

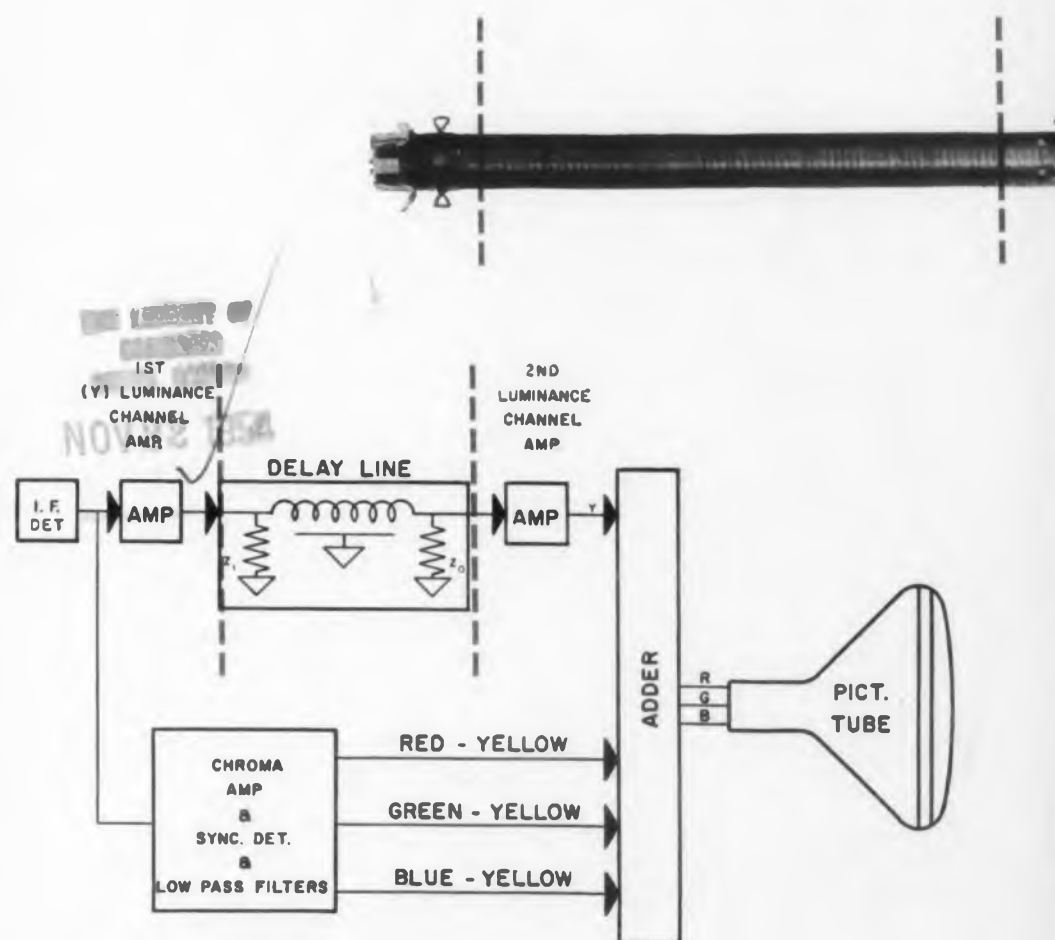
# ELECTRONIC

# design

SIMPLE, COMPACT, AND RELATIVELY INEXPENSIVE, THIS NEW COLOR TV COMPONENT IS KNOWN AS THE "DELAY STICK". IT DELAYS THE BLACK-AND-WHITE PICTURE SIGNAL SO THAT IT AND THE BASIC COLOR SIGNAL ARRIVE AT THE PICTURE TUBE SIMULTANEOUSLY. THE DIAGRAM SHOWS HOW THE DELAY STICK IS USED. ITS SMALL SIZE MAKES FOR EASY INSTALLATION IN COLOR TV RECEIVERS.

OCT 29 1954

Copy to L. of C. OCT 29 1954



October 1954

**HERE IT IS!**

**THE NEW MINIATURE**

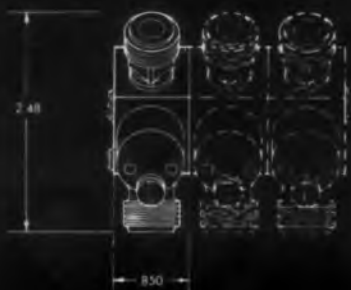
**TRANSCO**

## R. F. CO-AXIAL SWITCH

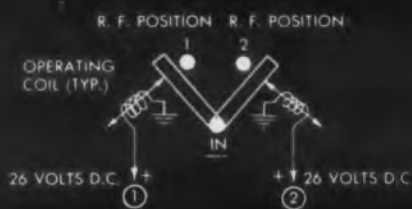


ACTUAL SIZE

TYPICAL STACKING & MOUNTING  
FOR MULTIPLE POLE INSTALLATION



SCHEMATIC TYPE SP2T



### DESIGNED TO MEET REQUIREMENTS OF MIL-E-5272

Are space, weight and mounting savings vital? Here's how you get them with these performance-proved, rugged, compact, lightweight units specifically designed to meet miniaturization demands under tough environmental conditions.

A new TRANSCO design concept that brings even greater performance and versatility to meet the exacting requirements of modern microwave components and accessories.

### CHARACTERISTICS

FREQUENCY RANGE: 0 to 8000 MC.  
VSWR: 1.3 MAX. WITH TYPE "N" CONNECTORS.  
INSERTION LOSS: 0.2 MAX.  
CROSS TALK: 50 DB MIN.  
LIFE DURATION: 500,000 OPERATIONS MIN.  
ACTUATOR POWER RATING: 18-30 VDC at 0.18 Amps, MAX. PER COIL.  
WEIGHT: 4.8 OUNCES APPROX.  
AMBIENT OPERATING TEMP. RANGE: -65° F. TO +225° F.  
ACTUATING TIME: 1/200 SECOND MAX.  
R. F. POWER RATING OF CO-AXIAL SWITCH EQUAL TO THAT OF IMPROVED TYPE "N" CONNECTORS.  
SWITCH CAN BE OPERATED WITH R. F. POSITIONS 1 OR 2 BOTH "ON;" OR "OFF;" SIMULTANEOUSLY.  
STACKING DIMENSIONS: .850" x 2.48"  
R. F. POSITIONS MAY BE OPERATED AS "MAKE BEFORE BREAK" OR "BREAK BEFORE MAKE"

This new addition to the famous TRANSCO line of remotely and manually controlled Co-Axial Switches is designed to supply economical, reliable and compact units for frequencies to 8000 MC. The 1460 series is available for more critical applications and frequencies to 11,000 MC. You will find a combination of exclusive features in TRANSCO Switches which will make your selection a confident one.

Complete technical specifications available upon request.

**TRANSCO PRODUCTS, INC.**

DESIGNERS & MANUFACTURERS OF AIRCRAFT & ELECTRONIC EQUIPMENT

12210 NEBRASKA AVENUE, LOS ANGELES 25, CALIFORNIA

CIRCLE ED-1 ON READER-SERVICE CARD FOR MORE INFORMATION

## Staff

Edward E. Grazda	Editor
M. Mandell	Associate Editor
M. J. Friday	Assistant Editor
R. Graham	Assistant Editor
P. L. Canfield	Editorial Assistant
N. Asto	Production Manager
E. Dadinis	Assistant Production Manager
H. W. Schlager	Business Manager
J. B. Gilchrist	Circulation Manager

## Co-Publishers

T. Richard Gascoigne  
James S. Mulholland, Jr.

## Advertising Representatives

New York: T. Richard Gascoigne,  
James S. Mulholland, Jr.  
Blair McClenachan  
19 East 62nd St.  
New York 21, N. Y.  
TEmpleton 8-1940

Chicago: Thomas P. Kavooras  
664 No. Michigan Ave.  
Chicago 11, Ill.  
SUperior 7-8054

Los Angeles: Robert E. Ahrensdorf  
1140 Wilshire Blvd.  
Los Angeles 17, Calif.  
MADison 9-2681

## Circulation 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 a subscription without charge provided you send us the following information on your company letterhead: your name and title; your company's name, address, and main product. Electronic, research, development, project, electrical, and chief engineers are typical qualifying titles.

If you have a design responsibility not indicated by your title, add a description of those responsibilities.

Any job change requires requalification.

Hayden Publishing Company, Inc.  
19 East 62nd Street  
New York 21, New York

Back issues of ELECTRONIC DESIGN, when available, may be obtained at a charge of \$1.00 per copy.

# ELECTRONIC

## DESIGN

Vol. 2  
No. 10  
October 1954

### Contents

<b>Cover</b> . . . . .	(see page 32)
<b>Editorial</b> . . . . .	4
<b>Engineering Review</b> . . . . .	5
<b>Features</b>	
Choosing Wire Sizes for High Temperatures, by John Holland . . . . .	18
Miniature Time-Delay Relay . . . . .	22
Diode Amplifiers . . . . .	24
Servomechanism Prototype Components . . . . .	26
CRO Dual-Trace Switch . . . . .	28
Color TV Delay Assembly . . . . .	32
Printed Circuit Design: II — From Circuit Diagram to Printed Wire Pattern, by George Maisch . . . . .	34
Audio Power Pentodes . . . . .	38
<b>Ideas for Design</b>	
Subjective Design, by Jack W. Dunlap . . . . .	30
<b>Departments</b>	
New Products . . . . .	40
Books . . . . .	92
New Literature . . . . .	96
Patents . . . . .	104
Advertisers' Index . . . . .	110



ELECTRONIC DESIGN is published monthly by Hayden Publishing Company, Inc. at 19 E. 62nd Street, New York 21, N. Y., T. Richard Gascoigne, President; James S. Mulholland, Jr., Vice-President & Treasurer, and Ralph E. Marson, Secretary. Printed at Publishers Printing Company, New York, N. Y., ELECTRONIC DESIGN is circulated monthly without charge to men in the electronic industries who are responsible for the design and specification of manufactured devices, including development and design men of consulting laboratories and government agencies. Acceptance under section 34.64 P. L. & R. authorized. Copyright 1954 Hayden Publishing Company, Inc. 24,000 copies this issue.

new approach to

# THERMAL RELAY DESIGN

## G-V TIME DELAY RELAYS

- Hermetically Sealed
- Still Adjustable
- Amazingly Rugged
- Thoroughly Dependable



### G-V ENGINEERING OFFERS A NEW APPROACH TO THERMAL RELAY DESIGN

- Stainless steel mechanism welded into a single integral structure and supported at both ends for unequalled resistance to vibration and shock
- Heater built inside expanding member for maximum efficiency and protection
- Rolling contact action for positive operation
- Easy adjustability where desired
- Precise operation never before available in thermal relays
- Time ranges: 3 seconds to 5 minutes
- Hermetically sealed in metal shell
- Heater voltages up to 230 volts
- Fully temperature compensated
- Suitable for military and industrial use
- Unequalled for ruggedness and precision

U. S. and Foreign Patents Pending

**G-V**  
CONTROLS INC.

The stainless steel structure of G-V Thermal Relays, encased in a metal shell, delivers dependable, trouble-free performance under the most severe operating conditions . . . proved in commercial and military service for three years.

Thermal Relays are the simplest, smallest, lightest, most economical means of introducing a substantial delay into an electrical circuit.

G-V Relays offer performance never before available.

Why not find out by writing today how they can help you. G-V Controls are Thermal Relay specialists. They originated the 7-pin miniature and now make more of these than all other producers combined.

Only G-V offers complete technical data and helpful engineering cooperation on THERMAL TIME DELAY RELAYS.

*Write for bulletin and help with your particular problems.*

18 Hollywood Plaza  
East Orange, New Jersey

Greatly expanded production facilities assure prompt deliveries.

CIRCLE ED-2 ON READER-SERVICE CARD FOR MORE INFORMATION



**Uniformity  
Ruggedness  
Reliability  
make the**



## **MACHLETT 2C39A**

**Preferred Choice of Equipment Manufacturers,  
Military and Commercial Users**

**New Standard for  
Electrical Uniformity**

The ML-2C39A sets the highest standard of electrical uniformity for UHF planar triodes.

Close tolerance parallelism between electrodes prevents uneven heating at high frequencies, minimizes arcing.

Uniquely processed grid, mechanically stable at high temperatures, assures frequency stability over broadest range of operating conditions.

Machined emitter surfaces with extremely uniform oxide deposit assure optimum cathode emission as well as freedom from uneven, grid distorting, heat.

**400% More Rugged**

Average strength of the ML-2C39A is over 400% greater than any other 2C39A, as measured in torque and pry tests.

**Unmatched Reliability**

Quality in design, materials, and production techniques build superior reliability into the ML-2C39A.

Final inspection includes r-f oscillation in both test oscillators, and prototypes of field equipments, to assure tubes of high power output and long, trouble-free life.

**Electrical Characteristics  
of ML-2C39A\***

Heater voltage, 6.3 volts	Grid-plate capacitance, 2.0 uuf
Amplification factor, 100	Maximum frequency, 2500 mc/sec
Transconductance, 22,000 umhos	Useful power output, 12-35 watts

\*Manufactured to JAN specifications.

Also made by Machlett to highest quality specifications: **ML-381** for pulsed applications (3500 V peak; 3 microsecond pulse; 1/2% duty cycle) and the **ML-322** clipper diode.

**For complete data write to:  
MACHLETT LABORATORIES, INC.  
Springdale, Connecticut**



*Over 55 years of electron tube experience!*

CIRCLE ED-3 ON READER-SERVICE CARD FOR MORE INFORMATION

### **Editorial**

#### **Designers Must Know**

How many design engineers know, or even have an idea of what is wanted by potential customers for the products they are designing? Looking at the products displayed at various shows throughout the country, one often has the impression that a good many designers have "missed the boat".

Their product may not be priced right. It may not look right. It may not be convenient to operate. Or it may be "too convenient" to operate, with all the fine adjustment controls so accessible that the user is continually fiddling with them and throwing the equipment out of alignment. It may be too large or too small, too light or too heavy. It may even perform *too* well. One phase of this problem is treated in Dr. Dunlap's article, "Subjective Design", which appears on pages 30 and 31 in this issue.

Many of these errors, possibly all of them, can be avoided. The successfully designed product, in terms of performance as well as company prestige and profit, is the result of a many linked chain of steps. One of the most important of these is the market research link, the flow of non-technical information which should reach the designer if he is to make intelligent, successful design decisions about his proposed product. If this flow is interrupted or the final information is incomplete or distorted, the end product will be affected accordingly.

How can the design engineer obtain this sort of data? He can consult the sales department in his company. He can talk to his company's customers. He can study their complaints. He can possibly sell his management on the idea of using the services of a competent market research organization. He can keep himself informed on the latest developments in the human engineering field. The point is that he must avoid confining his keeping-up-to-date efforts to the technical side of his field. He must continually broaden his background to supplement his technical skills.

Management can do its part to promote successful products by seeing that design engineers are provided with this sort of information, or that they are permitted to seek it out. This cooperation will result in flexible, harmonious relations which will help insure profits for the firm and stimulate growth in the electronic industries.

# Engineering Review . . .

*For more information on developments described in "Engineering Review", write directly to the address given in the individual item.*

**U-H-F Transistor . . .** With operation at frequencies as high as 3000Mc theoretically possible, a newly developed experimental transistor known as the "intrinsic barrier" or "p-n-i-p" junction transistor has generated frequencies as high as 440Mc. The germanium device can also dissipate relatively high power, perhaps up to 1/2w, and withstand as much as 100v. When the new unit is placed on the market, it will

make the transistor a real competitor of the vacuum tube over a much wider frequency and power range than before.

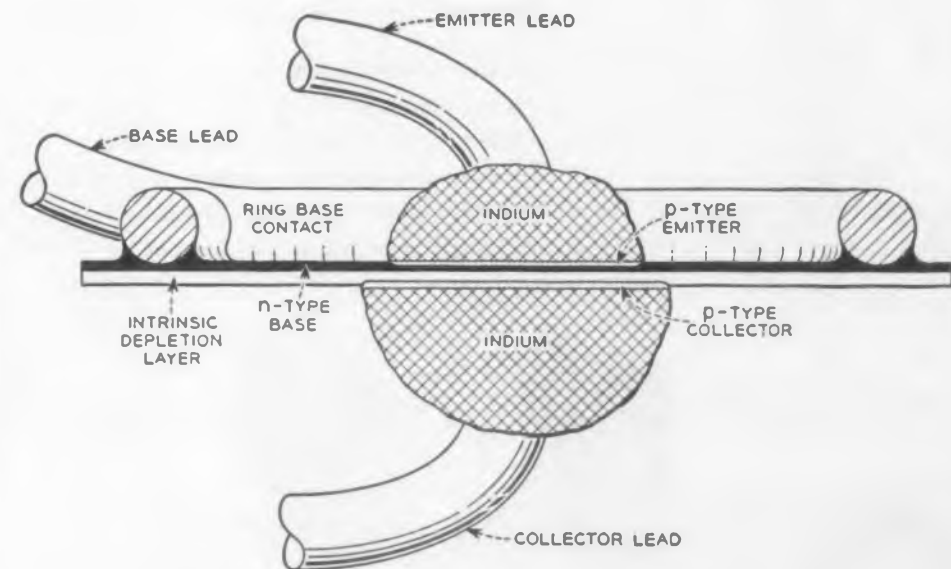
Developed by Bell Telephone Laboratories, 463 West St., New York 14, N. Y., where the transistor was invented, the semiconductor device resulted from the need to extend the capabilities of the p-n-p transistor now that the theoretical limits of the basic triode type have been largely achieved. In general, the frequency range of the p-n-p types is improved by making the base region thinner to increase alpha cutoff frequency, by using lower resistivity base material to reduce the base's resistance, and by de-

creasing the area of emitter and collector junctions to reduce collector capacitance. These structural changes, however, are not independent and affect the transistor's other characteristics. For example, the reduction in junction area reduces power rating.

New structures or materials were needed. By adding a layer of pure crystal to the collector, an approximate 10 fold increase in theoretical frequency limit has been gained. This layer results in low collector capacitance. The increased separation of input and output areas also permits operation at higher voltages. In addition, the thick depletion region makes the structure much more rugged for a high frequency device since the necessarily thin base layer now resembles a coating on a much thicker depletion layer rather than becoming a thin and fragile web.

Although operating principles of the p-n-i-p (or n-p-i-n) transistor are similar to those of the p-n-p type, new effects were noted. In the new transistor, the drift transit time through the collector field is now comparable to the diffusion transit time through the base, and contributes to phase shift of the short-circuit current-transfer ratio, alpha. In addition, the emitter depletion layer capacitance, which is unimportant in triode types, is relatively large in the p-n-i-p transistor and degrades performance at v-h-f and microwave frequencies by providing a low-impedance shunt around the emitter junction.

Fabrication methods of the intrinsic barrier transistor are based on methods of manufacturing triode transistors. As seen in the cross-section, the input and output electrodes are made of indium, a low-resistance metal found as an impurity in zinc blends.



The "intrinsic barrier" or "p-n-i-p" germanium junction transistor has a theoretical frequency limit of 3000Mc. A cross-section diagram of the transistor is shown above.

# MARION COAXIAL\* MECHANISMS MAKE NEW AIRCRAFT INSTRUMENTS LIGHTER, SMALLER, MORE STABLE

Engineering Review . . .

**Printed Circuit Symposium . . .** A Symposium on Printed Circuits will be held at the University of Pennsylvania, Philadelphia, Pa., on January 20-21, 1955. Sponsored by the Engineering Department of the Radio-Electronics-Television Manufacturers Association, 500 Fifth Ave., New York 36, N. Y., the symposium will include six sessions.

Tentative subjects of the sessions are: "Product Design Applications", "Reliability and Serviceability", "Management Considerations", "Techniques of Producing Printed Wiring Boards (panel session)", "Printed Components and Components For Use With Printed Wiring", and "Production Techniques and Manufacturing Methods".

**Computer School . . .** Two types of courses on digital computers are being offered by the computer center operated by ElectroData Corp., 717 N. Lake Ave., Pasadena, Calif. A two-week course, covering 80hr of classroom and computer studies, is given twice each month to teach management, professional, supervisory, and technical personnel how to program and code problems for computers. Students, who attend without cost, learn how to code routine problems relating to operations of their own companies. Before graduating, they code, program, and actually run a complete problem of their own on the computer.

The first course is a pre-requisite for the second course, which is three weeks long. Graduates of this course in maintenance and operation of computers are able to take over routine maintenance of computing systems installed in their respective firms by ElectroData.

To further spread knowledge of computers and their use, this corporation also grants scholarships to graduate mathematics students to enable them to undertake studies on computers.

**Titanium Heater . . .** A 3/8" diam rod of titanium can be heated to 3400°F in 9sec in a new high-speed induction heater. Previously, titanium was considered very difficult to heat with high-frequency waves. The heater is made by Radio Frequency Co., 44 Park St., Medford, Mass. It incorporates a 10kw air-cooled tube and mica-silicone transformers.

**More Thorium . . .** A new process for the recovery of thorium and the rare earth metals from monazite sand has been developed by Battelle Institute, 505 King Ave., Columbus 1, Ohio, in a research project sponsored by the Atomic Energy Commission. The process is simpler than present methods.

Thoria, the oxide of thorium, already has an established use in the making of tungsten-lamp filament wire and as a refractory material in boilers and fur-



**marion**  
advancement  
in instrument  
design

A new AN type multi-element aircraft instrument, incorporating recently developed Marion Coaxial Mechanisms, has greater durability and performance stability than many existing instruments of much greater size and weight. Applications of the new instrument, available with two, three or four elements, include ammeters, voltmeters, temperature indicators and radio navigational instruments. They meet the requirements of Army-Navy Aeronautical Design Standard AND10401 for 2 3/4" dial instruments.

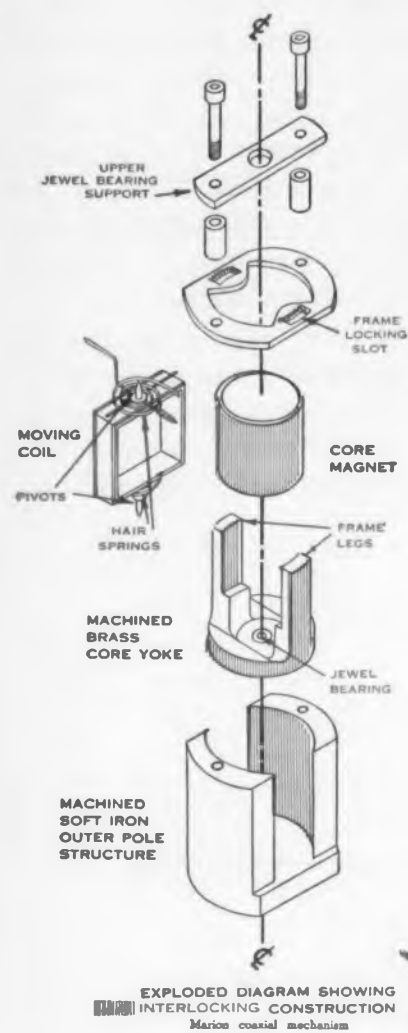
The Coaxial Mechanism making these improvements possible represents a new Marion concept in the mechanical design of moving coil mechanisms. The Coaxial assembly provides a self-shielded magnetic field of great strength, uniformity and stability. Ruggedness and stability are inherent in the basic simplicity of the design. Only two fasteners hold the rigid, interlocked assembly together. All critical dimensions are machined from a common center (the bearing axis), facilitating precise alignment of parts.

## MECHANISMS BY MARION

The Coaxial Mechanism typifies the way each Mechanism by Marion is designed to meet the particular requirements of a specific application — and to provide substantially improved performance, with large reductions in cube and weight. They are *not* adaptations or variations of standard, conventional mechanisms.

Marion Electrical Instrument Company  
417 Canal Street, Manchester, New Hampshire

\*Trade Mark Patents Pending



Reg. U. S. Pat. Off.

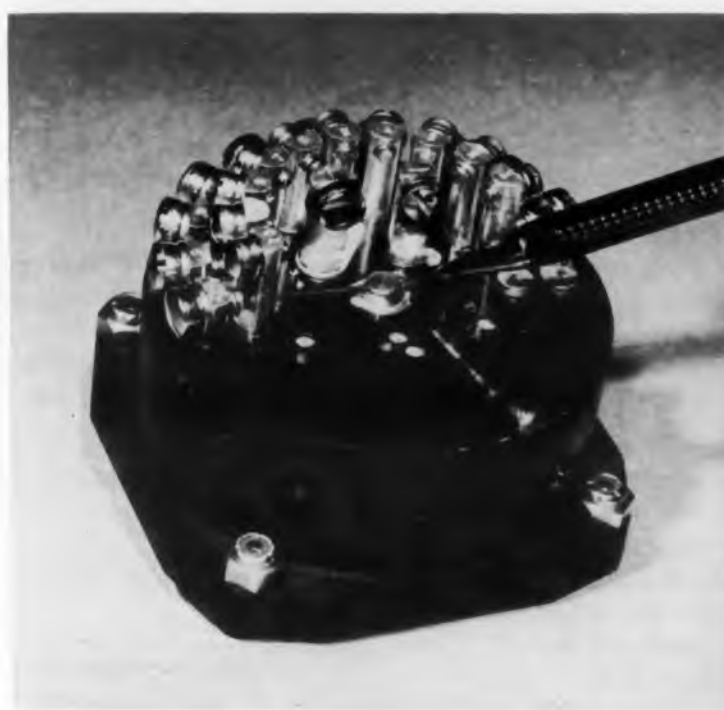
**marion meters**

MANUFACTURERS OF RUGGEDIZED AND "REGULAR" METERS AND RELATED PRODUCTS

CIRCLE ED-8 ON READER-SERVICE CARD FOR MORE INFORMATION

Copyright 1954 Marion

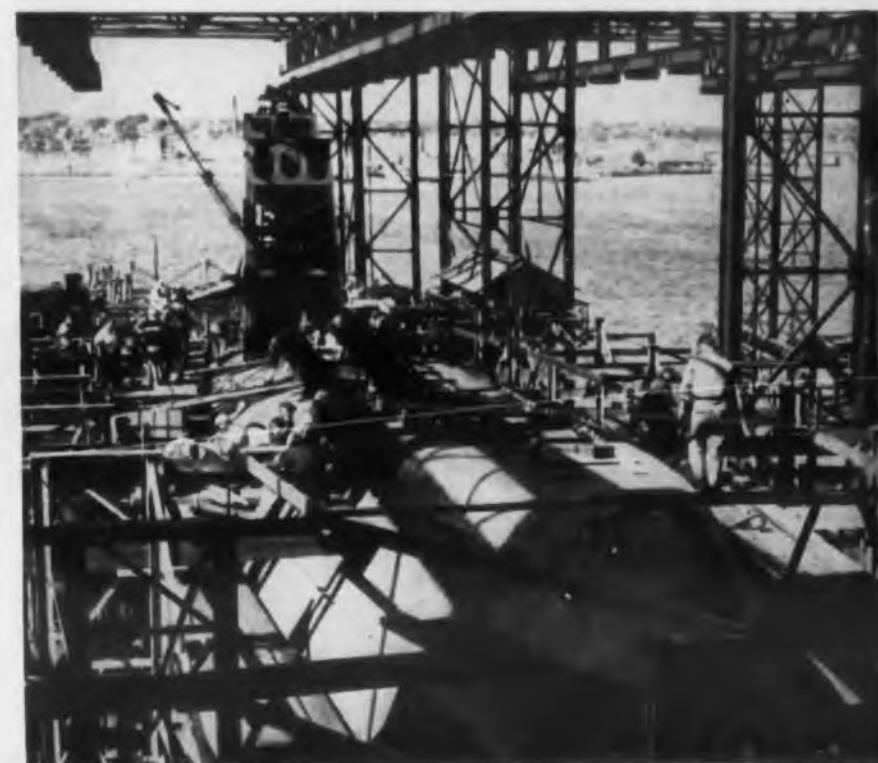




#### Redesigned Switch

In the early version of this thermocouple transfer switch shown at the top, dummy contacts were required to complete the entire circumference of the spring-loaded contact brushes' travel to prevent the brushes from dropping. By adding stops and simply lengthening the shaft retaining pin—indicated by the pencil, all the dummy contacts were eliminated. Manufactured by the Winslow Co., Newark, N. J., the switch utilizes "Rollpins", a self-retaining spring pin.

naces, while thorium is of interest in connection with nuclear "breeder" reactors. Monazite sand is one of the most important sources for thorium and the rare earths. The best known deposits of monazite are the beach sands of Brazil and India, but there is some in Florida and other parts of the United States.



## ATOMIC SUB USES NEW **AMP** WIRE TERMINATION TECHNIQUE

Typical of the results of AMP's program of research and development are the terminal installations shown above on the Navy's new atomic powered submarine, "Nautilus". In providing a practical method for terminating MSCA cable, AMP engineers have proven many advantages of solderless pressure-type wiring methods heretofore unknown in this field.

Whether it is lower cost, improved quality, or simplified installation methods, the millions of AMP terminals in use today are proving their value in all types of wiring applications. Wherever wire termination problems exist, AMP Field and Service engineers are ready to work right on the spot to add their experience, as well as the entire facilities of AMP's Research and Development Division to help solve the problem. That is why "Wherever There's Electricity You'll Find AMP"



**Aircraft-Marine Products, Inc.**  
2100 Paxton Street, Harrisburg, Pennsylvania

In Canada . . . Aircraft-Marine Products of Canada, Ltd.  
1764 Avenue Road, Toronto 12, Ontario, Canada

Find out about the New  
AMP "CREATIVE AP-  
PROACH TO BETTER  
WIRING"



... An evaluation survey  
without cost or obligation.

CIRCLE ED-5 ON READER-SERVICE CARD FOR MORE INFORMATION



## Engineering Review . . .

**Tallest Structure . . .** The world's tallest man-made structure, a TV mast that stands 1572 ft, is expected to be completed and in operation this month, according to Station KWTV, Oklahoma City, Okla., and Radio Corporation of America, 30 Rockefeller Plaza, New York 20, N. Y.

The 73 ft TF-12BII antenna is a 12-section, v-h-f superturnstile type. Designed for 50kw input, it will increase KWTV's effective radiated power from 50kw to 316kw, providing Grade A service to about 55 miles and Grade B service to 74 miles. The mast will also accommodate a second antenna for use by the Oklahoma Educational Television Authority.

The overall mast with antennas weighs more than 675 tons. It is a guyed type, and is designed to withstand wind velocity up to hurricane proportions. It will stand approximately 100 ft higher than the Empire State Building and more than 580 ft higher than the Eiffel Tower.

**Transistorized Recorder . . .** An all-transistor shock-and-vibration recorder recently developed uses 150 transistors. It will operate from self-contained batteries for 30 days, recording shock, vibration, and any other occurrence that might damage delicate and valuable devices.

The threshold level of the recorder, which is manufactured by Electronic Engineering Company of California, 180 S. Alvarado St., Los Angeles 57, Calif., is 2g. Any shock from 2 to 50g is first recorded on a magnetic drum. If a signal is small in magnitude and unimportant, the signal is almost immediately erased from the magnetic drum. If the shock, how-

CIRCLE ED-6 ON READER-SERVICE CARD ➤

8



# SERVES INDUSTRY

# THROUGH *coordinated*

The producing companies of General Precision Equipment Corporation are engaged in the development, production and sale of advanced technological products. These products all have a broad common base: 1) they represent precision equipment in some form; 2) they derive from similar fields of technical competence; 3) they save labor, increase productivity, or achieve results which cannot be attained with even limited use of on-the-spot manpower.

A general view of the technical capacities of the GPE Producing Companies is given in the chart. But the chart cannot show the very close interrelation of these capacities nor the highly flexible application of facilities, techniques and capabilities which exists among these companies. This is achieved through GPE's basic operating policy—Coordinated Precision Technology.

GPE Coordinated Precision Technology operates in all areas—in research, development and manufacture. The record of the GPE Producing Companies in solving advanced technological problems and meeting the demand for high speed, precision, reliability, light weight and compactness at competitive prices is the result of this coordination, the constant application of the newest and most highly advanced techniques, and unremitting insistence on highest quality.

Perhaps the most conspicuous advantage of GPE Coordinated Precision Technology is that the concept and development of equipment and systems, and of solutions to the underlying technical problems, are not restricted by being confined to the specialized techniques of a particular field. In short, GPE Coordinated Precision Technology permits each company to seek the optimum solution for the customer by the application of all relevant techniques within the total capacities of the entire group. Address inquiries to:

### GENERAL PRECISION EQUIPMENT CORPORATION

92 GOLD STREET, NEW YORK 38, NEW YORK



Over **2200** scientists, engineers, draftsmen, testers and other technical personnel in the GPE Companies work in the fields covered by this chart.

**CAPACITIES OF THE  
GPE PRODUCING COMPANIES**

PRECISION MECHANICS  
and CERAMICS

ELECTRICAL EQUIPMENT  
and COMPONENTS

ELECTRONICS

HYDRAULICS  
and LIQUIDS HANDLING

PROFESSIONAL and INDUSTRIAL  
TELEVISION EQUIPMENT

INSTRUMENTATION

SERVOS and CONTROLS

AUTOMATIC COMPUTERS  
and COMPONENTS

ULTRASONICS

RADAR and MICROWAVE

MOTION PICTURE  
and SOUND EQUIPMENT

OPTICAL DEVICES

THE PRODUCING COMPANIES



INTERNATIONAL PROJECTOR  
CORPORATION—BLOOMFIELD, N. J.

*Simplex*

*Peerless*

J. E. McAULEY MFG. CO.  
CHICAGO



GENERAL PRECISION LABORATORY  
INCORPORATED—PLEASANTVILLE, N. Y.



THE HERTNER ELECTRIC  
COMPANY—CLEVELAND








KEARFOTT COMPANY, INC.  
LITTLE FALLS, N. J.

One of a series telling  
how the producing companies of  
General Precision Equipment Corporation  
are contributing to America's progress.

# precision technology

F THE  
ANIES  
ANICS  
AMICS  
PMENT  
MENTS  
ONICS  
ULICS  
IDLING  
STRIAL  
PMENT  
TATION  
TROLS  
UTERS  
MENTS  
ONICS  
DWAVE  
ICTURE  
PMENT  
EVICES

	<i>Sturtevant</i>	<i>Peerless</i>		<i>Alta</i>	<i>Kearfott</i>			<i>Strong</i>	<i>ASKANIA</i> REGULATOR COMPANY		
	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	<input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	<input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	<input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	<input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	<input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	<input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

- Manufacturing
- Manufacturing and product development
- Manufacturing, product development and research
- Pilot manufacturing, product development and research

ever, is a severe one, the tape recorder is started and the information recorded on the magnetic drum is picked up and re-recorded on magnetic tape. The tape recorder will come up to speed in 0.2sec.

The tape records seven channels of information: six cover degrees of possible motion, and the seventh channel is a timing signal. The tape will run for a total time of 2 hr. Frequency response of the channels is from 0 to 2000cy, and the signal is f-m recorded. The signals on the tape may be played back by standard equipment.

**Economic Retaliation . . .** Because of the recent decision by the United States to raise the tariff on Swiss watch movements, the Swiss government may cancel concessions on such items as electronic equipment manufactured in this country, according to the September, 1954, issue of the "Du Mont Dispatch", published by Allen B. Du Mont Laboratories, Inc., Paterson, N. J. More than \$1,000,000 worth of electronic gear was shipped to Switzerland from the United States in 1953.

The Swiss may seek duty concessions from the Administration on other goods manufactured in their country, however, rather than take an action which could be interpreted as economic retaliation against the raising of the watch tariff.

**Sonar Transducers . . .** In order to obtain housing for sonar transducers that would withstand water pressures at depths down to 1000ft, one electronic manufacturer has turned to continuous-cast bronze tubing. The transducer, combining the input stage of a receiver and the output stage of a transmitter, is made by Massa Laboratories, Hingham, Mass. The tubing is supplied by American Smelting and Refining Co., Barber, N. J.

◀ CIRCLE ED-6 ON READER-SERVICE CARD

urfott  
PANY, INC.  
S. N. J.



AMPRO CORPORATION  
CHICAGO



LINK AVIATION, INC.  
BINGHAMTON, N. Y.



THE STRONG ELECTRIC  
CORPORATION-TOLEDO



ASKANIA REGULATOR  
COMPANY-CHICAGO



BLUDWORTH MARINE  
NEW YORK



LIBRASCOPE, INCORPORATED  
GLENDALE, CALIFORNIA





**O**ur new address is 19 East 62nd Street, New York 21, N. Y.

These larger quarters will enable ELECTRONIC DESIGN to accommodate the greatest growth of any business publication in any field!

As a result: bigger staff, more design information, and improved reader service.

ELECTRONIC DESIGN, Hayden Publishing Company, Inc., 19 East 62nd St., New York 21, N. Y.

## Engineering Review . . .

**Global Communications . . .** A joint resolution calling for the establishment of a Commission of International Telecommunications has been passed by both the House of Representatives and the Senate and signed into law by the President. The resolution calls for study of the possibilities of global communications and requires a report to the Congress by December 31, 1954.

A report accompanying the resolution states that the Commission's purpose will be to encourage the development and use of radio and TV to foster mutual understanding and cooperation among the free nations of the world.

**Non-Rotating Direction Finder . . .** By employing a new type of antenna that does not have to be rotated, a newly developed marine direction finder's readings are not affected by alterations of any metallic part of the ship's superstructure or rigging. The gear and its antenna are shown in the photos below.

The conventional single-loop antenna is hand-rotated to obtain a bearing and, therefore, is mounted directly above the receiver-indicator in the wheel-house or charthouse. Although such instruments are calibrated at installation to allow for the deflection of radio waves by the surrounding superstructure and rigging, any subsequent changes in rigging may cause appreciable errors in the bearings indicated.

Since the new cross-loop antenna can be located as far as 100ft from the receiver, it can be placed on top of a mast where it is not affected by alterations. The antenna is connected to the receiver by coaxial-cable. The entire equipment, designated Type 4003-A, is manufactured by Marine Division, Mackay Radio and Telegraph Co., a subsidiary of American Cable



call-  
inter-  
both  
and  
calls  
mea-  
De-

that  
e the  
foster  
g the

ing a  
tated,  
dings  
part  
r and

hand-  
unted  
wheel-  
ts are  
ection  
ature  
g may  
ed.

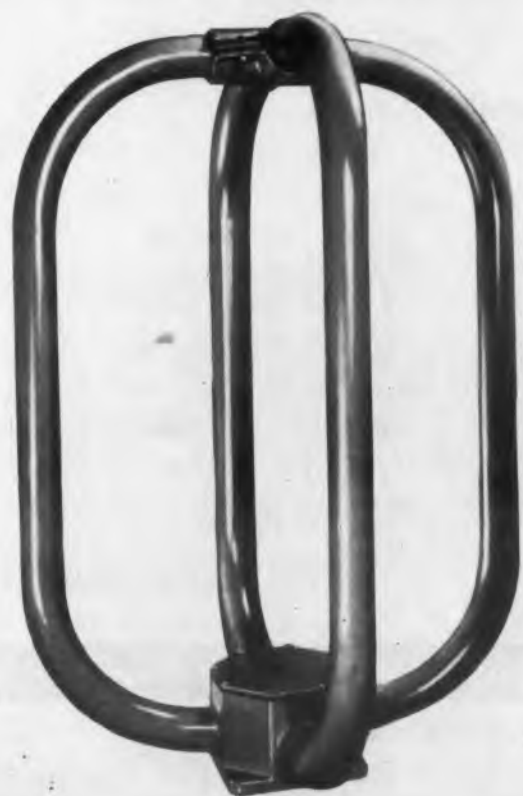
eated  
ed on  
ations.  
axial-  
003-A,  
Radio  
Cable



**"Crash-Proof" Recorder**

This Flight Recorder provides essential flight data in a form that will survive 2000°F heat and 100g shock. It contains no tubes, and will run for 15min after plane-power failure. The device is made by the Mechanical Div., General Mills, Inc., Minneapolis, Minn. The record is made on aluminum foil.

& Radio Corp., 67 Broad St., New York 4, N. Y. The instrument also features highly selective radio-frequency circuits and an audio filter to permit bearings to be fixed under adverse atmospheric conditions.



# BORG MICROPOTS

the  
**NEW STANDARD**  
of precision  
multi-turn  
potentiometers

**BORG 900 SERIES 3-TURN AND 10-TURN MICROPOTS**

**3-TURN MODELS 931-935**

**10-TURN MODELS 901-903**



Standard models of Borg 900 Series Micropots offer such flexibility that they may be specially designed. Borg has created a new standard for high precision, multi-turn potentiometers. Advantages of the Borg 900 Series include precise accuracy, long life, low torque, longer life, better performance under stress and resistance

vibration, great adjustment and removal of application. Standard models include 1/2 turn potentiometers, 3 turn to 3 1/2 turn potentiometers, 10 turn to 10 1/2 turn potentiometers, single or double shaft, screw or locking screws as motor or load shaft. Available in standard or special design to meet your requirements.

**SYNCHRONOUS AND INDUCTION BORG-MOTORS**

**1000 SERIES 2 POLE AND 4 POLE MODELS  
With and Without Gear Trains**

These Borg-Motors were designed specifically for instrumentation, control and timing devices. They are recommended for all applications where low torque, constant speed and long life are positive requirements.



For Complete Engineering Data



**SERVO-CONTROL  
Borg-Motors**

Two phase, 115 volt, 400 cps induction type Borg-Motors for servo control applications. Approximate size 1 1/2" diameter x 2" long with a locked rotor torque of 0.82 ounce-inch.

ATTACH TO YOUR LETTERHEAD

**BORG EQUIPMENT DIVISION  
THE GEORGE W. BORG CORPORATION  
JANESVILLE, WISCONSIN**

NAME.....

TITLE.....

Please send complete information and engineering data on items checked.

Precision Multi-Turn Potentiometers, 900 Series

Borg Standard Potentiometer, 1100 Series

Precision Multi-Turn Counting Dials

Servo Control Motors

Instrument Motors

Frequency Standards

Contract Manufacturing

**BORG EQUIPMENT DIVISION  
THE GEORGE W. BORG CORPORATION  
JANESVILLE, WISCONSIN**

CIRCLE ED-9 ON READER-SERVICE CARD FOR MORE INFORMATION



## Engineering Review . . .

**Nuclear Reactor . . .** The first nuclear reactor for industrial research will be established at Armour Research Institute of Illinois Institute of Technology, 35 W. 33rd St., Chicago 16, Ill. At present the only other reactor not devoted to Atomic Energy Commission research is a 10,000w unit at North Carolina State College. At least three more reactors are being planned for educational and college research, but the one at the Foundation is the first directed toward industrial research.

The proposed reactor, designed for 50,000w, will be a highly flexible neutron and gamma source, and is not intended for research on reactors themselves or for the generation of electrical power. Fuel for the reactor will be obtained from the AEC on "extended loan", as required by law. The fuel will be granted only after careful inspection by the Commission. The reactor room will be a gas-tight steel tank, approximately 60' diam x 25' high. It will be adjacent to laboratories for handling and storing radioactive material and for conducting nuclear research.

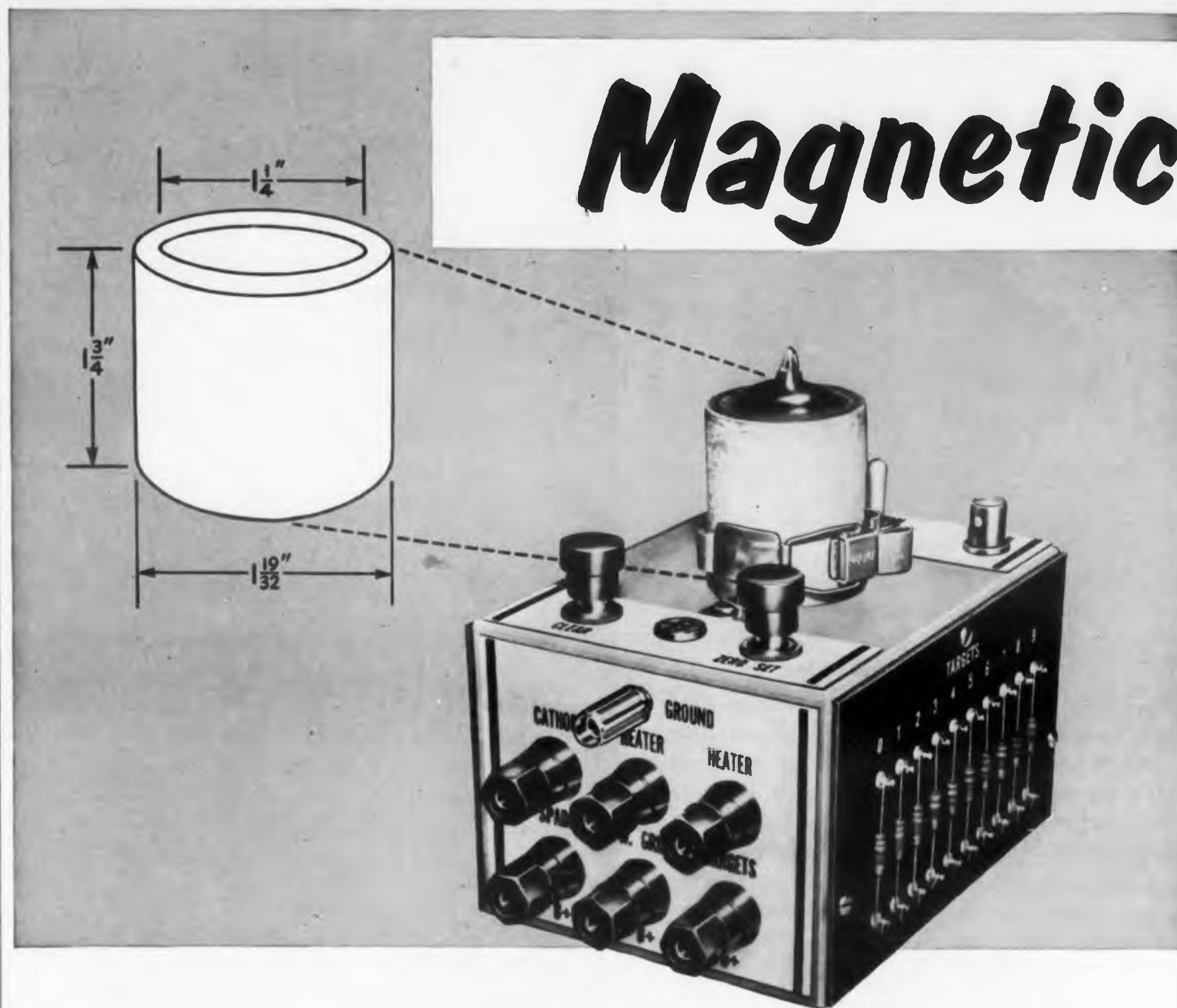
The reactor will permit investigations into such fields as: sterilization of foods and drugs; high polymer studies of the structure of plastics, rubber, and similar materials; glass and ceramics; wear and friction studies; the development of metals and alloys; and medical techniques for diagnoses and therapy.

Chicago-area industries will join the Foundation in financing the reactor and associated equipment, which will cost approximately \$500,000. The Foundation will assume about one-third of the cost, while the industrial organizations are being invited to participate with subscriptions of \$20,000 each, for which they will receive a number of benefits. An extensive research program will be conducted by the Foundation on problems submitted by subscribers. Results of this research, including any inventions that may result, will be made available to the subscribers.

The reactor will make available in the Chicago area short-lived radioisotopes that would be impractical to procure from distant government laboratories such as Oak Ridge. The reactor will be free of all AEC security restrictions.

**Reduced Inspection Plan . . .** Electronic manufacturers who produce consistently high-quality products for the Signal Corps can gain considerable advantages by qualifying for the recently inaugurated "Reduced Inspection Quality Assurance Plan" (RIQAP). Instead of inspecting every lot, Government inspectors in the 18 plants qualified to date only sample occasional lots and check the manufacturers' own records. The cost-saving system may be extended to the other services.

To qualify, a manufacturer must pass a rigorous inspection by a specially selected technical group.



## New Burroughs beam switching tube uses Thomas & Skinner permanent magnet

One of the principal problems in designing the new Burroughs Beam Switching Tube—recently announced by Burroughs Electronic Instruments Division—was a means of providing an electron beam, which could be formed, switched, and modulated in any one of 10 discrete automatically locked positions—consecutively or at random.

The solution was a combina-

tion of magnetic and electric fields. . . and to obtain a cylindrical permanent magnet to surround the tube, Burroughs called in Thomas & Skinner engineers. The result was a permanent magnet of the exact-type material needed—and with the specific magnetic characteristics required for successful operation, including maximum energy product, coercive force, residual induc-

tion, and other required characteristics.

It will pay you—as it did Burroughs—to investigate fully the design capabilities of Thomas & Skinner engineers . . . as well as Thomas & Skinner's productive capacity. Write for complete details . . . Thomas & Skinner magnetic materials may be your short cut to new designs and more profitable production.

Specialists in magnetic materials, Permanent Magnets, Electrical Laminations and Wound Cores

CIRCLE ED-10 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954

# Materials are our Business



**PERMANENT MAGNETS** Whatever your needs—Alnico, cobalt, chromium—Thomas & Skinner can meet your specifications for either standard designs or special shapes. Typical of T&S advanced materials is Alnico 5Cb, offering an energy product of 5.70 million *nominal*. And typical of T&S advanced techniques is shell-molding, offering intricate shapes with tolerances as close as  $\pm .005$ " without grinding or finishing.



**ELECTRICAL LAMINATIONS** Geared to high volume production, T&S uses the most modern equipment available to produce high quality laminations in quantity at the lowest prices possible. Rigid quality control is maintained through each phase of production—stamping—atmosphere annealing—every vital step in producing top quality laminations. For every type application, T&S can provide all grades, all gauges to meet your demands for standard or special laminations. T&S's OrthoSil is also available for applications requiring directional electrical characteristics with extreme high permeability and low core loss.



**WOUND CORES** You can save on both assembly costs and time—and reduce both size and finished weight—with "C" Type and Toroidal Wound Cores made from T&S OrthoSil. The directional magnetic characteristics and extremely rectangular hysteresis loop of oriented OrthoSil have proved advantageous on hundreds of applications, particularly in 400 cycle equipment at flux densities of 15,000 gauss and over.

Once the company and the Signal Corps agree to applying RIQAP, the plan is tailored to the manufacturer's products and control methods. RIQAP is not necessarily restricted to full plant application, but can be established for a test position, a subassembly operation, a production run of a particular type product, or a divisional element of the contractor's plant.

Smoother production is an obvious advantage to be gained from RIQAP. For example, there is less delay in production, since formation of lots for Government inspection is eliminated. Storage space for the holding of sample inspection lots is not required. With an increase in production, a firm would not have to supply additional test equipment for the inspectors, and test equipment provided for inspection under the old system can be diverted.

In addition to these production economies, the manufacturer receives other tangible results besides the satisfaction gained from the recognition of his skill. The contractor, after receiving Army approval, can advertise the fact that he has qualified for RIQAP. Qualification is also an important factor in awarding new contracts, since the Signal Corps affects savings in personnel as well as receiving a better product.

If a qualified manufacturer should produce a poor product, RIQAP is not suddenly withdrawn. The Signal Corps recognizes the fluid nature of production methods and the possibility of short runs of poorer quality equipment. Inspection may be increased for a short time to meet the situation.

There are 19 additional plants being considered for RIQAP, and it is expected that the plan will be introduced into these plants before the end of the year. According to the Office of the Deputy for Quality Assurance, Signal Corps Supply Agency, 225 South Eighteenth St., Philadelphia 3, Pa., the plan is in force only in the Signal Corps, but is being considered by the Department of Defense for wider application.

**World Component Standards . . .** A world standard on testing components previously unacceptable to American engineers but in use in many other nations has been revised and may now be accepted in the United States. A committee that completed its work during the recent International Electrotechnical Commission meeting in Philadelphia revised the test standard and also developed four new world specifications on capacitors and resistors.

Agreement was reached on specifications for paper dielectric, electrolytic, and ceramic dielectric capacitors and carbon composition resistors. These specifications will be circulated to the various nations for a six-month trial approval period. Work was also completed on a draft specification on mica-dielectric capacitors which will now be circulated in trial form for further comment.



1122 EAST 23RD STREET  
INDIANAPOLIS, INDIANA

write today  
for free  
catalogs!

- Magnet Design — Bulletin 151 (for the design engineer)
- Standard Magnets — Catalog SM-1252 (complete data with dimensional drawings)
- Alnico 5Cb — Bulletin 1253 (details on today's newest Alnico)
- Laminations — Bulletin L-752 (applications, specifications, value graphs)
- Wound Cores — Bulletin WC-353 (specifications, value graphs)

Name and Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

CIRCLE ED-10 ON READER-SERVICE CARD FOR MORE INFORMATION



**CUT  
PRODUCT  
SIZE**



**WITH  
TEXAS  
INSTRUMENTS  
SUBMINIATURE  
TRANSFORMERS**

All transformers shown ACTUAL SIZE

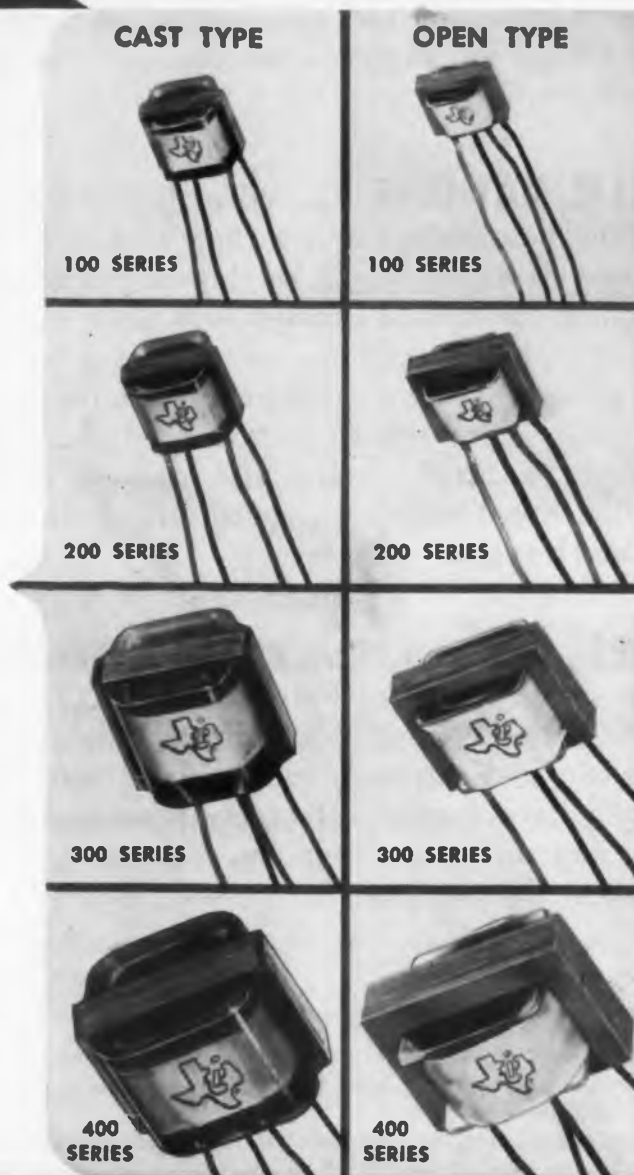
**T/I announces 32 new  
subminiature transformers...**

... for transistor and other miniaturization applications. Texas Instruments — also a leading transistor manufacturer — has applied its precise instrument standards in producing both transformers and transistors to bring you this first complete line of subminiature transformers. Behind every TI product are years of experience in meeting the exacting requirements of geophysical and military electronic equipment and components. This experience gives you added assurance of the reliable performance of these new transformers.

Input, interstage, choke, and output types are available in four size series ranging from less than  $\frac{3}{8}$  inch cubed (one milliwatt output) to slightly less than one inch cubed (over 100 milliwatts). Each series is manufactured in both open and cast construction, making a total of 16 basic types...32 models. Designed for use in the audio and ultrasonic frequencies, these subminiatures will operate over a temperature range of  $-25^{\circ}$  C to  $100^{\circ}$  C, with the cast units being particularly resistant to moisture and other environmental contamination. For your special applications, our engineers will design models to your detailed specifications.

**Write for literature!** Let our sales and design engineers help you with your specific transformer, magnetic amplifier or pulse network problems.

**TEXAS INSTRUMENTS  
INCORPORATED**  
6000 LEMMON AVENUE DALLAS 9, TEXAS



**Engineering Review . . .**

**Tougher Safety Film . . .** A new tougher safety film base designated "Cronar" has been developed that offers increased life for laboratory photographic records on motion picture film of microfilm. In tests of folding endurance, Cronar film base withstood an average of 17,000 flexings, while conventional safety film broke after 24 flexings.

Developed after eight years of research by E. I. du Pont de Nemours & Co., Wilmington, Del., the plastic is chemically related to "Dacron" polyester fiber for textiles and "Mylar" polyester film. It is a condensation polymer technically known as polyethylene terephthalate.

The greater toughness permits the thickness of motion picture film to be reduced from the standard 5.5mils. This decreased thickness will reduce shipping weight and storage volume per foot of film. Limited quantities of Cronar film are now commercially available for use as leader material in film processing.

**Flow Indicator . . .** The wind's force and direction are measured electrically by a newly developed instrument. Consisting of a hollow, 2" diameter ball on top of a cylinder, the sensing element contains two strain gages that measure wind-caused deflection of the ball. A photo of the sensor is shown below.

The resistance-wire strain gages are arranged to measure the strains caused by wind forces in two directions at right angles to each other. The strain gages are part of two independent Wheatstone bridge



More quality products  
from Texas Instruments'  
Components Division

CIRCLE ED-12 ON READER-SERVICE CARD FOR MORE INFORMATION

circuits, whose outputs are amplified for application to indicating instruments. Developed by the Baldwin-Lima-Hamilton Corp., Philadelphia, Pa., for use in aircraft research, the principle is applicable for use in water or other liquids as well as in air for the measurement of shock waves, explosion pressures, rates of flow, and similar phenomena.

**Long-Life Flexible Waveguides . . .** By heat treating flexible waveguides made of beryllium copper, great increases in life expectancy have been achieved. One of the newly developed waveguides showed no signs of failure after 500,000 cycles of reversed bending; conventional flexible waveguides broke after approximately 20,000 to 30,000 cycles. Preliminary tests indicate that the new waveguides are also exceptionally resistant to fatigue failure from vibration. A photo of the unit is shown below.

The precipitation-hardened beryllium copper waveguide will be manufactured by Techniraft Laboratories, Inc., Thomaston, Conn., under the name of "Seamless-Corrugated Flexible Waveguide". It will be produced in sizes to mate with RG-51/U and RG-52/U rigid waveguides.



**"Inductive Commutator" . . .** A new method of measuring the temperature of spinning gas turbine blades utilizes the "inductive commutator", which consists essentially of a number of pairs of input and output coils on the rotating shaft, with one stationary set of energizing and information-receiving coils mounted on the turbine frame.

Previous methods depended on blade-mounted thermocouples which are electrically connected to external measuring equipment through brushes and slip rings. With this method, good contact is difficult to maintain at high speeds, and the brushes wear rapidly.

In the new method, developed by M. L. Greenough of the National Bureau of Standards, Washington 25, D. C., for the Navy, rotation of the shaft brings each coil pair into and out of coupling with the stationary coils for periodic sampling. In addition to eliminating the wear problem, the "inductive commutator" may be run in either direction without modification.

ELECTRONIC DESIGN • October 1954

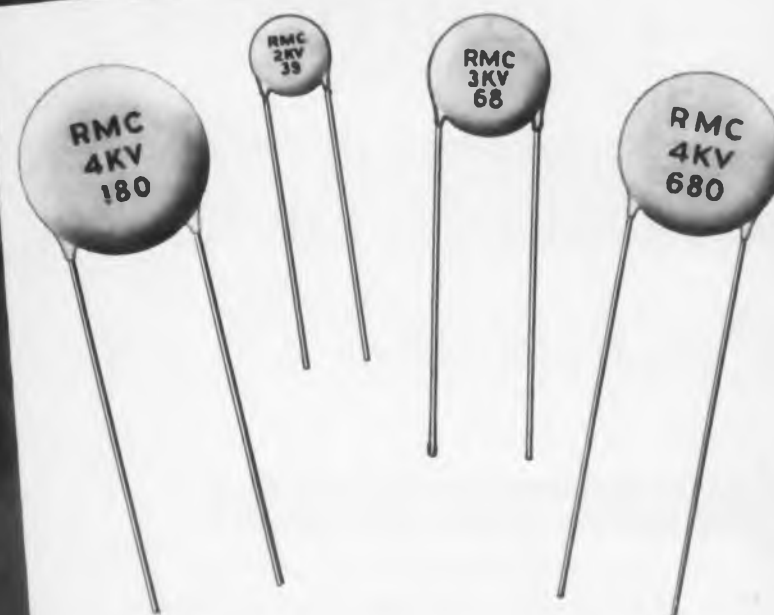
CAPACITY	DIELECTRIC	SIZE	AVAILABLE CAPACITY TOLERANCES	
2-KV				
5-47	N-750	3/16"	5-10-20%	GMV
48-68	N-750	1/2"	5-10-20%	GMV
69-82	N-750	3/8"	5-10-20%	GMV
83-130	N-750	3/8"	5-10-20%	GMV
131-200	N-1500	3/8"	5-10-20%	GMV
201-250	N-1500	3/4"	5-10-20%	GMV
251-330	N-1500	7/8"	5-10-20%	GMV
3-KV				
5-15	N-750	3/16"	5-10-20%	GMV
16-20	N-750	1/2"	5-10-20%	GMV
21-56	N-1500	3/8"	5-10-20%	GMV
57-180	N-1500	3/8"	5-10-20%	GMV
181-240	N-1500	3/4"	5-10-20%	GMV
241-330	N-1500	7/8"	5-10-20%	GMV
4-KV				
5-68	N-1500	7/8"	5-10-20%	GMV
69-180	N-1500	7/8"	5-10-20%	GMV
5-KV				
5-30	N-1500	3/8"	5-10-20%	GMV
31-60	N-1500	3/4"	5-10-20%	GMV
61-130	N-1500	7/8"	5-10-20%	GMV
6-KV				
5-20	N-1500	3/4"	-10-20%	GMV
21-100	N-1500	7/8"	-10-20%	GMV

POWER FACTOR: .1% Max. @ 1M C (initial)  
INSULATION: Durez phenolic—vacuum waxed

CAPACITY	DIELECTRIC	SIZE	AVAILABLE CAPACITY TOLERANCES	
2-KV				
331-470	1200-K	3/16"	± 20%	GMV
471-1000	1200-K	3/8"	± 20%	GMV
1001-2700	HI K	3/16"		GMV
2701-5000	HI K	3/8"		GMV
5001-10000	HI K	3/4"		GMV
3-KV				
220-500	1200-K	3/8"	± 20%	GMV
501-1000	1200-K	3/8"	± 20%	GMV
1001-5000	HI K	3/4"		GMV
4-KV				
181-680	1200-K	3/4"	± 20%	GMV
681-1000	HI K	3/8"		GMV
5-KV				
131-330	1200-K	7/8"	± 20%	GMV
331-1000	HI K	7/8"		GMV
6-KV				
101-220	1200-K	3/4"	± 20%	GMV
221-470	1200-K	7/8"	± 20%	GMV
221-1000	HI K	7/8"		GMV
471-1000	HI K	7/8"		GMV

POWER FACTOR: 1.5% Max. @ 1 KC (initial)  
INSULATION: Durez phenolic—vacuum waxed

Discaps with a dielectric of 1200 K or over are not recommended for deflection yokes or other 15,750 cycle applications.



production costs go  
down  
down  
down with RMC  
HIGH VOLTAGE DISCAPS

In addition to lower initial cost, RMC high voltage DISCAPS, offer the advantages of smaller size and greater mechanical strength for faster production line handling.

Rated at 2000, 3000, 4000, 5000 and 6000 volts DC, RMC DISCAPS assure the voltage safety factor required in deflection yoke or special electronic applications. They are available in any capacity between 5 MMF and 10,000 MMF.

RMC engineers are prepared to help you with your problems on standard or special ceramic capacitors. Write us today about your specific requirements.

DISCAP  
CERAMIC  
CAPACITORS



RADIO MATERIALS CORPORATION  
GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.

FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

CIRCLE ED-13 ON READER-SERVICE CARD FOR MORE INFORMATION



designer's

## INSTRUMENT guide

### RUGGEDIZED INSTRUMENTS

—to military specifications, available in 2½", 3½" and 4½" sizes in D-C, movable iron A-C, rectifier type A-C and thermo instruments. All have sealed, externally operated zero correctors—shock-resisting, flat plastic windows—and connection terminals molded into internal rubber.

### ULTRA-SENSITIVE RELAYS

—extremely compact and rugged relays which operate on values as low as ½ microampere or ¼ millivolt, direct from thermocouples, resistance bulbs or other generators of minute current. Handle substantial wattage at 110 volts on non-chattering magnetic contacts. Available with single or double contacts, fixed or adjustable, manual or solenoid reset.

### "MOTOR LOAD %" METERS

—WESTON "per-cent load" ammeters and wattmeters make it easy for operators to secure optimum production from lathes, milling machines, automatics, grinders, etc. Prevent overloading—reduce tool breakage—assure uniform quality with fewer objects. Other scale calibrations available.

### RECORDING POTENTIOMETER

—ideal for built-in needs because of its extreme compactness plus ruggedness and simplicity. Ranges changed simply by inserting required range standards. Chart speeds changed by simple screwdriver adjustment. Plug-in amplifier removed in a jiffy since no soldered connections are used.

Literature on any of the above instruments sent on request.  
WESTON Electrical Instrument Corporation,  
614 Frelinghuysen Avenue, Newark 5, New Jersey.

8106

**WESTON**  
*Instruments*

CIRCLE ED-14 ON READER-SERVICE CARD FOR MORE INFO

## Engineering Review . . .

**ECDA Meets . . .** "The Buyer's Viewpoint of New Products" was the subject of the Sept. 14th meeting of the recently organized Electronic Commercial Development Association. Mr. James B. Burke, Manager, General Purchasing Div., RCA Victor Div., Radio Corp. of America, Camden, N. J., discussed "The Purchasing Agent Looks at A New Product"; and Mr. James Brothers, Chief Components Engineer, Philco Corp., Philadelphia, Pa., spoke on "The Components Engineer Looks at A New Product". Their talks covered what the buyer and engineer need and expect in the new product and what they need and expect from the company bringing the new product to their attention. Mr. Campbell Rutledge Jr., General Sales Mgr., New Products Div., Corning Glass Works, Corning, N. Y., acted as chairman and moderator of the discussion that followed the talks.

The association is a non-profit group consisting of commercial development managers in the electronic industries who meet several times a year at informal dinner meetings to discuss mutual problems. Individual membership (not on a company basis) is open to qualified executives who have the responsibility of developing commercial products in their companies. Reprints of the talks are available from James S. Mulholland Jr., Secretary, Electronic Commercial Development Association, c/o ELECTRONIC DESIGN, 19 E. 62nd Street, New York 21, N. Y.

**Sound-Absorbing Helmet . . .** Engineers and technicians testing equipment in areas where there is noise loud enough to cause pain, such as that produced by jet engines, can be protected by a new sound-absorbing helmet. Known as the "Sound-Absorb" helmet, the safety device has accommodations for standard intercommunication earphones, and allows clear hearing, even in ambient noise levels of 150db. It is made by Bill Jack Scientific Instrument Co., P. O. Box C-23, Solana Beach, Calif., and attenuates noise from 50 to 60db in the range of 2500 to 10,000cy.

**Airborne Radar . . .** A new, compact radar operating in the 10,000Mc band was developed for troop-carrying transports and essential cargo planes. A single 5" radar screen combines many radar functions of search and surveillance, accurate navigation over uncharted airplanes, detection of distant storms, and warning of mountain tops, tall structures, or nearby aircraft.

Developed by Sperry Gyroscope Co., Div. of the Sperry Corp., Great Neck, N. Y., for the Air Force, the entire system only weighs 150lb. This weight includes an oddly-shaped "turtle shell" antenna only 18" in size, which is gyro-stabilized for positive steadiness against pitch and roll of the aircraft. Officially designated radar set APN-59, it incorporates radar beacon interrogation and reception. Fixed ranges are 50, 100, and 240 miles, with close-up enlargements variable from 3 to 30 miles.



## Meetings

**October 13-17:** *1954 Annual Convention, Audio Engineering Society*, Hotel New Yorker, New York, N. Y. For information, write to C. J. LeBel, P. O. Box 12, New York 11, N. Y.

**October 18-20:** *Radio Fall Meeting*, Hotel Syracuse, Syracuse, N. Y. For information, write to Radio-Electronics-Television Manufacturers Association, 777 14th St., Washington 5, D. C.

**October 18-20:** *Conference on Electrical Insulation*, Pocono Manor Inn, Pocono Manor, Pa. For information, write to D. A. McLean, National Academy of Science, 2101 Constitution Ave., Washington 25, D. C.

**October 26-28:** *National Conference on Tube Techniques*. Western Union Auditorium, 60 Hudson St., New York 13, N.Y. Sponsored by Working Group on Tube Techniques, Dept. of Defense. Papers should be submitted to Dr. Harold Jacobs, Thermionics Branch, Evans Signal Laboratory, Belmar, N.J. For information, write to Harold J. Sullivan, Advisory Group on Electron Tubes, 346 B'way, N. Y. 13, N.Y.

**November 4-5:** *East Coast Conference on Airborne and Navigational Electronics*. Sheraton-Belvedere Hotel, Baltimore, Md. For information, write to IRI, 1 East 79th Street, New York, N.Y.

**November 8-10:** *Symposium on Modern Advances in Microwave Techniques*, Engineering Societies Bldg., 33 W. 39th St., New York 19, N. Y. For information, write to Polytechnic Institute of Brooklyn, Microwave Research Institute, 55 Johnson St., Brooklyn 1, N. Y.

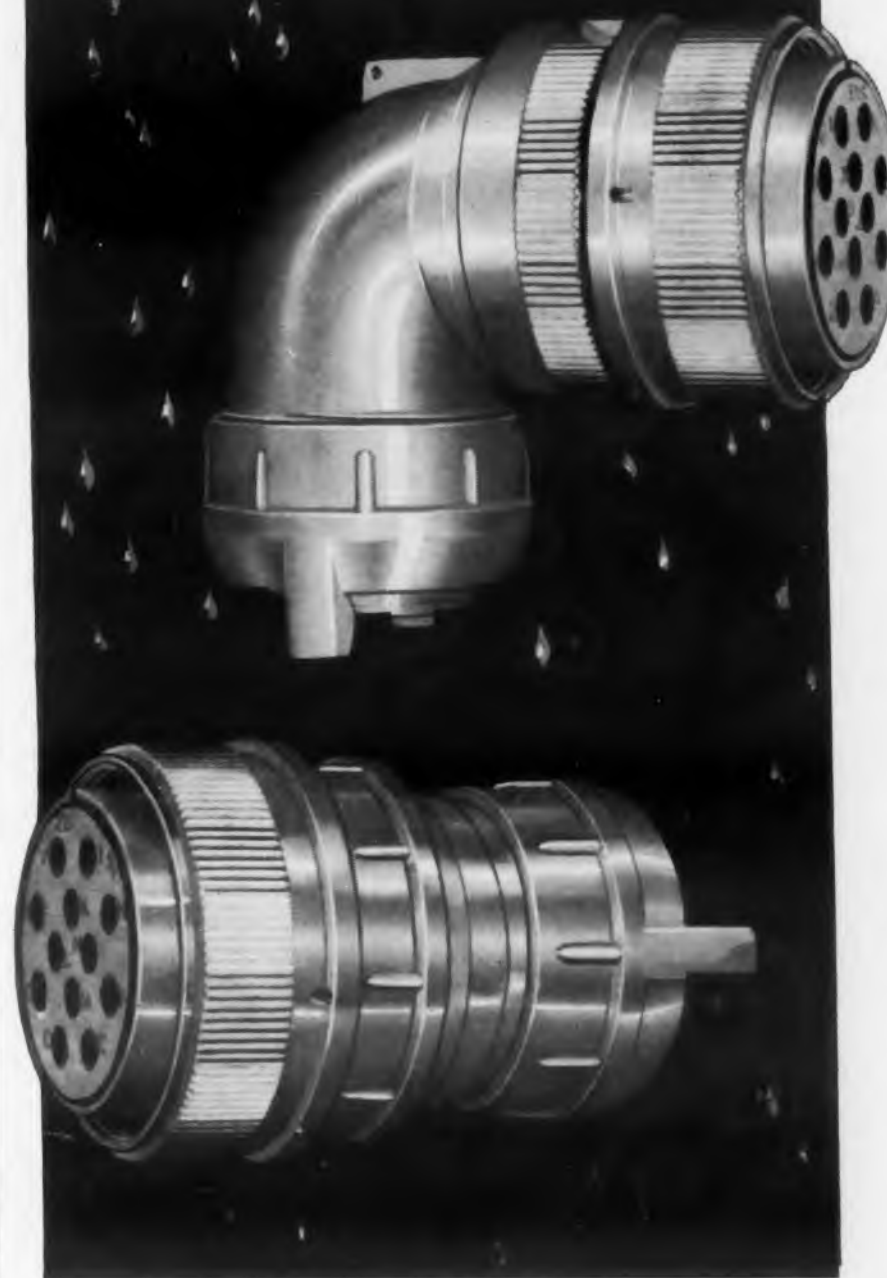
**November 10-11:** *Conference on Electronic Instrumentation and Nucleonics in Medicine*. Morrison Hotel, Chicago, Ill. For information, write to AIEE, 33 West 39th Street, New York 19, N. Y.

**November 15-17:** *ASA Fifth National Conference on Standards*. Hotel Roosevelt, N.Y.C. For information, write to Public Relations Director, ASA, 70 E. 45th St., New York, N. Y.

**November 18-20:** *Symposium on Precision Electrical Measurements*, National Physical Laboratory, Teddington, England. For information, write to Director, NPL, Teddington, Middlesex, England.

**November 29-December 3:** *First International Automation Exposition*, 242nd Coast Artillery Armory, New York, N. Y. For information, write to First International Automation Exposition, 845 Ridge Ave., Pittsburgh 12, Pa.

# now! BENDIX-SCINFLEX waterproof plugs



→ *for use with  
multi-conductor  
cables*

These new Bendix\*-Scinflex *waterproof* plugs are a modification of our standard AN type "E" (environment resistant) connector. They are designed to meet all "E" performance requirements when used with multi-conductor cables. Each plug includes a modified AN3057B cable clamp which provides inward radial compression on multi-conductor cables. This unique feature completely eliminates cable strain—a common source of circuit trouble.

In addition, there are gaskets at all mating surfaces and an accessory sleeve is available to accommodate an extreme range of cable sizes. A folder describing this new waterproof plug—and the various sizes in which it is manufactured—may be obtained by writing our Sales Department.

\* TRADE-MARK

### THESE BUILT-IN FEATURES ASSURE TOP PROTECTION AGAINST CIRCUIT FAILURE:

Shock and Vibration Resistant • Die Cast Aluminum Shell  
• Cadmium Plate—Olive Drab Finish • Moisture-Proof,  
Pressurized • High Arc Resistance, High Dielectric  
Strength • Silver-Plated Contacts • Resilient Inserts

## SCINTILLA DIVISION

**Bendix**  
AVIATION CORPORATION

SIDNEY, NEW YORK

Export Sales: Bendix International Division  
205 East 42nd St., New York 17, N. Y.

Factory Branch Offices: 117 E. Providencia Avenue, Burbank, California • Brouwer Building, 176 W. Wisconsin Avenue, Milwaukee, Wisconsin • Stephenson Building, 6560 Cass Avenue, Detroit 2, Michigan • 512 West Avenue, Jenkintown, Pennsylvania • 8401 Cedar Springs Rd., Dallas 19, Texas • American Building, 4 South Main Street, Dayton 2, Ohio

CIRCLE ED-15 ON READER-SERVICE CARD FOR MORE INFORMATION

**Bendix**

Table I. This data was employed to plot the curves in Fig. 1.

A	B	C	D	E	F	G	H	I	J	K	L	M <sub>1</sub>	M <sub>2</sub>
AWG	C.M. Area Nom.	Fusing Current I <sub>r</sub> (Amperes)	Max. Cdr. Resis. 25°C. (Ohms per ft) R <sub>c</sub>	I <sub>r</sub> <sup>2</sup>	I <sub>r</sub> <sup>2</sup> x R <sub>c</sub> (Watts)	(I <sub>r</sub> <sup>2</sup> x R <sub>c</sub> x .24) (Calories) H <sub>c</sub>	Above Ambient T	T x H <sub>c</sub>	T x H <sub>c</sub> / 1083 (Calories at T H <sub>c1</sub> )	R <sub>c</sub> x .24	H <sub>c1</sub> / R <sub>c</sub> x .24	$\sqrt{\frac{H_{c1}}{R_c \times .24}}$ = I (amp, Current to Initiate T)	0.5% MCM (Safety factor)
30	100	10.28	1.09	105.8	115.3	27.7	20	555	.512	.262	1.95	1.39	1.36
							30	832	.768	2.93	1.71	1.67	
							40	1108	1.023	3.91	1.97	1.92	
							50	1383	1.277	4.97	2.21	2.16	
							60	1660	1.532	5.85	2.42	2.36	
							70	1938	1.785	6.82	2.62	2.56	
							80	2215	2.042	7.80	2.79	2.72	
							90	2490	2.297	8.77	2.96	2.89	
							100	2770	2.553	9.35	3.06	2.98	
							125	3462	3.192	12.17	3.49	3.40	
150	4160	3.835	14.62	3.82	3.73								
24	442	31.2	.284	970	276	66.4	20	1328	1.224	.0682	17.95	4.24	4.13
							30	1992	1.835	26.91	5.19	5.06	
							40	2660	2.450	35.91	5.99	5.84	
							50	3320	3.062	44.90	6.70	6.53	
							60	3985	3.680	54.00	7.35	7.16	
							70	4650	4.280	62.80	7.92	7.71	
							80	5320	4.900	71.70	8.46	8.24	
							90	5980	5.520	80.8	8.98	8.76	
							100	6640	6.120	89.7	9.46	9.21	
							125	8310	7.675	112.5	10.61	10.33	
150	9970	9.200	134.9	11.62	11.30								
18	1624	82.87	.075	6875	516	123.8	20	2460	2.27	.018	126.1	11.23	10.87
							30	3690	3.41	189.3	13.74	13.30	
							40	4960	4.57	254.0	15.94	15.44	
							50	6190	5.72	317.0	17.80	17.22	
							60	7440	6.86	381.0	19.50	18.90	
							70	8670	8.00	444.0	21.05	20.39	
							80	9920	9.15	507.5	22.50	21.76	
							90	11140	10.27	572.0	23.95	23.20	
							100	12380	11.41	634.0	25.21	25.40	
							125	15450	14.25	793.0	28.20	27.30	
150	18560	17.13	953.0	30.90	29.93								
12	6500	234.5	.019	5500	1045	251	20	5250	4.63	.00457	1012	31.8	30.00
							30	7535	6.96	1520	39.0	36.80	
							40	10040	9.26	2024	44.9	42.43	
							50	12540	11.56	2534	50.4	47.60	
							60	15050	13.87	3044	55.2	52.10	
							70	17550	16.17	3545	59.6	56.20	
							80	20080	18.50	406.0	63.8	60.30	
							90	22580	20.83	457.0	67.6	63.70	
							100	25100	23.15	507.5	71.2	67.20	
							125	31400	28.95	634.0	79.6	75.20	
150	37680	34.75	762.0	87.3	83.75								
4	42600	932.5	.0029	872000	25250	582	20	11620	10.72	.000697	15380	124.0	95.30
							30	17420	16.06	23100	151.8	116.30	
							40	23250	21.47	30800	175.5	134.60	
							50	29080	26.80	38450	196.0	150.00	
							60	34900	32.20	46250	215.0	164.50	
							70	40700	37.55	53900	232.4	178.40	
							80	46600	42.90	61700	248.4	190.50	
							90	52400	48.30	69300	263.8	203.00	
							100	58200	53.70	77000	278.0	213.50	
							125	72800	67.20	96300	310.8	238.40	
150	87400	80.60	115500	340.0	261.00								

1. I<sub>r</sub> fusing current, is based on the formula  $I_r = 10244 \sqrt{d^2}$  where 10244 is the fusing constant for copper, and d is the diameter of the uninsulated conductor in inches.

2. Calories per second during the application of the fusing current were obtained from the formula  $I_r^2 \times R_c \times 0.24 = \text{Calories per second}$ , where I<sub>r</sub> is obtained from step 1, R<sub>c</sub> is copper resistance in ohms per foot, and 0.24 is the heat factor equal to 1 Joule.

3. Amount of energy in calories per second which produces a given temperature T can be obtained by applying the ratio H<sub>r</sub>:1083 as H<sub>r</sub>:T where H<sub>r</sub> equals calories per second at the fusing point, 1083 is the melting point of copper in °C, T is the given temperature, and H<sub>c</sub> is the unknown (calories per second).

The formula is then

$$H = (T \times H_r) / 1083$$

4. Finally, by the application of Joule's law, to find the current I which produces energy (calories per second) equal to the given temperature T we find that

$$I_c^2 R_c \times 0.24 = H_{c1}$$

and

$$I = \sqrt{\frac{H_{c1}}{R_c \times 0.24}}$$



# Choosing Wire Sizes for High Temperatures

By John Holland, Chief Engineer

Hitemp Wires, Inc., Mineola, L. I., N. Y.

**M**ETHODS for determining the proper wire size for conductors in equipment operated at high temperatures are given here for single- and multi-strand wires and for conductors carrying high, short-time pulses. The formulae and or charts apply equally well to wire insulated with Teflon, Silicone, or the conventional insulations.

The fundamental problem in selecting an optimum wire size has three elements:

1. To provide adequate circular mil area of copper to prevent excessive voltage drop or heat generation.
2. To meet space-factor requirements of a particular assembly or component.
3. To provide sufficient tensile strength and flexibility to meet mechanical as well as electrical needs.

Although all of these considerations must be met, the most difficult one to overcome is the problem of heat generation. The problem varies if an engineer is dealing with single conductors, multi-conductors or with a special situation—such as high, short-time pulse currents. For example, when dealing with pulse currents of short duration, the governing consideration is the fusing current of the conductor. In the other instances, it may be temperature rise above ambient, or perhaps physical wire size.

## Selecting Single Conductors

Table 1 lists five small-gage wires from 4 to 30 AWG, along with the permissible current flow through them for a particular temperature rise above ambient. Having this data, a number of useful charts can be prepared. To fully understand these charts, the table and its deviation should be considered first.

The calculations given with the chart are based entirely on the  $I^2R$  loss in a current-carrying conductor. Hence the tabulated results in column  $M_1$  do not represent actual conditions encountered in service.

In most cases other factors would be present to affect the current rating:

- A. Proximity Effects**—Although usually not a serious problem in most applications, a margin of safety should be allowed for proximity effects. In high power applications, for example, induction effects between conductors laid in parallel might lower their current rating.
- B. Voltage Stresses**—To be realistic, the engineer

should allow for repeated cycling, or perhaps voltages surges and peaks that may occur in service.

- C. Increase in Straight d-c Resistance**: Theoretical resistance of a conductor could change due to broken strands (while handling), cold solder or other poor terminations, or changes in ambient temperature that were not anticipated at the time of design.

For these and any other conditions which might

Fig. 1. Maximum current carrying capacity for the various wire sizes indicated can be calculated from these curves as shown in the first example on p. 20.

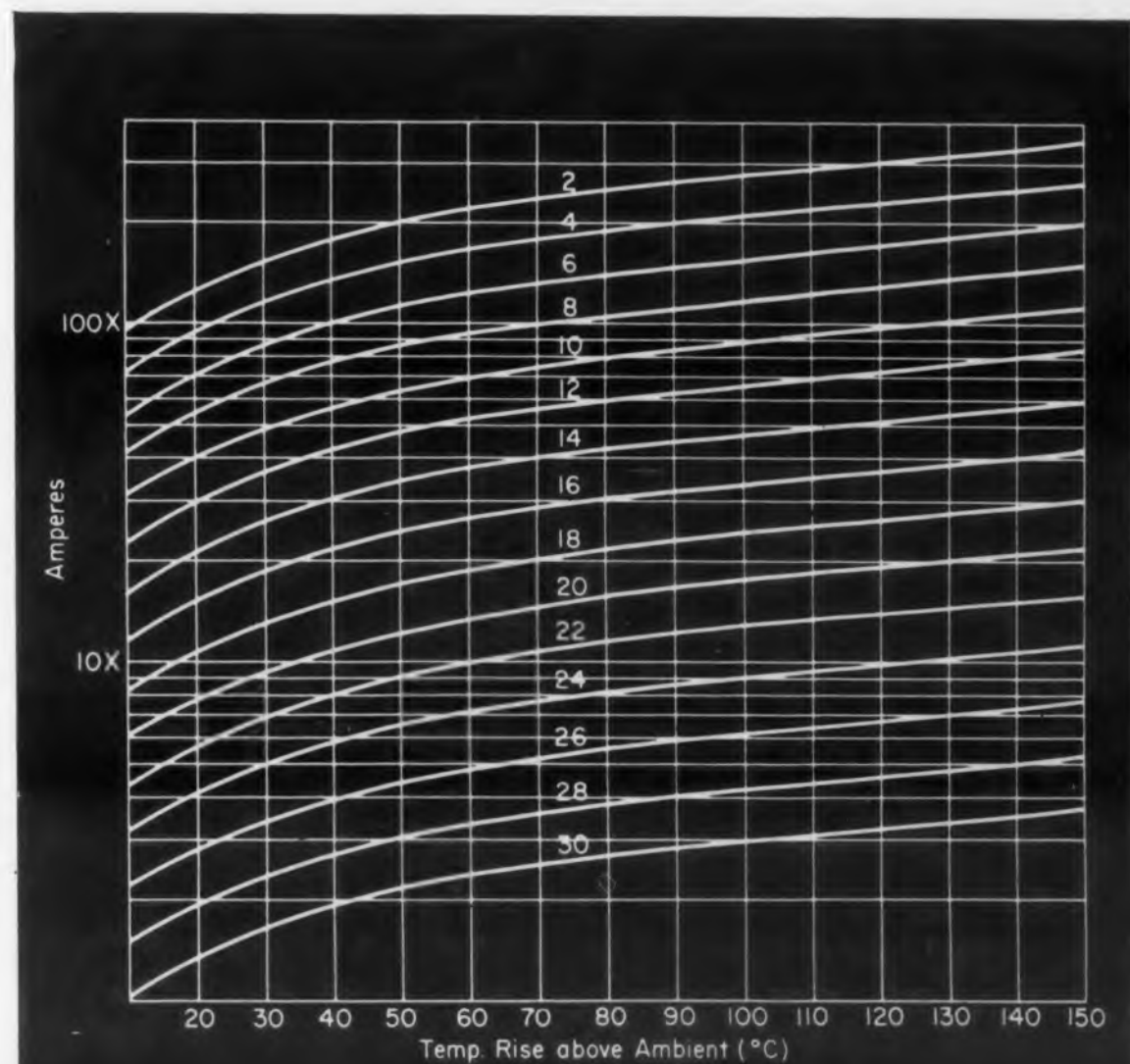


Fig. 2. Fusing times for various wire sizes. These plots apply to conductors carrying pulse currents.

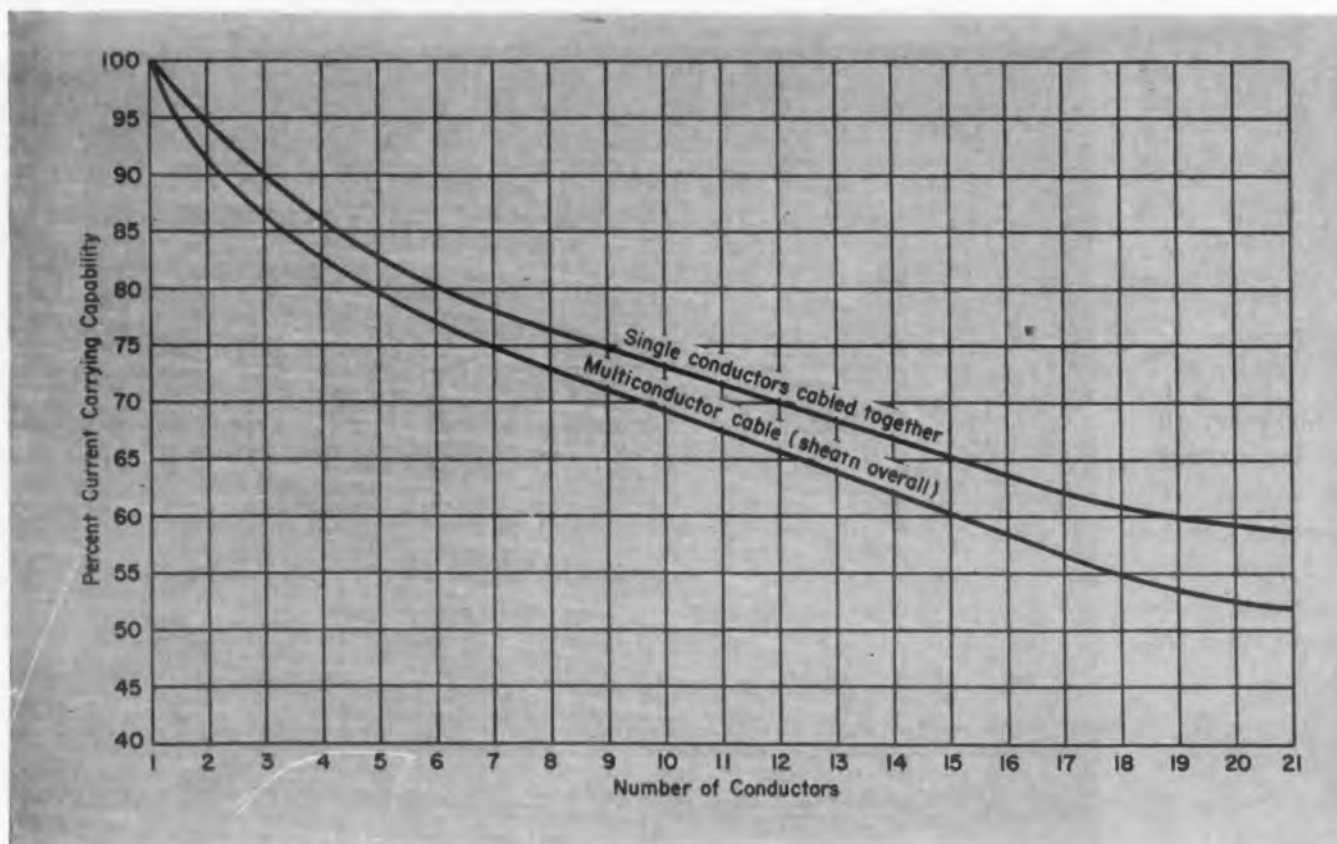
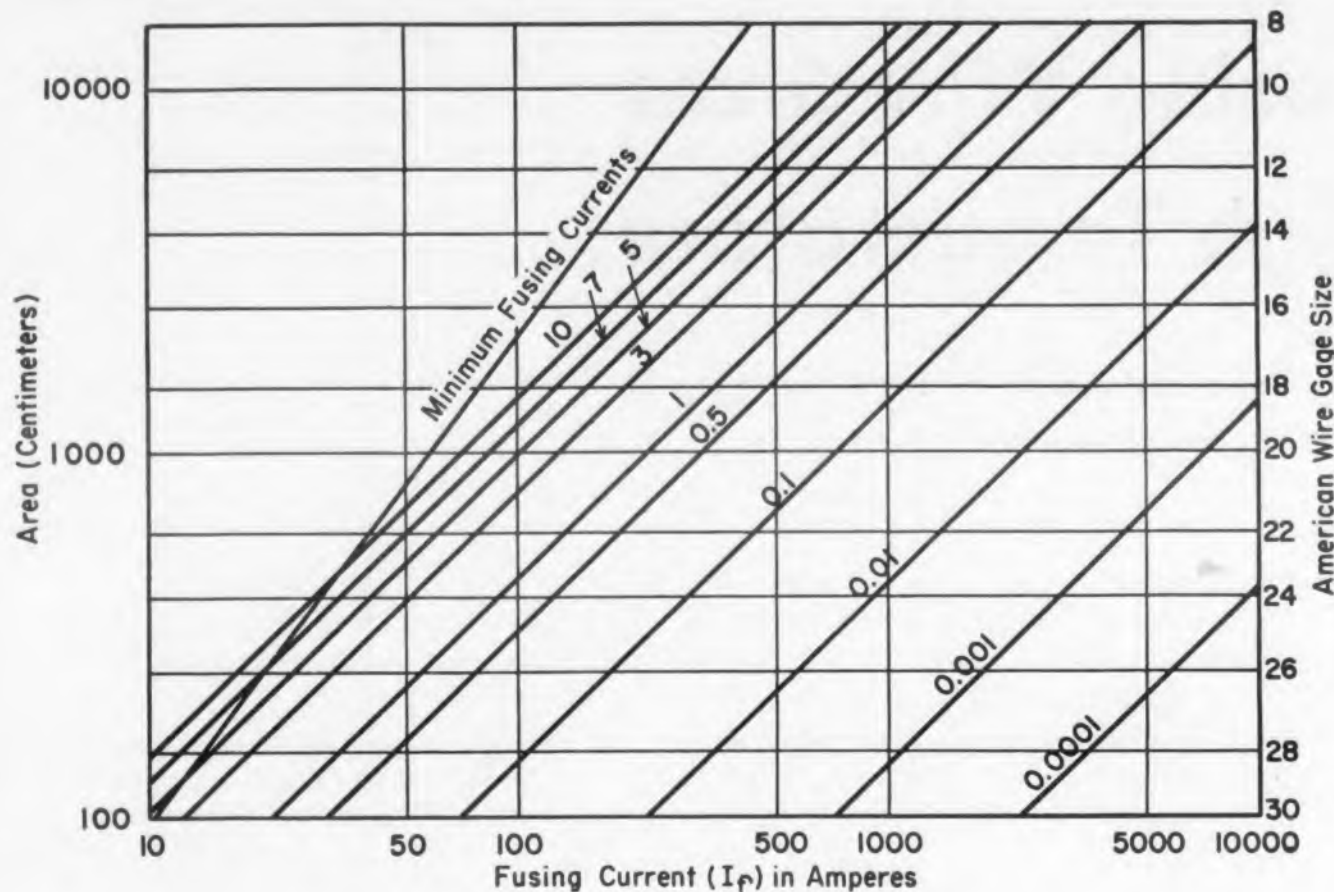


Fig. 3. The current carrying capacity of multi-conductor cable can be calculated from these curves after determining the capacity of the individual wires.

conceivably arise, the calculated results were modified with a safety factor of 0.5% per thousandth of circular mil of conductor area. Column  $M_2$  lists the new values of permissible current flow, derated to provide for proximity effects, increases in voltage stress, thermal resistance of insulation, and increases in electrical d-c resistance of the conductor as it varies with copper temperature.

To apply the data given in Table 1 the family of curves shown in Fig. 2 were drawn. Current in amperes taken from Column  $M_2$  is the ordinate, degrees-centigrade-temperature rise is the abscissa. Values were plotted for conductor sizes from No. 2 AWG to No. 30 AWG, inclusive.

Now if the maximum ambient temperature plus allowable rise is known, as well as the thermal limitation of the wire insulation being considered, the maximum current capacity of a wire size can be determined from the curves:

#### Example:

Q) What current can a No. 20 gage polyvinyl-chloride-insulated wire (60°C compound) carry when subjected to an ambient temperature of +40°C?

A) The 60°C limitation permitting only a 20°C rise in I<sup>2</sup>R temperature of the insulation is to remain unaffected. The curve for a No. 20 gage wire in Fig. 2 indicates that a current of approximately 7.5amp will cause the 20° allowable copper rise. Thus, if a maximum of 7.5amp is put through the conductor it will be functioning at its greatest capacity without exceeding its thermal limit.

Q) How much current can a No. 20 gage Teflon-insulated wire carry if it is to be subjected to an ambient temperature of +40°C?

A) Teflon has a maximum temperature limitation of +260°C. Therefore, a 220°C copper temperature rise can be tolerated without adverse effects. Again, from Fig. 2, it is found that a current flow of more than 20amp can be carried without exceeding the thermal limitation of Teflon. However, in this instance, such high current could not be tolerated if voltage drop is to be considered.

As indicated in the examples cited above, values obtained from Fig. 2 apply to the selection of single conductors only. Before the data can be applied to multi-conductor constructions such as cables and harness assemblies, an additional factor of safety must be allowed.

Conductors cabled together, as in a harness or as a multi-conductor cable with a protective covering overall, virtually behave as heaters. Since heat generated in one conductor of a cable is quickly transmitted to adjacent copper, the thermal considerations are more complex than those applying to single conductors.

To obtain useful design data, the chart must take into consideration the number of conductors in the cable, the type of cable construction, and the total energy loss in calories per second of the complete cable assembly. Other factors include the thermal resistance of the outer sheath, if there is one, and the Geometric Factor.

Thus, to find the current-carrying capacities of



conductors cabled together, first find the capacity of the individual conductors by using the family of curves in Fig. 3. Then, depending on the nature of the construction and the number of conductors, obtain the percentage of current-carrying capacity allowed. Because of thermal effects, the rated capacity of an individual conductor will be lower when used in a cable. However, the total flow in all conductors will, of course, be greater.

#### Example:

Q) If seven No. 20 gage wires, insulated with polyvinyl chloride, are contained in a multi-conductor cable (sheath overall), what is the permissible current flow through any one conductor in an ambient temperature of +40°C?

A) The conditions are identical with the first example given for single conductors, in which the maximum allowable flow was found to be 7.5amp. From the chart of Fig. 3, we find that the percentage reduction in capacity for a 7-conductor cable of this type is 25%. Therefore, allowable flow is only 7.5 x .75 or about 5.6amp.

#### Pulse-Carrying Conductors

In applications where high currents of short duration are encountered, it is often desirable to use small diameter wire. Within limits, high currents can be carried by small gages without degrading the conductor or its insulation. In this sort of problem, however, attention is focussed on the duration and frequency of the pulse being handled.

Curves in Fig. 2 therefore plot the fusing current and circular mil area of copper and indicate the length of time a current surge will take to fuse the conductor. Data is based on the formula:

$$I_f = A \sqrt{\log_{10} \left( \frac{T_m - T_a}{234 + T_a} \right) + 1} \frac{1}{33t}$$

Where:

- $A$  is conductor area in circular mils
- $T_m$  is melting temperature of copper (1083°C)
- $T_a$  is room temperature (21°C)
- $I_f$  is fusing current in amperes
- $t$  is fusing time in seconds (from Fig. 2)

Although most wire selection problems arise out of thermal restrictions, there are special cases where solvent resistance or perhaps weathering or fungus resistance are the prime factors. However, these are the exceptions rather than the rule.

For this reason, most of the foregoing data pertains to current-carrying limitations as affected by heat. Although the methods used depend on calculations, many of the values obtained have been proved in the laboratory and in actual service. In keeping with good engineering practice, the data should be used as a guide, and should not entirely govern the selection of wire sizes.

Really **R&R** Reliable

**SEMI-CONDUCTOR PRODUCTS**  
for all your rectifier,  
diode and transistor needs

- Outstanding performance
- Uniformly dependable
- Long life
- Rigid quality control
- Constantly improved

RADIO RECEPTOR CO. conducts continuing laboratory research to maintain highest standards for existing types of selenium rectifiers, silicon and germanium diodes and transistors—and to develop new units, including those to meet special needs where necessary.

As rapidly as possible we publish bulletins on our products and they are always available upon request. Sometimes, though, we find the printing presses simply cannot keep up with our progress . . . So, for the best and most up-to-date facts about RADIO RECEPTOR semi-conductor products *we suggest you submit your specifications*. Our engineers will gladly make recommendations incorporating the very latest information at their command. Just address Section D-1.



Semi-Conductor Division  
**RADIO RECEPTOR COMPANY, INC.**  
SALES DEPARTMENT: 251 WEST 19TH STREET, NEW YORK 11, N. Y.  
Telephone: WAtkins 4-3633, *Factories in Brooklyn, N. Y.*

CIRCLE ED-16 ON READER-SERVICE CARD FOR MORE INFORMATION

The New **SHURE** "TWIN-LEVER"

CERAMIC PICKUP CARTRIDGE

for High Fidelity systems



PC Series for 33 $\frac{1}{3}$ , 45, 78 r.p.m.

AN "AB" LISTENING TEST WILL PROVE THAT THIS CARTRIDGE SURPASSES ANY OTHER HIGH QUALITY COMMERCIAL CARTRIDGE!

A new frontier for the Ceramic principle has been crossed by the development of this cartridge. Designers of high fidelity phonograph systems and hi-fi radio or tv phono combinations, who have been "test piloting" this new "Twin-Lever" ceramic development, report an amazing superiority in tone quality that can be easily heard before the cartridge is even measured!

This "Twin-Lever", high fidelity ceramic cartridge represents the ultimate in commercial high fidelity reproduction—**without compensating preamplifiers!** Smooth, wide range response from 50 to 12,000 c.p.s., plus or minus 3 db. Other features which help to make this new cartridge so outstanding in performance are: high compliance that virtually eliminates tracking distortion . . . extremely low effective mass provided by new specially-designed needles and new coupling . . . tailored needles on separate needle shafts, functioning independently for best 78 rpm response, too—as well as the superior microgroove performance.

The new unique design eliminates "turnover" of either the cartridge or the needles. Both needles are in the same plane, and an ingenious, lever-operated shift mechanism gently moves each needle in and out of playing position.

**RADICAL NEW DESIGN FOR NEEDLE REPLACEMENT!**

Needle replacement is now so simple it can be done blindfolded!! This is a feature that will be of special interest to the ultimate users of your original equipment. Anybody can replace the needle, without tools, in a few seconds—while the cartridge remains in the pickup arm!

**TECHNICAL DATA for MODELS PC4 and PC5**

Output Level at 1,000 c.p.s.	.40 volts (33 $\frac{1}{3}$ , 45 rpm)
Output Level at 1,000 c.p.s.	.65 volts (78 rpm)
Frequency Response	50-12,000 c.p.s.
Compliance	1.30 x 10 <sup>-6</sup> cm/dyne
Tracking Force	5 to 8 grams
Net Weight	7.3 grams
Dimensions	1 $\frac{3}{4}$ " overall length; $\frac{1}{2}$ " wide $\frac{3}{8}$ " high

**ALSO . . . .**

New High Output Ceramic Cartridges NO LESS OUTSTANDING IN THEIR CONTRIBUTION TO LOW COST, FINE QUALITY REPRODUCTION ARE THE HIGH-OUTPUT CARTRIDGES, MODELS PC2 and PC3.

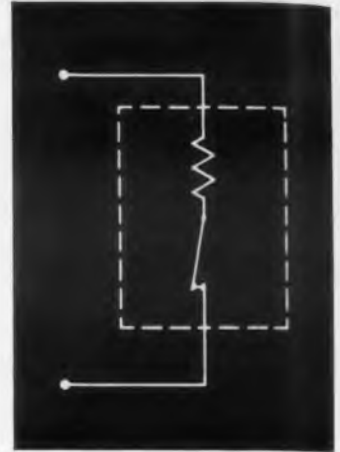
**SHURE** *The Mark of Quality*

For further information on these remarkable new cartridges, write SALES DIVISION—SHURE BROTHERS, INC., 225 W. HURON STREET, CHICAGO 10, ILL.





Fig. 1. This miniature relay furnishes a wide range of specified time delays.



# Miniature Time-Delay Relay

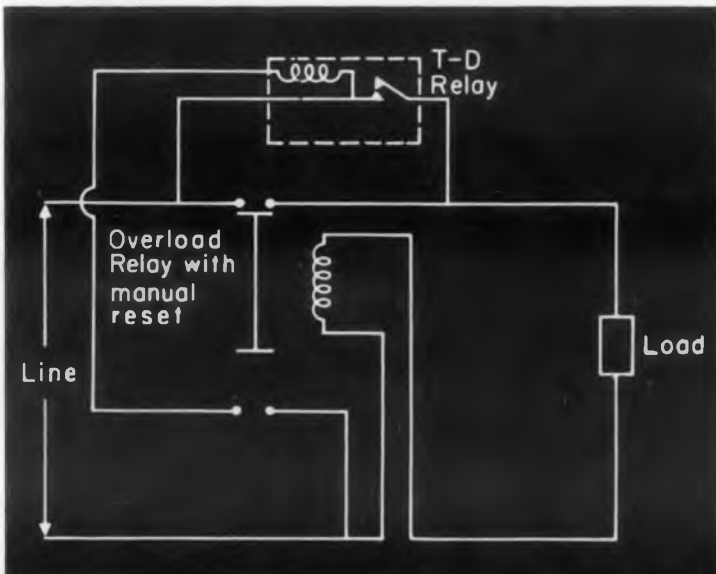
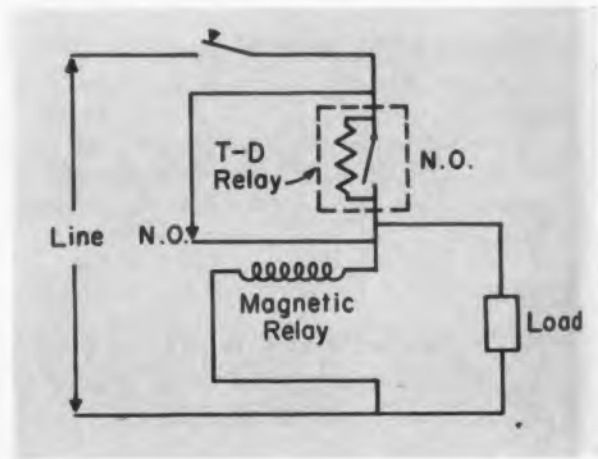
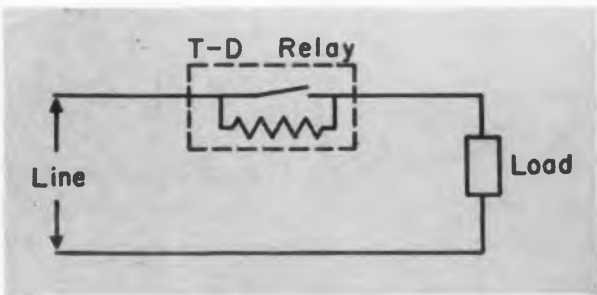


Fig. 3. Various delay circuits. A timing circuit for flashing a light or alternate starting or stopping of synchronous motors (upper left). A delay in energization occurs when the switch is closed in the upper right circuit. The circuit at the left is for delayed shutdown.

T  
tim  
in  
or  
am  
bey  
L  
ear  
wit  
arc  
eat  
Th  
ufa  
Ne  
of  
110  
2 t  
ore  
in  
3/4  
cir  
ste  
int  
sin  
ass  
mo  
to  
EL

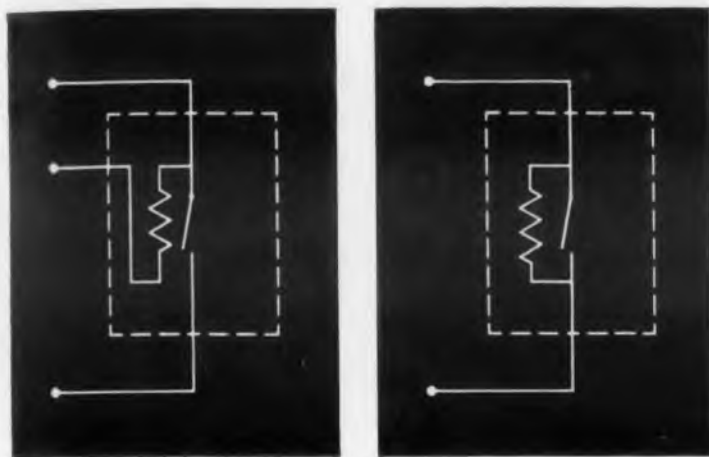


Fig. 2. Relay heater arrangements (from left to right): normally closed; normally open or closed; normally open.

**T**IME delays of from 2 to 120 sec can be specified at very low cost by using the miniature thermal time-delay relay shown in Fig. 1. Available only in single-pole, single-throw models—normally open or normally closed, the units can be utilized where ambient thermal and humidity conditions are not beyond average.

Because of its small size and weight, the relay can be wired directly into a circuit like a capacitor without requiring any support or base. Designed around a new type of heater element without delicate moving parts, the rugged unit has a long life. These miniature relays are made by Belltron Manufacturing Co., Inc., 204 Second St., Elizabeth, New Jersey.

The time delays are factory set with a tolerance of  $\pm 20\%$ . Operating voltages range from 6.3v to 110v, a-c or d-c. Standard contacts are rated from 2 to 5amp, with higher ratings available on special order. The various heater arrangements are shown in Fig. 2. The dimensions of the relay's body are  $3/8$ " diam x  $1-1/8$ " long. It weighs  $1/2$  oz. Various circuits utilizing the relay are shown in Fig. 3.

On special order, units can be supplied for stepped sequential timing of several devices with interlocks to guarantee order of sequence. If desired, the relay can be furnished as part of a larger assembly with other specified components. For more information on these inexpensive relays, turn to the Reader-Service Card and circle **ED-18**.

ELECTRONIC DESIGN • October 1954



Collins' new research and development facility in Cedar Rapids.



Dallas, Texas, facilities.

Burbank facilities.



## From COLLINS *outstanding research and development facilities* come these contributions to industry

Collins' new research and development facility in Cedar Rapids (pictured top above) houses 12 ultra modern laboratories, with especially designed equipment required by Collins in its diversified development program. It brings together, under one roof, highly trained engineering teams and the most advanced electronic research tools. This new Collins facility in Cedar Rapids is supplemented by Dallas and Burbank laboratories for the development of specialized electronic components for industry.

In addition to the finest facilities, Collins places even greater importance on engineering personnel. Some of the best engineering talent in the nation is at work on Collins' development projects. So today, with greatly expanded research and development laboratories, Collins is better equipped than ever to assist the Electronic Industry. Technical literature is now available on the Collins components shown, and your inquiry is invited.



Hysteresis Motors



Autotunes and Autopositioners



Oscillators



Mechanical Filters

### COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA

261 Madison Ave.  
NEW YORK 16

1930 Hi-Line Drive  
DALLAS 2

2700 W. Olive Ave.  
BURBANK

Collins Radio Company of Canada, Ltd., 74 Sparks St., OTTAWA, ONTARIO

CIRCLE ED-19 ON READER-SERVICE CARD FOR MORE INFORMATION



# Diode Amplifiers

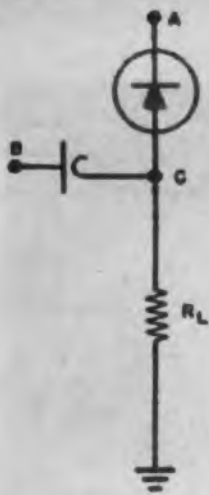


Fig. 1. The basic diode amplifier circuit. Input signal applied at point B. clock power at A. Output is at C.

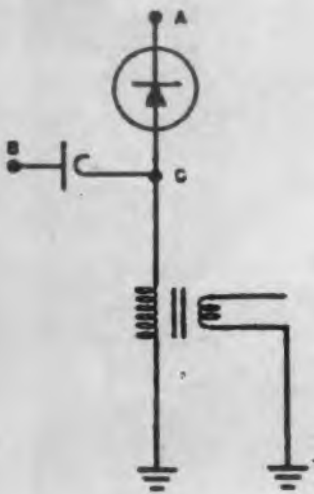


Fig. 2. Similar in operation to Fig. 1, this circuit provides current gain by use of a transformer.

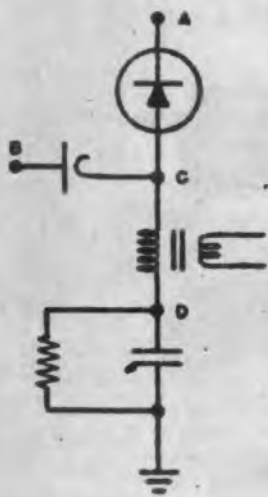


Fig. 3. The addition of a capacitor and resistor between the transformer and ground improves transformer "fly-back".

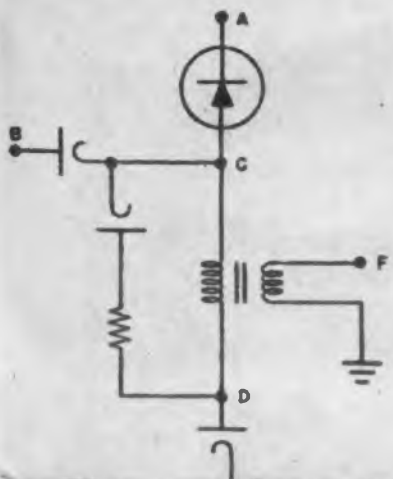


Fig. 4. By driving point E with a clock voltage  $180^\circ$  out of phase with the power supply clock, the circuit in Fig. 3 is further improved.

**P**OWER gains up to 10 per stage have been achieved with commercial germanium and silicon diodes in new applications utilizing their reverse transient characteristics. Of great promise in the future design of high-speed digital computers, the diode amplifier has been applied as a pulse repeater stage, in varied flip-flop circuits, or as a wide-band, flat-response amplifier. The silicon types have been operated to 25Mc, and further improvements in the manufacture of diodes may make the principle useful for amplification even at microwave frequencies. The diode amplifier was developed by A. W. Holt of the National Bureau of Standards, Washington 25, D. C. Some of the circuits based on this principle are shown on these pages.

The basic requirement of the diode amplifier is that it be supplied with power from an r-f source whose frequency is the same or higher than the modulating signal frequency. This requirement puts the circuit in the category of magnetic and dielectric amplifiers.

If the voltage applied to the diode is switched quickly from forward to reverse voltage, a transient phenomenon occurs in which a large reverse current flows for an appreciable time after switching takes place, and decays until the static reverse state of low conductivity is reached. The transient current occurs because the "carriers" which were present within the semi-conductor material due to the forward voltage remain available to be swept out by the application of the reverse voltage. The carriers do not remain indefinitely during a period of delay between cessation of forward voltage and application of reverse voltage, instead their number decreases with time during this period.

Although amplification in the diode is not a continuous phenomenon, the action may be likened to the way in which amplification is obtained in a transistor. In a transistor, the emitter can be regarded as a diode existing in the forward conducting state, and the collector as a diode in the reverse state. If any of the carriers created by the forward biased diode are transported to the vicinity of the reverse biased diode, a larger current than the static current will flow in the latter diode.

Voltage on the emitter of a transistor produces

current that creates carriers. These carriers change the current in the collector, which in turn changes the voltage across the collector. In the case of a junction transistor used in a common base circuit, the collector current is almost equal to the emitter current, so that power gain is effectively determined by the ratio between the forward and the reverse resistances. Thus, power gain is obtained by a transfer of current from one circuit of low impedance to another circuit of high impedance.

The diode amplifier obtains its power gain in a similar manner, except that one electrode serves as both emitter and collector, but at different times. During one-half of the cycle, the anode is more positive than the cathode, and the anode acts as the emitter of the junction transistor; during the other half-cycle, the anode acts like a collector. When it is an emitter, it injects carriers into the germanium with only a small applied forward voltage at a low impedance level. When it is a collector, the anode withdraws these same carriers, but only by applying a much higher voltage at a higher impedance level.

## Resistance-Diode-Coupled Amplifier

The simplest form of diode amplifier is the resistance-diode-coupled circuit shown in Fig. 1. The waveform applied to point A is from a 1Mc power source. This frequency was chosen for experimental purposes because its  $1\mu\text{sec}$  period is approximately equal to the decay time of the carriers in the diodes which have been most extensively used. The r-f supply, or "clock", not only acts as the power source, but also as the switch that controls the two separate phases of the amplification cycle: the intake of signal power into the amplifier diode (injection of carriers) and the output of amplified power (decay of carriers). As an analogy, the operation of the diode amplifier may be likened to that of a gasoline engine, where fuel is injected during one part of the cycle and fired at a later part of the cycle.

When there is no input at point B, there is no output because of the high impedance of the amplifier diode. A small voltage spike does appear in the output due to the small capacitance of the diode. This, however, can be decreased by paralleling the



load resistor with a capacitor for capacitance division. When point *B* is raised to +2v while the clock is at zero volts, carriers are injected into the diode by current in the direction *B-C-A*. The diode then presents for a short time a very low impedance to the reverse voltage that the clock applies. Since this impedance is low compared to the load resistor, most of the clock voltage appears across the resistor.

Power gains of about 10 (average output power/average input power) have been measured using a 20v clock. The only limitation on the amplitude of the clock voltage is that it not exceed the reverse breakdown voltage. The requirement on the clock supply is rather severe in that during the time that the clock is at zero volts, its impedance should be very low, so that as much as possible of the available input signal power will be across the diode and not divided between the diode and the clock source. In practical applications, the clock voltage may be distributed as a full sine wave and then half-wave rectifier near the point of use.

### Transformer-Coupled Circuit

Some circuit element that transforms voltage gain to current gain is essential to most of the circuits using the diode amplifier, because there is no average current gain in the diodes that have been used to date. The transformer-diode-coupled circuit shown in Fig. 2 achieves current gain through a step-down transformer. Its operation is similar to the resistance-diode-coupled amplifier. The circuit in this form is suitable for the amplification of low-duty-cycle pulses, but will not operate at high duty cycles because the stored energy in the magnetic circuit will not permit the transformer primary to "recover" or "fly back". A solution to this difficulty is obtained through the addition of a capacitor and resistor between the transformer primary and ground, as shown in Fig. 3. This circuit has the disadvantage that the flyback

requirements of the inductance are satisfied only on a many pulse basis and not on a pulse-to-pulse basis. The many pulse average can also cause trouble in turning off the stage at the end of a train of pulses.

If the end of the transformer primary (*E*, Fig. 4) were to be driven by a clock voltage 180° out of phase with the power supply clock, the flyback requirements would be satisfied on a pulse-to-pulse basis because point *D* would be allowed to fly back or not as necessary. During the time the clock pulse is on and when point *A* is up, point *E* is at ground and conventional current flows through the path *A-C-D-E*. After the power clock pulse, point *E* is driven positive by the other clock phase, disconnecting the diode between *D* and *E*. At this same time, point *B* may be charging the diode amplifier for the next power clock pulse. The series diode and resistor between *C* and *D* provide critical damping of the flyback.

### Pulse Repeater Stage

The circuit shown in Fig. 5 satisfies the essential requirements for a computer "pulse repeater" stage. It is a combination of the transformer-diode-coupled amplifier and an inhibiting gate. Extra gates may be added as desired. Delay lines may be used, but can be avoided in most cases, since the carriers in the amplifier diode store information. It may be necessary, however, to use some delay lines to time accurately the inhibiting pulses.

### Flip-Flop Circuits

The diode amplifier can be used as the basis for a variety of "dynamic" flip-flop circuits—oscillators which can remain stable either in an oscillating or a non-oscillating state. The circuit shown in Fig. 6 stores energy between clock pulses in a delay line. The oscillating state is started by raising point *B* to +2v to inject carriers. On the clock pulse immediately following, point *B* is raised to +20v, and the

pulse travels down the delay line. At point *C* it sees an open circuit and so is returned in the same polarity at the proper time to inject more carriers into the amplifier diode. The delay line serves as an impedance-matching device as well as a delay line, for it can provide the necessary current. In injecting carriers into the amplifier diode, however, the delay line sees a very low impedance, and so some energy is returned down the line for a third travel, negative this time. At point *C*, however, the negative pulse is matched and absorbed. If it were not absorbed, it would travel back down the line a fourth time and prevent the next carrier injection.

Another flip-flop circuit, shown in Fig. 7, is a current-doubler type. Essentially, it charges two capacitors in series and then discharges them in parallel. If point *B* is pulled positive, diodes No. 1 and No. 3, are cut off and current flows through the path *B-C-D-E*, thus charging the two capacitors in parallel. When point *B* becomes negative, diode No. 2 is cut off, and current flows through the paths *E-D-B* and *E-C-B*, thus discharging the capacitors in parallel. When used with the germanium diode amplifier, this circuit makes a flip-flop whose applied frequency can be varied over a very wide range. Many other flip-flop circuits have been developed, some of which are even simpler and less expensive than these described here.

### Higher-Speed Circuitry

Silicon junction diodes have a much faster transient recovery than germanium junction diodes, and therefore can be used in faster circuits. A current-doubler type of flip-flop with silicon diodes has been operated satisfactorily with a clock frequency of 25Mc. The circuit exhibited start-stop times of about 100 millimicroseconds. It should be possible to achieve much higher frequencies by using diodes with even shorter decay times.

Fig. 5. Additional gates may be added as desired to this computer pulse-repeater stage.

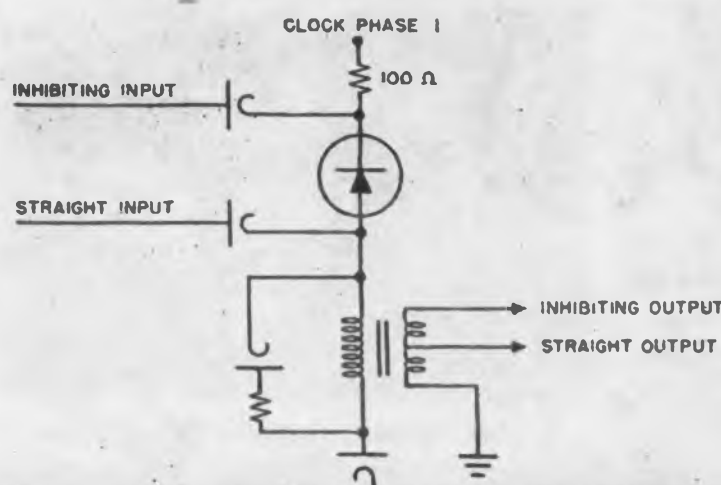


Fig. 6. This flip-flop circuit stores energy between clock pulses in the delay line (*D*).

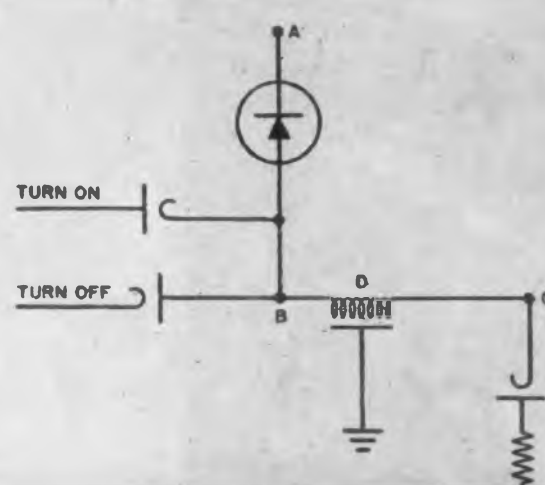
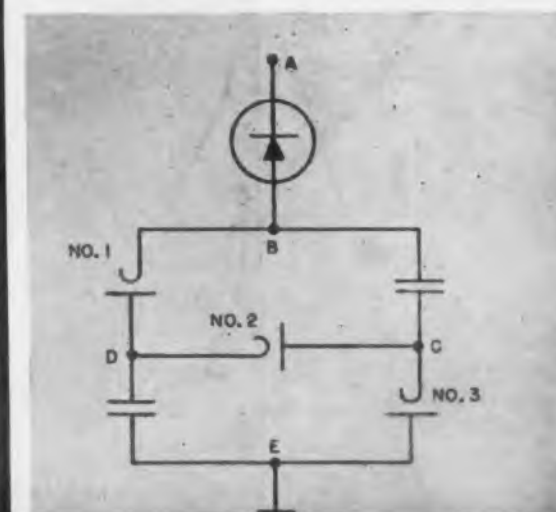


Fig. 7. Capacitors are charged in series and discharged in parallel in this circuit.



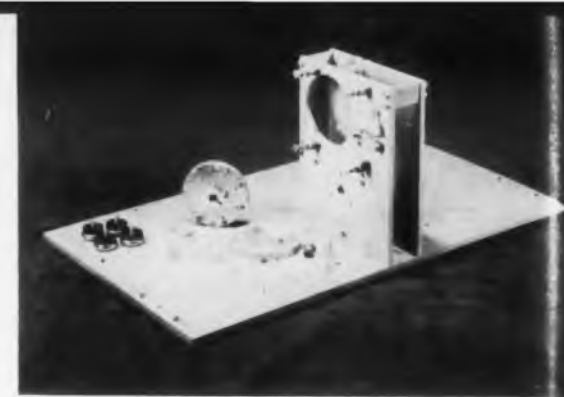


Fig. 1. The base plate with the clutch and various mounting parts. A number of tapped holes are drilled in the plate.

## Servomechanism Prototype Components

Fig. 2. The servo amplifier is 3" x 3-1/8" x 6" high including tubes and weighs 1-1/4 lb.



**D**ESIGN of servomechanism systems is simplified by use of the components shown on these pages. These electronic, mechanical, and mounting units can also be supplied for production models based on the prototypes developed from them or utilized alone.

The four plug-in electronic subassemblies are shown in Figs. 2 to 5. The Model 300 Servo Amplifier has a gain of 10,000 at 60 to 400cy, an output power of 14w, and a phase shift of less than  $\pm 5^\circ$ . The Model 301 Summing Amplifier, a conventional 60cy feedback-type operational amplifier, has a gain under open-loop conditions of about 70,000 with no load and 30,000 with a 100-ohm load. The Model 302 Linear Phase Detector provides a means of convert-

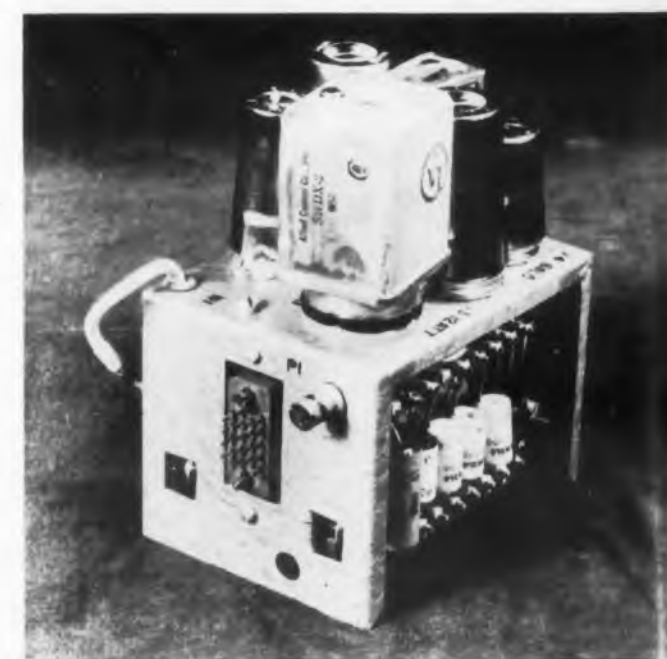
ing 60cy computer signals to d-c signals. It has an open-loop gain of 250 and an output limited at  $\pm 2.5v$ , d-c. The Model 303 Phase Detector compares a 60cy voltage input of reversible phase with two reference voltages differing in phase by  $180^\circ$ . When the input voltage changes phase as compared to the references, a dpdt relay is either energized or de-energized.

The Model 012 Gear Box is available in 46 different gear ratios from 12:1 to 3125:1. The gears are life-time lubricated with silicone grease suitable for operation from  $-100^\circ F$  to  $300^\circ F$ . Weighing only 16 oz, the dimensions of the unit are 3-1/2" x 3-1/2" x 2-7/32". Its output is 120 in-oz at the slow-turning shaft. The gear box is designed to be driven by a

Fig. 3. Weighing only 2 lb, the linear phase detector is 3-1/8" x 4" x 5-1/2" high including tubes.



Fig. 4. The Model 303 phase detector weighs 2 lb. It has a sensitivity of 2mv or less.



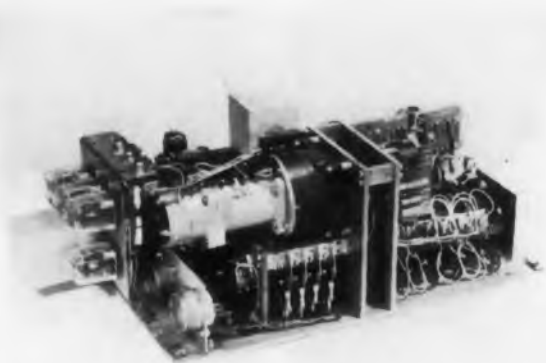


Fig. 6. An example of a completed servo system constructed largely with these components.

variety of motors of all manufacturers.

The Base Plate Assembly, Model 004, shown in Fig. 1, includes a clutch, upright plates, a stop, a dial assembly, a shaft, plus mounting hardware. The servo components can be mounted on the base plate in a wide variety of arrangements to meet most design requirements. The Model 039 Clutch Assembly has an average fall torque of 85 in oz, but the torque can be set between 30 and 100 in oz. It weighs 5-1/2 oz including coupling. These components are made by Link Aviation, Inc., Binghamton, N. Y. A variety of adapters, a gear kit, and mounting parts are also furnished. For more data on these units, turn to the Reader-Service Card and circle **ED-23**.

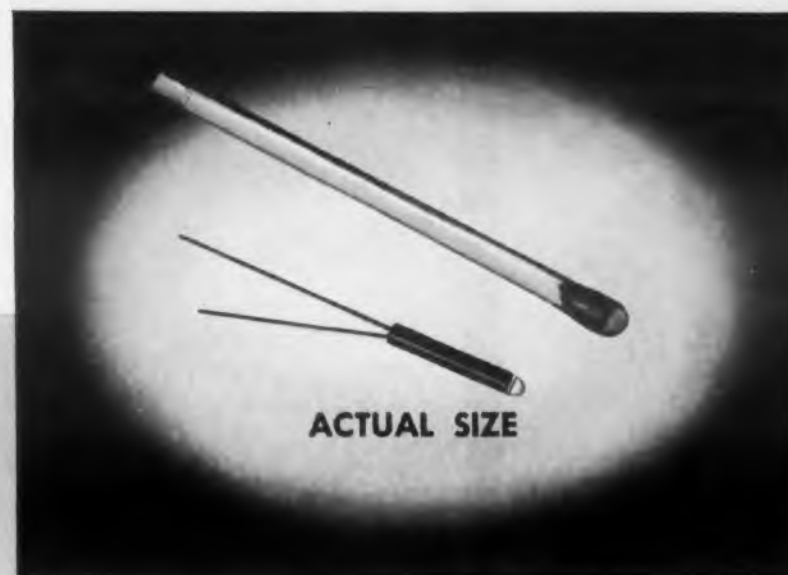
Fig. 5. The summing amplifier has a power output of 3w. It is 3-1/8" x 4" x 7" high with tubes in place and weighs 4 lb.



# HIGHLY SENSITIVE...COMPACT IN SIZE!

## SYLVANIA PHOTODIODE

### 1N77A



The Sylvania 1N77A is a highly sensitive compact junction photodiode.

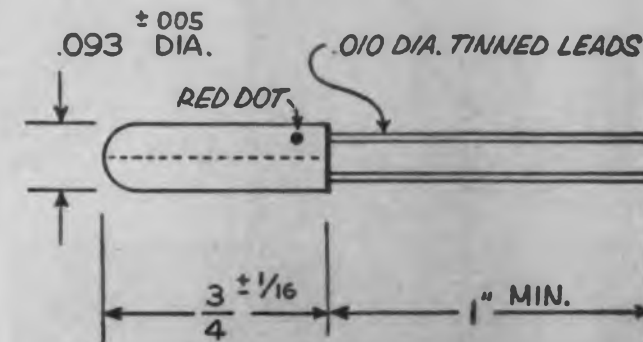
Its useful sensitivity covers the visible spectrum and extends into the infrared region where it peaks at approximately 15,000 Angstrom Units.

Consider these advantages:

- 1 Hermetically sealed in glass.
- 2 Extreme stability in operation.
- 3 Uniformly high sensitivity (8.5 volts min. to 17.0 volts max. across a 100 k-ohm load).
- 4 Low dark current (200  $\mu$ a @ -50 volts).

The high sensitivity and compact packaging of the 1N77A should provide the answer to many light-sensing application problems. *Still more reasons why it pays to specify Sylvania.*

#### DETAILED DRAWING



FOR FULL DETAILS about the complete line of Sylvania diodes write to Dept. 4E-1410 at Sylvania.

# SYLVANIA

Sylvania Electric Products Inc.,  1740 Broadway, New York 19, N. Y.

In Canada: Sylvania Electric (Canada) Ltd., University Tower Bldg.  
St. Catherine Street, Montreal, P. Q.

LIGHTING • RADIO • ELECTRONICS • TELEVISION

CIRCLE ED-24 ON READER-SERVICE CARD FOR MORE INFORMATION



**MYCALEX**

*Announces...*

**Substantial**

**Price Reductions**



**on**

*Mycalex 410  
Telemetry  
Commutator  
Plates*

Increased production of Mycalex 410 Telemetry Commutators now brings new savings to the user. Universally accepted as the finest commutator plate in the field, this precision-built unit injection-molded of Mycalex 410 glass-bonded mica insulation assures permanent dimensional stability—provides a tenacious bond to the metal inserts.



**Important MYCALEX features —**

- no dimensional change with age, humidity or temperature
- contact flatness within .0002"
- permanently high inter-contact dielectric strength
- repeated solderability — no loose contacts under vibration or shock
- high speed brush means no "bounce", no "hash", provides square wave switching

**MYCALEX  
ELECTRONICS  
CORPORATION**

Under exclusive license  
of Mycalex Corporation  
of America

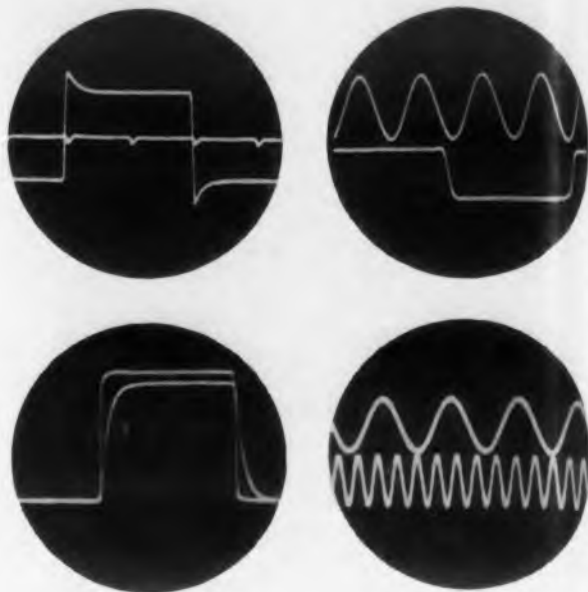
Executive Offices:  
30 Rockefeller Plaza,  
New York 20, N. Y.

Address Inquiries to  
General Offices and Plant:  
Dept. 123  
Clifton Boulevard  
Clifton, N. J.

Revised price lists are available now.  
Write for your copy today.



CIRCLE ED-25 ON READER-SERVICE CARD FOR MORE INFORMATION



## CRO Dual-Trace Switch

**T**WO different waveforms of up to 15Mc can be displayed pseudo-simultaneously on an oscilloscope by means of the Model ES-180 Wide Band Electronic Switch. Switching at rates up to 100kc, the instrument is capable of connection to almost any conventional cathode-ray-tube oscilloscope, including wide-band types. Four examples of oscilloscope traces produced by use of the unit are shown above.

The Model ES-180 Switch is 20-5/8" wide x 10-1/2" high x 14-1/4" deep. It is also made in a 19" wide relay-rack-mounting type.

The two signals are displayed on alternate sweeps, switching being accomplished during the usually blanked-out sweep flyback to allow unavoidable transients to decay before the next sweep is started. The two traces give the appearance of



These oscilloscope photographs demonstrate typical applications for the instrument. The upper left-hand photo shows traces for overshoot, rise time, and duration measurements. The upper right-hand one is for shape, time, and amplitude comparisons. Simultaneously display of related waveforms is shown in the lower left-hand photo. A simultaneous display of non-synchronous signals is given in the lower right-hand photo.

occurring simultaneously on individual baselines, which may be spaced apart vertically or made to coincide by means of positioning controls. Because of the high stability of the two amplifier channels and their practically identical characteristics, it is possible to compare two signals in time with an accuracy of one millimicrosecond.

The wide bandwidth (d-c to 15Mc), excellent transient response, high input impedance and low input impedance of the instrument, permit it to be used with most wide-band oscilloscopes without materially affecting normal performance. In addition, the switch furnishes a movable horizontal index trace for making rapid and accurate amplitude and time measurements without parallax error. The control dial is calibrated both in voltage and in percentage, and a connector is provided for introducing time-marker signals from an external source. Such markers appear on the index trace only and do not distort the signal traces. The switch is manufactured by Teletronics Laboratory, Inc., 54 Kinkel St., Westbury, L. I., N. Y.

The two feedback amplifiers have approximately unity gain, down 3db at 15Mc and 6db at 21Mc. Rise time is  $0.023\mu\text{sec}$ . Amplitude non-linearity is less than 2% and is independent of trace position. Regulated power supplies are provided for plates and critical heaters. The instrument employs 25 vacuum tubes. For more data on this switch, turn to the Reader-Service Card and circle **ED-26**.

**WHEN YOU SPECIFY  
Permalloy\*  
POWDER  
CORES  
SPECIFY**

**MAGNETICS inc.**  
*Performance-Guaranteed*

**HERE'S WHY . . .**

The Magnetics, Inc. "Performance-Guarantee" on molybdenum permalloy Powder Cores is a revolutionary concept in the communications and electronics industries, and opens the way to substantial savings in your production and assembly operations. The guarantee of performance to your specifications is your assurance that these Powder Cores are standardized to meet your circuit requirements.

These Performance-Guaranteed Powder Cores cost no more—indeed, despite the fact that you have a guarantee of performance, they are sold at prices standard in the industry. You can't afford not to investigate Magnetics, Inc. molybdenum permalloy Powder Cores.

**Keep in Mind These Advantages of Powder Cores . . .**

1. Low hysteresis and eddy current losses;
2. High electrical resistivity;
3. Constant permeability over widely varying flux densities;
4. Magnetic stability with dc magnetization.

**WANT THE COMPLETE STORY? . . .**  
Write us . . . on your company letterhead . . . we'll be delighted to send you literature, delighted to answer specific questions. No obligation, of course. . . .

**MAGNETICS Inc.**

**DEPT. ED-13 BUTLER, PENNSYLVANIA**

\*Manufactured under a license agreement with Western Electric Co.

CIRCLE ED-27 ON READER-SERVICE CARD FOR MORE INFORMATION



# dependable subminiature indicator lights

WITH W-I-D-E ANGLE  
VISIBILITY

Light "piped" throughout entire periphery of long plastic lens assures easy visibility of signal from all sides.



- ✓ Smaller, truly subminiature size
- ✓ Fully illuminated lens is clearly visible from any angle
- ✓ For either standard or edge-lit panels
- ✓ Designed to meet critical aviation performance standards

## Larger illuminated area... smaller physical size

Smaller than most subminiature lamps, yet with uniformly bright wide-angle visibility, Hetherington L6000 Series make ideal indicator or warning lights for critical military as well as many commercial applications. Using AN-3140 lamps fitted into a heavy plastic lens  $2\frac{7}{64}$ " long, these rugged lights are  $1\frac{1}{32}$ " overall, and mount in a  $1\frac{1}{32}$ " hole. Details in Bulletin L2.

## "Standard" Hetherington Lights Fill Most "Special" Requirements



### EDGE-LIT PANEL MOUNTING Series L2000

... for MIL-P-7788 panels. Sturdily constructed of nickel-plated brass with integral molded-in terminal and snug-fitting plastic lens that will not vibrate loose. Easy to mount. Write for Hetherington Bulletin L1.



### REGULAR PANEL MOUNTING Series L1000

Combines exceptionally small size and light weight with durable vibration-resistant construction. Sealed against moisture. Terminal is molded into the assembly. Ask for Bulletin L1.



### "PUSH-TO-TEST" INDICATORS Series L3000

Ideal for many military as well as industrial uses. Bulb is lit by pressing spring-mounted lens button. Supplied with or without silicone boot for moisture protection. Send for Hetherington Bulletin L1.



### SWITCHES WITH BUILT-IN LIGHTS . . .

Developed originally by Hetherington as hostess call lights, these compact little units are now available for a broad range of exacting commercial or military aircraft services. Write for Hetherington Catalog.

# HETHERINGTON

SHARON HILL, PA.

West Coast Division: 8568 W. Washington Blvd.  
Culver City, California

Indicator lights • Switch-indicator light combinations • Push-button, snap action, and toggle switches • "Hi-G" Relays • Aircraft and Electrical Equipment Assemblies.

CIRCLE ED-28 ON READER-SERVICE CARD FOR MORE INFORMATION

# Subjective Design

By **Jack W. Dunlap, President**  
**Dunlap & Associates, Inc.,**  
**Stamford, Conn.**

Ideas for  
Design

**I**NCREASED sales and lower production costs of electronic equipment for the consumer market could result from the substitution of subjective design standards for high technical goals. This article proposes that subjective human requirements that must be met to insure sales can be measured and used as guides in designing in the same way that wide frequency response, lack of distortion, good definition, sharp tuning, etc., are considered by the designer.

The human characteristics to be considered are hearing, vision, touch, smell, taste, reaction time, the physical structure of the average user, how he moves his arms and legs, and in certain cases even the emotions aroused in the consumer. By carefully considering these factors early in his design, the electronic engineer can effect remarkable improvements in product acceptability. At the same time, manufacturing costs can be lowered by not attempting to design to technical standards beyond the ability of the customer to recognize or use or beyond which he can be trained to recognize and operate.

## Subjective TV Ratings

For example, in developing a television receiver, it is not sufficient that the picture be clear, the contrast sharp, and the definition good, but it must have quality; i.e., it

must  
serv  
appa  
thin  
the  
prof  
met  
poss  
ceiv  
met  
phy  
1866  
exp  
used  
the  
ally  
B  
be a  
a s  
TV  
say  
els  
rate  
Fun  
nan  
ope  
seal  
seal  
tion  
wit  
vel  
mon  
suff  
wer  
exis  
sho  
ple  
T  
tur  
of  
eac  
exc  
tur  
Fin  
cou  
por  
eff  
det  
rec  
sib  
its

ha  
ton  
kn  
ne  
of  
for

EL

must be pleasing and satisfying to the observer. Quality is a psychological factor apparent to the observer and not something that the engineer can measure by the quantitative methods familiar to his profession. There are, however, qualitative methods of measurement by which it is possible to precisely rate a group of receivers as to quality of the picture. These methods were first devised by the German physicist G. T. Fechner and published in 1860, and are today the basis of modern experimental psychology. They can be used to order and correlate sensations and the stimuli that cause them, and to actually measure the intensity of sensations.

By these psychological methods it would be a relatively simple manner to establish a scientifically accurate quality scale for TV screens. Such a scale could consist of say seven screens against which new models could be compared and accurately rated as to the quality of the picture. Furthermore, the scale would be a dynamic one. As a better viewer is developed, it could be placed at the top of the scale and the lowest unit dropped. Such a scale would have many practical applications. For example, if two new receivers with different production costs were developed, management might choose the more expensive model if its quality was sufficiently greater. Conversely, if the costs were the same and quality differentials exist in the picture, then management should select the model with the more pleasing picture.

The scale would also enable the manufacturer to precisely rate the various models of the competition and thus determine for each price range whether his own models excelled, equalled, or were inferior in picture quality to those of his competitors. Finally, with such a scale, the designers could systematically vary different components in a set to determine their relative effect on picture quality. So far as can be determined, no manufacturer of television receivers has taken advantage of the possibility of establishing such a scale despite its low cost.

### Human Engineering

There are a group of specialists who have made a study of the subjective factors in the design of equipment. They are known as human engineers. Human engineering is concerned with the limitations of human sensory capacities and the performance capabilities of man in order to

facilitate the design of machines and appliances that can be operated with maximum efficiency ease, comfort, and satisfaction. Human engineers usually have a technical background drawn from experimental psychology, physiology, and engineering and can complement and support the designer's technical ability to develop a functionally satisfactory device.

The human engineer can establish subjective standards from the consumers' viewpoint (such as the TV screen scale) that can be used as a guide for the designer. This has already been demonstrated in a wide variety of fields, but the possibility is so novel that it has not yet had time to gain general recognition.

### Applying Subjective Design

Among the applications of human engineering principles, have been radio sets. Several years ago the development department of a large radio manufacturer devised two highly efficient speakers. Management was faced with the problem of which speaker to put into production.

Aware of the well-known qualities of "warmth" and "color" of tone, it was a simple matter for psychologists to set up tests for determining which speaker had the greater appeal to the public.

In another case, the question was raised by one organization as to the advisability of installing automatic volume control in radios. The first question the engineers proposed to the consulting human engineer was, "Do radio listeners need and want volume control?" It was found that the listeners desired automatic volume control. This determination raised the question, "How sensitive must the control unit be?" Basically the problem was one of determining at what point individuals would adjust volume control regardless of the level at which they initially set the volume. It was observed experimentally that the volume could vary as much as 4db before the listener would readjust the volume. Thus, the human engineer was able to provide the design engineer with definite limits of sensitivity when designing an avc unit.

The designer of equipment for the consumer market stands to gain greatly by considering the scientific measurement of subjective design factors. In this way, the application of high technical ability will not be cancelled out by a failure to provide human appeal.



# NEW



*Advanced  
Design...*

**MODEL DS-6100**

## FREQUENCY COUNTER

All new electronic pulse indicator with a completely different circuitry approach that reduces size and weight without sacrificing accuracy. Direct read out in events per second to 100,000.

Inherent accuracy is  $\pm 1$  event.

Time base — 100 KC crystal controlled oscillator circuit. Easily portable and weighs only 28 pounds. Price — \$675.00

### New MULTI-SAMPLING

... 3 to 60 second manual

### Greater STABILITY

... lower power consumption allows continuous, accurate operation without excessive heat

### Improved CIRCUITRY

... by utilizing a new and different approach in design

### Less WEIGHT

... advanced design offers ready portability

### Smaller SIZE

... unit size reduced by unique design. Uses less bench space.



### MODEL DS-660 FREQUENCY COUNTER

Designed for portability and low cost as well as accuracy, this new Detectron unit will count and display electrical or mechanical events which can be converted to a varying voltage of sufficient amplitude. Direct read out in events per second to 10,000. Accuracy — approximately .1%. Weighs only 16 pounds. Price — \$425.00



### DECIMAL DECADE TOTALIZERS

New, improved Totalizers designed for use where a number of pulsations are to be counted. Direct read out. Standard octal plugs assure adaptability to most existing scaling equipment.

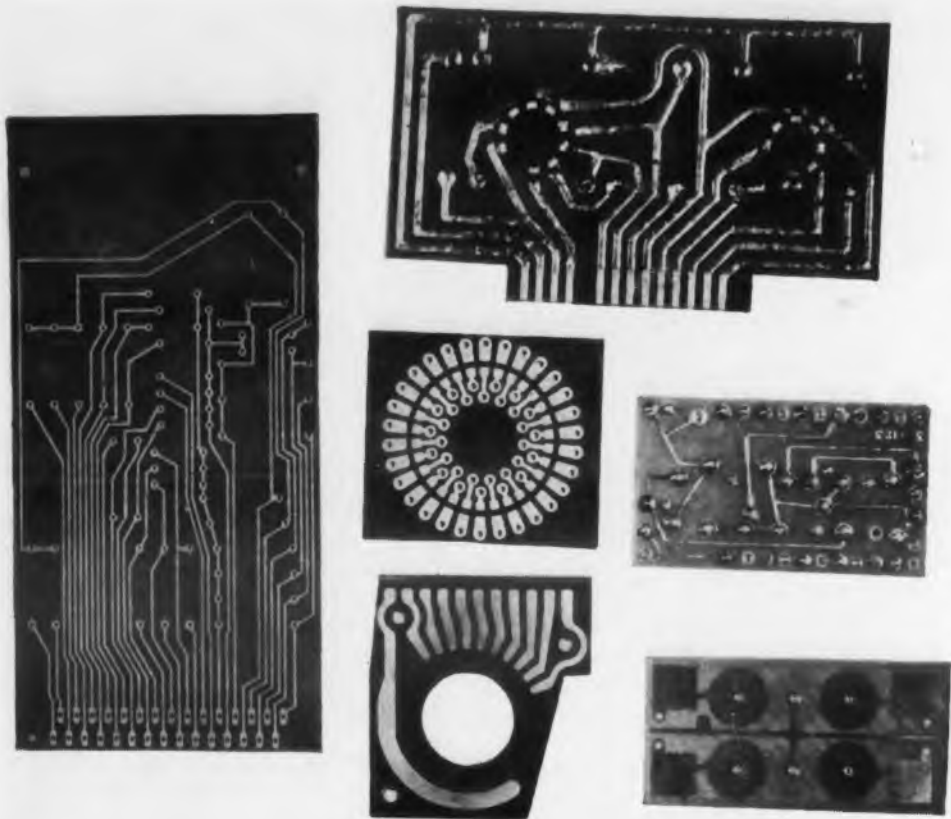
*For more detailed information,  
please write...*

COMPUTER-MEASUREMENTS Division of

The *Detectron* Corp.

5420 Vineland Avenue North Hollywood, California

CIRCLE ED-29 ON READER-SERVICE CARD FOR MORE INFORMATION



## Are You Switching to Printed Circuits? You Need **CASTOMATIC®** Solder!

Printed circuits save on solder and soldering time. In this work you don't use much solder and it doesn't cost much compared to what you are manufacturing. Therefore the solder should be the best quality you can buy . . . Federated **CASTOMATIC** bar solder. Here's why *machine-cast* **CASTOMATIC** is the best:

1. **Free of Dross**—the patented, pressurized casting system keeps air out; harmful dross-producing oxides are thereby excluded. Solder flows freely through tiniest openings. Your solder bath stays cleaner.
2. **Uniform Composition**—electronically controlled machine casting eliminates segregation of constituents. Joints are trouble-free. Every bar of a given analysis melts at the same temperature. Each piece of a bar of eutectic solder, for example, will melt at almost exactly 362°F.

Ask for a sample of **CASTOMATIC**. It will prove itself. Just return coupon for prompt action.

*Picture courtesy Photocircuits Corp., Glen Cove, N. Y.*

*Federated Metals Division*

AMERICAN SMELTING AND REFINING COMPANY  
120 BROADWAY, NEW YORK 5, N. Y.

In Canada: Federated Metals Canada, Ltd., Toronto and Montreal



- Please send a salesman.
- Please send me a sample of **CASTOMATIC** solder.

MY NAME \_\_\_\_\_ TITLE \_\_\_\_\_

COMPANY NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

CIRCLE ED-30 ON READER-SERVICE CARD FOR MORE INFORMATION

# Color TV

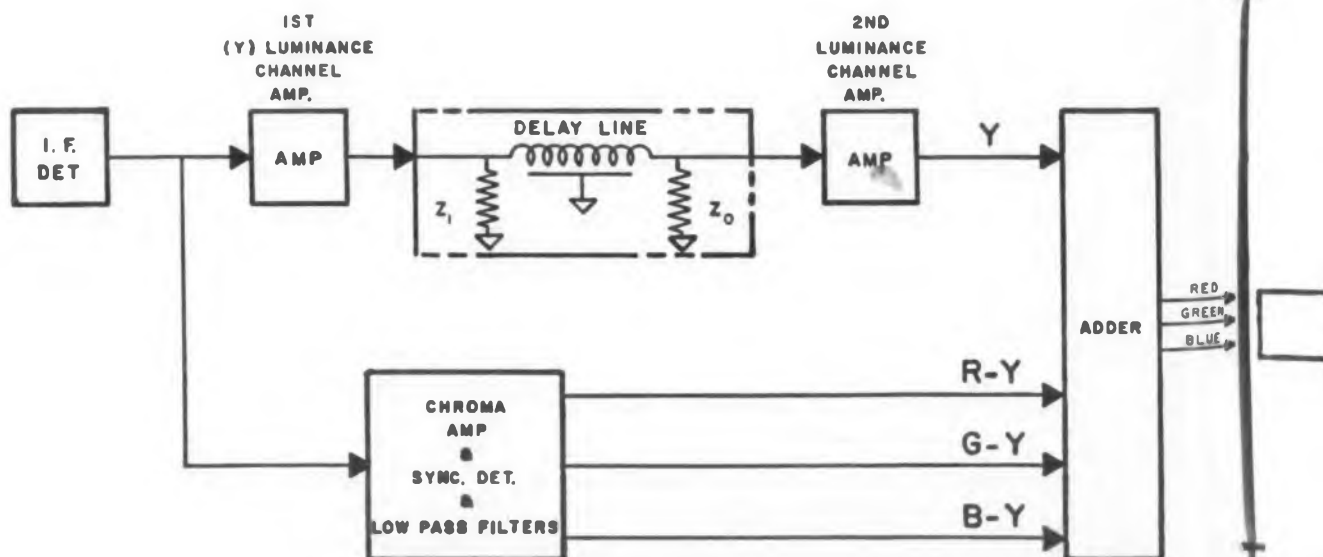
## Delay Assembly

**S**UBSTANTIAL cost reductions over conventional delay assemblies for color TV receivers can be gained by using a new type of delay line known as a "Delay Stick". The unit also offers neater and simpler assembly in the receiver with smaller space requirements. Circuit diagram of the assembly and its position in the set are shown in the block diagram below and on the cover.

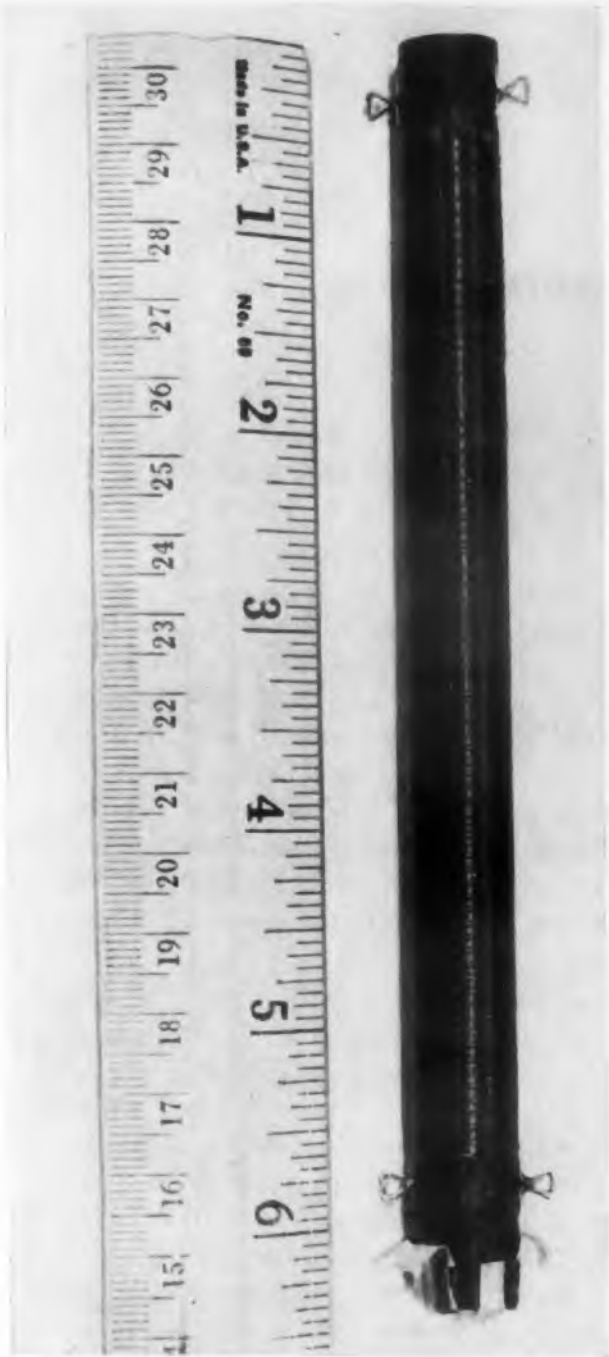
A delay mechanism is essential to color TV in order to slow down the black-and-white picture signal, which comes through faster than the basic color signals. All three signals must arrive at the picture tube simultaneously. The Delay Stick consists of a core around which are wound wire

and tape to form the selenoid and dielectric. The length of the unit is dependent upon characteristic impedance and delay time desired. Characteristic impedances to a maximum of 3000 ohms and rise times as short as  $0.1\mu\text{sec}$  can be specified.

The assembly's phase characteristic is linear within 5% to 6Mc. Mounting is facilitated by a standard coil tuning fastener and terminals for leads provided. Made by the General Electric Company, Components Department, Syracuse, N. Y., its lowered cost is achieved through the use of automatic machinery. For more information on this cost-saving assembly, turn to the Reader's Service Card and circle **ED-31**.







One version of the "Delay Stick". The diameter of the core is 1/2". The length is varied to meet characteristic impedance and rise time specifications.



## Magnets for rotors or stators ...any design or size you may require



### "MAGNETIC MATERIALS CATALOG"

Write for your copy

Contains handy data on various types of Alnico Magnets, partial lists of stock items, and information on other permanent magnet materials. Also includes valuable technical data on Arnold tape-wound cores, powder cores, and types "C" and "E" split cores in various tape gauges and core sizes.

ADDRESS DEPT. ED-10

The use of Alnico permanent magnets in rotor and stator assemblies of motors, generators, magnetoes and tachometers has revolutionized the designs of these devices. Whatever your need may be—from a tiny rotor for a timing device to a large slab for power generators—Arnold can take care of your requirements, either for experimental samples or production quantities.

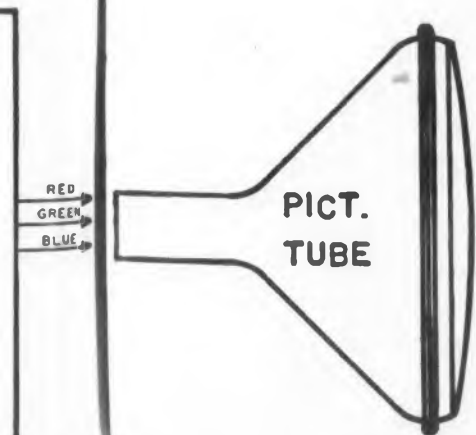
● *Let us work with you.* You will have the advantage of working with a leading producer of rotor magnets, whose manufacturing and testing facilities—the most modern in the business—give you the best assurance of high quality standards and uniform performance.

W405184

**THE ARNOLD ENGINEERING COMPANY**  
 SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION  
 General Office & Plant: Marengo, Illinois  
 DISTRICT SALES OFFICES ... New York: 350 Fifth Ave.  
 Los Angeles: 3450 Wilshire Blvd. Boston: 200 Berkeley St.

CIRCLE ED-32 ON READER-SERVICE CARD FOR MORE INFORMATION

and  
t is  
ape-  
har-  
num  
mort  
  
istic  
unt-  
coil  
for  
ien-  
ents  
its  
ugh  
ery.  
ost-  
er's  
31.



The assembly equalizes the transmission time of the luminance and chrominance channels. The time differential results from the difference in bandwidth of the channels, luminance being about 3.5Mc and chrominance 0.6Mc.

# Printed Circuit Design

## II—From Circuit Diagram to Printed Wire Pattern

By George Maisch, Chief Electronic Engineer,  
Photocircuits Corp., Glen Cove, N. Y.

OVERALL considerations governing the designer's decision to employ printed circuits in his electronic equipment were discussed in Part I of this series on printed circuit design (*pp. 16-19, September, 1954*). Having decided to use printed circuits on the basis of these factors, the designer must now consider the problems in determining layout. An "assembly" drawing showing all components and conductors is prepared first. From the assembly drawing, a "master" drawing is drawn. It is the master drawing that is photographed in the first stage of fabrication of the etched pattern.

As before, mechanical factors will be important. The size and shape of the circuit board are often determined by space available or by a cabinet whose size was determined by an earlier chassis design. For example, the proposed equipment may have to fit into a standard rack like a 19" wide relay rack. In another situation, the manufacturer wishes to retain an attractive cabinet design such as that of a table-model radio. For TV receivers, the size of the cabinet is now determined by picture tube dimensions. The most interesting situation would be the design of an entirely new device where the size of the pattern board determines the dimensions of the cabinet. (For simplicity, it will be assumed in this article that the size of the board on which the pattern will be laid out has already been set.)

In extremely complex circuits, it may be necessary to divide the circuit over one or more pattern boards to keep each board within the largest size that can be economically handled by fabricating machinery. Or, ease of servicing may demand subassembly construction techniques. The component pattern boards can then be "stacked", mounted side-by-side, or in "L", "T", inverted "T", or "H" arrangements. The particular arrangement of two or more boards must be determined early for best placement of interconnection points.

The mounting means for the circuit board is also important. Connection to large, separately mounted components such as transformers, speakers, cathode-ray tubes, etc., must be considered at the outset, since they determine the "form factor" of the circuit. For

example, in a computer plug-in package, it may be necessary to bring out all connections to fingers on one edge of the board to permit insertion into a printed circuit connector on the panel. Similarly, the need for accessibility of pot shafts, tuning capacitors, tubes, and other elements exerts an important influence on the general layout of the pattern.

Having determined the demands placed on the printed wire pattern by the mechanical factors of the circuit, the electrical factors have to be considered. The following electrical factors must be investigated:

1. *Voltage*—this will influence the spacing between lines.
2. *Current*—this will determine the width of lines.
3. *Frequency*—this will determine the line length, sometimes affect spacing, and indicate shielding required. It will also govern any special precautions to be taken because of impedance considerations (leakage resistance between conductors, distributed capacitance between conductors, etc.).

Another important electrical consideration is environment. Altitude, humidity, and ambient temperature are all factors that may influence the spacing and position of the lines in the printed wire pattern.

The method of assembly that will be used in the finished product has a profound influence on the pattern layout. Will it be dip soldered? If so, all components must be on one side of the board. Will the components be inserted by automatic machinery? If so, the limitations of the machinery must be taken into account. Will component leads be preformed and precut? If so, the standard hole spacings for the leads of each component must be adhered to in the pattern. It is a good idea to mark each component on the schematic circuit diagram with its lead hole spacing. RETMA committees are now working on standards for these hole spacings.

### Pattern Design Sequence

A valuable first step is to label each of the lines in the schematic circuit diagram with its peak voltage and minimum spacing required, and its current and minimum line width required. Signal-carrying lines should be marked so that when the layout is made they can be kept short and/or shielded.

Before starting on the assembly drawing of the

printed wire pattern, many designers prefer to use special "home-made aids" to assist them in the layout. Some of these are cardboard, perforated plastic, cheese cloth or wire screen panel, each cut to approximately the size of the proposed circuit board. The actual components are then placed on these panels and moved about in a trial-and-error process to arrive at the most practical layout. Lines may be drawn with crayon to simulate printed conductors. With this rough layout as a guide, the assembly drawing can be started.

The assembly drawing will contain all details of the finished assembly. The position of all components and their lead holes will be indicated for later assistance in assembly. A sheet of paper suitable for drawing and later reproduction by standard engineering drawing duplicating methods is attached to the drawing board. The scale of the drawing is determined by roughly calculating the anticipated fineness of detail in the proposed pattern—i.e., the width of conductor lines, spacing between lines, tolerances to be used, and the overall size of the circuit pattern board. Small circuit patterns having fine details such as patterns for hearing aids and subminiature assemblies will normally use a highly expanded scale ratio of 5:1 or 10:1. Radio receiver patterns are usually drawn to a scale of 2:1.

After this ratio is determined, a properly scaled pattern board is drawn. This outline will contain all of the circuit pattern and also serves as a border for cutting the board to size in later fabrication. A sample assembly drawing is shown in Fig. 4.

Keeping in mind the mechanical and electrical considerations previously mentioned, and using the rough layout made by means of the home-made design aid, the first thing the designer does is to locate the major components such as the transformers, tube sockets, potentiometers, tuning capacitors, and electrolytic capacitors.

These components should be placed in such a way that the circuit pattern will be uniformly distributed over the area available. A typical tube socket pattern is shown in Fig. 1. At this point it is well to again examine the schematic diagram to determine



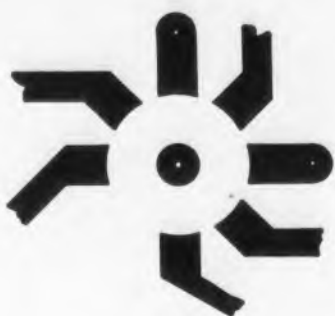


Fig. 1. A typical conductor pattern for a socket of the molded type designed for printed circuits.

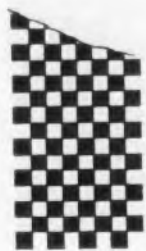


Fig. 2. The "checkerboard" method of breaking up large areas of foil to prevent blistering of the laminate.



Fig. 3. The possible results of making a termination too small is shown at the right in black. At the left, the same misregistration of the hole punch still leaves a usable termination.

locations of other smaller components. If the circuit contains, for example, a radio-frequency portion and an audio-frequency portion, the tube sockets may have to be moved to accommodate the greater number of components in certain portions of the circuit pattern. This is also true of circuits employing dual tubes utilizing 9-pin sockets. Here, because of the greater number of components associated with the socket, additional circuit pattern area will be required about the socket. When the two sections of the dual tube are not used sequentially, the pattern becomes even more complex. Automatic bias control tubes and audio amplifiers in the same envelope with r-f amplifiers are examples of such non-sequential use.

Smaller components are now considered. The object is to place each component in a location where it can perform its purpose most effectively and also connect into the circuit pattern without the use of "cross-overs" (see Fig. 6). Where cross-overs are required, components such as resistors or capacitors with insulated bodies should be used to economically add a third dimension to the pattern board.

All components are drawn to the proper scale and, wherever possible, standard lead hole spacings maintained. The first of the smaller r-f components to be drawn in are the by-pass capacitors. By-pass capacitors must be connected so that one lead is soldered (connected) directly to the point being by-passed. Leads must be kept to an absolute minimum length to reduce undesirable inductance effects. The other lead can be connected directly to the cathode terminal on the tube socket involved or to a point designated in the schematic as ground. In a lower frequency circuit, lead length is of lesser importance.

The various conductors in the pattern should now be drawn lightly in pencil as changes will no doubt be made. Each conductor should be represented on the drawing by two parallel pencil lines with the distance between them equal to the approximate width of the foil (to scale).

The conductor designated as ground is drawn first. This conductor may perform in four ways: as a d-c ground or B—; an a-c ground or a return for by-pass capacitors; one side of filament supply; and lastly as

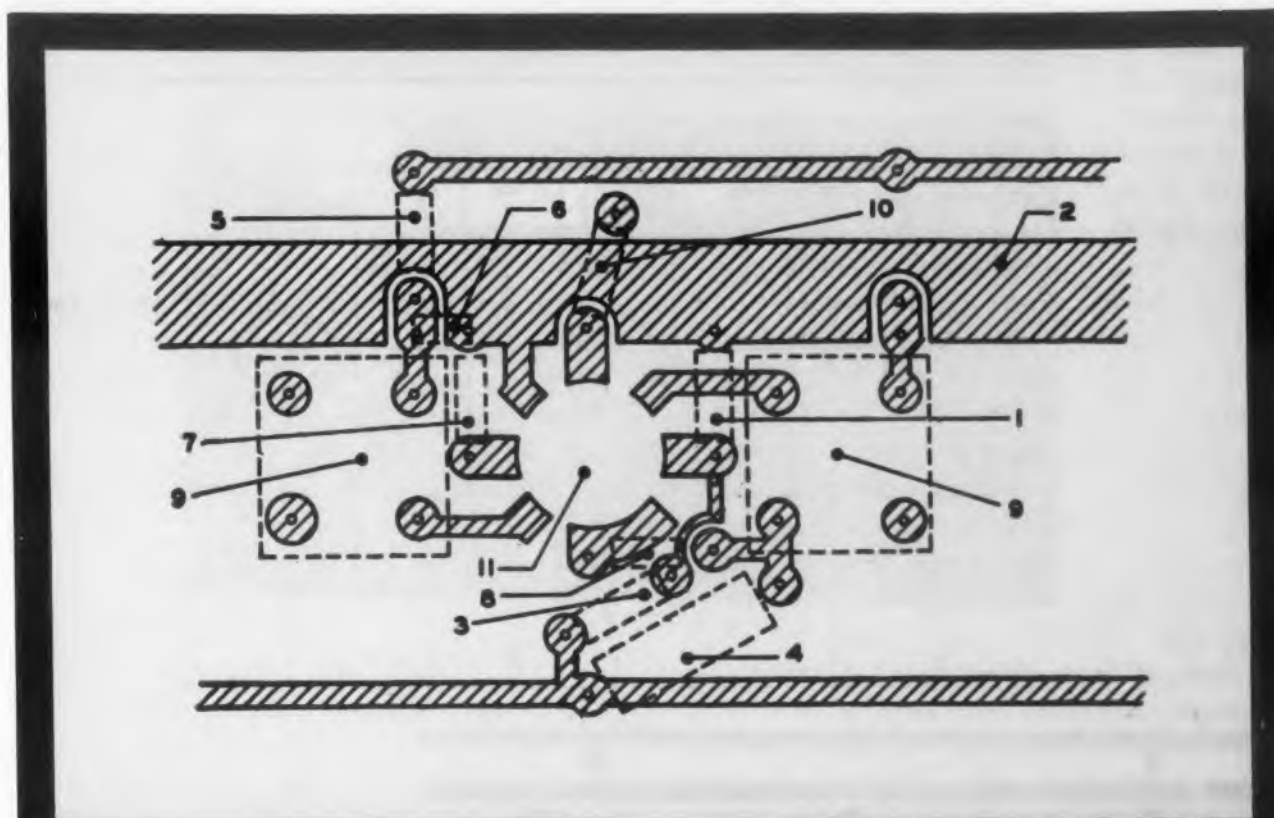


Fig. 4. A sample assembly drawing. The function of each part is listed below.

- |  |   |
|--|---|
| 1. screen grid bypass capacitor: note shortness of leads and pattern.                              | 6. grid return bypass capacitor: note shortness of leads. |
| 2. ground pattern: note area of pattern and means of connecting bypass capacitor most effectively. | 7. cathode resistor.                                      |
| 3. screen grid dropping resistor.  | 8. plate bypass capacitor.                                |
| 4. plate circuit isolating resistor.   | 9. two input-output transformers.                         |
| 5. AGC return resistor.  | 10. jumper lead to complete filament circuit.             |
|  | 11. tube socket.  |



a shield pattern. The first three functions are common to most electronic circuits; the fourth is peculiar to printed-circuit designs.

Copper foil can function as shield material in two ways: between two foil conductors on either side of the shield foil; and as a larger area shielding some component like the ground plane in a metal chassis. An example is the use of unetched foil to form the bottom of an i-f coil shielding can. When acting as a shield, this conductor should be of ample width to cover the area considered for shielding, although any large area of copper should be broken up, as shown in Figs. 2 and 6, by including configurations necessary to prevent over-heating of the laminate and the resultant blistering of laminate and pattern during the dip soldering operation.

Other long lines in the conductor pattern such as

B+, AGC, and filament leads should now be tentatively drawn into position.

Resistors are now considered. Good practice requires that resistors be placed near their associated circuitry. Lead length is again important, but is not as critical as for high-frequency, by-pass-capacitors.

Wherever a component lead connects to the pattern, a round area known as a "termination" or "land" should be provided. These are provided to permit a sizable fillet and a good dip-soldered joint. The diameter of the land should be at least 0.060" greater than the diameter of the hole for the component lead. This provision allows for some error or misregistration in punching the hole during fabrication. Fig. 3 shows what might happen if insufficient land areas are provided.

At this point in pattern development, sufficient

area may not be available to accommodate all the remaining conductors. Terminations take up a great deal of area in most designs. Conductor line width and termination diameters, therefore, become important. By consulting the tables and curves in the previous article in this series (*Table 1 and Fig. 1, p. 16, September*), safe pattern-line widths for various currents can be determined. It will be noticed that line widths for grid leads, AGC leads, and other low-current conductors may be 1/32" wide or less. B+ conductors may also be 1/32" wide, but due to short circuit possibilities, 1/16" lines are recommended. Filament leads should be as wide as surface area available will allow.

Spacing between lines in the pattern is determined by impedance and potential of the lines involved. Filament conductors may be as near as 0.020" from a ground conductor. A grid lead having an impedance of 1 to 10 megohms will require clearance of 1/32" to 1/16" from the nearest conductor. B+ leads should be well spaced from other leads because of their higher voltages. A separation of 1/32" for each 150v is a good rule of thumb to follow. Peak voltages should be considered where a-c components or transients are involved.

The completed assembly drawing should then be examined to be sure that "hot spots" are properly ventilated, and that adequate mechanical clearances exist. All mounting holes should be located and dimensioned as well as other holes for attaching miscellaneous hardware. Adequate clearance between hardware items and the pattern must be allowed.

In locating slots and holes, good plastic fabrication practice should be adhered to. A distance of twice the stock thickness should be left between the edge of any hole and the edge of an adjacent hole or the outer edge of the board. Hole diameters should not be smaller than 75% of the thickness of the material.

With regard to tolerances, most plastics require heating for punching operations. Their tendency to expand and contract is unavoidable; therefore, for greatest economy, certain minimum tolerances should apply. Tolerances closer than these will probably necessitate secondary operations and will incur added cost. The following values are recommended minimum tolerances:

*Hole locations:*  $\pm 0.005"$  to  $\pm 0.015"$  depending upon hole spacing dimensions and length and type of plastic.

*Overall dimensions:*  $\pm 0.010"$

*Registry of holes to pattern:*  $\pm 0.15"$  for glass base, and  $\pm 0.020"$  for paper base.

*Punched hole sizes:*  $\pm 0.003"$

It is considerably cheaper to keep the printed circuit on one side of the board. However, because of space limitations and circuit complexity, the designer may be forced to a two-sided pattern. In this event, plated-through holes are required (*Fig. 2, p. 17, September*). The area through which a plated-through hole is fabricated is drawn on the assembly drawing

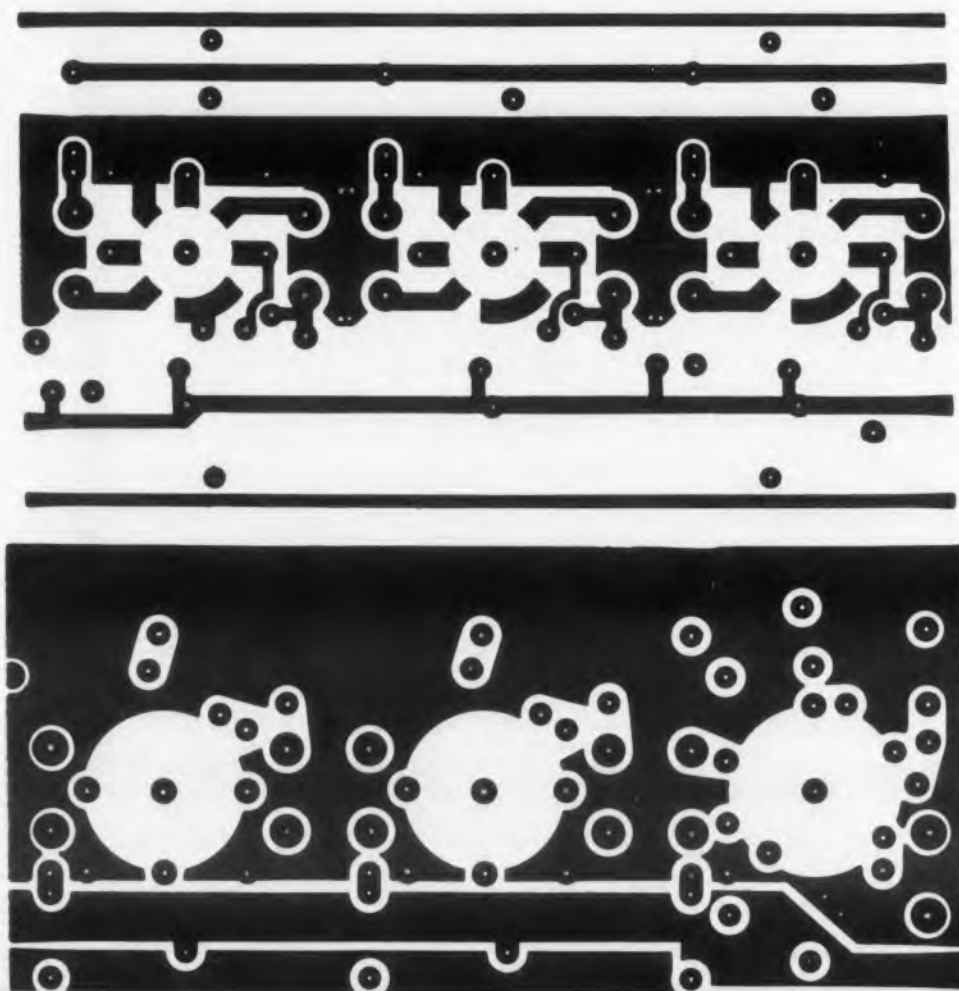
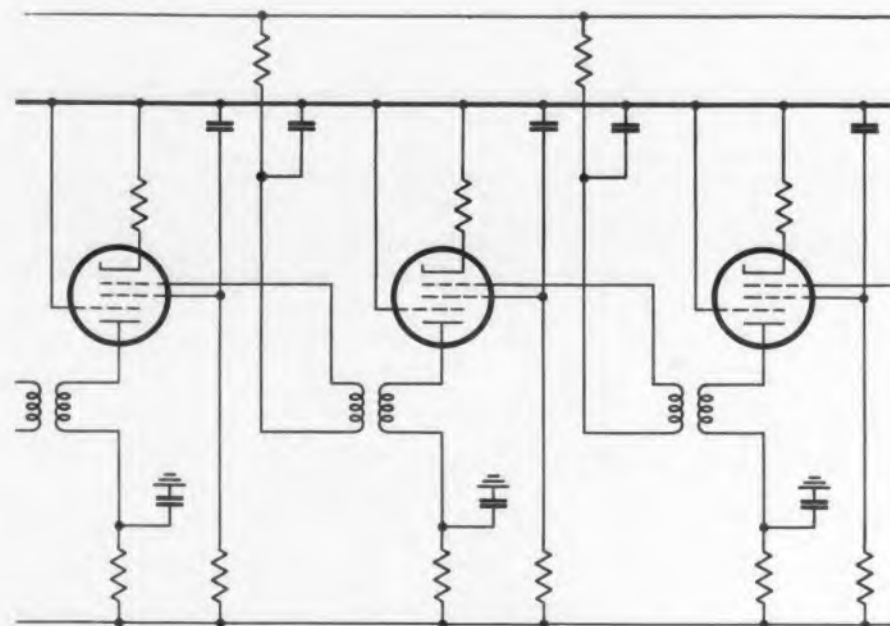


Fig. 5. These top and bottom master drawings represent the printed wire pattern of the three-stage circuit diagram shown above.

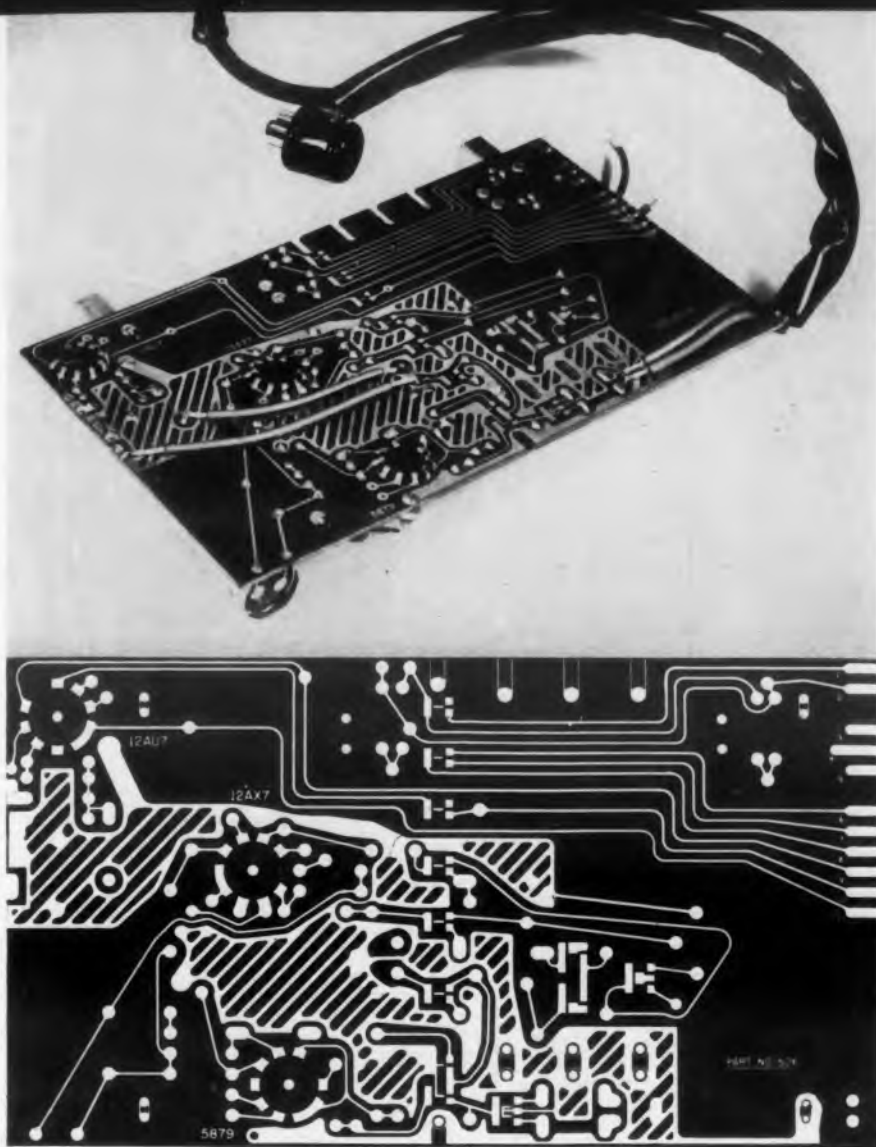


Fig. 6. A completed printed wire chassis and the master drawing for the conductor pattern on the top surface. Notice the two "cross-over" wires and the method of breaking up large areas of foil to prevent laminate blistering.

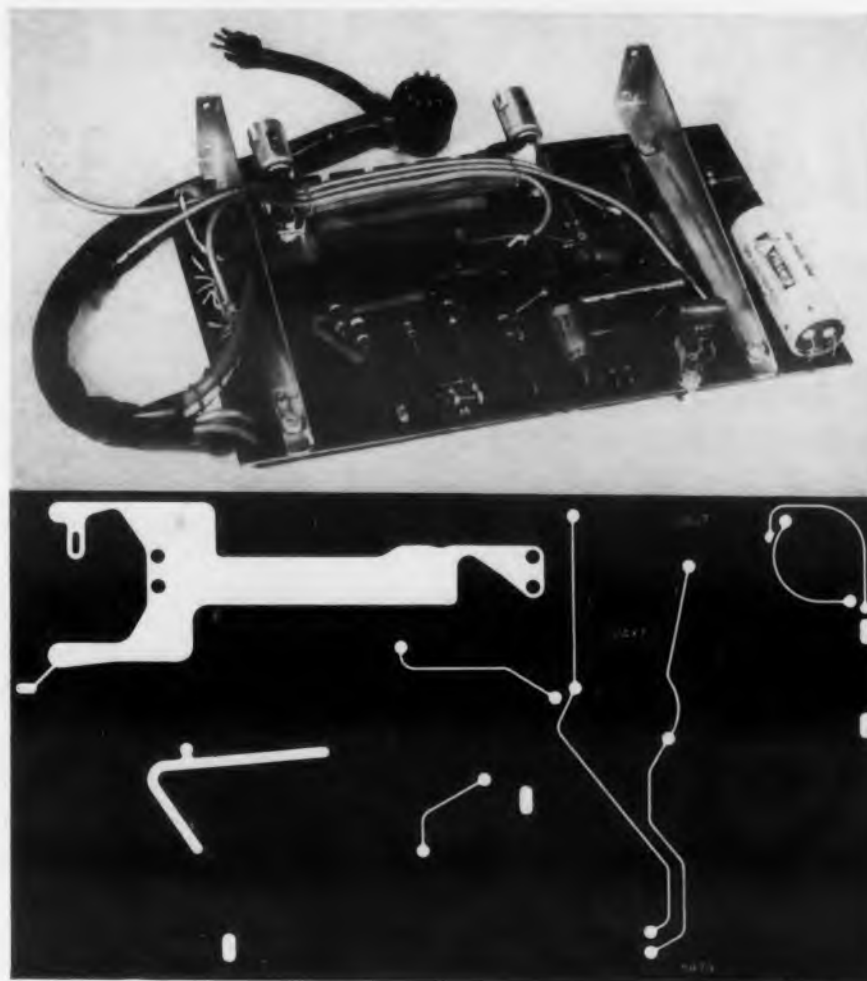


Fig. 7. A bottom view of the same chassis and its master drawing. This is a tape recorder manufactured by Daystrom Electric Corp., Poughkeepsie, N. Y.

and the master drawing as a round, shaded area. In making the assembly drawing, dotted lines may be used to represent the conductors on the other side of the board as shown in Fig. 4.

The pattern should be rechecked for accuracy in wiring and the assignment of the proper scale to the distance between lead holes, conductors, and locations of components.

#### Preparing Master Drawings

The final photo copy may now be prepared. The material to contain the inked pattern is placed over the prepared pencil copy. Transparent material such as plastic impregnated glass cloth (Keufel and Esser "Stabilene" or Deitzgen "Perma-Scale" are examples) is recommended because of its transparency and stability. Paper-base drawing materials have been found unsatisfactory because of their lack of dimensional stability.

The details of the conductor pattern are traced on the inking copy and all land patterns, shield areas and conductor lines are filled in. The borders of these details are drawn using a ruling pen or a compass with pen tip and the areas filled in using an artist's brush or a suitable pen for the purpose. Top and bottom master drawings are shown in Figs. 5, 6, and 7.

Clean edges, opaque black lines, clean background, and general neatness are necessary for a high quality circuit pattern. Details necessary to properly photograph the copy, such as size ratio, registry centers, and numbers to identify the work in later use should be included on the copy.

All hole centers, whether or not they are in the conductor pattern, should be located on the master drawing. All conductor pattern holes should be drawn as indicated in Fig. 5. The white center area should be about 0.020" diam when reduced to final size. Holes not in the conductor pattern should be indicated by a black annular ring with an inside diameter of 0.020" and a minimum outside diameter of 0.060" when reduced. This procedure simplifies the complete fabrication of initial sample runs when all the holes are drilled instead of punched.

The border line appearing on the assembly drawing should be transferred to the master drawing and made at least 1/16" wide. Size of letters or numbers should be at least 3/32" high with a minimum line width of 0.015" when reduced.

In making two-sided patterns, registry of one side with the other can easily be checked by simply placing one transparent master drawing over the other.

A number of very useful tricks and short cuts in

making the master drawing can be employed. Black tape can be used for conductor lines. Repetitive patterns such as coils, shield pattern areas, etc., may be made up in advance simply by drawing the configuration once, photographing the pattern, and making the required number of prints. These prints can then be pasted on the master drawing where they are required.

After the master drawing is completed, the only remaining job for the designer is to make a mechanical drawing of the piece. This drawing should contain the location of all the lead holes, slots, and cutouts, each properly dimensioned. It is preferable to use a hole center as a datum line rather than the edge of the part. The mechanical drawing is used in making the necessary tooling to pierce and blank out the board. It also serves to relate the design to its enclosure as well as any other subchassis.

The design of a printed-wire pattern is not a simple matter. A number of solutions are possible for each design problem, but with practice the best answers should be determined with ever increasing speed and dexterity. Within the limitations of the technique, it is the ingenuity of the individual electronic engineer rather than reliance on set rules that produces the best printed circuit design.



*Third in the series of  
important new instruments  
by DuMont . . . . . type 327*

- Vertical bandwidth, D-C to 5 MC; rise time of 0.07 usec
- Distortion-free, mono-accelerator cathode-ray tube
- Direct, accurate, reliable time measurement
- Measures signal amplitude accurately from calibrated screen



Continuing the pace set by the now-famous Du Mont Types 323 and 329, the new Type 327 provides the truly modern approach to the broad "middle range" of oscillography, offering superb performance characteristics from DC to 5MC.

At modest price — not a major investment in any sense — the Type 327 features accurate, time and amplitude calibration. And, measuring facilities are not degraded by the cathode-ray tube since a virtually distortion-free mono-

accelerator tube is used.

Useful from DC through the low-frequency spectrum and for many applications in the high-frequencies as well, the Type 327 is expected to find more actual use than any other single instrument.

By combining the best features of low- and high-frequency oscillographs this new instrument provides a uniquely efficient and practical tool for production as well as research.

### MAJOR SPECIFICATIONS

**VERTICAL AMPLIFIER:** Frequency response, flat from zero (d.c.) to down not more than 30% at 5 mc; Rise time, 0.07 usec; Deflection factor, 0.25 volts peak-to-peak per inch; Signal delay, 0.4 usec allows sweep to start before signal is applied.

**CALIBRATED SWEEPS:** (1) High-level calibrated, 19 steps from 1 sec/inch to 1 usec/inch; Accuracy  $\pm 5\%$ ; (2) Calibrated expansion, by factors of 2, 3, 4, or 5

with full positioning and accuracy of 15%; (3) Continuously variable, uncalibrated.

**AMPLITUDE MEASUREMENT:** Calibrating voltage, 0.5 volts p-p internal; Range, 10 full scale ranges from 0.5 to 500 volts full scale.

**CATHODE-RAY TUBE:** Distortion-free Mono-accelerator Type 5AMP—; Accelerating potential, 2500 volts, equivalent to operation at 3 kv on post-accelerator types.

## DU MONT

ALLEN B. DU MONT LABORATORIES, INC.

TECHNICAL SALES DEPARTMENT • 760 BLOOMFIELD AVENUE • CLIFTON, N. J.

CIRCLE ED-34 ON READER-SERVICE CARD FOR MORE INFORMATION



## Audio Power Pentodes

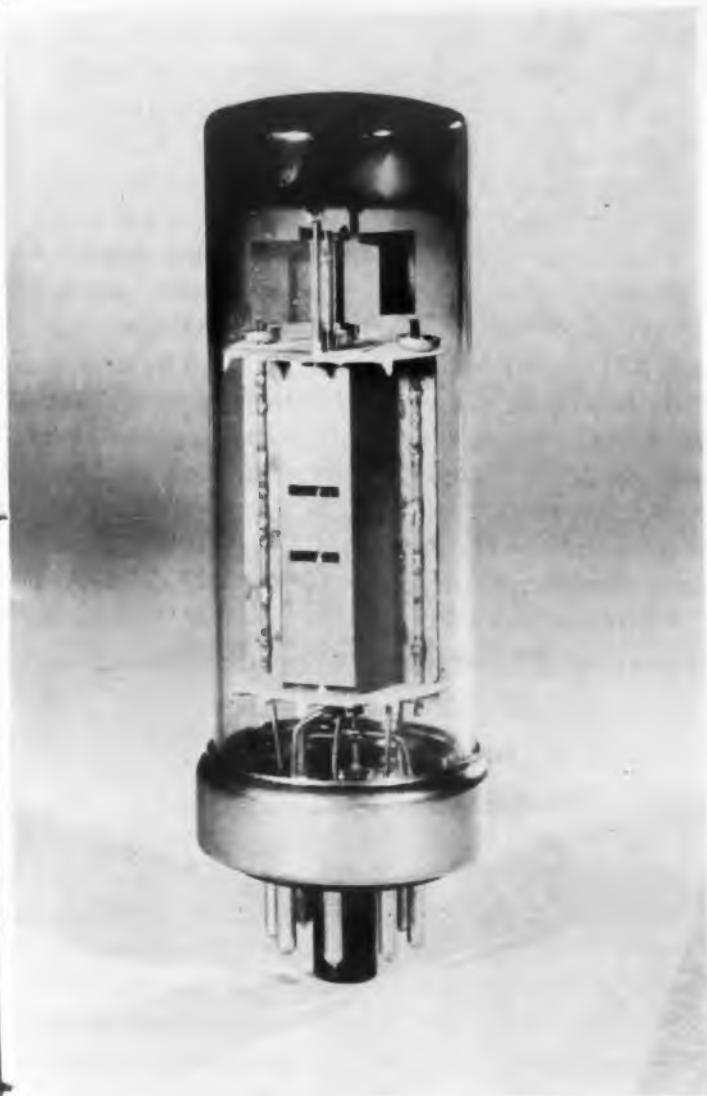
**D**ESIGNED expressly for good quality audio amplification at higher power levels, the two pentodes shown on these pages deliver high power without drawing control grid current. Designated the types 6CA7 and EL84, they are rated 25w and 12w plate dissipation, respectively. In many audio applications they can supply the required output power without the need for push-pull operation.

Mounted on an octal 8-pin base, the Type 6CA7 has 6.3v and 1.5amp filament power requirements. operated push-pull, Class B, with a plate voltage of 425v. This type of pentode delivers 45w with 6% harmonic distortion. The tube has a maximum seated height of 4-7/16" x 1-5/16" diam. It is designed to be used in place of the 6L6 and KT66 tube types.

Filament power requirements for the EL84 are 6.3v and 0.76amp. When operated push-pull, Class B, with a plate voltage of 300v, harmonic distortion is 4% for an output of 17w. The EL84 can be used in place of the 6AQ5 and the 6V6GT. The tube has a maximum seated height in its 9-pin miniature base of 2.75" x 0.79" diam. The suppressor grid of the tube is constructed with a varying pitch. It has a coated cathode.



The **EL84** miniature power pentode is designed to replace the **6AQ5** and **KT66**.



The plate of the **6CA7** pentode can dissipate as much as 25w at its maximum plate voltage of 800v. It can be mounted in any position.

Both of these power pentodes are manufactured by Amperex Electronic Corporation, 230 Duffy Ave. Hicksville, L. I. For complete technical data, base diagrams, and characteristic curves, turn to the Reader's Service Card and circle **ED-35**.



udio  
two  
wer  
ated  
and  
udio  
tput  
ion.  
CA7  
ents.  
tage  
with  
num  
de-  
T66

are  
Class  
stor-  
can  
The  
0-pin  
sup-  
ary-

# NEW G-E THRU-CON BOARD ASSURES SOLDER CONNECTIONS .. REDUCES PRODUCTION COSTS!

**H**ERE is an advanced printed circuit technique for preferred application in commercial and military equipment. Eye-lets are plated into specified holes at the same time the circuits are plated on one or both sides of each board. Thus, positive front-to-back connections are assured and solder connections to components made easier. Bond strength is outstanding. Remember, General Electric Thru-Con boards are available to your custom specifications. Why not investigate Thru-Con today!



*Electronic*  
**COMPONENTS**

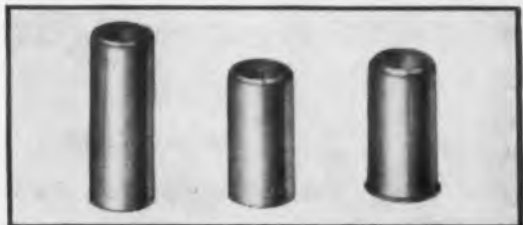
**New General Electric Delay Stick . . .**

- ★ The Industry's First, Low-Cost Signal Delay Unit
- ★ Developed Especially For Color Television

Receiver design engineers and purchasing agents take note! This *economical delay stick* can be made to your specifications from 0.2 to 1.0 microseconds delay. Available with or without terminating or compensating networks.



**G-E KOR-LES RESISTORS.** Famous for reducing resistor weight by as much as 50%. Other outstanding features include high power ratings and small size to make this ideal for new 600 ma. series filament connections. A wide variety of sizes and types for selection.



**G-E MINIATURE TUBE SHIELDS** (for 7 and 9-pin tubes). Miniature wrap-around types for efficient shielding in radio and TV circuits. Sizes 1 1/8", 1 1/4" and 1 3/8". Ideal for those who demand economy of space and cost. Bulk orders promptly delivered.

## OUR EXPERT APPLICATION ENGINEERS WILL ADVISE YOU!

General Electric Company, Components Department  
1811 LeMoyne Avenue, Syracuse, New York

Please send me literature and further details on your:

- Thru-Con Boards       Color TV Delay Stick       Kor-Les Resistors  
 Tube Shields       Have an Application Engineer Call

NAME.....

ADDRESS.....

CITY.....STATE.....

**GENERAL  ELECTRIC**

# New Products . . .

## Terminal Strip

For Assembly of Printed Circuits



Printed or etched cards are easily assembled to Terminal Strip No. 3366 by the fast dip method of solder points. Cards are held firm, preventing possible warpage in use. Fifteen 0.040" diam terminals are provided, although omission of certain terminals can be made to customer requirements, if desired. Nominal creep is 3/32". Pins are phosphor bronze, with plating of gold over silver.

Terminals extend through cards of 1/16", 1/8", and 1/4" thickness. Terminal strips for combination card thicknesses can be supplied. Also, strips can be mounted end-to-end for cards requiring additional terminals.

Material is standard 3700 green mineral-filled phenolic. Also available are strips in mineral-filled phenolic type MFE, diallyl phtalate MDG, or general purpose phenolic CFG. H. H. Buggie, Inc., Dept. ED, 726 Stanton St., Toledo 4, Ohio.

CIRCLE ED-37 ON READER-SERVICE CARD FOR MORE INFORMATION

## Delay Line

Adjustable up to 1.15  $\mu$ sec



The Model 2353 Panel Mounting Decade Delay Line has an adjustable delay in steps of 0.05  $\mu$ sec to a maximum of 1.15  $\mu$ sec. Characteristic impedance

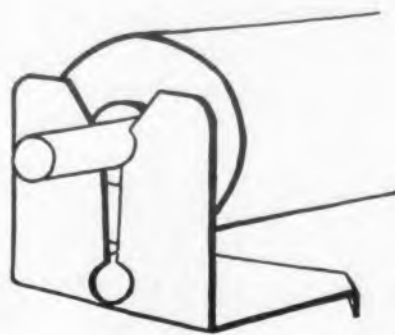
is 72 ohms. Pulse rise time is 0.13  $\mu$ sec after a total delay of 1.15  $\mu$ sec. Nominal delay tolerance is  $\pm 3\%$ .

Input and output connections are through BNC jacks. The line is a hermetically sealed unit with its network embedded in epoxy resin. Overall dimensions excluding jacks and switches are 4-5/8" x 1-3/4" x 3-1/4" deep. ESC Corp., Dept. ED, 578 East 161st St., New York 56, N. Y.

CIRCLE ED-38 ON READER-SERVICE CARD FOR MORE INFORMATION

## Diode Clips

Hold Most Crystal Types



The "Diode-Clip" is capable of holding all the major types of crystal diodes, including those with wire leads 0.018" diam and up, and/or terminals from 0.065" to 0.085" diam. Electrical tests show the clip has an average contact resistance of 750  $\mu$  ohms and a capacitance less than 1mmfd at 100kc at 9/16" spacing, making it ideal for u-h-f applications.

Mechanically the clip retains excellent grip even after more than 100 insertions. Withdrawal and longitudinal forces drop less than 6 oz from the initial value of more than 2 lb.

The clip is silver-plated phosphor bronze and is available in three styles: Type L (shown in cut) for eyelet or hollow rivet mounting and through-panel connections; Type U for surface panel mounting and connections; and Type S for rear-of-panel connections. Clips may be obtained separately or mounted in pairs on a phenolic base. Atlas E-E Corp., Dept. ED, Bedford Airport, Bedford, Mass.

CIRCLE ED-39 ON READER-SERVICE CARD FOR MORE INFORMATION

## Vibration Plotter

For Rotating Machinery



A new resonant vibration plotter to aid in the analysis of mechanical damping factors in rotating machinery automatically plots vibration amplitude as a function of frequency or speed. Features include scale expansion and an accuracy of frequency measurement to within 0.1%. By using an external meter, accuracy can be increased to as high as 0.01%. The equipment is designed and packaged for portability. Franklin Electronics, Inc., Dept. ED, 415 W. Pike St., Philadelphia 40, Pa.

CIRCLE ED-40 ON READER-SERVICE CARD FOR MORE INFORMATION

## Selenium Diodes

Deliver 5-11ma, 60-80v d-c



Four diodes have been added to this firm's line of sub-miniature selenium diodes. Known as Type 4V1, 5V1, 2Y1, and 3Y1 they are rated for maximum a-c input voltage (rms) from 52v to 130v

and for maximum d-c output voltage of 60v to 80v. They deliver output currents from 5ma to 11ma.

Each diode is completely encapsulated within a thermosetting plastic and may be operated in an ambient temperature range of  $-50^{\circ}$  to  $+100^{\circ}$ C. International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif.

CIRCLE ED-41 ON READER-SERVICE CARD FOR MORE INFORMATION

## Picture Tube Tester

Checks Tubes Dynamically



The Model 701 Picture Tube Tester dynamically tests all magnetically deflected monochrome or color tubes under actual receiving conditions. When used with this firm's high voltage probe, measurements over

a full-scale range of either 30kv or 60kv can be made safely.

The instrument is available either in kit form or assembled. The carrying-type case is 9" high x 6" wide x 5" deep. All connecting cables and an instruction manual are furnished with the unit. The tester has a 4-1/2" 100ma Simpson meter. Boland & Boyce, Inc., 236 Washington Ave., Belleville 9, N. J.

CIRCLE ED-42 ON READER-SERVICE CARD FOR MORE INFORMATION



## Magnetic Amplifier

### Features One-Cycle Response

The R6C10W1 Magnetic Amplifier is especially suited, without need of a preamplifier, for many medium performance indicating- or position-type servomechanisms. Through the addition of a simple preamplifier, it may be employed in the most accurate and demanding type of control systems.

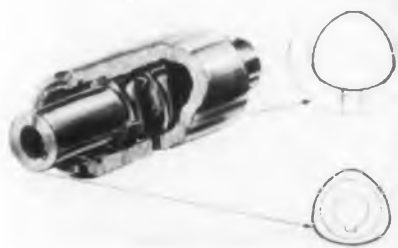


Design of the unit for one-cycle response assures the widest possible bandwidth consistent with the use of 60cy as the power supply frequency, and thus reduces many of the stabilization problems formerly encountered when incorporating magnetic amplifiers in servomechanisms. The unit delivers 10w reversible phase output for reversible phase a-c or reversible polarity d-c input. It has been designed with a minimum number of components to assure ruggedness and long life. Polytechnic Research & Development Co., Inc., Dept. ED, 202 Tillary St., Brooklyn 1, N. Y.

CIRCLE ED-404 ON READER'S SERVICE CARD FOR MORE DATA

## Universal Coupling

### Uses Tri-Lobe Design



This universal coupling has an equilateral tri-lobe shape on its driving members. The design was developed to increase coupling life expectancy when set to maximum misalignment. The tri-lobe shape is composed of a combination of radii, and is void of tangent flats. An accurate profile on the periphery of male members provides angular rotational displacement.

The design provides an 8° angular rotational displacement. Driving members are self-centering under all loads, and load carrying capacity is high. Engagement between male and female members is held to a maximum of 0.0002" side clearance. Bearing contact is 85% of total driving area.

The coupling is available in standard sizes up to 5" diam. Special sizes, types of material, heat-treat, and finish can be supplied upon request. Kerns Manufacturing Corp., Dept. ED, 45-18 Court Sq., Long Island City 1, N. Y.

CIRCLE ED-405 ON READER'S SERVICE CARD FOR MORE DATA

ELECTRONIC DESIGN • October 1954

# PERKIN

## TUBELESS MAGNETIC AMPLIFIER REGULATED DC POWER SUPPLIES

NO TUBES  
TO REPLACE

LOWER  
MAINTENANCE  
COST

LONGER LIFE

GUARANTEED

CONTINUOUSLY VARIABLE  
WITHOUT SWITCHING

MAGNETIC COMPONENTS  
UTILIZE HYPERSIL CORES



ORDER  
**NOW**

IMMEDIATE  
DELIVERY!

MODEL M1532-15

5 to 32 VOLTS @ 15 AMPS. (CONT.)

REGULATION:  $\pm 1\%$  (a) from 5-32 Volts D.C. (b) from 1.2 to 12 amps. (c) from 100-115 Volts A.C. (Single phase, 60 cps.)

RIPPLE: 1% rms @ 32 Volts and full load, increases to max. of 2% rms @ 5 Volts and full load.

RESPONSE: 0.2 Seconds

METERS: 4 1/2" AM and VM

DIMENSIONS: 22" x 17" x 14 1/2"

MOUNTING: Cabinet or 19" Rack Panel

FINISH: Baked Grey Wrinkle

WEIGHT: 150 lbs.

List Price: \$524 w/o cabinet, \$549 w/cabinet

MODEL M60VMC • 0 to 32 VOLTS @ 25 AMPS. (CONT.)

REGULATION:  $\pm 1\%$  (a) At 28 volts DC—increases to 2% max. over the range 24-32 V.; does not exceed 2 volts regulation over the range 4-24 volts D.C. (b) From 1/10 Full Load to Full Load. (c) At a fixed A.C. Input of 115 Volts.

RIPPLE: 1% rms @ 32V. and Full Load—2% rms. max. @ any voltage above 4 volts.

A.C. INPUT: 115 Volts, Single Phase, 60 c.p.s.

WEIGHT: 130 lbs.

FINISH: Baked Grey Wrinkle

DIMENSIONS: 22" x 15" x 14 1/2"

\*This unit is an economical solution to your power supply needs if stabilization for A.C. Voltage changes are not required. If this is required, see Model MR1040-30 below.

List Price: \$439 w/o cabinet, \$474 w/cabinet



MODEL MR1040-30 • 10 to 40 VOLTS @ 30 AMPS. (CONT.)

REGULATION:  $\pm 1\%$  (a) From 10 to 40 Volts D.C. (b) From 100 to 130 Volts A.C. (c) From 3 to 30 Amps. D. C.

RIPPLE: 1% rms

A.C. INPUT: 100-130 volts, 1 Phase, 60 Cycles

RESPONSE: 0.2 Sec.

METERS: 4 1/2" AM and VM

MOUNTING: Cabinet (or 19" rack panel)

FINISH: Baked Grey Enamel

WEIGHT: 200 lbs.

DIMENSIONS: 22" x 15" x 23"

List Price: \$792 w/o cabinet, \$827 w/cabinet

All prices F.O.B., El Segundo. Terms: 1% - 10 days, net 30. Phone collect for quantity discounts.

Write for Bulletin MA 154... also write (on company letterhead) for Free Subscription to technical periodical "PERKIN" Power Supply Bulletin.

ALSO AVAILABLE: Standard 6 and 115 volt models; Ground and Airborne Radar and Missile Power Supplies — Prompt Delivery!

# PERKIN

ENGINEERING CORP.  
215 MARSH ST., EL SEGUIN, TEX. PHONE 4-1213



CIRCLE ED-406 ON READER'S SERVICE CARD FOR MORE DATA

# Engineer assembles pulse system in 30 minutes, using Burroughs "do-it-yourself" units

Standard, matched units, performing basic functions, connect together to form even the most complex pulse systems



## 1. START

Engineer studies time chart of the desired pulse sequence. This is the output he wants the pulse system to produce.

## 2. PLANNING THE SYSTEM

He determines which Burroughs units he needs and how they should be connected together. This can be done by means of a simplified block diagram. Time: 10 minutes.

## 3. ASSEMBLING THE UNITS

Using standard coaxial cables, he completes his pulse system by connecting the units together according to his block diagram. Time: 20 minutes.

## 4. JOB COMPLETED

System now produces the exact pulse sequence desired. Engineer saves weeks of breadboard engineering, vital time, uncertainty, and considerable equipment cost. And his Burroughs "Unitized" pulse handling equipment can be used over and over again on different future projects.

### GET THE FACTS

No matter how complex the pulse sequence you need, you can produce it quickly and at relatively low cost with Burroughs "Unitized" pulse handling equipment. If you prefer, send us a timing diagram of the pulse sequence required, and we'll advise you what Burroughs units you need and the cost. Immediate delivery from stock. Write Burroughs Corporation, Electronic Instruments Division, Dept. 4K, 1209 Vine St., Phila. 7, Pa.

**ELECTRONIC INSTRUMENTS DIVISION**  
**Burroughs**

FIRST IN PULSE HANDLING EQUIPMENT

CIRCLE ED-61 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products . . .

### Resistor Only 1/4" Long



This tiny, wire-wound resistor has been developed to meet the needs of sub-miniaturizing. Built to customers' specifications, it is a hermetically sealed resistor available in standard sizes down to 1/4" by 1/4".

The units are designed to operate precisely in ambient temperatures ranging from  $-55^{\circ}$  to  $+125^{\circ}$ C. They feature a low temperature coefficient of  $\pm 20$  ppm/ $^{\circ}$ C, and high stability (resistance change with time is less than one-third the tolerance). Resistor Div., I-T-E Circuit Breaker Co., Dept. ED, 19th and Hamilton Sts., Philadelphia 30, Pa.

CIRCLE ED-62 ON READER-SERVICE CARD FOR MORE INFORMATION

### Connector

#### Microphone and Phone Types



The Series 2500 Microphone Connectors are designed for use with single conductor microphone cable.

The connector has a rugged body and coupling rings accurately machined from brass. The cable connector is provided with a flexible cord protector spring assembled into the body. The cable braid and spring are clamped by a hollow point set screw. This design, with coupling ring removable, results in quick change of female connector to male type.

The unit is available in straight connector, single contact, female type with coupling ring; straight connector, single contact, male type; panel connector, single contact, male type; and panel connector, closed circuit, male. Panel receptacles mount in 0.385" hole for connection to chassis; for insulated mounting, 2 conductor applications, insulating washers should be used with 1/2" diam mounting hole.

Also available is a phone connector that can be used in record players, f-m-a-m tuners, and sound recording equipment. It is made with phone jack 2 conductor, and phone plug —2 conductor. It is recommended for applications where disconnects are frequent. Switchcraft, Inc., Dept. ED, 1328 N. Halsted St., Chicago 22, Ill.

CIRCLE ED-63 ON READER-SERVICE CARD FOR MORE INFORMATION

## Digital Communication Engineers

with  
experience  
in  
the  
fields  
of

Systems Engineering  
Miniaturization  
Circuit Development  
Electromechanical Development  
Digital Techniques

### Long-Range Information Transmission

New advancements in the field of long-range information transmission are being made at Hughes with digital techniques.

### Areas of Work

To further expand work in this area, Hughes Research and Development Laboratories are interested in people with experience in airborne communication systems, digital storage, low frequency measurements, modulation systems, miniaturized packaging, audio, IF and RF circuitry in the HF range, analog to digital—and other data conversion methods.

Scientific and Engineering Staff

**Hughes**

RESEARCH  
AND DEVELOPMENT  
LABORATORIES

CULVER  
CITY,  
LOS  
ANGELES  
COUNTY,  
CALIFORNIA

Relocation of applicant must not cause disruption of an urgent military project.



## Magnetic Amplifiers

### For Servo Motor Applications

This series of magnetic amplifiers is for servo motor applications. Types MAT-1, MAT-2, MAT-3, and MAT-4, will handle 2w, 4w, 6w, or 9w respectively, servo motors, when used with a 115v, 400cy supply.



The units are extremely compact, hermetically sealed, and magnetically shielded. Output is sinusoidal, amplitude variable, and phase reversible. Control is provided by a dual triode, such as a 12AU7 operating at 400cy or higher. The signal to the triode grids can be polarity reversible d-c or phase reversible 400cy. Response time is about 7.5-millisecond.

In addition to the magnetic amplifiers, two accessory transformers are also available. The MAT-6 input transformer is designed to operate from a 10,000 ohms source to triode grid with a ratio of 1:15 center tapped. Phase shift is under 1°. The MAT-5 plate transformer has a primary of 115v, 400cy, and two 230v secondaries to provide either 230v at 48ma, d-c or 460v at 24ma, d-c. United Transformer Co., Dept. ED, 150 Varick St., New York 3, N. Y.

CIRCLE ED-43 ON READER-SERVICE CARD FOR MORE INFORMATION

## Fastener

### For Easy Mounting of Coil Tubes



This miniature coil tube fastener is available in two types to mount 0.218" OD coil tubes to chassis or terminal boards. Type 1 is for insert-type cores using No. 3-48 screws;

Type 2 has clearance holes for threaded cores. Both types are available to meet varying chassis thicknesses. The supporting legs and arms are designed to occupy minimum space and permit designers to use these fasteners on miniature coils and in areas where space is restricted.

The fastener incorporates three-way action: (1) thread design holds iron core in adjustment; (2) gripping points hold coil tube firmly; (3) resilient supporting arms quickly snaplock the entire assembly into position with a single push. Palnut Co., Dept. ED, 61 Cordier St., Irvington 11, N. J.

CIRCLE ED-44 ON READER-SERVICE CARD FOR MORE INFORMATION  
ELECTRONIC DESIGN • October 1954

# CONFIDENCE

• You can place your orders for printed circuitry and allied electronic sub-assemblies in the hands of Photocircuits Corporation with assurance of satisfaction for these reasons:

**SUCCESS.** Photocircuits Corporation has produced more printed circuits of the etched foil variety than any other company. It has an unexcelled reputation for reliability of quality and production performance. Photocircuits Corporation has played the largest part in bringing to maturity the young printed circuit industry.

**RESEARCH,** a never-ending activity at Photocircuits Corporation, does not stop with experimentation on production methods! Many suppliers, as well as its customers, have benefited greatly by Photocircuits' research efforts. Photocircuits Corporation's initiative has been the bulwark and bellwether of the industry's development of a variety of insulator-conductor laminates for printed circuitry.

**SPECIALIZATION.** At Photocircuits Corporation "printed circuitry" is the sole aim and product. Engineering and production staffs concentrate only on producing the best for each application of electronic and electrical circuitry... extending to switches, commutator discs etc.

**TECHNICAL AUTHORITY.** Coupled with actual production, the Photocircuits Corporation technical staffs have developed for the trade press authoritative information to aid the entire industry. This is also the product of pioneering, of concentration, of successful achievement. Engineering bulletins, furthermore, have been produced on all phases of design and production of printed circuitry. These are available to all on request.

**Photocircuits**  
CORPORATION

Pioneers in Cost-Cutting Printed Circuit Techniques  
Glen Cove 4-4000 • FLushing 3-5050



BOSTON: 25 Huntington Ave. • Commonwealth 6-7705  
CHICAGO: 4258 W. Irving Park Rd. • Palisades 5-1170  
PHILADELPHIA: 1531 Spruce St. • Kingsley 5-1205  
ROCHESTER, N. Y.: 3 Juniper St. • Culver 7635  
LOS ANGELES: 7407 Melrose Ave. • Webster 3-7276  
DAYTON, O.: 1521 Burroughs Drive • Randolph 5907  
KANSAS CITY, MO.: 903 McGee St. • Victor 8090



The information indicated in the coupon is yours on request.

PHOTOCIRCUITS CORPORATION  
Dept. ED10, GLEN COVE, N. Y.

Please send us the literature items checked:

- 1954 Engineering Brochure
- P-1 Fabrication
- P-2 Base Materials
- P-3 Platings & Plated-Thru Holes
- P-4 Etched or Plated Conductor Characteristics
- P-5 Printed Components
- P-6 Switch Plates & Commutator Discs
- P-7 Assembly & Dip Soldering
- P-8 Layout & Design

NAME.....

COMPANY.....

ADDRESS.....

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

\* Trade Mark

CIRCLE ED-33 ON READER-SERVICE CARD FOR MORE INFORMATION



## New Products . . .

### Trimmer Potentiometer

#### Features Infinite Resolution



Resistances of 20,000 ohms to 1 megohm are provided with Model 120 carbon "Trimpots", which are used for trimming or balancing circuits in minia-

turized electronic assemblies. Electrical adjustments with infinite resolution are made by turning the slotted shaft with a screwdriver. Settings are securely maintained during extremes of vibration, acceleration and shock.

These trimmer potentiometers may be mounted individually or in stacked assemblies with two standard 2-56 screws through the body eyelets. The units may be furnished with special features such as dual outputs, special resistances, and extended shafts. They are 1/4" x 5/16" x 1-1/4" in size and dissipate 0.2w. Bourns Laboratories, Dept. ED, 6135 Magnolia Ave., Riverside, Calif.

CIRCLE ED-45 ON READER'S SERVICE CARD FOR MORE DATA

### Liquid-Sensing Control

#### Fast Acting



This Liquid-Sensing Control unit will detect the presence of liquid in less than one second when the sensitive element is immersed 0.025" or more. It

will detect the absence of liquid in less than three seconds from the time it is withdrawn. The assembly consists of a small probe, an interconnecting cable, and a power control unit. A thermistor is the detector in the probe.

The length of the cable is not critical, and no vacuum tubes are used in the unit. Models for airborne use conform to applicable portions of MIL-E-5272A and MIL-F-8615(ASG). The entire unit is designed to withstand severe conditions of shock, vibration, temperature, humidity, altitude, and pressure. Control Instrument Div., Dept. ED, McDermott Water Heaters, Inc., 514 Genesee St., Trenton 10, N. J.

CIRCLE ED-46 ON READER'S SERVICE CARD FOR MORE DATA

## G. E.'s

LATEST CONTRIBUTION TO



# STACKED

CUSTOM BUILT TO PROVIDE  
143 POWER COMBINATIONS!



- ★ Smallest unit size yet developed!
- ★ Most reliable performance of any rectifier within this category!
- ★ Hermetically sealed for lifetime use!

The following germanium rectifier stacks, each occupying a volume of only 1.62" x 2.5" x 6.00", are typical of the 143 standard stacks in G. E.'s new rectifier line.

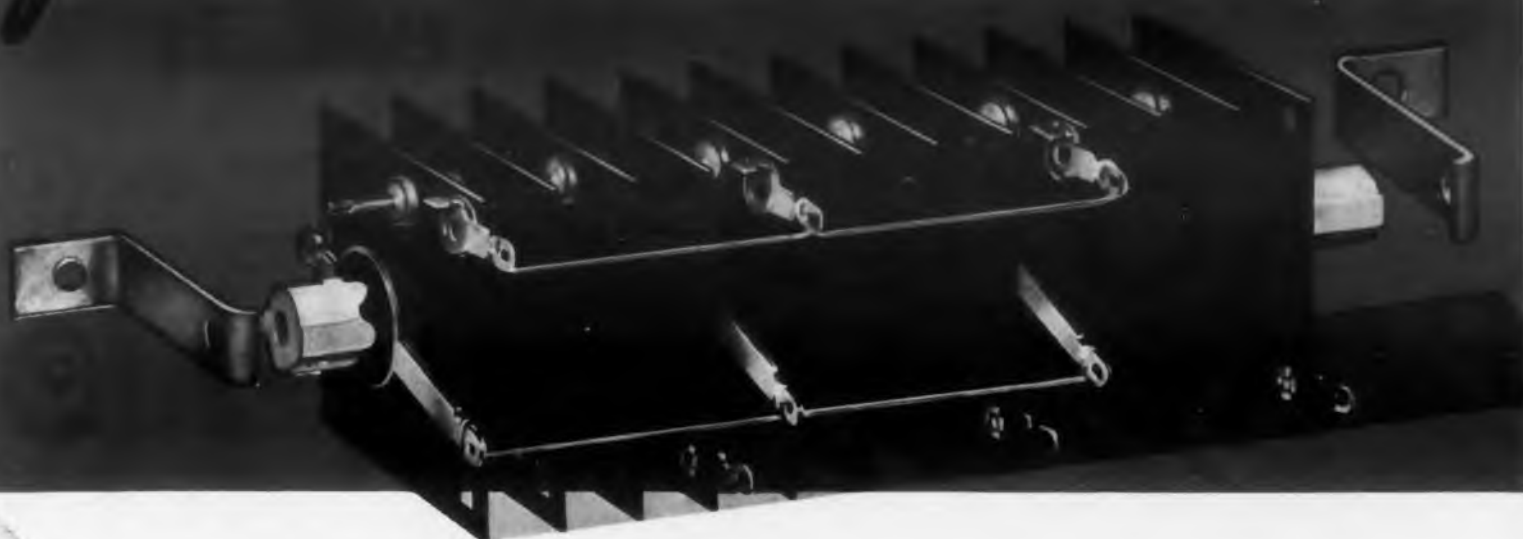
CIRCUIT	D.C. OUTPUT (55°C Resistive Load)
Half Wave . . . . .	2 amps @ 280 volts or 3 amps @ 190 volts
Full Wave Center Tap . . . . .	2 amps @ 280 volts or 3 amps @ 190 volts
Full Wave Bridge . . . . .	1 amp @ 565 volts or 3 amps @ 210 volts
Three Phase Half Wave . . . . .	1.12 amps @ 420 volts or 4.5 amps @ 140 volts
Three Phase Bridge . . . . .	1.3 amps @ 575 volts or 2.6 amps @ 280 volts
Three Phase Star . . . . .	1.8 amps @ 280 volts or 3.6 amps @ 140 volts



CIRCLE ED-47 ON READER-SERVICE CARD FOR MORE INFORMATION

THE PROGRESS OF POWER...

# Germanium RECTIFIERS



## Plus IMMEDIATE DELIVERY

General Electric leads the industry again! Announcement of this revolutionary G-E Stacked Germanium Rectifier opens up new avenues of power progress that were heretofore thought impossible to travel. Now, the amazing total of 143 power combinations has been provided with this one product! Your specifications requiring series or parallel stacks in single or polyphase circuits are custom-completed at G-E's factory.

This unit is smaller, weighs less, is more reliable, lasts longer, has better power ratings than any other dry rectifier made *any place by any other company*. AND, G.E. offers you *immediate delivery*.

Designed and built to deliver new *power performance*, the G-E Stacked Rectifier is 75% less by volume and weight than any other comparable dry type rectifier. And, rectifier losses are reduced to one-third or less of those encountered with any other type of rectifier. You can count on extreme reliability... tested for compliance to 10,000-hour standards. Note also that there are no forming or aging effects.

WRITE US TODAY! GET  
ALL THE FACTS ON THIS  
IMPORTANT NEW PRODUCT!

General Electric Company, Section X74104,  
Electronics Park, Syracuse, New York



★ ★ GENERAL  ELECTRIC

CIRCLE ED-47 ON READER-SERVICE CARD FOR MORE INFORMATION

### Variable Inductor Range of Inductance is 3:1



A continuously variable toroidal inductor called the "Rotoroid" can be used in tunable audio oscillators, variable

impedance devices, adjustable selective networks, variable phase-shift networks, variable filters, servo systems, and in telemetering.

The unit is stepless and employs no mechanical resistance contacts, therefore making it free of contact noise and wear. It provides a 3:1 range of maximum-to-minimum inductance in a 180° rotation of its shaft. Full Q of the toroid is available at maximum inductance. The components are hermetically sealed and resist the effects of vibration and shock. They can be chassis or panel mounted. Burnell & Co., Inc., Dept. ED, 45 Warburton Ave., Yonkers 2, N. Y.

CIRCLE ED-48 ON READER'S SERVICE CARD FOR MORE DATA

### TV Receiver Crystals Maintain Color Purity



For use in the sub-carrier oscillator circuits of color TV sets for maintaining color purity over a wide range of temperature and circuit variations, this 3579.545kc crystal has been designated

type TV-1. The unit causes the above oscillator to "lock" with the transmitter on every scan.

They have a frequency tolerance of 0.003% over the temperature range from 20 to 60°C. They are pressure mounted in nickel-plated brass holders 3/4" wide x 49/64" long exclusive of leads. The hermetically sealed container is nitrogen filled. Standard Piezo Co., Dept. ED, Carlisle, Pa.

CIRCLE ED-49 ON READER'S SERVICE CARD FOR MORE DATA

### "Mylar" Tape Base Much Stronger Than Acetate

"Audiotape" magnetic recording tape made with a "Mylar" base has very much high tear strength than acetate. It can be used under extremes of temperature and humidity and stored for long periods without deterioration. Available in 1 mil thickness. Audio Devices, Inc., Dept. ED, 444 Madison Ave., New York 22.

CIRCLE ED-50 ON READER'S SERVICE CARD FOR MORE DATA





**TEST THEM FREE!**

SEND FOR YOUR SAMPLE KIT OF  
**SHAKEPROOF**  
T.M. REG. U.S. PAT. OFF.  
**LOCK WASHERS**

Only SHAKEPROOF Lock Washers give you the powerful, positive locking action of tapered-twisted teeth. They actually bite deeper as vibration increases! A complete line of standard types and sizes meets nearly every fastening need.

WRITE FOR FREE  
SAMPLE KIT TODAY

**SHAKEPROOF**  
"Fastening Headquarters"

DIVISION OF ILLINOIS TOOL WORKS  
St. Charles Road, Elgin, Illinois  
Offices in principal cities

CIRCLE ED-53 ON READER-SERVICE CARD FOR MORE INFORMATION



**WIRE-MIKE**  
takes  
guesswork  
out of  
wiring

- pocket size, 4½" closed, 2 oz. weight
- heavy-gauge stainless steel
- inside and outside calliper, calibrated in 32nds
- precision-etched direct reading scales
- pipe size to I. d. conversion table
- genuine leather sheath

Frankly, we never intended to get into the WIRE-MIKE business. Our engineers designed WIRE-MIKE as a labor of love—because they felt such a tool was long overdue. We made several hundred for our friends, and thought we had heard the last of it. Not so. Before you could say "WIRE-MIKE," we were snowed under with demands for this handy gadget. Since our distributors knew we couldn't keep giving them away, they asked us to put WIRE-MIKE into production at a nominal price. A few improvements make WIRE-MIKE better than ever—now everyone can have this famous precision lifetime tool for instantly measuring conductor size (stranded, solid or ACSR), conduit size (rigid or thinwall), and pipe size. Only \$1.95 at your Burndy distributor. 54-20

BURNDY ENGINEERING COMPANY, Inc. • NORWALK, CONNECT.

CIRCLE ED-52 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products . . .

### Coaxial Termination Uses Tape Resistor Process



This miniature coaxial termination is made using the tape resistor process. Designed for application as a terminating resistor in miniature electronic equipment, the unit is also applicable as a replacement for the often used conventional 1/2w resistor when improved frequency response is desired.

A low cost unit, it has the light weight and ability to withstand high temperatures which can result from the use of tape resistors. The 51-ohm coaxial termination gives a vswr of 1.08 at 90Mc and 1.30 at 400Mc, as compared to respective figures of 1.40 and 3.70 for a conventional 1/2w carbon resistor.

The termination is also made with three leads, equally spaced radially on the outer terminal, to give still higher frequency response when needed. This unit (not illustrated) has a vswr of 1.0 and 1.08 at 90Mc and 400Mc, respectively. Diameter is 1/2"; thickness is about 11 mils. Hansen Electronics Co., Dept. ED, 7117-1/2 Santa Monica Blvd., Los Angeles 46, Calif.

CIRCLE ED-54 ON READER-SERVICE CARD FOR MORE INFORMATION

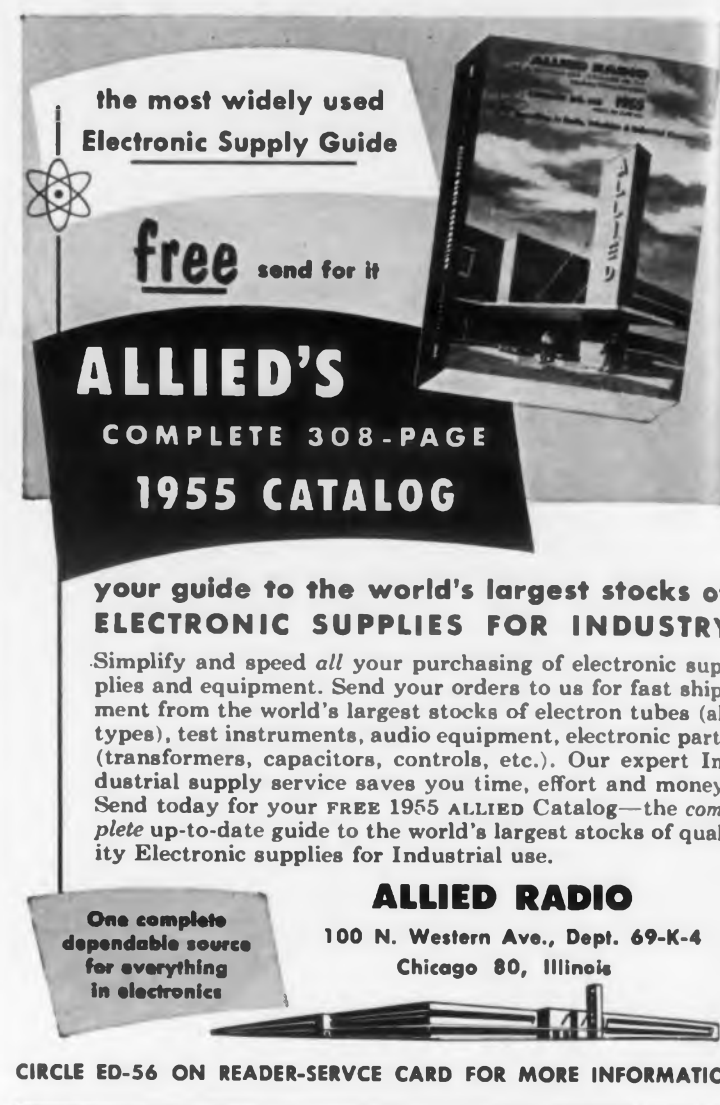
### Draftsmans' Lead Holder Pushbutton Type



This pushbutton holder takes leads of all diameters in all degrees. The heart of the newly-invented holder is the "Adapto-Clutch", a gold-lined collet to tightly clutch leads of any diameter. The Adapto-Clutch holds all leads—from 9H to 6B—tightly. It is guaranteed slip-proof against vertical pressure, and is turn-proof in all lead sharpeners and machines. The clutch was developed to solve the problem of producing a holder for leads of all degrees of hardness.

The holder is knurled for easy gripping. The clutch, nose-piece, and pushbutton are gold-filled. Koh-I-Noor Pencil Co., Inc., Dept. ED, Bloomsbury, New Jersey.

CIRCLE ED-55 ON READER-SERVICE CARD FOR MORE INFORMATION



the most widely used  
Electronic Supply Guide

free send for it

**ALLIED'S**  
COMPLETE 308-PAGE  
1955 CATALOG

your guide to the world's largest stocks of  
**ELECTRONIC SUPPLIES FOR INDUSTRY**

Simplify and speed all your purchasing of electronic supplies and equipment. Send your orders to us for fast shipment from the world's largest stocks of electron tubes (all types), test instruments, audio equipment, electronic parts (transformers, capacitors, controls, etc.). Our expert Industrial supply service saves you time, effort and money. Send today for your FREE 1955 ALLIED Catalog—the complete up-to-date guide to the world's largest stocks of quality Electronic supplies for Industrial use.

One complete dependable source for everything in electronics

**ALLIED RADIO**  
100 N. Western Ave., Dept. 69-K-4  
Chicago 80, Illinois

CIRCLE ED-56 ON READER-SERVICE CARD FOR MORE INFORMATION



**MIGHTY MIDGETS!**

CANNON MINIATURE D. C. SOLENOIDS

APPROXIMATELY 1½" x ¾"

POWERFUL! RELIABLE! MANY USES! LOW COST!

Here's YOUR answer to small traction problems. May be used to operate keyboards, light springs, control board signal flags, and door latches. Conventional design. Wide range of d. c. voltages. Self-lubricating Nylon bobbin. Side leads. Design variations available to meet YOUR specific problems. Write TODAY for full information!

**CANNON PLUGS**

Please Refer to Dept. 143  
CANNON ELECTRIC COMPANY, 3209 Humboldt St., Los Angeles, California  
Factories in Los Angeles; East Haven; Toronto, Canada; London, England.  
Representatives and distributors in all principal cities.

CIRCLE ED-57 ON READER-SERVICE CARD FOR MORE INFORMATION



### Molding Material Glass Filled

"Melmac" 3135, a glass-filled, electrical grade melamine molding material offers high strength and excellent resistance. The heat distortion point is over 200°C. Other featured properties are high dielectric strength and insulation resistance together with low shrinkage and moisture absorption. In addition, arc-tracking characteristics are excellent. Molding characteristics, including flow and cure time, are generally comparable to rag-filled materials. American Cyanamid Co., Plastics & Resins Div., Dept. ED, 30 Rockefeller Plaza, New York 20, N. Y.

CIRCLE ED-64 ON READER-SERVICE CARD

### Protective Coating Spray Contains Silicone

Packaged in an aerosol container and used as a spray, "SP-2" provides an additional insulative protection to electronic equipment, especially gear that is subjected to high altitudes, humidity, and marine atmospheres. Printed circuits can be coated with it. The spray, which contains silicone, is also available in bulk for large industrial use. Industrial Div., Dept. ED, Silatone Products Corp., Box 92, Dunellen, N. J.

CIRCLE ED-58 ON READER-SERVICE CARD

### Compacting Powder Produces Strong Parts

"Plast-Iron" B-212 is a reduced-oxide type of compacting powder recommended for the manufacture of mechanical parts (not bearings) where exceptionally high tensile and transverse strengths and superior wear resistance are required without the need for unusual ductility.

Another important characteristic of this powder is that parts made from it to which various percentages of copper may have been added show narrowly restrained growth upon sintering. Plastic Metals Div., National Radiator Co., Dept. ED, Johnstown, Pa.

CIRCLE ED-59 ON READER-SERVICE CARD

CIRCLE ED-60 ON READER-SERVICE CARD ►

# 90%

of those

*"SPECIAL DESIGN REQUIREMENTS"*

can be obtained  
with standard items

from *Ketay*

**FOR ECONOMY IN DESIGN... CHOOSE KETAY**  
... the complete line of synchros, servo motors, and resolvers.

**SYNCHROS:** From Size 10 to Size 37. There are units for every purpose including dual synchros as a control transmitter or a control transformer. Transolvers\*—special purpose devices for use in converting 3-phase data into 2-phase data.

**SERVO MOTORS:** Ketay offers 400 and 60 cycle Servo Motors. High torque to inertia servos are available as small as a penny and up to Size 23. Torques of 0.1 in.-oz. to 7.5 in.-oz.

**RESOLVERS:** Another highly developed Ketay specialty. Ketay offers resolvers for all applications... from Coarse  $\pm 0.2\%$  to Precision  $\pm 0.05\%$ . For use in computers, radar sweep circuits, phase shifters, and accurate transmission systems.

Ketay also manufactures a wide selection of aircraft, missile, marine, and ordnance instruments; and control systems.

Ketay has pioneered in the design of rotating precision instruments. For example, as design agent for Frankford Arsenal and the Bureau of Ordnance, Ketay designed the military Size 15, 16, 18, 19, 23, 31, and 37 synchros. The services of the Research and Development Division are available to you!



**Other Standard  
Items Include:**

Resolver Amplifiers  
Magnetic Amplifiers  
Gears and Gear Trains  
Airborne Instruments

*Ketay*

555 Broadway  
Pacific Division  
12833 Simms Avenue, Hawthorne, California

**USE COUPON FOR COMPLETE INFORMATION ON  
KETAY PRODUCTS!**

Ketay Instrument Corporation, 555 Broadway, New York 12, N. Y.

- Please send me bulletin on synchros, servos, resolvers.  
 Please send me information on \_\_\_\_\_  
 Please add my name to your mailing list.  
 Please have a representative call.

Name \_\_\_\_\_  
Company \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_

T

6AN5WA  
High Transconductance  
Power Pentode

5814WA  
Low Mu Dual Triode

OB2WA  
108 Volt Regulator Tube

5651WA  
Voltage Reference Tube



6101/6J6WA  
Medium Mu Dual Triode

5654/6AK5W/6096  
Sharp Cutoff Pentode

5670WA  
Medium Mu Dual Triode

5726/6AL5W/6097  
Dual Diode

6100/6C4WA  
Low Mu Triode

these are the

# STANDOUTS

for exacting military and commercial applications

## RAYTHEON

### RELIABLE MINIATURE TUBES

These tubes have earned the right to your confidence — and specification — by their demonstrated ability to stand up under the toughest service conditions . . . They are stable, rugged, reliable. They are subject to rigid quality control . . . Many of them meet 1000 hour life tests at elevated temperatures . . .

All of them meet the latest military Reliable Tube specifications . . . Specify them with confidence.

## RAYTHEON

RAYTHEON MANUFACTURING COMPANY

Reading Tube Division — Home Office 33 Chapel St., Hartford 24, Conn. Reg. No. 4-7200

R2 Application Information — Write Dr. Carl T. Hays, Office Dr. 4922 West Belmont Avenue, Chicago 27, Ill. Reg. No. 4-1775

235 First Avenue, New York 17, New York, Texas 7-3100 — 2419 South Grand Avenue, Los Angeles 7, California, Reg. No. 7-4511

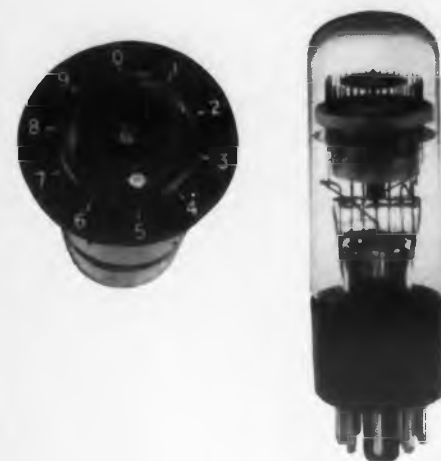
RAYTHEON MAKES ALL THESE:

RELIABLE TUBES AND MINIATURE TUBES — SEMICONDUCTOR DEVICES AND TRANSISTORS — ELECTRONIC TUBES — VACUUM TUBES — RECTIFIERS AND RECTIFIER TUBES

CIRCLE ED-401 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products . . .

### Counting Tube For High Speed Use



The Model GC-10D "Dekatron" cold cathode counting tube with a maximum input frequency of 20,000 counts per second can be utilized in fast registers and counters. The count is determined by

noting the position of the glow on any one of the 10 cathodes radially spaced around an axially positioned anode.

A light shield and bezel, Type 11807, with etched numbers makes notation of the glow position more convenient for recording and counting. The tube has an octal base with cathode number 0 brought out to an individual pin. The tube has the additional advantage of silent operation over mechanical counters. The tube operates on 420v, d-c. Anode current is 800 $\mu$ amp. Dimensions are 3.87" long x 1.12" diam. Manufactured in Great Britain by Ericsson Telephones, Ltd. Available from Atomic Instrument Co., Dept. ED, Cambridge, Mass.

CIRCLE ED-402 ON READER'S SERVICE CARD FOR MORE DATA

### Electronic Flash For Laboratory Photography



The "Hico-Lite" Model 109 portable electronic flash unit is useful for laboratory photographic needs.

The flash duration is about 1 millisecc, and flashes can be made as often as every 5 sec. The flash tube is guaranteed for long life.

The two-part unit is powered by two 240v dry batteries, which with normal use should yield 1200 to 1500 flashes. An a-c power pack is available as an accessory which can be used in place of the battery power for indoor work. The power supply has a safety feature to prevent shock on removing the 240v batteries. Total weight of lamp unit and power supply is 5 lb. Photronics Div., Hauman Instruments Co., Inc., Dept. ED, 70 Coolidge Hill Rd., Watertown 72, Mass.

CIRCLE ED-403 ON READER'S SERVICE CARD FOR MORE DATA

ELECTRONIC DESIGN • October 1954



## A-C Voltmeter

Range from 20cy to 10Mc



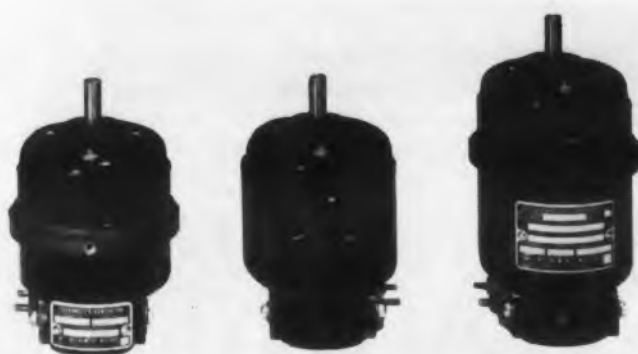
This video frequency VTVM Type MV-22 B, has an extremely wide frequency range of 20cy to 10Mc. Sensitivity is  $70\mu\text{v}$ , and the highest range on the meter is 1kv.

The flat frequency response of this instrument was made possible by a combination of extremely heavy degrees of negative feedback and frequency selective circuitry in the feedback path. The customary peaking coils in plate circuits are avoided. Millivac Instrument Corp., Dept. ED, 444 2nd St., Schenectady 6, N. Y.

CIRCLE ED-65 ON READER-SERVICE CARD FOR MORE INFORMATION

## Tachometer Generators

Range of 50 to 5000rpm



"Compsec" permanent-magnet d-c Tachometer Generators are similar to this firm's military models, yet are priced at a level that makes them attractive for commercial uses. Speed range is 50 to 5000 rpm.

Two sizes in three frames are presently available: The Type M-22 and Type M-24 frames for flat and flange mounting respectively, with outputs of 1v per 100rpm; and the Type L-24 for both flat and flange mounting, with an output of 3v per 100rpm. In all cases the tolerance on output voltage is  $\pm 10\%$ , and at constant ambient temperature the output is linear with speed  $\pm 1\%$ . At constant speed the output is constant within  $\pm 0.5\text{v}$  for rotation in either direction.

The generators have die-cast aluminum frames and end-brackets, with cast-in stainless steel inserts for the shielded ball bearings; stainless steel shaft of 0.250" diam. with a 5/8" extension; terminals shielded by molded-in barriers; 11-slot armature and commutator; and silver-graphite brushes.

The M-22 and M-24 units are 3-1/8" long and 2-1/4" and 2-1/2" in diameter, respectively; the L-24 has a diameter of 2-1/2" and a length of 4". Instrument Motors, Dept. ED, Box 5, Stamford, Conn.

CIRCLE ED-66 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954

## evolution of an

Idea... how KEYSTONE shortens the interval from

theory ...

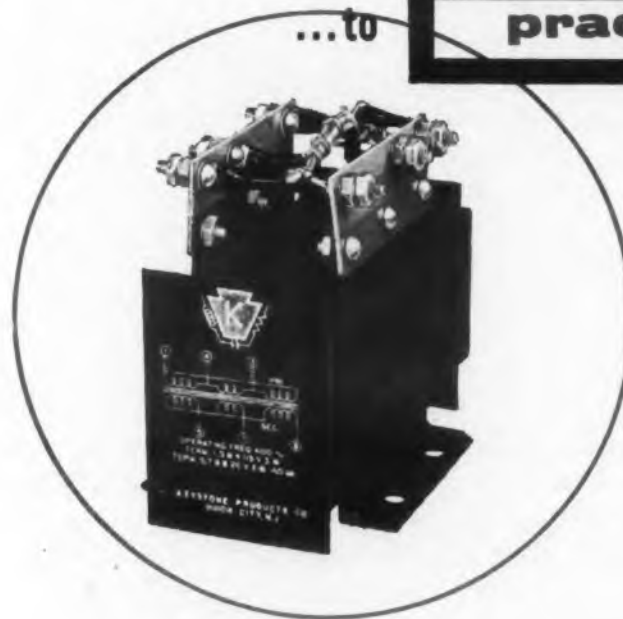
a hot new electronic idea with important uses but involved transformer problems which threaten to bog down the ultimate mass production... but schedules must be met. A smart engineer turns to KEYSTONE'S reply sheet... quickest way to filling the most exacting transformer requirements of all military and commercial units. KEYSTONE evaluates the conditions and custom engineers the correct type transformer... putting it into immediate production... exclusive KEYSTONE techniques and internal flexibility cut your costs through faster deliveries of precision custom-built units... which have proven to be the economic solution to leading electronic manufacturers' most difficult applications.

"KEYSTONE is correct for every application."

...to

practice

KEYSTONE'S free engineering service and handy REPLY SHEETS are yours for the asking... write Dept. E-8 today!



**keystone**   
PRODUCTS COMPANY

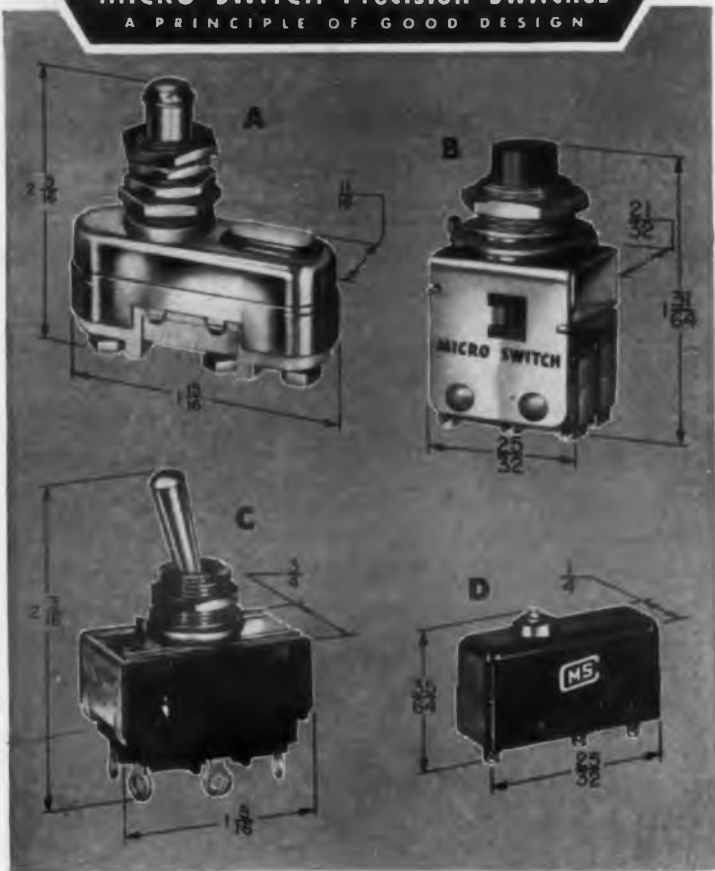
904 23RD STREET UNION CITY 2, N. J.

CIRCLE ED-67 ON READER-SERVICE CARD FOR MORE INFORMATION



## MICRO SWITCH Precision Switches

A PRINCIPLE OF GOOD DESIGN



There are uses unlimited for these small MICRO SWITCH precision switches in electronic devices and instruments

**A** The high temperature basic switch will operate satisfactorily in a temperature range of from  $-50^{\circ}$  to  $+1000^{\circ}$ F. It is designed for applications which require a high-temperature switching component.

**B** The subminiature push button switch assembly is composed of two single-pole, double-throw subminiature switches. The plunger provides an unusually good snap make and break. Available with red or black plastic buttons and either solder post or turret-type, wrap-around terminals.

**C** This sealed toggle switch is supplied with an external panel seal and an internal bushing seal below the bat handle. It has a bushing for panel mounting and may also be supplied with keying tab.

**D** Tests show that this long-life subminiature switch is capable of operations in excess of 20 million. It is an improved type of the basic subminiature switch and is available with either solder post or turret type, wrap-around terminals.

MICRO SWITCH engineering service, fully experienced in every type of switch use, is available at 16 branch offices to consult with you on your switch application problem. A call to the branch office near you may save time and money.

# MICRO SWITCH

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY  
FREEPORT, ILLINOIS



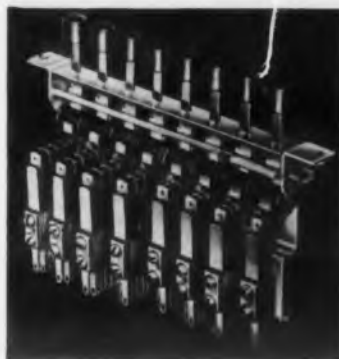
CIRCLE ED-68 ON READER-SERVICE CARD FOR MORE INFORMATION

50

## New Products . . .

### Pushbutton Switches

With 4 to 12 Stations



Two multiple-station, interlocking, pushbutton switches, the Series 5700 and Series 5900, are available in capacities of 4 to 12 stations. Each station may be equipped with various combinations of contact assemblies. All stations are interlocked, so that depressing any button

releases any other previously operated button. Several optional features are also available.

Switches in the two new series are designed for use on communication equipment, alarm and signalling apparatus, radio and television broadcast and control equipment, test panels, industrial process control units, railway communications systems, controls, and instruments. Donald P. Mossman, Inc., Dept. ED, Brewster, N. Y.

CIRCLE ED-69 ON READER-SERVICE CARD FOR MORE INFORMATION

### Grouped Resistors

Made in Two-to Six-Unit Models



Grouped - typed encapsulated precision resistors are made up of from two to six individual, lug-type "Riteohm" resistors, arranged end-

to-end in a one piece, molded resin body. (Illustration shows 3-, 5-, and 6-resistor units). A special resin completely encloses the individual resistors and gives maximum protection against mechanical damage and ambient conditions. The coefficient of expansion of the resin closely matches that of the other materials of the unit.

These grouped-type "Riteohms" are available in lengths up to approximately 3". The individual resistor units in the group can be obtained in wattage sizes of 1/4w, 1/2w, and 1w (125°C ambient), and in resistance values up to a maximum of 1,950,000 ohms. Tolerances as close as  $\pm 0.1\%$  are available.

Individual resistors of the grouped-type units consist of enameled alloy resistance wire that is non-inductively pie-wound on rigid, steatite bobbins. The resistance wire is welded to the terminal, giving a permanently stable electrical connection. Ohmite Manufacturing Co., Dept. ED, 3664 Howard St., Skokie, Ill.

CIRCLE ED-70 ON READER-SERVICE CARD FOR MORE INFORMATION

on the design table  
...and in the  
production line

# ACE NYLON BALLS

KEEP THINGS MOVING SMOOTHLY IN HUNDREDS OF INDUSTRIAL APPLICATIONS!

MASS-PRODUCED OF DuPONT NYLON FM No. 10001 TO CLOSE TOLERANCES OF  $\pm .001$ . Sizes  $1/8"$  to  $3/4"$

Ace Nylon Balls have brought new design flexibility and production economy to many of America's largest manufacturers. Uniform, precision-fabricated, light-weight Ace Nylon Balls are tough at low temperatures, stable at high temperatures, and resistant to chemicals and abrasion. Ace Nylon Balls may add greater efficiency and economy to your products, too.

Write for samples, bulletin, price list today.

WHY NOT LET OUR ENGINEERS ADVISE YOU?

Complete facilities for fabricating plastic parts for all industries. Estimates submitted promptly on receipt of blueprints or specifications.

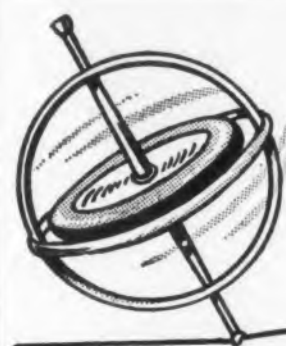
## ACE PLASTIC COMPANY

Precision Plastic Fabricators and Extruders



91-58 Van Wyck Expressway • Jamaica 35, N. Y.

CIRCLE ED-71 ON READER-SERVICE CARD FOR MORE INFORMATION



## CASTELL push button LOCKTITE lead holder has PERFECT BALANCE

Perfect balance makes Push Button CASTELL LOCKTITE Holder the king of its class.

Exclusive collet holds lead in bull dog grip, preventing slipping or turning.

No graphite dust stains your fingers—because with one-hand push-button action you extend and retract the lead. No need to touch graphite. Comfortable "wood-pencil" feel—not metallic.

Equipped with easily-replaced clutch, giving your LOCKTITE indefinite life.

Imported CASTELL 9030 Lead inserted in your LOCKTITE Holder gives you the combination for brilliant results on your drawing board. Ask your Dealer for both—LOCKTITE Holder and Imported CASTELL 9030 Lead in 19 degrees, 7B to 10H.

## AW. FABER-CASTELL

PENCIL COMPANY, INC., NEWARK 3, N. J.

CIRCLE ED-72 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954

Write today for your free copy of this Technical Paper.

ask for data file

1007

## Computing with Servo-Driven Potentiometers

BY F. R. BRADLEY & R. D. MCCOY  
Reeves Instrument Corp.

Reprinted from TELE-TECH & ELECTRONIC INDUSTRIES

385



CIRCLE ED-74 ON READER-SERVICE CARD FOR MORE INFORMATION

## STANDARD-Signal Generator

16 kc to 50 Mc for  
RESEARCH • DESIGN • PRODUCTION TESTING



Type 805-C Standard-Signal Generator: \$1495.00

- ★ 7 Direct-Reading Ranges to  $\pm 1\%$  accuracy
- ★ Drift less than  $\pm 0.1\%$  on any range during five hours continuous operation
- ★ Direct-Reading Slow-Motion Dial for frequency increments as small as 0.01%
- ★ Output Voltage continuously adjustable from 0.1  $\mu$ v to 2 v, indicated on panel meter
- ★ Modulation continuously variable from 0 to 100%, indicated on panel meter
- ★ Output Impedance 75 ohms at panel jack; 75-ohm cable supplied, with termination impedance of 37.5, 7.1 and 0.75 ohms
- ★ Regulated Power Supply eliminates effects of line voltage variations

**GENERAL RADIO Company** 275 Massachusetts Ave. Cambridge 39, Mass.  
90 West St. NEW YORK 6 8055 13th St. Silver Spring, Md. WASHINGTON D.C.  
920 South Michigan Ave. CHICAGO 5 1000 North Seward St. LOS ANGELES 38

CIRCLE ED-75 ON READER-SERVICE CARD FOR MORE INFORMATION  
ELECTRONIC DESIGN • October 1954

## Coaxial Cable

Available in Continuous Lengths



"Mininoise" cable, developed for high impedance circuitry, is now available in continuous cable form at greatly reduced cost. First developed to reduce self-generated noise

readings in circuitry, the cable greatly reduces cable noise. Microdot Division, Felts Corp., Dept. ED, 1826 Fremont Ave., South Pasadena, Calif.

CIRCLE ED-76 ON READER-SERVICE CARD FOR MORE INFORMATION

## Precision Cams

For Computing and Motion Applications



A wide variety of types and sizes of custom-made precision cams is offered by this firm for practically any kind of application. They are especially valuable as highly accurate, compact mechanical "memories" for analog computers and similar systems. The cams can be manufactured as "packaged units", or supplied to be mounted by the user.

The cams fall into two major groupings: three-dimensional cams and "single-input" cams. The 3-D cams make available a compact unit that continuously and accurately satisfies an arbitrary function:  $z=f(x, y)$ , where  $x$  and  $y$  are independent variables, and  $z$  is the output. Bomb characteristics, navigational data and ballistic corrections are typical functions.

"Single-input" cams include grooved flat cams, external flat cams, and grooved cylindrical cams. These designs are most often used to obtain a motion or function which bears a non-linear relation to another single motion or function:  $y=f(x)$ . Squares, trigonometric functions, logs, ballistic data, and reciprocals of square roots are typical outputs. Ford Instrument Company, Division of the Sperry Corp., Dept. ED, 31-10 Thomson Ave., Long Island City 1, N. Y.

CIRCLE ED-77 ON READER-SERVICE CARD FOR MORE INFORMATION

# MINIATURIZING YOUR EQUIPMENT?

Specify SIMPLEST, MOST COMPACT

## AMPERITE

### THERMOSTATIC DELAY RELAYS

MOST ECONOMICAL, HERMETICALLY SEALED



STANDARD



MINIATURE

Provide delays ranging from 2 to 120 seconds.

- Actuated by a heater, they operate on A.C., D.C., or Pulsating Current.
- Hermetically sealed. Not affected by altitude, moisture, or other climate changes.
- Circuits: SPST only — normally open or normally closed.

Amperite Thermostatic Delay Relays are compensated for ambient temperature changes from  $-55^{\circ}$  to  $+70^{\circ}$ C. Heaters consume approximately 2 W. and may be operated continuously. The units are most compact, rugged, explosion-proof, long-lived, and — very inexpensive!

TYPES: Standard Radio Octal, and 9-Pin Miniature.

PROBLEM? Send for Bulletin No. TR-81

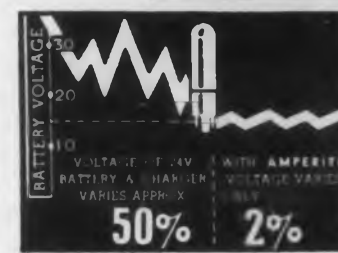
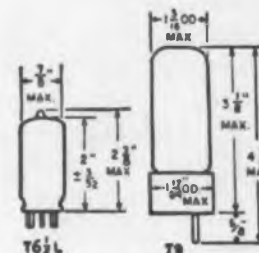
## BALLAST-REGULATORS

- Amperite Regulators are designed to keep the current in a circuit automatically regulated at a definite value (for example, 0.5 amp).
- For currents of 60 ma. to 5 amps. Operates on A.C., D.C., or Pulsating Current.
- Hermetically sealed, light, compact, and most inexpensive.

Maximum Wattage Dissipation:  
T6 $\frac{1}{2}$ L—5W. T9—10W.



T9 BULB



Amperite Regulators are the simplest, most effective method for obtaining automatic regulation of current or voltage. Hermetically sealed, they are not affected by changes in altitude, ambient temperature ( $-55^{\circ}$  to  $+90^{\circ}$ C), or humidity. Rugged; no moving parts; changed as easily as a radio tube.

Write for 4-page Technical Bulletin No. AB-51

**AMPERITE CO. Inc.**, 561 Broadway, New York 12, N. Y.  
In Canada: Atlas Radio Corp., Ltd., 560 King St. W., Toronto 2B

CIRCLE ED-78 ON READER-SERVICE CARD FOR MORE INFORMATION



# for complex electronic equipment

# ERCO

Engineering and Research Corp.  
Riverdale, Maryland

*chose*

# CHICAGO

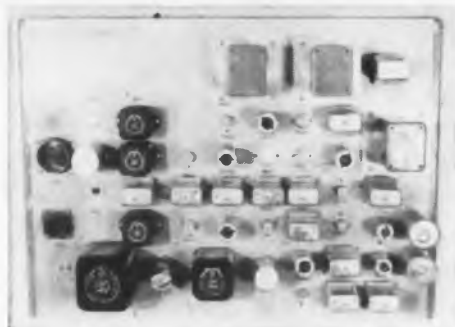
## THE WORLD'S TOUGHEST TRANSFORMERS



A partial view of the computer cabinets of the "Flightronic" Simulator.

The "Flightronic" Simulator, designed and produced by ERCO, trains Air Force pilots in cockpit checks, navigation, interception and emergency procedures of the famed F86D "Sabre" Jet Interceptor.

The "brains" of the Simulator are intricate computers containing complicated electronic and electro-mechanical systems. To insure accurate, uninterrupted duplication of flight conditions, only the most dependable components can be used. That's why ERCO chose CHICAGO transformers: to be sure of reliable, trouble-free service.



One of the many electronic units using CHICAGO transformers.

Despite the specialized nature of this equipment, all of the CHICAGO transformers used were *shipped from stock*. These transformers were all cataloged units, listed in CHICAGO Catalog CT-554 and available for immediate delivery. This valuable publication is available FREE from your CHICAGO distributor or from Chicago Standard Transformer Corporation.

## CHICAGO STANDARD TRANSFORMER CORPORATION

ADDISON AND ELSTON  
CHICAGO 18, ILLINOIS



EXPORT SALES:  
Roburn Agencies, Inc.  
431 Greenwich Street  
New York 13, N. Y.

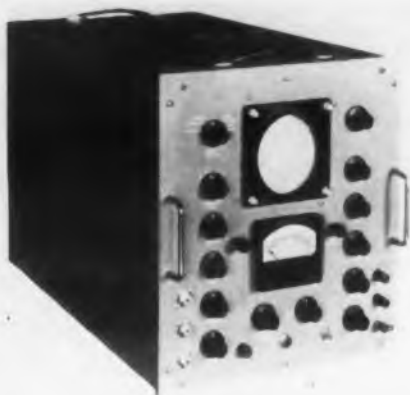
CIRCLE ED-80 ON READER-SERVICE CARD FOR MORE INFORMATION



# New Products . . . .

## Synchroscope

### For Radar Pulse Studies



The Model C-04 Synchroscope is a redesign of the "P-5" synchroscope originally developed by the Massachusetts Institute of Technology Radiation Laboratories. The writing rate of the unit is  $0.05\mu\text{sec}$

per inch. The vertical channel frequency response is 600Mc without resonance or distortion.

This highly stable unit features a drift of less than 0.4% per month and high calibration accuracy. The trigger output directly fires any hydrogen thyratron up to the Type 5C22. Shielding and geometry of the input circuit permits operation of the instrument in close proximity to 40megw pulsers. TLG Electric Corp., Dept. ED, 31 W. 27th St., New York 1, N. Y.

CIRCLE ED-81 ON READER-SERVICE CARD FOR MORE INFORMATION

## Multichannel Oscillographs

### Direct-Writing Units



These multichannel direct-writing oscillographs are offered in four and six channel systems. The same basic chassis, used throughout the series, permits the four-channel oscillographs to be expanded to six channels as requirements change. Four- or six-channel chart paper may be used interchangeably on six-channel units.

An electrically controlled chart drive system permits instantaneous speed selection. A total range of 16 accurate chart speeds is possible from 1 cm/hr to 250mm/sec. All speeds are selected with a front panel control or with an accessory remote control unit.

ble from 1 cm/hr to 250mm/sec. All speeds are selected with a front panel control or with an accessory remote control unit.

All of the oscillographs can be mounted on roller slides in a standard 19" rack or can be furnished in a console for operation on a bench or cart. Both ink writing and combination ink and electric writing units are available, all using the Brush electrodynamic penmotor, which instantaneously records static and dynamic phenomena from d-c to 100cy when used with Brush amplifiers. Brush Electronics Co., Equipment Department RT-1, 3405 Perkins Ave., Cleveland 14, Ohio.

CIRCLE ED-82 ON READER-SERVICE CARD FOR MORE INFORMATION



precision resolvers

SIZES 11, 15, 23



400~ servo motors

SIZES 11, 15, 18



brushless induction potentiometers

SIZE 15



RELIABLE  
AND STABLE  
PERFORMANCE

servo components,  
instruments,  
synchros

Let us quote on your  
detailed requirements.

**American Electronic Mfg., Inc.**

9503 W. JEFFERSON BLVD., CULVER CITY, CALIF.

TELEPHONE: TEXAS 0-5471

## D-C Relay

### Withstands Extreme Environments



Part No. DC-36 is a compact, rugged, d-c relay designed for use in circuit applications characterized by severe service conditions. The unit is evacuated, filled with an inert gas, and sealed off, making the coil and contacts impervious to dust, corrosion and moisture. The relay ex-

ceeds the electrical and mechanical requirements of USAF Specification MIL-R-5757.

Characteristics include 6pdt (break-before-make) pure silver contacts; a rating of 2amp at 25v d-c resistive load; input sensitivity of 72mw.

Contact resistance is 0.03 ohm max. Coil voltage is 26.5v d-c. Coil resistance 250 ohms  $\pm 10\%$ ; pull-in is 18v d-c max; drop-out is 13v d-c max; with other coil ratings available upon request.

Ambient temperature range is  $-65^{\circ}$  to  $+125^{\circ}$ C. The relay is built to rugged standards required for operation, energized or non-energized, under extremes of temperature, humidity, 100g shock, and 10-500cy vibration at over 30g amplitude. Terminals are of the closed loop type (also available with spade, plug-in or AN connector, on order). Weight is 4 oz and dimensions are 1-3/16" diam x 1.430" height above mounting plate. Deltron Corp., Dept. ED, 9010 Bellanca Ave., Los Angeles 45, Calif.

CIRCLE ED-84 ON READER-SERVICE CARD FOR MORE INFORMATION

## Power-and-Phase Converter

### Weighs Only 2 lb



The Model P-1 Power - and - Phase Converter changes single - phase power into three-phase, delta - connected power for aircraft instruments. The converter meets specifications USAF 32574A and MIL-N-8357.

These units weigh only 2 lb and eliminate the need for rotary power conversion equipment. Each converter is able to successfully supply up to four separate instruments without sacrificing operating efficiency. Maintenance costs are cut because the units have no moving parts. Although being offered from stock, each unit can be individually adjusted to meet all types of gyro and instrument needs. White Industries, Dept. ED, 421 West 54th St., New York, N. Y.

CIRCLE ED-85 ON READER-SERVICE CARD FOR MORE INFORMATION

good medicine

for

MINIATURIZATION

By their very nature, *printed circuits* are extremely compact. They open up virtually unlimited possibilities to alert designers concerned with the miniaturization of electrical and electronic devices. From the simplest switches to the most complex computers, printed circuits are proving their versatility and great potential application.

Complicated manual wiring is replaced by a pattern of conductors, coils, resistors, and other components "printed" on a sheet of laminated plastic. Low in cost, uniform in performance, and free of wiring "bugs," such assemblies are speedily mass-produced. Labor costs are drastically cut two ways—far fewer personnel are needed, and lesser-skilled workers can easily assemble (and service) complex devices with less chance of error. Since exact wiring duplication is achieved, inspection is greatly simplified. Assemblies grow small in size, overhead is reduced, less floor space is needed . . . the whole problem takes a big "easy-

does-it" step toward complete automation.

National Vulcanized Fibre Co. is a pace-setter in the development of foil-clad laminates—the basic materials for most printed circuitry. Copper-Clad Phenolite—by National—is recognized as the standard by fabricators everywhere. For Phenolite is a high-quality base laminate that can be *engineered* to fit *your* conditions. It has the high insulation resistance, low electrical loss, and low moisture absorption required in the *right* base material for printed circuits. It is light in weight, easily punched and worked, and withstands effects of the various circuit-printing processes.

No matter which method you use to produce printed circuits, Phenolite clad laminates are the ideal base materials. Whether clad with metal foils, or non-metallic materials (such as rubber, vulcanized fibre, etc.) there is a Phenolite laminate for *your* particular job.

Ask any of our district offices or Wilmington headquarters for details.

PHENOLITE  
Laminated PLASTIC

HERE'S HELP FOR YOU—our new, fact-filled, 12-page bulletin entitled "Mechanize Your Wiring With Copper-Clad Phenolite." Contains full information and application data on Copper-Clad Phenolite and other metal and non-metal clads. Write for it today! Address Dept. AG-10.

Also manufacturers of Vulcanized Fibre,  
Vul-Cot Waste Baskets, Peerless Insulation,  
Materials Handling Equipment and Textile Bobbins



**NATIONAL**  
VULCANIZED FIBRE CO.

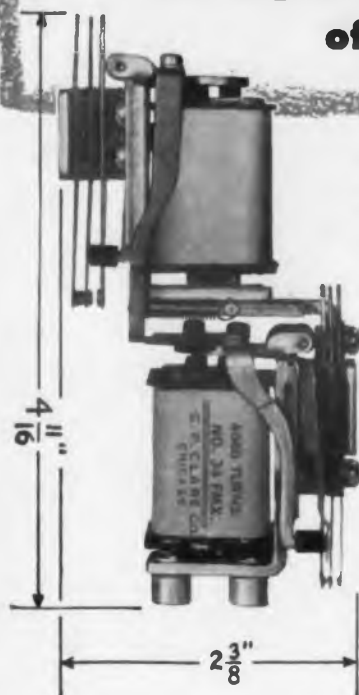
WILMINGTON 99, DELAWARE

CIRCLE ED-86 ON READER-SERVICE CARD FOR MORE INFORMATION





**New CLARE Type LG Relay  
increases life expectancy  
of electromechanical  
latching relays to millions  
of operations**



**Typical Circuit Functions**

- 1 Hold contacts operated any length of time without consuming power.
- 2 Operate contacts over one lead; release them over another.
- 3 Act as overload relay — electrically reset from remote point when tripped.
- 4 Act as interlocking relay pair on either a-c or d-c—or on combination of both.

CLARE Type LG Electromechanical Latching Relays consist of two CLARE Type GAC a-c relays with interlocking armatures. They are aligned one above the other on a common mounting bracket to save chassis space. The assembly may also consist of two Type G d-c relays, or one a-c and one d-c relay.

Relay operation is as follows:

- 1 When either relay is energized while the other, deenergized, relay is latched up, it will unlatch the other relay, allowing it to restore, and will latch itself up.
- 2 When either relay is energized while the other is already energized, it will operate its own contacts without latching up, and without affecting the other relay. It will release as soon as its coil circuit is opened. The two relays, however, can be interlocked electrically so that both coils cannot be energized at once.
- 3 When either relay is deenergized while the other relay is energized, it will latch up to the other relay.

For full information on this new relay or for consultation on any relay problem, we invite you to contact your nearest CLARE sales engineer or write to C. P. Clare & Co., 3101 West Pratt Blvd., Chicago 45, Illinois. In Canada: Canadian Line Materials Ltd., Toronto 13, Ontario. Cable Address: CLARELAY.

Write for Bulletin 118

**CLARE RELAYS**  
FIRST IN THE INDUSTRIAL FIELD

CIRCLE ED-88 ON READER-SERVICE CARD FOR MORE INFORMATION

**New Products . . .**

**Plastic Film Capacitors  
For Use Up to 200°C**



These capacitors employ a high-polymer plastic film dielectric that is stable up to 200°C. Encased in a tubular metal container, units are hermetically sealed with rugged glass end seals. Cans are floating or grounded, and leads are axial.

Standard units guarantee insulation resistance of  $5 \times 10^9$  ohms at 200°C and  $5 \times 10^{13}$  ohms to 180°C. Capacitance ratings are guaranteed within  $\pm 10\%$ . Special units are available with insulation resistance of  $5 \times 10^{15}$  ohms and tolerances of  $\pm 1\%$ .

Temperature coefficient of these capacitors is less than 75 parts per million from  $-70^\circ$  to  $+200^\circ\text{C}$ , and power factor is less than 0.0005 even in the v-h-f band. Tests show no deterioration in this performance after 13,000 hr at 200°C and 140% of rated voltage. These characteristics exceed the requirements of MIL-C-5 for micas. Standard ratings are from 0.0003mfd to 1.0mfd. Balco Research Laboratories, Dept. ED, 49-53 Edison Pl., Newark, N. J.

CIRCLE ED-89 ON READER-SERVICE CARD FOR MORE INFORMATION

**Cycle Timer  
Motor-Driven Design**

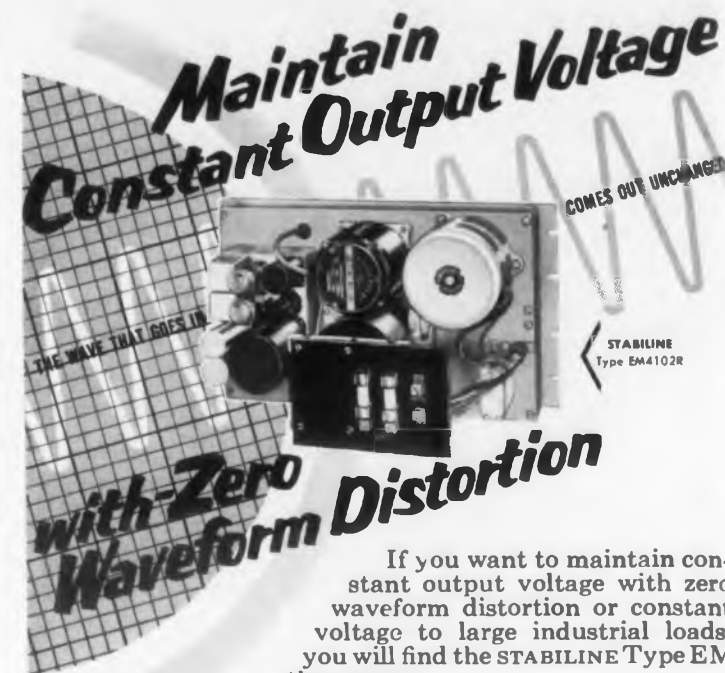


The very low power requirements of the motors used with these hermetically sealed, miniaturized Repeat Cycle Timers makes them useful for both

local and remote control applications or continuous duty. They can be supplied with 50cy, 60cy, or 400cy a-c motors or standard or governed d-c motors. Radio interference filtering to meet Specification MIL-I-6181 is available for d-c units.

An intercam reduction can be provided to allow high speed pulsing with an extended cycle time. A wide range of basic speeds are available, and intercam reductions up to 960:1 can be incorporated. Special ratchet drive in d-c units prevents damage in case of reversed polarity to motor. The units are supplied with flange or three-stud mounting, and with AN connectors or glass-metal headers. A. W. Haydon Co., Dept. ED, 230 N. Elm St., Waterbury, Conn.

CIRCLE ED-90 ON READER-SERVICE CARD FOR MORE INFORMATION



If you want to maintain constant output voltage with zero waveform distortion or constant voltage to large industrial loads, you will find the STABILINE Type EM the answer.

STABILINE automatic voltage regulators Type EM not only stabilize and regulate the voltage output and exactly reproduce the input waveform, but feature:

- outstanding efficiency — comparable to the most conservatively designed fixed-ratio transformers
- fast correction rates for voltage changes
- wide input voltage ranges
- adjustable output voltage settings
- adjustable operating sensitivity

See the Superior Electric's Mobile Display when it is in your area.

**The SUPERIOR ELECTRIC Company**  
1710 CLARKE AVE., BRISTOL, CONN.

CIRCLE ED-91 ON READER-SERVICE CARD FOR MORE INFORMATION

**NEW  
SUB-MINIATURE  
UNIMAX® SWITCH**

Type U S M



ACTUAL SIZE

for easy wiring in miniaturized apparatus.

- Sturdy, standard flat terminals are widely spaced for rapid wiring and easy soldering.
- Case size  $25/32'' \times 23/64'' \times 1/4''$ .
- Long life.
- Available in plain or leaf-actuator style.
- Rated 5 amperes at 125/250 volts, a-c. or 2 amperes at 30 volts d-c.; SPDT.

Write for data sheet.

**UNIMAX**

DIVISION OF THE W. L. MAXSON CORPORATION  
460 WEST 34th ST. NEW YORK 1, N. Y.

CIRCLE ED-92 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954



the Solution to  
your Big Problem is often  
a little different.

## SET SCREW

Send for bulletins on these special set screws made by set screw specialists who have 20 years' experience with problems similar to yours.



**Improved ZIP-GRIP\***  
For holding locking action at any point! Resist vibration.

**FLUTED**  
Meet Federal Standards. Furnished with any type point.



**OFF-SET Locking**  
Where slotted screws are preferred. Spring locking action.

**NU-CUP\***  
42% sharper angle than regular cup point. Give greater holding power.



**Set Screw & Mfg. Co.**

For complete general set screw data send for new Catalog No. 19, or, check product in which you are interested; write name and address in page margin and mail.

\*Patent applied for

265 Main St., Bartlett, Ill. (Chicago Suburb)

We Specialize in Solving Puzzling Set Screw Problems

CIRCLE ED-93 ON READER-SERVICE CARD FOR MORE INFORMATION

**New!**  
**Incomparable!**

*dyna-trol*  
**ELECTRIC FURNACES**

COMPARE THESE FEATURES

- Infinite Zone Control to 2000° and 2300°F
- Zone temperature indication by Pyrometer Selector Switch
- Porcelain Element Holders
- Automatic Hold and Cut-off instrument available
- Infinite Variety of Time-Temperature Curves Obtainable
- Rugged Construction. Highest quality insulation used.

COMPARE THESE PRICES

Firing chamber (H. W. D.)	Semi-Auto. prices	Auto. prices
6"x12"x12"	\$295.	\$432.
12"x12"x12"	\$405.	\$550.
9"x 9"x18"	\$480.	\$625.
14"x14"x14"	\$525.	\$680.
20"x20"x20"	\$975.	\$1140.
18"x18"x36"	\$1125.	\$1375.

(To 2000° Maximum Temp.)

Over 40 Standard Models — Write for complete literature

**L & L**

INDUSTRIAL DIVISION  
**MANUFACTURING CO.**  
Chester 43, Pa.

Some Territories Available For Representation

CIRCLE ED-94 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954

### High Impedance VTVM

50 Megohm Input Impedance



The Model 1060 High Impedance Vacuum Tube Voltmeter is valuable for making tuned circuit measurements at audio and supersonic frequencies. The meter has the following features: input im-

pedance of 50megohm in parallel with a 25mmfd capacitor; accuracy of 2% on all five ranges of 0.001v to 100v; and frequency range from 10cy to 300kc. Full wave average reading is calibrated in rms.

A line variation from 100 to 125v produces less than 2% change in reading, while effect of change of tubes is less than 1/2%. The logarithmic voltage scale is calibrated from 1 to 10, plus a linear decibel scale calibrated from 0 to 20db. Freed Transformer Company, Inc., Dept. ED, 1715 Weirfield St., Brooklyn 27, N. Y.

CIRCLE ED-95 ON READER-SERVICE CARD FOR MORE INFORMATION

### Bolometer Preamplifier

Linear, Low Noise Instrument



The Model BA-1 Bolometer Preamplifier is a linear, low noise instrument for precision measurement of power ratios in the frequency range from 20Mc to 10,500Mc. Its input noise is below 30μv

when operated with a 200 ohm bolometer. Its linearity is better than 0.1db at 400cy and 1,000cy. The instrument is used to measure r-f ratios from 1db to 30db with an overall accuracy of 0.1db. Insertion loss measurements of coaxial or waveguide attenuator pads, and measurement of antenna radiation patterns, are among the major applications.

The unit is supplied with plug-in networks to make it selective for either 400cy or 1,000cy, with a 3db bandwidth of approximately 14cy or 35cy, respectively. Designed to operate with a 200 ohm bolometer element, the amplifier has a d-c supply (battery) to furnish a bias current of 4ma.

The standard panel for relay rack mounting measures 8-3/4" x 19" with a maximum depth behind panel of 13". Connectors are BNC panel type for input and output. Weinschel Engineering Co., Inc., Dept. ED, 10503 Metropolitan Ave., Kensington, Md.

CIRCLE ED-96 ON READER-SERVICE CARD FOR MORE INFORMATION

**Go Get the Axe  
There's a Fly  
on Baby's Knee!**

*Weight and bulk which contribute nothing functional in a glass-to-steel hermetic terminal may be a rather harmless type of parasite.*

*On the other hand if the hermetically sealed electrical component is sometimes called upon to fly, each milligram of lazy fat becomes more sinister.*

*Fusite Terminal bases are light formed stampings yet are strong enough to act as structural parts.*

*Write for catalog  
and samples -  
DEPT. L4*



**THE FUSITE CORPORATION**

6026 FERNVIEW AVE., CINCINNATI 13, OHIO

CIRCLE ED-97 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products . . .

### Shielded Enclosures High Low-Frequency Attenuation



A shielded enclosure employing galvanized iron sheet panels for better suppression of r-f energy at lower frequencies is also useful at high frequen-

cies. Measurements made in accordance with Specification MIL-S-4957 show the insertion loss to electric field is at least 110db from 14kc to 1000Mc.

Insertion loss to magnetic field is equal to that for electric fields above 1Mc (102db at 150kc), and decreases at lower frequencies at the rate of approximately 28db per decade, with 9db at 60cy. The enclosure consists essentially of 24 gage galvanized-annealed iron sheets joined to rigid 1/8" electro-galvanized steel channel frames, and bolted at all seams, where r-f leakage is further minimized by the use of tensioners. The panels are interchangeable, and only standard tools are required for assembly. The unit is portable in the assembled or disassembled state. Ace Engineering & Machine Co., Dept. ED, 3644 N. Lawrence St., Philadelphia 40, Pa.

CIRCLE ED-99 ON READER'S SERVICE CARD FOR MORE DATA

### TV Picture Tubes Includes a 27" Type

These six monochrome TV picture tubes comprise five 21" types and one 27" type. The 27" 27RP4 is a spherical faced, all glass, aluminized tube employing magnetic deflection and focusing. Its outer conductive coating, when grounded, serves as a high-voltage filter capacitor.

The Types 21AMP4 and 21AMP4-A are spherical-face, 90° deflection, magnetically focused and deflected tubes with outer conductive coatings. The latter has an aluminum-backed screen.

The 21ZP4B has a grey-glass spherical face plate for greater contrast under high ambient light conditions. It is also magnetically deflected and focused, and has an aluminum-backed screen.

Unlike the above types, the 21ALP4 and the 21ALP4-A feature electrostatic focusing with 90° magnetic deflection. They are also shorter. The 21ALP4 is aluminized. CBS-Hytron, Div. of Columbia Broadcasting System, Inc., Dept. ED, Danvers, Mass.

CIRCLE ED-100 ON READER'S SERVICE CARD FOR MORE DATA

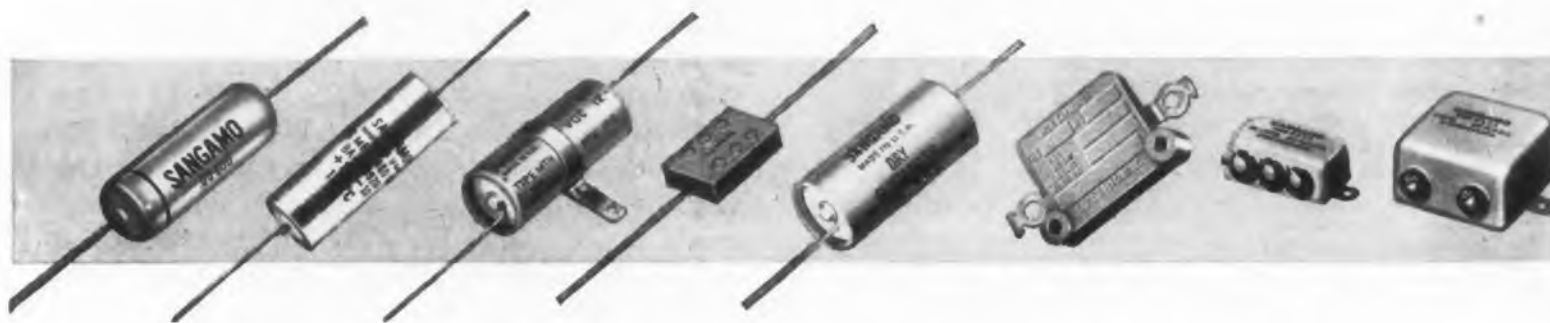


## ...that's why IBM uses Sangamo

The amazingly complex IBM "702" electronic calculator is hailed as the fastest and most flexible commercial data processing system ever devised. The central Arithmetical and Logical Unit performs calculations and makes decisions at a rate of more than 10,000,000 operations in an hour. Data and instructions for processing are stored in an electrostatic memory bank of cathode ray storage tubes. Output can be in the form of punch cards at the rate of 100 per minute.

A machine like this needs components that assure maximum performance to meet its exacting demands. That's why several different types of Sangamo Capacitors are used in the 702.

If you need capacitors for demanding electronic applications, Sangamo engineers can help you. You can choose from a complete line of paper, mica, electrolytic and button type capacitors for every industrial, electronic, and radio application.



## SANGAMO ELECTRIC COMPANY

MARION, ILLINOIS

CIRCLE ED-101 ON READER-SERVICE CARD FOR MORE INFORMATION





**SANGAMO  
CAPACITORS**

**Longer Life  
at High Temperatures**

**Stability  
Under All Conditions**

**Capacitors in the new**

**702**



*Those who know...*



*choose Sangamo*

CIRCLE ED-101 ON READER-SERVICE CARD FOR MORE INFORMATION

### **Cathode Ray Tubes Both 3- and 6-Gun Types**



These two multi-gun cathode ray tubes are designed for multi-channel oscilloscopes that must display more than

one parameter simultaneously and with great accuracy. The 5" Type 53RAP tube has three electron guns, and the 7" Type 76RAP has six guns. The former is illustrated.

Each gun can be controlled independently and scans the entire useful screen area. Electrostatic focusing and deflection are employed, with adequate electrostatic shielding of the individual guns to eliminate crosstalk. Leads for the deflection plates and pre-acceleration intensifying electrodes are brought out through the bulb wall to minimize lead inductances and capacitance.

Overall length for the 3-gun type is 18-5/8" x 5-1/4" max diam. The same dimensions for the 6-gun unit are 19" x 7". Although normally supplied with Types P1, P2, P7, or P11 phosphors, any other standard phosphor can be furnished. Electronic Tube Corp., Dept. ED, 1200 E. Mermaid Lane, Philadelphia 18, Pa.

CIRCLE ED-102 ON READER'S SERVICE CARD FOR MORE DATA

### **Aluminum Locknut Meets Requirements of Steel**



This one-piece aluminum nut, the latest addition to the "Flexloc" line, has the torque and strength characteristics of a standard all-steel nut, but weighs 65% less. It is for use on steel bolts or studs in

place of steel nuts wherever weight is a factor and temperatures do not exceed 250°F.

Known as the "105 F S High-Tensile Aluminum Self-Locking Nut", the new product is made of 24ST aluminum, a far stronger alloy than 17ST. It is designed to Specification AN-N-5b, and chemically treated against corrosion to Specification MIL-C-5541. It is blue-dyed for identification.

Spring tension of resilient segments of the locking section lock the nut securely at a desired position whether it is seated or not. It can be reused without loss in locking efficiency. It is available in five sizes: 6-32, 8-32, 10-32, 1/4-28 and 5/16-24. Standard Pressed Steel Co., Dept. ED, Jenkintown, Pa.

SC54-N

CIRCLE ED-103 ON READER'S SERVICE CARD FOR MORE DATA



*precision-designed  
to your specifications*

Now you can order direct! Your call to Thermador's new, completely self-contained Electronics Plant quickly brings you the engineering ingenuity... the precision designing... the dependable, quick delivery that has gained Thermador's world-wide reputation for excellence. 35 years of quality service!

Let a Thermador engineer work with you to develop the

## Thermador Transformers

finest transformer for your application, chassis, or performance standards. Thermador's complete environmental testing facilities make certain that each transformer exceeds your specifications and MIL requirements. One or a thousand — certified without delay — delivered quickly. Order direct. Call us today. Request literature from: Electronic Division, Thermador Electrical Manufacturing Company, 2000 South Camfield Avenue, Los Angeles 22, Calif. PARKVIEW 8-2105



**THERMADOR**  
*Electronic Division*



SEVEN LEAGUES AHEAD  
3-918

CIRCLE ED-105 ON READER-SERVICE CARD FOR MORE INFORMATION

58

## New Products . . .

### Sound System Control Easily Installed



Installation of these sound system controls is aided by the wiring instructions, dial plate and bar knob packed with constant - impedance attenuator. L- and T-

pads, as well as the 10w constant-impedance output attenuator are included in the present line of controls.

The wiring instructions included a schematic and data on actual connections to and bussing of terminals. The dial plate is marked 0 to 100, and is used in conjunction with the pointer of the bar knob included in the package. Clarostat Mfg. Co., Inc., Dept. ED, 1 Washington St., Dover, N. Hampshire.

CIRCLE ED-106 ON READER-SERVICE CARD FOR MORE INFORMATION

### Vacuum Switch For High Voltage D-C



This vacuum switch, Part No. NVS-300, is externally operated by a d-c solenoid, and it is especially suited for switching purposes in d-c pulse systems, such as in radar instal-

lations. It also can be used in many circuits where the switching current and the isolation of high voltage is required. The switch is a normally closed spdt high voltage device.

For pulse application, switching is done under no-load conditions. The breakdown test voltage between open contacts should be 20kv d-c. In typical pulse operation, pulse duration is 2.4 $\mu$ sec, pulse repetition is 420 pulses per sec, and peak current is 300amp. With coil No. NVS-301, the pull-in current should not exceed 115ma. Typical d-c conditions: 1.5amp at 5kv; this may be switched under load in non-inductive circuits.

The external electromagnetic coil is located axially over the arm of the switch which contains the soft iron core. The switch withstands vibrations of 10g acceleration. Naer Corp., Dept. ED, 2301 S. Purdue Ave., West Los Angeles 64, Calif.

CIRCLE ED-107 ON READER-SERVICE CARD FOR MORE INFORMATION

## Another Arm-The NO. 40 CIRCLE TEMPLATE



\$1.00 AT YOUR LOCAL DEALER

030 MATTE FINISH MATHEMATICAL QUALITY DOUBLE-CURED PLASTIC. ALL HOLES SMOOTH-MILLED TO ENGRAVING MACHINE ACCURACY. ONE OF MORE THAN 30 RAPIDESIGN TIME-SAVER TEMPLATES - ALL OF WHICH ARE BETTER MADE, MORE USEFUL AND LESSER PRICED.

CATALOGUE NO. 49 AVAILABLE UPON REQUEST

**RAPIDESIGN** INC.

P. O. BOX 592 GLENDALE, CALIF.

CIRCLE ED-108 ON READER-SERVICE CARD FOR MORE INFORMATION

## Send for Your Copy of This New ENGINEERING MANUAL

NEW QUICK  
VISUAL INDEX

112  
prints

68  
pages



40,000 types and sizes of loop clamps, center clamps, wire harness clamps, wave guide clamps, bonding clamps, multiple clamps, plus blocks, brackets, busbars, line supports, shims and related items.

Save design, tool and production time and expense with TA Standards. Clamp sizes range from miniatures of 1/8" on up to 6" diameter in 1/16ths for bolt mountings from #4 to 3/8". Available in aluminum, steel and stainless steel. New 2-page chart tabulates design data on a wide variety of cushioning or insulating materials for service from—130°F to +1200°F. New Engineering Manual shows all, lists 24 new items. For your free copy write Thomas Associates, 4607 Alger Street, Los Angeles 39, California.

**THOMAS ASSOCIATES**  
Los Angeles, Calif. • Coffeyville, Kans. • Hagerstown, Md.

Reg. U.S. Pat. Off. Engineering Service Offices in 12 principal areas

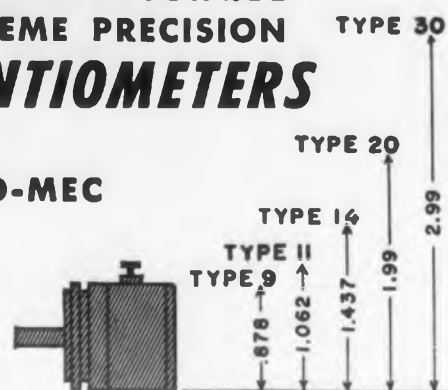
CIRCLE ED-109 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954

**T  
POT  
R**

... a complete line  
ULTRA-LOW-TORQUE  
EXTREME PRECISION  
**POTENTIOMETERS**

by  
**ELECTRO-MEC**



- Proven by designers and manufacturers of high performance computers.
- Available in many sizes for all applications of ultra-low-torque potentiometers.
- Custom-engineered for your special needs. Never a compromise.
- Ganged assemblies available in all sizes.
- For detailed specifications and information on all types contact our engineering department (Stillwell 6-3402).

**ELECTRO-MEC Laboratory, Inc.**

21-09 43 Avenue Long Island City 1, N. Y.

Sales representatives needed for several territories.

CIRCLE ED-110 ON READER-SERVICE CARD FOR MORE INFORMATION

**Power Equipment Company's  
NEW VOLTAGE  
REGULATING CIRCUIT**



**Offers These Design Advantages In Power Supplies!**

- ★ Greater provision for heavier power requirements.
- ★ Need for fans, blowers or other moving parts eliminated.
- ★ A VR-105 single voltage regulating tube is only tube used. This has an alternate VR-105 which is used as a ready standby to assure continuous power flow.
- ★ Filtered to hold ripple voltage in D-C output to less than 0.5% RMS at full load.
- ★ Not dependent upon accurate maintenance of line frequency. Successfully used with emergency, portable or standby units.
- ★ New supplies listed in standard sizes.

These new Peco power supplies are designed to do a better job simply, inexpensively and with less maintenance. Write for free bulletin listing specifications and standard sizes.

**POWER EQUIPMENT COMPANY**

5740 Nevada, East • Detroit 34, Michigan

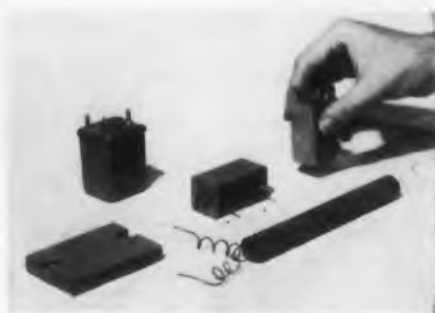


CIRCLE ED-111 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954

**Delay Lines**

Offered in 0.5-10 $\mu$ sec



Several designs have been added to this firm's group of delay lines to give a complete range of miniature lumped constant delay lines. As passive networks, these lines are cur-

rently being used to perform a number of functions, such as: delaying trigger pulses; use in pulse forming networks with thyatron tubes or blocking oscillators; and in pulse width discrimination.

High-quality, precision units, they are offered in a standard impedance range of 25 ohms to 3000 ohms, with time delay of 0.05-10 $\mu$ sec, rise time of 0.03-0.5 $\mu$ sec, maximum attenuation of 20%, and maximum pulse voltage of 3000v. All units are designed to meet MIL-T-27 specifications.

In addition to these standard delay lines, the firm custom designs lines to special applications, in many different packages and configurations. Neutronics, Inc., Dept. ED, 2908 Nebraska Ave., Santa Monica, Calif.

CIRCLE ED-112 ON READER-SERVICE CARD FOR MORE INFORMATION

**Thermostat**

Sealed, Quick-Action Design



The Type A hermetically sealed thermostat is designed for applications where moisture, corrosion, dust, or altitude might adversely affect

thermostat life or performance, or for use in explosive atmospheres. It employs a disc-type bimetal thermal element for quick make and break operation.

The design features an insulated, electrically independent bimetal that eliminates false cycling and life-shortening "jitters". The bimetal is in extremely close proximity to the controlled surface and is heated by conduction, resulting in rapid response and close temperature control. A wide variety of mounting arrangements is available to simplify installation and assembly. Maximum operating temperature is 300°F. Temperatures as low as -40°F do not impair normal operation. Stevens Manufacturing Co., Dept. ED, Mansfield, Ohio.

CIRCLE ED-113 ON READER-SERVICE CARD FOR MORE INFORMATION

**an important move**



that

means -

**INCREASED  
PRODUCTION**

**GREATER  
EFFICIENCY**

**BETTER  
SERVICE**

for **EAD** customers

Until recently, EAD's expansion was the acquisition of more and more small plants clustered about our main building in Brooklyn. Sooner or later something permanently suitable to our growing needs had to be found...and our new plant, in Dover, New Hampshire, is it. Now, under one tremendous roof—with more than 130,000 square feet of working space occupied, and additional space available for future needs—EAD has the elbow room to offer you better service than ever on all your motor and blower requirements. In looking forward to still greater expansion, we recognize the source of our progress—you, our customers and friends—and we shall strive to keep your friendship through constant development of newer and better rotating electrical equipment.

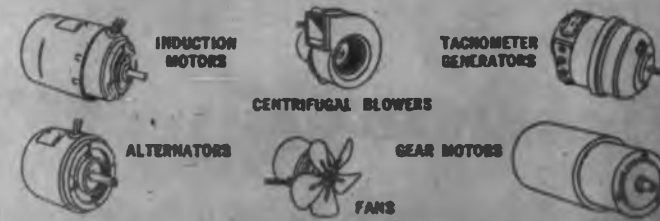
**Solving Special Problems Is Routine at EAD**

If your problem involves small rotating electrical equipment, bring it to EAD. Our completely staffed organization will modify one of our standard units or design and produce a special unit to meet your most exacting requirements.



**EASTERN AIR DEVICES, INC.**

SOLVING SPECIAL PROBLEMS IS ROUTINE AT EAD



391 CENTRAL AVENUE—DOVER, NEW HAMPSHIRE

CIRCLE ED-114 ON READER-SERVICE CARD FOR MORE INFORMATION

# DEPEND ON



## RELIABLE ELECTRON TUBES



With electronic controls taking over more and more operational functions in military and industrial applications, it is becoming increasingly important that the electron tubes used be dependable under extremely severe conditions. This applies particularly to installations in aircraft where tubes must operate reliably at high altitudes, while subjected to continuous vibration, varying voltages and frequent shock. Because of their advanced design and construction . . . born of never-ceasing research and special production skills . . . Bendix Red Bank Reliable Electron Tubes have the dependability necessary to meet these severe operating conditions. You can depend on our long, specialized experience to give you the right answer . . . for all types of regular as well as special-purpose tube applications. Tubes can be supplied to both commercial and military specifications. Call on us for full details.

Manufacturers of Special-Purpose Electron Tubes, Inverters, Dynamotors, Voltage Regulators and Fractional D. C. Motors

DESIGNATION AND TYPE					TYPICAL OPERATING CONDITIONS		
Type	Proto-type	Bendix No.	Description	Base And Bulb	Heater Voltage	Plate Voltage Per Plate	M.A. Load
5838	6X5	TE-3	Full Wave Rectifier	Octal T-9	12.6	350.	70.
5839	6X5	TE-2	Full Wave Rectifier	Octal T-9	26.5	350.	70.
5852	6X5	TE-5	Full Wave Rectifier	Octal T-9	6.3	350.	70.
5993	6X4	TE-10	Full Wave Rectifier	9-Pin Miniature	6.3	350.	70.
6106	5Y3	TE-22	Full Wave Rectifier	Octal T-9	5.0	350.	100.

Type	Proto-type	Bendix No.	Description	Base And Bulb	Heater Voltage	Plate Voltage	Screen Voltage	Grid Voltage	Gm	Plate Current	Power Output
5992	6V6	TE-8	Beam Power Amplifier	Octal T-9	6.3	250.	250.	12.5	4000	45. MA	3.5 W
*6094	6AQ5 6005	TE-18	Beam Power Amplifier	9-Pin Miniature	6.3	250.	250.	12.5	4500	45. MA	3.5 W
6385	2C51 5670	TE-21	Double Triode	9-Pin Miniature	6.3	150.	—	-2.0	5000	8. MA	—

\*Tube Manufactured with Hard (Nonex) Glass for High Temperature Operation (Max. Bulb Temp. 300°C.)



DIVISION OF



EATONTOWN, N. J.

West Coast Sales and Service: 117 E. Providencia Ave., Burbank, Calif. • Export Sales: Bendix International Division, 205 East 42nd St., New York 17, N. Y.  
Canadian Distributor: Aviation Electric Ltd., P.O. Box 6102, Montreal, P. Q.

CIRCLE ED-116 ON READER-SERVICE CARD FOR MORE INFORMATION



# New Products . . .

## Mica Capacitors

With Greatly Increased Capacitance



The "Super Micadon" is a style of midget mica capacitor in the form of an "encapsulated" unit. The capacitor section is separately processed in its entirety and then inserted

and sealed into a premolded case. The units house five to six times the capacitance now possible in CM-20 and CM-30 cases. Two sizes are available: Type 5A is 51/64" x 15/32" x 7/32"; Type 1A is 53/64" square x 9/32".

Life expectancy has also been greatly increased. In a 4000 hr life test (at two times rated voltage), there was only 4% failure. In rigorous humidity tests, the capacitors showed a high moisture resistance and high insulation resistance.

The capacitors have flat, clinched wire leads, giving improved voltage breakdown safety and enabling overall inductance to be reduced by 30%. The design provides a permanent impervious bond between section, wire leads, and molded case. Long parallel rigid leads are provided which may be cut to "plug-in" length for printed circuit mounting or left long for conventional chassis wiring. Cornell-Dubilier Electric Corp., Dept. ED, South Plainfield, N. J.

CIRCLE ED-117 ON READER-SERVICE CARD FOR MORE INFORMATION

## Modulation Meter

For 25 to 500Mc Range



The Model 205-A f-m Modulation Meter is an improved version of this firm's Type 205. With a frequency range of 25 to 500Mc, it

measures f-m deviation  $\pm 0$  to 25ke. Its accuracy is within 10%, read full scale on a 3" meter calibrated in kilocycles. It can also be used as a relative field-strength meter. The meter is provided with a built-in speaker and a jack for oscilloscopes. Dimensions are 7" x 12" x 7-1/4", and it weighs less than 14 lb. Lampkin Laboratories, Inc., Dept. ED, RFD 1, Bradenton 9, Fla.

CIRCLE ED-118 ON READER-SERVICE CARD FOR MORE INFORMATION

SWITCHING  
SAMPLING  
SEQUENCING

HIGH  
SPEED

# Multi-Pole Commutators

Precision, rotary, electro-mechanical switching unit with precious metal contacts for long life, low noise, trouble-free operation. Contact cleaning device extends life, permits low level switching in some applications. Multi-pole units with any number of contacts can be furnished. Switching can be "make before break" or "break before make."



MODEL  
85561  
Torque: 2 oz. in. or less.  
Weight: 4 oz. Will withstand 50G acceleration and operate within specifications at 10G vibration from 55 to 500 cps.  
Noise Level: Will not exceed 1.0% of full signal amplitude.

MODEL  
85562  
Motor driven model. DC governor-controlled constant speed 1/2 to 1800 rpm., or speed varies linearly w/ applied voltage. Other drives available.

## Giannini

Product of Electromechanical Division  
EAST ORANGE, NEW JERSEY

for information write  
**G. M. GIANNINI & CO. INC.**  
PASADENA 1, CALIFORNIA

CIRCLE ED-119 ON READER-SERVICE CARD

# The Ultimate in Labeling

## Metal-Cal

Colorful anodized aluminum  
for permanent identification



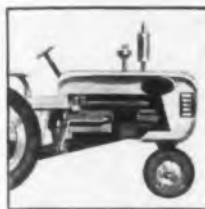
### TOUGH

Metal-Cals withstand extreme surface abrasion — are ideal under the most adverse conditions. They are thin, tough, modern nameplates — with no projecting rivets or screws.



### HEAT RESISTANT

Metal-Cals meet all government requirements for permanent adhesion in extreme heat and cold. May be used under any conditions, from  $-62^{\circ}\text{F.}$  to  $300^{\circ}\text{F.}$



### VERSATILE

Metal-Cals excel for any type of permanent labeling... for product identification, wiring diagrams, detailed instructions, component parts and finished assemblies.

**Metal-Cals**

come in a variety of attractive colors—matte or shiny finish—any size or shape.

**Metal-Cals**

apply easily and quickly. Pressure-sensitive adhesive eliminates drilling, screws, rivets, pins or other fasteners.

**Metal-Cals**

assure permanent legibility of the finest lettering or diagrammatic detail.

Write for **FREE SAMPLE**  
TEST the advantages of **METAL-CAL**

**Metal-Cal**

Manufactured by C & H Supply Co.  
415 East Beach Ave., Inglewood 3, Calif.

Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

\*T.M. Reg. U.S. Pat. Off.

CIRCLE ED-120 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 1954

## 400cy Transformer

Weights Only 1-1/2 oz



These 400cy transformers are offered in outputs of 3va and 6va. Typical of the series is the TW-6 unit illustrated. This miniature transformer is

only 1" OD x 3/4" high and weighs but 1-1/2 oz. Electrical ratings are: input, 115v, 400cy; power output, 6va; regulation 10%; heat rise,  $40^{\circ}\text{C}$ , Class "A". It is hermetically sealed in a metal case to MIL-T-27 requirements. Transformers with special ratings can also be obtained. Torwico Electronics, Inc., Dept. ED, 961 Frelinghuysen Ave., Newark 5, N. J.

CIRCLE ED-121 ON READER-SERVICE CARD FOR MORE INFORMATION

## Linear Amplifier For Nuclear Detection Devices



The Model 218 Linear Amplifier, patterned after the latest O.R.-N.L. models, includes many improvements for

added stability when used with proportional counters, scintillation counters and other nuclear detectors.

A 10-turn helical potentiometer provides control of the pulse height discriminator at the high level output. More complete electrostatic shielding of amplifier and discriminator circuits reduces interference from near-by equipment. Hermetically sealed transformers prevent high frequency transients when the rectifier switches from one half cycle to the other. A separate transformer supplies filament voltage to the preamplifier (Model 219 shown) to prevent pulses produced in the power transformer from being transmitted to the preamplifier input.

Controls include: power switch; coarse gain control, 6 steps; fine gain control for setting between the 6 steps; three-position bandwidth switch: delay line (2.0Mc), 0.5Mc, 0.1Mc; pulse height selector, "Use-Test" switch. The high level output has a maximum linear signal of  $+90\text{v}$  into 1000 ohms; low level had maximum of  $+2.5\text{v}$ .

Designed for use with the Model 218 Linear Amplifier, the Model 219 Preamplifier provides the added gain necessary for use with ionization chambers or other high-impedance, low-level radiation detectors. Atomic Instrument Co., Dept. ED, 84 Massachusetts Ave., Cambridge 30, Mass.

CIRCLE ED-122 ON READER-SERVICE CARD FOR MORE INFORMATION

# precision potentiometers by DeJUR

Simplify your design problems



RUGGEDIZED METERS



STANDARD AND POWER  
POTENTIOMETERS



DUAL UNIT CONSISTING OF  
2 SERIES HP-300 HIGH  
RESOLUTION, LOW TORQUE  
LINEAR POTENTIOMETERS

Choice of turret terminals  
(illustrated) or  
tinned solder lugs

## 3", high resolution linear potentiometers

Extremely fine settings and readings, plus better linearity and low physical height are achieved in the Series HP-300 Potentiometer through a combination of long winding length and a small diameter cylindrical Kohlrausch winding. Torque is minimized through use of fine resistance wires and pitches. The unit features  $360^{\circ}$  mechanical rotation and  $356^{\circ}$  electrical rotation  $\pm 1/2^{\circ}$ .

Series HP-300 potentiometers are available as single units or ganged multiples with up to sixteen taps per section. Taps and end connections are available in either silver plated turret terminals or semi-flush tinned solder lugs. Housing is one piece molded low loss Bakelite—end plates of precision turned blue Alumilite finished aluminum.

For complete illustrated engineering literature, plus other designs for special applications, write Dept. EDP, DeJUR-Amsco Corporation, 45-01 Northern Blvd., Long Island City 1, N. Y.

Electronic  
Sales  
Division **DeJUR**

45-01 NORTHERN BLVD., LONG ISLAND CITY 1, N. Y.



SEALED METERS  
SQUARE AND ROUND



FULLY ENCLOSED  
POTENTIOMETERS



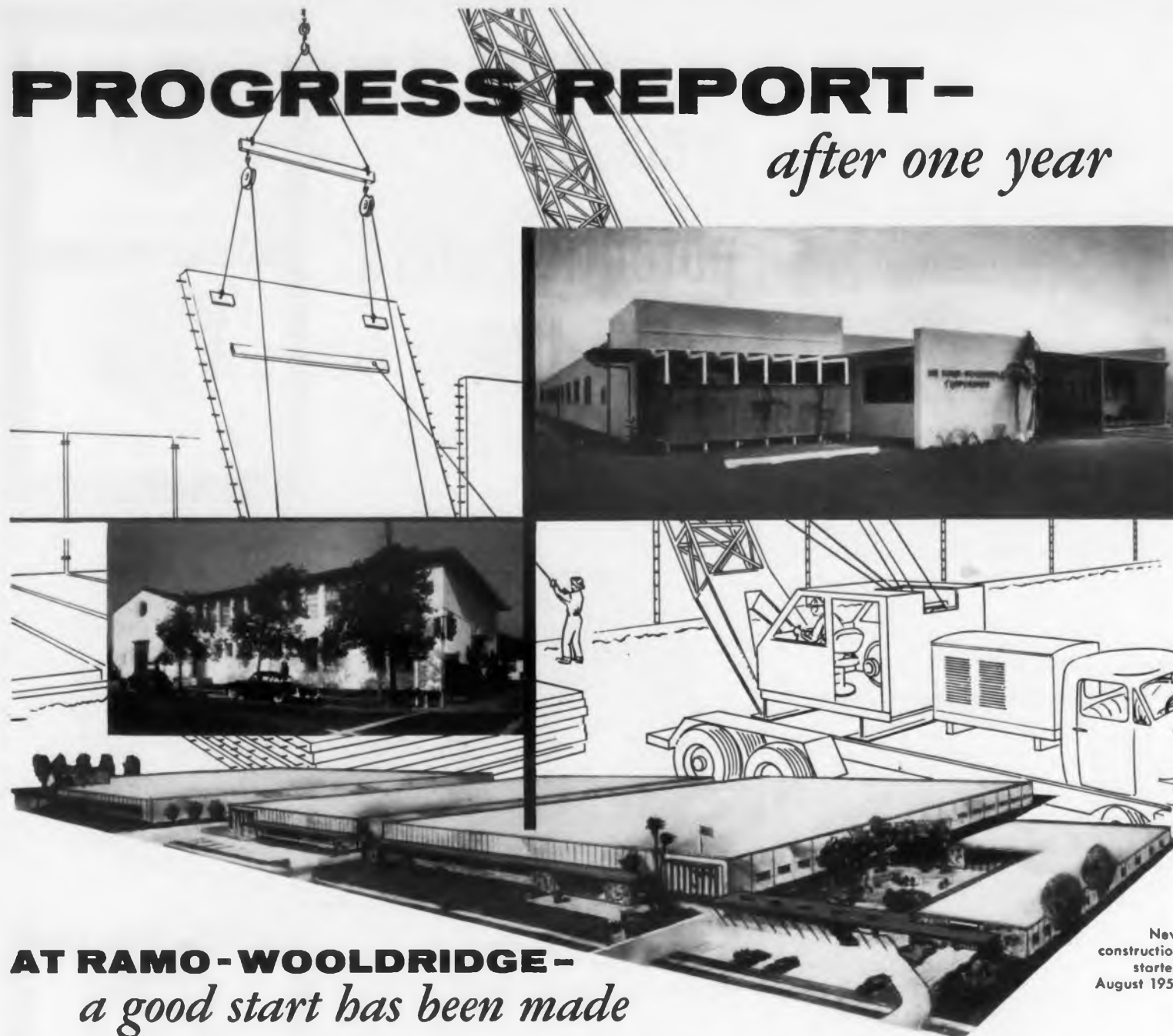
HIGH RESOLUTION  
POTENTIOMETERS

CIRCLE ED-123 ON READER-SERVICE CARD FOR MORE INFORMATION



# PROGRESS REPORT—

*after one year*



## AT RAMO-WOOLDRIDGE— *a good start has been made*

Progress during a new company's first year can be measured in terms of plant and equipment, contract back-log, or quality and quantity of personnel.

By any of these standards the first year's experience of THE RAMO-WOOLDRIDGE CORPORATION has confirmed the soundness of the basic theses on which the company was established:

1. Competence in systems analysis, engineering and development, a relatively scarce commodity, is one of the most salable articles in America today.
2. Scientists and engineers find unusual satisfaction in participating in the development of a company in which, from the outset, all features of the organization and of the operational procedures are designed to be as appropriate as possible to their special needs.

Today, research and development activities are being conducted by an organization of approximately two hundred people, which will more than double within

twelve months. Urgent project responsibilities have led to the temporary use of such quarters as the former school and church shown in the photograph, but construction is complete on 20,000 and well along on an additional 80,000 square feet of the 200,000 square foot permanent laboratory building program. Orders have been placed for \$1,500,000 worth of digital and analogue computers that will be installed the end of this year to facilitate the extensive analyses required by current projects.

In the light of the first year's progress THE RAMO-WOOLDRIDGE CORPORATION anticipates expanding opportunities to perform major research, development and—a little later—manufacture in the fields of commercial and military electronic systems, and in guided missiles.

## The Ramo-Wooldridge Corporation

8820 BELLANCA AVENUE, LOS ANGELES 45, CALIF. • DEPT. ED-1

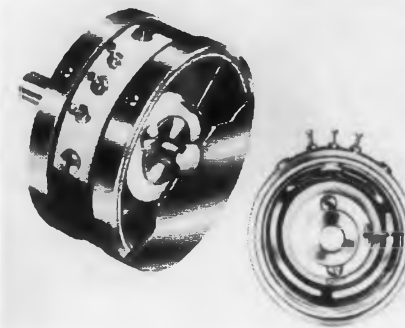
- Guided Missile Research and Development
- Digital Computer Research and Development
- Business Data Systems Development
- Radar and Control Systems Development
- Communication Systems Development

CIRCLE ED-124 ON READER-SERVICE CARD FOR MORE INFORMATION

POSITIONS ARE  
AVAILABLE FOR SCIENTISTS  
AND ENGINEERS IN  
THESE FIELDS OF  
CURRENT ACTIVITY

## New Products . . .

### Potentiometer Operates Over 125°C



The Type 415 continuously variable, wire-wound precision potentiometer is designed to operate at ambient temperatures over 125°C and still maintain rated performance characteristics.

The unit also features a low-mass wiper that permits operation under severe vibration and acceleration. The coupling for ganging cups provides zero backlash and low torque for accurate phasing.

Based on a 330° function angle, resistances available range from 30 ohms to 125,000 ohms. Standard resistance tolerance is  $\pm 5.0\%$ , but tolerances as low as  $\pm 1.0\%$  can be specified. Linearity can be specified as low as 0.25%. For non-linear windings, conformity better than  $\pm 1\%$  is obtainable.

Power rating is 2.5w. Temperature range is  $-55^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$ , derated so that ambient temperature plus heating does not exceed  $+150^{\circ}\text{C}$ . At sea level, dielectric strength between terminals and ground is 900v, rms. Torque requirements are 1.5 oz-in per cup. One tap is available, but with a special terminal board, more than one tap can be furnished.

Maximum terminal voltage is 400v, d-c, or less dependent on resistance and wattage rating of the unit. The nominal contact angle is  $345^{\circ}$ . The potentiometers may be ganged as required. Daven Company, Dept. ED, 191 Central Ave., Newark 4, N. J.

CIRCLE ED-130 ON READER-SERVICE CARD FOR MORE INFORMATION

### Synchronous Motor Has Polarized Rotor



The RBCP-2510 polarized synchronous motor always pulls into synchronous speed with the rotor in the same position with respect to the polarity of the motor field. Rated at 0.3

oz-in torque, 3600 rpm, it has a  $40^{\circ}\text{C}$  continuous temperature rise. It requires a 115v, 60cy, 12w input.

In a typical application, the motor has been used to drive an instrument type d-c/a-c synchronous chopper. Holtzer-Cabot Motor Div., National Pneumatic Co., Inc., Dept. ED, 125 Armory St., Boston 19, Mass.

CIRCLE ED-131 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954



## PULSE TRANSFORMERS

BLOCKING OSCILLATOR  
INTERSTAGE  
MAGNETRON



We have facilities for complete electrical and environmental testing to 20,000 volts. Design facilities also available.

### 50 KW MAGNETRON TRANSFORMERS

(Now in production)

INPUT — 1250 V, 28 ohms; OUTPUT — 7500 V, 1100 ohms; PULSE WIDTH — 0.85 to 2.4 Microseconds; DUTY CYCLE — .002-5% Max. Droop; .1 Microsecond Rise Time; 0.7 Amp. Bifilar Filament. All units completely tested to these specifications.

Write or phone for detailed information.

## ATLANTIC TRANSFORMER CORP.

30 Hynes Avenue, Groton, Connecticut • Hilltop 5-0353

CIRCLE ED-128 ON READER-SERVICE CARD FOR MORE INFORMATION

## Test for Electrical LEAKAGE • SHORTS • BREAKDOWN

with

## “HYPOT” JUNIORS



### HIGH POTENTIAL TESTING INSTRUMENTS

#### WRITE FOR BULLETIN 4A

- ONLY ONE instrument necessary to make high potential tests for leakage, breakdown or shorts!
- PORTABLE, with rugged steel case...Operates in any position!
- SAFE to use, with protected test leads, shielded high voltage, grounded case!
- SIMPLE—only three easy steps to make a complete test!
- VISUAL INDICATIONS from neon lights give positive test results. Audible test indication for leakage also available.
- RANGES 0-1500 to 0-6000V.A.C. output. Other “Hypots” to 50,000V.A.C. output at 5 K.W.
- WRITE for complete data on “HYPOTS” for your jobs.

## ASSOCIATED RESEARCH, Incorporated

Precision Instruments Since 1936

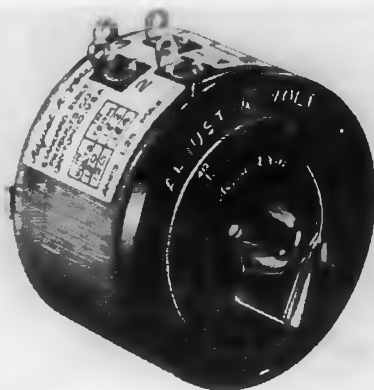
3769 West Belmont Avenue, Chicago 18, Illinois

CIRCLE ED-129 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954

## New Products . . .

### Variable Transformer For Low Wattage Applications



The “Adjust-A-Volt” 100BU Variable Transformer for low-wattage applications (50-100-150w loads) is designed for use as a variable a-c voltage component to replace rheostats in electric and electronic equip-

ment. It is easily installed in back-of-panel position. Small and compact, it takes less space, and ventilation is not a problem.

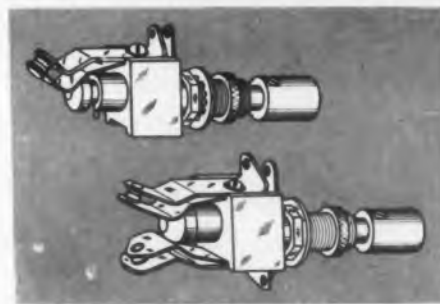
The unit, a toroidally-wound, hydrogen annealed auto transformer, will smoothly and continuously deliver any output voltage from zero to above line voltage. Voltage is adjusted with excellent regulation and no waveform distortion.

Two design features are: an extra-long brush spring which allows free action and maintains constant brush pressure during entire brush life, and a safety stop on the spring, which prevents burn-outs by making it impossible for the brush-holder to contact the winding when the brush has completely worn down. Alloy brush track plating eliminates deterioration of the commutation surface and gives long life.

The transformer is rated single-phase, 60cy, 120v input; 0-120v output; 1.25amp output; 150/165va. Standard Electrical Products Co., Dept. ED, 2240 E. Third St., Dayton, Ohio.

CIRCLE ED-126 ON READER-SERVICE CARD FOR MORE INFORMATION

### Push-Button Switches Have Low Contact Resistance



These instrument push-button switches were especially designed for use in galvanometer circuits and other instruments where extremely low contact resistance is

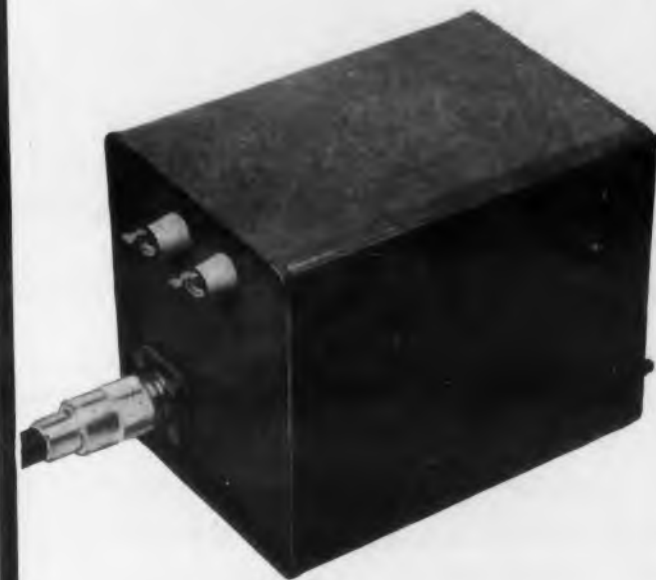
desired. They are molded of mica-filled phenolic.

Type 10057, spst, and Type 10058, dpst, can be used as both momentary contact and turn-to-lock switches. Types 10059, spst, and 10060, dpst, do not have the locking feature. All contacts are normally open. These switches are 2-19/32" long and mount in a 3/8" hole on panels up to 1/4" thick. Shallcross Manufacturing Co., Dept. ED, Collingdale, Pa.

CIRCLE ED-127 ON READER-SERVICE CARD FOR MORE INFORMATION

# 400 Cycle POWER PACKS

## Designed for Airborne Use



### Features:

- Input 400 cycles 115 V. RMS
- Output range 1 to 25 KVDC in 6 models
- Temperature range —60°C to 85°C
- Hermetically sealed
- Altitude 50,000 feet
- Ripple less than 1%
- Regulation less than 5% per milliamper
- Operating position Any amount is effected by 4 studs on one surface.
- Smallest size and Lightest weight
- Choice of selenium or vacuum tube rectifiers in high voltage ranges.

Write for free brochure on Power Packs

★ Plastic Film Capacitors

★ High Voltage Power Packs

★ Pulse Forming Networks



Plastic Capacitors, Inc.

2511 W. MOFFAT STREET, CHICAGO 47, ILLINOIS

CIRCLE ED-125 ON READER-SERVICE CARD FOR MORE INFORMATION

Available NOW in quantity...

# POWER TRANSISTORS



Transistor uniformity and high performance are assured with the constant temperature, humidity and dust-free conditions provided for our production line.

THE Honeywell 2N57 power transistor is now available in quantities from 1 to 10,000 with new low prices and quantity discounts.

The remarkable high power 2N57 has now moved from the pilot line stage to mass production. Operating from a standard DC supply the 2N57 will deliver watts to a load while still providing maximum power gain.

Already driving servo motors and tripping relays in airborne applications, the 2N57 offers a solution to your weight, space, reliability and vibration problems.

Write for full information on your business letterhead to Transistor Division, Dept. ED-24, Honeywell, Minneapolis, Minnesota.

## REAL POWER—2N57 POWER TRANSISTORS

Collector current 800 ma max.	DC switching 40 watts max.
Collector voltage 60 volts max.	Power gains for ordinary applications 15-25 db.
Collector dissipation—20 watts max. at 70° F. mounted on adequate heat sink.	Maximum temperature—will operate at conservative output levels up to 165° F.
Frequency Range—Audio	Vibration resistance 30 G up to 1000 cycles/sec.
Sinoidal power outputs 5 watts max.	Hermetically sealed.
Push-pull output 10 watts (2 units) max.	

MINNEAPOLIS  
**Honeywell**  
Transistor Division



112 OFFICES ACROSS THE NATION

CIRCLE ED-134 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products . . .

### Pulse Transformer With 0.03μsec Rise Time



The Type PT-4 hermetically sealed pulse transformer is a versatile four-winding unit with 2:2:1:1 turns ratios. Measured para-

meters include 120 ohms characteristic impedance, 0.03μsec rise time, 20% droop at 1μsec, and 40% droop at 2μsec. As a pulse or trigger generator, the unit may be used in many different blocking oscillator circuits. It may also be used for coupling, impedance matching, etc.

The core is of the wound type, using high-quality magnetic material, uncut. The case is of steel, hot tinned, with gray paint finish. The windings are brought out to eight terminals provided with solder lugs. The unit meets MIL-T-27 specifications.

A non-hermetic, octal base, plug-in version of the same transformer is also available and is designated Type PT-3. Berkshire Laboratories, Dept. ED, 578 Beaver Pond, Lincoln, Mass.

CIRCLE ED-135 ON READER-SERVICE CARD FOR MORE INFORMATION

### Power Supply Regulation Better than 1%



The Model I electronically regulated d-c constant voltage power supply provides continuously variable output voltage from 200v to 325v, d-c, for load currents 0 to 100ma. Regulation of d-c voltage is better than 1% for loads of 0 to 100ma and line voltage variations from 105v to 125v. Ripple output is less than 10mv rms. An isolated a-c voltage of 6.3v at 3 amps is available at the output terminal connections.

All input and output connections are made to a single terminal strip conveniently located on the rear of the chassis. Required input is 105-125v a-c, 50/60cy. Dimensions are: standard 19" relay rack mounting (19" x 5-1/4" x 8-1/8" deep behind panel). Weight is approximately 20 lb. Associated Specialties Co., Dept. ED, 1751 Main St., Orefield, Pa.

CIRCLE ED-136 ON READER-SERVICE CARD FOR MORE INFORMATION

**teflon**  
... and We Can Deliver!



## EXTRUDED & MOLDED ROD and TUBE Small Machined Parts! Sheets!

Heavy demand has put many TEFLON fabricators in a "back ordered" condition. The effect—stymied or crippled production on your end.

At FLEXROCK we have licked this problem. New TEFLON producing equipment has been added. We have substantially increased capacity. We can't take on all things just yet. But soon we will be ready to "throw the book at you" with a complete range of TEFLON services. RIGHT NOW we are set to ship you TEFLON Rod and Tube, extruded or molded, Sheets, and small parts — no matter how intricate — machined from Rod and Tube. We can promise good delivery — yes, FAST DELIVERY . . . with closest possible tolerances on your small parts. Tell us your needs — we will be happy to quote delivery and price.

\*DuPont trade-mark  
for tetrafluoro-  
ethylene resin



SEND US YOUR "SPECS" LET US QUOTE!

FLEXROCK COMPANY  
3608-B Filbert St., Phila. 1, Pa.

- We are enclosing sample, specs, and quantity for our TEFLON requirements. Please furnish quotation.
- Please send us your TEFLON Bulletin including stock list.

Name .....

Company .....

Address .....

City ..... Zone ..... State .....

CIRCLE ED-137 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 1954



## Test Probes

### Used With Oscilloscopes



Types 2607, 2608, and 2609 Test Probes are designed for use with general-purpose cathode-ray oscilloscopes. Types

2607 and 2608 are small, lightweight probes of pistol-grip design. They are shielded against stray pickup and incorporate a tip that permits point-to-point circuit checks or which can be easily clipped for prolonged tests. They have BNC terminations.

The first type is a passive probe with a flat response from direct current to 10Mc. It is used where negligible loading of a high impedance circuit is important. Type 2608 is of the cathode-follower type. It is useful when signal amplitudes are low, but output impedances are high. It has a useful response over the range from 5cy to 20Mc.

The Type 2609 detector probe will operate over a carrier-frequency range of 250kc to 400Mc, and has a flat response within 1db over any 6Mc band in this range. Termination of the five-foot cable is by a banana-jack with terminals spaced 3/4" on centers. Allen B. Du Mont Laboratories, Inc., Dept. ED, 760 Bloomfield Ave., Clifton, N. J.

CIRCLE ED-138 ON READER-SERVICE CARD FOR MORE INFORMATION

## Subminiature Relay

### In SPST and SPDT Styles



The PE5A-III Class "II" relay, in contact arrangements of spst and spdt, is designed for applications where size, sensitivity, and high and low temperatures are a major factor. This unit is

hermetically sealed in a 3/4" diam can and mounts in a standard 7-pin miniature socket, or can be supplied with a solder header. It meets and exceeds specifications MIL-R-5757B and MIL-R-6106A.

The unit is made in 6v d-c and 24-28v d-c. It uses palladium silver contacts that are rated up to 2amp inductive load. Available coil resistance range from 100 ohms to 10,000 ohms. The firm also has high temperature relays available in contact arrangements up to 4pdt. Polytron Engineering, Inc., Dept. ED, 32 W. Biddle St., Baltimore 1, Md.

CIRCLE ED-139 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954



SALES OFFICES IN

ED  
BE  
eets!

fabrica-  
ne effect  
our end.  
problem,  
as been  
creased  
just yet.  
he book  
TEFLON  
ship you  
molded,  
ter how  
ube. We  
s, FAST  
erances  
s — we  
d price.


ira  
OCK  
PA

LET US  
QUOTE!

s, and  
ements.  
atin in-

CE CARD  
er 1954





# MOLONEY *HiperCore* ELECTRONIC CORES

## Check and double Check

HiperCore Electronic Cores measure up to the highest standards of quality and performance. One check is not enough . . . each core undergoes at least two rigid inspections. The first makes certain that it is of the specified size . . . and the second determines that the finished cores have the desired electrical qualities. All HiperCore electronic cores *must* test well within industry tolerances. Special tests for specific operating conditions can also be made if desired.

These tests are the real proof of the superior fabrication which combines the finest materials with superior "know how". Result; electronic cores that give better performance . . . have greater flux carrying capacity and lower losses. And since Moloney HiperCore Electronic Cores are wound cores of cold-rolled oriented silicon steel, they are smaller and lighter.

ME53 36



If your product requires a better electronic core and size and weight are critical, specify Moloney HiperCore Electronic Cores. Available in over 1000 standard sizes. Write today for Bulletin SR-205 containing specifications, performance data and prices.

## MOLONEY ELECTRIC COMPANY

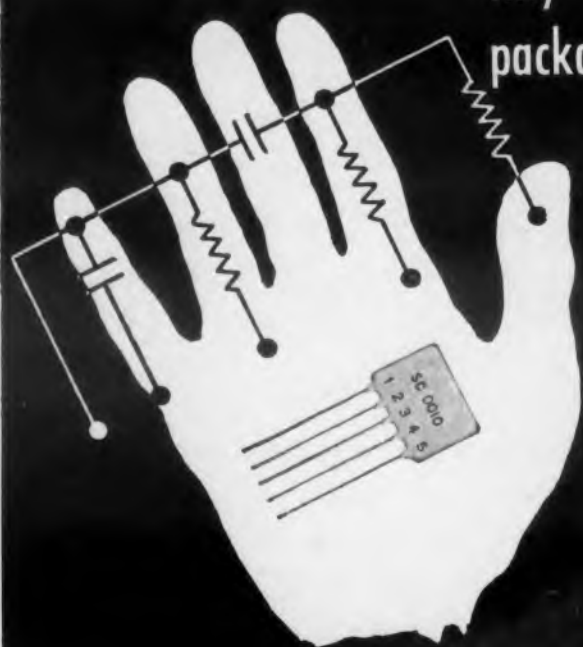
*Manufacturers of Power Transformers • Distribution Transformers • Load Ratio Control Transformers • Step Voltage Regulators • Unit Substations*

ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS, MO. AND TORONTO, ONT., CANADA

CIRCLE ED-140 ON READER-SERVICE CARD FOR MORE INFORMATION

a handful of components

in one  
tiny  
package



**Stupakoff**

Printed Circuits

Space is saved, assembly time reduced and errors eliminated when sturdy, compact Stupakoff Printed Circuits are used. In one tiny package—half the size of a book of matches—few or many accurately rated components—resistors and capacitors—are permanently assembled according to specifications. The only connections to be made are the external leads.

Stupakoff excels in the development and manufacture of Printed Circuits, and today is equipped with modern facilities for the mass-production of dependable units made to your specifications. Write for Bulletin 1151-A.

**STUPAKOFF CERAMIC & MFG. CO.**  
LATROBE, PENNSYLVANIA  
DIVISION OF THE CARBORUNDUM COMPANY

CIRCLE ED-141 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products . . .

### Carrier Amplifier

Has 0 to 3000cy Flat Response



The Type 1-127 four-channel carrier amplifier has a flat frequency response over 0 to 3000cy. With a wider than usual frequency range,

it should be of value, especially in the aircraft, guided missile, and atomic energy fields, for reproducing outputs of resistance or reluctance-type transducers.

The instrument contains a regulated power supply, 20kc oscillator, four-carrier amplifiers with associated bridge balancing and demodulator circuits, control and metering system, and a calibrating system. For nominal amplifier sensitivity, a 1mv modulation signal causes full scale output of  $\pm 50$ ma. The amplifier is provided with a gain control to adjust for full scale when an input of 1mv is applied with any source impedance from 60 ohms to 1000 ohms. Amplifier accuracy is  $\pm 1\%$  for modulating frequencies from 0-3000cy.

The instrument will operate on line frequencies of 50cy, 60cy, and 400cy, and voltages of 105-125v a-c. Ambient temperature range is from  $-20^\circ$  to  $+50^\circ$ C. Consolidated Engineering Corp., Dept. ED, 300 N. Sierra Madre Villa, Pasadena 8, Calif.

CIRCLE ED-142 ON READER-SERVICE CARD FOR MORE INFORMATION

### Potentiometer

Long-Life, Rotational Design



The Type 2094 Rotational Potentiometer is designed for applications where long life, substantially infinite resolution, and low noise under extreme vibration

and acceleration are essential. It carries a life guarantee of 5 million revolutions at 600rpm or less.

The active element is a solid resistance track of conductive plastic which is integrally co-molded to terminals, taps, and rigid supporting phenolic insulator plastic. Standard resistance values of 2000 ohms to 100,000 ohms, with linearity of  $\pm 1.0\%$  or  $\pm 0.5\%$ , are available. Rectilinear motion potentiometers are also available with the conductive plastic resistance elements. Markite Corp., Dept. ED, 155 Waverly Pl., New York 14, N. Y.

CIRCLE ED-143 ON READER-SERVICE CARD FOR MORE INFORMATION

## Slug Tuned Coils Precision Wound to Specifications by C.T.C.



Whatever your requirements — military or commercial — you can depend on CTC to give you *guaranteed accuracy* in every detail. All CTC materials, methods, and finishes meet applicable government specifications — and are under the most minute quality control.

CTC coil forms are made of quality paper base phenolic or grade L-5 silicone impregnated ceramic with slugs and mounting hardware furnished. A table of frequencies and permeabilities for slugs used in coil forms appears in CTC Catalog 400, available on request.

Of further interest to design engineers is CTC's new CST-50 capacitor which surpasses the range of capacitors many times larger in size.

For full details on these and other CTC products — custom or standard, the guaranteed components — write Cambridge Thermionic Corporation, 457 Concord Ave., Cambridge 38, Mass.

CIRCLE ED-144 ON READER-SERVICE CARD FOR MORE INFORMATION

## Self-Locking Fasteners for Electronic Applications



When weight reduction, space limitations, and vibrations in electronic equipment are problems, use Elastic Stop nuts, with the famous red insert collar. The nylon collar grips bolt threads —damps out severe shock and vibration—permits accurate bolt loading—maintains adjustment. Elastic Stop nuts are reusable many times. Instrument nuts (top) are for mounting instruments in panel faces; clinch nuts for pre-positioning in thin section metal components. Hex nuts in sizes from .109 across flats.



For information on any electronic fastener problem write: Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, N. J. Address Dept. N59-1057.

**ELASTIC STOP NUT CORPORATION  
OF AMERICA**

DESIGN HEADQUARTERS FOR SELF-LOCKING FASTENERS

CIRCLE ED-145 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954



## Magnetic Amplifiers

### Have Three Control Windings

The RG-60-D Series is comprised of three magnetic amplifiers which incorporate extreme ruggedness, dependability, three control windings, and hermetically sealed cases. They are designed to eliminate costly maintenance and greatly reduce replacement costs. They have the added advantage of allowing simplified wiring in associated circuitry.

All three ranges of the series have three control windings, one of which may be used to provide a lead (anticipation) signal when fed from a conventional differentiating network. The other control winding may be used to provide a positive feedback signal to compensate for load line voltage drop.

The three models provide maximum output currents of 4.5amp, 1.2amp, and 225ma; mean output voltage of 6.0v, 27v, and 115v. Size of all three units is 4-5/16" x 3-11/16" x 4-1/2" high. Four mounting studs 8-32 x 5/8" are provided, and unit weight is 2 lb, 3 oz. Atlas Engineering Co., Dept. ED, Roxbury, Mass.

CIRCLE ED-146 ON READER-SERVICE CARD FOR MORE INFORMATION

## Motor Alternator

### Converts 115v, 60cy to 115v, 420cy



The SA-40 synchronous motor alternator has been designed to meet the demand for a 420cy power supply. It has an output of 250v. The compact design (approximately 7" x 11-1/2") facilitates portability.

An outstanding feature is that any 115v, 60cy power source can be converted by this motor alternator to 115v, 420cy power. The synchronous motor maintains constant frequency regardless of the load or input voltage to the machine.

The generator rotor is mounted on the same shaft as the 1/2hp, single-phase motor rotor. This construction eliminates misalignment difficulties. Electric Motors and Specialties, Inc., Dept. ED, Garrett, Ind.

CIRCLE ED-147 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954

DOW CORNING  
CORPORATION

# Silicone News

FOR DESIGN ENGINEERS

## Dependability of Overload Relay Assured with Silicone Fluid

Latest addition to the series of silicone-containing Hydraulic-Magnetic Circuit Breakers developed by the Heinemann Electric Company is the Silic-O-Netic type C Overload Relay. A 400-volt service unit, the Type C resets itself immediately when the circuit fault is corrected.

The Type C Relay combines hydraulic and magnetic action. When an overload occurs, a spring-loaded iron core in a non-magnetic tube filled with Dow Corning 200 silicone fluid is actuated by a solenoid coil. The core travels toward the end of the tube to complete a magnetic circuit. Resistance of the silicone fluid slows core travel providing a time delay inversely proportional to the overload current. Extreme overloads actuate the armature instantly before the core reaches the end of the tube.

Time delay characteristics are determined by core design and fluid viscosity. Of these,

the easiest and least costly to vary is the choice of a fluid having the proper viscosity. Key to the consistent dependability of the time delay is the fact that the initial viscosity remains constant, even after millions of operations in service.

Unlike organic oils, Dow Corning 200 Fluid retains a relatively constant viscosity over a wide temperature range; it does not thicken or thin out. This important feature plus high resistance to oxidation and gumming helps keep the relay's actuation point unaffected by variations in the ambient temperature.

These same properties are utilized in another type Heinemann relay which is pre-set at the factory for delay intervals of from 1 second to 2 minutes. The delay interval is determined almost entirely by the viscosity of the Dow Corning 200 Fluid selected. In all these relays hermetic sealing is used to assure cleanliness and freedom from tampering. No. 6



## New Silicone Rubber Gum Can Be Sulfur Vulcanized and Blended with Organic Rubbers to Increase Their Stability

Rubbery parts with properties intermediate between those of silicone rubber and organic rubbers can now be produced by compounding with a new silicone polymer that can be vulcanized with sulfur and blended in any proportion with organic rubbers.

Identified as Dow Corning 410 Gum and available now in commercial quantities, this new polymer can be blended with or applied as a protective coating to extend the serviceable temperature limits and the weather resistance of organic rubbers.

Brittle point in the range of -70°F and usefulness at temperatures up to 400°F can be realized by proper blending. The physical properties of the blend will fall between those of high strength silicone rubber and the organic rubber constituent.

Dow Corning 410 Gum can also be blended

with oil resistant rubbers to increase their stability in contact with hot oil. Such blending also markedly improves the ozone and weather resistance of organic rubber.

Tested in an atmosphere created by an ozone generator, for example, a Buna N type rubber, compounded for test purposes, showed failure cracks in less than 30 minutes. Under the same conditions, a fifty-fifty blend of the same organic elastomer and Dow Corning 410 Gum, compounded with the same fillers and vulcanizer showed no cracks after more than 8 hours.

Priced in the same range as standard silicone rubber gums, Dow Corning 410 Gum is currently available for immediate shipment in commercial quantities. Experimental samples for testing and evaluation are available on request. No. 7

ATLANTA • CHICAGO • CLEVELAND • DALLAS • DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D. C. (Silver Spring, Md.)  
Canada: Dow Corning Silicones Ltd., Toronto; England: Midland Silicones Ltd., London; France: St. Gobain, Paris

CIRCLE ED-148 ON READER-SERVICE CARD FOR MORE INFORMATION



## Silicone Paint Improves; Protects Appearance of Mercury Manifolds

To preserve a quality appearance in keeping with the automobile itself, the exhaust manifolds and crossover connection of all Mercury automobiles are coated with a heat resistant silicone based paint. Formulated by Midland Industrial Finishes of Waukegan, Ill., the coating stays black and glossy despite surface temperatures in the range of 500 F. Compare that with the burnt-brown appearance of conventional manifolds.

First used on the manifolds of the 1953 Lincoln automobile, the silicone finish is expected to last the life of the automobile. No noticeable deterioration has been observed after as much as 100,000 miles.

No additional work is required to apply the silicone paint. It's simply sprayed on the manifolds with conventional production line equipment and baked only 30 minutes at 500 F. No. 8

Dow Corning 6 Compound, a grease-like, non-hardening, rust preventative for ferrous alloy metal parts in delicate mechanisms and fine instruments, provides excellent protection during long time, indoor or outdoor storage. No. 9

### Design Edition 2

DOW CORNING CORPORATION - Dept. DA-22  
Midland, Michigan

Please send me more data on numbers:

6 7 8 9

NAME \_\_\_\_\_

TITLE \_\_\_\_\_

COMPANY \_\_\_\_\_

STREET \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_



# TV set costs go down-quality stays high with Tung-Sol "series string" TV tubes

## 2AF4

(Prototype—6AF4)  
Heater Current 0.6 A  
Heater Volts 2.35

## 3AL5

(Prototype—6AL5)  
Heater Current 0.6 A  
Heater Volts 3.15

## 3AU6

(Prototype—6AU6)  
Heater Current 0.6 A  
Heater Volts 3.15

## 3AV6

(Prototype—6AV6)  
Heater Current 0.6 A  
Heater Volts 3.15

## 3BC5

(Prototype—6BC5)  
Heater Current 0.6 A  
Heater Volts 3.15

## 3BE6

(Prototype—6BE6)  
Heater Current 0.6 A  
Heater Volts 3.15

## 3CB6

(Prototype—6CB6)  
Heater Current 0.6 A  
Heater Volts 3.15

## 4BQ7A

(Prototype—6BQ7A)  
Heater Current 0.6 A  
Heater Volts 4.2

## 4BZ7

(Prototype—6BZ7)  
Heater Current 0.6 A  
Heater Volts 4.2

## 5AN8

(Prototype—6AN8)  
Heater Current 0.6 A  
Heater Volts 4.7

## 5AQ5

(Prototype—6AQ5)  
Heater Current 0.6 A  
Heater Volts 4.7

## 5BK7A

(Prototype—6BK7A)  
Heater Current 0.6 A  
Heater Volts 4.7

## 5T8

(Prototype—6T8)  
Heater Current 0.6 A  
Heater Volts 4.7

## 5U8

(Prototype—6U8)  
Heater Current 0.6 A  
Heater Volts 4.7

## 5V6GT

(Prototype—6V6GT)  
Heater Current 0.6 A  
Heater Volts 4.7

## 6AU7

(Prototype—12AU7)  
Heater Current 0.6 A  
Heater Volts 3.15\*

## 6AX7

(Prototype—12AX7)  
Heater Current 0.6 A  
Heater Volts 3.15\*

## 6S4A

(Prototype—6S4)  
Heater Current 0.6 A  
Heater Volts 6.3

## 6SN7GTB

(Prototype—6SN7GTA)  
Heater Current 0.6 A  
Heater Volts 6.3

## 12AX4GTA

(Prototype—12AX4GT)  
Heater Current 0.6 A  
Heater Volts 12.6

## 12B4A

(Prototype—12B4)  
Heater Current 0.6 A  
Heater Volts 6.3\*

## 12BH7

(Prototype—12BH7)  
Heater Current 0.6 A  
Heater Volts 6.3\*

## 12BQ6GA

(Prototype—6BQ6GA)  
Heater Current 0.6 A  
Heater Volts 12.6

## 12BQ6GT

(Prototype—6BQ6GT)  
Heater Current 0.6 A  
Heater Volts 12.6

## 12BY7A

(Prototype—12BY7)  
Heater Current 0.6 A  
Heater Volts 6.3\*

## 12L6GT

(Prototype—25L6GT)  
Heater Current 0.6 A  
Heater Volts 12.6

## 12W6GT

(Prototype—6W6GT)  
Heater Current 0.6 A  
Heater Volts 12.6

## 19AU4

(Prototype—6AU4GT)  
Heater Current 0.6 A  
Heater Volts 18.9

## 25CD6GA

(Prototype—25CD6G)  
Heater Current 0.6 A  
Heater Volts 25

Thermal characteristics of all the heaters are controlled so that heater voltage surges during the warm-up cycle are minimized, provided that these tubes are used with other types similarly controlled.

Heater ratings are based on 600 milliamperes of current with heater voltage adjusted for same power as in the prototype. All other characteristics and ratings identical to those of the prototype.

Use of these tubes provides completely satisfactory receiver characteristics during warm-up.

(Other types are in development)

\*Using heaters connected in parallel.

All the economies of series string design, with no sacrifice in reception quality, are available to TV set manufacturers who engineer their sets around this new line of Tung-Sol Receiving Tubes.

The competitive position you achieve through savings in transformer and circuitry costs will be strengthened by the long life and high performance of these Tung-Sol Tubes.

The statistical quality control methods by which Tung-Sol maintains

outstanding uniformity in tube production, make these new types your best assurance of utmost economy in series string TV set manufacture. For more information, write to Commercial Engineering Department, Tung-Sol Electric Inc., Newark 4, New Jersey.

Sales Offices: Atlanta, Chicago, Columbus, Culver City (Los Angeles), Dallas, Denver, Detroit, Newark, Philadelphia, Seattle.



Tung-Sol makes All-Glass Sealed Beam Lamps, Miniature Lamps, Signal Flashers, Picture Tubes, Radio, TV and Special Purpose Electron Tubes and Semiconductor Products.

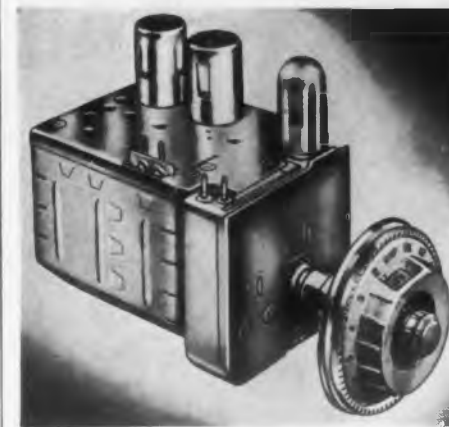
# TUNG-SOL Radio and TV Tubes, Dial Lamps

CIRCLE ED-167 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products . . .

### Tuner

Covers U-H-F and V-H-F Bands



The UV-13 tuner, covering the full u-h-f and v-h-f bands, is actually two separate tuners mounted coaxially and plugged together to make a single, compact unit no larger than standard v-h-f tuners. Logical straight-line

electrical sequence of compartmented circuits is the basic design feature; this provides greatest efficiency by eliminating regeneration, pick-up of spurious signals, and other undesired effects due to stray capacitances and inductances.

The two units combined measure 3-5/16" x 3-17/64" x 4-3/4" deep. Tube height above chassis may be kept to 1-7/16". The complete tuner consists of a cascode v-h-f tuner, Type V-13, and a capacitance tuned, resonant coaxial cavity, u-h-f tuner, Type U-13.

Features include: rugged construction, ease of installation and servicing, single dial tuning of u-h-f stations, solderless pin connections on external terminals, 41Mc single-superhetrodyne conversion, and many circuit stabilizing features, such as Invar temperature compensation which reduces drift due to temperature variations. The tuner is suited for use as original equipment in both color and monochrome sets and as a replacement for older sets. Sarkes Tarzian, Inc., Tuner Div., Dept. ED, Bloomington, Ind.

CIRCLE ED-165 ON READER-SERVICE CARD FOR MORE INFORMATION

### Potentiometer Waterproof Design



With a diameter of only 1.312", the Model RE-101 potentiometer is designed for minimum noise and a life of over one million cycles. Its linearity is

±0.25%, and resistances furnished are from 500 ohms to 10,000 ohms.

The design is waterproof, incorporating O-rings. Mounting is by a 3/8-32 bushing. Galetronics, Inc., Dept. ED, 2607 E. Foothill Blvd., Pasadena 8, Calif.

CIRCLE ED-166 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954

## Magnetic Clutches

### Cable Driven



Cable driven instead of utilizing gearing, these magnetic clutches allow greater flexibility in hand-drive positioning, as well as being a simple, low-cost, anti-backlash servo drive system. They are made in three models: a general purpose multi-turn slip-ring unit, a potentiometer slip-ring unit, and a single-turn pigtail unit. One of the clutches in a typical servo-and-hand-positioning system is shown in the photo.

These units can be specified to operate at fixed voltage in the range from 6 to 30v, d-c. Power consumption is less than 0.5w. The response time is approximately 5millisec. Clutch surfaces move less than 0.0002", with torque transmitted at less than 0.5 oz-in and more than 10 oz-in from disengagement to engagement. Electronic Manufacturing Engineers Co., Dept. ED, 2410 Beacon St., Seattle 44, Wash.

CIRCLE ED-157 ON READER-SERVICE CARD FOR MORE INFORMATION

## Telephone-Type Relays

### In Sensitivities from 20-500mv



These relays are designed to provide utmost dependability with minimum maintenance. They are available in a complete line of models

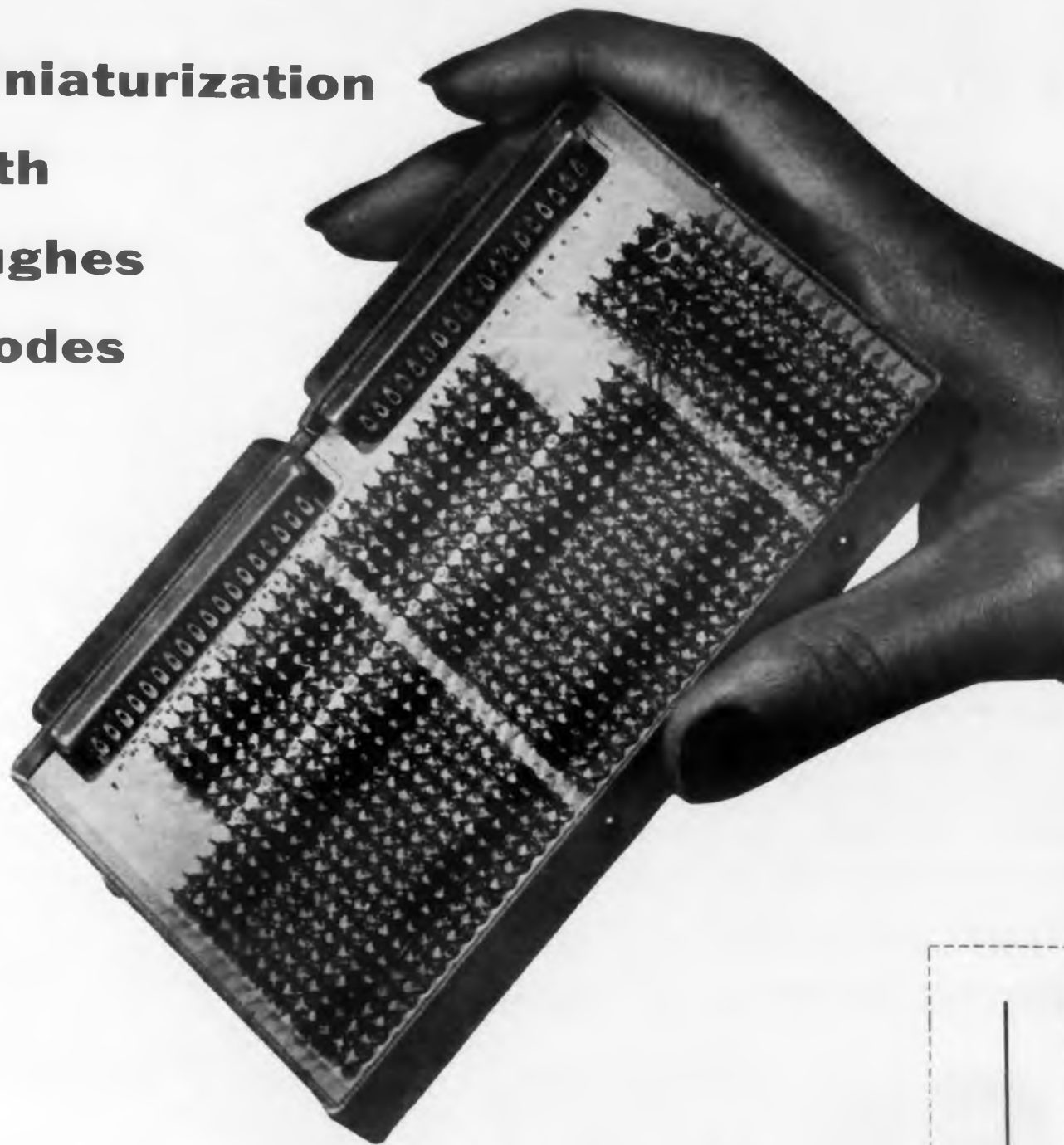
and switching arrangements, to meet all the needs for relays of this general description.

Sensitivity ranges from 20mw to 500mv, depending on the model and on the number of springs in the springset. The springset units are easily and accurately adjusted because of the design of the supporting buffer block, and their contacts are designed to be self-cleaning.

Operating coils and springsets will withstand up to 650v in the high-voltage model, and to 250v in others. Current carrying capacity ranges from 0.3amp to 5amp, depending chiefly on contact design. Coil impregnation and the finish of metal parts can be made suitable for extremes of climate. Made by General Electric Co., Ltd., Eng. Available from Imtra Corp., Dept. ED, 58 Charles St., Cambridge, Mass.

CIRCLE ED-158 ON READER-SERVICE CARD FOR MORE INFORMATION

## Miniaturization with Hughes Diodes



### New computer matrix has high component density

*This experimental reading gate matrix for airborne computers effectively utilizes the subminiature size of Hughes Point-Contact Germanium Diodes\*. Developed by the Miniaturization Group of Hughes Research and Development Laboratories, the unit measures 5 1/4 by 3 1/8 by 1/2 inches (excluding plugs and frame). It contains 504 diodes, 209 resistors. Average component density: 94.5 per cubic inch!*

Frequently, space requirements of conventional wiring techniques will not permit electronic equipment to be miniaturized to the same extent as the components. However, spot-welded connections can effectively reduce wiring space . . . and it is easy to spot-weld the dumet leads of Hughes diodes. There is no adverse effect on diode characteristics, even when the connections are welded close to the diode body. With Hughes

diodes, designers can take full advantage of advanced packaging and wiring techniques.

Hughes diodes are easy to mount in conventional assemblies or in subminiature equipment. In service, these diodes have earned a reputation for reliable performance and stability under severe operating conditions. Make your selection from the many standard and special types available — all listed and described in our new Bulletin, SP-2A.



\*Actual size, diode body: 0.265 by 0.130 inches, maximum.

Reprints of a paper describing the packaging techniques of the subminiature matrix are available, too. Your copy will be sent promptly on request.

## Hughes

Aircraft Company, Culver City, Calif.

SEMICONDUCTOR SALES DEPARTMENT



New York Chicago

CIRCLE ED-159 ON READER-SERVICE CARD FOR MORE INFORMATION



# NEW ALL-METL VIBRATION ISOLATORS

Operate at Extreme Temperatures



Series M24 Isolator



Series M44 Isolator



Series M64 Isolator

New, miniature, ALL-METL BARRYMOUNTS — Series M24 — have been added to the Barry line. The stainless-steel spring and wire-mesh construction of this tiny, new mount enable it to provide excellent isolation at extreme high or low temperatures. The M24 series meets all pertinent requirements of MIL specifications, as also do the larger M44 and M64 ALL-METL BARRYMOUNTS.

The weights and load ranges of ALL-METL BARRYMOUNTS are: miniature Series M24 — 1/2 oz., 9 load ratings covering range of 0.1 to 3 lbs.; JAN-size 1, Series M44 — 1 1/2 oz., 6 load ratings covering range of 1/2 to 10 lbs.; JAN-size 2, Series M64 — 4 1/4 oz., 8 load ratings covering range of 2 to 40 lbs. Write for Product Bulletins 542(M24), 534(M44), or 536(M64).

Special and standard mounting bases using any of these three ALL-METL BARRYMOUNTS can be furnished; detailed recommendations on request. BARRY CORP. 775 Pleasant St., Watertown 72, Mass.

CIRCLE ED-185 ON READER-SERVICE CARD FOR MORE INFORMATION

## There's always room for a Fenwal Miniature THERMOSWITCH® control



SEND FOR BULLETIN

Designed for:

CRYSTAL OVENS  
GUIDED MISSILES  
WAVE GUIDES  
RADAR • COMPUTERS  
ANTENNAS

and many others where temperature control is vital and space is at a premium, the new Fenwal Miniature THERMOSWITCH units are real problem solvers.

Bringing you advantages never before found in so small a control, these rugged little devices are extremely sensitive to temperature variations and positive in action. Adjustable anywhere within the range of 0°F to 200°F, they maintain normal control characteristics under vibrations ranging up to 5 G's.

For details on how you can get maximum dependability of temperature control in minimum space, send for your copy of the Miniature THERMOSWITCH Control bulletin.

Write Fenwal Incorporated, 910 Pleasant St., Ashland, Mass.



**THERMOSWITCH®**

Electric Temperature Control and Detection Devices  
SENSITIVE...but only to heat

CIRCLE ED-186 ON READER-SERVICE CARD FOR MORE INFORMATION

70

## New Products . . .

### Capacitors

Inexpensive, Miniature Types



Known as "Tekaps", these inexpensive miniature, capacitors are most practical in values of 0.5 to 10mmfd. Standard tolerance is 10%. They are available in a number of lengths to suit different applications, the ones

illustrated being 7/16" long. Silver plated terminals allow soldering directly into circuits, but leads can be furnished if desired.

These units have a zero temperature coefficient from -60°C to 300°C; a dielectric constant of 2.0 at all operating frequencies; a power factor of 0.0005 at all operating frequencies, and a moisture absorption factor of zero. Anchor Radio Corp., Dept. ED, 2215 S. St. Louis Ave., Chicago 23, Ill.

CIRCLE ED-187 ON READER-SERVICE CARD FOR MORE INFORMATION

### Ratiometer

Reads Resistor Values



The "Precision Ratiometer", designed as a laboratory, production or field instrument, is for use primarily in accurate determination of either impedance ratios or absolute values of resistors. The unit has two resistive networks that may be used separately or in conjunction with each other, a transformer for either a-c inputs or as an a-c null detector, microammeter for d-c measurements, calibrated capacitor to null out reactive components that exist in resistors, and switches for meter reading.

It is readable to five significant figures, which, in combination with the precision resistors, permits a wide range of ratio tests with extreme accuracy. The "Ratiometer" is packaged in a standard 8-3/4" x 19" cabinet, with the front panel containing a complete circuit diagram and convenient built-in jumpers for rearranging the networks into the desired test pattern. Cal-Tronics Corp., Dept. ED, 11307 Hindry Ave., Los Angeles 45, Calif.

CIRCLE ED-188 ON READER-SERVICE CARD FOR MORE INFORMATION

See our display—Nat'l. Metals Show: Booth 702

for

made-to-order precision at mass-production prices

Illustrated Actual Size



SEE

## GRC SMALL NYLON COIL BOBBINS

GRC Nylon Bobbins serve you better because they are made to your exact specifications. Yet they cost far less, thanks to Gries' mass-production methods. Bobbins are automatically produced, ready-for-use, in one swift, cost-saving operation. And Gries' unique single-cavity molding technique assures accuracy and uniformity—at prices that afford substantial savings. Send specification for Prompt Quotations on Production runs of 25,000 or more.

MAX. weight .025 oz.  
length 1"

NO MINIMUM SIZE!

WRITE FOR FULL INFORMATION AND SAMPLES



**GRIES REPRODUCER CORP.**

World's Foremost Producer of Small Die Castings

40 Second St., New Rochelle, N.Y. • Phone NEW Rochelle 3-8600

CIRCLE ED-189 ON READER-SERVICE CARD FOR MORE INFORMATION

## PRINTED CIRCUITS

can simplify your design . . .  
speed output . . . cut costs

Eliminate wires! With Du Pont Conductive Coatings, you can print circuits for capacitors and couplings; for static shielding to replace foils and cans; for resistors and solder seals. Streamline your designs in television sets and radios, electronic equipment, meters and switchboards.

Coatings are easily applied by spray, brush, dip or stencil on metals or non-conductors. Fit right into high-speed assembly-line operation. Save you money. For up-to-date, descriptive bulletin write to: E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Department, Wilmington 98, Delaware.

**DU PONT**  
**CONDUCTIVE COATINGS**  
—Best for printed circuits!



BETTER THINGS FOR BETTER LIVING  
...THROUGH CHEMISTRY

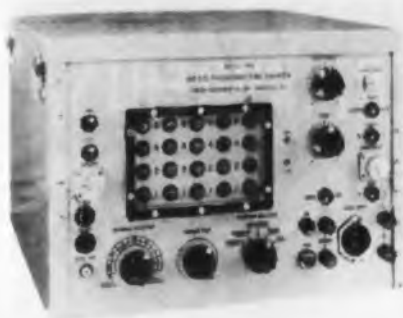
CIRCLE ED-190 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954



## Counter

### For Frequency and Time Measure



The Model 3149 is a general-purpose instrument for making direct frequency and time measurements under field conditions with laboratory type accuracy and complete reliability.

Designed for military specifications, it is housed in a reinforced, easily removed, drip-proof cabinet made of extra heavy gage aluminum. Gold-plated switch contacts and JAN components are used throughout. All components are turret-lug mounted.

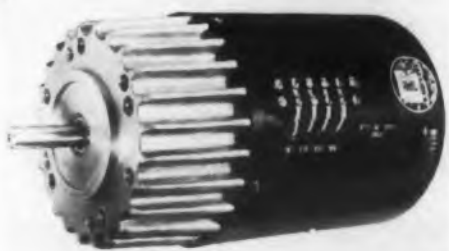
Direct measurement of frequency up to 150kc is provided by means of five electronic counter decades that count the cycles of the unknown for an exact crystal-controlled interval of time. Low frequencies are measured by counting time-base pulses occurring during 1cy or 10cy of the unknown. Time intervals may be measured to the nearest 0.00001sec. The instrument also serves as a secondary frequency standard and as a totalizing counter.

The Model 3149 is available with either 4-lamp binary-coded decimal (illustrated) or 10-lamp indication at no difference in cost. A mechanical register may be added for extending count indication to 11 digits, and high-speed printers and recorders are available for making permanent records automatically and at high rates of speed. Potter Instrument Co., Inc., Dept. ED, 115 Cutter Mill Rd., Great Neck, New York.

CIRCLE ED-191 ON READER-SERVICE CARD FOR MORE INFORMATION

## Drive Motor

### For Radar Antennas



Designed especially for radar antenna drive, the Model K16-YB2 is a capacitor start and run a-c induction motor which conforms to specification MIL-M-1940. The motor is instant reversing, 115v a-c, 60cy, single phase. Running torque is 430 in-oz at 1475rpm. Locked rotor torque is 500 in-oz at zero rpm, and pull-out torque is 700 in-oz at zero rpm.

The motor is fan cooled on a totally enclosed frame. Shaft and hardware are of stainless steel, and ball bearings are employed throughout. Weight is 22lb. Mission-Western Engineers, Inc., Dept. ED, 132 W. Colorado St., Pasadena 1, Calif.

CIRCLE ED-192 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954



# Why we choose **WINCO** DYNAMOTORS

"Precision airborne communication equipment must have a dynamotor of consistently reliable quality . . . that's why we specify Winco."

says Mr. Paul Wulfsberg,  
Ass't. Director Engineering and Research

## COLLINS RADIO CO.

Cedar Rapids, Iowa.

WINCO DYNAMOTORS are manufactured on a wide range of rugged frames that allow for broad design applications. Winco engineers have a decade of experience in successfully designing dynamotors to rigid military and commercial specifications. They tackle each power conversion and/or supply problem individually, either modifying a standard Winco machine, or designing a special unit to meet your exact requirements. Winco specialists then plan its manufacture on a production basis to keep costs down and final performance quality at its best.

Winco dynamotors are lightweight, compact and totally enclosed and ventilated. Precise static and dynamic balance is assured by the most modern machines — each dynamotor is thoroughly tested with periodically calibrated precision meters.



Collins 18S Transmitter/Receiver, used for reliable HF communications in major air-lines and executive aircraft uses a Winco-Engineered Frame 51 Dynamotor



**SEND THIS COUPON TODAY** for complete information on how Winco can supply you with reliable, efficient dynamotors and power supplies produced in volume at low cost.



**POWER** for the Nation's Mobile Communications

# WINCHARGER CORPORATION

Sioux City 2, Iowa

Subsidiary of ZENITH Radio Corporation

CIRCLE ED-193 ON READER-SERVICE CARD FOR MORE INFORMATION

To Wincharger Corp., Sioux City 2, Iowa.

Send me the facts on Winco Dynamotors and Power Supplies

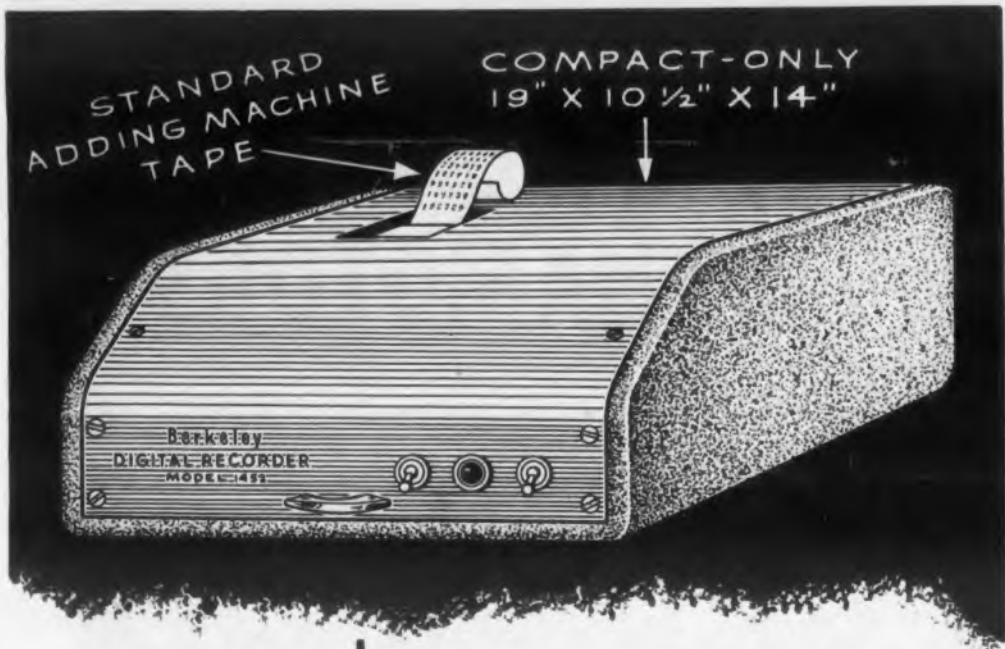
Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

Coupon No. 166



**NEW**  
**Berkeley**  
**DIGITAL**  
**RECORDER**  
**COMBINES**  
**HIGH SPEED**  
**PRINTER**  
**AND**  
**SCANNER**  
**IN SINGLE**  
**UNIT**

Automatically provides permanent printed record of data from universal counter-timer, frequency, time interval or EPUT meters, counters or scalars...no duplication of counting units required.

The BERKELEY Model 1452 Digital Recorder provides a simple, reliable and inexpensive means of converting electronic count information into printed form. It couples directly to any late model BERKELEY\* counting device and prints up to 10 digits on standard adding machine tape.

Manual transcribing of visual indication with its high possibility of error is thus eliminated and cycling rate can be increased several hundred percent. The Model 1452 can be modified to print "Time" or "Code" information simultaneously with count data on the same tape. Interlocks prevent clearing of the electronic counter until printing is completed, eliminating lost counts.

\* Older BERKELEY models may be adapted for use with the Model 1452.

**CONDENSED SPECIFICATIONS**

Recording capacity	6 digits standard, 8 or 10 on special order
Max. cycling rate	1 printout every 0.85 sec. for 6 digits
Power requirements	100-130 v., 50/60 cycles, 125 watts (approx.)
Input requirements	Direct connection to basic counting unit
Dimensions, weight	19" wide x 10½" high x 14" deep; 60 lbs.
Price, Model 1452	\$750.00 f.o.b. factory
(Prices and specifications subject to change without notice)	

Write for complete specifications and data; please address Dept. D10.

M-40

**Berkeley**

*division*  
**BECKMAN INSTRUMENTS INC.**  
 3200 WRIGHT AVE., RICHMOND, CALIF.

CIRCLE ED-161 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products . . .

### Gear Trains For High Precision Uses



These highly precise computer gear trains are designed and engineered for minimum backlash and low loss of torque due to friction. Trains are available in any practical ratio and may be ordered with slip clutch, rotational limit stop, and single or multi-speed dials constructed within the gear housing.

Data output gearing is available for many different types of component assemblies. Complete units, including servo systems, can be furnished to specifications. Feedback Controls, Inc., Dept. ED, 503 Rhode Island Ave., N. E., Washington 2, D. C.

CIRCLE ED-162 ON READER-SERVICE CARD FOR MORE INFORMATION

### Microwave Dielectrometer Handles Many Materials



The Microwave Dielectrometer measures the dielectric constant and loss of a wide variety of materials. Operating at nominal frequencies of 1kMc, 3kMc, and 8.5kMc, corresponding to free-space wavelengths of 30cm, 10cm and 3.5cm, it is used for measuring dielectric materials in the microwave region,

research on new materials, propagation and utilization of microwave energy, and correlation of dielectric loss data with other properties.

The instrument consists of a slotted waveguide; precision traveling probe; probe-output amplifier, separate, square-wave modulated klystron oscillators for each frequency; associated power supplies and equipment. Operating as a coaxial line at 1kMc and 3kMc, solids are measured directly in the waveguide in the form of cylindrical samples 1" in diameter and about 1" to 2" long with a 3/8" coaxial hole. When the guide is operated as a pipe at 8.5kMc, the coaxial hole is omitted. Measurement range of the dielectric constant extends from 1 to 100, and the dissipation factor from 0.0001 to 1.0. Central Research Laboratories, Inc., Dept. ED, Red Wing, Minn.

CIRCLE ED-163 ON READER-SERVICE CARD FOR MORE INFORMATION

## Delegate Your SPECIAL COMPONENTS

to



We have the Engineers, Plants, Equipment and Know-How to produce SPECIAL PURPOSE DEVICES and COMPONENTS AT LOW COST.

Illustrated below are only 5 of over 500 different SPECIAL PURPOSE DEVICES we've made to perform functions specified by our customers.



INSTRUMENT SHUNTS

AIR COOLED SHUNTS



RATIO ACCELEROMETERS  
Potentiometer Types

MAXIMUM CURRENT CONTROLS  
for Generators



REMOTE CONTROL SYSTEMS

Send your specifications to us for prompt quotations.

Ask for Brochure J54

# RAM METER, INC.

Founded 1936

1108 Hilton Road, Ferndale  
DETROIT 20, MICHIGAN  
Telephone Lincoln 4-7220

CIRCLE ED-164 ON READER-SERVICE CARD



# COOL



## BIRTCHEK KOOL KLAMPS



KOOL KLAMPS are made of a specially developed, heat treatable alloy 99½% pure silver. Under certain conditions, KOOL KLAMPS reduce subminiature tube temperatures as much as 40° C.

In addition, KOOL KLAMPS hold tubes firm and secure, regardless of how they are shaken or vibrated.

Where heat conditions are less critical, beryllium copper KOOL KLAMPS are available.

**The BIRTCHEK CORPORATION**  
4371 Valley Blvd.  
Los Angeles 32, California



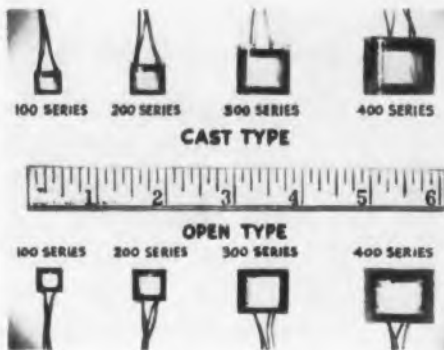
Dept. EL 10-54  
Please send Bulletin which describes and illustrates Kool Klamps in detail.

Company .....  
Attention of .....  
City ..... State .....

CIRCLE ED-156 ON READER-SERVICE CARD

## Subminiature Transformers

32 Models Available



Especially designed for transistor and other miniaturized circuit applications, a new 32-model line of subminiature transformers have power capabilities ranging from less than 1mw to over 100mw. They are suitable for use in the audio and ultrasonic ranges. Divided into four different sized series, they are available in input, interstage, choke, and output types in each series. Each of the 16 basic types is made in both open and cast construction as illustrated.

The smallest of the four series is particularly designed for transistorized hearing-aid use. The 16 cast types are equipped with flat surfaces to further facilitate product miniaturization by gluing into position where desired.

All the units will operate satisfactorily over a temperature range of -25°C to 100°C. They range in size from 3/8" x 3/8" x 11/32" to 3/4" x 7/8" x 1". Mounting and lead arrangements can be specified. Texas Instruments, Inc., Dept. ED, 6000 Lemmon Ave., Dallas 9, Tex.

CIRCLE ED-154 ON READER-SERVICE CARD FOR MORE INFORMATION

## Vibration Exciter

Tests Miniature Electron Tubes




This shaker provides data on vibratory response of subminiature electron tubes and ability to their stand severe vibration in service. It vibrates at frequencies up to 10,000cy.

On electromagnetic equipment, it provides for rigidly clamping tubes in the vibrating armature. It also includes a flat-top table for use in calibrating small vibration pickups and accelerometers.

Ratio of table acceleration to input voltage is flat within 15% from 200cy to 10,000cy with a tube load of 3gr. At such load, the exciter will deliver a 10g acceleration. Distortion of output wave form is less than 3%. The MB Manufacturing Co., Dept. ED, New Haven, Conn.

CIRCLE ED-155 ON READER-SERVICE CARD FOR MORE INFORMATION



## AUDIO ATTENUATORS

### OVER 200 BASIC TYPES TO CHOOSE FROM

Do audio attenuator problems cost you money? Chances are Shallcross has a model to match your specifications exactly—and at moderate cost.

Shallcross attenuators are made in over 200 basic types. Each type can be supplied with a choice of attenuation characteristics . . . with a positive detent mechanism . . . and in numerous input and output impedances. Where calibration must be extremely accurate, Shallcross precision wire-wound resistors are used. For less critical applications, models with high grade composition resistors can be supplied—often at lower cost.

A complete description of all Shallcross attenuators — mountings, characteristics, and circuits is yours for the asking in Bulletin L-4A. SHALLCROSS MFG. CO., 526 Pusey Avenue, Collingdale, Penna.

**QUICK DELIVERIES!** Small quantities of popular 20 step Shallcross composition resistor potentiometers and wire-wound ladders without detents are immediately available.

# Shallcross

CIRCLE ED-153 ON READER-SERVICE CARD FOR MORE INFORMATION

Remember...

# STANCOR

## REPLACEMENT TRANSFORMERS

are used for  
original  
equipment too!

Perhaps we shouldn't even mention it . . . but some people forget that a transformer had to be used in original equipment before it became a replacement unit. Many Stancor cataloged replacement transformers are being used in today's new equipment . . . because they represent the most efficient and economical original equipment design.

No matter what kind of equipment you are designing . . . for economical production of samples, pilot runs, etc. you are likely to find the transformers you need in the New 1954 Stancor Catalog.

Write now for your free copy, or get it from your authorized Stancor distributor. You'll find it a handy book to have around.



### CHICAGO STANDARD TRANSFORMER CORPORATION

3576 ELSTON AVENUE  
CHICAGO 18, ILLINOIS



EXPORT SALES:  
Roburn Agencies  
431 Greenwich Street  
New York 13, N. Y.

CIRCLE ED-169 ON READER-SERVICE CARD FOR MORE INFORMATION



# New Products . . .

## Amplitude Modulator

### Wide Band, Low Distortion Design



This high-efficiency, wide-band amplitude modulator has extremely low distortion and small phase shift suitable for use in applying complex wave, high level plate modulation to Class C r-f amplifiers. Suggested uses are multiplex telephone carrier, multiple tone radio control systems, extreme high quality radio telephone

transmission such as broadcasting, or any case requiring very wide band characteristics at extremely low harmonic and intermodulation distortion.

Class C plate current is carried by a modulator output transformer, eliminating need for additional modulation components. Standard models are available for modulating up to 400w power input to a Class C stage at less than 1% harmonic distortion at full output and less than 0.5% at 50% modulation from lowest design frequency to 20,000cy.

Through the use of a patented output circuit, the modulator drives a single-ended high impedance load with constant modulator efficiency and tube load balance over the entire band. Low generator impedance allows variation of Class C power input over wide limits without readjustment of audio input level. High power units are available on special order. McIntosh Electronics Co., Dept. ED, 5232 River Rd., Washington 16, D. C.

CIRCLE ED-170 ON READER'S SERVICE CARD FOR MORE DATA

## Plastic Capacitors

### With $\pm 30\text{ppm}/^\circ\text{C}$ Coefficient



Type GC capacitors, with plastic film dielectric, are for use in integrating circuits, tuned filters and timing oscillators. They feature a temperature coefficient of  $\pm 30\text{ppm}/^\circ\text{C}$  and are available in capacitances from 0.1 $\mu\text{fd}$  to 10 $\mu\text{fd}$ .

Voltage range is from 100v to 1000v. Other features are excellent capacitance retrace, stability with life, temperature range from  $-60^\circ$  to  $+85^\circ\text{C}$ , and hermetic sealing. Plastic Capacitors, Inc., Dept. ED, 2511 W. Mofatt St., Chicago 47, Ill.

CIRCLE ED-171 ON READER'S SERVICE CARD FOR MORE DATA

\* PRECISION \*  
**components**  
*tuned to tomorrow*

**POPULAR DIALS AND KNOBS**

For years, NATIONAL dials and knobs have been the popular choice of amateurs, experimenters, and commercial users. NATIONAL dials feature smooth, velvety action, easily-read scales and quality construction. Many dials, like the N and ACN dials shown, can be specially calibrated or supplied with blank scales for commercial applications.

NATIONAL knobs — distinguished by their clean, functional, chrome and plastic styling and sturdy construction — are the most popular of their type ever produced. All fit  $1/4$ " shafts. For commercial applications, they can be supplied in special colors and with special calibrations.

Write for new NATIONAL catalog of dial and knobs to Dept. ED-954

**National**

NATIONAL COMPANY, INC.  
61 SHERMAN ST.  
MALDEN 48, MASS.

CIRCLE ED-172 ON READER-SERVICE CARD

The  
-65  
150cy  
ture  
dwell  
No  
eratic  
offset  
ments  
1 me  
150 $\mu$ v  
ment  
Airp  
more  
CIRCLE

The  
5000  
rang  
form  
of si  
ance  
d-c p  
Th  
pull  
tiple  
ment  
f-m  
fere  
ment  
York  
CIRCLE  
ELEC

## Chopper

### Miniature 60cy Design



This 60cy Chopper is a break-before-make design. It is exceptionally rugged, withstanding 30g vibration. It will handle signal levels from 100v down to other microvolt region at 1 ma.

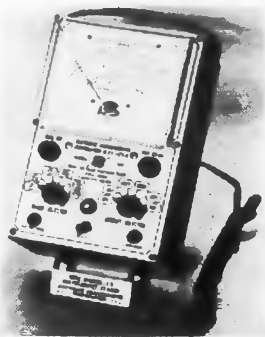
The chopper can be operated at any ambient from  $-65^{\circ}$  to  $+100^{\circ}\text{C}$  or at any frequency from 30cy to 150cy. It is hermetically sealed with a 7-pin miniature base. At 6.3v 60cy, the phase angle is  $20^{\circ}$ , the dwell time  $167^{\circ}$ .

Noise level is extremely low: in experimental operations, in an amplifier having 5kc response, the zero offset was less than  $10\mu\text{v}$ . In direct noise measurements with a 200kc bandwidth amplifier, the noise at 1 megohm impedance was about  $50\mu\text{v}$  rms, or about  $150\mu\text{v}$  peak-to-peak. Life tests on recording equipment showed life considerably in excess of 1000 hr. Airpax Products Co., Dept. ED, Middle River, Baltimore 20, Md.

CIRCLE ED-173 ON READER-SERVICE CARD FOR MORE INFORMATION

## VTVM Meter

### Directly Measures Complex Waveforms



This VTVM, the Model 107, is a compact instrument that directly measures capacity, resistance and complex waveforms, peak-to-peak. To facilitate easier, more accurate readings, an expanded scale with clear plastic cover has been incorporated. The meter will not burn out.

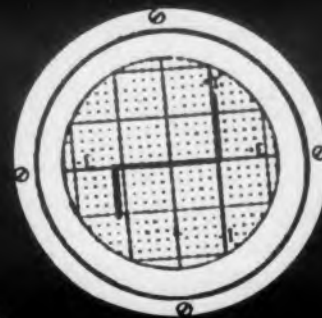
The VTVM measures capacity from 50mmfd to 5000mfd, inductance from 1.4h to 140,000h in 4 ranges; all peak-to-peak voltages of complex waveforms between 0.2v and 2800v, in 6 ranges, rms values of sine wave voltages between 0.1v and 1000v, resistance from 0.2 ohms to 1000 megohms. The supplied d-c probe has a 1 megohm isolating resistor.

The instrument uses an electronic balanced push-pull circuit, and peak-to-peak rectification 1% multipliers for voltage capacity and resistance measurements. Also incorporated is a zero center position for f-m discriminator alignment. The Model 107 is offered completed or in kit form. Electronic Measurements Corp., Dept. ED, 280 Lafayette St., New York, N. Y.

CIRCLE ED-174 ON READER-SERVICE CARD FOR MORE INFORMATION  
ELECTRONIC DESIGN • October 1954

# SILICONDUCTORS\*

TRADE-MARK



## \*SINGLE CRYSTAL SILICON JUNCTION DIODES

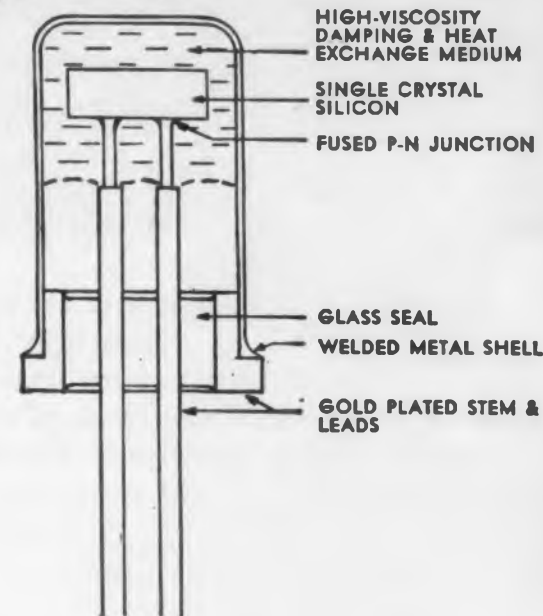
BROAD RANGE  
IN137A & IN138A

NARROW RANGE  
A5B and  
IN200 TO IN215  
17 TYPES IN  $\pm 10\%$   
VOLTAGE RANGES  
FROM 3 TO 180 VOLTS

AS

ZENER DIODES  
VOLTAGE REGULATORS  
HIGH BACK IMPEDANCE RECTIFIERS

AVAILABLE AS  
MATCHED PAIRS & QUADS  
CLOSE TOLERANCE ZENER VOLTAGE



IN PRODUCTION QUANTITIES FOR IMMEDIATE DELIVERY

LICENSED BY WESTERN ELECTRIC CO., INC.

## NATIONAL SEMICONDUCTOR PRODUCTS

DIVISION OF NATIONAL FABRICATED PRODUCTS, INC.

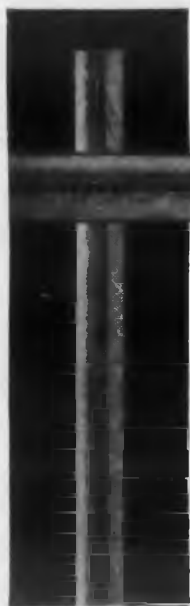
930 PITNER AVENUE

DAvis 8-0800

EVANSTON, ILLINOIS

CIRCLE ED-175 ON READER-SERVICE CARD FOR MORE INFORMATION





Introducing . . .

**NEW**



## CONSTANT-TORQUE SPIRAL TUBING Grade 5

Available in lengths up to 14" to take .248" to .250" core, 28 threads per 1".

Here is the most recent C-D-F development in kraft paper, spirally wound tubing for coil forms using threaded iron tuning cores. After the tuning core is inserted and finally adjusted, the same stable torque rating is maintained at all times—regardless of the number of adjustments. Exact threading (every thread) features 3-point contact with core, preventing binding and permitting positive tuning and re-tuning. There is no breakthrough of outer surface due to weak spots. Cement leakage through wall of tube to the tuning core is prevented. Constant torque tubing, and standard tubing (every other thread), are custom-fabricated in C-D-F plants to meet a variety of requirements as to shape, torque, etc.

See our general catalog in Sweet's Design File for more data, the address and telephone number of your nearest C-D-F sales engineer. Also, write for 8-page Technical Folder ST-53 which describes all grades of C-D-F Spiral Tubing, free test samples, or send us your print for quotation.



### Continental-Diamond Fibre

CONTINENTAL-DIAMOND FIBRE COMPANY • NEWARK 107, DELAWARE

CIRCLE ED-195 ON READER-SERVICE CARD FOR MORE INFORMATION



## Complete Data on Magnet Wire

G-E booklet

contains magnet wire selection data and complete information on insulation types, shapes, sizes and weights, and operating conditions.

Here are all the details you need to select General Electric magnet wire—both Formex\* (with space-saving, film-type Class A insulation) and Deltabeston\* (with glass or asbestos Class B insulation for high-temperature work). This 32-page booklet describes electrical and physical properties with tables and charts for easy reference.

Write for your free copy of "General Electric Magnet Wire." Section W107-1020, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

\*Registered Trade-mark General Electric Company

Progress Is Our Most Important Product

# GENERAL ELECTRIC

CIRCLE ED-196 ON READER-SERVICE CARD FOR MORE INFORMATION

76

## New Products . . .

### X-Y Recorder

With Sensitivity of 1/2mv/inch



The "Autograf" Model 2 X-Y Recorder is for use with 11" x 16-1/2" standard graph papers. Designed for desk or table top use, it is made with a flat-bed pa-

per table so that curves are available for observation and labeling while they are being drawn.

Available attachments make the instrument versatile for data handling and computer applications. It may be equipped with curve follower attachment, or modified for digital point plotting. Additional equipment, such as keyboards, and card and tape readers are available. F. L. Moseley Co., Dept. ED, 409 N. Fair Oaks Ave., Pasadena 3, Calif.

CIRCLE ED-197 ON READER-SERVICE CARD FOR MORE INFORMATION

### Pulse Transformer Kit

Contains 10 Hypersil Core Units



Plug-in Pulse Transformer Kit No. 2 contains 10 plug-in hypersil core transformers to fit a standard 7-pin miniature tube socket. The function of the kit is to enable circuit designers to quickly plug in a variety of

transformers to determine the final type needed.

The 10 transformers cover a pulse width range from 0.1sec to 23sec, using five two-winding transformers and five three-winding transformers. The kit is extremely flexible, in that by varying cathode resistance and circuit bias, large variations in pulse width can be achieved. Also, step-up and step-down ratios can be had by connecting two windings of a three-winding transformer in series.

Hypersil cores make the transformers especially valuable for blocking oscillator circuits, impedance matching and phase inversion, linear oscillators, wide band input and output transformers. Each transformer is 1" high x 5/8" OD or 11/16" OD. All hermetically-sealed, they are designed to meet MIL-T-27 specifications. PCA Electronics, Inc., Dept. ED, 2180 Colorado Ave., Santa Monica, Calif.

CIRCLE ED-198 ON READER-SERVICE CARD FOR MORE INFORMATION



Miniature,

### Hermetically Sealed, Aircraft Type Relays

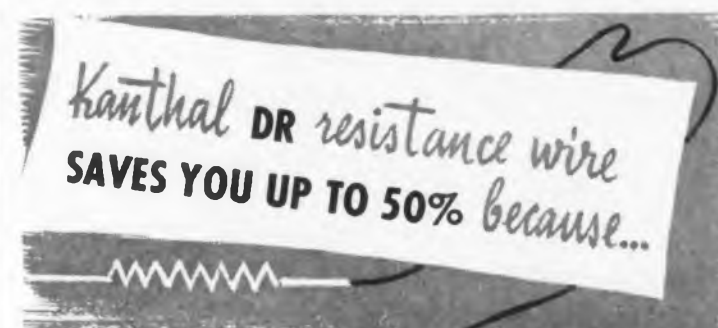
Have a New, Wider Range of Performance Characteristics

If you need a small, light 4 PTD or DPDT relay to operate consistently under extremely critical or downright adverse conditions, chances are your requirements can be readily met by one of the multitude of variations possible with the basic "Diamond H" Series R relay. Originally designed to meet all requirements of USAF Spec. MIL-R-5757B, they far surpass many. For example: Various brackets of vibration resistance from 10 to 2,000 cps, plus temperature ranges from -55° to +200° C., coil resistances from 1 to 50,000 ohms, contact capacities from 350 V., D.C., 400 MA, to 10 A. at 30 V., D.C. (20 A. for reduced life). Also reliable in signal circuits. Operating time (24 V. models) 10 ms. or less; dropout less than 3 ms. Dielectric strength 450 to 1,250 V., RMS. Insulation resistance 1,000 megohms at room temperature (100 at 200° C.). Operational shock resistance 30, 40 or over 50 "G". Mechanical shock resistance to 1,000 "G". Single or two independent coils, either or both of which will operate unit. All standard mounting arrangements.

Call on "Diamond H" engineers to work with you in developing a variation to meet your specific needs.

**THE HART MANUFACTURING COMPANY**  
210 Bartholomew Ave., Hartford, Conn.

CIRCLE ED-199 ON READER-SERVICE CARD FOR MORE INFORMATION



. . . it is lighter in weight (more feet per pound), and the per pound price is low. Total savings approximately 50%.

. . . Kanthal DR improves the performance of resistors and precision equipment. Its electrical resistivity is high — 812 ohms per circular mil foot — its temperature coefficient is low ( $\pm 0.00002^{\circ}\text{C}$  between -50° and +150°C), and it has a low thermal EMF to copper.

Available in fine gages and all types of insulation.

WRITE FOR FURTHER INFORMATION AND PRICES TODAY

**KANTHAL THE KANTHAL CORPORATION**  
8 AMELIA PLACE, STAMFORD, CONN.

CIRCLE ED-200 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954



Every User  
of  
**SOLDERING  
LUGS  
•  
TERMINALS  
•  
SMALL  
STAMPINGS**



### CAN PROFIT through MALCO'S Low Cost, Quantity Production

We manufacture a complete line of standard and custom-made solder and solderless lugs, terminals, corona rings, and small stampings for radio, television, industrial and military electrical/electronic use.

Precision tooling and rigid quality control insures tolerances to your most critical specifications. High production techniques, plus over 1000 different standard parts permit prompt delivery at lowest possible unit cost.

Let us know your requirements.  
Request our new 38-page  
convenient reference catalog.



**Malco TOOL and MANUFACTURING CO.**  
4027 W. LAKE ST., CHICAGO 24, ILLINOIS

CIRCLE ED-201 ON READER-SERVICE CARD FOR MORE INFORMATION

## MARKEM MACHINES

Solve "IN-PLANT"  
PRINTING PROBLEMS

- FASTER - NEATER - AT LOWER COST

The Markem Model 45AF Machine prints trade name, trade mark, specifications, etc., on resistors, condensers, capacitors, diodes, triodes, transistors, etc., at production rates. Feeds, prints, and ejects automatically. Quickly insertable type provides easy change in data being printed.

Write for further information. Submit sample of item you wish to mark.

WIRE LEAD  
COMPONENT  
PRINTING



MODEL  
45AF



**MARKEM  
MACHINE CO.**  
KEENE 19,  
NEW HAMPSHIRE

CIRCLE ED-202 ON READER-SERVICE CARD FOR MORE INFORMATION  
ELECTRONIC DESIGN • October 1954

### D-C Converters Produce Phase Reversing A-C



This standard line of "Micromag" low-level d-c converters produces a phase-reversing sinusoidal voltage in response to a polarity reversing d-c input voltage. Utilizing no vacuum

tubes or no moving parts, these static magnetic converters are rugged and reliable, and exhibit a very constant conversion gain over a wide ambient temperature range. The line has two basic types.

The units find wide application in computers as summing amplifiers and as null detectors in self balancing potentiometer circuits. They are used in many other applications in the control and measurements field where conversion of low level d-c signals from sensing elements, such as strain gauges, thermocouples, photocells, etc., is required. The magnetic converter can be used in place of a mechanical chopper in numerous applications.

Excitation voltage required by "Micromag" converters is 6.3v, and with excitation frequency of 400cy, the excitation current is less than 0.5ma. They are hermetically sealed in a deep-drawn steel can with a phenolic header. The Model MH-1, weighs 2 oz and had dimensions of 7/8" x 1-1/16" x 1-1/4". Magnetic Research Corp., Dept. ED, 318 Kansas St., El Segundo, Calif.

CIRCLE ED-203 ON READER-SERVICE CARD FOR MORE INFORMATION

### Analyzer-Simulator

For Transconductance and Other Studies

The Transconductance Analyzer and Circuit Simulator, Model 901, can measure transconductance under all kinds of operating voltages. It can also reproduce any type of static or dynamic tube characteristic.

Means are available on the instrument for connecting components to simulate the circuitry in which the tube will operate. Simple pushbutton switching applies the appropriate voltages to each tube element from a highly regulated power supply. The instrument is entirely self contained. New London Instrument Co., Dept. ED, P. O. Box 189, New London, Conn.



CIRCLE ED-204 ON READER-SERVICE CARD FOR MORE INFORMATION



- ① Glass-hermetically sealed sub-miniature paper tubulars. Manufactured to the highest commercial standards and engineered to the exacting performance requirements of Military Specification MIL-C-25-A.
- ② Oil paper capacitors of finest possible commercial quality, meeting MIL-C-25A and Jan-C-25 standards of precision.
- ③ Electrolytics of superior commercial performance characteristics, meeting Jan-C-62.

Write for Catalog J-8 for further detailed information.  
Or call your local Pyramid Sales Representative or write to:

**PYRAMID ELECTRIC COMPANY**  
Dept. 123, 1445 North Hudson Blvd., North Bergen, New Jersey

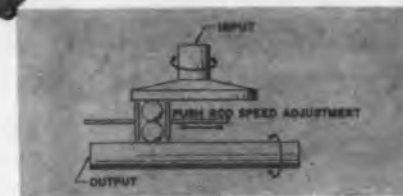
CIRCLE ED-205 ON READER-SERVICE CARD FOR MORE INFORMATION

## NEW BALL & DISK SPEED CHANGER



High Precision  
Variable Speed  
Device

- Reversible
- Stepless
- Precise
- Compact



Moving parts are of hardened alloy steel. Light in weight, long life, great accuracy and reasonable cost. A comparatively low torque speed changer for generating reversible speeds in a smooth and stepless fashion from forward to zero to full reverse.

Size: Width 2-1/8" Length 2-3/4"  
Height 3-11/16" Weight 17 oz.  
\$90.00 F.O.B. Stamford.  
Quantity Discounts.

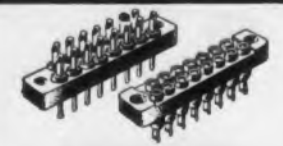
Used as INTEGRATORS for analog computers, servo mechanisms and similar devices requiring smooth and high precision speed control.

**TRC THE REFLECTONE CORPORATION**  
639 W. Main Street  
Stamford, Connecticut

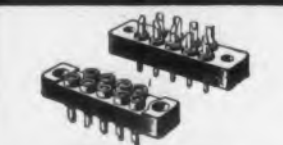
CIRCLE ED-206 ON READER-SERVICE CARD FOR MORE INFORMATION



SERIES "E-Z 16" EASY RELEASE



SERIES "16" POWER



SERIES "14" POWER

new...  
precision

## Continental Connectors\*

simplify your connector problems

### 34 CONTACT SERIES "20"

with polarizing screwlock  
guide pins and sockets

Hoods with either top  
(illustrated) or side cable opening  
available for most models



SERIES "20" MINIATURE



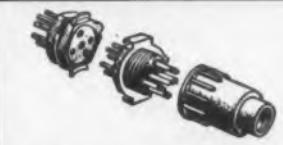
SERIES "SM-20" SUBMINIATURE



SERIES "P-C" PRINTED CIRCUIT



SERIES "H-20" HERMETIC SEAL



SERIES "C-20" HEXAGONAL

### Series "20" Miniature

with POLARIZING SCREWLOCK (PAT. PEND.)

Polarizing screwlock guide pins and sockets provide this connector with positive means of locking plug and receptacle against vibration or accidental disconnection. Connector is easily opened without prying or forcing. Available in 14 different contact arrangements for 7 to 104 circuits, and in choice of Melamine, Plaskon-Alkyd and Diallyl Phthalate insulating materials. All models can be ordered with aluminum hood (as illustrated).

Note: New series "14" power connectors also available with polarizing screwlock.

For complete illustrated engineering literature, and assistance on special or unusual connector problems, write Dept. ED, DeJUR-Amsco Corporation, 45-01 Northern Blvd., Long Island City 1, N. Y.

Electronic  
Sales  
Division  
**DeJUR**

45-01 NORTHERN BLVD., LONG ISLAND CITY 1, N. Y.  
\*World's largest manufacturers of miniature precision connectors.

CIRCLE ED-176 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products . . .

### Pressure Transducer

Has 50 $\mu$ sec Rise Time



The Model S-3 Pressure Transducer is suitable for use with a wide variety of recording and telemetering systems. When the gage is connected in a bridge circuit, the output signal will be proportional to the input pressure.

Operating on the variable reluctance principle, the unit

is especially suited for transient and high-frequency measurements. Because of its small size, low temperature shifts, and small hysteresis, the transducer has advantages for many static and slow response applications. An unusual feature of the unit is its ability to withstand pressure overloads in excess of 2000% without zero shift.

The unit has a 50 $\mu$ sec rise time, less than 1% non-linearity, 0.1 to 0.4% hysteresis, and 0.01% per degree F zero shift with temperature. It weighs 2 oz and is 3/4" x 3/4" x 1-1/16" in size. Ultradyn Engineering Laboratories, Inc., Dept. ED, P. O. Box 8007, Albuquerque, N. Mexico.

CIRCLE ED-177 ON READER-SERVICE CARD FOR MORE INFORMATION

### Power Supply

For Mobile Transmitters



This mobile transmitter power supply, "RODIC" Type RO-2, converts low d-c voltages to those levels required in mobile and marine transmitter operation. Engineered

for completely automatic operation, it has such features as: 75% efficiency, 5% to 8% regulation and low starting current with no surge whatever.

A rugged, compact unit, it is designed for instant starting and stopping, long operating life, and ease of maintenance. Operating from a 6v battery, the supply has two filtered outputs available: 520v at 320ma, or 330v at 320ma. Tech Laboratories, Inc., Dept. ED, 50 E. Edsall Blvd., Palisades Park, N. J.

CIRCLE ED-178 ON READER-SERVICE CARD FOR MORE INFORMATION



### Veco Thermistors also are sensitive to temperature!

These versatile sensing elements are resistors with a high negative temperature coefficient of resistance — temperature goes up — resistance goes down. This characteristic makes thermistors useful components in electronic circuits as temperature compensators, surge suppressors, voltage regulators, automatic gain controls, etc.

They are used also as sensing elements in high speed thermometry and temperature control for which they are available in a multiplicity of forms such as small beads, rods, discs, washers, glass, plastic or metal probes, or even embedded in the tips of hypodermic needles! Because of their extremely small size, they assist in miniaturization.

Victory is the important name to remember in thermistors. This company has done most to perfect the materials and employ precise quality control in their manufacture. You can depend on "VECO" thermistors for absolute uniformity and efficiency.

To find out how "VECO" thermistors can improve your products, write for free information. New M-168 kit of 6 thermistors and 1 varistor with suggested circuitry. \$5.00 postpaid, or available at electronics parts wholesalers.

### Victory Engineering Corporation

102 Iorio Court, Union, New Jersey  
Tel. UNionville 2-7150



CIRCLE ED-179 ON READER-SERVICE CARD





It means that you can now specify a 3 pole double throw 400 cycle A.C. Aircraft Relay without THE USE OF A RECTIFIER.

It also means the relay is hermetically sealed, Stratopaxed and equipped with Uniterms.

It further means that it weighs only 14 ounces,—its cubical displacement is 10 cubic inches—contact rating 10 amperes, up to 208 volts, 400 ~, inductive, resistive or motor load. • Qualification tested by Inland Testing Laboratories to MIL-R-6742.

Diaphlex also engineers and manufactures low current 400 ~ Relays ideally suited for electronic circuitry.

*We invite your inquiry.*

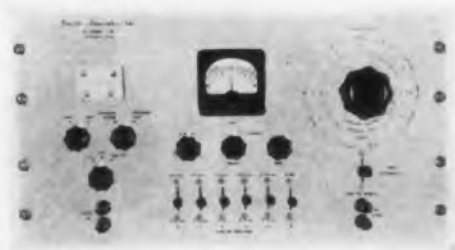
## Cook Electric Company

Established 1897

2700 Southport, Chicago 14, Illinois  
 Diaphlex—Aircraft Components and Accessories • Wirecom—Wire Communications, Protection & Distribution Apparatus • Magnilastic—Expansion Joints, Heavy Industry Equipment, and Airframe Structures • Cook Research Laboratories—8100 Monticello Avenue, Skokie, Illinois • Inland Testing Laboratories—1457 Divensey Parkway, Chicago 14, Illinois • Electronic Systems Division—2533 N. Ashland Avenue, Chicago 14, Illinois • Subsidiary: Canadian Diaphlex Limited—Aircraft Components and Accessories, Toronto, Ontario, Canada • Plymold Division—3415 Belmont Avenue, Chicago 18, Illinois.

CIRCLE ED-180 ON READER-SERVICE CARD

## Transistor Test Set Measures Over 100cy to 1Mc Range



The Model GP 1 Transistor Test Set features dependable, direct measurement of transistor characteristics at any frequency from

100cy to 1Mc. NPN and PNP type transistors may be tested in either grounded-base or grounded-emitter configuration. Coefficients are read directly and include Hybrid, Equivalent "T", and "Black Box" parameters, alpha cut-off, collector capacitance and  $I_{co}$ , as well as current gain and voltage feedback ratio.

The test set is used in conjunction with an external oscillator and vacuum-tube voltmeter of types commonly encountered in electronic laboratories. Provision is made for measuring phase angle as well as magnitude of the hybrid coefficients, thus permitting accurate design of a-f, i-f, and r-f circuits. Baird Associates, Inc., Dept. ED, 33 University Rd., Cambridge 38, Mass.

CIRCLE ED-181 ON READER-SERVICE CARD FOR MORE INFORMATION

## Calorimetric Wattmeter Wide Band, Wide Range Unit



Model L-20, a calorimetric wattmeter, gives fast, better than 5% accurate power measurements from 10mw to 10w. It is a compact, portable instrument for simplified power measurements over the whole frequency range from d-c to 10kMc.

Input vswr is less than 1.1 full range, and response time is less than 1 minute at 10mw, or 5sec at 10w. True average power is indicated, regardless of the type of modulation.

The instrument employs the basic calorimetric principal, yet is completely self-contained. No auxiliary equipment or water connections are required. It is specifically designed for portability, and may be used wherever 110v a-c power is available.

Features include a Type "N" input connector mounted on a toggle so that connections may be made from the front or side of the instrument case. The instrument employs a constant-speed motor, driving a pump of positive displacement type. Oil used is a silicone product of high mechanical and electrical stability. Alto Scientific Co., Dept. ED, 3404 Cowper St., Palto Alto, Calif.

CIRCLE ED-182 ON READER-SERVICE CARD FOR MORE INFORMATION

a UNIQUE application . . . of a NEW principle  
 for a BETTER instrument

# Doelcam

## D-C Indicating Amplifier



Type 2HLA-3

Write for Bulletin 1A-10

- ▶ **High Stability**  
Less than 10 microvolts long term drift
- ▶ **Wide Dynamic Response**  
Flat from 0 to greater than 20 cps
- ▶ **Magnetic Input**  
Second-Harmonic Magnetic Converter for input stage
- Linearity within 1 %
- High input impedance
- Zero-center meter
- Will drive recorders

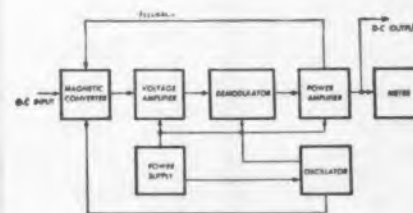
THE DOELCAM D-C Indicating Amplifier is a completely self-contained instrument for the amplification and measurement of d-c voltages and currents of minute magnitude. A new design concept employing the remarkable sensitivity and inherent stability of the second harmonic magnetic converter is used in the input stage of the amplifier. This design feature, by eliminating all moving parts such

as mechanical choppers, makes this instrument ideally suited for applications where accuracy, reliability and insensitivity to changing ambient conditions are of prime importance.

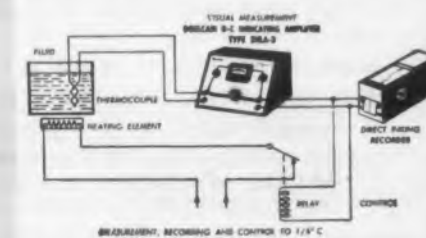
### Doelcam CORPORATION

SOLDIERS FIELD ROAD, BOSTON 35, MASS.  
 West Coast Office: 304 Tejon Pl., Palos Verdes, Calif.

Instruments for Measurement and Control  
 Synchros • Gyros • Servos • Microsyns • Servo Motors



MAGNETIC INPUT . . . Block Diagram showing DOELCAM Second Harmonic Magnetic Converter as input stage . . . a new design concept



MEASUREMENT - RECORDING - CONTROL to 1/5° C. A typical Process Control application showing high accuracy of DOELCAM Type 2HLA-3

CIRCLE ED-183 ON READER-SERVICE CARD FOR MORE INFORMATION



## ANOTHER NEW FAIRCHILD POTENTIOMETER



**TYPE 741  
1-1/8" LINEAR**

You can gang up to five cups on a single shaft without increasing the 1 1/8" over-all diameter of the Type 741 because of its internal clamp ring construction. Phasing is easy and accurate too. Available in a resistance range of 500 to 25,000 ohms, this new potentiometer has a standard linearity of  $\pm 0.5\%$ . A one-piece palladium-silver alloy wiper and simplified slip ring construction give longer life with low noise and high resolution. Welded taps, and a newly-designed radial-type terminal board with gold-plated terminals, are other features.

### SAMPLES AVAILABLE ON ORDER

The Type 741 is another reason why Fairchild can help you solve all your precision potentiometer problems. For more information, write Fairchild Camera & Instrument Corp., Potentiometer Division, 225 Park Avenue, Hicksville, L. I., N. Y., Department 140-47N1.

**FAIRCHILD**  
PRECISION POTENTIOMETERS

CIRCLE ED-208 ON READER-SERVICE CARD FOR MORE INFORMATION

## Special Purpose WIRE

**BERYLLIUM  
COPPER**  
Silvercote ®

titanium

phosphor bronze

ALUMINUM

### OTHER NON-FERROUS

Consider WIRE and the importance of its function in your product. Whether a highly engineered application or a simple stapling purpose, your choice of the proper alloy or composition, temper and type of wire could mean success or failure during crucial test.

round • flat — square ■ half-round ▲

Precision gauges from 1/8 to .002. Close tolerances hold.

**SPRING WIRE — WIRE FOR INSTRUMENTS  
ELECTRONICS — STRAND FOR WIRE ROPE AND  
BRAIDED APPLICATIONS — MANDREL WIRE  
WIRE FOR FORMS — RIVETS — STAPLING**

Send for descriptive folder.



**LITTLE FALLS ALLOYS**  
INCORPORATED  
195 Caldwell Avenue • Paterson 1, N. J.

CIRCLE ED-209 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products . . .

### Germanium Junction Diodes Provide High Forward Conductance



The Types CK-741, CK745, and CK747 germanium junction diodes are designed to provide high forward conductances (up to 300-ma at 1v), high reverse resist-

ances, exceptional electrical and mechanical stability, and freedom from hysteresis, drift and flutter. The CK741 and CK747, which have very low forward impedance and high ratios of reverse to forward resistance, are useful for computer and similar applications. The CK745 is rated for a peak inverse voltage of 125v. Raytheon Manufacturing Co., Dept. ED, 55 Chapel St., Newton, Mass.

CIRCLE ED-210 ON READER'S SERVICE CARD FOR MORE DATA

### Relays

#### In Special Purpose Designs



Designated Part No. 8-4C, these miniature, telephone-type relays are for all forms of communication applications as well as electronic control circuits, computers, and other

types of instrumentation and controls. Designed to insure positive, long-life operation, they have extremely low friction loss and withstand extreme vibration at minimum power consumption.

Contacts are made of palladium (standard). Various contact arrangements up to a maximum of 4pdt, 6pdt, or 2d (make-before-break) can be obtained by combinations of basic types. Available ratings are 3amp, 32v d-c resistive; 3amp, 115v, a-c, non-inductive.

Coils (d-c only) are up to 8000 ohms; nominal, 2.8w, maximum, 3.85w. Maximum sensitivity is 90mw for spdt; 750mw for 4pdt.

The relays withstand 10g at 55cy vibration, and 25g shock. Weight is 2.25 oz. Dimensions are 1-7/16" x 1-11/32" x 15/16". Leach Relay Co., Dept. ED, 5915 Avalon Blvd., Los Angeles 3, Calif.

CIRCLE ED-211 ON READER'S SERVICE CARD FOR MORE DATA

## Read TORQUE like you read the TIME



## WATERS TORQUE WATCH

**New** — two pocket-sized torque meters  
**Easy To Read** — linear scale on a one-inch watch face  
**Compact** — 1 1/8 in. diameter and 3 7/16 in. long  
**Versatile** — reads starting and moving torque  
**Wide Range** — 0.010 to 2 inch-ounces or 1.0 to 20 inch-ounces  
**Accurate** — repeat accuracy of 5% over a rotation of 300 degrees  
**Flexible** — Jacobs chuck fits shafts up to 1/4 in. diameter  
**Stop guessing** — Read torque accurately on potentiometers, servo mechanisms, variable condensers, spring mechanisms.

Model 6000-1 0.010 to 1.2 inch-ounces  
Model 6000-2 1.0 to 20 inch-ounces



**WATERS MANUFACTURING, inc.**  
Waltham 54, Massachusetts

APPLICATION ENGINEERING OFFICES IN PRINCIPAL CITIES

CIRCLE ED-133 ON READER-SERVICE CARD FOR MORE INFORMATION

**For ANY speed...**

**use Metron MINIATURE VARIABLE SPEED DRIVES**

Variable speed drives give you variable speeds from 1-5 increase through 1-1, to 5-1 decrease! Just move the lever to the desired speed ratio and the miniature variable instantly produces the speed you want!

- Speeds up to 10,000 Rev/minute or down to 1/4 Rev/day
- Small — to fit into your product
- Permanently lubricated
- Your choice of 6 controls
- Output up to .025 HP

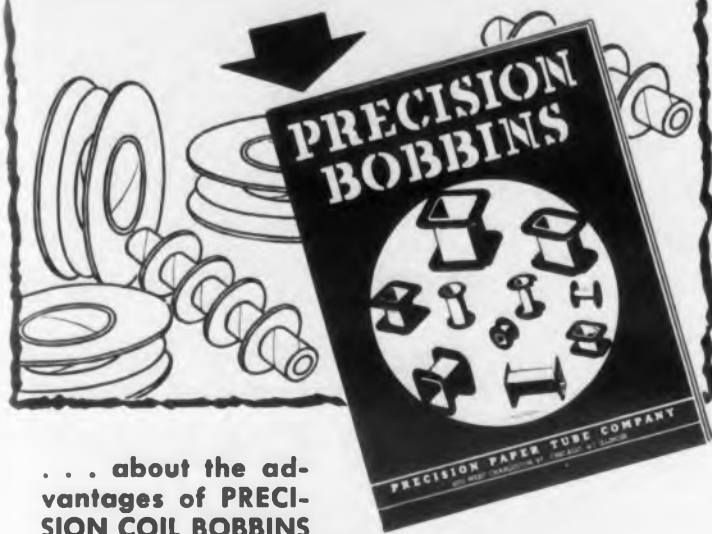
\*representative speeds only

**for details write for Bulletin No. 99**

**Metron INSTRUMENT CO.**  
450 Lincoln St., Denver 3, Colorado  
DISTRICT OFFICES • NEW YORK • CHICAGO • LOS ANGELES

CIRCLE ED-160 ON READER-SERVICE CARD FOR MORE INFORMATION

# Get the facts...



... about the advantages of PRECISION COIL BOBBINS

... about what goes into them to make them better—the research, the materials, the precision workmanship. Learn these facts to improve your coils.

Send for your copy of this informative PRECISION BOBBIN bulletin . . . write today!

## PRECISION PAPER TUBE CO.

2055 West Charleston Street, Chicago 47, Illinois  
Plant No. 2: 79 Chapel St., Hartford, Conn.  
Also Mfrs. of Precision Paper Tubes

CIRCLE ED-214 ON READER-SERVICE CARD FOR MORE INFORMATION



**NEVER BEFORE!** A SWITCH SO SMALL  
SO LIGHT (6½ oz.) • SO LOW PRICED  
**AS LINEMASTER COMPACT**  
FOOT SWITCH

Write for folder and prices NOW.

Let us quote on your special switch requirements.

Our brand new Linemaster "COMPACT" combines unbelievable low price with the finest, most efficient design now available. It's small and light for maximum adaptability. The absolutely fool-proof actuating mechanism has amazing sensitivity which permits versatile operation by foot, finger, knee or elbow. Ruggedly constructed of long lasting heavy gauge steel, featuring a handsome black crackle finish and non-skid base, "COMPACT" switch has thousands of potential profit-making industrial applications.

### LINEMASTER SWITCH CORP.

130 Putnam Road • Woodstock, Connecticut

CIRCLE ED-215 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954

## Transducer

### Pressure-to-Frequency Type



Incorporating an f-m oscillator and a variable inductance pressure pickup, the Series P300 Pressure-To-Frequency Transducer can be supplied

in differential or gage types for measuring pressure in non-corrosive liquids or gasses. Applied pressure is changed to proportional frequency within the transducer and is supplied at constant amplitude across the output terminals.

These transducers are designed primarily for use with standard RDB f-m/f-m telemetering systems, but are convenient for use in the laboratory. The units are furnished in pressure ranges from  $\pm 3$ psi to  $\pm 100$ psi. Center frequencies from 1kc to 80kc are offered. Sensitivity change with temperature is less than 0.02% per degree F., and zero drift is less than 0.02% of bandwidth per degree F. The units have a high natural resonant frequency. Their dimensions are 3-1/8" long x 1-1/2" diam, and they weigh 6-1/2 oz. Datran Engineering Corp., Dept. ED, 6312 W. 92nd St., Los Angeles 45, Calif.

CIRCLE ED-216 ON READER-SERVICE CARD FOR MORE INFORMATION

## NEW! PORTABLE DIRECT READING SPECTRUM ANALYZER

- 10 to 22,000 MCS
- Only 3 R.F. Heads
- Single Dial Tuning



Now, a spectrum analyzer only 21 inches high that covers the entire frequency range 10 to 22,000 mcs with but 3 interchangeable R-F tuning heads.

These exclusive Polarad design and operating features provide highest accuracy and reliability, and save engineering manhours: single frequency control with direct reading dial; no klystron modes to set; tuning dial accuracy 1%... easy to read 5 inch CRT display... swept IF provides 250 kc to 25 mc display independent of R-F frequency setting... Klystron is temperature compensated... internal R-F attenuator provided... frequency marker measures differences from 100 kc to 25 mc.

Write today to your nearest Polarad representative or inquire directly to the factory for complete information.



### ELECTRONICS CORPORATION

100 METROPOLITAN AVENUE, BROOKLYN 11, NEW YORK

CIRCLE ED-217 ON READER-SERVICE CARD FOR MORE INFORMATION

## Linde synthetic sapphire

... for excellent optical transmission

**PLUS** physical strength and chemical inertness

Sapphire is hard, strong, chemically inert and transmits a high percentage of radiation in the important ultra-violet and infra-red regions. At 1750A forty per cent of the radiation is transmitted by a .059 inch section; at 5.7 microns forty per cent is transmitted by a .100 inch section. This unique combination of properties makes it ideal for optical systems that require resistance to abrasion and corrosion and high temperature strength as well as excellent optical transmission.

Now single-crystal sapphire windows are available in diameters up to 2 inches in several finishes. For further information, call or write your nearest LINDE office.

### LINDE AIR PRODUCTS COMPANY

A DIVISION OF UNION CARBIDE AND CARBON CORPORATION  
30 East 42nd Street, New York 17, N. Y. **UCC** Offices in Other Principal Cities

In Canada: DOMINION OXYGEN COMPANY  
Division of Union Carbide Canada Limited, Toronto

"Linde" is a registered trade-mark of Union Carbide and Carbon Corporation.

CIRCLE ED-218 ON READER-SERVICE CARD FOR MORE INFORMATION



## Get This Informative Free Booklet on New Uses for Straits Tin

New, 20-page booklet tells important story of Straits Tin and its many new uses today. Fully illustrated. Includes sections on new tin alloys, new tin solders, new tin chemicals. Covers tin resources and supply, Malayan mining. Booklet is factual, informative—could well prove profitable to you. Mail coupon now.

### THE MALAYAN TIN BUREAU

Dept. C, 1028 Connecticut Ave., Washington 6, D.C.

Please send me a copy of your free booklet on new uses for Straits Tin.

Name \_\_\_\_\_  
Firm Name \_\_\_\_\_  
Street \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

CIRCLE ED-219 ON READER-SERVICE CARD FOR MORE INFORMATION

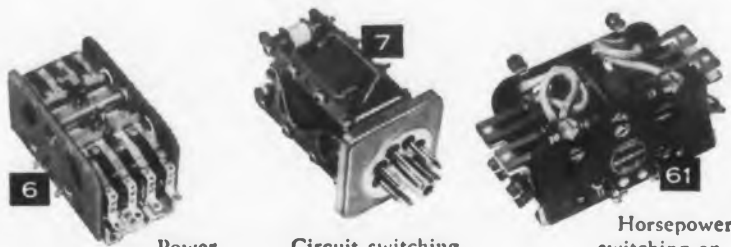


## POLARIZED SENSITIVE RELAYS

We have been making polarized relays for a number of years and at the present time find, to our own surprise, that we have seven basic types in production, ready for production, or in the prototype stage. We have analyzed their relative usefulness for our own information. The condensed result may be of interest.

First, as to polarized relays in general, a word or two. All of them respond according to polarity of a direct current applied to their coils, or "follow" (if they can) an alternating current. All of them can be wound with two separate coils, responding to the magnitude and polarity of the difference between the two (opposed) coil currents.

Depending on arrangements, some "latch" or "remember", occupying either of two switch positions indefinitely until a new pulse of opposite polarity is received in the windings (our "Form Z"). If to this type, spring bias is added so it will remain in only one of the two positions unless current of proper polarity is applied to oppose the spring, it is called "biased polar" (our "Form Y"). Finally, if some rather involved centering mechanisms are added, it will stay in neither position without coil signal but occupies one midway between. Of course, a simple stiff spring would do this but in an undesirable way. (Treatise available.) The result is a "3-position" or "null-seeking" relay (our "Form X").



**6**  
Power switching on inputs from 8 to 450 milliwatts.

**7**  
Circuit switching on inputs of 1 to 15 milliwatts. Pulse repeating, light duty telegraphy.

**61**  
Horsepower switching on inputs of 200 to 450 milliwatts. Exceptional latching contactor.

SWITCH RATING*	2 TO 5 AMP.	.06 AMP. (2.0 AMP.)	20 AMP.
MAX. SWITCH COMB.	4P2T	5PDT	2P2T
FORMS AVAILABLE (SEE TEXT)	X, Y, Z	X, Y, Z	Z, LATCHING
RATED LIFE, NO. OF OPERATIONS*	100,000	100,000,000 (100,000)	100,000
VIBRATION IMMUNITY	10 G TO 55 CPS	10 G TO 55 CPS	30 G TO 55 CPS



**23**  
12 milliwatts, 2 pole, 3-position, plug-in with improved thermal stability.

**72**  
Highly developed pulse repeater for telegraphy and data handling up to 400 bauds/sec.

**73**  
Small and military. 6 to 90 milliwatts.

**75**  
Cheap, commercial and rugged.

SWITCH RATING*	2 AMP.	.06 AMP. (0.5 AMP.)	1.5 AMP.	1 AMP.
MAX. SWITCH POLES	2P2T	5PDT	5PDT	2P2T
FORMS AVAILABLE (SEE TEXT)	X (Z)	Z, Y	X, Y, Z	Y, Z
RATED LIFE, NO. OF OPERATIONS*	100,000	500,000,000 (100,000)	100,000	100,000
VIBRATION IMMUNITY	10 G TO 55 CPS	15 G TO 500 CPS AT HIGHEST SENSITIVITY.	30 G TO 500 CPS	NOT YET RATED.

\*Switch rating and life rating are both conservative and arbitrary, rated current at 110V AC (resistive load) can be switched for rated number of operations without failure, however.

# SIGMA

SIGMA INSTRUMENTS, INC.  
91 PEARL STREET, SO. BRAintree, BOSTON 85, MASS.

CIRCLE ED-221 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products . . .

### Magnetic Counter Additive or Subtractive



Additive or subtractive, this precision counter is adaptable to many industrial and experimental needs. It is available with three or four digits, with manually reset counter

wheels, and will record to a maximum recommended speed of 1,200 counts per minute.

Weight of the counter mechanism is 2 oz; mounted in a die-cast, lacquer-finished case, it has a total weight of 5 oz. It measures 7/8" high and less than 2" deep. Actuated electro-magnetically, the counter can be connected in vacuum tube plate circuits or operated by any contacting device.

Because of a wide variety of possible mounting methods, units can be had with or without cases. A snap door on the front of the case allows convenient resetting. Counters can be wound to any voltage from 6-110v d-c. Abrams Instrument Corp., Dept. ED, 606 E. Shiawassee St., Lansing 1, Mich.

CIRCLE ED-222 ON READER-SERVICE CARD FOR MORE INFORMATION

### Wire-Wound Resistors Resist Shock and Vibration

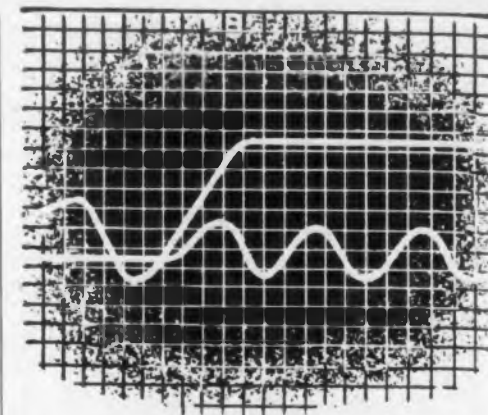


withstand severe shock and vibration.

By winding on steatite bobbins, dimensional stability is assured. By sealing in epoxy resin, they are protected against outside elements. They have, in many tests, withstood 30 humidity cycles of MIL-R-93A moisture resistance tests without deterioration. They also withstand temperature cycling in excess of MIL-R-93A requirements, and withstand the salt water test for Characteristic A in JAN-R-93.

The resistors are furnished with lug-type terminals or wire leads, in a complete line of standard, midsize, and sub-miniature sizes. A wide range of performance is available. Resistance Products Co., Dept. ED, 714 Race St., Harrisburg, Pa.

CIRCLE ED-223 ON READER-SERVICE CARD FOR MORE INFORMATION



EPSC

## EPIC FAST PULSE AND COUNTING EQUIPMENT



Proved Dependability In A  
Versatile Range Of Assemblies

**0.001 MICROSECOND RISE TIME SQUARE PULSE GENERATORS**  
for the millimicrosecond to microsecond range.

**0-10 MC DECADE AND BINARY SCALERS FULLY AUTOMATIC 0-10 MC NUCLEAR SCALERS** with predetermined count, predetermined time operation, precision high voltage power supplies, preamplifiers and discriminators.

- PLUG IN COUNTING STRIPS
- 0.1 MICROSECOND COUNTER CHRONOGRAPHS
- PRECISION DC HIGH VOLTAGE SUPPLIES
- WIDE BAND AMPLIFIERS

ALSO CUSTOM DESIGNED EQUIPMENT TO MEET YOUR INDIVIDUAL REQUIREMENTS!

Write for Bulletin No. 301

EPSC

**ELECTRICAL AND PHYSICAL INSTRUMENT CORPORATION**  
Engineering Division  
42-19 27th Street, Long Island City 1, N. Y.

CIRCLE ED-224 ON READER-SERVICE CARD



### Signal Generator Highly Stable V-H-F Unit



This v-h-f signal generator, Model 608D, offers residual f-m of less than 1kc, drift less than 0.005%, sensitivity measurements to 0.1v, and extremely high stability. It covers the frequency range 10-420Mc.

A directly set and read output of 0.1v to 0.5v is available throughout this range.

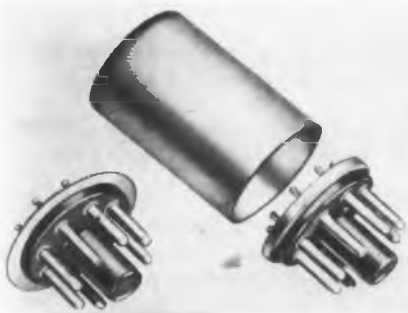
A built-in crystal calibrator provides a frequency check accurate within a few kilocycles every 5Mc through the range. The instrument provides flat response from 20cy to 1Mc, a-m modulation to 80%, and other forms of modulation including internal, external, external pulsed, and frequency modulation. Internal impedance is 50 ohm and vswr is a maximum of 1.2.

Mechanical features include new, lightweight aluminum castings, ball bearing condenser and turret drives, sealed transformers, militarized construction, and special electrically welded condensers of low-temperature-coefficient Invar steel plates.

In addition, this firm also offers a new general purpose instrument, Model 608C, providing 1v output and frequency coverage of 10-480Mc. Hewlett-Packard Co., Dept. ED, 395 Page Mill Rd., Palo Alto, Calif.

CIRCLE ED-225 ON READER-SERVICE CARD FOR MORE INFORMATION

### Hermetic Seal Terminals For Plug-In Applications



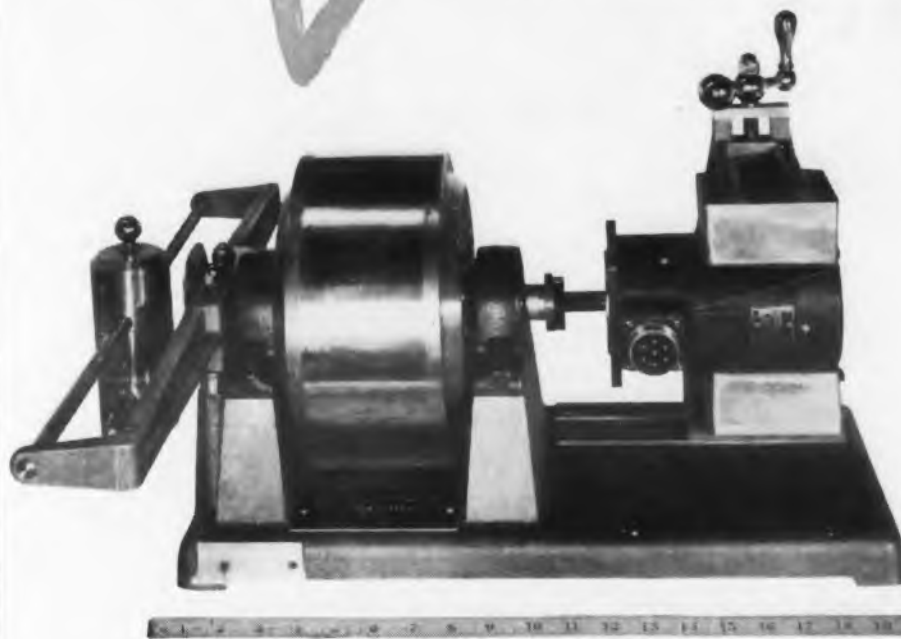
Type A-4098 Hermetic Seal Terminals are designed for plug-in applications. They are fitted with an octal plug that mates with a standard octal socket. These headers

meet MIL-T-27 requirements. They feature gold-alloy-plated, solid brass pins to promote easier soldering and prevent corrosion. They are available with either rolled or flat flanges. The rolled flange will fit either a 1" or 1-1/8" OD round can, also available from the firm. Triad Transformer Corp., Dept. ED, 4055 Redwood Ave., Venice, Calif.

CIRCLE ED-226 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954

## For specialized electronic equipment... check Western Gear



*Dyna-Chek*

provides tested

and proven accuracy in measuring  
the output of fractional and  
integral horsepower motors —

Model DM4 up to 1HP in continuous duty, and Model MDM for 1/10 HP or less. Manufactured by Mission-Western Engineers, Inc., Dyna-Chek provides a simple and convenient method of motor testing. Two types of broad range speed measuring equipment available as extra accessories, both supplying a high degree of accuracy. For information, address Mission-Western Engineers, Inc., 132 W. Colorado, Pasadena 1, Calif.



### HIGH PRECISION GEARS and precision fine pitch

gearing from 200 to 6 diametral pitch and dimensions from .125" to 10" diameter. Western Gear Works makes available complete engineering and manufacturing facilities for the application of high precision gearing and gear drives in electronics equipment. For assistance without obligation write Executive Offices, Western Gear Works, P.O. Box 182, Lynwood, Calif.



PLANTS AT LYNWOOD, PASADENA, BELMONT, SAN FRANCISCO (CALIF.), SEATTLE, HOUSTON — REPRESENTATIVES IN PRINCIPAL CITIES

CIRCLE ED-227 ON READER-SERVICE CARD FOR MORE INFORMATION

• An affiliate of Western Gear Works, since 1888 a leader in the mechanical power transmission field.



## New BRADLEY RECTIFIER MANUAL

FOR THE ENGINEER... AN INVALUABLE TOOL!  
FOR THE PURCHASING AGENT... A HELPFUL GUIDE!

Accurate, up-to-the minute and complete, the Bradley Metallic Rectifier Manual is the most comprehensive guide available on selenium and copper oxide rectifiers. Types, designs, circuitry, applications, characteristics, all are discussed in the book's 128 pages. Your manual will be kept up-to-date, too; as new developments occur, revisions and additions will be mailed to you automatically.

- For prompt delivery send in your order today. The price is only \$2.00 for each copy.



BRADLEY LABORATORIES, INC., 174 Columbus Ave., New Haven 11, Conn.  
CIRCLE ED-229 ON READER-SERVICE CARD FOR MORE INFORMATION

### ...KULKA TERMINAL BLOCKS

CUT COSTS... SPEED PRODUCTION

- SIMPLIFY WIRING •
- NO SPLICING
- NO LEAKS OR SHORTS

Molded Barrier-type Terminal Blocks in approved materials and several styles, ranging in size from miniature to jumbo (90 amps.). With or without plain or printed Marker Strips in fibre or bakelite.

Catalog on Request

**KULKA ELECTRIC MFG. CO., Inc.**  
Manufacturers of Electrical Wiring Devices  
MOUNT VERNON, N. Y.

CIRCLE ED-230 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products . . .

### Barreter Mount

For Power Measurements



This fixed-tuned barreter mount is for use with 1.00" x 0.500" OD waveguides. It is designed for employment with microwave crystal-mount-type barreters and contributes a maximum vswr of 1.5 over an operation frequency range of 8500-9600Mc. For power measurements, the mount and associated barreter are used in conjunction with suitable wattmeter bridges. The mounts are also useful with an amplifier and a proper bias source for square law detection applications.

Other features of the instrument include a choke filter incorporated in the output connector to reduce microwave leakage from the mount, and an impedance matching diaphragm at the waveguide's UG-39/U input connector to produce broadband characteristics. The mount is brass, silver plated, and finished in flat black enamel. Airtron, Inc., Dept. ED, 1103 W. Elizabeth Avenue, Linden, N. J.

CIRCLE ED-231 ON READER-SERVICE CARD FOR MORE INFORMATION

### Ultrasonic Generator

Produces 1Mc Vibrations



The inexpensive-ly priced Model 50 Series Liquid Load Ultrasonic Generator is a laboratory instrument for ultrasonic experimentation and cleaning of delicate

or complex parts. A barium titanate transducer, resonant at a frequency of about one megacycle, driven by a 50w r-f generator, radiates vibrations into a liquid sample in a test tube or a quart-size container of cleaning solvent.

Used as a cleaning apparatus, parts to a maximum dimension of 4" may be cleaned by the simple technique of immersing them into the ultrasonically energized cleaning solvent for a short time. Especially suited for ultrasonic cleaning are instrument movements, ball-bearing assemblies, vacuum tube elements, miniature machined parts, and small-size glassware.

Construction features are a stainless steel cleaning container, with plug-in interchangeability, and a light, compact power supply (110v, 60cy). McKenna Laboratories, Dept. ED, 2503 Main St., Santa Monica, Calif.

CIRCLE ED-232 ON READER-SERVICE CARD FOR MORE INFORMATION

## New! Torwico TINYMAX transformers for 400 cycle applications

- \*Output—6 V.A. \*Regulation—10%
- \*Size—Dia. 1", Ht. 3/4"
- \*Weight—1 1/2 ounces

Now, to meet the demand for smaller but highly efficient miniature transformers, Torwico has designed the Tinymax Series. Compact, light and durable, these miniatures are ideal for airborne use. Typical of the Tinymax series are the following electrical and dimensional characteristics:

TW-6 — Electric Rating: Input—115v, 400c; Power Output—6 VA; Regulation—10%; Heat Rise—40°C, Class "A". Mechanical Measure: 1 in. x 3/4 in., weighs 1.5 oz.

TW-3 — Electric Rating: Input—115v, 400c; Power Output—3 VA; Regulation—15%; Heat Rise—40°C, Class "A". Mechanical Measure: 1 in. x 9/16 in., weighs 1 oz.

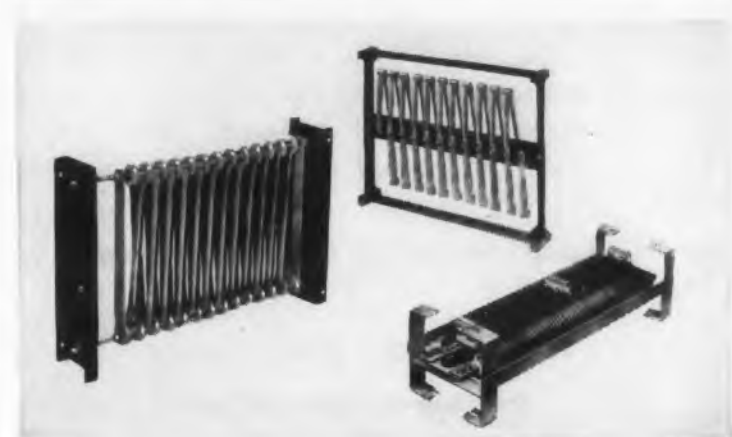
Meets MIL-T-27 Specifications.

We are prepared to design and produce TINYMAX transformers to your specific requirements.

Write today...  
for full  
information.

**TORWICO ELECTRONICS, INC.**  
963 Frelinghuysen Avenue, Newark 5, New Jersey

CIRCLE ED-234 ON READER-SERVICE CARD FOR MORE INFORMATION



## 3 heavy-duty resistors meet high-current needs

Barohm unit is used for continuous-duty battery charging, space heating, load bank, projection arc, similar equipment.

Loopohm, another continuous-duty unit, is designed for applications where mechanical shock or vibration prevail, such as crane hoists, welding and other portable equipment.

Edgeohm, an intermittent-duty unit, is used in motor starting, plugging, field discharging and similar applications.

Write for Bulletin 35 for complete details. Ward Leonard Electric Co., 77 South St., Mount Vernon, N.Y.

4.14

**WARD LEONARD ELECTRIC CO.**  
Result-Engineered Controls Since 1892  
RHEOSTATS • RESISTORS • MOTOR CONTROLS • CHROMASTER

CIRCLE ED-235 ON READER-SERVICE CARD FOR MORE INFORMATION





**Hundreds of USES!**  
SMALL, DEPENDABLE  
**MICRO-METERS**  
by **DURANT**

- **READABLE** — Big, well-defined white numerals on black — no metallic glare.
- **COMPACT** — Round case, saves space. Can be positioned for user's convenience and accessibility.
- **ATTRACTIVE** — Highly polished die cast case — won't tarnish or rust.
- **VERSATILE** — Panel or Base mount in Rotary, Stroke or Ratchet-Rotary actions.

**DURANT MANUFACTURING CO.**

1993 N. Buffum St. Milwaukee 1, Wis.      193 S. Water St. Providence 3, R. I.

Representatives in Principal Cities

Send for Literature

**PRODUCTIMETERS**  
SINCE 1879 *Count Everything*

CIRCLE ED-236 ON READER-SERVICE CARD FOR MORE INFORMATION



**Miniature Metal Tubing**  
for the  
**ELECTRONIC INDUSTRY**

● Looking for a good source of miniature and sub-miniature metal tubing? Uniform Tubes has been drawing fine, seamless tubing for over 20 years, furnishing O.D.'s down to .010"; walls down to .0010"; and tolerances as close as .00025"—in metals of almost any desired analysis. We helped pioneer the development of miniature tubing components for transistors and other advanced electronic equipment. Write for information or quotation. You'll like our prices and our 3-4 weeks delivery.



**UNIFORM TUBES, INC.**  
LEVEL ROAD, COLLEGEVILLE 2, PENNSYLVANIA  
Offices in principal cities

CIRCLE ED-237 ON READER-SERVICE CARD FOR MORE INFORMATION  
ELECTRONIC DESIGN • October 1954

**Vertical Drawing Board**

Also Serves as Desk



Known as the "Power-Slide" Drawing Board, a vertically adjustable drawing-board-and-desk combination increases the productivity of designers and draftsmen. It is more comfortable to work at, and thus reduces fatigue. Quick, easy adjustment of board height without manipulating any levers or knobs permits frequent change of working positions. Draftsmen can work comfortably in either standing or sitting positions.

The board provides ample desk space when utilized in row installations, eliminating the need for an additional reference desk or table. Drawers can be provided to open from either the desk or board side. The 48" x 72" drawing surface requires only 15 sq ft of floor space. It is made of plywood faced with pinewood. Power-Slide Drawing Board Co., Dept. ED, 58 Emmons St., Milford, Mass.

CIRCLE ED-238 ON READER'S SERVICE CARD FOR MORE DATA

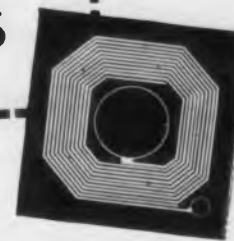
**Coaxial Cable Connector**  
In Solderless Design



This coaxial cable connector has features that recommend it for incorporation in communications and TV equipment, particularly its electrical reliability, high mechanical strength, and effective shielding. The latter factor is obtained by a radial grounding contact. Quickly and easily installed, the design is completely solderless. Entron, Inc., 4902 Lawrence St., Dept. ED, Bladensburg, Md.

CIRCLE ED-239 ON READER'S SERVICE CARD FOR MORE DATA

**PRINTED CIRCUITS**



USECO announces expanded production facilities in a separate new plant devoted exclusively to production of

- Printed Circuits • Etched Circuits
- Terminal Boards (Standard and Custom Built)

Our additional facilities permit MASS PRODUCTION techniques without forfeiting the QUALITY or FAST DELIVERY for which USECO is noted.

Printed and etched circuits in sizes to 18" x 18". Samples on request. We meet all Mil Specs. Complete line of Standardized Electronic Hardware. 24-hour service on quotations. Write today for further information.



**U. S. ENGINEERING CO.**

521 Commercial St., Glendale 3, Calif.

CIRCLE ED-240 ON READER-SERVICE CARD FOR MORE INFORMATION

**This fastener works through thick and thin!**



Spring-Lock works whether panel thicknesses run over or under specifications! Spring wire deflects automatically to handle greater or lesser thicknesses. Spring-Lock's design flexibility makes it more than a fastener: it can be adapted as a shelf support, door strike, knob or any similar panel-mounted device. Many standard shapes and sizes of Simmons Spring-Locks are available from stock.

SIMMONS FASTENER CORPORATION  
1763 North Broadway, Albany 1, N. Y.  
Spring-Lock • Quick-Lock • Roto-Lock

CIRCLE ED-241 ON READER-SERVICE CARD FOR MORE INFORMATION

**HERE'S HOW SPRING-LOCK WORKS**



1. Insert fastener. 2. Half-turn to lock.

- Installation is **BLIND**
- Installation is **EASY**: no special tools are needed
- Installation is **QUICK**: a half-turn locks it in place
- Installation is **SECURE**: the spring steel locks the fastener, resists vibration

Send for details and samples, or write us about your fastening problem.



# NEY'S SMALL PARTS

## PLAY A BIG PART IN PRECISION INSTRUMENTS

The accurate transmission of electrical impulses through a movable contact is dependent solely upon the properties of that contact. Illustrated at the right is a Ketay Synchro, which is the heart of many precision indicating, communicating and control devices. Ketay is noted for Synchros and Resolvers capable of extreme accuracy. Therefore, Ney Precious Metal Contacts have been selected because of their practically ideal physical and electrical properties.

Ney Precious Metal Alloys have high resistance to tarnish, are unaffected by most industrial corrosive atmospheres, and are fabricated into slip rings, brushes, commutator segments, wipers, contacts and similar components for use in electrical instruments. Call the Ney Engineering Department for help in selecting the right Ney Precious Metal Alloy which will improve and prolong the life and accuracy of your instruments.

**THE J. M. NEY COMPANY • 373 ELM STREET, HARTFORD 1, CONN.**  
Specialists in Precious Metal Metallurgy Since 1812

7NY54A

CIRCLE ED-243 ON READER-SERVICE CARD FOR MORE INFORMATION



## New Products . . .

### Electronic Photoflash For Laboratory Photos

The "Synetron" 223 Commercial and Industrial Speedlight is useful for laboratory photograph requirements. The equipment is designed for continuous service. The power supply provides a half light and a full light switch, which, combined with two lights on each supply, furnishes a range of power from 100 to 400w seconds per light for a brightness range of one to four. The unit operates from 115v, 60cy. Dormitzer Electric & Manufacturing Co., Inc., Dept. ED, 5 Hadley St., Cambridge, Mass.

CIRCLE ED-242 ON READER'S SERVICE CARD FOR MORE DATA

### "Teflon" Adhesive Features Temperature Stability

This adhesive will bond "Teflon" to itself or any other material. It is a pressure-sensitive adhesive having a peel strength of 5psi and a shear strength of 25psi. It has very good adhesive qualities for "Mylar", silicone-glass laminates, polyethylene, and polyester film. This bonding compound has good dielectric strength, is weather resistant, and features excellent heat stability. Gilbreth Co., Dept. ED, 1211 Chestnut St., Philadelphia 7, Pa.

CIRCLE ED-245 ON READER-SERVICE CARD FOR MORE INFORMATION

### Frequency Meters In Ranges from 900-8200Mc

A line of field test frequency meters covers the following ranges: 900-1200Mc; 1200-1700Mc; 1700-2300Mc; 4400-5800-Mc; 5800-8200Mc. Accuracy is 0.01%, 0.02%, 0.02%, 0.01%, 0.01%, respectively. A usable indication on the self-contained micro-ammeter is obtained with 1mw input.



The wavemeter is mounted in an aluminum carrying case. All models have type BNC input and accessories, such as coax-to-waveguide transducers and cables, which are available for the particular requirements of the customer. Each meter is individually calibrated, and charts or curves are supplied. The frequency determining elements are made of Invar to keep the temperature coefficient of the instruments as low as possible. Frequency Standards, Dept. ED, Box 504, Asbury Park, N. J.

CIRCLE ED-246 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954

These compression seals are in addition to our regular and complete line of Kovar to hard glass seals.



HIGH  
COMPRESSION  
GLASS-TO-METAL  
VACUUM  
SEALS

These are the only seals that are hot tin dipped at 530°F.



#### CONDENSER END SEALS

Our complete line of special END SEALS assures a stabilized atmosphere, thus making them especially adaptable to capacitors, filters, delay lines, and precision resistors. Special finishes available.



#### TRANSISTOR MOUNTS

CONSTANTIN TRANSISTOR MOUNTS assure dependable, long-life transistor service for all types of electronic instruments. Glass-to-metal sealing allows the germanium block to be permanently sealed in a vacuum or inert gas. This prevents aging and gives lasting protection against variations due to moisture, dirt, and changing atmospheric or light conditions.



#### TERMINALS

Constantin's extensive line of HIGH COMPRESSION TERMINALS is available in all combinations of hooks, eyes, tubes and pierced flats. Standard units of the complete line have test ratings from 1,000 to 15,000 volts R.M.S. and 5 to 25 amperes.



#### MULTI-PIN HEADERS

The new vacuum tight, HIGH COMPRESSION glass to metal seal makes CONSTANTIN HEADERS ideal for use in the manufacture of practically any product which demands a stabilized atmosphere, and protection from moisture. Ingenious seal engineering and flexible manufacturing methods permit numerous additional configurations and the adaptation of CONSTANTIN HEADERS to any requirement.

*L. L. Constantin & Co.*  
MANUFACTURING ENGINEERS  
Rt. 46 and Franklin Ave., Lodi, N. J.



Also manufacturers of—

MULTI-PIN CON PLUGS  
CRYSTAL HOLDERS  
VACUUM COATING EQUIPMENT

CIRCLE ED-244 ON READER-SERVICE CARD FOR MORE INFORMATION

# Stop Corrosion with RHODIUM PLATING

New uses for Rhodium Plating are constantly being found by electronic design engineers where hard, corrosion resistant electrical contact surfaces are required.

**RHODIUM PLATE** offers these advantages:

- assures low and stable contact resistance
- allows higher pressures to be used in sliding contacts
- not affected by atmospheric changes
- oxide-free contacts eliminate partial rectification and unwanted signals
- provides low noise level for moving contacts
- extremely long-wearing

These properties are particularly well-suited to electrical and electronic applications. RHODIUM plate affords excellent protection against atmospheric corrosion for printed circuits and permits incorporation of sliding contacts as part of the circuit.

Write for Free, detailed booklet on RHODIUM PLATING.

**BAKER**  
& COMPANY INC. **PRECIOUS METALS**

113 ASTOR STREET, NEWARK 5, NEW JERSEY  
NEW YORK • SAN FRANCISCO • CHICAGO • LOS ANGELES

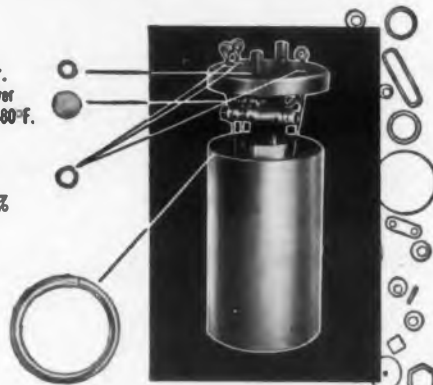
CIRCLE ED-247 ON READER-SERVICE CARD FOR MORE INFORMATION

## 3 Soldering Operations in 1 Easy as ABC with KESTER "SOLDERFORMS"

**A** Solder screws and stud to can cover.  
"Solderform" Disc & Rings 5% Silver  
—95% Lead Alloy. Melting Point 680°F.

**B** Solder glass terminals to cover.  
"Solderform" Rings 63% Tin—37%  
Lead Alloy. Melting Point 361°F.

**C** Hermetically seal cover on can.  
"Solderform" Ring 28.5%  
Bismuth—28.5% Tin—43%  
Lead Alloy. Softening Point 250°F.



Here's a typical example of a tough resistance soldering job involving progressively lower melting temperatures. Kester "Solderforms" made sure this high precision oscillator coil came through every test successfully.

WRITE TODAY for free "Solderform" samples and literature.

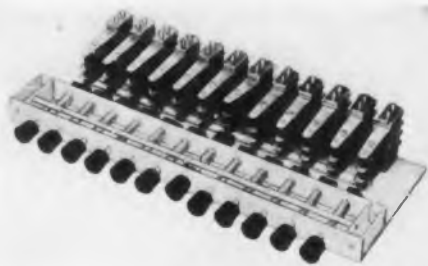
**KESTER**  
SOLDER COMPANY

4266 Wrightwood Avenue • Chicago 39, Illinois  
Newark 5, New Jersey • Brantford, Canada

CIRCLE ED-248 ON READER-SERVICE CARD FOR MORE INFORMATION

## Pushbutton Switches

With 7 to 12 Positions



The Model MPB Switch, which represents a redesign of this firm's line of pushbutton switches, consists of a new, extruded, sturdy frame on which are mounted

pushbutton units of from two to a maximum of 12 positions. Switches can be supplied in the following types: Accumulative Lock, No Two Interlock, Lock Release, and Non-Lock.

The new model is more rugged and shock resistant than this firm's previous design, and it has longer life; easier operation, mounting and assembly; and reduced size. The same ratings and mounting dimensions have been preserved. General Control Co., Dept. ED, Boston 34, Mass.

CIRCLE ED-249 ON READER-SERVICE CARD FOR MORE INFORMATION

## Recorder Console

Has Direct Writing Oscillograph



The Model F6C Console Recorder is suitable for use with any computer now on the market. Six-chart speeds are available: 0.5, 1, 2.5, 5, 10 and 25mm/sec.

The console is available with a-c, d-c high gain, d-c low gain, or strain amplifiers. Three large doors at the rear of the unit give access to amplifiers and the back of the control panel. The oscillograph chart feeds through an opening into a large drawer. The unit is on casters, but two legs on the left may be lowered to make it stationary. A "Plexiglas" cover over the oscillograph allows the operator to read it from a sitting or standing position. The oscillograph recording unit is also available without a console. Photron Instrument Company, Dept. ED, Union Commerce Building, Cleveland 14, Ohio.

CIRCLE ED-250 ON READER-SERVICE CARD FOR MORE INFORMATION

**ELCO**  
SCREWS

ELCO SCREWS ARE GOOD SCREWS



**ELCO** TOOL AND SCREW CORPORATION  
1948 BROADWAY • ROCKFORD, ILLINOIS

CIRCLE ED-252 ON READER-SERVICE CARD FOR MORE INFORMATION





Are Your  
Components  
Guilty of  
**RADIO  
NOISE?**

**POTTER** can tell you "why"

**POTTER** can tell you "how"

and **POTTER** can make  
the **FILTER** that will  
confirm that "how"

Once it's stated completely and correctly,  
a problem is half solved.

Potter can put the facts and figures of  
your problem on paper . . . can  
chart its limits in laboratory tests . . . can  
engineer the solution. And Potter  
can embody that solution in  
subsequent design and production.

Call Potter to engineer, design and  
produce the filter to solve your  
radio interference problem.

Write for Bulletin 41C.



THE  
**potter**  
COMPANY

SPECIALISTS IN  
FIXED PAPER  
CAPACITORS  
SINCE 1925

1950 SHERIDAN ROAD  
NORTH CHICAGO, ILL.

CIRCLE ED-255 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products . . .

### D-C Power Supply For Rugged Airborne Use



This dual mag-  
netic "Stabvolt"  
d-c power supply  
unit uses no vac-  
uum tubes or mov-  
ing parts. Designated the Model  
MRP-5-1, it is de-  
signed for the  
compactness, rug-  
gedness, and re-

liability required in aircraft, drone target, and mis-  
sile applications. For use in airborne telemetering  
instrumentation, the unit substitutes for a battery  
and provides a constant d-c output voltage practi-  
cally free of line voltage transients. The transient-  
free feature is achieved by utilizing dual magnetic  
regulation circuitry. Ripple is less than 0.25%.

The output capacity of 5v at 1amp is sufficient to  
provide power to a great number of resistance  
bridges, potentiometer type end organs, and strain  
gauge elements. The unit operates from 115v 400cy  
line. For a-c line variations of 105-125v, output volt-  
age regulation is practically instantaneous with a d-c  
output stability of better than 0.2%. Stability of out-  
put is better than 0.25% for line frequency changes  
of 380-420cy. Regulation for 20% load current  
changes is better than 0.2%. Response time for load  
current changes is faster than 0.2sec. Stability of  
output voltage against environmental temperature  
changes, from 80° to 150°F, is better than 1%.

The unit is self-protecting against external overload  
and short circuits, with no fuses required. It is her-  
metically sealed in a type JA steel can, and conforms  
to MIL-T-27 specifications. Dimensions are 3-9/16"  
x 3-1/16" x 4-7/8" high. Weight is only 4 lb. Mag-  
netic Research Corp. Dept. ED, 200-202 Center St.,  
El Segundo, Calif.

CIRCLE ED-256 ON READER-SERVICE CARD FOR MORE INFORMATION

### Laminate

#### Glass Fiber Impregnated

Known as "Insurok XT-200", a new insulating,  
high-pressure sheet stock laminate with glass fibers  
impregnated with a thermosetting resin to the re-  
quired thickness, features low water absorption. It  
also has excellent electrical properties, good strength  
characteristics, and high arc resistance. It has very  
satisfactory machining characteristics, and can be  
punched cold to intricate shapes. The laminate is  
available in sheets 34" x 34", in thicknesses of 1/16",  
1/8", 1/4". Richardson Co., Dept. ED, 27th Ave. and  
Lake St., Melrose Park, Ill.

CIRCLE ED-257 ON READER-SERVICE CARD FOR MORE INFORMATION

COMPACT  
DEPENDABLE  
EFFICIENT  
*Rotary Power*  
by Carter



THE NEW

*Custom*

### DC-AC CONVERTER

These latest of all Carter DC to AC  
Converters are specially engineered  
for professional and commercial ap-  
plications requiring a high capacity  
source of 60 cycle AC from a DC power  
supply. Operates from storage bat-  
teries, or from DC line voltage. Three  
"Custom" models, delivering 300,  
400, or 500 watts 115 or 220 V. AC.  
Wide range of input voltage, 12, 24,  
32, 64, 110 or 230 V. DC. Unequalled  
capacity for operating professional  
recording, sound movie equipment  
and large screen TV receivers. Avail-  
able with or without manual fre-  
quency control feature.



### MAIL COUPON FOR CATALOG

Carter Rotary Power Supplies are  
made in a wide variety of types and  
capacities for communications, labora-  
tory and industrial applications. Used  
in aircraft, marine, and mobile radio,  
geophysical instruments, ignition, tim-  
ing, etc. MAIL COUPON NOW for  
complete Dynamotor and Converter  
Catalogs, with specifications and per-  
formance charts on the complete line.

**Carter MOTOR CO.**  
2664 N. Maplewood Ave.  
Chicago 47

Carter Motor Co.  
2664 N. Maplewood Ave., Chicago 47  
Please send new catalogs containing com-  
plete information on Carter "Custom" Con-  
verters and other Rotary Power Supplies.  
Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_

CIRCLE ED-258 ON READER-SERVICE CARD



### Microphone Cord Extremely Flexible

Cadmium copper conductors for improved flex life are a feature of a microphone cord that also has a close-wave, semi-conducting textile wrap and a stranded flexible drain wire instead of the conventional braided copper shield. The neoprene outer jacket is tough and abrasion resistant. The cord is available in 2-conductor, No. 18 AWG and 3-conductor No. 20 AWG. Whitney Blake Co., Dept. ED, New Haven, Conn.

CIRCLE ED-259 ON READER-SERVICE CARD

### Adhesive

#### Bonds Silicone to Metal

Designated "A-4000", this silicone rubber adhesive bonds silicone rubber to itself or to aluminum, magnesium, stainless steel, butyl, or saran rubber. It sets without pressure in 24 hr at room temperature, with maximum strength reached in about 3 to 7 days. Peel strengths of 15psi, measured according to MIL-C-4003, have been obtained between extruded "Silastic" and aluminum. With molded silicone rubber, peel strengths are in the range of 9psi. The bond exhibits heat and creep resistance at temperatures through 100°C. Dow Corning Corp., Dept ED, Midland, Mich.

CIRCLE ED-260 ON READER-SERVICE CARD

### Metalized "Mylar"

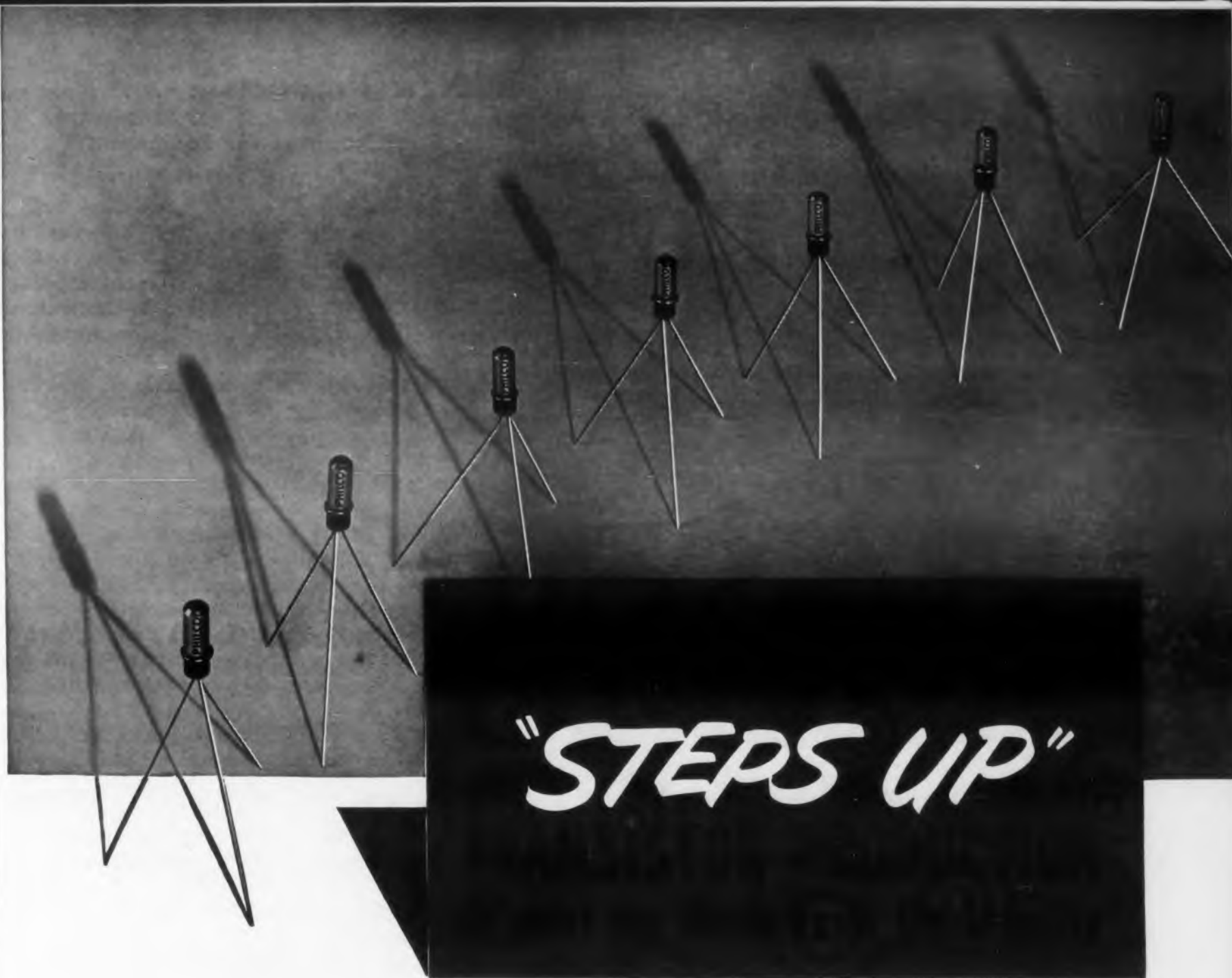
#### Has High Mechanical Strength

"Mylar" polyester film is now available with metalized surfaces. The coated product has all the valuable properties of the transparent Mylar, such as high tensile strength, dielectric constant, and tear resistance. A possible application is in plastic-film capacitors.

The film can be laminated to other materials. It can also be woven in fabrics and cords. It is available in slit-to-size rolls in 20" and 36" widths in the following thicknesses: 0.00025", 0.00050", 0.001", 0.002", 0.005", and 0.0075". Samples will be supplied on request. Coating Products, Dept. ED, Englewood, N. J.

CIRCLE ED-261 ON READER-SERVICE CARD

CIRCLE ED-262 ON READER-SERVICE CARD ➤



#### SUPERIOR PERFORMANCE

*makes Philco Transistors  
the recognized standard.*

*With Philco*

*Alloy Junction Transistors*

*you gain the advantages of*

*small size, low power consumption*

*and simplified circuitry to*

*improve your product.*

**RELIABILITY**... six years of Philco research and development in semi-conductors have established the quality, uniformity and production standards (from basic materials to tested transistors) required for large scale production.

**AVAILABILITY**... recognizing the potential transistor requirements of the electronic industry, Philco planning has resulted in production facilities which assure an unfailing supply of high quality transistors—now!

*Phone, write or wire Dept. ED today for descriptive literature and specifications on Philco transistors.*

#### PHILCO TRANSISTORS FEATURE...

- Maximum reliability
- Uniform characteristics
- Hermetically-sealed resistance-welded case... leads fused in glass
- Minimum size
- Ruggedized construction



PHILCO CORPORATION

GOVERNMENT & INDUSTRIAL DIVISION • PHILADELPHIA 44, PA.



*A new, large size,  
flat bed,  
versatile  
2-axis recorder...*

**AUTOGRAF**  
*trademark*  
**MODEL 2**



*Curves are available for observation and labeling while they are being drawn.*

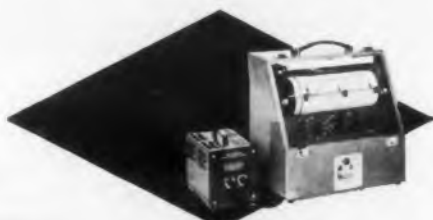
The versatility and labor-saving convenience of the original portable Autograf have now been built into an instrument which handles standard 11" x 16½" graph papers. Model 2 has the same scales and ranges as Model 1 (0-5 millivolts to 0-100 volts each axis); same speed (full scale X and Y in one second); same input impedance (200,000 ohms per volt). In addition, depressed zero available each axis, larger recording area (twice as big), flat bed, easy-reading design.



**THE AUTOGRAF  
MODEL 1**

general purpose 8½" x 11" X-Y recorder — is doing duty in hundreds of laboratory applications: chemical, electrical, electronic, wind tunnel, computer... And on production lines: measuring motors, filters, tubes, transistors, airfoils, amplifiers, rectifiers, magnetic circuits and materials, nuclear devices, etc. . . .

**BOTH AUTOGRAF  
MODELS ARE OUTSTANDING  
FOR THEIR VERSATILITY**

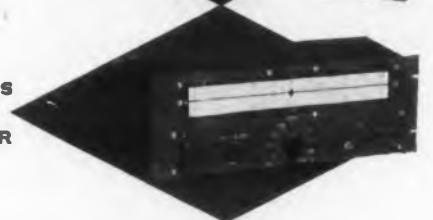


**AUTOGRAF  
CURVE FOLLOWER**  
plots or reads out Y vs. X. Either Model 1 or Model 2 can be furnished as a recorder/curve follower.

**NEW MODEL 20 SERIES  
DC VOLTMETER**



**AUTOGRAF  
POINT PLOTTER**  
Models 1 and 2 may be fitted for point plotting from keyboard or other digital sources.



A new high accuracy, easy-to-read, multi-range servo-voltmeter with fast response. Scales 0-3 millivolts to 0-300 volts. Zero left or zero center. Designed for indication, control, or analog to digital conversion.

*Bulletins describing these instruments are available, and we will be glad to send you the ones you want. Write...*

**F. L. MOSELEY CO., 409 N. Fair Oaks Ave., Pasadena 3, Calif.**

CIRCLE ED-266 ON READER-SERVICE CARD FOR MORE INFORMATION

# New Products . . .

## Calibration Equipment For Wide Variety of Uses



The Model 829 a-c/d-c Instrument Calibration Equipment is designed to fill the need of the average laboratory and industrial maintenance organization for

calibration service on electrical instruments. It can also be used as a laboratory standard.

Both the a-c/d-c power circuits and the basic current and voltage instrumentation are provided. The frequency of the output on the a-c ranges is that of the power source, which may be from 50 to 400 cy.

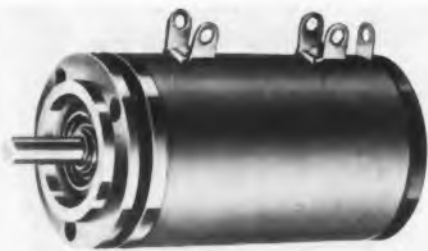
Panel arrangement and switching circuits provide for quick instrument calibration, while electrical interlocks protect against misoperation. Enclosed in a ventilated aluminum alloy cabinet and weighing only 150 lb, the unit is intended for bench or roller table operation.

Overall accuracy is guaranteed to 0.5% of full-scale with calibration chart. Calibration charts show the comparison of all ranges to basic standards with recent Bureau of Standards calibration certificates. The 75 full-scale ranges provided cover 1.5-750mv, a-c; 0.25-500mv, d-c; 1.5-1500v, a-c; 1-2000v, d-c; 1.5-500ma, a-c; 2-500 $\mu$ a, d-c; 1-500ma, d-c; 1-20amp, a-c; and 1-20amp, d-c. Radio Frequency Laboratories, Inc., Dept. ED, Boonton 11, N.J.

CIRCLE ED-267 ON READER-SERVICE CARD FOR MORE INFORMATION

## Potentiometers

### In Linear and Non-Linear Versions



Series AJ "Helipot" 10-turn miniaturized precision potentiometers, newly redesigned, are available in both linear and non-

linear versions, for servo or bushing mounting. Only 1-1/2" long x 7/8" diam, they combine high resolution and close linearity or conformity characteristics with minimum size and weight (only 1.1 oz).

AJSP models have servo lid and precision miniature ball bearings; AJS models, servo lid and sleeve bearings; AJ models, threaded bushing and sleeve bearings. Power rating is 2w at 40°C ambient. Standard mechanical and electrical rotation is 3600° (+10°, -0°). Helipot Corp., Dept. ED, 916 Meridian Ave., South Pasadena, Calif.

CIRCLE ED-268 ON READER-SERVICE CARD FOR MORE INFORMATION

## Viking miniature connectors

DESIGNED FOR  
LONG RELIABLE  
SERVICE LIFE



**VIKING circular types.** Positive polarization and shielding. Simple locking device mates units against vibration. One to four contacts on small units—5 to 9 on large units.



**VIKING printed circuit receptacle.** Increases your circuits—unit shown has 20 contacts, and is interchangeable with 18-contact types. Extremely strong contacts, pierced or unpierced.

**Hermetic sealing** is available on the circular and rectangular series. Write for literature on these or the complete line of VIKING connectors.

# VIKING

ELECTRIC

1061 INGRAHAM STREET  
LOS ANGELES 27, CALIF.

See our complete line at the  
**WESCON SHOW • BOOTH #257**

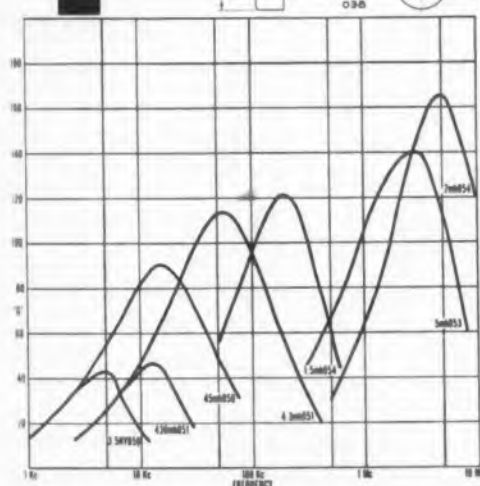
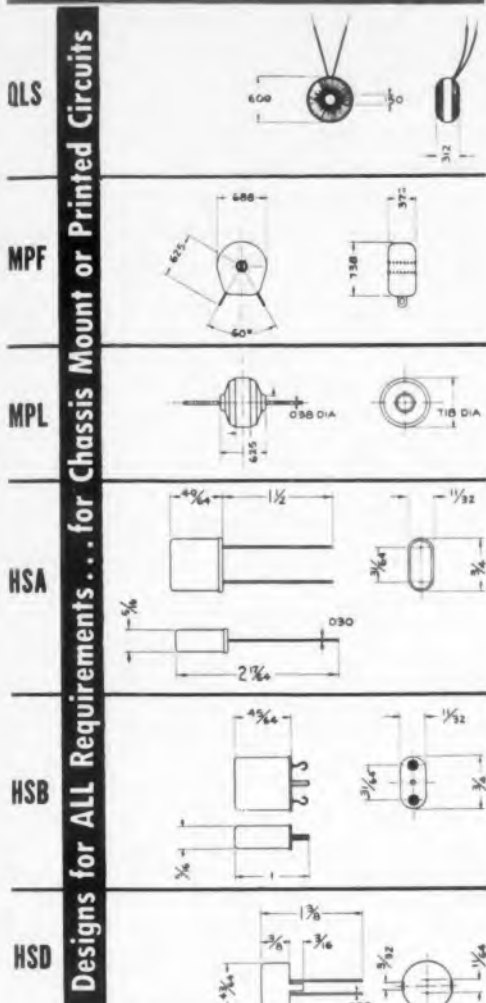
CIRCLE ED-269 ON READER'S SERVICE CARD





## Toroids Subminiature

HS—HERMETIC SEALED  
MP—MOLDED PLASTIC  
QL—VACUUM IMPREGNATED



Write for Additional Information  
**COMMUNICATION ACCESSORIES COMPANY**  
Hickman Mills, Mo.      Phones: SOuth 5528-5529

CIRCLE ED-270 ON READER-SERVICE CARD

## Image Orthicon For Color-TV Cameras



The 6474/1854 Image Orthicon is a TV camera tube designed for use in color cameras using simultaneous pick-up. This method employs three tubes, one for each channel. The tube has high sensitivity combined with a spectral response approaching that of the eye, plus good resolution capability. With a camera designed with a good optical system and utilizing efficient filters, commercially acceptable pictures can be obtained with about 350 ft-candles of incident illumination and a lens stop of  $f:5.6$ .

In typical operation, the photocathode voltage is  $-300$  to  $-500$ v, the accelerator voltage is  $-275$  to  $-375$ , the anode voltage is 1250v, and the anode current is  $30\mu\text{amp}$ . The tube is available with a small-shell diheptal 14-pin base or a keyed jumbo annular 7-pin base. Over-all length is  $15\text{-}3/16'' \pm 1/4''$ . Tube Div., Radio Corporation of America, Harrison, N. J.

CIRCLE ED-271 ON READER'S SERVICE CARD FOR MORE DATA

## "C" Band Wavemeter Coaxial-Line Type Unit



The Model 230 "C" Band Wavemeter is a coaxial-line type instrument covering the frequency range from 3500 to 6500Mc by either the transmission or absorption method. The use of Invar in the line displacement portion affords high-frequency stability.

Among the features are a precision-ground lead screw; a cavity body made from a solid block, precision-machined to close tolerances, giving mechanical stability; and tri-plating of all r-f surfaces. Type "N" constant impedance coaxial connectors are used for both transmission and absorption inputs. Power-handling by transmission method is from 0.5mw to 1w. Cabinet size is  $8'' \times 6\text{-}1/2'' \times 5''$ . Net weight is  $4\text{-}3/4$  lb. Amerac, Inc., Dept. ED, 116 Topsfield Rd., Wenham, Mass.

Power-handling by transmission method is from 0.5mw to 1w. Cabinet size is  $8'' \times 6\text{-}1/2'' \times 5''$ . Net weight is  $4\text{-}3/4$  lb. Amerac, Inc., Dept. ED, 116 Topsfield Rd., Wenham, Mass.

CIRCLE ED-272 ON READER'S SERVICE CARD FOR MORE DATA

Thinking of  
**SMALL  
RELAYS?**

**ADVANCE**

*builds 'em  
for heavy loads  
and long  
service!*



**"Tiny Mite"  
MM & MP SERIES**

This ultra-small dc relay occupies less than 1/2 cu. in. mounting space! It's stable under vibration and shock... plated to prevent corrosion. Operate time is 5 milli-seconds. Contact rating: .5 amp. or 1 amp.



**Miniature Telephone Type  
TQ SERIES**

Only .94 cu. inches in size, yet this relay carries 5-amp. loads in any combination up to 4 PDT. Mechanically secured throughout, it's extremely efficient. Non-gassing insulation. Withstands 10G vibration. Temp. range: -55° to +125°C.



**General Purpose Midget  
MG & MF SERIES**

Endless uses for this midget ADVANCE relay. It's engineered for high efficiency and low price. Operates in any position, with positive contact. Light vibration and shock resistance. Two-amp. or 5-amp. contacts.

**Hermetic enclosures** on these types are impervious to varying climatic conditions...are sealed and carefully checked against leakage.

**Write for literature** on any of the above series, or the complete ADVANCE line.

**ADVANCE ELECTRIC AND RELAY CO.**

2435-K NORTH NAOMI STREET, BURBANK, CALIFORNIA

Sales Representatives in Principal Cities of U.S. and Canada



CIRCLE ED-273 ON READER-SERVICE CARD FOR MORE INFORMATION



**faster! more channels!  
more versatile!**

## **THE NEW POTTER DIGITAL MAGNETIC-TAPE HANDLER**

**0 to 60 inches/sec. in 5 msec! 2, 6 or 8 channels**

High-speed magnetic tape recorders with low start-stop times bring a new dimension to data handling by absorbing and dispensing digital information when and where it's needed! Any phenomenon can be recorded as it occurs, continuously or intermittently, fast or slow. It can later be fed into computers, punch cards, printers, etc.

Speeds of 60 inches per second with 5-millisecond start-stop times permit digital techniques with jobs previously requiring more expensive, less reliable methods. Typical applications include business problems, high-speed industrial control processes, missile study, and telemetering.

In addition, Potter Magnetic Tape Handlers offer wider tape widths for more channels with lower tape tension controlled by photoelectric servos. Yet, the price is a fraction of much less versatile recorders. Other data handling components and complete systems are available for special problems.

### **DETAILED SPECIFICATIONS**

Model	902AJ	902BJ	902BK	902CJ	902CK
Number of Channels	2	6	6	8	8
Tape Width (Inches)	¼	½	½	¾	¾
Tape Speed (in./sec.)	15/30	15/30	15/60	15/30	15/60
Reel Size (dia. in inches)	10½	10½	8	10½	8
Reel Capacity (feet)	2,400	2,400	1,200	2,400	1,200
Start Time	5 Milliseconds				
Stop Time	5 Milliseconds				

For complete information, write to Department 10-F.



**POTTER INSTRUMENT CO., INC.**

115 Cutter Mill Road, Great Neck, N. Y.

CIRCLE ED-275 ON READER-SERVICE CARD FOR MORE INFORMATION



# Books . . .

**Human Engineering Guide for Equipment Designers . . .** By Wesley E. Woodson, 262 pages, paper-bound. University of California Press, Berkeley, Calif. \$3.50.

The publication of this guide marks another milestone in the development of human engineering. Unlike the existing source books, which are primarily for a psychological audience, this guide has been written for equipment designers. The author's purpose is ". . . to aid the designer in making optimum decisions wherever human factors are involved in man-operated equipment, by providing a central source of information about the human operator, by pointing up the relative importance of variables which make a difference, and by indicating solutions for typical design problems." The work serves its purpose well.

#### Prepared by Navy

The guide was prepared by the Human Engineering Section of the Naval Electronics Laboratory, San Diego, Calif., a group well known for its research and applied work in this field. A preliminary copy was submitted to both human engineering specialists and design engineers for criticisms of content and format. It is to the author's credit that the guide is applicable not only to naval problems but to industrial and military design problems in general.

The engineer should have no trouble in understanding the content: the writing is simple and concise, the numerous illustrations very helpful. The arrangement of topics, however, makes it difficult to look up the answers to specific problems in any one part of the guide, despite a subject index.

There are five chapters. Chapter 1, "Design of Equipment and Work Space", comprises almost half the book and will be of most value to engineers. It includes specifications for the design of controls and displays, the layout of consoles and panels, the dimensions of workplaces and pieces of furniture, and various characteristics of the working environment. All recommendations have been spelled out in detail and can be applied directly to design problems.

Chapters 2 and 3, "Vision" and "Audition", describe important characteristics of seeing and hearing. General information is presented without giving detailed design recommendations. It is doubtful whether many engineers will have the time or interest to study these two chapters.

The dimensions of various parts of the body, the extent of motion and the strength of different limbs—all of which are useful in laying out workplaces—are covered in "Body Measurements", Chapter 4. The anthropometric data, however, are not presented in a form immediately applicable in solving design problems, nor is there coverage of the rules and precautions to follow in using these data.

Chapter 5, "Other Factors", covers body sensitivity, movement and control, and body orientation. The middle section will be of most value to engineers—it includes brief discussions of reaction time, tremor, characteristics of different body movements, tracking performance and motion economy. Finally, at the end of the book there is a very comprehensive and useful topical bibliography.

#### Man-Machine Dynamics

The electronics engineer will be disappointed with the meager coverage of the

recent  
Little  
fects o  
parts o  
man tr  
men an  
the typ  
operat  
mit hin  
areas  
young  
since t  
one ca  
such a

A fu  
over-si  
dom ca  
sign r  
tions.  
and o  
states  
almost  
efficien  
would  
guide,

Recent work in man-machine dynamics. Little is said about such topics as the effects of time (or phase) lags in various parts of a system, the development of human transfer functions, the comparison of men and computers for different tasks, and the types of inputs and outputs around the operator in a closed-loop system which permit him to perform most effectively. These areas of human engineering are very young and relatively unexplored and, since this guide was begun a few years ago, one cannot expect it to be up to date in a such a rapidly expanding field.

#### Over-Simplification

A further limitation of the guide is its over-simplification of certain topics. Seldom can a specific human engineering design recommendation apply to all situations. For example, in comparing pursuit and compensatory tracking, the guide states that ". . . pursuit tracking, under almost all circumstances, is by far more efficient." To cover all specific situations would have been beyond the scope of this guide, but there are numerous ones in

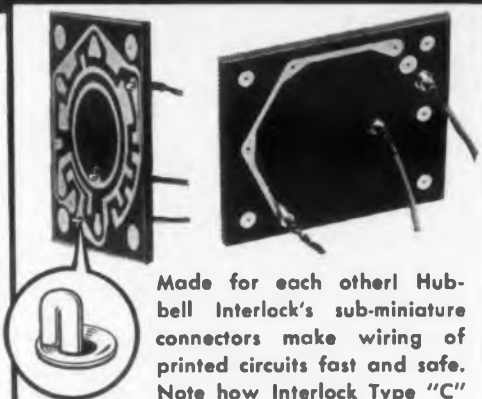
which a compensatory display is preferable. The reader should have been admonished that there are exceptions to all the recommendations made, that no design specification should be followed completely in all problems, and that good design almost inevitably is the result of a series of compromises.

Despite these limitations, this guide is the most useful human engineering source book yet published for equipment designers. Having been in contact with the authors during its evolution, and having attempted a similar project, I fully appreciate the difficulties of preparing such a book. Although I do not agree completely with some of the recommendations, and would have preferred to see some topics eliminated and others added, I consider the book to be of considerable value and a "must" for the library of all electronic engineers concerned with design.

DR. JEROME H. ELY

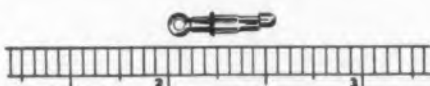
Research Director  
Dunlap and Associates, Inc.  
Stamford, Connecticut

## PHOTOCIRCUITS, INC. selects *NEW HUBBELL Interlock* SUB-MINIATURE CONNECTORS FOR WIRING PRINTED CIRCUITS!



Made for each other! Hubbell Interlock's sub-miniature connectors make wiring of printed circuits fast and safe. Note how Interlock Type "C"

Connectors pass through set-in eyelets from back and lock automatically on opposite side. Eyelets manufactured by United Shoe Machinery Corp. Eyelet setting machines are available.



Hubbell Interlock sub-miniature Type "C" Connector. Simplicity of design is the key to its constant low contact resistance and ease of installation.

Hubbell Interlock's latest development, the sub-miniature Type "C" Connector, featuring low contact resistance, automatic locking — quick disconnect wiring, found immediate application to another recent advancement in the electronic field — the "printed" circuit. The tiny connectors met every requirement for wiring the illustrated rotary switch plate circuit manufactured by Photocircuits, Inc. of Glen Cove, N.Y. Their automatic locking — quick disconnect feature eliminated difficult soldering and made possible fast, easy wiring maintenance. The exclusive Hubbell Interlock mechanism assured a vibration-proof, constant low contact resistance.

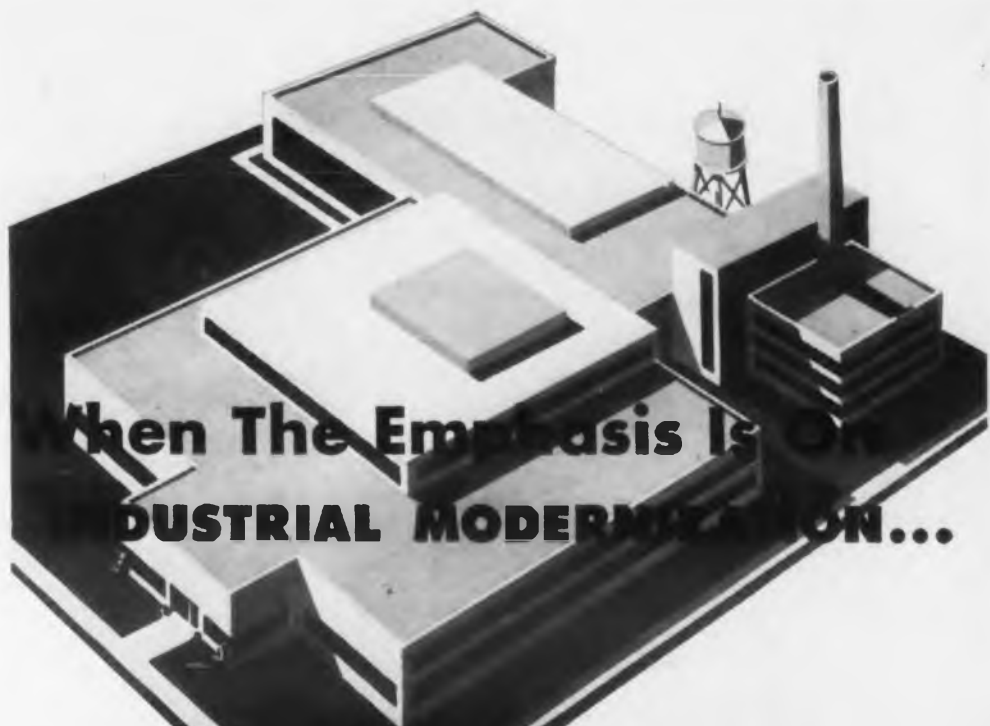
For Difficult Wiring Problems Requiring Sub-Miniature Connectors, Our Development Laboratory Will Cooperate With Your Engineers To Adapt Interlock For Your Specific Applications.

**HARVEY HUBBELL, INC.**

Interlock Dept., Bridgeport 2, Conn.



CIRCLE ED-276 ON READER-SERVICE CARD FOR MORE INFORMATION



When The Emphasis Is On  
**INDUSTRIAL MODERNIZATION...**

*Specify*

**JEFFRIES**  
**DRY TYPE**  
**TRANSFORMERS**

Quiet and efficient, they provide the easiest, quickest and most economical means to *modern* industrial load distribution. Suitable for platform or wall mounting, they eliminate long secondary runs and do not require enclosures or specially constructed vaults. Compact design saves space and installation is simplified by utilization of integral cable compartments.

Installation at load centers improves regulation and reduces light flicker. Low losses decrease operating costs and maintenance of oil is eliminated. Available in all voltage classifications up to 15 KV in standard sizes, 5 VA to 1000 KVA or built to specifications. Our engineers will be glad to discuss your requirements.

*Reduce operating costs and modernize...*  
**Specify JEFFRIES DRY TYPE TRANSFORMERS**



*Write for additional information  
and Catalog.*



**JEFFRIES TRANSFORMER CO.**  
**SUBSIDIARY OF LEACH CORPORATION**  
1710 East 57th Street, Los Angeles 58, California  
Phone LOgan 8-3436

**MANUFACTURERS OF DRY TYPE TRANSFORMERS & ELECTRICAL WINDINGS**  
**CIRCLE ED-277 ON READER-SERVICE CARD FOR MORE INFORMATION**



*It takes more than  
parts to make an*

## **ARGA RESOLVER**



**15 size      23 size**  
**Uncompensated**  
**Resistor compensated**  
**Feedback winding compensated**

**maximum error** ▶

**Grade 1 — .05%**

**Grade 2 — .10%**

**Grade 3 — .20%**

**Null voltage less than  
1 millivolt per volt**

**Built to military  
specifications**

**Write for data file, 10-11**



# **Arga**

*division*

**BECKMAN INSTRUMENTS, INC.**

220 PASADENA AVE., SOUTH PASADENA, CALIFORNIA

CIRCLE ED-279 ON READER-SERVICE CARD FOR MORE INFORMATION

## Books . . .

**The Present State of Physics . . .** Arranged by Frederick S. Brackett, 265 pages. American Association for the Advancement of Science, 1515 Massachusetts Ave., N. W., Washington 5, D. C. \$6.75 to non-members, \$5.75 to members.

Since all electronic devices are based on physical phenomena, the electronic designer, no matter how specialized, cannot afford to lose contact with the work of the physicist. An insight into such phenomena can also provide the clue to a better design. This book briefly discusses many of the latest developments in physics. It is the report of an AAAS-sponsored symposium.

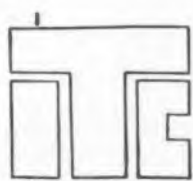
The volume is divided into four sections: elementary particles; physics of the solid state; chemical physics; and biophysics. The second section contains chapters entitled: "The New Electronics", "Flow of Electrons and Holes in Semiconductors", and "Barium Titanate Ferroelectrics". Each chapter is well illustrated with photographs and charts.

**Applied Electronics . . .** By Truman S. Gray, 2nd edition, 881 pages. Technology Press, John Wiley & Sons, 410 Fourth Ave., New York 16, N. Y. \$9.00.

This second edition of a well-known textbook in electronics can serve as a valuable reference work for the design engineer who requires a review of basic material to balance an increasing absorption in a specialty. Careful definition of terms is stressed instead of advanced mathematical derivations.

The first part of the book deals with basic physical phenomena. The second part is an explanation of the way the phenomena combine to determine the characteristics of electronic devices, and the third part deals with applications. Finally, the fourth part deals with semiconductors, particularly transistors. The consideration of transistors parallels the discussion of vacuum tubes for ease of comprehension.

One of the "Principles of Electrical Engineering" series by the staff of the Massachusetts Institute of Technology, this new edition is part of a planned, general revision of the series.



featuring

**MINIATURE SIZE**

**INFINITE RESOLUTION** plus

**"ZERO PHASE-SHIFT"**

### Diminutive Size

. . . (approximately  $\frac{1}{8}$ " square mounting surface), permits stacking many in a square inch of panel area. Ideal for trimming adjustments in computers, analysers, telemeter and airborne electronic equipment.

Rugged construction insures dependability despite wide changes in ambient temperature and extreme conditions of salt spray, humidity and vibration.

### Infinite Resolution

. . . of the unique deposited metal resistance element embodied in Type RFT Metallfilm Trimmer Potentiometer is available over a wide resistance range. 9000° of adjustment, the equivalent of 25 turns of the adjustment screw on which sliding contact rides, permits voltage settings to be set and maintained with extreme precision.

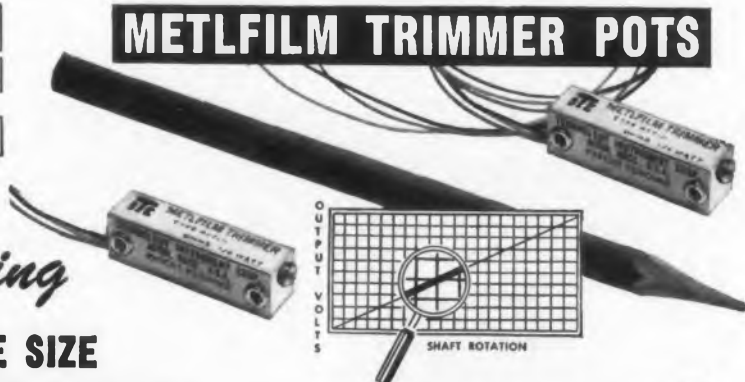
For further details write:

**TECHNOLOGY INSTRUMENT CORP.**

555 Main Street, Acton, Mass. Colonial 3-7711  
West Coast Eng'g. Facility P.O. Box 3941, North Hollywood, Calif.  
Popular 5-8620

CIRCLE ED-280 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954



### SPECIFICATIONS

#### Electrical

Resistance Range: 50-25,000 ohms  
Total Resistance Tolerance:  $\pm 10\%$   
Independent Linearity:  $\pm 5\%$  of total resistance  
Resolution: Infinite  
Power Rating:  $\frac{1}{2}$  watt at 40°C,  $\frac{1}{4}$  watt at 125°C per IAN-R-19 test specification.  
Ambient Temperature Range: - 65°C to + 125°C.  
Temperature Coefficient of Resistance Element: 0.00250/°C (nominal)  
Dielectric Test: 500 volts DC between all leads, shaft and mounting eyelets for 5 seconds without flashover or breakdown.

#### Mechanical

Resistance Element: Metal film deposited on inert base.  
Mechanical Rotation: 26 complete turns (nominal).  
Usable Mechanical Rotation: 90% minimum of slider travel is on resistance element.  
End Stops: Will withstand 1 inch pound maximum applied torque.  
Vibration: Exceeds exacting requirements of MIL-E-5272a.

Symp

gratis  
Ind.

This  
compl  
ented  
held  
Techn  
bookle  
fished  
factur  
such  
posia.  
design

Am  
titles:  
Use",  
vestig  
Relay  
for B  
the I  
Therm  
Minia  
above  
physic  
lating

ELEC

**Symposium on Electro-Magnetic Relays**  
... 84 pages, paper-bound. Available gratis from Potter & Brumfield, Princeton, Ind.

This well-illustrated volume contains complete versions of all the papers presented at the Second Relay Symposium held this year at the Oklahoma Institute of Technology, Stillwater, Okla. A similar booklet for the first symposium was published by Potter & Brumfield, relay manufacturers, who plan to continue publishing such proceedings for future relay symposia. It should be of special interest to designers who use relays in their equipment.

Among the 23 papers are the following titles: "Engineering Materials for Relay Use", "Relay Contact Rating", "An Investigation of the Effects of Vibration on Relay Operation", "Relay Requirements for Business Machines", "Some Notes on the Design and Application of Electro-Thermal Relays", and "Practical Relay Miniaturization". The first article listed above gives a number of useful charts on physical properties of metals and insulating materials.

**Proceedings of the Symposium on Automatic Production of Electronic Equipment** ... 119 pages, paper-bound. Automatic Production Symposium, Stanford Research Institute, Stanford, Cal. \$4.00

Ostensibly the subject of the production engineer, automatic production methods for both components and equipment are actually of vital interest to the electronic design engineer because they demand important design changes and even new design techniques. This volume is the proceedings of a recent symposium on automatic production sponsored by Stanford Research Institute and the U. S. Air Force.

Although some of the material has already been widely publicized, such as the Sylvania "stacked" tube (*ED*, p. 5, July, 1951), most of it is published here for the first time. The volume is divided into four parts: "General Aspects of Automation", "Product Design, Construction Techniques, Materials, and Components", "Design of Automatic Production Lines", and "Panel Discussion". The first three sections are well illustrated with photos and drawings.



## DEVELOPMENT ENGINEERS

**FOR:** Design Engineering, Practical Research, Investigations of Theories, Functional Analysis

An interesting challenge for senior design engineers to work directly with top project supervisors helping through the prototype stage new developments in:

- Automatic Control Instruments
- Electronic Navigational Aids
- Magnetic Amplifiers
- Airborne Armament Systems
- Guided Missile Controls
- Computing Equipment

For these jobs we are interested in men with two or more years experience in electro-mechanical work related to the above fields or in men with superior scholastic records in physics, electrical, electronic or mechanical engineering.

### YOU'LL LIKE WORKING AT FORD INSTRUMENT

- Not too large, not too small
- Stable but progressive company
- N. Y. C. location with all its additional varied opportunities
- Above-average fringe benefits
- Pension Plan
- Nine Paid Holidays
- Two Weeks vacation with pay
- Tuition assistance for further related studies

Our policy of permanency of positions and continuity of service does not allow us to employ engineers unless there is a *clear and definite need for them projected years into the future*. And we promote from within. If you can qualify, we urge you to contact by mail, or if in N. Y. C. phone:

Mr. P. F. McCaffrey, Stillwell 4-9000, Extension 416

## FORD INSTRUMENT COMPANY

Division of the Sperry Corporation

31-10 Thomson Ave., Long Island City, N. Y. (20 minutes from the heart of New York City)  
VISIT OUR BOOTH NO. 533 AT THE DAYTON IRE SHOW

CIRCLE ED-281 ON READER-SERVICE CARD FOR MORE INFORMATION



# INTERNATIONAL RECTIFIER

C O R P O R A T I O N

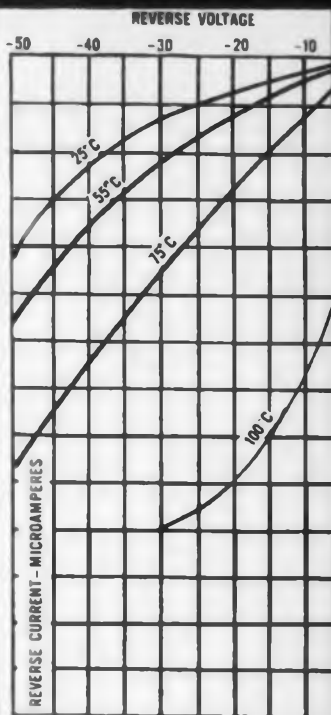


Here's more data about INTERNATIONAL'S



## Germanium Diodes

100° C



● TYPE G44  
REVERSE CURRENT (MAX.)  
300  $\mu$ a AT -30 V  
FORWARD CURRENT (MIN.)  
5 MA AT +1 V



Note These  
RED ● DOT  
Characteristics  
at 100° C . . .

- TYPE G66  
REVERSE CURRENT (MAX.)  
12  $\mu$ a AT -2 V  
FORWARD CURRENT (MIN.)  
5 MA AT +1 V
- TYPE G71  
REVERSE CURRENT (MAX.)  
50  $\mu$ a AT -10 V  
FORWARD CURRENT (MIN.)  
5 MA AT +1 V
- TYPE G75  
(85° C)  
REVERSE CURRENT (MAX.)  
300  $\mu$ a AT -60 V  
FORWARD CURRENT (MIN.)  
4 MA AT +1 V

WRITE FOR  
RED DOT BULLETIN  
ER 191

# INTERNATIONAL RECTIFIER

C O R P O R A T I O N

1521 E. Grand Ave., El Segundo, Calif. • Phone: OREGON 8-6281  
CHICAGO: 205 W. Wacker Drive • Phone: Franklin 2-3889  
NEW YORK: 501 Madison Avenue • Phone: Plaza 5-8665

CIRCLE ED-282 ON READER-SERVICE CARD FOR MORE INFORMATION

# WIDE-RANGE FREQUENCY METER 85-1000 MEGACYCLES

## TS-175A/U

**Government Approved**

**Calibration Accuracy:**  
.005 %

**Stability:**  
.0025 %

**Resettability:**  
.0025 %



**IMMEDIATE  
DELIVERY**

### **A VERSATILE PRECISION MEASURING INSTRUMENT**

#### **Recommended Applications:**

- Precise Measurements of Frequencies
- Production Testing
- Alignment of Transmitters and Receivers
- Laboratory Testing
- Portable Field Testing
- A Secondary Frequency Standard
- Signal Generator Calibration
- U.H.F. and V.H.F. Television Alignment

**Calibration:** Each instrument is individually calibrated, without interpolation, at 50 Kilocycle intervals throughout its range.

**Frequency Range:** The unit covers the calibrated range of 85 to 1000 megacycles. The fundamental of the precision variable frequency oscillator is 85 to 200 megacycles.

**Sensitivity:** The Frequency meter can detect a radio frequency signal of 20 microvolts with an audio power output up to 50 milliwatts depending on the frequency.

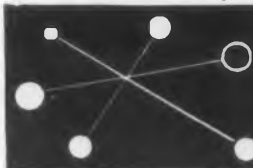
**Internal Modulation:** When desired, amplitude modulation of 1000 cycles in frequency can be employed. The modulation percentage is approximately 30%.

**Radio Frequency Output:** The output voltage from a 50 ohm source, varies from 300 to 100,000 microvolts, within the range of 85 to 1000 megacycles.

**Secondary Frequency Standard:** A 5000 Kc. oscillator incorporating a CR-18/U crystal can be used as a secondary frequency standard with harmonics of 5 megacycles up to 200 megacycles.

*Territories for representation available.*

*We offer a complete automatic recalibration service on all frequency meters.*



## **COLORTONE**

**ELECTRONICS, Incorporated**

238 William Street, New York, N. Y. • COrtlandt 7-5160

Executive Offices: 400 Duffy Ave., Hicksville, Long Island

CIRCLE ED-283 ON READER-SERVICE CARD FOR MORE INFORMATION

# New Literature . . .

## Tube Manual

A revised edition of the RCA Receiving Tube Manual provides basic technical data on over 500 receiving-type electron tubes used in radio, television and sound equipment. The manual (RC-17) features 67 new tube types, including the company's tricolor kinescope. Pertinent technical information for each of the tubes contained in the book is amplified by outline drawings, socket diagrams, and characteristic curves. The manual also provides new hi-fi amplifier circuits, a receiving tube classification chart, a kinescope characteristics chart with indexed kinescope data, socket information and phosphor curves; it further includes a reference listing of the most important obsolete tube types with technical data important to service technicians, and revised and expanded text material which describes cathode drive circuits and the effect of contact potential on tube performance. *Price of the manual is 60 cents. Write direct to Commercial Engineering, RCA Tube Division, Harrison, N. J.*

## Power Supplies

284

Descriptions of several new product lines are contained in these new catalog pages and folders. Included are pages on: Model 3-150-L low cost power supply and a wide range of sub-chassis mounting type regulated power supplies for developmental work; Model D3-300E multiple super precision power supply, whose range is from zero to 300v d-c at 300ma; Models T-100-B and T-100-D transistor power supplies, both built in two versions—one with meters and voltage adjustment by decade switches and potentiometer, and the other without meters and voltage adjustment entirely by direct reading decade switches; and four pages on closely regulated power supplies for development and research which covers ten models. Dressen-Barnes Corp., 250 N. Vinedo Ave., Pasadena 8, Calif.

## Buying Guide

285

Everything in electronic devices from transistors to consumer goods is listed in this 306-page, paper-bound catalog. This distributor supplies components to the industrial market from stock. In addition to transistors, germanium, selenium, and silicon diodes of all manufacturers are listed with prices. The catalog is particularly useful to designers who require components quickly or who require samples of a particular type of component in order to select the best product for their needs. Allied Radio Corporation, Dept. ED, 100 N. Western Ave., Chicago 80, Ill.

## Metallized Terminals

286

Bulletin No. 5410 gives the latest information on "AlSiMag" metallized hermetic terminals. Illustrations are approximately actual size, and a detailed property chart is included. These alumina ceramics are of high strength and have excellent resistance to thermal shock. Precision machined, they meet L5A requirements of JAN-1-10 specifications. American Lava Corp., Chattanooga 5, Tenn.

## R-F Interference Filters

287

Engineering bulletin No. 107 is a 4-page brochure illustrating 11 types of r-f interference filters and r-f noise suppression capacitors. Each unit is described with a photograph and dimensional drawing, plus a table of specifications and three curves of typical attenuation.

Also available from this company is Bulletin No. 108, dealing with pulse forming networks and delay lines and describing the operating principle of the units, suggesting applications, and discussing construction details. Typical circuits showing the arrangement of multiple capacitor and coil sections are also presented. Micamold Radio Corp., 1087 Flushing Ave., Brooklyn 37, N. Y.



## Electrical Tapes

288

A 20-page catalog contains the latest information on "Permacel" pressure sensitive electrical tapes, as well as on non-electrical "Texcel" and "Permacel" tapes. The self-sticking electrical tapes covered in the catalog are: acetate cloth, acetate film, acetate film cloth combination, flat-back and crepe paper, vinyl film, cotton cloth, glass cloth, and "Mylar" polyester film. These are corrosion and solvent-resistant tapes used for a variety of electrical insulating and fastening purposes. Most of the electrical tapes have heat curing adhesives. Insulation Manufacturers Corp., 565 W. Washington Blvd., Chicago 6, Ill.

## Magnetic Relays

289

This 4-page bulletin (No. 506A) is a quick reference showing the various types of open and hermetically sealed a-c and d-c relays in the company's line. It readily indicates general characteristics such as maximum coil resistance and power requirements, contact forms available, approximate weight and dimensions. R-B-M Division, Essex Wire Corp., Logansport, Indiana.

## Test Equipment

291

Complete specifications and data on this firm's line of test and measuring equipment are presented in Catalog No. 54-A. Listed are an i-f sweep generator; beat frequency oscillators; audiomatic generators; a transmission measuring set; signal generators; a capacity-resistance-inductance bridge; and an extended audio oscillator. Clough-Brengle Co., Dept. EX, 6014 Broadway, Chicago 40, Ill.

## Capacitors

292

A comprehensive 48-page catalog (AC-4) shows the latest types, complete listings, and technical data on electrolytic, paper foil, and metalized paper capacitors available from this company. Paper foil and metalized paper units are arranged according to operating temperature and performance characteristics as well as by case types. This arrangement makes it easy for the user to determine, select, and specify capacitors to meet specific electrical and mechanical requirements. Astron Corp., 255 Grant Avenue, East Newark, N. J.

## NOISE

### FIGURE TEST SET



Simplifies measurement of tuner noise figure of any receiver. Test set combines broad band I.F. Amplifier, built in 3db network and output indicator, and regulated power sources. Permits uniform consistent measurements of noise factor, observation of tuner R.F. selectivity.

#### FEATURES: MODEL HF-20

- Band-width 10 mc centered 20, 30, 40, or 60 mc
- Ideal for production testing or incoming inspection
- Employs most accurate NF test method
- Plate and bias voltages electronically regulated
- Provisions for accommodating variety input circuits

WRITE FOR CATALOG

**LINEAR** EQUIPMENT LABORATORIES  
MASSAPEQUA, L. I., N. Y.

## VHF-UHF

### REFLECTION BOX



Specifically designed to facilitate the measurement of reflection coefficient of VHF and UHF tuners and converters. Enables simple visual observation of the ability of a tuner to provide a proper match to a 300 ohm transmission line over the VHF and UHF TV bands

#### FEATURES:

- Aids in design of tuner input and coupling networks
- Eliminates cumbersome, unsightly transmission line installations in lab or factory.
- Increases sensitivity in measurements of impedance
- Permits accurate measurement of attenuation
- Models available 50 or 75 ohm source; VHF-50-220 mc or UHF-470-890 mc

WRITE FOR CATALOG R-9

**LINEAR** EQUIPMENT LABORATORIES INC.  
MASSAPEQUA, L. I., N. Y.

CIRCLE ED-290 ON READER-SERVICE CARD FOR MORE INFORMATION

# A HIGH PERFORMANCE MAGNETIC *SERVO* AMPLIFIER

**- expressly designed for high temperature Mark 7 and 8 Servo Motor applications**



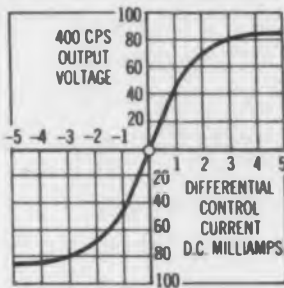
Features of the  
PRD Type R40G10W1  
Magnetic Amplifier:

- Response time of one cycle
- Temperature range  $-55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  with normal servo duty cycles
- Hermetically sealed reactor unit only  $2\frac{1}{2}$ " high and  $2\frac{1}{4}$ " diam., weighs less than 12 oz.
- Power supply  $115\text{V} \pm 10\%$ , 400 cps  $\pm 10\%$ , single phase
- Rugged design meets MIL-5272 Procedure I Vibration Spec.

**Specify this improved  
Magnetic Amplifier for  
Miniaturization plus!**



The R40G10W1 can be supplied as illustrated or with built-in magnetic, transistor, or vacuum tube pre-amplifier. In all cases, no additional power supply is required. The moisture and fungus proofed rectifier is supplied for external mounting. Containing a minimum number of components, the R40G10W1 assures the utmost in ruggedness and long, trouble-free life at minimum cost. It is ideal for use in servo systems requiring up to 10 watts amplifier output such as the control phase of Mark 7 and Mark 8 servo motors. Write for information on the R40G10W1 or send your specifications for applications of magnetic servo amplifiers, low level amplifiers, or regulators of voltage, frequency, speed, and torque.



TRANSFER CHARACTERISTIC

*Polytechnic*

RESEARCH

& DEVELOPMENT CO • Inc

Telephone:  
ULster 2-6800



202 TILLARY STREET, BROOKLYN 1, N.Y.

CIRCLE ED-297 ON READER-SERVICE CARD FOR MORE INFORMATION

# miniatures of Mighty Importance



U.S.G. Stand-off and Feed-through Insulators made with tough TEFLON, are fast supplanting units made with brittle glass.

TEFLON's superior insulating characteristics made these miniatures possible. Here are their features:

Better for high frequency, high temperature service. Higher surface and volume resistivity. Lower loss factor. Higher dielectric strength. Wider service temperature range ( $-110^{\circ}\text{F.}$  to  $+500^{\circ}\text{F.}$ ). Zero water absorption (A.S.T.M. Test). Won't carbonize under arcing or DC-plate. Non-flammable, non-gassing, chemically inert.

Read these Points for Assembly Savings and Service Satisfaction.

#### COMPRESSION MOUNTING

impossible with glass. Fits like a cork. Also withstands shock and vibration in service. Assembly costs greatly reduced. No additional mounting hardware or soldering required.

#### PLASTIC MEMORY

securely locks insulator permanently in place. Minimum pull

test 10 lbs., insulator to hardware, insulator to deck.

#### MINIATURIZATION

is easily accomplished.

#### NINETEEN STOCK SIZES

including sub-miniatures, in Stand-off and Feed-through types. Other dimensions feasible.

• Write for Catalog No. EC-1153

**UNITED  
STATES  
GASKET  
COMPANY**

  
**FLUOROCARBON  
PRODUCTS, INC., DIVISION  
CAMDEN 1 • NEW JERSEY**

Representatives in Principal  
Cities Throughout the World

CIRCLE ED-301 ON READER-SERVICE CARD FOR MORE INFORMATION



## New Literature . . .

### Component Parts 302

A 100-page catalog (Bulletin GEC-1025) contains complete information for original equipment manufacturers who incorporate electrical components into their products. Components covered include circuit breakers, disconnect switches, open knife switches, and component parts used in switchboards and panel boards. General Electric Co., Trumbull Components Dept., Plainville, Conn.

### Plastic Components 303

This bulletin, contained in a filing cover unit, together with engineering reference sheets on plastic component parts for connectors, offers a complete line of precision-machined plastic components. Made in standard sizes or in accordance with exact specifications, the components can be machined from any plastic material required, such as "Teflon", "Kel-F", "Nylon", laminated phenolics, etc. Tri-Point Manufacturing and Developing Co., Inc., 401 Grand St., Brooklyn 11, N. Y.

### Capacitors 305

Paper, electrolytic, mica, ceramic plastic-film, and special-purpose capacitors are illustrated with complete technical data in this 91-page, spiral-bound catalog (No. GA217/7M/354). A line of subminiature tubular electrolytics specially designed for use with transistors is included. Among the paper types, are many models developed for operation at extremes of temperature and humidity. Capacitors for pulse-forming networks are included in the special-purpose types. Telegraph Condenser Co., Ltd., Radio Div., North Acton, London, W. 3, England.

### Test Standard

Methods of testing rubber insulated wire and cable are covered in a new American Standard (No. C8.22-1954). Tests for physical properties, aging, voltage, insulation resistance, moisture absorption, ozone resistance, and flame tests are included. The price is \$0.50. Write direct to the American Standards Association, 70 East 45th St., New York 17, N. Y.

for all applications  
requiring exceptionally  
high insulation  
resistance and unusual  
stability at high  
temperature



2082 Lincoln Ave.,  
Altadena, Calif.  
SYcamore 8-1185  
Offices in  
WASHINGTON, D.C.  
and DETROIT

## HOPKINS "HY-THERM"

New sub-miniature  
high temperature

## CAPACITOR

Hermetically sealed and metal encased, new HY-THERM capacitors have been designed to meet or exceed military requirements (Mil-C-25A). Example: At 125°C the minimum insulation resistance is 20 megohm-microfarads and maximum insulation resistance is 500 megohms. Available in all standard values and tolerances. Variety of mounting and circuit combinations. Special units designed to meet individual requirements.

**HOPKINS**  
*Engineering Co.*

Have a special problem? Write,  
wire or phone for details, TODAY!  
Catalog available.

CIRCLE ED-304 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1954

Circ

Th  
appli  
tectiv  
in co  
and c  
break  
delay  
other  
conce  
tectio  
trate  
449 I

Pack

Th  
scrib  
any  
the P  
tion  
The  
the r  
and  
in re  
and  
or r  
33 W

ELEC

## Circuit Breaker Engineering 310

This 24-page booklet is a guide to the application of circuit breakers to protective and control functions. It describes in complete detail the principle, design, and operation of hydraulic-magnetic circuit breakers. Included in the guide are time delay curves, impedance charts, and much other data of practical value to anyone concerned with circuit or equipment protection. Photographs and diagrams illustrate the text. Heinemann Electric Co., 449 Plum St., Trenton 2, N. J.

## Packaging 311

This 4-page folder illustrates and describes the research, design, and testing of any type of product packaging, carrying the project through to the actual production packaging, final crating, and shipping. The brochure also covers briefly some of the modern techniques, skills, equipment, and materials which have been developed in recent years to provide more efficient and economical packaging for industrial or military products. Webhart Corp., 33 West Union St., Pasadena 1, Calif.

## Mercury Plunger Relays 313

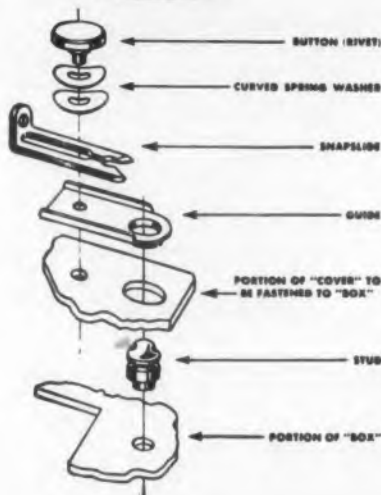
The information contained in this brochure gives full facts and information on the company's line of UL-approved mercury plunger relays. Applications cover a broad industrial field, from new equipment manufacture and design to plant control and maintenance. All electrical characteristics and ratings are included. Ebert Electronics Corp., 212-26 Jamaica Ave., Queens Village 26, N. Y.

## Adhesives 314

This new illustrated leaflet (No. 130) covers a full range of adhesives for use with Mylar polyester film. Such applications as Mylar to paper, aluminum foil, steel, vinyl, and polyethylene are described and illustrated, along with recommendations as to the adhesives to be used for each lamination, plus the characteristics provided by the adhesive: high temperature, color stability, resistance to heat in electrical usage, metallic yarns, linings, etc.; and resistance to outdoor weathering. Rubber and Asbestos Corp., Dept. P, Bloomfield, N. J.



## How can YOU use this simple, rugged SNAPSLIDE FASTENER?



This positive, quick-action fastener was originally developed to hold airborne equipment with security—even under severe stress and shock of carrier-based aircraft operations—and yet permit equipment replacement in a matter of seconds.

A wide variety of industrial uses has been found for the fastener. Perhaps you can use it profitably. It requires no tools; thumb and finger fasten and release. Even with repeated use no adjustments are necessary. Available in two sizes, with parts to match different thicknesses of mounting plates.

Write for details.

Dependable Airborne Electronic Equipment Since 1928

**AIRCRAFT RADIO CORPORATION**  
BOONTON, NEW JERSEY



CIRCLE ED-312 ON READER-SERVICE CARD FOR MORE INFORMATION

the  
"MACH MASTER"

*Lightweight*

**RUGGED**

**RELIABLE**

(No Vacuum Tubes)



Pin-point accuracy, ruggedness and exceptional lightweight (4½ lbs.) are features of Servomechanisms' "Mach Master". This precision-built 400 cycle computer utilizes a force balance linkage to determine Mach number, thus eliminating vacuum tubes and other complexities. Pressure ratio is measured directly.

The "Mach Master," when combined with a temperature bulb and relative wind detectors, produces outputs proportional to Mach number, true air speed, true angle of attack, true angle of yaw, altitude, air density and free air temperature. These outputs are readily useable in other computer equipment or may be made available for visual indication.

The highly efficient and rugged equipment meets all appropriate military specifications.



**RELATIVE WIND TRANSDUCER**

Produces an electrical output proportional to the angle it measures.

*For additional information write to:*

**SERVOmechanISMS** INC.

EL SEGUNDO DIVISION . . . 316 Washington St., El Segundo, Calif.  
WESTBURY DIVISION . . . Post & Stewart Aves., Westbury, N. Y.

CIRCLE ED-315 ON READER-SERVICE CARD FOR MORE INFORMATION



# LOWER YOUR SET COSTS WITH THIS LOWER-PRICED DEPENDABLE SPEAKER

A line of 4" and 5" speakers designed for peak performance. Break off or cast magnet may be used.

Low priced only because of unusually efficient manufacturing techniques.

Produced under rigid quality control. Metal stampings completely manufactured in our own Tool, Die and Punch Press Departments. Exceptionally thorough final inspection.

Plugs, transformers and/or brackets to your specifications.

Lower your set costs with this dependable speaker. Write for further information TODAY.



OTHER HEPPNER PRODUCTS:  
Ion Traps, Centering Devices, Fly-  
Back Transformers and Focomags.

## HEPPNER

MANUFACTURING COMPANY  
ROUND LAKE, ILLINOIS  
(50 Miles Northwest of Chicago)  
Phone: 6-2161  
Specialists in Electro-Magnetic Devices

Representatives:

JAMES C. MUGGLEWORTH, 324 Haddon Avenue, Collingswood 7, New Jersey • RALPH HAFEEY, R.R. 1, U.S. 27, Coldwater Rd., Ft. Wayne 8, Indiana • IRV. M. COCHRANE CO., 408 So. Alvarado St., Los Angeles, Calif. • JOHN J. KOPPLE, 60 E. 42nd St., New York 17, N. Y.

CIRCLE ED-319 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Literature . . .

### Computer Potentiometers 320

*Characteristics of Precision Servo Computer Potentiometers*, by D. C. Duncan, is a 12-page technical paper (No. 341) originally presented at the AIEE Conference on Feedback Control Systems. It discusses linearity and sets forth data on research, development, and trends in precision potentiometers. It is fully illustrated with charts and diagrams. Helipot Corporation, 916 Meridian Ave., S. Pasadena, Calif.

### Panel Meters 321

An engineering data sheet gives complete information on 1-1/2" DB panel meters for commercial and military applications. Weighing less than three ounces, the instruments are constructed to meet applicable government specifications and are housed in metal cases with watertight seals. Both round and square types are supplied, and all are self-contained, individually calibrated, and ready for use. International Instruments, Inc., P. O. Box 2954, New Haven 15, Conn.

### Indicating Instruments 323

This 4-page technical brochure describes the company's line of standard range electrical indicating instruments. These instruments are available in round, square, and rectangular models and are adaptable to most panel uses. Electronic Sales Div., De-JUR Amseco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.

### Vacuum Furnaces 324

Applications of vacuum furnaces in melting and casting about 30 new metals which have been added to the industrial spectrum are described in a brochure entitled, "High Vacuum Furnaces, Their Use and Application". Covering sintering, annealing, hardening, brazing, and de-gassing, the booklet discusses at length this rapidly growing field of vacuum metallurgy, and includes a comprehensive treatment of the effects of processing various metals and alloys in vacuum. Further, it presents illustrations and drawings with descriptions of several types of vacuum furnaces now being built by the company. F. J. Stokes Machine Co., 5500 Tabor Road., Philadelphia 20, Pa.

## encapsulated PULSE TRANSFORMERS wound to your requirements

### SMALL IN SIZE Weight—1/3 oz.



Write for Bulletin 166 E  
for additional information  
and specifications.

### SMALL IN PRICE

**T**  
**ECHNITROL**  
ENGINEERING COMPANY  
2751 N. 4th St., Philadelphia 33, Pa.

CIRCLE ED-322 ON READER-SERVICE CARD FOR MORE INFORMATION

## Connector Charts

328

To facilitate selection and identification of this company's line of connectors, multi-colored wall charts are available. They list insulated and uninsulated compression terminal and link sizes up to 2/0. Each connector is listed with the conductors accommodated, tooling required for installation and, for terminals, the screw sizes accommodated. There are three charts in the series. Burndy Engineering Co., Inc., Norwalk, Conn.

## Alloy Designation System

329

A 6-page pamphlet describes the new alloy designation system developed by the Aluminum Association for wrought aluminum and aluminum alloy products. The system, effective Oct. 1, 1954, was developed as a result of the growth of the aluminum industry and the multitude of alloys and commercial designation systems in use. None of these systems was adequate for all alloys as this one is believed to be. The Aluminum Association, 420 Lexington Ave., New York 17, N. Y.

## Phase Meter

331

This two-color brochure illustrates and describes the firm's "Phazor" Phase Meter Model 200A for precision phase measurements. It covers the instruments principle of operation, and gives its complete technical specifications, and outstanding features. Industrial Test Equipment Co., 55 East 11 Street, New York 3, N. Y.

## Gear Drives

332

"ANGLgear" standardized right angle bevel gear units for aircraft and industry are illustrated and described in this two-color, 4-page catalog. Featured are drawings showing how "Coniflex" bevel gears (which recently replaced straight tooth gears in the units) utilize the principle of localized bearing to give quieter, cooler operation and maximum service life. A cutaway illustration shows the important design features of the unit. These include Coniflex gears, anti-friction bearings, flanged end mountings, three-bolt side mounting, and internal pilot on mounting sides. Applications are also given. Airborne Accessories Corp., 1414 Chestnut Ave., Hillside, N. J.

**ONLY I.E.R.C. tube clamps eliminate vibration resonance effects— assure longer tube life in missile uses!**

**ONLY I.E.R.C. tube clamps give lowest bulb temperature and increased tube reliability!**

Patent pending

The I.E.R.C. subminiature shield has no resonances when shaken at 10G from 0 to 2000 cycles. The shield relies upon intimate contact of the soft pure silver with the bulb to conduct heat from the tube to the heat sink, and in all cases holds the tube firm in relation to the heat sink.

Use of the I.E.R.C. shield provides the *only method*, with the exception of potting, that does not have a resonant condition of a tube and shield combination. Any high spots existent on the tube readily embed themselves with the soft silver of the shield preventing the movement of a tube in relation to the silver.

I.E.R.C. subminiature tube clamp shields reduce bulb temperature more than any other type shield or mounting procedure and result in a maximum temperature gradient of 5° C per watt of plate dissipation between the bulb of the subminiature tube and the heat sink when the shield is either soft or silver soldered to the heat sink.

I.E.R.C. can also supply, on request, aluminum subminiature shields. The aluminum subminiature shields are ideal for use where aluminum chassis are used and may be spot welded or aluminum welded directly to the chassis.



**free booklets!**

There's a wealth of practical engineering information, graphs, test

facts on miniature and subminiature tube clamps in these booklets. Write on company letterhead for your copies.

# International

**electronic research corporation**  
177 WEST MAGNOLIA BOULEVARD • BURBANK, CALIFORNIA  
REPRESENTATIVES

NEW YORK: B. B. Taylor Company,  
Rockville Centre, Rockville Centre 6-1014  
MASSACHUSETTS: Malliday-Nathaway Inc.,  
Cambridge, Eliot 4-1751

CALIFORNIA: G. S. Marshall Co.,  
Pasadena, Ryan 1-9663  
ILLINOIS: Magnuson Associates,  
Chicago, Kildare 5-4426

CIRCLE ED-330 ON READER-SERVICE CARD FOR MORE INFORMATION

Opening vast  
new fields  
in automatic  
circuitry . . .



*Sterling's* **NEW**

# BI-DIRECTIONAL STEPPING SWITCH

GOING FAR BEYOND the limitations of stepping switches that operate in only one direction, STERLING'S new Type SS Stepping Switch operates in *both* directions!

This *bi-directional* stepping switch, having *two* driving magnets, is normally equipped with a 4-level, 12-position bank and wipers. The wiper shaft is rotated—either clockwise or counterclockwise, in 10° increments—by an intermittent ratchet-and-pawl action, depending on which of the electro-magnets is energized. Interrupter contacts act as an interlock to protect against partial steps and to permit self-stepping. Limit switches stop rotation at the end of the bank travel. Coils are available for DC currents up to 120 volts.

The range of possibilities of Model SS as a stepping switch alone is extremely wide . . . differential counting, remote selection of circuits under control of impulses, as a digit-storage register in automatic computers, etc.

Without wipers, the impulse-operated "motor" may be adapted to position servo-motors or potentiometers. Designers of automatic machinery will undoubtedly find many more uses for this versatile, new STERLING product.

For further details, write STERLING ENGINEERING COMPANY, INC., 54 Mill Street, Laconia, N. H. (Subsidiary of American Machine & Foundry Company).



CIRCLE ED-333 ON READER-SERVICE CARD FOR MORE INFORMATION





## SPECIAL OPPORTUNITIES FOR ELECTRONIC ENGINEERS

Convair in beautiful, sunshiny San Diego invites you to join an "engineers" engineering department. Interesting, challenging, essential long-range projects in missiles, engineering research and electronics development. Positions open in these specialized fields:

Microwave Antennae	Dynamics Testing
Microwave Components	Telemetry
Electronic Packaging	Servomechanisms
Mathematical Physics	Electron Tubes
Electronic Components	Radome Design
Electronic Systems	Digital Computers
Applied Mathematics	Test Equipment
Transmitters & Receivers	Miniature Circuits

Generous travel allowances to those accepted. For free brochure, write Mr. H. T. Brooks, Engineering Dept. E-9

# CONVAIR

IN BEAUTIFUL  
**SAN DIEGO**

Division of General Dynamics  
3302 PACIFIC HIWAY  
SAN DIEGO 12, CALIFORNIA



## New Literature . . .

### Colloidal Dispersions

341

How "dag" colloidal dispersions serve industry in a wide range of uses is thoroughly treated in Bulletin No. 460. A centerfold table lists 40 basic dispersions of graphite, molybdenum disulfide, vermiculite, and zinc oxide in carriers such as water, oil, volatile hydrocarbons, resin solutions, alcohol, glycol, and wax emulsions. Comparative particle size and consistency of each dispersion are given, as well as dilution information and typical applications.

In addition to the more common lubrication and electrical applications, selected dispersions are used as interior and exterior coatings for television tubes, in mark-sensing inks for business machines, and in lubricant formulations for extreme-temperature or extreme-pressure operations. Acheson Colloids Co., Div. of Acheson Industries, Inc., Port Huron, Mich.

### Audio Equipment

342

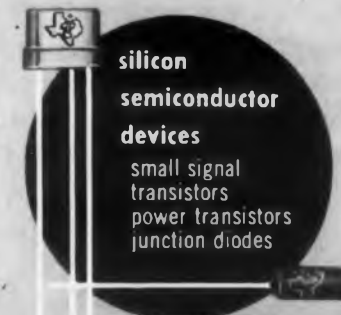
This new catalog, in condensed form, gives basic facts about the company's products developed and produced for the audio and video fields. It illustrates and describes microphones for TV broadcasting, public address, paging, recording, and communications systems. It also covers high-fidelity speakers, components, enclosures, and complete 2-, 3-, and 4-way reproducing systems; phono-cartridges for high-fidelity reproduction and general record player replacement use; CDP public address loud speaker systems; v-h-f, u-h-f and f-m boosters. Electro-Voice, Inc., Buchanan, Mich.

### Wire Standards

These 11 American standards just published by the ASA list specifications for various types of insulated wire and cable. Specifications are included for physical properties, voltage test, insulation resistance, thickness, and workmanship for the following types of insulated wire and cable: (1) Performance Synthetic Rubber Compound (No. C8.23-1954); (2) Heat-Resisting Synthetic Rubber Compound (No. C8.24-1954); (3) Rubber Sheath Compound (No. C8.25-1954); (4) Performance Rubber Compound (No. C8.26-1954); (5) Heat-Resisting Rubber Compound (No. C8.27-1954); (6) GR-S Synthetic Rubber Compound (No. C8.28-1954); (7) Ozone Resistant Type Insulation (No. C8.29-1954); (8) Polyvinyl Insulating Compound (No. C8.30-1954); (9) GR-M Polychloroprene Sheath Compound Where Extreme Abrasion Resistance Is Not Required (No. C8.31-1954); (10) GR-M Polychloroprene Sheath Compound (No. C8.32-1954); (11) Thermoplastic Vinyl Polymere Sheath Compound (No. C8.33-1954). The standards are each priced at \$0.35. Write direct to American Standards Association, 70 East 45th St., New York 17, N. Y.

select your  
**semiconductor  
devices**  
from TI's wide  
range

Outstanding research-to-production teamwork makes Texas Instruments your best source of supply for reliable semiconductor devices. The new *silicon* transistor—produced first by TI in commercial quantities—is the most recent result of this teamwork. All TI semiconductor devices are glass-to-metal hermetically sealed and are tested over 20 times before shipment.



**silicon  
semiconductor  
devices**  
small signal  
transistors  
power transistors  
junction diodes



**germanium  
general purpose**  
p-n-p alloyed  
junction transistors  
n-p-n grown junction  
transistors  
grown junction tetrodes  
power transistors  
photo transistors  
point contact  
transistors



**hearing aid  
transistors**



**WRITE FOR LITERATURE:**  
Detailed information is  
available on every type in  
the complete TI line of  
semiconductor devices.

**TEXAS INSTRUMENTS**  
INCORPORATED  
6000 LEMMON AVENUE, DALLAS 9, TEXAS

CIRCLE ED-343 ON READER-SERVICE CARD

## Insulating Material

349

Designed for low-loss, high frequency service, unaffected by a wide range in ambient temperatures, pressures, altitudes, mechanical shock and vibration, this firm's line of "Chemelec" stand-off and feed-through insulators is presented in a 12-page illustrated catalog, designated Bulletin No. EC-1153. Two series of miniature and subminiature stand-off insulators, and four series of feed-through insulators are shown. Fluorocarbon Products, Inc., div. of U. S. Gasket Co., Camden 1, N. J.

## Pressure Switches

350

A complete line of aircraft fluid pressure switches is described in Bulletin 101. Both metallic diaphragm and metallic bellows types are included in the series, and every instrument meets basic military standards. Pressure, high and low differential pressure, altitude and other special purpose switches are described, together with float switches also manufactured by the company. Aircraft Controls Co., Division of Gorn Electric Co., 883 Main Street, Stamford, Conn.

## Set Screws

352

Catalog No. 19 is a 24-page booklet devoted to the description, technical data, reference and price information on this manufacturer's line of set screws of both the conventional and self-locking types. Among the unusual features of the catalog are an enlarged section on general screw thread data, a preview of other set screws soon to be commercially available, and illustrations of the various set screw problems solved by this company. Set Screw and Manufacturing Co., 265 Main St., Bartlett, Ill.

## Engineering Services

353

"A Story of Accomplishment" is the title of an 8-page booklet that describes and illustrates the design, development, production, and assembly work done by this organization for the electronics industry. Complete lines of products, including power supplies, gasoline and diesel electric power plants, dry batteries, and telecommunications equipment. Allied International, Inc., Allied Engineering Div., 230 Park Ave., New York 17, N. Y.

**NEW**

We're Glad we Bought a  
**HIGHER ATTENUATION**  
**SCREEN ROOM**



*Lindgren* "AMERICAN 40"

**LONGER LIFE . . . GREATER EFFICIENCY . . .  
IMPROVED COMFORT . . . LOWER COST!**



When you buy screen rooms it pays to get **HIGHEST GUARANTEED ATTENUATION** to take care of future as well as present needs. Due to exclusive construction features, Lindgren true-isolated, double shielded **BRONZE** Screen rooms offer high attenuation (128 DB) at lower cost than cell type rooms rated below 100 D.B. Bronze lasts longer, costs less, is self-ventilating through open mesh. Also available in Copper up to 146 D.B.

Meets U. S. Gov't performance specifications

**CONSISTENTLY HIGHEST ATTENUATION**  
"In our experience, your screen rooms consistently showed highest attenuation."  
—(Engineering Report.)

**Get this FREE BOOK**  
Gives construction diagrams, complete specifications, photos, sizes, prices, performance charts, engineering reports . . . Everything you need to know to buy Screen Rooms intelligently. Send for "Screen Rooms" of Quality, before you decide your screen room purchase.



**ON DISPLAY** National Electronics Convention, Booth 73 Sherman Hotel, Chicago, October 4-6

**ERIK A. Lindgren & ASSOCIATES**  
Established 1939 Phone SUnnyside 4-0710  
DEPT. D, 4515-17 N. RAVENSWOOD AVE. CHICAGO 40, ILL.


CIRCLE ED-354 ON READER-SERVICE CARD FOR MORE INFORMATION



NOW! SPECIFICATION STRIPING ON TEFLON HOOK-UP WIRE... ANOTHER TENSOLITE "FIRST!" New TENSOLON high temperature Teflon insulated hook-up wire is striped with one broad and one or two narrow stripes for circuit identification. Teflon inks fused into the insulation make sequence of colors easily distinguishable. Striping conforms to commercial (GEN-104) and military (MIL-W-76A) specifications for color coding. Wire sizes available from No. 26 to No. 10 AWG with 819 different striping combinations possible. Insist on TENSOLON when specifications call for...

*Breaking The Temp Barrier!*

**TENSOLON**  
TEFLON<sup>®</sup> INSULATED  
**WIRE & CABLE**



Tensolite has complete fabricating facilities for solving your high temperature wire problems —

- PARALLEL WRAPPED TEFLON
- SPIRAL WRAPPED TEFLON
- EXTRUDED TEFLON
- SPIRAL STRIPING WITH  
TEFLON INKS

Watch Tensolite for progress in electronic wiring — inquiries are invited.



NEW! 16 pages of specifications and data covering the complete Tensolite line; a note on your letterhead will bring your copy promptly.

*Tensolite*  
**INSULATED WIRE CO • INC**

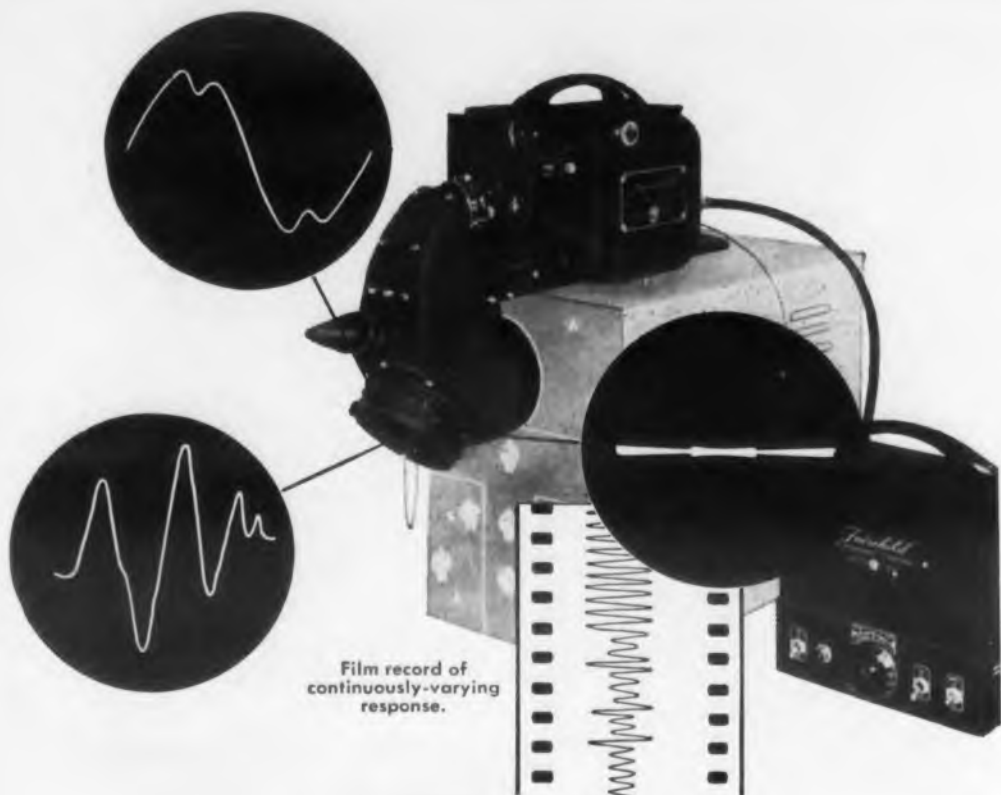
© Du Pont

TARRYTOWN, NEW YORK — TARRYTOWN 4-2300

**Tensolite products include:** TENSOLON — Teflon Hook-up Wire to MIL-W-16878A and Miniature Teflon Jacketed Cables; TENSOLEX—Vinyl Insulated Wires to JAN-C-76, MIL-W-76A, MIL-W-16878A; TENSOLITE — Super-flexible Constructions including Phonograph Pick-up Cables and Hearing Aid Cordage.

CIRCLE ED-351 ON READER-SERVICE CARD FOR MORE INFORMATION





Film record of continuously-varying response.

# the **FAIRCHILD** Oscillo-Record Camera **WILL CATCH ANY TYPE PATTERN**

Any type of wave pattern—stationary, single-transient or continuously varying, can be photographed with the Fairchild Oscillo-Record Camera. Film speed is electronically controlled and continuously adjustable for all speeds from 1 to 3600 inches per minute (on special order, 2 to 7200 inches per minute). You can adjust to the correct speed for maximum clarity without wasting film. The sprocket film drive eliminates film slippage.

The Oscillo-Record will accommodate either 100-, 400- or 1000-foot lengths of 35 mm film. The entire length of film can be exposed at any speed. Fairchild's top-of-scope mounting permits easy adjustment of the oscilloscope controls and eliminates the use of a tripod.

### Fairchild-Polaroid® Oscilloscope Camera

You can produce a print of any stationary or single-transient pattern in one minute with this Fairchild camera. The trace reads from left to right and is reduced to exactly one-half life size for easy measurement. Two images may be exposed on each 3¼ x 4¼ print.

For more information on Fairchild oscilloscope cameras and how they can assist you in engineering and research analysis, write *Fairchild Camera and Instrument Corporation, Robbins Lane, Syosset, L. I., N. Y., Department 120-22G1.*

# FAIRCHILD

**OSCILLOSCOPE RECORDING CAMERAS**

CIRCLE ED-360 ON READER-SERVICE CARD FOR MORE INFORMATION

# Patents . . .

**Electrical Condenser . . . Patent No. 2,668,936.** *Preston Robinson (Assigned to Sprague Electric Co., North Adams, Mass.).*

Rolled paper and stacked mica capacitors as made require a margin of at least 0.05" between the edge of the conductive coating or foil and the edge of the insulation for the purpose of reducing the possibility of breakdown between the edges of adjacent conducting foils. Such margins increase the ratio of volume to capacitance of the condensers. Attempts have been made to achieve a higher capacitance at small volume by dipping the conducting foil in waxes and lacquers or by electrophoretic deposition in an attempt to avoid the use of dielectric spacers. Ceramic coatings have also been tried. These various methods either fail to secure or find it difficult to secure adequate insulation at the edges of the foil.

A capacitor of high capacity with relatively low volume is constructed by using electrode foils (10, Fig. 1) of less than 0.0005" thickness which are coated with a suitable dielectric material (12 and 13) having a thickness of less than 0.005". Suitable foils are made of aluminum, tantalum, or titanium. Many suitable dielectric materials are mentioned. The coated

foils are processed, either before or after being made into a finished capacitor, to oxidize all exposed surfaces of the foil and particularly the edges (14 and 15) of the foil. The oxidation is secured by immersing the condenser or coated foil in a film-forming electrolyte having a cathode therein and connecting all of the foil elements or terminals to the positive terminal of an electrical source. For high voltage capacitors, boric and citric acids dissolved in water or a solvent are suitable electrolytes. For low-voltage capacitors, the electrolyte may be oxalic, sulfuric, succinic or chromic acid. Upon completion of the oxidation step, the insulated foil or capacitor is washed and dried.

The oxidized edges of the foil fully insulate the same at the points where breakdowns are most likely to occur. It has been found, too, that the oxidation process will also correct any other defect or break in the insulation on the foil such as pin holes, cracks and the like. One final form of capacitor is shown in Fig. 1.

**Vertical Synchronization Circuit for Television Receivers . . . Patent No. 2,672,510.** *Kurt Enlein. (Assigned to Stromberg-Carlson Co., Rochester, N. Y.)*

The vertical scanning generator of a television receiver may be controlled by simply integrating the composite synchronization signal and applying the integrated signal to the generator. This direct method is sensitive to noise and in addition noise may block an amplifier so that consistent triggering of the generator is not secured. The use of resonant circuits have been considered as noise discriminators. However, they are not too satisfactory at the low frequencies at which vertical synchronizing generators operate, and are costly as well. Receivers may utilize an automatic frequency control

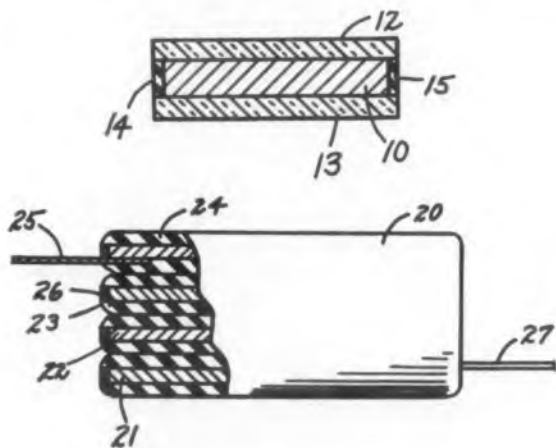


Fig. 1. Construction details of this mica capacitor are shown at the top.

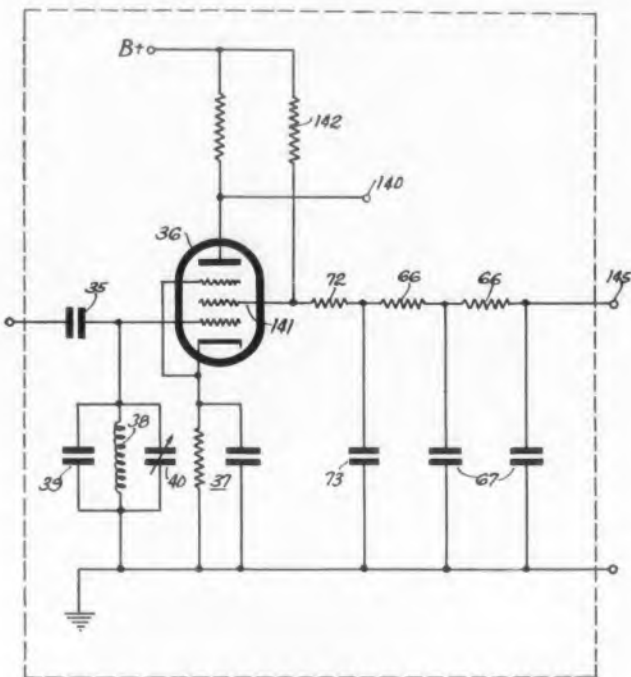
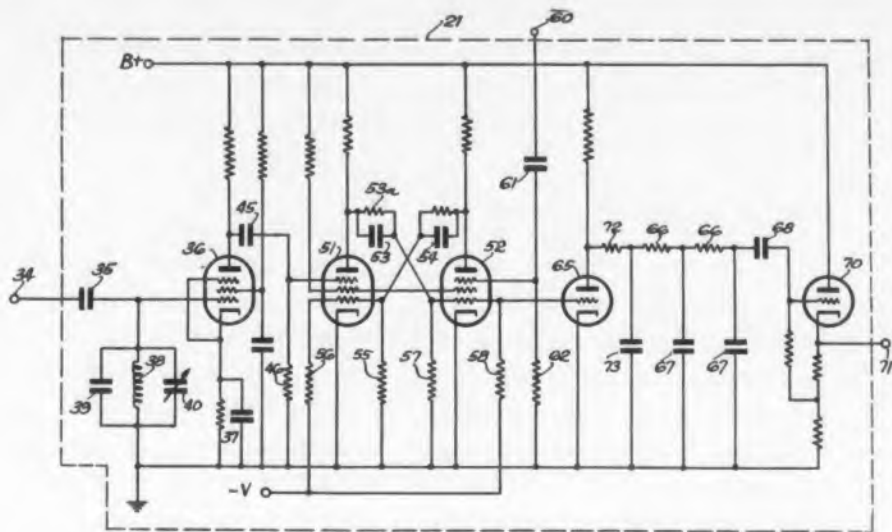


Fig. 2. Two forms of an inexpensive vertical synchronization circuit for television receivers.

circuit for the horizontal scanning generator; however, the addition of such a circuit for the vertical scanning generator would be costly.

A circuit for the control of the vertical scanning generator is shown in Fig. 2, top, which discriminates against noise voltages, is stable, and is expensive. The circuit includes a tuned circuit (38, 39, 40) that is tuned to a frequency well above that of the horizontal synchronizing signal so that damped, sinusoidal wave trains are produced that decay before the next synchronization pulse is received. Substantial noise discrimination is secured by making this tuned circuit of narrow band width. The damped waves are amplified and their polarity is reversed by tube 36. The amplifier is coupled with the suppressor grid of an Eccles-Jordan trigger circuit consisting of tubes 51 and 52, which are alternately switched from a conductive to non-conductive state upon the application of a negative control pulse

derived from the horizontal scanning generator and applied to terminal 60 and the suppressor grid of tube 52. The trigger circuit is sensitive to negative pulses only and insensitive to positive pulses. A composite synchronization signal is therefore reconstructed at the control grid of tube 52 and applied to the integrating network (66, 67) through a driven tube (65). A positive signal for control of the vertical sweep generator is derived from the cathode connection (71) of cathode follower tube 70, which is coupled to the integrating network.

The trigger circuit affords substantial discrimination against noise and furthermore, since it is controlled from the pulses of the horizontal scanning generator, is stabilized by the automatic frequency control circuit of the latter. The patentee also describes a simpler circuit (Fig. 2, bottom) for controlling the vertical scanning generator, which also provides substantial noise discrimination.



# New FOR STILL FASTER COMPUTERS

G.E.'s high-perveance, high-capacity twin triode . . .

**H**IGH CURRENT OUTPUT enables the GL-6463 to maintain voltage when tube plate resistance is lowered for extra-fast computer circuits now being developed. Ample plate dissipation assures long and dependable tube performance under high-output conditions.

Get ratings, performance curves, and prices on this newest G-E tube to be designed, built, and life-tested for computer service! *Tube Department, General Electric Company, Schenectady 5, N. Y.*

Three special twin triodes are the first types in General Electric's extensive program of computer-tube development. Step-up in capacity gives you a choice for different circuit needs. **▶**

GL-5844	GL-5965	GL-6463
.5 w dissip. per plate	2.2 w dissip. per plate	4 w dissip. per plate
1 w tube dissipation	4 w tube dissipation	7 w tube dissipation
.3 amp heater current	.45 amp heater current	.6 amp heater current

## GL-6463

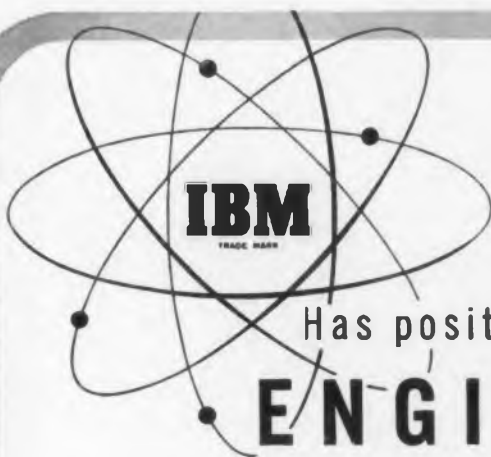
- Per plate: 28 ma avg current, 4 w dissipation.
- On-off dependability assured by special cathode design.
- Life-tested under cutoff conditions.



**GENERAL ELECTRIC**

162-1B12

CIRCLE ED-361 ON READER-SERVICE CARD FOR MORE INFORMATION



**WORLD'S LEADING PRODUCER  
OF ELECTRONIC ACCOUNTING  
AND COMPUTING MACHINES**

Has positions open for

# ENGINEERS

Challenging career opportunities await you in the company acknowledged to be the leader in its field.

Many positions are open now in an outstanding engineering organization engaged in electronic computer development. Men with BSEE degrees and some experience in design are required.

Excellent salaries, many educational opportunities, and generous employee benefits. Moving expenses paid to Poughkeepsie, N. Y.

Your inquiry will be treated confidentially. Send resume of education and experience to:

W. M. Hoyt, Dept. 686(9)

INTERNATIONAL BUSINESS MACHINES

590 Madison Ave., N. Y. 22, N. Y.

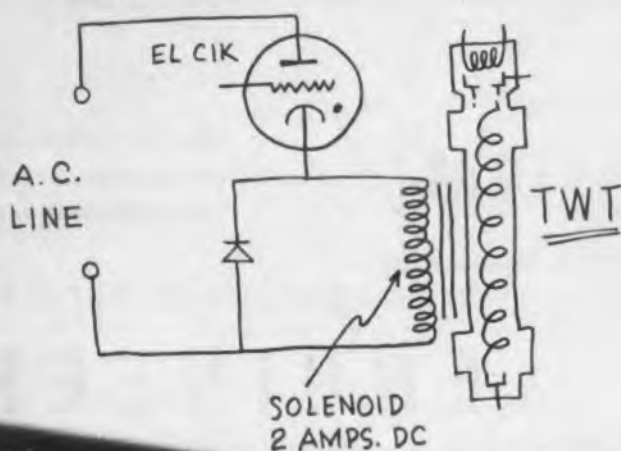


MEMO

*Traveling-Wave Tube  
Solenoid Power Supply*

*A simple thyatron circuit which has  
been used for electromagnet or field  
supplies and -*

- 1. Operates directly from the  
A.C. line.*
- 2. With simple grid circuits  
can adjust or regulate current  
as desired.*



**ELECTRONS, INCORPORATED**  
127 SUSSEX AVENUE  
NEWARK 3, N. J.

## Patents . . .

**Triangular Wave Generator . . . Patent No. 2,669,656. Larned A. Meacham. (Assigned to Bell Telephone Laboratories, New York, N. Y.).**

Generators of triangular waves are well known. They consist primarily of a multi-vibrator that generates a rectangular wave and this wave is then fed to an integrating circuit which is an indirect method of generation. The patentee has developed a new circuit that generates the wave directly. This circuit, shown in Fig. 3, is a modification of a two-tube slicer circuit.

The circuit for generating the triangular waves includes two triodes (1 and 2). A signal wave ( $E_i$ ) of the same frequency as that of the desired triangular wave is fed to the control grid of tube 1. As the grid goes positive from zero or approximately zero, tube 1 becomes conducting, which depresses the potential on the anode of the tube. As a consequence, a negative surge is transmitted through coupling condenser  $C_2$  to the control grid of triode 2

tending to drive this tube to cut-off. This action reduces current flow through the common cathode resistor  $R_3$  and reduces its potential drop, the effect of which is to increase current flow through tube 1. This action is regenerative and abruptly cuts off current flow through tube 2. Current continues to flow through a constant current choke coil ( $L$ ) provided in the anode circuit of tube 2 with a high load impedance, and charges condenser  $C_3$  at a constant rate. The charging of the condenser provides the increasing potential of the triangular output wave  $E_b$ .

The input wave passes through its peak and decreases to a point of approximately zero potential, during which time tube 1 behaves as a cathode follower with the cathode potential always above the grid potential. When zero potential is approached or reached, the cathode potential of tube 2 has fallen to a point where tube 2 begins to conduct and thereby prevents any further decrease in the cathode potential of tube 1. This action decreases current flow through the latter tube. In addition, potential drop across the anode re-



sistor  
potent  
2 so t  
transf  
tube 2  
Wit  
discha  
rate b  
would

**PERIPHERAL**

**MULTISTAGE BLOWERS**

**AIR-FILTER**

**HIGH  
STATIC PRESSURE**

**LOW VOLUME**

**LOW NOISE LEVEL**

**60 CPS — 400 CPS  
and DC**

ROTRON MODEL M multistage blowers direct-driven by INDUCTION motors, incorporate 3 to 9 cascaded impellers. Static pressures as high as 15 inch water column (at 60 CPS, 3400 RPM) and 80 inch water column (at 400 CPS, 7000 RPM) are obtained at air volumes ranging from 3 to 35 CFM. Also available with DC commutator motors. Extremely low noise level and low power consumption.

MODEL M blowers are available with integrally fitted filters of 3 different types. Shown above is Type 10016 down-filter, which removes finest dust particles. Also available with integral activated-carbon filters for use on silverplated microwave cavities.

SHOWN ABOVE is dual blower assembly combining multistage high-pressure blower and a conventional centrifugal blower, driven by one single induction motor, representing special assembly for use with General Electric air-cooled tetrode transmitting tubes.

**ROTRON MFG. CO.**

**7 Schoonmaker Lane Woodstock, N. Y.**

CIRCLE ED-365 ON READER-SERVICE CARD FOR MORE INFORMATION



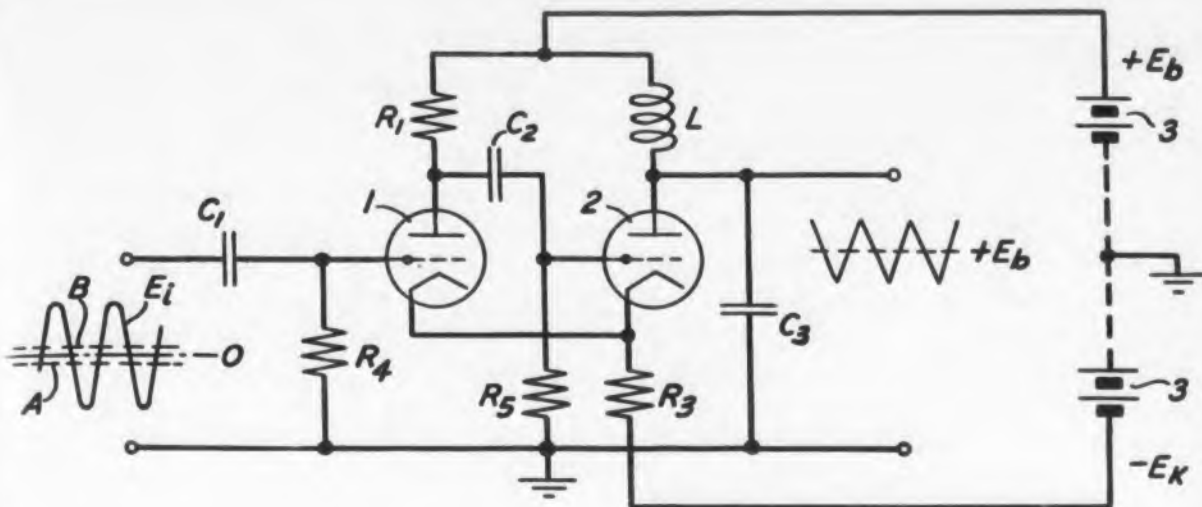


Fig. 3. This triangular wave generator is a modification of a two-tube slicer circuit.

sistor  $R_1$  decreases to provide a positive potential surge on the control grid of tube 2 so that it becomes conducting and the transfer of conduction from tube 1 to tube 2 is complete and abrupt.

With tube 2 conducting, condenser  $C_3$  discharges through the tube at a uniform rate because any reduction in the current would reduce the potential drop across the

cathode resistor, the effect of which is to increase the grid bias and increase current flow. The discharge of the condenser is therefore uniform and this provides the linearly decreasing potential of the output wave. The slope of each side of the output wave is the same provided the positive and negative sides of the input signal are the same.

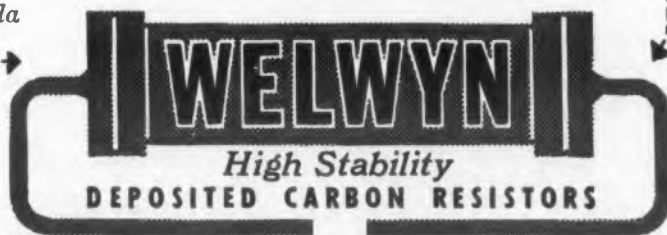
## NOW... *Insulated* DEPOSITED CARBON RESISTORS

After intensive study of the many special requirements arising in modern resistor applications, Welwyn has succeeded in developing a resistor-encapsulating process employing a new, insulating material. When thus applied, this material will withstand an applied potential of 8000 volts. Its insulating effectiveness is in excess of 100,000 megohms.

Welwyn insulated resistors can be placed contiguous to each other without the need for additional insulating material. In all other respects, these new insulated resistors offer the same performance and quality advantages generally associated with Welwyn Deposited Carbon resistors. Available in  $\frac{1}{4}$ ,  $\frac{1}{2}$ , 1 and 2 watt ratings.

*Manufactured in  
England and Canada*

For complete data  
and specifications  
write to Dept. KK-1



**ROCKBAR CORPORATION** 215 East 37th Street, New York 16, N. Y.

CIRCLE ED-366 ON READER-SERVICE CARD FOR MORE INFORMATION

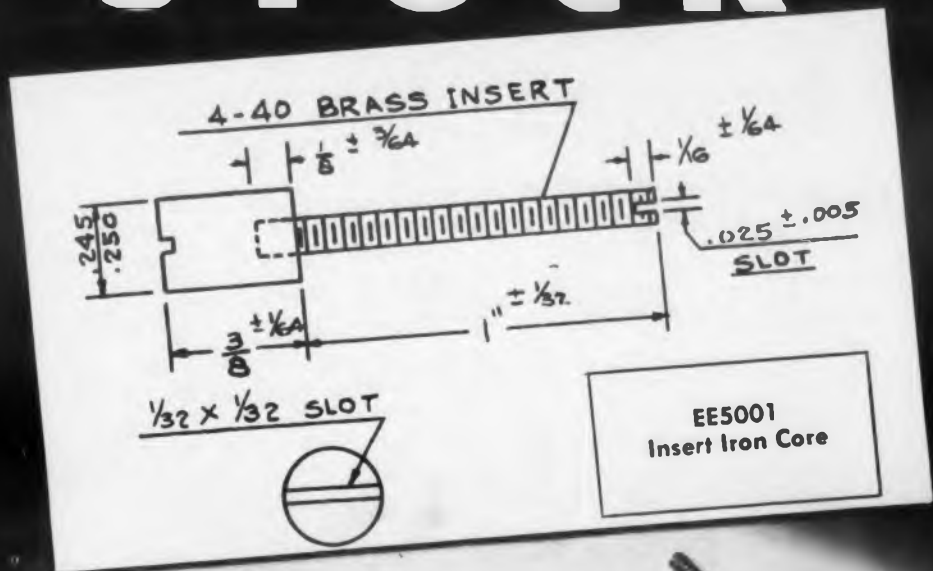
ELECTRONIC DESIGN • October 1954

Engineered Economy Iron

**CORES**

from

**STOCK**



*Engineered  
Economy means:*

- HIGHEST PERFORMANCE
- HIGHEST QUALITY MATERIALS
- UNIFORM HIGH QUALITY
- LOWEST COST
- STANDARDIZATION

In response to consistent demand, we guarantee prompt delivery of iron cores . . . right from stock . . . at volume prices. We carry inventories of cores proven to be of the widest and highest use . . . standard enough in mechanical and electrical specifications so that with little effort your design engineers may apply these cores to a wide variety of uses.

We invite your inquiry . . . literature is available upon request!

*If you still need "Custom Engineered Cores", send your specifications.*

**DELIVERY FROM STOCK**

**Radio Cores, Inc.**

9540 Tulley Avenue Oak Lawn, Illinois

CIRCLE ED-367 ON READER-SERVICE CARD FOR MORE INFORMATION



# Original Thinking plus Precision Components



3/4" DIA. SERVO MOTOR—FULL SIZE



R500 SYNCHRO—3/4 SIZE



R804 SERVO MOTOR-GENERATOR—1/2 SIZE



3/4" DIA. SYNCHRO—FULL SIZE

## KEARFOTT COMPONENTS INCLUDE:

Gyros, Servo Motors, Synchros, Servo and Magnetic Amplifiers, Tachometer Generators, Hermetic Rotary Seals, Aircraft Navigational Systems, and other high accuracy mechanical, electrical and electronic components.

Send for Bulletin giving data of components of interest to you.

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

## KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.

Sales and Engineering Offices: 1378 Main Avenue, Clifton, N. J.  
Midwest Office: 188 W. Randolph Street, Chicago, Ill. South Central Office: 6115 Denton Drive, Dallas, Texas  
West Coast Office: 253 N. Vinado Avenue, Pasadena, Calif.

## Kearfott Firsts

**1947** First with "Penny Size" Servo Motors .938" diam. x 31/32" long.

**1948** First with Servo Motors in Navy BuOrd Sizes 15 and 18 featuring straight-thru bores and integral ("potted")\* stator-housing assemblies.

**1949** First with Navy BuOrd Size 11 Synchros featuring "potted"\* stator construction and straight-thru bores.

**1950** First with Navy BuOrd Size 11 Servo Motors featuring "potted"\* stator construction and straight-thru bores.

**1951** First with Navy BuOrd Sizes 15 and 18 Servo Motor—Rate Generator combinations featuring "potted"\* stator construction and straight-thru bores.

**1952** First with temperature stabilized Drag Cup Motor-Integrator Generator combinations in Navy BuOrd Size 15 featuring "potted"\* stator construction and straight-thru bores.

**1953** First with Servo Motor-damping Generator combinations in Size 11 featuring "potted"\* stator construction and straight-thru bores.

**1954** First with 3/4" Diam. "Penny-Size" Servo Motors and Synchros. First with .05% linearity Tachometer Generators in Size 18. First with 115 volt Servo Motor Generator .980" in diameter. All featuring "potted"\* stator construction and straight-thru bores.

\*"Potted" construction for optimum performance at lowest cost.

All items discussed and illustrated are in production—available to you for your prototype, pre-production or production systems. Write today for more detailed information.



CIRCLE ED-369 ON READER-SERVICE CARD FOR MORE INFORMATION



## Patents . . .

**Low-Noise Amplifier . . . Patent No. 2,673,251. Robert C. A. Eland (Assigned to Philco Corporation, Philadelphia, Pa.).**

Of use in radio and TV receivers, cascode amplifiers consisting of two triodes are connected in cascade with the cathode of the first tube grounded and a grounded grid for the second tube. One such amplifier is arranged so that the signal on the plates of the two tubes are in phase and require a delay circuit between the plate of the second tube and the grid of the first tube. Other circuit arrangements are also used. Such amplifiers are known to provide a stable, low-noise circuit.

The circuit shown in Fig. 4, uses an arrangement by which a substantial reduction in the signal-to-noise ratio is secured over the circuit arrangements previously used. The cascode amplifier (17) employs a phase-delaying transmission line (23) made up of two windings (23a) and (23b) connecting the plate of the first triode with the cathode of the second tube.

For a television receiver, the transmission line has a length preferably equal to one-half the wave length of the center frequency of the higher band of television frequencies and has a characteristic impedance about the same as the impedance seen when looking into the cathode of the second tube. With a transconductance of 6000 micromhos for the second triode, a transmission line of 150 ohms and a length of 30" will serve. The transmission line may be wound as a coil of about 1/4" diam x 1-1/2" long. The new arrangement also includes an inductance (31) in the heater circuit having a value such that it will resonate at the higher band of television frequencies with the input capacitance of the second triode so that a low resistive impedance is presented.

By using a double triode tube properly selected as to parameters, substantial neutralization may be secured through interelectrode capacitance (32, 32) bearing in mind the difference in interelectrode capacitance and the amplification factor. This action results because the signal on the plates of the two tubes are 180° out

Another

# CHATHAM

Exclusive Design!



**Type VC-1258  
MINIATURE HYDROGEN  
THYRATRON**

*with 10KW  
peak rating!*

MANY OTHER TYPES  
AVAILABLE—

This tube is one of many CHATHAM thyratrons ranging in size to 40 megawatts, all of which represent an advantageous departure from conventional designs and are the result of several years of concentrated development work. Full information on request.

MAX. PEAK ANODE VOLTS	1000
MAX. PEAK ANODE AMPS	20
MAX. AVER. ANODE AMPS	0.05
NOMINAL FILAMENT WATTS	12.6

Specifically designed for pulse generating applications, this tube handles peak pulse power up to 10 KW. Repetition rates in excess of 10,000 pps are possible at lower power. Type VC-1258 operates at zero bias, fits a standard ceramic miniature socket, and is designed to withstand all shock and vibration tests of a ruggedized electronic tube.



**CHATHAM ELECTRONICS CORP.**

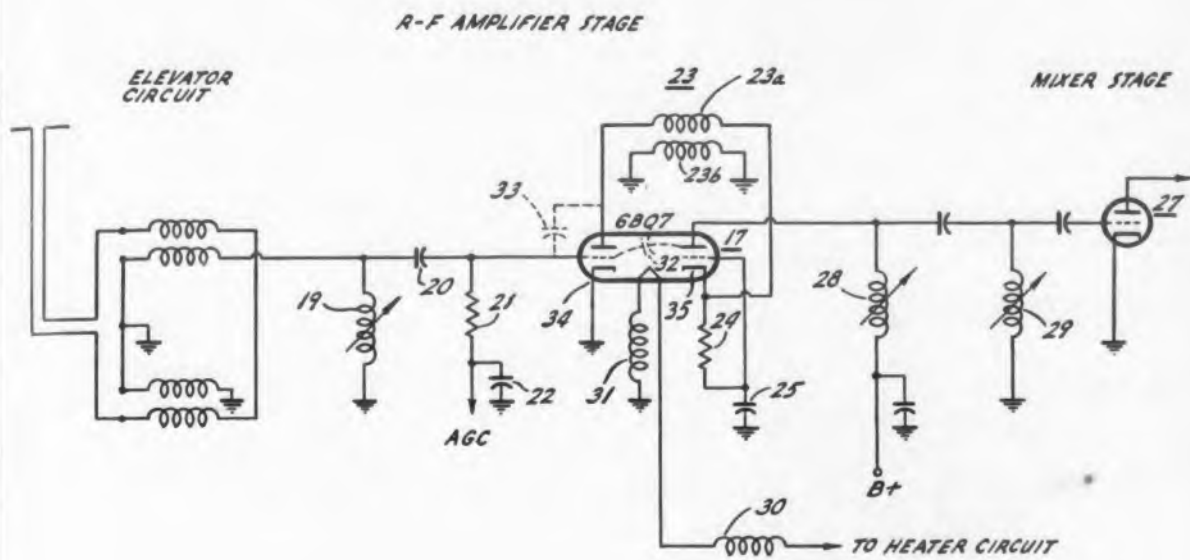
Executive and General Offices: LIVINGSTON, NEW JERSEY  
Plants and Laboratories: NEWARK and LIVINGSTON, NEW JERSEY

CIRCLE ED-370 ON READER-SERVICE CARD FOR MORE INFORMATION

phase so that current fed back from the plate of the second triode to the grid of the first triode would be in phase opposition to that fed back from the plate of the first tube to its grid. The circuit arrange-

ment not only reduces substantially the signal-to-noise ratio for the higher band of television frequencies, but also secures substantial reduction in this ratio for the lower frequency band.

Fig. 4. A cascode amplifier for the tuner or input stage of a television receiver which features low noise over a wide band of frequencies.



**UNIVERSAL**  
meets exacting  
**DESIGN**  
**REQUIREMENTS**

*in*

**TOROIDAL COILS**

Our specially designed machines now wind Toroidal Coils quicker and with more accuracy than other standard methods. Universal Toroidal Coils in any size wire to your specifications—are economical in materials and possess the smallest external leakage field of all other shapes.

Universal Toroids wound to Mil-T-27 specs.  
Wire sizes #42 (.00249 mils) to #10 (.1019 mils).  
Excellent Delivery in small or large quantity.

Engineering Service Available.

"ACCURACY IS A UNIVERSAL WORD"

**UNIVERSAL** **MANUFACTURING COMPANY, INC.**  
410 HILLSIDE AVE., HILLSIDE, N. J.

CIRCLE ED-371 ON READER-SERVICE CARD FOR MORE INFORMATION

**MADE  
TO  
SURVIVE**



10-Watt  
Type RS-10

5-Watt  
Type RS-5

2-Watt  
Type RS-2

Also Available — RH Types — 25, 50 and 250 Watts

**Miniature POWER Resistors**

Carefully crafted for matchless performance, Dalohm miniature power resistors are made to survive the most severe environmental, shock, and vibration conditions. Smallest in size, they also represent the answer to the space problem.

Dalohm RS type miniature power resistors are completely welded from terminal to terminal; silicone sealed, offering maximum resistance to abrasion, and high dielectric strength. They are 100% impervious to moisture and salt spray.

- Temperature coefficient 0.00002/deg. C
- Ranges from 0.1 Ohms to 55,000 Ohms, depending on type
- Tolerance 0.05%, 0.1%, 0.25%, 0.5%, 1%, 3% and 5%
- Manufactured in accordance to applicable JAN and MIL specifications.

**DALOHM PRODUCTS, INC.**

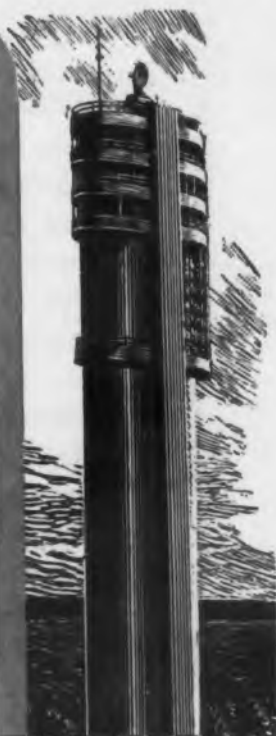
CIRCLE ED-372 ON READER-SERVICE CARD FOR MORE INFORMATION

**Stability and opportunity for  
ELECTRONIC ENGINEERS  
at the "Laboratory in the Sky"**

One of America's leading centers of long-range radio and electronic developments offers outstanding opportunities for accomplishment, advancement and stability. Write for booklet describing projects, facilities and employee benefits.

**INTERESTING ASSIGNMENTS IN:**

- Microwave Links • Pulse Networks • Radar
- Direction Finders • Air Navigation Systems
- Television Transmitters and Studio Equipment
- Antennas • Computers • Guided Missiles
- Telephone and Wire Transmission Systems
- Microwave and Gas Discharge Tubes • Dielectrics



**MAIL THIS COUPON TODAY**

**Federal  
Telecommunication  
Laboratories**

A Division of International Telephone and Telegraph Corporation



Federal Telecommunication ED-10  
Laboratories  
500 Washington Ave., Nutley, N. J.  
Please send me a copy of "Your future is with FTL."

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

CIRCLE ED-373 ON READER-SERVICE CARD FOR MORE INFORMATION



## Get a head-start in mechanical assembly

Let Hermetic's Vac-tite\* Headers win part of the race for you with mechanical designs to solve your problems.

Here are just a few Hermetic Vac-Tite\* seals that eliminate extra production operations and save you money!

1. Unit Header with Studs Attached—Saves space; shaped to fit enclosure or can; eliminates extra welding and soldering operations.
2. Weld Seals—Has the proper projections for leak-tight welds.
3. Lock-Ring "Safety" Seal—Simple, sure method for installing headers that is not dependent on solder alone for mechanical security; removable.
4. Threaded Bushing Seal—Firm mechanical connection has maximum shock and vibration resistance and adaptability for positioning and adjustment.
5. Taper Tab Headers & Terminals—Quick, solderless connections adaptable to many applications.
6. Terminal Strip—Pre-mounted terminals offer advantages of a conductive surface for heat dissipation, arc-resistance of glass, one piece assembly.
7. Attached Bracket Seal—Supports entire assembly on built-in structural member.

Write for engineering assistance, data, prices

### HERMETIC SEAL PRODUCTS CO.

39 South Sixth Street, Newark 7, New Jersey

\*VAC-TITE is HERMETIC's exclusive vacuum proof compression construction glass-to-metal seal.

FIRST AND FOREMOST IN MINIATURIZATION

CIRCLE ED-398 ON READER-SERVICE CARD FOR MORE INFORMATION

## Advertising Index

October 1954

Inquiry No.	Advertiser	Page
71	Ace Plastic Co.	50
273	Advanced Electric & Relay Co.	71
5	Aircraft-Marine Products, Inc.	7
312	Aircraft Radio Corp.	99
56	Allied Radio Corp.	46
	American Electronic Mfg., Inc.	52
78	Amperite Co., Inc.	51
279	Arga, Div. of Beckman Instruments, Inc.	94
32	Arnold Engineering Co., The	33
129	Associated Research, Inc.	63
128	Atlantic Transformer Corp.	63
247	Baker & Co., Inc.	87
185	Barry Corp., The	70
116	Bendix Aviation Corp., Red Bank Div.	60
15	Bendix Aviation Corp., Scintilla Div.	17
161	Berkeley, Div. of Beckman Instruments, Inc.	72
156	Birtcher Corp., The	73
9	Borg, George W., Corp., The	11
229	Bradley Laboratories, Inc.	84
52	Burdny Engineering Co.	46
61	Burroughs Corp., Electronic Instruments Div.	42
120	C & H Supply Co.	61
144	Cambridge Thermionic Corp.	66
57	Cannon Electric Co.	46
258	Carter Motor Co.	88
370	Chatham Electronics Corp.	108
80	Chicago Standard Transformer Corp.	52
169	Chicago Standard Transformer Corp.	74
88	Clare, C. P., & Co.	54
19	Collins Radio Co.	23
283	Colortone Electronics, Inc.	96
270	Communication Accessories Co.	91
244	Constantin, L. L. & Co.	86
195	Continental-Diamond Fibre Co.	76
	Convair, Div. of General Dynamics	102
180	Cook Electric Co.	79
372	Dale Products, Inc.	109
123	DeJur Amsco Corp., Electronic Sales Div.	61
176	DeJur Amsco Corp., Electronic Sales Div.	78
29	Detectron Corp., The	31
183	Doelcam Corp.	79
148	Dow Corning Corp., The	67
34	Du Mont, Allen B., Laboratories, Inc.	38
190	du Pont, E. I., de Nemours & Co., Inc.	70
236	Durant Mfg. Co.	85
114	Eastern Air Devices, Inc.	59
145	Elastic Stop Nut Corp. of America	66
252	Elco Tool & Screw Corp.	87
224	Electrical & Physical Instrument Corp.	82
110	Electro-Mec Laboratory, Inc.	59
364	Electrons, Inc.	106
72	Faber-Castell, A. W., Pencil Co., Inc.	50
360	Fairchild Camera & Instr. Corp.	104
208	Fairchild Camera & Instr. Corp., Potentiometer Div.	80
373	Federal Telecommunication Laboratories	109
30	Federated Metals, Div. of Amer. Smelting & Refining Co.	32
186	Fenwal, Inc.	70
137	Flexrock Co.	64
281	Ford Instrument Corp.	95
97	Fusite Corp., The	55
2	G-V Controls, Inc.	3
36	General Electric Co., Components Dept.	39
196	General Electric Co., Construction Materials Div.	76
47	General Electric Co., Electronics Div.	44
361	General Electric Co., Tube Dept.	105
6	General Precision Equipment Corp.	8
75	General Radio Co.	51
119	Giannini, G. M., & Co., Inc.	60
189	Gries Reproducer Corp.	70
199	Hart Mfg. Co., The	76
74	Helipot Corp.	51
319	Heppner Mfg. Co.	100
398	Hermetic Seal Products Co.	110
28	Hetherington, Inc.	30
399	Hewlett-Packard Co.	111
304	Hopkins Engineering Co.	98
276	Hubbell, Harvey, Inc.	93
159	Hughes Aircraft Co.	69
	Hughes Research & Development Labs.	42
	International Business Machines	105
330	International Electronic Research Corp.	101
282	International Rectifier Corp.	95

Page	Inquiry No.	Advertiser	Page
2	1	Jeffries Transformer Co.	93
2	2	Kanthal Corp., The	76
2	3	Kearfott Co., Inc.	108
2	4	Kester Solder Co.	87
50	5	Ketay Mfg. Corp.	47
71	6	Keystone Products Co.	49
7	23	Kulka Electric Mfg. Co., Inc.	84
9	9	L & L Manufacturing Co.	55
99	21	Linde Air Products Co.	81
46	35	Lindgren, Erik A., & Associates	103
52	29	Linear Equipment Labs, Inc.	97
51	21	Linemaster Switch Corp.	81
94	20	Little Falls Alloys, Inc.	80
33	20	Machlett Laboratories, Inc.	4
63	27	Magnetics, Inc.	29
63	27	Malayan Tin Bureau, The	81
87	201	Malco Tool & Mfg. Co.	77
70	8	Marion Electrical Instrument Co.	6
60	202	Markem Machine Co.	77
17	160	Metron Instrument Co.	80
72	68	Micro Switch	50
73	134	Minneapolis Honeywell, Transistor Div.	64
11	140	Moloney Electric Co.	65
84	266	Moseley, F. L. Co.	90
46	25	Mycalex Corp. of America	28
42	172	National Co., Inc.	74
61	175	National Semi-Conductor Products	75
66	86	National Vulcanized Fibre Co.	53
46	243	Ney, J. M., Co., The	86
88	105	Norris-Thermador Corp.	58
108	406	Perkin Engineering Corp.	41
52	262	Philco Corp.	89
74	33	Photocircuits Corp.	43
54	125	Plastic Capacitors, Inc.	63
23	217	Polorad Electronics Corp.	81
96	297	Polytechnic Research & Dev. Co., Inc.	97
91	255	Potter Co., The	88
86	275	Potter Instrument Co., Inc.	92
76	111	Power Equipment Co.	59
102	214	Precision Paper Tube Co.	81
79	205	Pyramid Electric Co.	77
109	367	Radio Cores, Inc.	107
61	400	Radio Corp. of America, Tube Dept.	112
78	13	Radio Materials Corp.	15
31	16	Radio Receptor Co., Inc.	21
79	164	Ram Meter, Inc.	72
67	124	Ramo-Wooldridge Corp.	62
38	108	Rapi Design, Inc.	58
70	401	Raytheon Mfg. Co.	48
85	206	Reflectone Corp., The	77
59	366	Rockbar Corp.	107
66	365	Rotron Mfg. Co.	106
87	101	Sangamo Electric Co.	56
82	315	Servomechanisms, Inc.	99
59	93	Set Screw & Mfg. Co.	55
106	53	Shakeproof, Div. of Illinois Tool Works	46
50	153	Shallcross Mfg. Co.	73
104	17	Shure Brothers, Inc.	22
80	221	Sigma Instruments, Inc.	82
109	241	Simmons Fastener Corp.	85
32	333	Sterling Engineering Co., Inc.	101
70	141	Stupakoff Ceramic & Mfg. Co.	66
64	91	Superior Electric Co., The	54
95	24	Sylvania Electric Products, Inc.	27
55	322	Technitrol Engineering Co.	100
3	280	Technology Instrument Corp.	94
39	351	Tensolite Insulated Wire Co., Inc.	103
76	12	Texas Instruments, Inc.	14
44	343	Texas Instruments, Inc.	102
105	109	Thomas Associates	58
8	10	Thomas & Skinner Steel Products Co., Inc.	12
51	234	Torwico Electronics, Inc.	84
60	1	Transco Products, Inc.	2
70	167	Tung-Sol Electric, Inc.	68
76	237	Uniform Tubes, Inc.	85
51	92	Unimax Switch, Div. of The W. L. Maxson Corp.	54
100	371	Universal Mfg. Co., Inc.	109
110	240	U. S. Engineering Co.	85
30	301	U. S. Gasket Co.	98
111	179	Victory Engineering Corp.	78
98	266	Viking Electric	90
93	235	Ward Leonard Electric Co.	84
69	13	Waters Mfg. Co.	80
42	22	Western Gear Works	83
105	1	Weston Electrical Instrument Corp.	16
101	15	Wincharger Corp.	71
95			



Frequency 10 cps to 220 mc  
Interval 1 usec to 100 days  
Period 0 cps to 10 kc

measured instantly,  
automatically, directly by  
the revolutionary new...



-hp- 525A  
Frequency Converter



-hp- 525B  
Frequency Converter



-hp- 526A  
Video Amplifier



-hp- 526B  
Time Interval Unit

## -hp- 524B ELECTRONIC COUNTER

Why buy more instrumentation than you need? The new all-purpose -hp- 524B Electronic Counter with Plug-In Units gives you *precisely* the frequency, time interval or period measuring coverage you want now. Later, you can add other inexpensive plug-in units to double or triple the usefulness of the Counter.

Model 524B offers direct, instantaneous, automatic readings requiring no calculation, interpolation or complex instrument set-up. It has high sensitivity, high impedance, and its operation is so simple and dependable it can be used readily by non-technical personnel. Resolution is 0.1  $\mu$ sec, and accuracy is  $1/1,000,000 \pm 1$  count. Construction throughout is of highest quality components in a compact militarized design.

The new Counter with Plug-In Units gives you more range, more convenience, smaller size and lower cost than any commercial instrument combination ever offered. With this one compact equipment, you readily measure transmitter and crystal oscillator frequencies, time intervals, pulse lengths, repetition rates, frequency drift; make high accuracy ballistics time measurements or high resolution tachometry measurements, or use as a precision frequency standard giving convenience and flexibility not provided in the usual primary standard.

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

### BASIC COUNTER

The basic -hp- 524B Counter unit measures frequency from 10 cps to 10 mc with accuracy of  $\pm 1$  count  $\pm$  stability, reading direct in kc; or measures period from 0 cps to 10 kc with accuracy of  $\pm 0.3\%$  reading direct in seconds, milliseconds or microseconds. Eight-place registration, short term stability 1/1,000,000, display time variable 0.1 to 10 seconds. \$1,890.00

### COUNTER WITH PLUG-IN UNITS

-hp- 525A Frequency Converter extends Counter's range to 100 mc, maintains accuracy, and increases Counter's video sensitivity to 0.1 volts through basic 10 cps to 10 mc range. \$225.00

-hp- 525B Frequency Converter like 525A but extends Counter's range from 100 to 220 mc at 0.25 volts sensitivity. \$225.00

-hp- 526A Video Amplifier increases Counter sensitivity between 10 cps and 10 mc to 10 millivolts for low level frequency measurement. \$125.00

-hp- 526B Time Interval Unit measures interval 1.0  $\mu$ sec to 100 days with accuracy of 0.1  $\mu$ sec  $\pm$  0.001%, reading direct in seconds, milliseconds or microseconds. Start, stop triggering in common or separate channels, through positive or negative going waves. \$150.00 (Plug-in units supplied in aluminum storage case).

Request complete details today from your  
-hp- Field Representative, or write direct

### HEWLETT-PACKARD COMPANY

2998K Page Mill Road • Palo Alto, California, U. S. A.



INSTRUMENTS

COMPLETE  
COVERAGE

CIRCLE ED-399 ON READER-SERVICE CARD FOR MORE INFORMATION



For **DEMANDING** requirements . . .



**SPECIFY RCA  
"SPECIAL  
REDS"**

**The "10,000-hour plus line"**

For day-in and day-out production line operations . . . for uninterrupted communications . . . for unattended monitoring services . . . in fact, for any electronic application where operating demands are critical or severe, RCA "Special Red" tubes provide that extra margin of safety.

*Special features include:*

- remarkable stability — throughout life.
- excellent resistance to shock and vibration.
- exceptional uniformity from tube to tube.
- 10,000 hours plus life.

Specially designed and built for extraordinary dependability and long life, "Special Reds" are backed by RCA for 10,000 hours minimum life and normally can be expected to greatly exceed 10,000 hours of stable operation.

RCA "Special Reds" are the finest receiving-type tubes made specifically for those industrial applications in which unusually exacting demands are placed on tubes and where continuous operation is paramount. That's why recent price reductions and increased availability make RCA "Special Reds" your best buy for your latest industrial equipment designs.

For technical information write RCA, Sec. J18Q, Commercial Engineering, 415 S. 5th St., Harrison, N. J. Or call your nearest RCA Field Office:

- EAST**—HUMboldt 5-3900—415 S. 5th St., Harrison, N. J.
- MIDWEST**—WHitehall 4-2900—589 E Illinois St., Chicago 11, Ill.
- WEST**—MAdison 9-3671—420 S. San Pedro St., Los Angeles 13, Calif.



Ask for new booklet (3F215) outlining advantages of RCA "Special Reds."



**RADIO CORPORATION of AMERICA**  
ELECTRON TUBES

HARRISON, N. J.