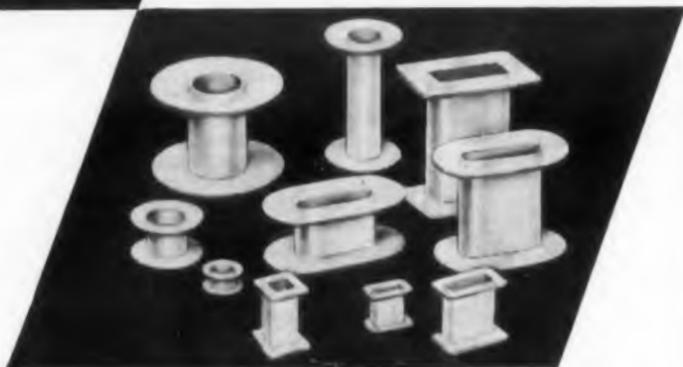
SPECTROL

ELECTRONICS  
CORPORATION  
"precision electronic components"

1704 South Del Mar Avenue, San Gabriel, Calif.

CIRCLE 58 ON READER-SERVICE CARD

## GRC small nylon coil bobbins



### NOW available from stock

NOW Gries offers a wide variety of nylon coil bobbins from stock. Automatically mass produced at low cost—ready for use. Stock sizes from  $\frac{1}{4}$ " diameter x  $1\frac{1}{64}$ " long minimum up to  $1\frac{1}{16}$ " diameter x  $1\frac{1}{16}$ " long—round, square, rectangular, oval shapes. Check Gries for your bobbin needs—either from stock—or to your size, shape and material specifications on special order.

Write today for specification order.

GRIES REPRODUCER CORP.

World's Foremost Producer of Small Die Castings

40 Second St., New Rochelle, N. Y., New Rochelle 3-8600

Wide range of  
shapes and sizes1-pc. Nylon mold-  
ing speeds windingIrregular shapes  
and special mate-  
rials to orderAccurate, uniform  
ready-for-use

GRIES

## REPORT BRIEFS

### Graded-Base-Transistor Switching

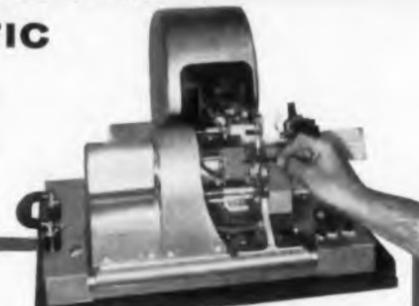
Graded-base transistors (GBT) of the pnp type were incorporated into the following switching circuitry designs: (1) constant amplitude oscillator, (2) sine-to-pulse converter, (3) regenerative pulse amplifier, (4) AND gate, (5) AND-OR gate, (6) flip-flop, (7) indicator lights, and (8) large computer (a 6-bit parallel shift register and a binary accumulator) elements. The RCA 26384 GBT's used in these circuit designs resemble vacuum-tube characteristics more closely than do the alloy units used in the past. Specifically, while the units have hf response ( $\alpha_{co} = 50$  to  $70$  mc) due to the built-in field arising from the nonuniform doping of the base region, the saturation time is long, i.e., of the order of that exhibited by 1 to 5 mc ( $\alpha_{co}$ ) transistors. Initial results with these high-speed circuits indicate that the GBT's are well suited for deriving high-power gains at high frequencies, in spite of the fact that the transistors are early samples and are not optimized for switching work. An extension of circuit speed capabilities included the completion of an ultra-high-speed bistable configuration with buffer outputs and antirace circuit. *High Speed Graded-Base-Transistor Switching Circuits*, R. H. Baker, E. J. Chatterton, Jr. and A. C. Parker, Lincoln Laboratory, Massachusetts Institute of Technology, Lexington, Dec. 1957, 29 pp, Microfilm \$2.70, Photocopy \$4.80. Order PB 139204 from Library of Congress, Washington 25, D.C.

### Video and Hydrophone Audio Amplifier Subassemblies

Subminiature video amplifier, trigger amplifier, hydrophone amplifier and power supply subassemblies have been developed for the U. S. Navy, Bureau of Ships, to provide reliable electronic equipment capable of long life operation under extreme environmental conditions. These unitized components exhibit improved electronic performance over a range of "sing connector" temperatures from  $-40$  to over  $110$  C and are smaller, lighter, and more efficient than their larger counterparts. The subassemblies are hermetically sealed and include plug-in connectors for rapid interchangeability in major units of electronic equipment. *Standard Subminiature Packaged Electronic Video Amplifier and Hydrophone Audio Frequency Amplifier Subassemblies*, James P. Welsh, Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y., Sept. 1953, 107 pp, Microfilm \$5.70, Photocopy \$16.80, Order PB 139629 from Library of Congress, Washington 25, D.C.

## High Speed Marking at Lowest Costs! BRADY MARKERMATIC

### AUTOMATIC MARKING MACHINE



#### Fast!

Automatically applies pre-cut, pre-printed, self-sticking markers around objects 3-5 times faster than manual methods.

#### Low Cost!

Markermatic pays for itself. Markers in production quantities cost less than 1/6¢ each.

#### Small Parts!

Wires, components, small tools — any cylindrical, oblong or tubular shape gets complete wrap around or flag identification in seconds.

#### Versatile!

Bundles tiny wires, parts. Applies stock or special Brady self-sticking markers from Blue Streak® Dispenser Cards.

W. H. BRADY CO.

756 W. Glendale Ave., Milwaukee 9, Wis. EST 1914

Mfrs. of quality pressure sensitive tape products and dispensing machines

CIRCLE 60 ON READER-SERVICE CARD



New

## INDUCTANCE BRIDGE

for Rapid Measurements of High Precision  
0.001  $\mu$ h to 1,111 h  
Basic Direct-Reading Accuracy of  $\pm 0.1\%$

- ★ No sliding balance
- ★ Easy, in-line readout
- ★ Range switch locates decimal point and identifies units of measurement
- ★ High resolution . . . six significant figures
- ★ For use to 1 kc; to at least 10 kc with slightly decreased accuracy
- ★ Measures parallel inductance for high Q; series inductance when Q is low
- ★ Direct-reading in conductance and inductance

Type 1632-A Inductance Bridge: \$875  
Write for Complete Data

GENERAL RADIO COMPANY

WEST CONCORD, MASSACHUSETTS

Broad Avenue at Linden, Ridgefield, N. J. NEW YORK AREA 1000 N. 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 61 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 2, 1959

A New and Specialized  
Technique . . .



## CUSTOM PACKAGING

by General Electric

Specialized defense requirements necessitate new packaging techniques for electronic circuit modules. Working from schematics or performing the entire design task from customer requirements, General Electric creates small lightweight, high-density components. Engineering and production staffs skilled in new packaging techniques deliver tested prototypes in four to six weeks.

With maximum environmental stability, lower noise and higher signal levels, applications for such electronic packages as inverters, flip-flops, encoders, amplifiers, exist throughout the military market. Where the advantages of modular replacement over technical field repair are of the utmost importance, the high-density volume efficiency of these circuit modules is the answer to extreme space limitation.

For more information on Custom Packaging, write to Defense Industries Sales, Section 227-27A

DEFENSE ELECTRONICS DIVISION  
HEAVY MILITARY ELECTRONICS DEPARTMENT

**GENERAL ELECTRIC**

SYRACUSE, N. Y.

CIRCLE 62 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 2, 1959

### Transistor Video Amplifiers

A single stage amplifier is analyzed on the basis of the Giacoletto equivalent circuit. Four methods of exchanging amplification and bandwidth are described. High-frequency compensation techniques are also presented. Multistage amplifier design is then considered, including the effect of bandwidth shrinkage due to multiple stages. *Analysis and Design of Transistor Video Amplifiers*, T. A. Prugh, Diamond Ordnance Fuze Labs., Washington, D. C., Dec. 1957, 15 pp, Microfilm \$2.40, Photocopy \$3.30, Order PB 137380 from Library of Congress, Washington 25, D. C.

### High Temperature Printed Circuitry

Research investigations relevant to printed circuit development of miniature components capable of continuous operation at temperatures up to 750 C have been continued. Investigations involving the preparation of miniature capacitors by vacuum evaporation techniques have illustrated the need for multiple dielectric layers in minimizing porosity effects. Diffusion of the electrode metal into the dielectric at elevated temperatures has been overcome by the interposition of a barrier layer of MgF<sub>2</sub>. Gold-palladium alloy film resistors exhibiting negative and positive temperature coefficients of resistance have been prepared. *High Temperature Printed Circuitry*, G. H. Young, C. H. T. Wilkins and others, Mellon Institute of Industrial Research, University of Pittsburgh, Pa., Jan. 1959, 52 pp, Microfilm \$3.60, Photocopy \$9.30. Order PB 138813 from Library of Congress, Washington 25, D.C.

### Magnetic Tape Recorder

A wide-band multi-channel magnetic tape recording system has been designed for unattended use under adverse field conditions. The recorder can be packaged in a hermetically sealed enclosure where provisions are made for bringing in the transducer information and a timed pretest signal. Timing control of all internal operations is assumed by the system itself upon receipt of the timing signal. The equipment is powered by an integral 24 v, 35 amp-hr battery. Each complete data channel will yield useful recorded information from 1 cps to over 200 kc. A dynamic range of over 30 db is maintained to beyond 100 kc. The total record time is 40 sec. There are four complete data channels and one 10 kc marker channel. *A Rugged, Wide-Band Magnetic Tape Recorder*, J. D. Rosenberg, Diamond Ordnance Fuze Labs., Washington, D. C., July 1957, 18 pp, Microfilm \$2.40, Photocopy \$3.30, Order PB 137087 from Library of Congress, Washington 25, D. C.



SAVE  
\$10,000  
EVERY  
200 HOURS

WITH A MASSA 1 CHANNEL RECORDING SYSTEM. After operating only 200 hours at an average chart speed of 50 mm/sec, this direct ink writing system saves \$10,000 in chart costs alone when compared to other systems with rectilinear readouts.

MODEL BSA-1200  
WITH 12 PLUG-IN PREAMPLIFIER  
CABINET HEIGHT 62 INCHES

In this new system, Massa has combined all the advantages of rectilinear recording with the economy of ink writing. The result is a compact (50% more channels in a standard cabinet), reliable, and versatile recording system featuring a choice of interchangeable plug-in preamplifiers.

#### FEATURES

- CHOICE OF DC, AC, CARRIER OR CHOPPER PLUG-IN PREAMPLIFIERS.
- DC TO 200 CYCLES PER SECOND FREQUENCY RESPONSE.
- 18 SPEEDS — PUSH-BUTTON CONTROLS.
- INDIVIDUAL POWER SUPPLIES AND TRANSISTORIZED DRIVERS FOR EACH CHANNEL.
- INTERCHANGEABLE INK AND ELECTRIC STYLI.
- MODULAR DESIGN THROUGHOUT FOR EASE OF SERVICING.
- MICROMETER ADJUSTMENTS FOR ACCURATE PEN ALIGNMENT.
- PEN MOTOR OVERLOAD PROTECTION.
- REMOTE CONTROL (OPTIONAL).

Write for complete specifications on Massa Recorders.

At ISA Show—Visit our Booth No. 751.

#### Other MASSA Products

SONAR TRANSDUCERS  
ACCELEROMETERS  
MICROPHONES  
HYDROPHONES  
AMPLIFIERS  
COMPLETE LINE OF MULTI-CHANNEL AND PORTABLE RECORDING SYSTEMS

**MASSA**  
A DIVISION OF  
**COHU**  
ELECTRONICS INC.

7 FOTTLER RD.

HINGHAM, MASSACHUSETT

CIRCLE 63 ON READER-SERVICE CARD



## FOR FASTER ASSEMBLY!

One way to speed up production is to use solder that's prefabricated to the job . . . the right size, shape, alloy and flux. KESTER SOLDERFORMS are doing a big job in reducing labor and material costs in electronic and other applications . . . will greatly speed up production for you.

## KESTER SOLDERFORMS

WRITE TODAY for sample assortment and full details on KESTER SOLDERFORMS.

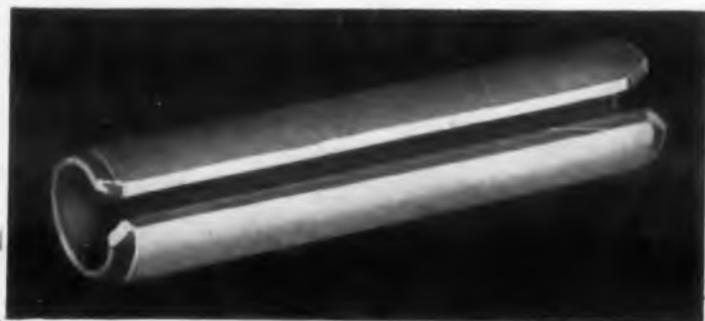
### KESTER SOLDER COMPANY

4201 Wrightwood Ave., Chicago 39, Ill.  
Newark 5, N. J. • Anaheim, Cal. • Brantford, Can.



OVER 60 YEARS' EXPERIENCE IN  
SOLDER AND FLUX MANUFACTURING

CIRCLE 64 ON READER-SERVICE CARD



## Versatile Rollpin®

simplifies design, speeds production

**ROLLPIN** can be used in place of taper pins, solid straight pins, set screws, hinge pins, dowels, clevis pins . . . and in some cases as a rivet.

**ROLLPIN** is a slotted, cylindrical spring pin deliberately oversized in relation to standard production drilled holes . . . compressive forces lock it in place. Reaming or secondary safety operations such as peening are eliminated.

**ROLLPIN** is easy to install, easy to drive out with a drift pin or punch, yet will "stay put" indefinitely.

**ROLLPIN** is available for immediate off-the-shelf delivery—comes in sizes from .062" diameter to .500" in carbon steel, corrosion resistant steel or beryllium copper.

For a free bulletin detailing Rollpin applications and installation methods, write to Dept. R54-957.



**ELASTIC STOP NUT CORPORATION OF AMERICA**

2330 Vauxhall Road, Union, New Jersey



CIRCLE 65 ON READER-SERVICE CARD

## REPORT BRIEFS

### Microwave Research

Five projects are presently supported by this contract. In the large-signal klystron theory project, an expression for the radial distribution of the fundamental component of rf current as a function of the distance down the klystron drift tube has been evaluated numerically on a computer. In the connected-ring structure project, the experimental work has been completed, and a report of the results of the work is in preparation. In the coupled-cavity-theory work, an attempt was made to obtain a more detailed verification of the equivalent circuits used. In the electron gun studies project, the design of an electron gun based on one of the curvilinear space-charge-flow solutions described in Scientific Report No. 4 has been carried out. *Basic Microwave Research, M. Chodorow, Microwave Laboratory, Stanford University, Calif., May 1958, 14 pp, Microfilm \$2.40, Photocopy \$3.30. Order PB 137681 from Library of Congress, Washington 25, D.C.*

### Comparison of Error-Correcting Eight-Unit Code With Other Teleprinter Codes

Teleprinter information is transmitted electrically using a sequence of "marks" and "spaces." A study is made of an eight-unit "four marks plus four spaces" binary code to determine whether the proposed eight-unit code is optimum with respect to character errors for various bit error rates, for binary transmission and ternary reception. Tables and graphs of the probability of character errors of different codes versus the proportion of bit errors for the range of 10% missing bits to 1% missing bits are given for two cases: (1) missing bits only; (2) 10% as many wrong bits as missing bits. The results indicate that the eight-unit double parity check code is definitely the best of the seven codes studied. However, the eight-unit "four marks plus four spaces" code and the seven-unit parity check code are nearly as good. The use of letter-figure shifts greatly increases the probability of a wrong character. The parity check codes are superior to the codes with constant number of marks and spaces in that they yield a smaller probability of character errors. *A Comparison of an Error-Correcting Eight-Unit Code with Other Teleprinter Codes for Binary Transmission and Ternary Reception, Mary D. Lum, Aeronautical Research Laboratory, Wright Air Development Center, Wright-Patterson AFB, Ohio, Jan. 1959, 45 pp, \$1.25, Order PB 151659 from OTS, Washington 25, D. C.*

## standard knobs



## widest choice



## fastest delivery



Variety and versatility in a complete standard line of thermosetting plastic knobs. Combinations, variations in types, sizes and colors delivered promptly. Send for catalog.

## kurz-kasch

Kurz-Kasch, Inc., 1415 S. Broadway, Dayton 1, Ohio

CIRCLE 66 ON READER-SERVICE CARD



**ONLY  
\$3.25**

## ELECTRONIC DESIGN BINDER

. . . KEEPS YOUR BACK COPIES FOR HANDY REFERENCE

These strong, 12 $\frac{3}{4}$ , 12 $\frac{1}{4}$  x 5" binders offer an easy means of filing your back copies of *Electronic Design*. Each binder holds 13 normal size issues, and permits substitution of magazines if desired. Cost to *Electronic Design* subscribers is only \$3.25.

CIRCLE 67 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 2, 1959

## NEW! THE MERCURY "10" SERIES TRIODE CAVITIES



10% tuning range

Fully standardized line for design and production . . . Frequency range from 225mc to top existing tube limits

**DELIVERY—30 DAYS OR LESS!**

Only JVM offers these outstanding engineering advancements—low cost standardized production—off-the-shelf availability—design flexibility and uniform performance.

Miniaturized MERCURY "10" cavities are precision engineered for restricted tuning range, minimum weight-frequency stability and temperature compensation. The "10" series includes 720 different cavities designed for maximum power and or voltage ratings of a variety of tubes.

Call or write for engineering drawings and specifications.

### J-V-M MICROWAVE CO.

9302 W. 47th Street Brookfield, Illinois HUnter 5-2000  
TWX Brookfield, Ill. 2796

CIRCLE 68 ON READER-SERVICE CARD

## specify... G-E KSR\* TANTALYTIC\* CAPACITORS

for computer, missile, radar, and airborne electronic equipment.

• Provide high microfarad ratings in cases of nominal size and weight without loss of quality or reliability.

• Offer voltage ratings to 150 volts d-c from -55C to +85C; to 100 volts for 125C operation.

• Are up to 50% lighter, 30% smaller compared with lower microfarad units rated for 125C.

SPECIFYING INFORMATION on G.E.'s complete Tantalytic line is available from your nearest Apparatus Sales Office, or write for GEA-6766A, to General Electric, Section 449-11, Schenectady 5, N. Y.

\*Registered Trademark of General Electric Co.

## GENERAL ELECTRIC

CIRCLE 69 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 2, 1959

## Magnesium Waveguide

Determination of electrical and mechanical properties, method of fabrication, and a method to prevent corrosion of the pressurized magnesium waveguide are covered. Thinner wall tubing can be obtained, and inner surfaces made smooth. *Development of Lightweight Magnesium Waveguide, Anthony F. Gurdo and John E. McCormick, Rome Air Development Center, Griffiss AFB, N.Y., June 1958, 28 pp, Microfilm \$2.70, Photocopy \$4.80. Order PB 137674 from Library of Congress, Washington 25, D.C.*

## Radio-Active Energy as a Source of Battery Power

Modifications in construction and techniques are described for reducing the temperature coefficient of voltage. Tritium was considered the most promising isotope for use in the gaseous ionization contact potential difference (CPD) type of nuclear battery. Changing from spot welded to evaporated low-work-function electrodes greatly improved the flatness and uniformity of the electrode couples without sacrificing the high CPD when used with PbO<sub>2</sub> anodized on the other side. The change from plastic to inorganic insulation increased the useful temperature range, probably decreased the ingassing, and reduced the temperature coefficient of voltage. Mica spacers were as good as polystyrene electrically, but hand splitting of the mica was more time consuming and made greater variation in cell spacing. After radiation conditioning, Alsimag 243 glazed with Pb borosilicate was an excellent sleeve and terminal insulator surface with respect to low electrical conductivity and high-temperature stability. A coating of silicone over the outer-glazed ceramic surface prevents electrical leakage due to fingerprints. The coating is not affected by extreme temperatures. A month or more of radiation conditioning is necessary for mica-Alsimag-Mg-PbO<sub>2</sub> battery models to reach maximum voltage and to diminish the sluggishness in current response under load. The best temperature coefficient of voltage above room temperature for model 23C was 0.06 per cent per C; that for model 21B below room temperature was 0.28 per cent. In cold tests under load, all of the models were characterized by a slow drop in current to a somewhat lower equilibrium value than at room temperature and by a slower recovery of voltage. *Investigations on Utilization of Radio-Active Energy as a Source of Battery Power, Alexander Thomas and Imogene DiBello, Tracerlab, Inc., Boston, Mass., Oct. 1955, 65 pp, Microfilm \$3.90, Photocopy \$10.80. Order PB 139279 from Library of Congress, Washington 25, D.C.*



## NEW!

COLORFUL,  
LOW COST,  
PRECISION  
SHAFT TURNS  
COUNTER

# VerniDial

The VerniDial H5850 is a lightweight, reliable and economical turns counter for accurately positioning multi-turn devices such as potentiometers, capacitors, valves and other equipment where micrometer readout of a setting is desired. Graduated in hundredths, it accumulates to 20 turns . . . reading or positioning from zero to 2000/100.

7 Colors (solid or combinations!): Black, Gray, Off-white, Yellow, Orange, Red, Green.

RESISTS CORROSION  
INSULATES CIRCUITRY  
and BODY CAPACITY

COLORFUL  
for CODING and DESIGN

LIGHT WEIGHT  
MOLDED PLASTIC

EASILY INSTALLED

Write for  
Bulletin H5850

**HOWELL INSTRUMENT COMPANY**

3101 Trinity Street, Fort Worth 7, Texas

CIRCLE 70 ON READER-SERVICE CARD



from  
Alpha  
Metals

New  
Flux Finder  
Guide

A valuable aid, ALPHA's exclusive *New Flux Finder Guide* contains such data as:

- Coatings for reducing oxides in solder baths
  - Preventing reoxidation of base metals
  - High-speed fluxing for printed circuit dip soldering
- For your copy, act now!



In Chicago, Ill.  
ALPHA-LOY CORP.  
2250 S. Lumber St.

Other ALPHA products:  
Core & Solid Wire Solder  
Solder Preforms  
High Purity Metals

ALPHA METALS, INC., 58B Water St., Jersey City 4, N. J.  
Send me free your *New Flux Finder Guide*.

Name \_\_\_\_\_ Title \_\_\_\_\_  
Company \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

CIRCLE 71 ON READER-SERVICE CARD



**Over 500 solutions to miniaturization problems**

There's a sure way to get precisely the miniature bearings you need. MPB makes them in over 500 types and sizes, ranging down to 1/10" O.D., with specials as required. For details, write MPB, Inc., 909 Precision Park, Keene, N. H.

MINIATURE PRECISION BEARINGS INC.

# MPB

Helps you perform miracles in miniaturization  
CIRCLE 72 ON READER-SERVICE CARD



## ARNOLD/TOROIDAL COIL WINDER

*sets up quickly...easy to operate...  
takes wide range of wire sizes*

### SPECIFICATIONS:

Min. finished hole size: .18 in.  
Max. finished toroid O.D.: 4.0 in.  
Winding speed: 1500 turns/min.  
Wire range: AWG 44 to AWG 26  
Dual, self-checking turns counting system  
Loading (wire length) counter  
Core range: 1/4" I.D. to 4" O.D. to 1 1/2" high

### LABORATORY USE

- Change wire and core size in 45 sec.

### PRODUCTION USE

- 1500 turns per minute
- Insert core and load in 20 sec.

*includes all rings, counters and accessories*

*immediate delivery. literature on request*

**ARNOLD MAGNETICS CORP.**

4615 W. Jefferson Blvd., Los Angeles 16, Calif.  
REpublic 1-6344

CIRCLE 73 ON READER-SERVICE CARD



## STANDARDS AND SPECS

Sherman H. Hubelbank

### Antennas and Waveguides

IRE 59IRE 2.S1, ANTENNAS AND WAVEGUIDES; WAVEGUIDE AND WAVEGUIDE COMPONENT MEASUREMENTS, 1959

Covered in this standard are measurements of the quantities which characterize a waveguide or component and associated electromagnetic fields. The term waveguide as used in this standard is a generic term and includes transmission lines and uniconductor waveguides as special cases. Measurements are described in general terms. Also included are definitions of terms. This standard also clarifies the differences in the usage of terms common to both microwave and low-frequency circuit practices. This standard is limited to measurements in linear, reciprocal systems, and to single-frequency sources. Copies are available from the Institute of Radio Engineers, 1 E. 79th St., New York 21, N.Y., for 75 cents per copy.

### Squelch Systems

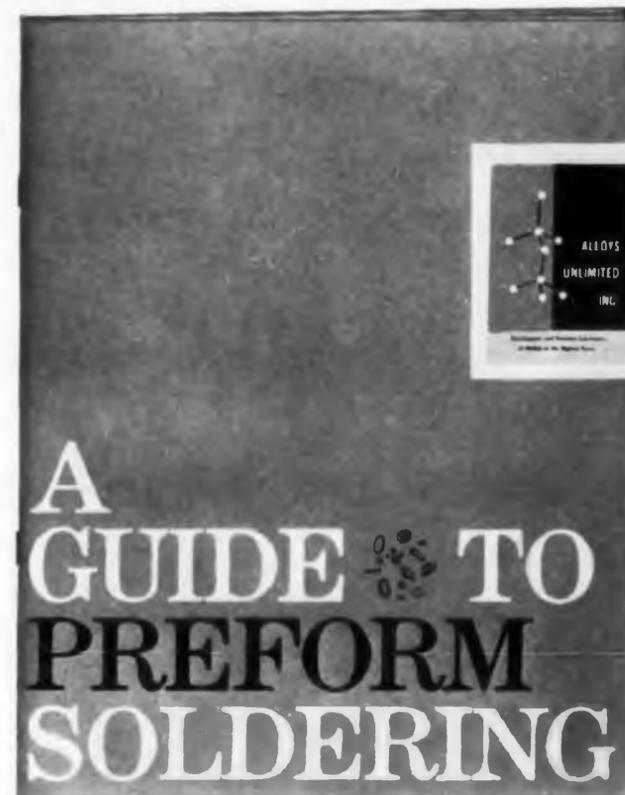
EIA RS-220, CONTINUOUS TONE-CONTROLLED SQUELCH SYSTEMS, APRIL 1959

Minimum standards are established for systems where the radio receivers are equipped with continuous tone responsive which allow audio signals to appear at the audio output only when a carrier modulated with a specific tone is received. The continuous-tone-controlled squelch system is considered primarily as a means for group calling as distinguished from individual calling. Copies of this standard are available from the Electronic Industries Association, 11 W. 42nd St., New York 36, N.Y., for \$1.20 each copy.

### Preferred Numbers

ASA Z17-1-1958, PREFERRED NUMBERS

This standard establishes a group of geometric series in which each number is a selected percentage higher than the preceding one. Preferred numbers provide a logical series of steps for such significant design features as length, volume, weight, and performance. Copies of this standard are available from the American Standards Association, 70 E. 45th St., New York 17, N.Y., for \$1.00 per copy.



## FREE! NEW 8 PAGE GUIDE

Complete information on solder preforms, their selection and use. Technical diagrams. Send for your copy today.

21-01 43rd AVENUE, LONG ISLAND CITY 1, N.Y.



CIRCLE 74 ON READER-SERVICE CARD

**another** reader reports:

**ELECTRONIC DESIGN** is "Most Helpful"...



"Your magazine is the most important to me of the six technical journals which I read regularly".



### Resistor Brackets

MS75009, RESISTOR BRACKET ASSEMBLY, 5 MAY 1959

The entire bracket assembly for mounting power resistors is covered in this new standard. All the tubular styles in MIL-R-26 and MIL-R-11804 are provided for, and each is assigned military standard dash numbers for a complete bracket assembly or for any part.

### Connectors

MIL-C-71A, CONNECTORS, "N", FOR RADIO FREQUENCY CABLES, GASKETS FOR 5 JUNE 1959

The MS military standards which form a part of this spec are listed in Supplement-1E.

MIL-C-12520B, CONNECTORS, PLUG AND RECEPTACLE AND ACCESSORIES, 3 JUNE 1959

The detail spec format is now provided for in this revision. Connector types and accessories formerly covered in service drawings are now covered by detail specs. Connector types of shell size 20 and 26 with round shape and male inserts are now covered.

### Communications Equipment

RTCA 49-59/DO-95, MINIMUM PERFORMANCE STANDARDS, PORTABLE AIRCRAFT EMERGENCY COMMUNICATIONS EQUIPMENT OPERATING WITHIN THE RANGE OF 450 TO 8500 KC, 10 MARCH 1959

Established in this spec are minimum performance standards under standard and environmental test conditions. Also included are complete test procedures. Copies of this standard are available from the Radio Technical Commission for Aeronautics, 16th & Constitution Ave., N.W., Washington 25, D.C., for 30 cents per copy.

### Capacitors

MIL-C-5B, FIXED MICA DIELECTRIC CAPACITORS, 12 MAY 1959

The type designation has been changed. It now includes 11 characters. A typical designation follows: CM15B100KN3. Capacitors having an operating temperature range of  $-55$  to  $+150$  C have been added. A high frequency vibration test has been added. Styles CM15 through CM55 are subject to this test and are classified as vibration grade 3. Styles CM60 through CM95 are subject to the low frequency vibration test and are classified as vibration grade 1. The electrical and environmental tests have been rewritten to be in accordance with MIL-STD-202. Capacitors of  $+20\%$  tolerance have been deleted.

## To all the combined advantages of Synthane Laminated Plastics ... add one more big plus—**MACHINABILITY**



There are many reasons why plastic laminates such as Synthane are well regarded. They offer—in combination—resistance to heat, wear, chemicals, oil, water; light weight; excellent dielectric properties and mechanical strength; dimensional stability. On top of all these, however, is the one property that makes Synthane practical—Machinability.

This means that whatever your application you may obtain parts of Synthane in the form desired and at a reasonable cost whether you require one or a million.

### How Machinable is Synthane?

Synthane laminates are easy to machine, using ordinary wood or metal working machinery with only a few modifications of method. As an example, here are some standard machining operations readily performed on Synthane:

Shearing	Screw Machine Operations
Band Sawing	Planing
Circular Sawing	Shaping
Drilling	Punching
Tapping	Broaching
Fly cutting	Shaving
Milling	Sanding
Gear cutting	Grinding
Turning	Boring
Turret Lathe Operations	Tumbling
	Buffing

Practically all of these operations can be handled on standard machines, many with standard cutters. But the nature of the material, being softer and more resilient than metal, and being laminated and a poor heat conductor, often makes the



Sawing long lengths. One of the numerous special tools whose advantages are available when Synthane fabricates the material.

use of cutters with special rake and clearance, operating at special feeds and speeds, desirable.

The successful machining of Synthane laminates is aided by proper design of parts for ease of machining. A Synthane booklet: "Design Hints for Laminated Plastics\*" adequately covers design recommendations.

### It pays to let Synthane machine laminated plastics for you

Although Synthane laminated plastics are easy to machine, it will usually pay you to have us handle the machining for you—for these reasons:

1. All of our equipment is especially designed or adapted for the fabrication of plastics.
2. We are constantly developing new, \*Booklet available upon request.

faster, and more economical methods of machining Synthane laminated.

3. We make all of our own tools, dies, fixtures and jigs, quickly and economically.

4. We relieve you of all production worries: machining errors, rejects, waste, mistakes in dimensions or tolerances, and delays in delivery.

5. Because we combine manufacturing and fabrication in one location, we can maintain high quality control while solving difficult machining problems. When necessary, we can even modify the properties of a given grade of material to meet special requirements.

For further information, write Synthane Corporation, 42 River Rd., Oaks, Penna.



Metal disintegration, a fast, economical way Synthane uses to produce or revise dies.

# SYNTHANE

CORPORATION, OAKS, PENNA.  
Laminated Plastics for Industry

Sheets, Rods, Tubes, Fabricated Parts  
Molded-laminated, Molded-macerated

CIRCLE 76 ON READER-SERVICE CARD



New Series of Sprague Cylindrical-Style Radio Interference Filters: top row, l. to r.—4JX14, 5JX94, 1JX115, 20JX15, 50JX20 bottom row—5JX27, 1JX54, 1JX113, 1JX117, 2JX49, 1JX118.

## New Series of Small, Light Radio Interference Filters

The new cylindrical-style radio interference filters recently announced by Sprague Electric Company are the smallest and lightest filters of their type available for military and industrial electronic and electrical equipment. Their basic design was pioneered by Sprague in order to achieve maximum miniaturization.

This new series of standard filters, believed to be the largest in the industry, ranges in current rating from 5 milliamperes to 50 amperes to cover the great majority of application needs.

The natural shape of the rolled capacitor section and of the toroidal inductors dictates the cylindrical form. All filters have threaded-neck mountings for use on panels or bulkheads. This assures both the proper isolation between input and output terminals as well as a firm peripheral mounting with minimum impedance to ground.

Listed in Sprague Engineering Bulletin 8100 (available upon request to the Technical Literature Department) are 68 of the more popular low-pass filter designs intended for use as three-terminal networks connected in series with the circuits to be filtered. The excel-

lent interference attenuation characteristics reflect the use of Thrupass® capacitor sections.

Since maximum effectiveness of filtering involves elimination of mutual coupling between input or noise source and output terminals, filters should be mounted where the leads being filtered pass through a shielded chassis or bulkhead. The threaded neck mounting is designed to give a firm metallic contact with the mounting surface over a closed path encircling the filtered line and to eliminate unwanted contact resistance so that the theoretical effectiveness of these units is realized in practice.

Typical insertion loss is determined by measurements made in conformance with Military Standard MIL-STD-220. Minimum curves for specific filters are available upon request.

For assistance in solving unusual interference, rating, or space problems, contact Interference Control Field Service Manager, Sprague Electric Co., at 12870 Panama Street, Los Angeles 66, California; 224 Leo Street, Dayton 4, Ohio; or 347 Marshall Street, North Adams, Massachusetts.

## NEW LITERATURE

### Voltage Regulators

78

The application, description, selection, weight, dimensions, and connection diagrams of voltage regulators are given in booklet GEC-1450A, 58 pages. Dry-type single-phase regulators are offered in ratings to 180 kva, 600 v and below, three-phase to 720 kva. Liquid filled units are rated up to 2200 kva, 13,800 v and below. General Electric Co., Voltage Regulator Product Section, Pittsfield, Mass.

### Ferrite Devices

79

Specifications for ferrite devices, including circulators, high-power isolators, broadband test equipment isolators and ferrite duplexer packages are given in bulletin 59F. The isolators cover S band through V band; the circulators cover C band through Ka band; and the duplexers X band through Ka band. Microwave Assoc., Inc., South Ave., Burlington, Mass.

### Miniature Connectors

80

Miniature connectors are described in these catalog sheets. The connectors, called the FBI series, absorb shock in their mounting brackets rather than in the connector body itself. Other connectors described are: subminiature types, and two-unit printed circuit units. U.S. Components, Inc., 454 E. 148th St., New York 55, N.Y.

### Variable-Speed Drive

81

Illustrated bulletin 195, eight pages, describes the firm's variable-speed drives. Included is detailed information regarding horsepower, speed variation, enclosures and electrical characteristics. Variable-speed applications are given, along with photographs of a variety of modifications, including a shaft-mounted right-angle variable-speed drive. Sterling Electric Motors, Inc., 5401 Telegraph Rd., Los Angeles 22, Calif.

## STODDART COAXIAL TERMINATIONS operate from $-450^{\circ}\text{F}$ to $+440^{\circ}\text{F}$

Resistive elements of these units are made of thin platinum films fired at high temperatures on ceramic forms and treated with a protective coating of silicone varnish. These elements do NOT become superconductors at temperatures at least as low as 4.2° Kelvin. Due to the temperature coefficient of the element, however, a unit having a resistance of 60-ohms at room temperature will become a 50-ohm element at this low temperature.

Temperatures as high as  $+440^{\circ}\text{F}$  may be induced inside the terminations by an electrical overload of at least 3 times the rated average power dissipation, which is 1 watt. No permanent damage to any part of the termination is produced when subjected to such rigorous treatment.



### SPECIFICATIONS:

Frequency range is dc to 3000 mc, 50 or 70-ohm resistance, types "N" or "C" male or female connectors, VSWR is less than 1.2 to 3000 mc and average power dissipation is 1 watt.

Send for literature on complete line of coaxial line terminations, coaxial attenuators and 2, 6 and 10-position turret attenuators.

Immediate delivery

**STODDART**  
AIRCRAFT RADIO CO., INC.

6644 SANTA MONICA BOULEVARD  
HOLLYWOOD 38, CALIF., HOLLYWOOD 4-9292

CIRCLE 77 ON READER-SERVICE CARD

CIRCLE 82 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 2, 1959

## Vibrometer 83

A reed vibrometer which measures and indicates frequency and amplitude of vibration is described in bulletin K14A. Applications of the vibrometer include tracking down sources of vibration and noise and measuring machine speed. Korfund Co., Inc., 48-22H 32nd Place, Long Island City 1, N.Y.

## Pressure Pickup 84

Electrical and mechanical specifications for a small, lightweight pressure pickup transducer are given in two-page bulletin CEC-1541D. This pickup can be used in corrosive, explosive or radioactive atmospheres. Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif.

## Transistorized Logic Circuits 85

Twenty basic transistorized logic circuits are presented in four-page brochure, No. 11959. Included are emitter follower, AND gate, OR gate, and inverter circuits. These are made in single and dual plug-in units, with pnp, npn or complementary-symmetry circuits. Walkirt Co., 141 W. Hazel St., Inglewood 3, Calif.

## Magnetic Tape Recorder 86

The AR-200 magnetic tape recorder is described in this 12-page brochure. A general description, features, module information, specifications and pictures are included on the recorder designed for airborne data acquisition. Ampex Corp., Instrumentation Div., 934 Charter St., Redwood City, Calif.

## Digital Readout 87

An in-line, in-plane digital readout is described in this two-page brochure SGS-101. Character size, input, operating range, characters available and viewing screen specifications are listed, as well as selective group switching diagrams. I.D.E.A., Inc., Electronic Equipment Div., 7900 Pendleton Pike, Indianapolis 26, Ind.

## Strain Reliefs 88

This four-page illustrated brochure describes the firm's three types of strain reliefs for power cords and cables. Dimensional and physical information is provided. George Walker Co., Passaic, N.J.

## ELECTROCRAFT Connectors and Switches

### JACK PANELS

Steel reinforced black phenolic panels with 24, 48 or 52 telephone type jacks in a wide variety of circuits. Mounting brackets are slotted to fit standard 19" relay racks. Furnished with identification cards and clear plastic shields.

Have wide application for low level audio and military use. Interchangeable with telephone equipment manufacturers standard panels. Write for complete information.



All items in the entire line of Connectors and Switches are soundly engineered, sturdily constructed of high grade materials and designed to require minimum space. Design changes for other than standard applications readily supplied. Our engineering department will work with you on any such desired variations from standard items. Write for complete catalog.

### ELECTROCRAFT, INC.

44 N. Kedzie Avenue  
Chicago 25, Illinois

CIRCLE 89 ON READER-SERVICE CARD

FOR  
ROCKET ENGINES

## ACCURACY IN SPITE OF BLAST



### SATHAM P285TC Oil-Damped Pressure Transducer

This new, extremely rugged oil-damped miniature pressure transducer easily survives the step function pressures and blast pressures of rocket engine environments.

Measures pressures from 0-50 to 0-1000 psi with the infinite resolution, accuracy and reliability of unbonded strain gage instruments.

Absolute and gage models.

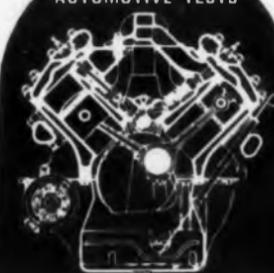
Write for Data File ED-603-2.

SATHAM INSTRUMENTS, INC.  
12401 West Olympic Boulevard  
Los Angeles 64, California



CIRCLE 281 ON READER-SERVICE CARD

IN  
AUTOMOTIVE TESTS



## OUTLIVES ENGINE AFTER ENGINE



### SATHAM P10 Pressure Transducer

In automatic transmission pressure tests run by one of the world's leading auto manufacturers, this rugged pressure transducer has outlived engine after engine throughout more than two years of 24-hour-a-day test operation.

Built to stand rough handling and mechanical overload in many applications, the P10 affords the accuracy, reliability and infinite resolution of an unbonded strain gage instrument.

Write to Dept. ED-604-2

SATHAM INSTRUMENTS, INC.  
12401 West Olympic Boulevard  
Los Angeles 64, California



CIRCLE 282 ON READER-SERVICE CARD

**791D** **\$920**

**DEVIATION MEASURED**  
10cps to 125kc

New FM Deviation Meter has carrier frequency range 4-1024Mc; crystal controlled LO enables measurement down to 10cps deviation. Used with a 'scope, it measures peak deviation of complex wave-forms. Very easy to operate, Model 791D *speeds* deviation measurements.

Carrier Freq. Range: 4-1024Mc, xtal locked  
Mod. Freq. Range: 25cps to 35kc  
Deviation Ranges: 0.5, 25, 75, 125kc  
Accuracy: 3%, Xtal standardized  
Distortion: Less than 0.2%  
21 tubes: 6AK5, 6C4, 0B2, 5651, 6CD6G, 5Z4G, 5647, 6AS6



111 CEDAR LANE • ENGLEWOOD, NEW JERSEY  
CIRCLE 91 ON READER-SERVICE CARD



*Gertsch CRT-3 Subminiature Coaxial RatioTran*

- ONLY 2½" IN DIAMETER
- ACCURATE TO 0.001%
- QUALIFIED TO MIL SPECS

**EXCELLENT PERFORMANCE.** This Gertsch AC voltage divider, has inherent characteristics of high input impedance, low effective output impedance, and very low phase shift. Input voltage: 0.35 f (f in cps) or 140-volt max at 400 cps. Frequency range: 50 to 10,000 cps. Unit is age less, requiring no calibration tests. Performance approaches that of the ideal divider.

**MANY TYPES.** Subminiature RatioTrans are available with 4-place, 5-, and 6-place resolution, and in a wide variety of decade arrangements. Available either servo mount or flange mount. Complete data sent on request. Bulletin CRT-3. Or contact your Gertsch representative.

<b>SHOCK</b>	50 G's - 7 ms
<b>VIBRATION</b>	
<b>OPERATING:</b>	MIL-STD-167, Type I
<b>NON-OPERATING:</b>	MIL E-4970, Proc. III
<b>SALT SPRAY:</b>	MIL E-5272A
<b>DRIP PROOF:</b>	MIL-STD 108
<b>FUNGUS:</b>	MIL E 5272
<b>HUMIDITY:</b>	MIL-STD-202A
<b>HIGH TEMP.</b>	
<b>OPERATING:</b>	+ 52° C
<b>NON-OPERATING:</b>	+ 71° C
<b>LOW TEMP.</b>	
<b>OPERATING:</b>	- 18° C
<b>NON-OPERATING:</b>	- 54° C
<b>DIELECTRIC</b>	
<b>STRENGTH:</b>	900 V RMS, 60 cps

**Gertsch**

GERTSCH PRODUCTS, INC. 3211 S. La Cienega Blvd., Los Angeles 16, Calif. • Upton 0-2761 • Vermont 9-2201

CIRCLE 92 ON READER-SERVICE CARD

## NEW LITERATURE

### Ultrasonic Cleaning 93

"Tips on Ultrasonic Cleaning," 12 pages, provides a simplified explanation of the basic principles of ultrasonics, a brief description of the generating equipment and transducers required, and a discussion of applications. Circo Ultrasonic Corp., 51 Terminal Ave., Clark, N.J.

### Digital Data Recording 94

Two-page bulletin 350-4 describes a strain gage digital data recording system. Electrical and physical specifications and a block diagram are provided. The system is used to test structures, valves, and other metal products. Datex Corp., 1307 S. Myrtle Ave., Monrovia, Calif.

### Spotweld Fasteners 95

Six-page bulletin 595 gives complete information on spotweld fasteners. In addition to dimensional data, typical applications and welding recommendations are provided. Ohio Bolt and Nut Co., 33 First Ave., Berea, Ohio.

### Bistable Transistors 96

Four-page bulletin C 410-01 describes six types of silicon Trigistors, triggered bistable transistors. Electrical specifications, characteristic curves, and dimensional data are given. Solid State Products, Inc., 1 Pingree St., Salem, Mass.

### Electronic Components 97

Catalog 31, 40 pages, lists over 1700 stock variable resistors, ceramic capacitors, switches and packaged circuits. It contains 128 new products, including a full line of miniature wirewound variable resistors, ultra-miniature capacitors for transistor circuits, and other items. Centralab, A Division of Globe-Union, Inc., 900 East Keefe Ave., Milwaukee 1, Wisc.

### Ball Bearings 98

Double-row ball bearings are described in four-page illustrated bulletin 111. Complete dimensional information is given on open, shielded and snap ring types. Hoover Ball and Bearing Co., 5400 S. State Rd., Ann Arbor, Mich.



## Attach Leads to Ultra-Fine Magnet Wire? Sure!! ...and Economically

Send for samples illustrating how Deluxe Coils' advanced engineering and manufacturing know-how can supply miniaturized coils (48-56 gauge wire) with leads. Cut your scrap and termination problems.

**DELUXE COILS, INC.**  
POST OFFICE BOX 318 WABASH, INDIANA

CIRCLE 99 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 2, 1959

**Shipping Cases 105**

This two-page data sheet describes a line of reusable instrument shipping cases. The vulcanized fibre containers are designed for transporting all types of delicate instruments and electronic equipment. Information on sizes and specifications are presented in tabular form. Continental-Diamond Fibre Corp., Newark 107, Del.

**Thermistors 106**

Catalog SB51 on the firm's thermistors, and four information folders on matched thermistors, temperature sensor assemblies, thermal conductivity cells, and circuit design kits are available from this company as well as a 600 item technical catalog. Victory Engineering Corp., 519 Springfield Rd., Union, N.J.

**Regulators 107**

Data sheet F-1237 describes a line of lightweight missile regulators. Information is given on single-stage, feedback, high-pressure, small-flow, two-stage, two-stage feedback, and high-pressure two-stage feedback regulators. Linde Co., 420 Lexington Ave., New York 17, N.Y.

**Tachometers 108**

This four-page illustrated bulletin describes a line of electric tachometers. Dimensional drawings and electrical and mechanical specifications are included for six indicator models and three generator types. Ignition and economy tachometers are also covered. Electro-Mechano Co., 241 E. Erie St., Milwaukee, Wis.

**Preamplifiers 109**

Two-page bulletin 3023-9 provides illustrations and electrical and physical characteristics of five preamplifiers for use with scintillation, proportional counter, or Geiger-Müller tube detectors. Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio.

**Transformers 110**

Illustrated bulletin MC 559, four pages, describes a line of high power pulse transformers and inductor devices. Included are electrical specifications of pulse transformers with output voltages up to 100 kv and charging reactors with inductances up to 16 h. Stavid Engineering, Inc., Plainfield, N.J.

**ADEL LINE SUPPORTS**

*designed for every application*

**CLAMPS · BLOCKS · HARNESS STRAPS**  
*for military & industrial systems & equipments*

They cut maintenance and replacement costs . . . performance and reliability far beyond specifications of any other Line Support.

 **CLAMPS** provide cushioned, vibration absorbing support for cables, tubing and piping.

 **BLOCKS** provide resilient support for multiple grouping of lines to eliminate failures.

 **HARNESS STRAPS** embody heat and cold resistant material for temperatures far above +550°F to well below -99°F.

For safety, flexibility, durability and economy SPECIFY ADEL and be certain of getting the best possible service from products that are the result of advanced engineering design and the most modern production techniques.

A COMPLETE LINE . . . SERVICE-FITTED, TESTED AND APPROVED. SPECIFICATIONS ARE AVAILABLE TO AIRCRAFT, MISSILE AND ORIGINAL EQUIPMENT MANUFACTURERS . . . WHAT ARE YOUR REQUIREMENTS?

*Reliability*  
**ADEL PRECISION PRODUCTS**  
A DIVISION OF GENERAL TRANSISTOR CORPORATION

DISTRICT OFFICES: Birmingham • Memphis • Dayton • Wichita • Dallas • Toronto

Direct inquiries to  
Huntington Division  
1444 Washington Ave.,  
Huntington 4,  
West Virginia

CIRCLE 111 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 2, 1959

**MAGNETIC TAPE & DRUM HEADS**

*quality control from prototype to production*



The Magnetic Head Division of General Transistor Western Corporation designs and produces premium quality magnetic heads to your specifications . . . at lowest cost. Special quality control checks insure an extremely narrow channel to channel and head to head uniformity; all metal construction plus precision lapped gaps and mounting surfaces account for their excellent reputation in the computer and missile field. Write or call now for complete design portfolio.



Subsidiary of  
General Transistor Corporation

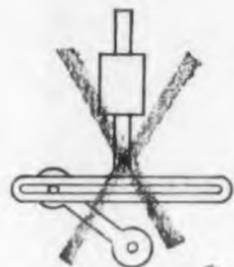
**General Transistor Western Corporation**

6110 Venice Boulevard, Los Angeles, California • WEbster 3-5867

CIRCLE 112 ON READER-SERVICE CARD

## How to keep computers compact

You can often save space, weight and money in equipment employing sine-cosine operations by "designing in" Gamewell Sinusoidal Potentiometers. Far lighter and more compact than gears, cams, and other complicated mechanisms, they're widely used in analog computers, data converters, Tacan systems, and radar components. Advanced design produces functions with smoothness and precision unobtainable by other resistive methods. For details and latest catalog, write THE GAMEWELL COMPANY, Dept. 14D, Newton Upper Falls 64, Mass.



### CONDENSED SPEC OF RVG-30XS-4

Resistance .....	16,000 ohms $\pm 5\%$
Conformity .....	1.0% peak to peak
Starting Torque .....	0.5 oz. in. max.
Angular Accuracy .....	$\pm 0.7^\circ$
Weight .....	2 oz. max.
Mechanical Rotation .....	Continuous
Electrical Rotation .....	$360^\circ$
Nominal Life .....	350,000 cycles

# Gamewell

**PRECISION POTENTIOMETERS**

INTEGRALS OF  
HIGH PERFORMANCE

RVG-30XS-4

CIRCLE 113 ON READER-SERVICE CARD



### MINIATURIZATION

We are far into new areas with miniaturized and microminiaturized electromagnetic devices used in the inertial Guidance systems we build. Our staff openings in miniaturization are for men who think big. Write to Mr. C. T. Petrie, Manager, Research & Engineering Staff.



LITTON INDUSTRIES Electronic Equipments Division  
Beverly Hills, California

CIRCLE 114 ON READER-SERVICE CARD

## NEW LITERATURE

### Computing Instruments 115

Four-page illustrated brochure 559 20M outlines the firm's electronic analog computing instruments, services, and available literature. Included are brief descriptions of operational amplifiers, manifolds, linear and nonlinear computing operators, regulated power supplies, and calibrated displays. George A. Philbrick Researches, Inc., 285 Columbus Ave., Boston 16, Mass.

### Control Synchros 116

This 25-page comprehensive report discusses the latest techniques of control synchro and control resolver testing. It describes in detail the test procedures and application factors associated with electrical zero, electrical error, fundamental null, total null, transformation ratio, and phase shift. The significance and application of each electrical parameter is explained. Theta Instrument Corp., 48 Pine St., East Paterson, N.J.

### Magnetrons 117

"New Trends in Magnetrons," four pages, provides complete electrical and performance characteristics on X-, Ka-, and K-band magnetrons. Illustrations are included. Sylvania Electric Products Inc., Central Advertising Distribution Dept., 1100 Main St., Buffalo, N.Y.

### Temperature Controls 118

Four-page illustrated brochure MC-182 describes 19 different midget and miniature temperature controls. Dimensions, temperature range, electrical ratings, and available modifications are given for each unit. Fenwal Inc., Ashland, Mass.

### Electrode Chart 119

This 25 x 30 in. chart lists 25 items of comparative information on more than 130 of the most commonly used electrodes. Included are specifications of mild steel, and low-alloy, low-hydrogen and stainless steel electrodes. Chemetron Corp., National Cylinder Gas Div., 840 N. Michigan Ave., Chicago 11, Ill.

there's a  
**STURGES BATTERY**  
for EVERY JOB  
requiring portable power

- From 2 volt basic components for laboratory use to high voltage applications required in electronics, sound recording, photographic, electrical instrument and television lighting fields, Sturges nonspill storage batteries have exceptionally high output.
- Uniformly high voltage is maintained throughout discharge period.
- Nonspill structural features limit emission of corrosive acid spray during charging.
- Transparent molded plastic case allows visual inspection of condition and electrolytic level.



SPECIAL PURPOSE BATTERIES  
CAN BE TAILORED TO FILL  
YOUR INDIVIDUAL SPECIFICATIONS.

manufactured by

**ELECTRONIC BATTERIES, INC.**

Bush Terminal Building No. 4 • 28-34 35th Street, Brooklyn 32, New York

CIRCLE 120 ON READER-SERVICE CARD

CIRCLE 121 ON READER-SERVICE CARD

# Millimicrosecond Sampler Makes Any Scope High Speed



**M**ILLIMICROSECOND pulses show up sharp and clear on almost any scope when they are first passed through a new sampling unit. Completely transistorized, the sampler operates with conventional oscilloscopes having a 500 kc band-pass or better. It works with even very low cost oscilloscopes to display extremely fast waveforms.

With this instrument, low cost scopes can show pulses with risetimes measured in fractions of a millimicrosecond. The photo in Fig. 1, for example, shows a pulse with a rise time of 0.4  $\mu$ sec.

The instrument, Model SU-22 Millimicrosecond Sampling Unit, was shown for the first time at WESCON two weeks ago. It's a product of Lumatron Electronics, Inc., 68 Urban Ave., Westbury, N. Y.

Its low price, well under a thousand dollars, is hard to believe when one looks at the sampler's specifications. The sampling unit boasts:

- A rise time of 0.5  $\mu$ sec.
- A maximum sweep rate of 0.5  $\mu$ sec/cm.
- A stability better than 0.2  $\mu$ sec.
- A sensitivity as high as 30 mv/cm (with 3:1 signal to noise ratio).
- A repetition rate of up to 50 kc.

When used with a companion instrument, the Lumatron Model ST-2, the sampler can be triggered by pulses and even by sine waves with rep rates exceeding 300 mc.

The SU-22 is really easy to use. It has only

three input connections and two outputs. It requires a signal and a trigger input, and a sawtooth from the sweep circuit of the slave oscilloscope. It provides a signal for the scope's vertical amplifier and an unblanking pulse for the scope's intensity axis.

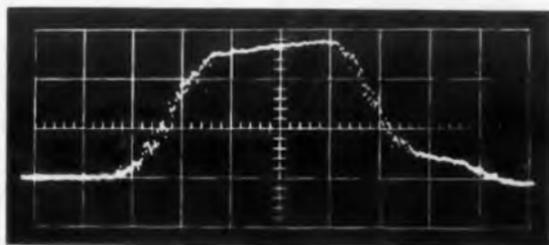
## Displays Trace Dot by Dot

The sampler doesn't use traveling wave tubes, wideband amplifiers, and other brute force measures. Instead, it uses a transistor circuit that amplifies narrow samples of the waveform, rather than the waveform itself.

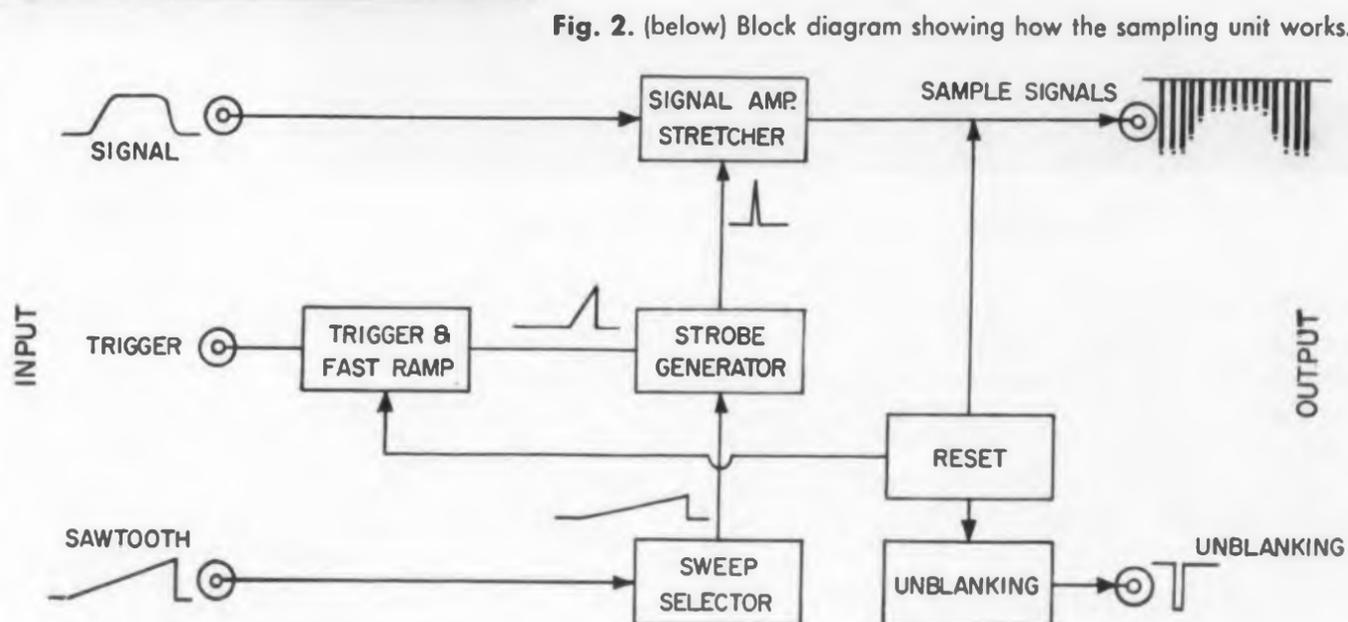
In this sampling circuit, unamplified, repetitive, low-level, signal waveforms are sampled by a very fast strobe pulse generated by an avalanche transistor. The sample is stretched, amplified, and displayed on the scope screen as a dot.

The next pulse is strobed too, an instant later. The new sample corresponds to the instantaneous amplitude of the pulse at the new sampling point. The resulting dot is displayed next to the preceding dot, and so on until the entire waveform has been strobed and displayed as a continuous pattern. Then the sampling pulse starts at the beginning of the waveform again and the process is repeated. The block diagram of Fig. 2 shows the basic simplicity of operation of the sampler.

For more information on this ultra-high-speed sampling unit, turn to the Reader-Service Card and circle 103.



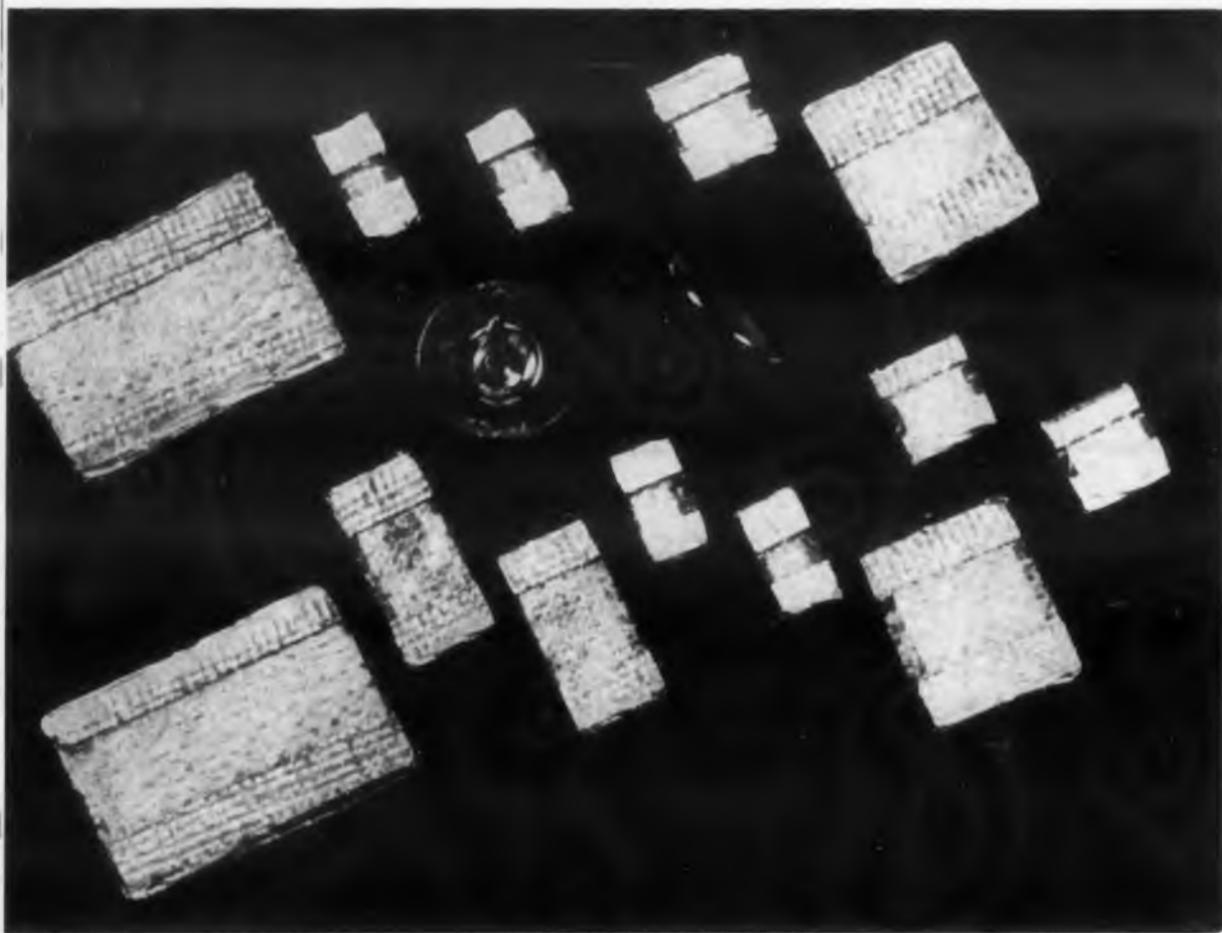
**Fig. 1.** (left) This pulse has a rise time of 0.4  $\mu$ sec. It is shown on an inexpensive scope using a Millimicrosecond Sampling Unit sweeping at 0.5  $\mu$ sec/cm.



**Fig. 2.** (below) Block diagram showing how the sampling unit works.

# NEW PRODUCTS

*Covering all new products that might generally be specified by an electronics engineer engaged in the design of original equipment.*



## Glass Wafer Capacitors Are Smaller Than Thumbtack Head

Smaller than the head of a thumbtack, these miniature glass wafer capacitors operate at temperatures from  $-55$  to  $+125$  C at full voltage rating. Designated W-1 through W-5, they have capacitances from 1 to 10,000  $\mu\text{f}$  at 300 v. They are available with folded tab leads; the two smallest units, W-4 and W-5, may be obtained with high temperature soldered leads. Dimensions range from 0.281 to 0.531 in. long, 0.218 to 0.812 in. wide, and 0.060 to 0.090 in. thick. Applications include lumped constant delay lines, potted assemblies, and miniaturized modular circuits.

Corning Glass Works, Dept. ED, Bradford, Pa.

CIRCLE 123 ON READER-SERVICE CARD



## Pressure Transducer Is 3-1/2 in. Long

Designed for airborne applications, model 180 pressure transducer weighs 10 oz and is 3-1/2 in. long. It measures corrosive fluid and gas pressures up to 1000 psi at 1 msec response times. The proving ring provides a heat sink for the normal heating of the resistance gages. This unit has low sensitivity to vibration, infinite resolution, and a high overload capacity. Linearity is 0.3%, hysteresis is 0.25%, and repeatability is 0.1%. Operating temperature range is  $-100$  to  $+275$  F.

Taber Instrument Corp., Electronics Div., Dept. ED, N. Tonawanda, N.Y.

CIRCLE 124 ON READER-SERVICE CARD

## Cold Cathode Tube Controls High Energy Discharges

Able to control pulse discharges as high as 1100 amp at 2500 v, type KP-130 cold cathode tube replaces trigger tubes, timer tubes, and spark gaps. A size T-3 subminiature tube, it has an anode delay time of 0.2  $\mu\text{sec}$ , and a variation in delay time which averages less than 0.05  $\mu\text{sec}$ . It incorporates a low-level radioactive material which emits Beta radiation. This tube has a hold-off voltage of 3000 to 4000 v, and low trigger grid power.

Kip Electronics Corp., Dept. ED, P.O. Box 562, Stamford, Conn.

CIRCLE 125 ON READER-SERVICE CARD



# Creative Microwave Technology

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

## Dual Power Supply

Has remote control programming terminals

On one rack-mounted chassis, the model 2-212A Regatron power supply provides two 0 to 100 v dc, 0 to 100 ma sources which may be used independently, in parallel, or in series. Load regulation is 0.1% or 0.05 v, line regulation is 0.15% or 0.05 v, and ripple is less than 0.5 mv for each output independently. Remote control terminals for programming may be had on either front or back with provision for remote sensing to maintain regulation at the load. Chopper stabilization is optional. Each supply can deliver nearly three times its specified maximum voltage at derated current values, and parallel or series use doubles the appropriate over-voltage ratings. Dimensions are 5-1/4 x 9-1/4 x 19 in. The model 2-212AM, a metered version, is also available.

Electronic Measurements Co., Inc., Dept. ED, Eatontown, N.J.

CIRCLE 126 ON READER-SERVICE CARD

## Shaft-Angle Digitizer

Two-piece

Split into two separate packages, the model DV-13D digitizer is designed for systems that require precision optical shaft-angle encoding and have limited space at the point of angle measurement. It consists of a 25 cu in. optical-mechanical converter and a 37 cu in. amplifier assembly. The 13-digit reading signals are carried from the converter head to 13 separate amplifier channels by a cable that is up to 3 ft long. The device provides angle reading at a rate of 100 digital words per sec and an accuracy of  $\pm 2.5$  min from  $-65$  to  $+165$  F. Electrical output of each amplifier channel is 5 v for a one and less than 50 mv for a zero. The model DV-13A, a single package version, is also available.

Dychro Corp., Dept. ED, 12 Centre Ave., Newton 58, Mass.

CIRCLE 127 ON READER-SERVICE CARD

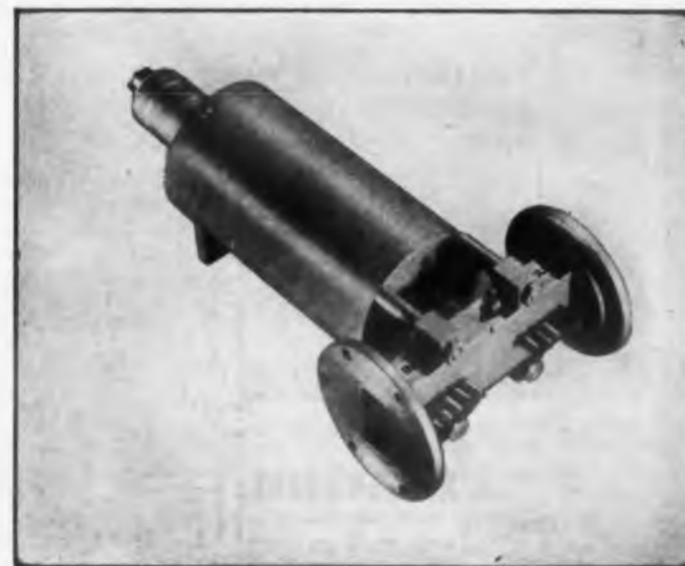
CIRCLE 128 ON READER-SERVICE CARD

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

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

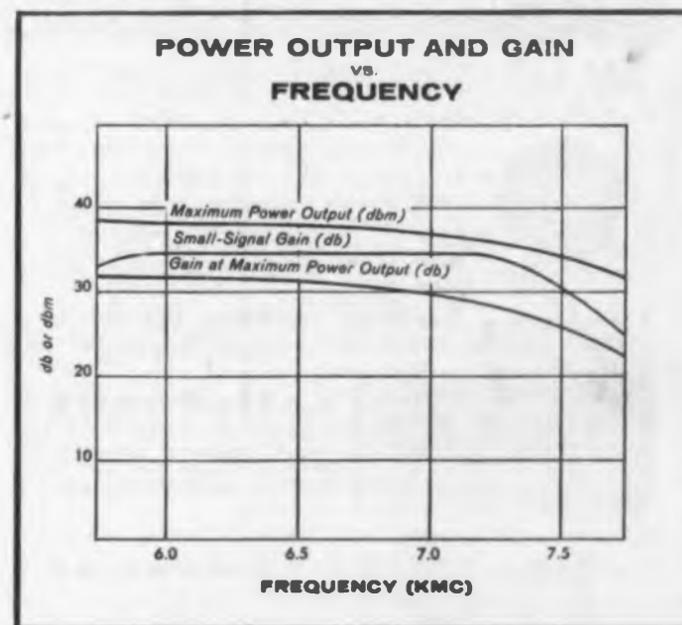
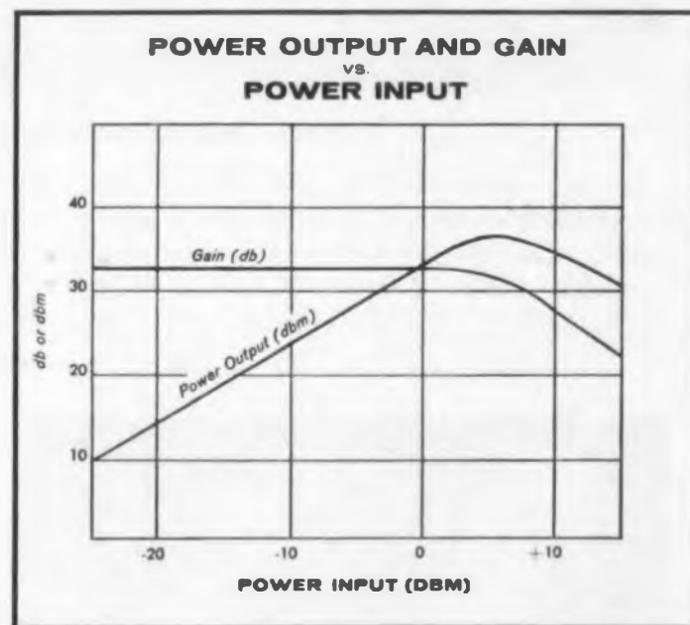
High amplification over a wide range of power levels results in small-signal gain of up to 35 db. A special control electrode facilitates low-voltage pulsed or amplitude modulation.

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



### Typical Operating Characteristics

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



Excellence in Electronics



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

A LEADER IN CREATIVE MICROWAVE TECHNOLOGY

**marion**  
advancement  
in instrument  
design



**SEALED  
RUGGEDIZED  
PANEL METERS**

The "Original"  
MIL-M-10304-A  
Instrument

HERMETICALLY SEALED... GLASS-TO-METAL

MIL 2 1/2" (MR26) and MIL 3 1/2" (MR36) sizes. Also 1 1/2" Ruggedized and 4 1/2" Sealed Models. ua, ma, amp, mv, volt, KV, AC rectifier types for voltage, decibel and VU measurement. Standard ranges. Bulletin on request. Marion Instrument Division, Minneapolis-Honeywell Regulator Company, Manchester, N. H., U. S. A.

Copyright © 1958, Marion

**marion**  
"WHERE ELECTRONICS MEETS THE EYE"  
**meters**



CIRCLE 133 ON READER-SERVICE CARD

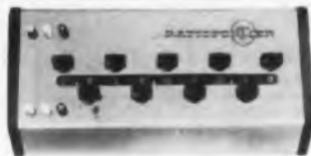
## BOOST SPEED and EASE of Production Line Testing

*End Calculation and Transcribing Errors*



- 0.001% Ratio Accuracy at a 1000:1 step down; this is terminal linearity of 1 part in 10 million.
- Resolution: 1 part in 100 million of input—300 million discrete steps above and below unity.
- Ratios of 3-to-1 step up to 10<sup>-8</sup> step down.
- Direct, in-line readout of numbers on sloping panel.

**Transformers, synchros, resolvers, computers, and meters can be tested on a simple "go/no-go" basis.**



MODEL NO. 7600

### RATIOFORMER

Ruggedly built. High input, low output impedance, extremely low phase shift make the OEEO Ratioformer a versatile and adaptable instrument.



MODEL NO. 7500

### DEVIAFORMER

Direct readout of percent of deviation from specified voltage ratios. Used with a ratio standard such as the OEEO Ratioformer, reduces measurement to extremely accurate % answer.

Write for descriptive folder.

**OSBORNE** electronic sales corp.

712 S. E. Hawthorne Blvd., Portland 14, Oregon  
13105 S. Crenshaw, Hawthorne, California

CIRCLE 134 ON READER-SERVICE CARD

## NEW PRODUCTS



CIRCLE 129 ON READER-SERVICE CARD

### Cathode Ray Tube for Very High Altitudes

Improved performance of oscilloscopes at extremely high altitudes is possible through use of rectangular cathode ray tube type 3ASPI. It has an altitude rating of 35,000 ft, and achieves greater display clarity through use of a pressed flat glass faceplate. The anode button is located on the bulb wall for greater freedom from external arcing. The tube has a vertical sensitivity of 28 to 38 v per in. It measures 1-1/2 x 3 in., is less than 9 in. long, and weighs 8 oz.

Sylvania Electric Products Inc., Dept. ED, Seneca Falls, N.Y.

### Driver Transistors Dissipate 300 mw at 75 C

Contained in the JEDEC TO-9 package, these audio transistors are capable of dissipating 300 mw at 25 C and 50 mw at 75 C. Called 2N1176, A, B, these three units have low saturation resistance; a typical value is 1 ohm at 100 ma dc. Maximum voltage ratings are 15, 40, and 60 v; maximum current rating is 300 ma dc. High current gain combined with linear current gain characteristics result in low distortion output. These transistors have welded construction and a vacuum-tight seal.

Bendix Aviation Corp., Dept. ED, Long Branch, N.J.



CIRCLE 130 ON  
READER-SERVICE  
CARD



### Intricate Shapes produced by Paste Extrusion Process

A wide variety of complex, dimensionally accurate Teflon extrusions for electronic and mechanical applications is available. Continuous shapes are made from segmented dies to customer's specifications. These plastic extrusions have a continuous service temperature of 250 C and are impervious to corrosive attack. Applications include shaped insulators, spacers, and terminal receptacles or plugs. Pennsylvania Fluorocarbon Co., Inc., Dept. ED, 1115 N. 38 St., Philadelphia 4, Pa.

CIRCLE 131 ON READER-SERVICE CARD



### One-Half in. Semi-Flexible Coaxial Connector

This one-half in. semi-flexible coaxial connector is available to series N. It is lightweight, compact, and may be quickly assembled. Used for aluminum sheathed coaxial cable, it has a low vswr. No special tools or dies are necessary to prepare the cable. This connector is slipped onto the cable and securely fixed with standard wrenches. Reliability at environmental extremes is assured with 0 seals.

Spec Electronics, Dept. ED, P.O. Box 64314, Los Angeles 64, Calif.

CIRCLE 132 ON READER-SERVICE CARD

CIRCLE 350 ON READER-SERVICE CARD >

ELECTRONIC DESIGN • September 2, 1959

## NEW PRODUCTS

### DC Amplifier

Has stability of  $\pm 2\%$



For use with millivolt inputs typical of strain gages and thermocouples, this dc amplifier provides a stability of  $\pm 2\%$  for temperatures from  $-55$  to  $+85$  C and linearity of  $\pm 1\%$ . The amplifier requires 15 ma at 20 v dc. Output is 5 v dc or peak-to-peak ac into an external 100,000 ohm load. Weighing less than 10 oz, it is hermetically sealed in a container 1 x 2 x 4 in.

Missile Electronics Engineering Co., Dept. ED, 14644 Keswick St., Van Nuys, Calif.

CIRCLE 163 ON READER-SERVICE CARD

### Transistorized Data Amplifier

For high-temperature applications



Designed for amplification of millivolt level ac instrumentation signals, model 3300 transistorized data amplifier operates in a temperature range of  $-55$  to  $+100$  C. Voltage gain is  $20 \pm 1\%$ . Input impedance is greater than 5 meg at 400 cps, independent of input amplitude. Output impedance is less than 10,000 ohms and output linearity is over 1%. The unit is 7/8 in. sq x 1-3/8 in. high and weighs 1.5 oz. It is hermetically sealed to meet MIL-P6889. Frequency response is flat within 1 db between 10 cps and 100 kc when operated from a low impedance source. Vibration requirements of MIL-E-5272B, Procedure II, are met.

The Mira Corp., Dept. ED, 2656 N. Pasadena Ave., Los Angeles 31, Calif.

CIRCLE 164 ON READER-SERVICE CARD

**CASE HISTORIES**

Comparator measures dimensions to one-millionth of an inch. One of many pieces of ultra-precision equipment in the New Departure instrument/miniature ball bearing laboratories.

In many bearings, various dimensions and surface finishes must be held to within tolerances of one millionth of an inch.

## **ND** Instrument Ball Bearings Help Missiles Along A Bright Path Of Precision!

### CUSTOMER PROBLEM:

Missile guidance system manufacturers require a dependable source for super precise instrument ball bearings. When used in spin axis and gimbal applications, for example, these ball bearings help restrict vitally important drift, through extremely close tolerances and high precision uniformity.

### SOLUTION:

New Departure research, development and production facilities were applied to solving the vital problem. Visual evidence of New Departure's success is the bright path of precision written across the skies by Sperry,

ACHIEVER and other guidance systems used in many of the most advanced missiles and space craft. In the case of Sperry's gyrosyn guidance system, for example, New Departure instrument ball bearings are credited with a remarkable 1200% gain in gyro accuracy. Proof enough that New Departure has the know-how and facilities to solve tomorrow's instrument/miniature ball bearing design problems in missile and space exploration.

What's more, these New Departure facilities are available for *your* design development right now! Call or write Department J-9.

**NEW DEPARTURE**  
DIVISION OF GENERAL MOTORS, BRISTOL, CONN.

NOTHING ROLLS LIKE A BALL  
CIRCLE 165 ON READER-SERVICE CARD

## NEW PRODUCTS

### Antenna Pattern Integrator

Provides 1000 antenna signal samples

Series API-1 antenna pattern integrator provides 1000 antenna signal samples for 360 deg rotation and has automatic shut-off after 1000 samples. The integral sum is read out on decimal counting units with an accuracy of at least 0.5% of max count or single samples.

Scientific-Atlanta, Inc., Dept. ED, 2162 Piedmont Road, N.E., Atlanta 9, Ga.

CIRCLE 166 ON READER-SERVICE CARD

### Turret Attenuators

Low insertion loss

These turret attenuators have an insertion loss of 0 to 200 mc, 0.1 db to 500 mc, and 0.2 db to 900 mc at 0 db position. Accuracy is 2% to 200 mc and 2%  $\pm$ 0.5 db to 900 mc. Impedance is constant at 50 ohms and vswr is between 1 and 1.1 to 300 mc and less than 1.5 to 900 mc. Type TA-50 provides 0, 10, 20, 30, 40, or 50 db attenuation by turning a six-position switch. Other models provide 0, 1, 2, 3, 4, and 5 db; 0, 2, 4, 6, 8, and 10 db; and 0, 5, 10, 15, 20 and 25 db. The units may be used singly or in series and measure 2-1/4 x 1-3/4 in.

Telonic Industries, Inc., Dept. ED, Beech Grove, Ind.

CIRCLE 167 ON READER-SERVICE CARD

### Fixed Coaxial Attenuators

Cover 1 to 12.4 kmc

Covering 1 to 12.4 kmc, these fixed coaxial attenuators are available with type TNC connectors. Model 633 has 1 male and 1 female connector, model 634 has 2 female connectors, and model 635 has 2 male connectors. Attenuation range is 1 to 20 db and impedance is 50 ohms.

Weinschel Engineering, Dept. ED, 10503 Metropolitan Ave., Kensington, Md.

CIRCLE 168 ON READER-SERVICE CARD



COOLANOL: Monsanto T. M., Reg. U. S. Pat. Off.

**FRESCANAR** (frequency scan radar) is the eyes of the Army's "Missile Monitor," a guided missile fire distribution system for mobile field army use in air defense. This revolutionary electronic beam radar system developed by Hughes Aircraft Company scans space without requiring a separate height-finding radar system! Hughes designed it for rugged reliability, ease of maintenance, reduced size and weight, speed, and total simplicity of operation.

**FRESCANAR** consists of a single antenna in the inflated radome on the trailer, one power van with a diesel generator and one equipment van for the radar gear. It can be converted for travel in minutes. **FRESCANAR** concentrates all available power in sharp pencil beams of energy flashing on and off in fan-shaped array—pinpoints targets at great distance with extreme accuracy. The **FRESCANAR** klystron tube efficiently and effectively produces the tremendous RF pulse power required.

**COOLANOL 45** coolant-dielectric liquid assures reliability by keeping klystron temperatures within critical operating limits. Versatile **COOLANOL 45** provides efficient heat transfer for accurate temperature control of many electronic systems. It also serves as a high-temperature hydraulic fluid in a number of units . . . remains a pumpable liquid over the remarkable temperature range of -65° to 400° F.!

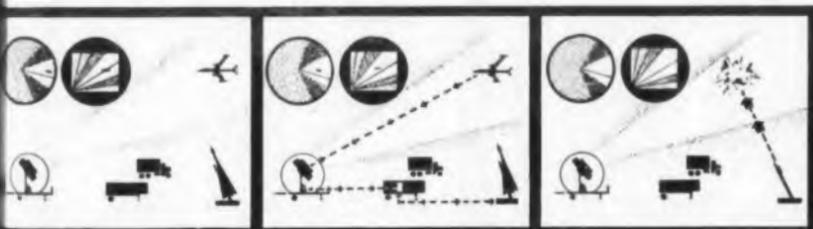
When you need a synthetic fluid, come to Monsanto—creator of fluids for the future.

# Coolanol 45 Hughes

How **FRESCANAR**  
pinpoints targets  
in 3 dimensions!

*COOLANOL 45 liquid  
cools the FRESCANAR  
high-powered klystron  
Pumped around the collector  
COOLANOL 45 absorbs  
surface heat from  
tube wall and carries  
it away for dissipation  
in the heat exchanger*

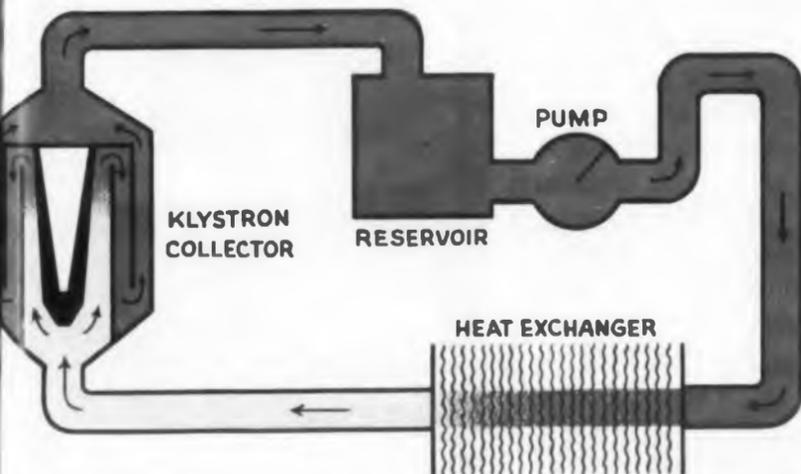
# 45 liquid cools klystron in new rescanar—first "3-D" radar



Pencil-beam antenna scans  
at extreme range to de-  
tect "enemy" craft. Almost  
simultaneously, it...

flashes range and azimuth on  
one monitorscope, altitude on  
another, and relays essential  
data to control centers.

While guided missile scores  
"kill," FRESCANAR continues  
to seek other targets... can  
track many more than conven-  
tional systems.



CIRCLE 169 ON READER-SERVICE CARD

## Send for New Booklet...



Gives useful information about static and dynamic cooling methods, how to apply the package concept to cooling design, how to simplify and standardize cooling and hydraulic units. Through a step-by-step solution to a typical klystron cooling problem, it shows you how to apply principles of heat transfer in actual practice. For your copy, circle the reader-service number or write:



Monsanto Chemical Company  
Organic Chemicals Division  
Dept. AV-12  
St. Louis 66, Missouri

## Ceramic Capacitors

Voltage to 100 kv

High current ceramic feed-through capacitors, with voltages up to 100 kv, can be constructed in a wide value ranges of capacity, voltage, and rf current. A 20 kv unit, for example, may be 3 in. in diam and 6 in. long, or 5 in. in diam and 4 in. long, with the same ratings.

Centralab, Div. of Globe-Union, Inc., Dept. ED, 900 E. Keefe Ave., Milwaukee 1, Wis.

CIRCLE 170 ON READER-SERVICE CARD

## Servo Repeater

Operates from 117 v, 400 cps line

Designed to follow the position of a remote synchro, type 770A servo repeater operates from 117 v, 400 cps and includes servo motor, gearing, control transformer, and servo amplifier in one package. Top speed is 120 rpm; max output torque, 30 oz-in.; and stiffness, 3 oz-in. per deg. The amplifier has transistor-magnetic circuits. An output driver shaft is provided and a register positions the assembly in mounting. A size 18 temperature control is used for stator drain. Typical applications are as servo driven indicators, multipliers, and digitizers.

Industrial Control Co., Dept. ED, 805 Albin Ave., Lindenhurst, L.I., N.Y.

CIRCLE 171 ON READER-SERVICE CARD

## Transistorized Plug-In Chopper

Operates on 400 cps power

Model 65 transistorized plug-in chopper operates on 400 cps power or from a drive source common to the dc voltage being chopped. Sinusoidal or square wave drive may be utilized over 270 cps to 30 kc frequency range. The unit may be used as a synchronous demodulator and is capable of linearly switching or chopping voltages from less than 1 mv to 5 v.

Solid State Electronics Co., Dept. ED, 8158 Orion Ave., Van Nuys, Calif.

CIRCLE 172 ON READER-SERVICE CARD

# BENDIX GEAR HEAD MOTORS AND MOTOR GENERATORS

... tailor-made or standard  
for any requirement



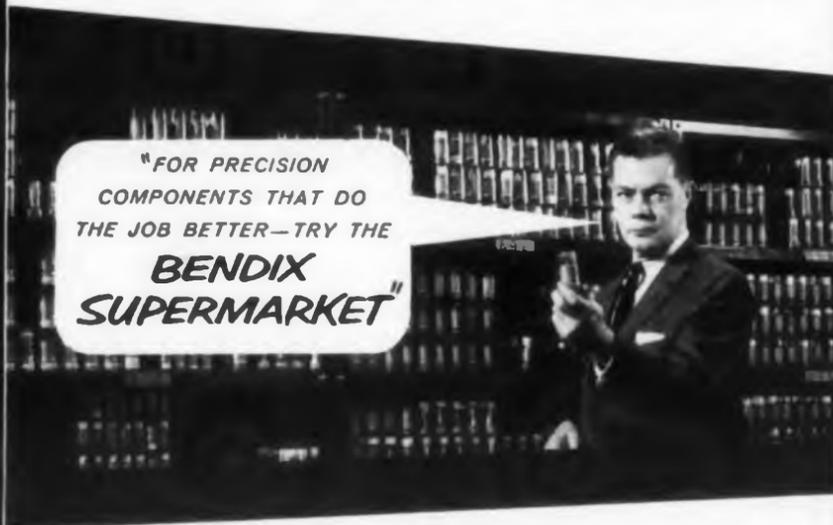
"Ratios to order" describes the complete Bendix line of gear head motors and motor generators. Long experience in the design and production of these precision devices has taught us how to pack high-operating torque capacities and power into small packages—and into big ones, too, if that's what you need. And we can deliver from our wide standard line at volume-production prices. We've a wide range of frame sizes available or will build special sizes on special order. No matter what the size or ratio required, we can produce it. In fact, units have been delivered from our standard line with ratios ranging from 7.22:1 up to 42,471.90:1. Many other "production" models are now under development. DESIGN VARIATIONS, TOO! For example, we can provide units with: backlash of 1/10° without using anti-backlash devices; offset output shafts; gear heads to be mounted by internal fasteners or by external clamps; and many other variations.

Whatever your requirements in gear head motors and motor generators, our experience and facilities can produce the unit you need. Write for details.

## Eclipse-Pioneer Division

Teterboro, N. J.

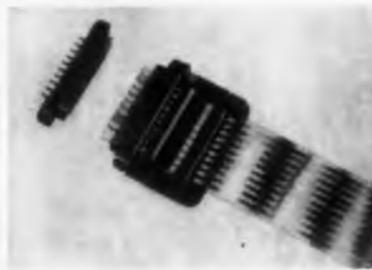
District Offices: Burbank and San Francisco, Calif.; Seattle, Wash.; Dayton, Ohio; and Washington, D. C. Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.



"FOR PRECISION  
COMPONENTS THAT DO  
THE JOB BETTER—TRY THE  
**BENDIX  
SUPERMARKET**"

CIRCLE 173 ON READER-SERVICE CARD

## NEW PRODUCTS



**Connector**  
For flat conductor  
wiring

This Plyo-duct connector is designed for use with film insulated flat conductor wiring. The plug-in units incorporate an insulated strain relief handle which can be mounted to either male or female connector. Both rack and panel and cable to cable connections have the new in-line construction.

Methode Manufacturing Corp., Dept. ED, 7447 W. Wilson Ave., Chicago 31, Ill.

CIRCLE 174 ON READER-SERVICE CARD

## High-Speed Typewriter

600 lines per minute

Electronic Mini-typewriter model 320 has a speed of 600 lines per minute and provides a choice of any 64 alpha-numeric characters with punctuation and special symbols. It provides 14 columns with the characters spaced 5 per in. horizontally and measures 20 x 20 x 26 in.

Shepard Laboratories, Inc., Dept. ED, Summit, N.J.

CIRCLE 175 ON READER-SERVICE CARD



**Servo Mount  
Potentiometer**

Handles 3.5 w

Built for heavy duty service in servo applications, model 176 wirewound servo mount potentiometer handles 3.5 w continuous power and can be supplied with up to 100,000 ohms resistance. Torque is less than 5 oz-in. per section in standard construction. It operates with ambient temperature range of -55 to +105 C and has insulation resistance of 100,000 meg in the standard unit. Life span will reach 5,000,000 revolutions in some combinations. Every unit meets or exceeds MIL-5272A and applicable parts of JAN-R-19.

New England Instrument Co., Dept. ED, 350 Main St., Woonsocket, R.I.

CIRCLE 176 ON READER-SERVICE CARD

P.S. and don't forget these  
other quality products at the

## BENDIX "SUPERMARKET"

With our greater variety and greater volume of the precision components listed below, we have become the "supermarket" of the industry. We feature fast delivery and mass-production economy—plus the highest precision quality.

**400-CYCLE SYNCHROS**  
(Frame sizes: 8, 10, 11, 15, 22)  
Control Transformers  
Differentials • Receivers  
Resolvers • Transmitters

**GYROS**  
Directional, Free, Rate, Roll  
and Vertical Gyro Transmitters  
• Stable Platforms

**MOTORS AND GENERATORS**  
• Low-Inertia Servo Motors  
• Motor Generators • Precision  
Induction Tachometer  
Generators • Rate Generators

**PACKAGED COMPONENTS**  
Analog-Digital Converters •  
Azimuth Counters • Cam Compensators • Clutched Synchros • Dual-Speed Synchros • External Slip-Ring Synchros • Follow-Up Mechanisms • Miniature Differential Gear Assemblies • Servo Assemblies

**RADAR DEVICES**  
Airborne Radar Antennae •  
Ground Antenna Pedestals

YCBTBS

You Can't Beat The Bendix  
"Supermarket". Try us.

## Eclipse-Pioneer Division



Teterboro, N. J.



"FOR PRECISION  
COMPONENTS THAT DO  
THE JOB BETTER—TRY THE  
**BENDIX  
SUPERMARKET**"

CIRCLE 177 ON READER-SERVICE CARD

## Molded Potential Transformer

For metering applications

Designed for metering applications, type EMPL molded potential transformer is available in ratios of 2:1, 2.4:1, 4:1, and 5:1 in either 600 or 1200 v. Molded from polyester rubber, the transformer maintains metering accuracies through 75 va at 85% pf. In the 1200 v class it is available with or without fuses.

Westinghouse Electric Corp.,  
Dept. ED, Pittsburgh, Pa.

CIRCLE 178 ON READER-SERVICE CARD

## Power Supplies

Regulated to 0.05%

G series high current dc power supplies are regulated to 0.05% for 0 to full load or 10% line change. Ripple is 2 mv; output impedance is 0.5 ohms dc, 0.2 ohms from 2 cps to 10 kc, rising to 1 ohm at 100 kc and to 3 ohms at 600 kc. Transient response is 0.1 sec; square wave load may be supplied. Model G3050M has an output voltage to 300 v at 0 to 0.5 amp, in steps: 0 to 85 v, 80 to 140 v, 135 to 185 v, 180 to 220 v, 215 to 250 v, 245 to 275 v, and 270 to 300 v. Input is 105 to 125 v ac, 50 to 400 cps. It measures 7 x 19 x 14-7/8 in. Other models have output to 250 v at current ranges up to 0 to 3 amp.

Universal Electronics Co., Dept. ED, 1720 22nd St., Santa Monica, Calif.

CIRCLE 179 ON READER-SERVICE CARD

## Metallic Brush Commutator

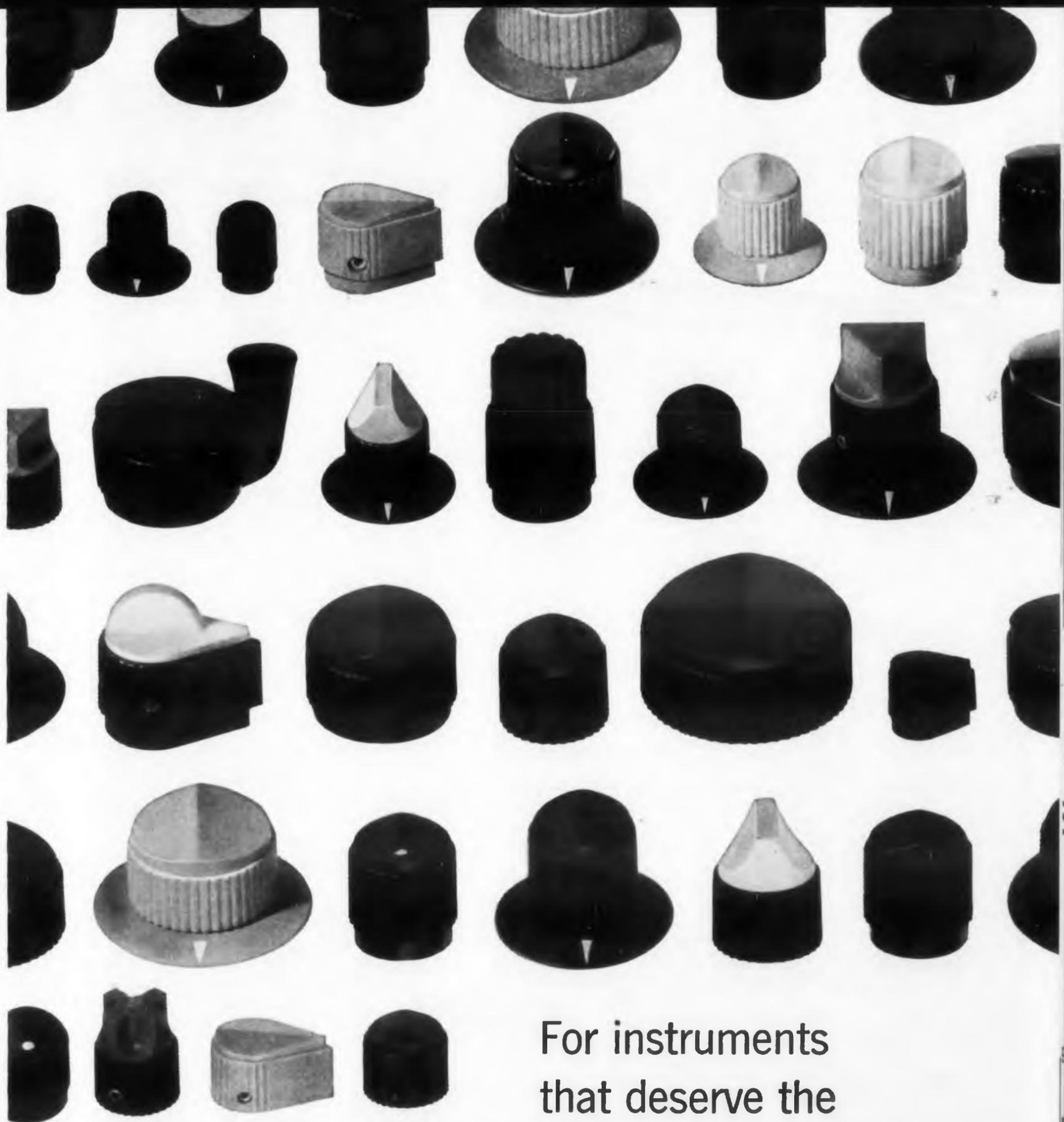
For radar confidence systems

Model 1212B-1 metallic brush commutator is used in radar confidence systems to sample up to 30 voltage signals per pole. A three-pole type, it has an interval 100 rpm synchronous motor without gear train.

General Devices, Inc., Dept. ED,  
P.O. Box 253, Princeton, N.J.

CIRCLE 180 ON READER-SERVICE CARD

CIRCLE 181 ON READER-SERVICE CARD →



*\*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.

# NEW

## Transistorized Modules

## Magnetic Digital Modules

### Compatible in One Self-Powered Case

Increase the reliability of your digital systems and cut design time—with Packard Bell Computer's newest solid state digital modules. Advanced design eliminates troublesome eyelets and etched-circuit connectors and reduces active circuit elements—50 core stages can be driven by a single transistor. One self-powered case provides all power and gating voltages for medium and high speed, transistorized and magnetic modules.

#### TRANSISTORIZED MODULES

- Medium speed (nominally 200KC)
- High speed (nominally 3mc)
- Special high temperature modules
- NOR logic modules

#### MAGNETIC MODULES

- Medium speed (50KC)
- High speed (100KC)
- First commercially available transistorized driving circuits



## PACKARD BELL COMPUTER CORP.

*A subsidiary of Packard Bell Electronics*

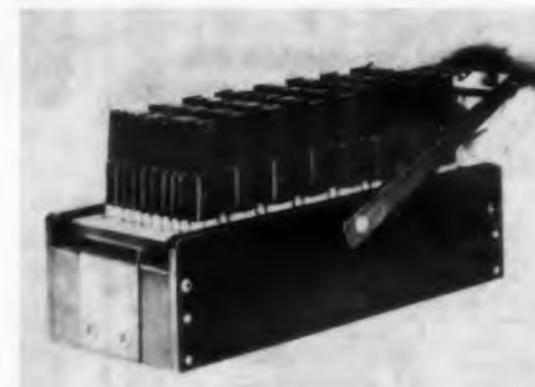
1905 ARMACOST AVENUE, LOS ANGELES 25, CALIFORNIA, OR 8-4347

CIRCLE 182 ON READER-SERVICE CARD

## NEW PRODUCTS

### Program Selector Switch

Offers up to 1500 poles



Designed for applications such as missile instrumentation circuitry, this double throw selector switch permits instant selection of either of two distinct electrical circuit combinations and offers up to 1500 poles. The switch is fully shielded and provides for pre-cleaning all contacts when the circuits are activated. Wiring to rear of switch is with taper pins. Current rating is 5 amp max, continuous duty. Voltage rating is 1500 v dc between adjacent contacts at sea level.

AMP Inc., Dept. ED, Harrisburg, Pa.

CIRCLE 183 ON READER-SERVICE CARD

### 200 Channel Analyzer

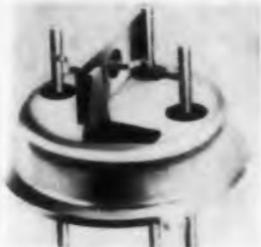
Uses ferrite core memory system



Model 34-8 transistorized 200 channel analyzer uses ferrite core memory system for rapid, accurate spectrum analysis. Linearity is better than 0.5%, average dead time is 60  $\mu$ sec, and normal capacity per channel is 100,000 counts. The unit employs direct parallel decimal readout to printer. Input counting rate without distortion or shift of data is greater than  $5 \times 10^6$  counts per min.

Radiation Instrument Development Laboratory, Inc., Dept. ED, 5737 S. Halsted St., Chicago 21, Ill.

CIRCLE 184 ON READER-SERVICE CARD



## Germanium Transistor

For switching applications

Type 2N1313 pnp germanium alloy junction transistor is designed for use in high current, high speed, computer switching applications. The transistor junction tab is securely bonded to the unit's base plate for electrical insulation and heat dissipation. Maximum ratings are  $BV_{CBO}$ , -30 v;  $BV_{EBO}$ , -20 v; continuous  $I_C$ , 400 ma; and  $P_C$ , 175 mw. The unit withstands 20,000 g centrifuge and has low beta fall-off. It exceeds Mil specs for shock, vibration, centrifuge, and resistance to salt spray and moisture.

Tung-Sol Electric, Inc., Dept. ED, 1 Summer Ave., Newark, N.J.

CIRCLE 185 ON READER-SERVICE CARD

## Recorder-Controller

Controls up to six points

This combination recorder-controller offers increased flexibility in controlling up to six points and recording up to 24 points. It can operate from either one or two separate thermocouples, or other inputs, per point. Positive protection against failures of either half of the system is provided when the dual inputs are used. Both on-off and proportional electric control are available.

Daystrom, Inc., Daystrom-Weston Industrial Div., Dept. ED, 614 Frelinghuysen Ave., Newark 12, N.J.

CIRCLE 186 ON READER-SERVICE CARD



## Temperature Sensitive Fuse

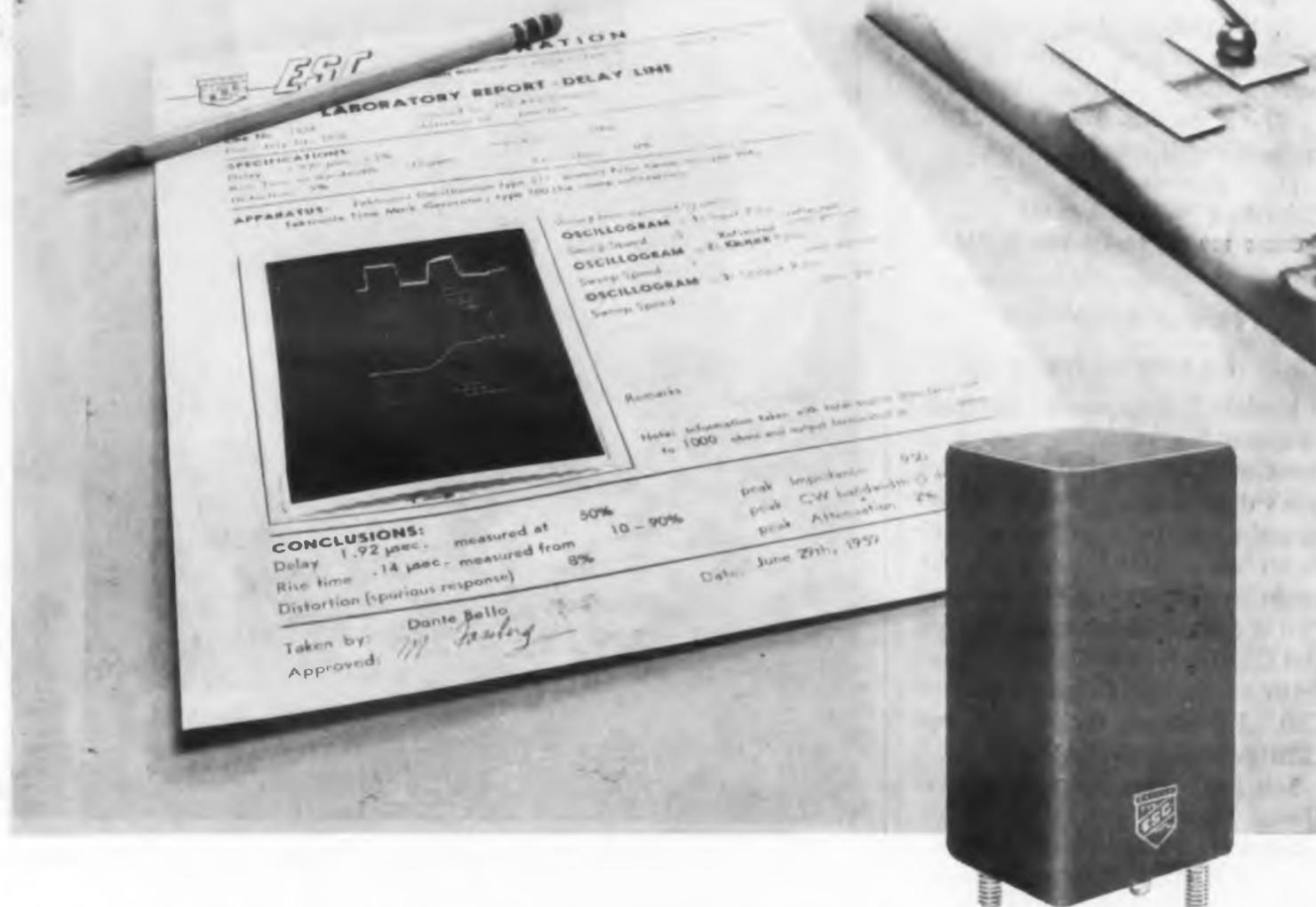
Handles up to 15 amp

Model 7503, a miniature, temperature sensitive fuse, handles up to 15 amp continuous current over temperature range of -65 to +200 F. The circuit opens at 281 F. Internal resistance is less than 1 milliohm at 15 amp. Measuring 1.25 x 0.285 in. diam, it is hermetically sealed. Environmental requirements for aircraft, missile, and ordnance applications are met.

Networks Electronic Corp., Dept. ED, Van Nuys, Calif.

CIRCLE 187 ON READER-SERVICE CARD

# REPORT CARD FOR A DELAY LINE...



ESC was the first to provide complete laboratory reports with each delay line prototype—containing 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. ESC

was also the first company devoted exclusively to the design and manufacture of custom-built and stock delay lines... for all military and industrial applications.

Whatever the application, ESC can design and build precisely the delay line you need—easily, efficiently and exactly as specified.



# ESC

## CORPORATION

WRITE TODAY FOR COMPLETE TECHNICAL DATA.

*exceptional employment opportunities for engineers experienced in computer components... excellent profit-sharing plan.*

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 188 ON READER-SERVICE CARD

## NEW PRODUCTS

### Miniature Wirewound Resistor

Rated at 1/2 w

Rated at 1/2 w up to an ambient temperature of 75 C, designated RS 1/2 miniature wirewound resistor offers resistance from 1 ohm to 6 K depending on tolerance. Tolerances are: 0.05%, 0.1%, 0.25%, 0.5%, 1%, and 3%. Temperature coefficient is 20 ppm. Operating temperature range is from -55 to 275 C. The resistor is 0.338 x 0.071 in. in diam and is silicone coated.

Dale Products, Inc., Dept. ED, Columbus, Nebr.

CIRCLE 189 ON READER-SERVICE CARD

### Power Amplifier

For vibration testing

Model T-151 power amplifier, designed for vibration testing, is rated at 3 kw. At full output this unit's distortion is less than 5% and its noise and hum level is at least 40 db below signal level. Frequency range in cps for models C10 and C20 is 5 to 3000; for models C25H and C25HB, 5 to 2000. Vector force in lb for model C10 is 1200; for C20, 1300; and for C25H and C25HB, 2200.

MB Electronics, Dept. ED, New Haven, Conn.

CIRCLE 190 ON READER-SERVICE CARD

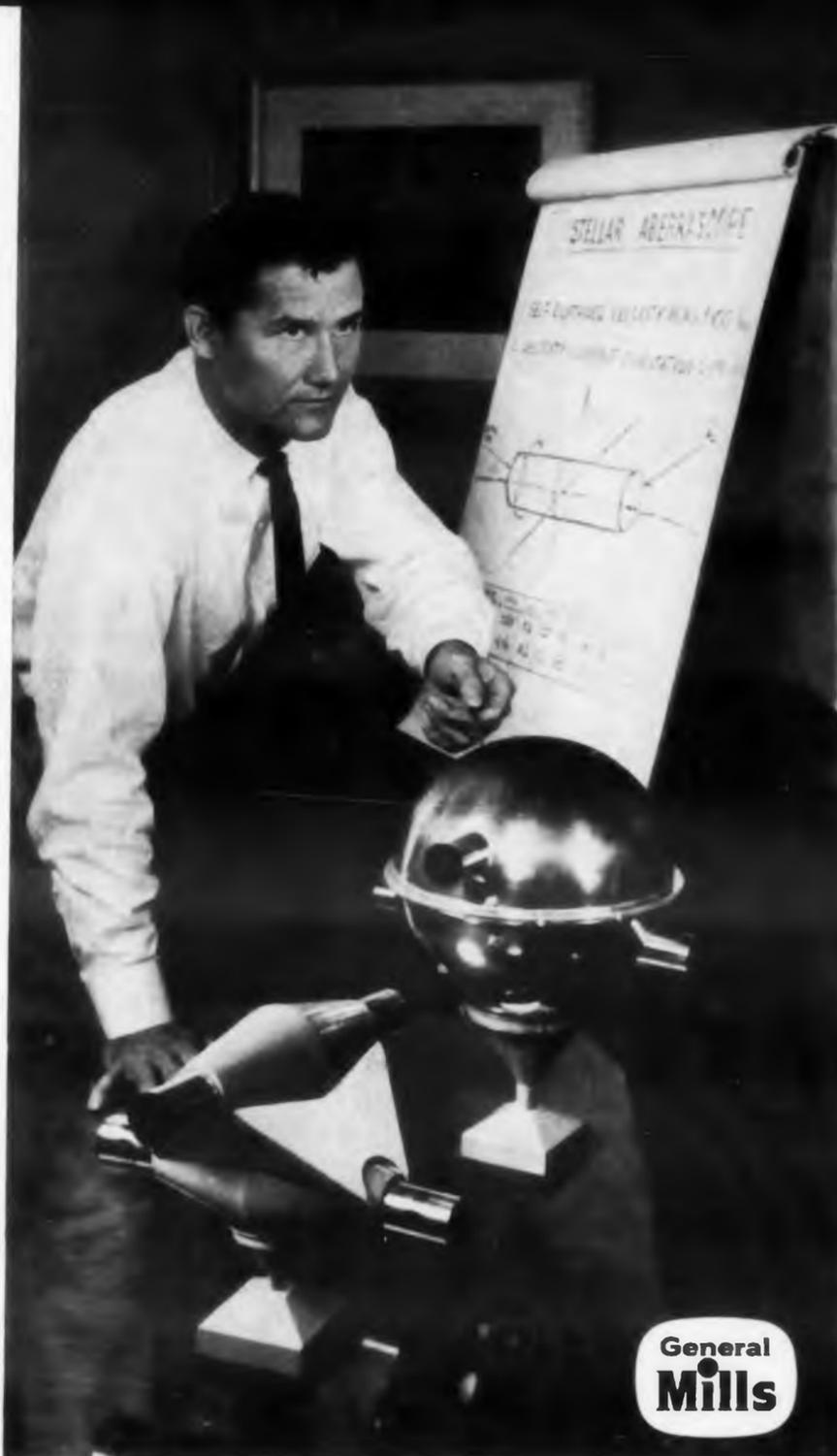
### Electronic Micrometer

Reads to  $10 \times 10^{-6}$  in.

Model PDR automatic electronic micrometer gives direct measurements to 10 millionths of an inch. Two types of micrometer tips are provided, one for conducting parts at zero pressure, and one for non-conducting materials at hold-down pressures of 1.5, 5, 10 and 20 grams. The unit has a built-in fan and ventilating system. Work capacity is 3 in., throat depth is 3 in., weight is 60 lb.

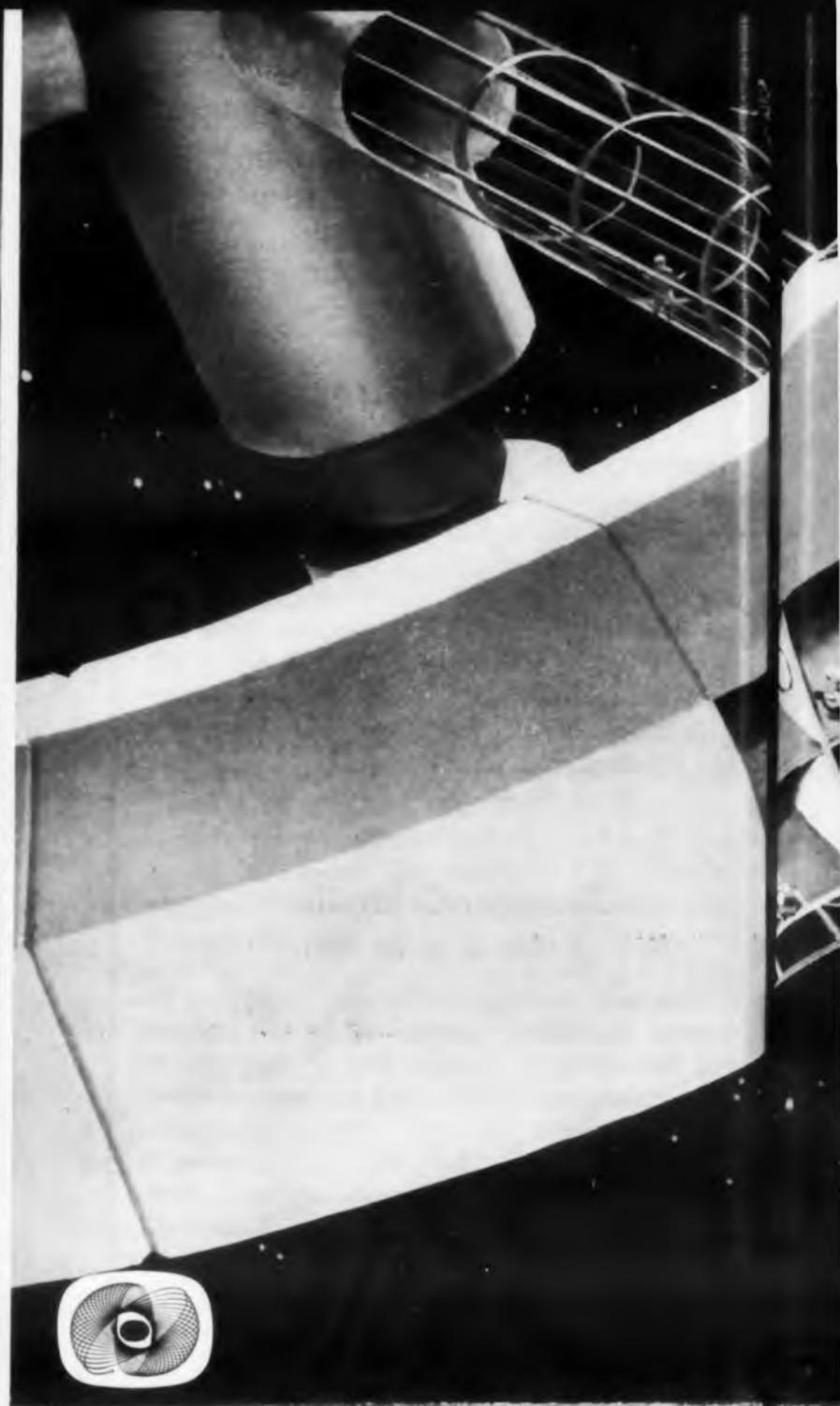
J. W. Dice Co., Dept. ED, Englewood, N.J.

CIRCLE 191 ON READER-SERVICE CARD



General  
Mills

This is our R. L. Lillestrand, Project Engineer. Here he examines a model of his Stellar Aberrascop, a multiple star tracking device which is expected to provide the measurement of space vehicle velocities to accuracies of the order of



100 feet per second. The Aberrascop is designed so that precise alignment of the star trackers is not necessary. His investigations could have a bearing on self-contained guidance systems used in future space vehicles.

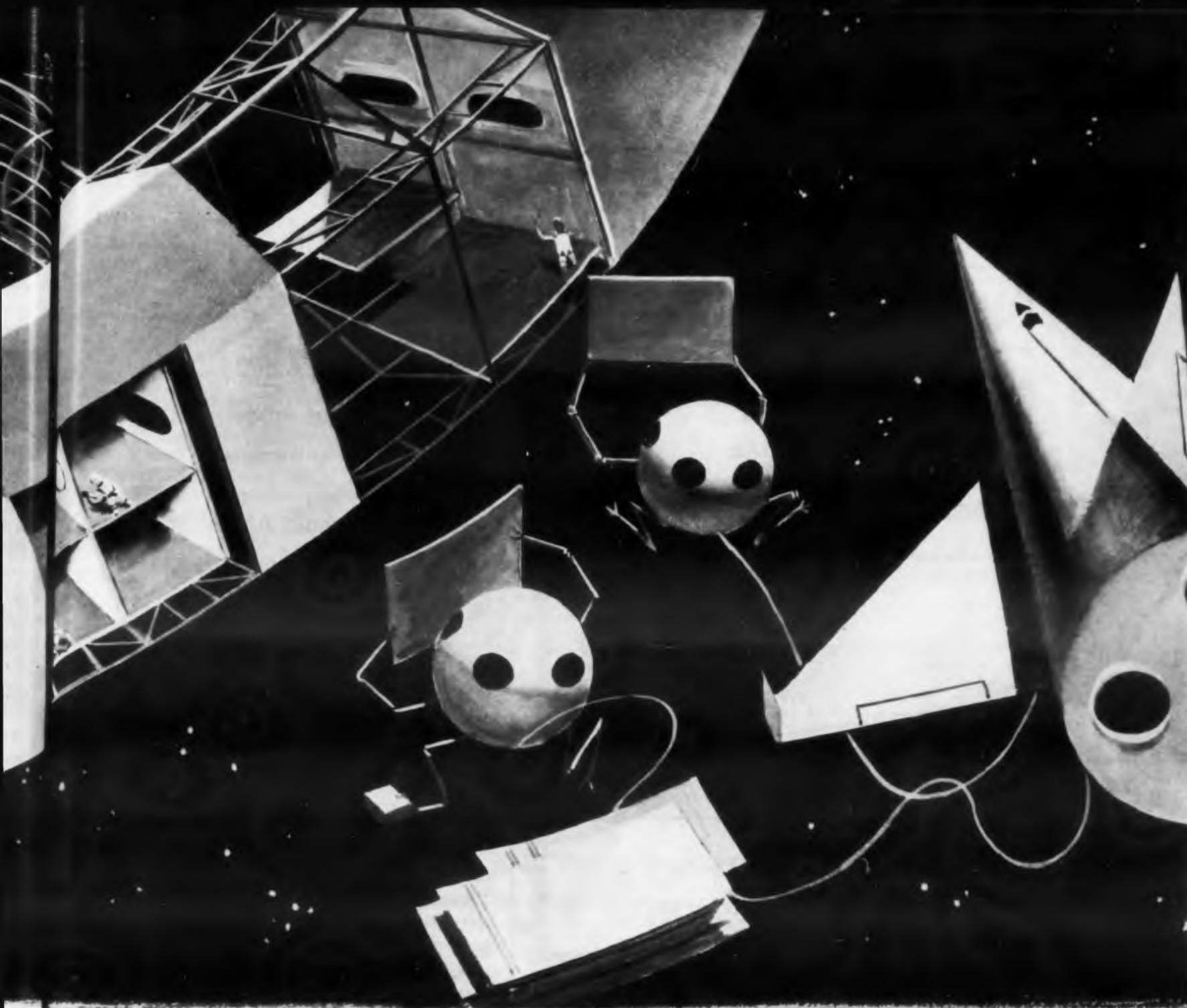
## General Mills is working today to help

Development of a space vehicle guidance system which may one day be a factor in sending manned U.S. space stations into orbit around the earth is just one problem being attacked at the Mechanical Division of General Mills. In research, engineering and manufacturing, we are finding solutions to many problems that have application in the space age.

Our research activities cover broad areas in physics, chemistry, mechanics, electronics

and mathematics. Some of the studies representative of these activities are: ions in vacuum, deuterium sputtering, dust erosion, magnetic materials, stress measurements, surface friction and phenomena, trajectory data and infrared surveillance.

In our engineering department, current projects include: airborne early warning systems, micro wave radar test equipment, antennas and pedestals, infrared and optics, inertial



assembling a space station . . . illustration from a book written for General Mills by Willy Ley.

## elude vehicles in outer space tomorrow

guidance and navigation, digital computers.

Our entire manufacturing department is geared to produce systems, sub-systems and assemblies to the most stringent military requirements. Our people have a wealth of

experience in complex military projects.

We will be happy to discuss with you the many ways in which our research, engineering and manufacturing capabilities can serve you. Write for more information.

### MECHANICAL DIVISION

1620 Central Avenue, Minneapolis 13, Minnesota

*To wider worlds—through Intensive Research • Creative Engineering • Precision Manufacturing*



### Swinging Head Counter

Rated at 9000 cpm

This direct read-out swinging head counter continuously prints digital data ranging from plus to zero to minus numbers. Rated at 9000 counts per min, it uses two sets of four-digit print wheels, both the positive and negative sets printing out digits ranging from 1 to 9999.

American Electronics, Inc., American Data Div., Dept. ED, 75 Front St., Brooklyn 1, N.Y.

CIRCLE 192 ON READER-SERVICE CARD

### Self-Indicating Thyratrons

Three types available

Two cold cathode and one hot-filamentary self-indicating thyratrons are available. Cold cathode types 7400 and 7401 require no heater power and may be viewed end-on. A pulse voltage is superimposed on a dc bias to trigger the tubes. Type 7323 filamentary-type indicator requires 1/3 w filament power and -4.5 v dc grid bias. Trigger signals can be applied directly at ground reference level. The gas discharge glow can be viewed end-on or from any side.

Tung-Sol Electric, Inc., Dept. ED, 95 Eighth Ave., Newark 4, N.J.

CIRCLE 193 ON READER-SERVICE CARD

### Power Oscillator

Supplies 320 va

Model 150-2 power oscillator supplies 320 va of power at 400 cps  $\pm 0.25\%$ . Other frequencies are available. Output voltage is continuously variable from 0 to 120 v. Displacement is  $90 \pm 1$  deg. This model has less than 1% distortion and better than 1% regulation from no load to full load. A standard rack cabinet 20 in. high houses the complete instrument. Three-phase units are also available.

Industrial Test Equipment Co., Dept. ED, 55 E. 11th St., New York, N.Y.

CIRCLE 194 ON READER-SERVICE CARD

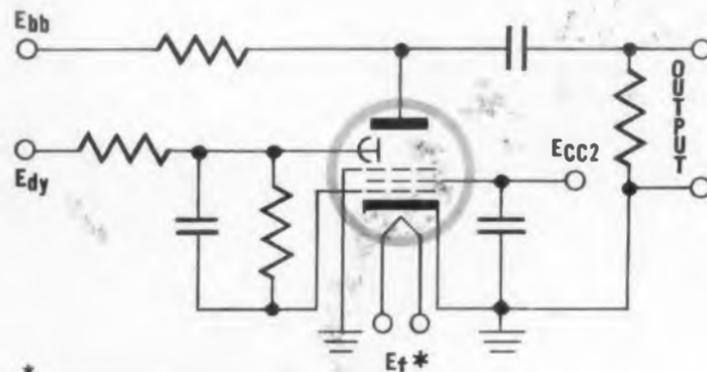
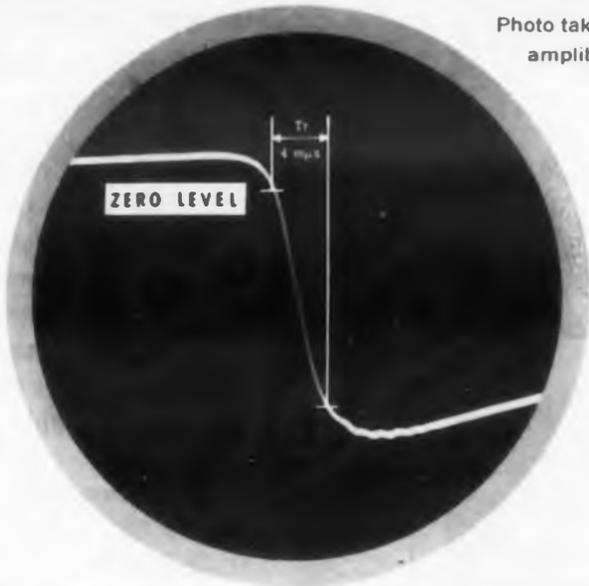
CIRCLE 195 ON READER SERVICE CARD



# Practical secondary-emission pulse tube with...

**ULTRA-FAST RISE TIME  
HIGH PULSE CURRENT  
AND DEPENDABLE LIFE**

Photo taken with direct coupling to CRT ( $T_r$  1.5  $\mu$ s):  
amplitude 1 amp., rep. rate 100kc.



\* REGULATED TO  $\pm 1.0\%$

High-Performance Pulse Generator with Fast Rise Time

### CHECK THESE CBS 7548 CHARACTERISTICS

Pulse output current	1 amp max
Rise time	4 $\mu$ s (N.S.)
Transconductance ( $I_b = 18$ ma)	25,000 $\mu$ mhos

### Maximum Ratings for Pulse Service

Plate voltage	1000 vdc
Dynode voltage	300 vdc
Screen voltage	200 vdc
Plate dissipation	4 w
Dynode dissipation	3 w
Screen dissipation	1.4 w

*More  
Reliable Products  
through Advanced Engineering*



**CBS ELECTRONICS**, Danvers, Massachusetts  
A Division of Columbia Broadcasting System, Inc.

CIRCLE 196 ON READER-SERVICE CARD

## NEW PRODUCTS

### Solenoid

Operates at 1000 F

This solenoid operates continuously at ambient temperatures up to 1000 F. It is designed for strokes of from 0.010 to 0.060 in. At 0.010 in. stroke and 1000 F, the unit will produce a minimum force of 15 lb. It requires a power source of 18 to 30 v dc. Coil resistance is 35 ohms at 1000 F; its diameter is 1-7/8 in. and it weighs 1.3 lb.

Rocker Solenoid Co., Dept. ED, 140 N. Marine Ave., Wilmington, Calif.

CIRCLE 197 ON READER-SERVICE CARD

### Electronic Ammeter

Has 24 ranges



Model 120 electronic ammeter measures current from 1  $\mu$ a through 300 ma full scale in 24 ranges. Its applications include measurement of leakage currents, vacuum tube grid currents, and semiconductor characteristics. Accuracy is  $\pm 1\%$  from 1  $\mu$ a through 300 ma and  $\pm 2\%$  from 1  $\mu$ a through 300  $\mu$ a. Battery life is 1500 hr. The unit measures 13 x 7-1/2 x 8-3/4 in. and its operating weight with batteries is 17 lb.

Belleville-Hexam Corp., Dept. ED, Los Gatos, Calif.

CIRCLE 198 ON READER-SERVICE CARD

### Stretch Cables

Come with one or two conductors

Neoprene compliance cables models SWR-1 and SWR-2 have one and two conductors, respectively. They feature an extension and return of over 200%; 1 lb of stress produces a stretch of 50%, 2 lb of stress produces a stretch of 90%. Type SWR-2 has a resistance of 0.15 ohms per extended foot. The circuit resistance does not change with a change of the length of the cable. It has a capacitance of 24  $\mu$ f per relaxed foot and an inductance of 0.26  $\mu$ h. Individual conductors are insulated to withstand 1000 v.

Stretch Wire Corp., Dept. ED, P.O. Box 893, New Rochelle, N.Y.

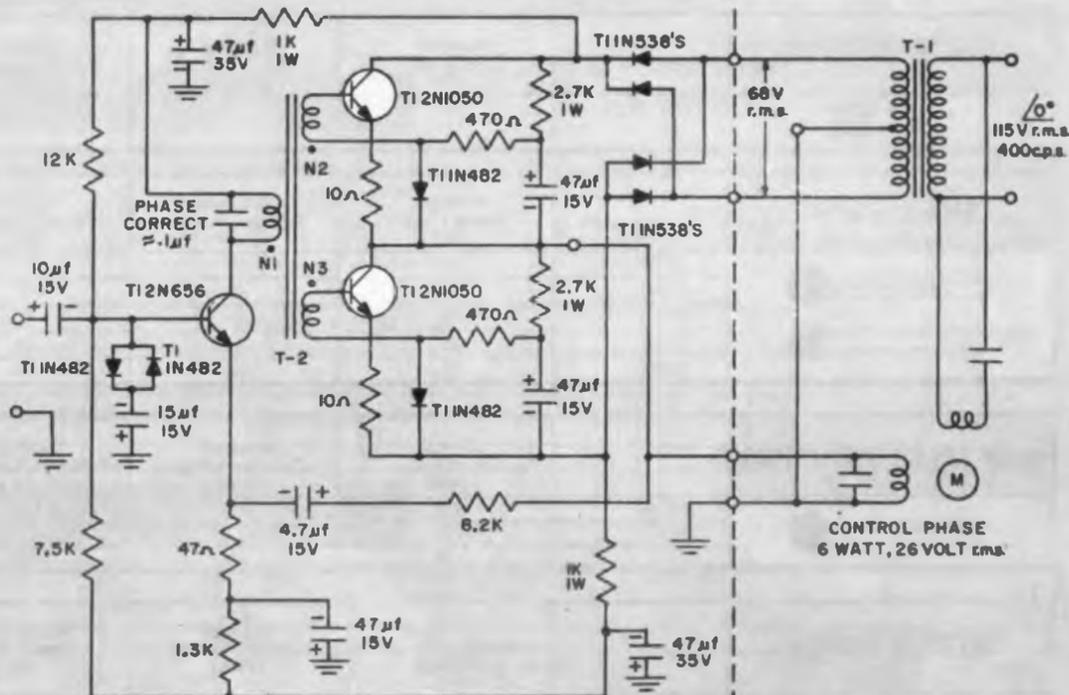
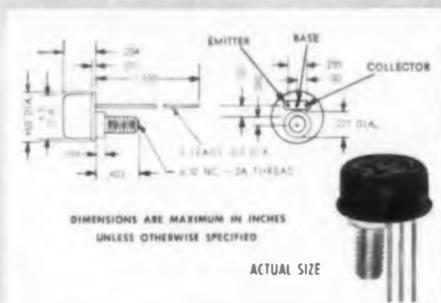
CIRCLE 199 ON READER-SERVICE CARD

# How to get 55% over-all efficiency in transistorized 6-watt servo amplifier

## HIGH-EFFICIENCY SERVO CIRCUIT REQUIRES . . .

- no output transformer
- no center-tap motor winding

Higher over-all efficiency than in a conventional Class-B push-pull amplifier is achieved in this servo by use of unfiltered rectified a-c for current supply voltage—with resulting reduction in size, weight and power supply requirements. This higher efficiency means greater transistor reliability, smaller heat sink and/or higher allowable ambient temperatures. Output will remain sinusoidal when amplifier is overdriven.



**TRANSFORMERS**  
 T-1 400 cps, 12-watt power transformer step-down 115 volt to 68 volt c.t.  
 T-2 400 cps, 65-mw driver transformer. Turns ratio N1: N2: N3=2: 1: 1  
 Primary Current = 10 ma d-c. Primary Inductance = 1.5 hy.

## ...with TI 2N1050 N-P-N silicon transistors!

Exclusive TI 2N1047 intermediate-power series now gives you maximum design flexibility plus high efficiency . . . all in a miniature package!

Consider the design flexibility made possible by the exclusive features of this series . . . 40 watts dissipation at 25°C case temperature . . . unique stud mounting for maximum thermal efficiency . . . 80- and 120-volt

$BV_{CEX}$  . . . 15-ohm  $R_{CS}$  . . . -65°C to +200°C operating and storage range . . . choice of beta spreads.

Apply TI's guaranteed specs to your design situations today. This use-proved series is available off-the-shelf — at factory prices — in 1-999 quantities from your nearby authorized TI distributor, and in production quantities from your TI sales office.



Write on your company letter-head for illustrated TI APPLICATION NOTES on the transistorized servo amplifier.

PARAMETER	TEST CONDITIONS	2N1047	2N1048	2N1049	2N1050	unit
		min. max.	min. max.	min. max.	min. max.	
$BV_{CEX}$ Breakdown Voltage	$I_C = 250 \mu a$ $V_{BE} = -1.5V$	80	120	80	120	v
$BV_{EBO}$ Breakdown Voltage	$I_E = 250 \mu a$ $I_C = 0$	10	10	10	10	v
$I_{CBO}$ Collector Cutoff Current	$V_{CB} = 30V$ $I_E = 0$	15	15	15	15	$\mu a$
$h_{FE}$ Current Transfer Ratio †	$V_{CE} = 10V$ $I_C = 200ma$	12 36	12 36	30 90	30 90	—
$h_{IE}$ Input Impedance †	$V_{CE} = 10V$ $I_B = 8ma$	500	500	500	500	ohm
$R_{CS}$ Saturation Resistance †	$I_C = 200 ma$ $I_B = 40ma$	15	15	15	15	ohm
$V_{BE}$ Base Voltage †	$V_{CE} = 15V$ $I_C = 500ma$	10	10	10	10	v

†Semiautomatic testing is facilitated by using pulse techniques to measure these parameters. A 300-microsecond pulse (approximately 2% duty cycle) is utilized. Thus, the unit can be tested under maximum current conditions without a significant increase in junction temperature, even though no heat sink is used. The parameter values obtained in this manner are particularly pertinent for switching circuit design and, in general, indicate the true capabilities of the device.

germanium and silicon transistors  
 silicon diodes and rectifiers  
 tan-Ti-cap solid tantalum capacitors  
 precision carbon film resistors  
 sensistor silicon resistors

TEXAS



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

CIRCLE 202 ON READER-SERVICE CARD



**TEXAS INSTRUMENTS**  
**SEMICONDUCTORS**  
 From  
**NEWARK**  
**ELECTRIC CO.**

Your Authorized  
 TI Distributor

TI semiconductors are USE-PROVED by thousands of customers and GUARANTEED for one full year! Now available at Factory Prices in 1-999 quantities:  
 Silicon transistors, germanium transistors, silicon diodes and rectifiers and carbon film resistors.  
 sensistor silicon resistors: 1-499  
 tan-Ti-cap tantalum capacitors: 1-99

**FREE**  
 Newark Electric's all-new,  
 1959 INDUSTRIAL ELECTRONICS CATALOG #69

Order now for your copy of this 388-page reference to the newest electronic devices, including Texas Instruments complete line of semiconductors and components.

**NEWARK**  
 ELECTRIC COMPANY  
 233 W. Madison Street • State 3-2944  
 Chicago 6, Illinois

CIRCLE 203 ON READER-SERVICE CARD

## NEW PRODUCTS

### Servo Motors

#### Gearhead and non-gearhead models

Size R-24 stock motor program includes gearhead and non-gearhead models in the RBC 2407 series with gear reductions of 5:1, 10:1, 30:1, and 60:1. Control windings are center-tapped for convenient use in push-pull circuits and have standard impedances of 5400 or 2700 ohms (locked rotor) and 7400 ohms (no load). Rated loads are 1.1, 2.5, 5.0, 15, and 30 oz-in., at corresponding speeds of 1300, 270, 135, 44, and 22 rpm.

National Pneumatic Co. Inc., and Holtzer-Cabot Div., Dept. ED, 125 Amory St., Boston, Mass.

CIRCLE 204 ON READER-SERVICE CARD

### Acceleration Switch

#### Has spdt, normally open contacts

Acceleration switch AS-13 has spdt, normally open contacts. It weighs less than 4 oz and can be furnished with a built-in relay to provide more complex switching contacts. Operation is based on high resolution flexure pivots, resulting in high accuracy.

Humphrey, Inc., Dept. ED, 2805 Canon St., San Diego, Calif.

CIRCLE 205 ON READER-SERVICE CARD

### Tubeaxial Fan

#### For electronic equipment

Tubeaxial fan No. 89B222 may be used for ventilating cubicles, racks, and cabinets housing electronic equipment. This air unit is powered by a 1/70 hp shaded pole electric motor operating on 115 v, single-phase, 60 or 50 cps. It will deliver 450 cfm of air at 0 SP and 100 cfm of air at approximately 0.22 in. water gage SP. The unit weighs 8 lb and may be installed in a 9 in. circular opening with 11-1/2 x 11-1/2 in. mounting plate.

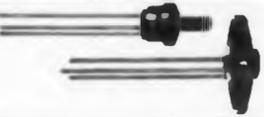
American-Standard, Industrial Div., Dept. ED, Detroit 32, Mich.

CIRCLE 206 ON READER-SERVICE CARD

Transitron offers ...

# INDUSTRY'S MOST COMPLETE LINE

## SILICON TRANSISTORS

JAN TRANSISTOR	Minimum Current Gain (B)	Maximum Collector Voltage (Volts)	Typical Cut-off Frequency (MC)	Maximum $I_{CO}$ @ 25°C and $V_C$ Max. ( $\mu A$ )	FEATURES	
 JAN-2N118	10	30	10	1	• Only Jan Silicon Transistor	
SMALL SIGNAL	Minimum Current Gain (B)	Maximum Collector Voltage (Volts)	Typical Cut-off Frequency (MC)	Maximum $I_{CO}$ @ 25°C and $V_C$ Max. ( $\mu A$ )	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	
 2N1139	150	15	60	500	• High Frequency Operation • Low Saturation Resistance • Low $I_{CO}$	
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 (B)	Typical Rise Time ( $\mu sec$ )	Typical Fall Time ( $\mu sec$ )	FEATURES
 2N545	5	60	15	.3	.5	• Fast Switching • High $V_C$ • Rugged Construction
2N547	5	60	20			
2N498	4	100	12			
2N551	5	60	20			
2N1140	3	40	20	.2	.1	
HIGH POWER	Maximum Power Dissipation @ 25°C Case (Watts)	Minimum DC Current Gain (B)	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		

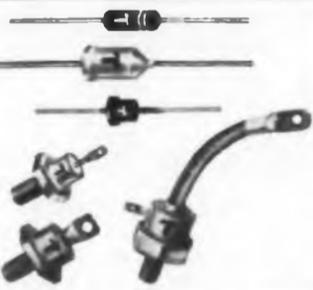
Write for Bulletins: TE-1353 and TE-1355

## SILICON DIODES

FEATURES	Fast Switching and High Frequency Types Ratings @ 25°C			Military and High Conductance Types Ratings @ 150°C				
	Max. Inverse Voltage (Volts)	Max. Average Fwd. Current (ma)	Inverse Recovery Time ( $\mu sec$ )	Max. Inverse Voltage (Volts)	Max. Average Fwd. Current (ma)	Max. Inverse Current ( $\mu A$ ) @ V		
<ul style="list-style-type: none"> <li>• Recovery Times Under 15 <math>\mu sec</math></li> <li>• High Conductance Combined With Fast Switching</li> <li>• Subminiature Size</li> <li>• High Inverse Resistance</li> </ul>	1N808	100	100	.3	JAN 1N457	60	25	5 @ 60
	1N809	200	100	.3	JAN 1N458	125	25	5 @ 125
	1N658	120	200	.3	JAN 1N459	175	25	5 @ 175
	1N659	55	100	.3	1N485B	180	50	5 @ 175
	1N643	110	100	.3	1N488A	380	50	25 @ 380
	JAN 1N251	30	75	.15	1N464	175	40	30 @ 125

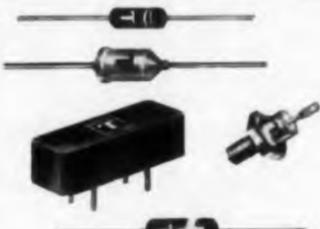
Write for Bulletin TE-1350

## SILICON RECTIFIERS

Ratings @ 150°C Case Temperature		Peak Recurrent Inverse Voltage (Volts)	Maximum Average Forward Current (ma)	Maximum Inverse Current (ma)	FEATURES	
	Subminiature Glass	1N689 1N649	600 600	150 150	0.2 0.2 (@ 25°C)	<ul style="list-style-type: none"> <li>• Reliability at High Temperatures</li> <li>• High Efficiency</li> <li>• Rugged Construction</li> <li>• Hermetic Sealing</li> <li>• Low Thermal Resistance</li> </ul>
	Miniature	TJ60A TJ30A	600 300	200 200	0.5 0.5	
	Axial Leads	SL715 1N547	1500 600	100 250	0.2 0.3	
	Military	JAN 1N256	570	200	0.25 (@ 135°C)	
	Stud Mounted	TM155 TM67	1500 600	400 3000	0.5 0.5	
	Medium Power	TR402 TR601	400 600	Amps 20 10	5 5	
	High Power	TH402B	400	50	15	

Write for Bulletin TE-1351

## SILICON REGULATORS AND REFERENCES

		Voltage Range (Volts)	Maximum Dynamic Resistance (ohms)	Maximum Current @ 25°C (ma)	Maximum Current @ 125°C (ma)	FEATURES
	Subminiature — SV-5	4.3-5.4	55	50	10	
Miniature — SV-815	13.5-18	120	40	8		
Power — SV-924	20-27	8	55°C (amps)*	(ma)*		
Stabistor — SG-22	.64	40	.4	100		
Reference — SV-3176	8-8.8	15	Temp. Coefficient ±.001%/°C			
Ref-Amp — 3N44	8.3-9.8		±.002%/°C			

\*Case temperature ratings

Write for Bulletin TE-1352

## SILICON CAPACITORS

	Ultra High Frequency Types — Ratings @ 25°C						FEATURES
	Cut-off Freq. (mc)	Capacity (μf) @ V Max.	Q @ -0.1V	Q @ 50Mc	Q @ -4V @ 100Mc	Maximum Working Voltage	
SCH-51	5000	.35	2	100	50	10	<ul style="list-style-type: none"> <li>• Subminiature Size</li> <li>• High Q</li> <li>• High Temperature Operation</li> </ul>
SCH-52	5000	.8	4	100	50	7	
	High Frequency Types						
				Q @ 5mc	Q @ -4V @ 50mc		
SC-1		4.4	24	350	35	22	
SC-5		25	120	350	35	11	
SC-15		120	360	350	35	6	

Write for Bulletin PB-45

## GERMANIUM DIODES

Specifications and Ratings at 25°C		Forward Current @ +1V (ma)	Inverse Current at Specified Voltage (μa @ V)	Max. Oper. Voltage (volts)	Description
	JAN-1N270	200	100 @ -50	80	JAN TYPES
	JAN-1N277	100	250 @ -50 @ 75°C 75 @ -10	100	
	JAN-1N281	40	500 @ -50 30 @ -50	60	
	JAN-1N126	5	500 @ -50 30 @ -10	60	
	JAN-1N198	5	250 @ -50 @ 75°C 75 @ -10	50	
	1N283	200	20 @ -10	20	
<b>FEATURES</b> <ul style="list-style-type: none"> <li>• Milli Microsecond Switching</li> <li>• Superior Forward Conductance</li> <li>• High Inverse Resistance</li> <li>• Uniformity and Stability</li> <li>• Gold Bonded Construction</li> </ul>	T16G	40	100 @ -50	60	COMPUTER TYPES
	1N278	20	125 @ -50 @ 75°C	50	HI-TEMPERATURE TYPES
	T22G	40	20 @ -10 @ 75°C	15	HI-RESISTANCE TYPES
	T9G	100	20 @ -50 2 @ -10	60	
	1N67A	5	50 @ -50 5 @ -5	80	
	T8G	100	20 @ -100 5 @ -10	100	
	S570G	10	30 @ 6	Recovery Time .002 (μsec)	MILLI-MICROSECOND SWITCHING

Write for Bulletin TE-1300 & TE-1319

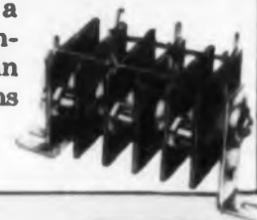
## GERMANIUM COMPUTER TRANSISTORS

		Minimum Current Gain (β)	Maximum Collector Voltage (volts)	Typical Cutoff Freq. (MC)	FEATURES
2N427	40	15	8	<ul style="list-style-type: none"> <li>• High Frequency Switching</li> <li>• Low Saturation Resistance</li> <li>• Uniform Input Characteristics</li> </ul>	
2N428	60	12	13		

Your local authorized TRANSITRON DISTRIBUTOR now carries in-stock inventories for immediate delivery.

Transitron's TD series of rectifier stacks offer a wide range of ratings in seven standard circuit configurations. High voltage cartridges, quads, plug-in assemblies, and many other special encapsulations are also available. Your inquiries are invited.

Write for Bulletin TE-1342.



# Transitron

electronic corporation • wakefield, massachusetts



## Waveguide Switch

Weights 6.5 oz

The Delta microminiature waveguide switch weighs 6.5 oz and is used in the 12.4 to 18 kmc range. It has a maximum vswr of 2.1 during the switching cycle and 1.2 max in either position over the entire frequency range. This switch, model W-6KS, is remotely controlled and has a switching time of 0.007 sec and isolation of 40 db min. It is available in 26 v dc and 115 v ac, 400 cps types.

Don-Lan Electronics Inc., Dept. ED, 1101 Olympic Blvd., Santa Monica, Calif.

CIRCLE 207 ON READER-SERVICE CARD

## Inertia-damped Servomotor

Size 18

Model 18 M 460 inertia-damped servomotor measures 2.525 in. in length and provides an upper corner frequency of 27 cps. This unit operates from a 115 v, 400 cps source to deliver 2.35 oz.-in. of torque at stall.

Beckman Instruments, Helipot Div., Dept. ED, 2500 Fullerton Road, Fullerton, Calif.

CIRCLE 208 ON READER-SERVICE CARD

## Printed Circuit Switch

Has 0.031 in. diam terminals

These miniature precision rotary switches with 0.031 in. diam terminals can be mounted quickly in printed circuit boards up to 1/16 in. thick. These switches measure 1-3/4 in. sq and have a 1 in. back-of-panel depth including 1/16 in. printed circuit board. Available in both shorting and non-shorting types with 1 to 4 poles per deck and up to 32 positions per deck, the switches may be ganged up to 10 decks. Only the last deck is furnished with printed circuit terminations.

Shallcross Mfg. Co., Dept. ED, Selma, N.C.

CIRCLE 209 ON READER-SERVICE CARD

◀ CIRCLE 278 ON READER-SERVICE CARD



## ...and now for the sealing test!

If the pots you need *must* function in a dust or sand environment, you could build 'em yourself to make sure they stay clean! But before you move heaven and earth while testing your creation, exactly what have you planned, to give you a tight seal, yet low torque? And if that isn't enough of a problem, how do you keep foreign matter out of the bearings?

But why move heaven and earth, mostly earth, to test your own dirt-free pot, when Ace has the pots with the dust-free features? Special O-rings seal sand, dust and other foreign matter eliminating abrasion damage. Our wound nylon packing delivers excellent sealing with lowest torque. Also, a special silicone-type grease, located in shaft pockets, captures foreign particles before they ever get a chance to do any damage. So if grit's a problem for you, come to Ace for the answer. See your ACErep!



This 3" AIA Acepot (shown 1/3-scale), meeting all MIL spec's on sealing, incorporates these exclusive anti-dirt and dirt-trapping features. Mandrels are also fungicide-varnished, to insure long life.

**ACE** ELECTRONICS ASSOCIATES, INC.  
99 Dover Street, Somerville 44, Mass.  
SOMersat 6-5130 TMX SMVL 181 West. Union WUX

Acepot® Acetrim® Acoset® Aceohm® \*Reg. Appl. for  
CIRCLE 210 ON READER-SERVICE CARD

## NEW PRODUCTS

### Backward Wave Oscillators

Have frequency ranges from 1 to 18 kmc

These wide-band voltage-tuned backward wave oscillators are available in nine frequency ranges, covering 1 to 18 kmc. They require a magnetic field of 800 to 1000 gauss, and are encapsulated in 1 x 14 in. anodized aluminum tubes. A grid voltage of -15 v is sufficient to stop oscillation over the entire band. Maximum helix potential is 2500 v. These units weigh 15 oz and have a minimum power output of 10 mw.

Stewart Engineering Co., Dept. ED, Soquel, Calif.

CIRCLE 211 ON READER-SERVICE CARD



### Potentiometer

Taps set to  $\pm 0.1$  deg  
every 5 deg

This potentiometer features taps set to  $\pm 0.1$  deg as close as every 5 deg over winding. The unit can be supplied in diameters as small as 1 in. with up to 50 K resistance. Servo or special mountings with or without ball bearings can be made. Ambient operating temperature range is -50 to  $\pm 100$  C. The unit meets salt spray, humidity, vibration, and shock requirements of Mil specs and NAS-710.

Precision Line Inc., Dept. ED, 63 Main St., Maynard, Mass.

CIRCLE 212 ON READER-SERVICE CARD

### Impedance Tester

Frequency range is 30 to 20,000 cps

This impedance tester and phase extrapolator accurately measures impedance, inductance, capacitance, phase shift, trigonometric functions of phase shift, dissipation factor, storage factor, power factor, core loss, and incremental inductance. Accuracy of 1% is obtained over the frequency range of 30 to 20,000 cps. The impedance range is from 1 to 99,999 ohms, with provisions for extension.

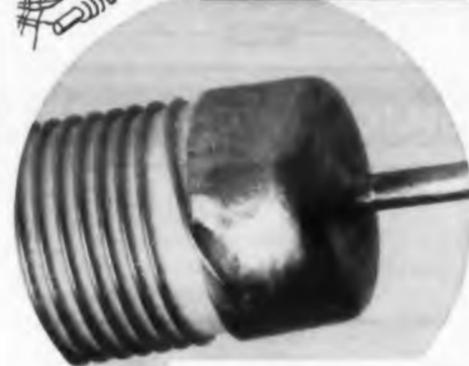
Western Electronic Products Co., Dept. ED, 655 Colman St., Altadena, Calif.

CIRCLE 213 ON READER-SERVICE CARD

## AN INSIDE LOOK AT



**SAGE**



Unretouched photograph of SAGE Resistor (Magnified 6 times)

Take a SAGE Precision Resistor apart and you'll discover how a new brazing technique enhances SAGE's reputation for trouble-free performance.

Close inspection shows that resistance wire is literally "floated" into silver-braze connections at the time of winding, thus eliminating possibility of weakening deformities or variable contacts. This in-process procedure is but one of many which support SAGE's claim—"QUALITY BUILT-IN FIRST... TO LAST"!

\*For the present, applicable to  $\pm 1\%$  and closer tolerances only.

If you are looking for the operating dependability your product needs, you'll find the answer with SAGE PRECISION POWER RESISTORS.



TYPE "S"—Axial Lead Units (2-10 Watts) (.1 to 175,000 ohms) to MIL-R-26C (Insulated) Specifications—Char. G.

TYPE "M"—Metal Clad (Chassis-Mounted) Units (10-25-50 Watts) (.1 to 175,000 ohms) to MIL-R-18546B (Ships) Specifications—Char. G.

Literature, samples and prices on request.

**SAGE**  
**ELECTRONICS CORP.**  
P.O. BOX 126 • ROCHESTER 10, N. Y.

CIRCLE 214 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 2, 1959

**OSCILLOSCOPE CAMERA.**—Type C6 is adaptable to any type oscilloscope with 5 in. tube, has two interchangeable gears that provide speeds of 1/4 to 17 ips and 5 to 275 ips. Incorporates 1:1 high speed lens and viewing aperture.

Hamilton Watch Co., Hathaway Instrument Div., Dept. ED, 5800 E. Jewell Ave., Denver 22, Colo.

**CIRCLE 215 ON READER-SERVICE CARD**

**TUBULAR EYELETS.**—In OD's to 1/2 in. and any desired length with rolled, flared, or beaded ends. Made from brass, aluminum, other metals.

H & H Machine Co., Inc., Dept. ED, Noble and Jackson Sts., Norristown, Pa.

**CIRCLE 216 ON READER-SERVICE CARD**

**DRAFTING FILM.**—This highly durable Futura film is on Cronar polyester. Available with a matte finish on one or two sides, it has been prepared for perfect pencil drawings over a wide degree of lead weights.

Chart-Pak, Inc., Dept. ED, One River Rd., Leeds, Mass.

**CIRCLE 217 ON READER-SERVICE CARD**

**SCANNING PRINTER.**—Works directly from logical levels and has a keyboard for supplemental data entry. Model 1961 has 12 digit decoding and printing capacity for electronically controlled data from both decimal and binary-coded decimal sources. Applications include missile checkout systems and engineering analysis equipment.

Clary Corp., Electronics Div., Dept. ED, 408 Junipero St., San Gabriel, Calif.

**CIRCLE 218 ON READER-SERVICE CARD**

**POTTING FORMS.**—Serve as a mold to retain compounds used to pot electrical connectors against the effects of moisture, oil, fuel and fungus. Simple to use, models PF-8 to PF-23 are made in a range of sizes to fit standard connector back shells from 1/2 to 1-1/2 in. ID. The form may be left on as a permanent part of the connector, or removed.

Electronic Production & Development, Inc., Dept. ED, 205 S. Beverly Blvd., Beverly Hills, Calif.

**CIRCLE 219 ON READER-SERVICE CARD**

**POWER TRANSISTORS.**—Types 2N375 and 2N618 are germanium pnp high voltage, 3 amp units for switching and amplifier applications in the audio frequency range. They have a maximum beta spread of 2.5 to 1.

Motorola Inc., Semiconductor Products Div., Dept. ED, 5005 E. McDowell Rd., Phoenix, Ariz.

**CIRCLE 220 ON READER-SERVICE CARD**

**RETRACTING SAFETY PRODS.**—Rated at 5000 v and 1 amp, these prods are used for high voltage test positions and run-test stations. Prod extensions are spring loaded.

Slaughter Co., Dept. ED, Piqua, Ohio.

**CIRCLE 221 ON READER-SERVICE CARD**

**MILITARY PLUGS.**—Feature a one-piece tip rod and a one-piece sleeve and plug body. Twin-Plugs are independent two-conductor plugs. Type 411 has provision for internal cord clamp; type 412 has external cord anchor. Littel-Plugs have screw terminals and internal threads. Types 421 and 425 are two-conductor; type 482 is three-conductor.

Switchcraft, Inc., Dept. ED, 5555 N. Ellston Ave., Chicago 30, Ill.

**CIRCLE 222 ON READER-SERVICE CARD**



## THE COST OF SHUT-DOWNS TELLS YOU

*It pays to design around Tung-Sol/Chatham shield grid thyratrons*

Actually, you pay no premium to buy maximum uninterrupted tube performance in relay and switching circuits. All that is needed is the decision to use Tung-Sol/Chatham shield grid thyratrons.

Available in subminiature to T12 bulb sizes, Tung-Sol supplies these tubes for every application requiring current ratings up to 500 milliamperes. Minute pre-conduction current, provided by shield grid design, eliminates preamplifiers in most uses.

Many Tung-Sol/Chatham shield grid thyratrons were originally developed for military duty. They are particularly suited to industrial service where trouble-free operation of long duration is essential.

Tung-Sol will gladly help with any design problem you may have. For further information or specific data sheets, write: Tung-Sol Electric Inc., Newark 4, N. J. TWX: NK193.

TUNG-SOL/CHATHAM SHIELD GRID THYRATRONS						
Type	Size	Peak Inverse Voltage	DC Output Current	Peak Current	Filament Volts Amps	
5643	T3 Submin	500 v	16 mA	0.1 amp	6.3	0.15
5696	7 pin min	500	25	0.1	6.3	0.15
2021 2021W 5727/2021W	7 pin min	1300	100	0.5	6.3	0.6
2050 2050W	T9 Octal	1300 350	100 200	1.0 1.0	6.3	0.6
6012	T12 Octal	1300	500	5.0	6.3	2.6

CIRCLE 223 ON READER-SERVICE CARD

**TUNG-SOL**



**Be sure the  
TEFLON\*  
you buy  
has the  
Qualities  
you need**

### *Processing can radically change Teflon properties*

**Take flex life as an example.** The Teflon sheet illustrated was quenched to 50% crystallinity, resulting in an excellent flex life of 60,000 cycles. However, through lack of process control, it might have been cooled more slowly, giving a 56% crystallinity and a flex life of 40,000 cycles . . . **A LOSS OF 20,000 CYCLES OF FLEX LIFE!**

You can be sure of proper processing by specifying Teflon stocks made by Garlock's Plastics Division, the United States Gasket Company. U.S.G.'s years of experience with fluorocarbon resins guarantees you the right properties every time. This, plus assurance of fast delivery anywhere, makes Garlock your prime source of Teflon sheet, rod, tape, tubing, bars, cylinders. Find out more by calling one of Garlock Packing Company's 26 sales offices and warehouses throughout the U.S. and Canada.

THE GARLOCK PACKING COMPANY, Palmyra, N. Y.

**United  
States  
Gasket**

\*DuPont Trademark  
for TFE Fluorocarbon Resin

*Plastics Division of*  
**GARLOCK**



CIRCLE 224 ON READER-SERVICE CARD

## NEW PRODUCTS

**ANTENNA ANALYZER.**—Model B-3-58 insures perfect matching of antennas and feeder lines. It operates from 3 to 260 mc with powers up to 1 kw and does not alter characteristic impedance of the line.

Haydu Industries, Inc., Dept. ED, 1426 W. Front St., Plainfield, N.J.

CIRCLE 225 ON READER-SERVICE CARD

**JUNCTION-TERMINAL BUSHINGS.**—Snap into curved and flat surfaces. They are available in individual units or as flexibly connected groups (up to five in a group). Heyco bushings are miniature accordion type nylon insulated receptacles which mate with 3/16 and 1/4 in. disconnect terminals.

Heyman Manufacturing Co., Dept. ED, 1200 Michigan Ave., Kenilworth, N.J.

CIRCLE 226 ON READER-SERVICE CARD

**PILOT LIGHTS.**—Have push-on terminals, eliminating soldered connections. Omni-Glow lights can have high-brightness neon lamps, and are also available with lead wires or solder lugs.

Industrial Devices, Inc., Dept. ED, Edgewater, N.J.

CIRCLE 227 ON READER-SERVICE CARD

**COPPER BRIGHTENER.**—Cleans copper of oxides, carbonates and complexes by simple dip. Used for printed circuits and bus bars, Copperbrite No. 48 has an indefinite bath life.

London Chemical Co., Inc., Dept. ED, 1535 N. 31st Ave., Melrose Park, Ill.

CIRCLE 228 ON READER-SERVICE CARD

**POINTER KNOBS.**—Used on miniature rotary switches. They are available for use with 1/8 in. shafts. Part of the 50 series, these thermoplastic knobs are stocked in both mirror and non-reflective matte black finishes.

Raytheon Co., Dept. ED, Waltham 54, Mass.

CIRCLE 229 ON READER-SERVICE CARD

**DIAZO PRINTER.**—Blu-Ray whiteprinter, 14 in., makes blue or black line prints of anything drawn, typed, written or printed on any kind of translucent material. It is also available in 22 and 42 in. sizes.

Reproduction Engineering Corp., Dept. ED, 420 N. Main St., Ivoryton, Conn.

CIRCLE 230 ON READER-SERVICE CARD

**NYLON SET SCREWS.**—These inexpensive set screws are used for positive locking or adjusting applications. They are available in plain, oval, cone, flat, half-dog, and full-dog point types, in lengths from 1/4 to 13/32 in.

Richco Plastic Co., Dept. ED, 4445 W. Fullerton Ave., Chicago 39, Ill.

CIRCLE 231 ON READER-SERVICE CARD



To meet demands for perfect finish on stainless and nickel Thinstrip®, Somers installs unique new annealing furnace.



This new Selas vertical continuous annealing furnace assures uncontaminated, commercially unmarred surfaces as well as uniform temper and faster delivery on stainless, nickel and nickel alloy Thinstrip up to 25" wide. But this is only part of the story of Somers' quality. Sendzimir rolling mills, Accu-Ray gauging plus 50 years leadership in thin gauge metals (from .010 down to .000125") are a few of the features Somers offers to assist you with your Thinstrip® problems.

Write for Confidential Data blank — no cost or obligation.



Somers Brass Company, Inc.

116 BALDWIN AVE. WATERBURY, CONN.

CIRCLE 232 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 2, 1959



## Solenoids

Designed for 400 cps

These 400 cps ac solenoids, using internal rectifiers, may be used in airborne systems, avionics, computers, instruments, valves, and ground support equipment. Temperature range is  $-65$  to  $+250$  F. They are made in accordance with MIL-S-4040C and meet environmental requirements of MIL-E-5272B and MIL-E-5400.

PSP Engineering Co., Dept. ED, 6059 Walker Ave., Maywood, Calif.

CIRCLE 233 ON READER-SERVICE CARD

## Printed Circuit Terminals

Are floating type

These floating printed circuit terminals prevent lifting of conductor lines during the swaging operation, even under continued application of heat. The 7000 series uses a funnel-shaped terminal to relieve stresses produced between the base material and the circuit copper during the swaging operation.

Litton Industries, USECO Div., Dept. ED, 13536 Saticoy St., Van Nuys, Calif..

CIRCLE 234 ON READER-SERVICE CARD

## Radial Double-Stub Tuner

Covers 100 to 2000 mc range



Model S-200 radial double-stub tuner covers 100 to 2000 mc range. The rotating tuning rings of the unit give calibration references from 0 to 25 and the double-stub provides adjustment of 12.6 in., with 1.9 in. spacing. Characteristic impedance is 50 ohms. The unit weighs 2 lb and measures 3-3/8 x 4 in.

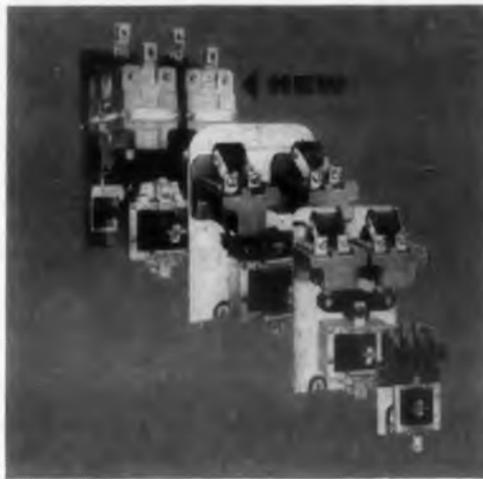
Don-Lan Electronics, Inc., Dept. ED, Santa Monica, Calif.

CIRCLE 235 ON READER-SERVICE CARD

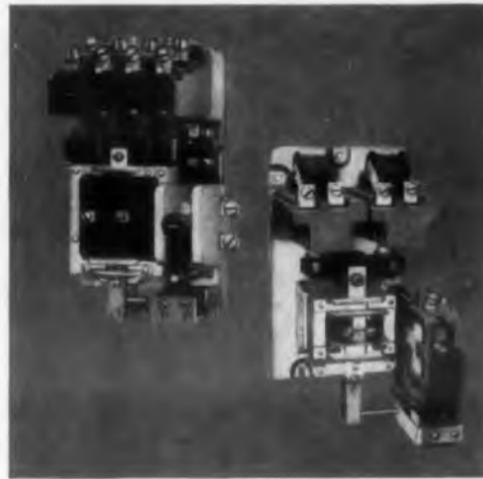
**HERE'S A  
CONTROL  
COMPONENT  
LINE YOU CAN  
STAKE YOUR  
REPUTATION ON**



AC Solenoid Contactors • NEMA sizes: 00 to 5



DC Solenoid Contactors to size 4



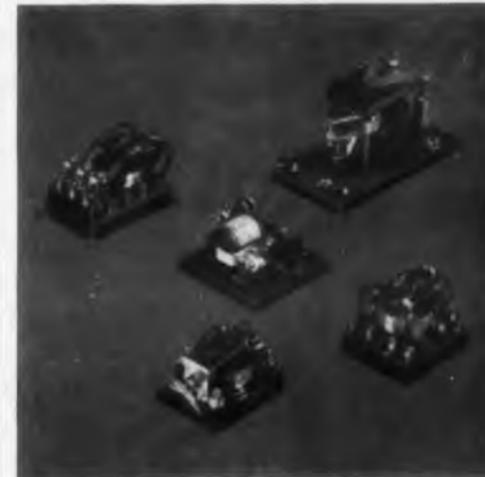
AC and DC units with DC and AC power plants, dynamic brake contacts



Auxiliaries: standard, low power



Dependable thermal O.L. relays



AC and DC power relays, too

**It's completely versatile and designed for both standard and specialized controls**

From the little Size 00's to the powerful Size 5 contactors you'll find maximum reliability built right in . . . whether your application is in motor control, resistive heating or lamp switching.

Meticulous attention to design features guarantees you top-notch performance . . . especially where hi-reliability is a "must." All AC and DC contactors for example, come equipped with simple, fast-acting, trouble-free solenoids. There are no complicated linkages or potentially troublesome pins or bearings . . . no adjustments needed either.

The main and auxiliary contacts are of the double break type designed for

maximum reliability even where high in-rush currents are met. Contacts are accessible for inspection, too!

Other key contactor design features include: identical mounting centers for AC and DC; all units designed for front-of-board wiring and mounting; magnetic blowouts furnished above 25 amp. size on DC; fully accessible terminals make installation easy.

On your next control job, standard or special, specify W/L Control Components. Send for detailed Control Catalog: Ward Leonard Electric Co., 77 South St., Mount Vernon, N. Y. (In Canada: Ward Leonard of Canada, Ltd., Toronto.)

CIRCLE 236 ON READER-SERVICE CARD

**WARD  
LEONARD**  
ELECTRIC COMPANY  
MOUNT VERNON, NEW YORK

LIVE BETTER...Electrically

Result-Engineered Controls Since 1892



**HIGH SPEED,**

# Sensitive Polarized RELAYS



**"DIAMOND H"**



**SERIES P  
Relays**

**FOR ELECTRONIC AND  
COMMUNICATIONS APPLICATIONS**

Engineered to provide extremely fast action with high sensitivity, freedom from bounce and excellent stability, "Diamond H" Series P Polarized Relays give consistent performance with low distortion. Under some conditions they will handle over 1,000 pulses per second.

Magnetically latched SPDT, with two independent coils, Series P Relays are available with various coil resistances from 10 to 4,000 ohms each coil. Contact ratings will vary with switching speeds desired, but range from 60 milliamperes to 2 amperes.

Extremely compact, to save space and weight, they fit standard octal sockets. Their impact and vibration resistance is excellent for relays of this type, thanks to extra-rugged construction.

"Diamond H" engineers are prepared to work out a variation to meet your specific requirements. Write or phone us your needs.

**THE  
HART MANUFACTURING  
COMPANY**

**210 Bartholomew Ave., Hartford, Conn.  
Phone Jackson 5-3491**

CIRCLE 237 ON READER-SERVICE CARD

## NEW PRODUCTS

**SHOCK MOUNT.**—Model W681 offers high levels of shock attenuation and withstands temperature extremes, water, dust, oil, and chemical solvents with no adverse effects. It is available in three load ranges.

Robinson Technical Products, Inc., Dept. ED, Teterboro Air Terminal, Teterboro, N.J.

CIRCLE 238 ON READER-SERVICE CARD

**MARKERS.**—Self-sticking Micro-Markers are used for identification of thin wire and small electronic components. They are 5/16 x 5/64 in. and can withstand an operating temperature of 180 F.

W. H. Brady Co., Dept. ED, 727 W. Glendale Ave., Milwaukee 9, Wis.

CIRCLE 239 ON READER-SERVICE CARD

**FLAT-PLATE BATTERIES.**—Have 8-hr capacities ranging from 840 to 1680 amp-hr. Type FWA batteries are applicable in microwave systems and have 15, 19, 23 and 29 plates.

Electric Storage Battery Co., Exide Industrial Div., Dept. ED, Rising Sun and Adams Ave., Philadelphia 20, Pa.

CIRCLE 240 ON READER-SERVICE CARD

**MOUNTING STUDS.**—Electrically isolate Endevco accelerometers. Models 2980 and 2983 are constructed of hardened stainless steel parts.

Endevco Corp., Dept. ED, 161 E. California Blvd., Pasadena, Calif.

CIRCLE 241 ON READER-SERVICE CARD

**INSTRUMENT COLLARS.**—Simplify gear train construction. They have bores of 0.187, 0.250, and 0.312 in. and are used in place of conventional split clamps to hold split hub gears.

Gap Instrument Corp., Dept. ED, 116 E. Merrick Rd., Freeport, N.Y.

CIRCLE 242 ON READER-SERVICE CARD

**TRANSPARENT CORROSION CABINET.**—Model H-T Plexiglas cabinet for salt, Corrodokote, acetic acid, and humidity tests. Maintains temperatures within  $\pm 0.5$  F, meets or exceeds A.S.T.M. and government specifications.

G. S. Equipment Co., Dept. ED, 15583 Brookpark Rd., Cleveland 35, Ohio.

CIRCLE 243 ON READER-SERVICE CARD

**EPOXY IMPREGNATING SYSTEM.**—Unfilled, low viscosity Isofil 211 compound can be used at 500 F for extended periods when properly cured. Heat distortion temperature is 370 F. Working life is two weeks.

Isochem Resins Corp., Dept. ED, 221 Oak St., Providence 9, R. I.

CIRCLE 244 ON READER-SERVICE CARD

# D-C POWER

**Precisely Regulated for  
Missile Testing and  
General Use**



**CHRISTIE  
SILICON  
POWER  
SUPPLIES**

available in 30 standardized and militarized models from 30 to 1500 amps... 6 to 135 volts. CHRISTIE'S QUALITY CONTROL is approved by the A.E.C., leading aircraft and missile manufacturers.

Write For Bulletin AC-58-A

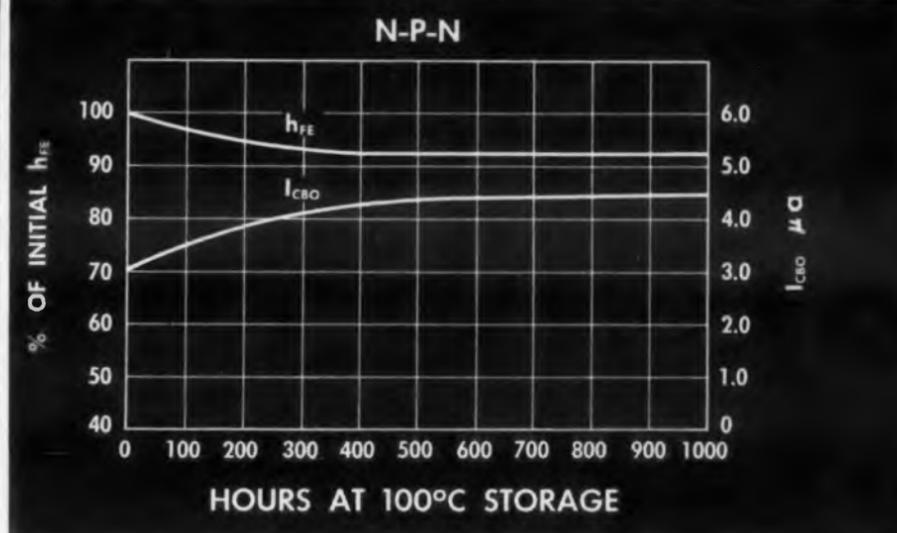
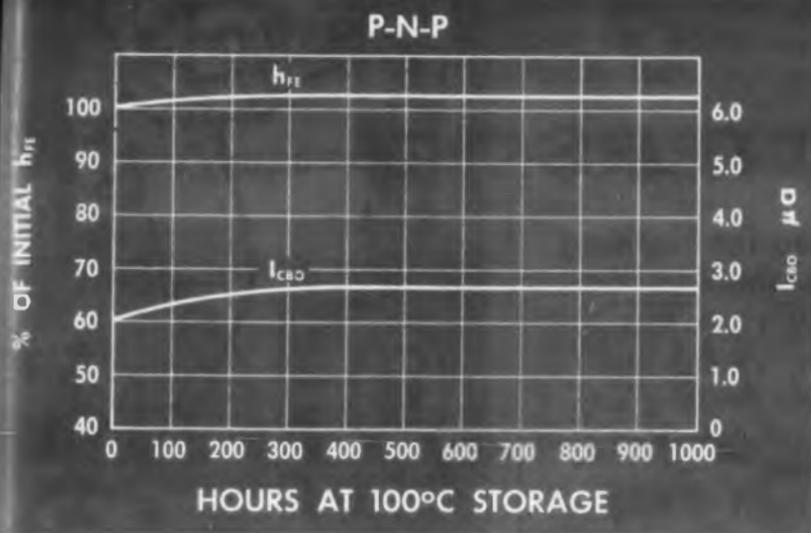
**CHRISTIE  
ELECTRIC CORP.**

3410 W. 67th Street  
Los Angeles 43, Calif.

CIRCLE 245 ON READER-SERVICE CARD

Backed by more than

# 10,000,000 LIFE TEST HOURS



## TI COMPLEMENTARY COMPUTER TRANSISTORS!



Now commercially available... and backed by more than 10,000,000 hours of recorded life test reliability data... eight types of performance-proved P-N-P and N-P-N alloy-junction germanium computer transistors! Take advantage of the high-reliability/low-cost benefits made possible by manufacturing economies already realized in 1½ years of high-volume production to the stringent

requirements of International Business Machines Corporation. Mechanized production equipment *has been built*... quality assurance controls and techniques *have been perfected*... and are in full use *now*, making these high-volume/high-reliability/low-cost units a reality *today*. Check the detailed specifications below and call your TI distributor or sales engineer for the low prices of these new computer transistors.

COMPLEMENTARY TI COMPUTER TRANSISTORS	MAXIMUM RATINGS AT 25°C							ELECTRICAL CHARACTERISTICS AT 25°C							
	Emitter-Base Voltage	Collector-Base Voltage	Collector-Emitter Voltage	I <sub>C</sub> Collector Current	I <sub>E</sub> Emitter Current	T <sub>STG</sub> Storage Temperature	P <sub>O</sub> Total Device Dissipation*	I <sub>EB0</sub> † Emitter Reverse Current	I <sub>CB0</sub> † Collector Reverse Current	h <sub>FE</sub> † Current Transfer Ratio	h <sub>FE</sub> † Current Transfer Ratio	f <sub>α0</sub> † Alpha Cutoff Frequency	C <sub>OB</sub> † Output Capacitance		
								V <sub>E</sub> = 25v, I <sub>C</sub> = 0	V <sub>C</sub> = 25v, I <sub>E</sub> = 0	I <sub>C</sub> = 10ma, V <sub>CE</sub> = 1v	I <sub>C</sub> = 200ma, V <sub>CE</sub> = 0.35v	V <sub>CE</sub> = 5v, I <sub>E</sub> = -1ma	V <sub>CE</sub> = 5v, f = 1mc		
								Min	Max	Min	Max	Min	Max	Min	Max
2N1302 N-P-N	25	25	25	300	-300	↑	↑	6	6	20	10	3	20		
2N1303 P-N-P	-25	-30	-25	-300	300	↑	↑	-6	-6	20	10	3	20		
2N1304 N-P-N	25	25	20	300	-300	↑	↑	6	6	40	200	15	20		
2N1305 P-N-P	-25	-30	-20	-300	300	-65 to 100	150	-6	-6	40	200	15	20		
2N1306 N-P-N	25	25	15	300	-300	↑	↑	6	6	60	300	20	20		
2N1307 P-N-P	-25	-30	-15	-300	300	↑	↑	-6	-6	60	300	20	20		
2N1308 N-P-N	25	25	15	300	-300	↑	↑	6	6	80	20	15	20		
2N1309 P-N-P	-25	-30	-15	-300	300	↑	↑	-6	-6	80	20	15	20		
Units	v	v	v	ma	ma	°C	mw	μa	μa			mc	μμf		

\* Derate at 2.5 mw/°C increase in ambient temperature over 25°C.

† Conditions listed apply to N-P-N. Negative values used for P-N-P.

CIRCLE 249 ON READER-SERVICE CARD

germanium and silicon transistors  
silicon diodes and rectifiers  
*tan-TI-cap* solid tantalum capacitors  
precision carbon film resistors  
*sensistor* silicon resistors

### TEXAS



### INSTRUMENTS

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

CIRCLE 279 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

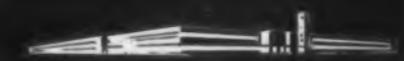
# O. E. M.

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: 1-999

## ALLIED RADIO CORP.

100 N. WESTERN AVE.  
CHICAGO 80, ILLINOIS  
HAYmarket 1-6800  
TWX: CG - 2898





The 6116/TE-39 ruggedized Reflex Klystron thermally tunes a band of 8500 to 9660 MC by means of a diode within the vacuum envelope. Tuning speed over the required frequency range is 0.7 seconds min. to 3.0 seconds max.

The 6940/TE-58 is identical to the 6116, but has special characteristics limiting spectrum width and spectrum continuity under adverse load conditions.

The 6845/TE-59 is similar in electrical and mechanical characteristics to the 6116 but may be operated under pulsed conditions with minimum frequency modulation.

## BENDIX RUGGEDIZED REFLEX KLYSTRONS WITH THERMAL TUNING

The 6116/TE-39 Klystron tube combines ruggedized construction and thermal tuning. The combination provides a desirable tube for use in airborne radar and similar applications. Ruggedization makes possible a frequency jitter of less than  $\pm 1.3$  MC . . . at vibration levels up to 10 G at 50 cps. Thermal tuning provides a twofold advantage. It permits tuning the tube over its entire operating frequency remotely without mechanical means—and the tube can be

repeatedly cycled throughout its tuning range without damage or deterioration.

These Reflex Klystrons are but one example of how Bendix Red Bank technology can help you meet specialized tube needs. For information on these tubes . . . and on backward-wave oscillators and traveling-wave tubes . . . write RED BANK DIVISION, BENDIX AVIATION CORPORATION, EATONTOWN, NEW JERSEY.

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.  
Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N.Y.  
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508, Ottawa 4, Ontario

**Red Bank** Division



CIRCLE 250 ON READER-SERVICE CARD



## LETTERS

### Down With "Something for Nothing"

Dear Sir:

Your "Open Letter to All Local Newspaper Editors" (ED, June 24, 1959) is more helpful in explaining the reasons for the declining interest in engineering careers than in stimulating such interest by students and parents.

You speak of "false appraisal of long-range engineering opportunities" by parents and others. You admit, however, that engineering offers "no higher salary" than other "easier careers" while offering prospects of much harder study and work.

You have accurately pictured engineering as a career which offers poor economic rewards not commensurate with the value of its "much needed" work. Thus, you have correctly explained the current decline in engineering enrollment. The existence of this situation together with much publicity advocating increased enrollment merely indicates that efforts are being made to get "something for nothing."

Under these circumstances parents, counsellors and experienced engineers cannot truthfully say that engineering careers offer much long-range opportunity. The financial condition of the typical capable experienced engineer today does not offer evidence of opportunity nor of the value of his work.

The "something for nothing" effort will attract those few who have no pecuniary interest in their work but they are not typical of most persons who have a normal desire for adequate financial remuneration and a sense of responsibility to their families.

If there is really an engineering shortage and you are really interested in relieving it, you should work for improved incentives, principally improved economic remuneration at all phases of the engineering career.

John R. Disston  
Alexandria, Va.

### Engineers Should Do Engineering

Dear Sir:

Your "Open Letter" in the June 24th issue is as misleading as anything I have ever seen in print in an authoritative publication such as yours! At



## No solvent residue

...with new Freon\* solvents

In degreasing of sensitive mechanical and electrical assemblies, "Freon" solvents by Du Pont evaporate completely—leave no deposit. "Freon" solvents are high-purity chemicals, and because no inhibitors are needed to keep "Freon" solvents neutral, no residue is left on parts as they dry. "Freon" solvents can be recovered and reused without adding inhibitors.

Here are four more reasons why new "Freon" solvents are extraordinarily safe for cleaning delicate parts and assemblies.

- **Low toxicity**—"Freon" solvents are odorless and much less toxic than ordinary solvents. Vapors won't cause nausea or headaches.
- **Won't burn or explode**—Underwriters' Laboratories report "Freon" solvents nonexplosive, noncombustible and nonflammable.
- **Noncorrosive**—"Freon" solvents remain neutral through repeated degreasing use without the need of inhibitors.
- **Negligible effects on plastics, elastomers, insulation and color coding**—"Freon" solvents remove oil and grease with minimum swelling of plastics or rubber and without crazing or softening paint, wire coatings or insulation.

Write for free solvents booklet. E. I. du Pont de Nemours & Co. (Inc.), "Freon" Products Division 549, Wilmington 98, Delaware.

\*Freon is Du Pont's registered trademark for its fluorinated hydrocarbon solvents.

**FREE BOOKLET!**  
No obligation—write for booklet which tells how new "Freon" solvents by Du Pont minimize cleaning hazards.



Better Things for Better Living  
... through Chemistry

CIRCLE 255 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 2, 1959

## DORSETT Telemetry Systems & Components



Custom -  
designed to  
meet your  
space & weight  
requirements

- Complete Systems • FM Transmitters
- VC Oscillators • RF Power Amplifiers
- Transistorized VCO's

Save size, weight, power, time and money . . . with a Dorsett complete telemetry package. Includes power supplies, regulators, calibrators, amplifiers, the required number of VCO's, mixer and FM transmitter. Dorsett also designs and manufactures individual telemetry components . . . like the new transistorized VCO's which are revolutionizing power, space, and weight concepts. Dorsett engineers will work closely with you on your special needs. Dorsett equipment has passed the most rigid inspections of prime contractors and military agencies. You can be sure of prompt delivery of reliable equipment. Dorsett has designed many different types of telemetry packages and can provide you with the smallest, lightest, lowest power equipment available. For example, one of Dorsett's many models provides 9 oscillators, mixer, and power supply in as little space as 2 3/4" x 3 1/4" x 5 1/4". For complete information on your specific needs call, write, or wire, Dorsett, today.

TEL. JE 4-3750

**DORSETT** Laboratories, Inc.

Box 862  
Norman, Okla.

CIRCLE 256 ON READER-SERVICE CARD

\_\_\_\_\_, an engineer spends about 20 per cent of his time working as an engineer.

The national average is not over 50 per cent. The conclusion: Engineers are frequently less well paid than skilled workers—are not utilized fully, and are actually in oversupply.

(Name withheld)

### "Diode Filtering" Clarified

Dear Sir:

I was pleased with your tight editing of my paper "Using Diodes as Power Supply Filter Elements," (*ED*, June 10). But somewhere in the submission or publication process one idea had become confused and an acknowledgment was omitted.

The diode filtering method generates less heat and consumes less power than electronic regulators. It requires less capacitance than equivalent LC filtering. I felt, in reading the article, that these two advantages had been condensed to a possibly confusing extent.

It should be noted that the reported work was done as a part of my duties in my former employment with Sprague Electric Company of North Adams, Massachusetts, and that they made this report possible.

D. T. Geiser  
General Electric Co.  
Utica, N.Y.

### Bravo for Diode Report

Dear Sir:

Regarding your diode article which appeared in the June 10, 1959 issue of *ELECTRONIC DESIGN*, it is about time someone attacked the ridiculous rat-race you describe. Bravo!

How about an equal attack on the tube numbering system? It seems that every new tube for quite some time now has had a number assigned which has little or nothing to do with the operation of the tube. As you suggest for diodes, perhaps a number designation that would denote some of the tube specifications would be worthwhile.

K. Robert Morris, Development Engineer  
Micrometrical Development Corp.  
Ann Arbor, Mich.

Dear Sir:

Although I am a little late in my reading, I am sure it is not too late to congratulate you on the fine job your staff did on Diodes in the June 10th issue. All of us here have read it with interest. Please keep up the excellent job.

Walter J. Werbos, Vice President  
The Harry P. Bridge Co.  
Philadelphia 7, Pa.

► More diode letters coming in the next issue.

## TEXAS INSTRUMENTS INCORPORATED simplified this electronic assembly



to this



by using one

**HELI-COIL® SCREW-LOCK INSERT\***

### Radar assembly made lighter • simpler • stronger

With only a minor redesign of the magnesium housing—using one *Heli-Coil* Screw-Lock Insert—Texas Instruments simplified this complex 6-piece closure assembly to a simple plug and O-ring. In this and other Texas Instruments applications involving closures, supports and assemblies with threaded fasteners, *Heli-Coil* stainless steel wire thread inserts save weight, space and manufacturing costs, permit extensive use of light-weight magnesium with strong steel threads.



*Heli-Coil* Screw-Lock Inserts, made of 18-8 stainless steel, provide an *internal lock*, are easily installed, eliminate need for lock nuts, lock wiring and . . .

- positively lock screws against loosening under impact or vibration
- prevent thread wear, stripping, corrosion, galling and seizing
- can be used in standard proportion bosses without need for redesign
- permit repeated disassembly and reassembly for inspection or service
- simplify screw assembly at inaccessible locations
- meet government specs for locking torque and vibration

\*Patented



**HELI-COIL CORPORATION**  
DANBURY, CONNECTICUT

**HELI-COIL CORPORATION, 409 Shelter Rock Lane, Danbury, Connecticut**

I'd like more information on *Heli-Coil* Screw-LOCK Inserts

NAME \_\_\_\_\_ TITLE \_\_\_\_\_

FIRM \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_ 1959

IN CANADA: W. R. WATKINS CO., Ltd., 41 Kipling Ave., S., Toronto 18, Ont.

CIRCLE 265 ON READER-SERVICE CARD



## Thanks For Your Help

One of the questions most often raised by advertisers concerns the conversion of inquiry to sale. Over a period of years, *Electronic Design* has contacted inquirers to find out (1) if the inquiry was prompted by a specific use in mind, (2) needed for future reference, or (3), needed for work in progress. The questionnaire also asked the inquirer if he had specified the product or intended to in the near future.

The results of these polls have been most helpful to potential advertisers, offering proof of the important communication function provided by this magazine.

Those subscribers who have cooperated in filling out their inquiry questionnaire deserve our thanks. By helping us to prepare more accurate information about the market we serve, *Electronic Design* becomes an even more basic media choice in this industry.

**ELECTRONIC  
DESIGN**

A HAYDEN PUBLICATION  
830 THIRD AVENUE, NEW YORK 22, N.Y. PLaza 1-5530

## LETTERS

### Problem Clearing House

Since *ELECTRONIC DESIGN* crosses the desks of many erudite designers, you have a wonderful opportunity to establish a communication system for an interchange of problem solutions.

Very often, however, designers are reluctant to let it be known that they need help in certain problem areas.

To overcome this reluctance, may I suggest that you establish a feature in which reader problems are published anonymously and any solutions received be sent to a box number. These solutions could then be forwarded to the sender or published in subsequent issues.

Richard A. Jones  
Test Engineer  
Grand Central Rocket Co.  
Redlands, Calif.

► We'll accept Mr. Jones' suggestion—it's been made before but we've been reluctant to initiate the service because of a shortage of secretarial help to handle the correspondence.

We have always offered to run open letters of engineers looking for help but not too many have taken advantage of this offer. Admitting what one does not know is supposedly good for the soul but we suspect many do not care to bare their soul or ignorance so ignominiously.

Henceforth requests for technical information will be published anonymously and we will forward answers from readers. Those of widespread interest will be published. Who has the first question?

For that matter, let's make our service ask for solutions to theoretical problems as well. Answers can be theoretical too.

### Houseflies Take Bumps, Not Chills

Dear Sir:

On page five of your June 24th issue, you wrote about the intoxicating effects of a 50,000 foot altitude on a housefly, trapped in a vacuum chamber.

If my memory serves me from similar environmental tests eight years ago, we found our "space flies" capable of withstanding extended periods of excessive vibration. The flies, Buzzwell I, II, and III, were placed inside a cellophane cigarette wrapper and taped to electronic equipment under test.

Forty-eight hours later, after continued bouncing from one wall to the other of the cellophane container, the flies emerged and flew excellent barrel rolls and inside loops before regaining equilibrium and flying off. Further tests in a temperature chamber, however, caused them to drop like flies at slightly lowered temperatures.

Robert Marie  
Hagerstown, Indiana

**PAGES  
MISSING  
ARE NOT  
AVAILABLE**