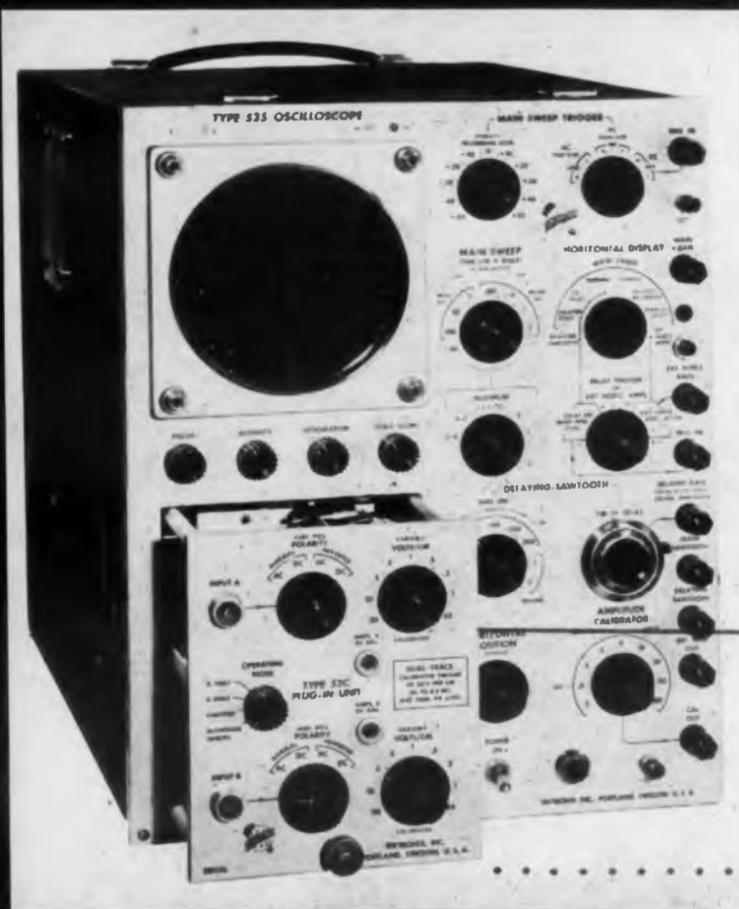


# ELECTRONIC

# design

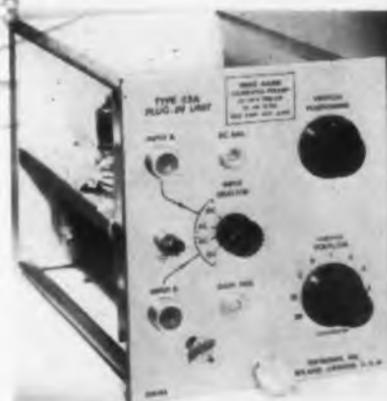
ELECTRONIC



*Plug-in vertical preamplifier units greatly increase the usefulness of the Type 535 Cathode-Ray Oscilloscope (shown at the left). A dual-trace unit (plugged in), a wide band d-c unit (upper right), and a differential-input high-gain d-c unit (lower right) are presently available. Others are being developed.*

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October 1953



## for QUALITY TRANSFORMER COMPONENTS

The bulk of UTC industrial transformer production is to customer's specifications for such organizations as G. E., Westinghouse, RCA, etc. However, a standardized line of approximately 700 stock items for industrial and communication service are available. A few of these types are illustrated here.

### STEP DOWN AUTO-TRANSFORMERS

With 6 foot cord and female receptacle 220-240 to 110-120 Volts—50/60 Cycles

Type No.	Application	L	W	H	Wgt. Lbs.
R-41	85 watt capacity	2 $\frac{3}{8}$	2 $\frac{3}{8}$	3 $\frac{1}{8}$	4
R-42	125 watt capacity	3	3	3 $\frac{1}{2}$	5
R-43	175 watt capacity	3 $\frac{1}{4}$	3 $\frac{1}{4}$	3 $\frac{7}{8}$	5 $\frac{1}{2}$
R-44	250 watt capacity	3 $\frac{7}{8}$	3 $\frac{1}{4}$	3 $\frac{7}{8}$	6 $\frac{1}{2}$
R-45	500 watt capacity	4 $\frac{1}{2}$	3 $\frac{7}{8}$	4 $\frac{5}{8}$	12
R-46	1200 watt capacity	6 $\frac{3}{8}$	3 $\frac{7}{8}$	4 $\frac{5}{8}$	18
R-48	2500 watts, no cord	10 $\frac{1}{2}$	4 $\frac{3}{4}$	6 $\frac{3}{4}$	30



### ISOLATION TRANSFORMERS

Ideal for isolating line noise, AC-DC sets, etc. Excellent electrostatic shielding. 1500 volt breakdown test. Six foot cord and male receptacle.

Primary 110-120 volts, 50/60 cycles—Secondary 110-120 volts

Type No.	Rating	L	W	H	Wgt. Lbs.
R-72	40 watts	2 $\frac{3}{4}$	2 $\frac{3}{8}$	3 $\frac{1}{8}$	4
R-73	100 watts	3 $\frac{3}{8}$	3 $\frac{1}{4}$	3 $\frac{7}{8}$	6
R-74	250 watts	4 $\frac{3}{8}$	3 $\frac{7}{8}$	4 $\frac{5}{8}$	12
R-75	600 watts	6 $\frac{7}{8}$	3 $\frac{7}{8}$	4 $\frac{5}{8}$	20
R-76	1200 watts	8 $\frac{3}{8}$	4 $\frac{1}{2}$	5 $\frac{7}{8}$	30
R-77	2500 watts (no-cord)	12	7	9	70



### LINE VOLTAGE ADJUSTERS WITH METER

The perfect answer to abnormal or fluctuating line voltage. Adjust switch so that meter reads at red line and you know that your equipment is working at correct voltage.

These units combine a tapped auto-transformer with a switch and meter in a compact, rugged assembly. The nine tap switch provides for line voltages of 60 to 140 volts on 115 volt output models and 160 to 240 volts on 230 volt output models.

All units are designed for 50/60 cycle service and come complete with 6 foot input cord and plug and outlet receptacle.



Type No.	Primary Voltages	Sec. Volts	Watts	L	W	H	Wt. Lbs.
R-78	60, 70, 80, 90, 100, 110, 120, 130, 140	115	150	7	4	4 $\frac{3}{4}$	6
R-79	60, 70, 80, 90, 100, 110, 120, 130, 140	115	300	7	4	4 $\frac{3}{4}$	9
R-80	60, 70, 80, 90, 100, 110, 120, 130, 140	115	600	10 $\frac{1}{4}$	4	4 $\frac{3}{4}$	13
R-81	60, 70, 80, 90, 100, 110, 120, 130, 140	115	1200	10 $\frac{1}{4}$	4	4 $\frac{3}{4}$	21
R-83	160, 170, 180, 190, 200, 210, 220, 230, 240	230	150	7	4	4 $\frac{3}{4}$	6
R-84	160, 170, 180, 190, 200, 210, 220, 230, 240	230	300	7	4	4 $\frac{3}{4}$	9
R-85	160, 170, 180, 190, 200, 210, 220, 230, 240	230	600	10 $\frac{1}{4}$	4	4 $\frac{3}{4}$	13
R-86	160, 170, 180, 190, 200, 210, 220, 230, 240	230	1200	10 $\frac{1}{4}$	4	4 $\frac{3}{4}$	21

### EXPORT VOLTAGE ADAPTER

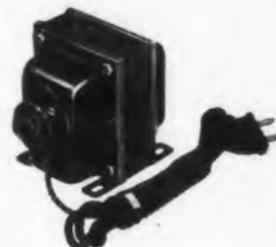
Complete with cord and plug and special locking switch providing for line voltages of 105, 115, 125, 135, 150, 210, 230, 250 volts; 42 to 60 cycles. Output voltage 115.

Type No.	Rating	Wgt. Lbs.
R-47	85 watts	4 $\frac{1}{2}$
R-48	150 watts	5 $\frac{1}{2}$

### TV VOLTAGE REGULATOR

Complete with cord, plug, and special locking switch. Permits operation of 115 volt 50/60 cycle TV sets on line voltages of 85, 90, 95, 100, 105, 110, 120, 125 V.

Type No.	Rating	Wgt. Lbs.
R-49	350 Watts	5



### SIGNALLING AND CONTROL TRANSFORMERS

Primary 110-120 volts, 50/60 cycles—Secondary 110-120 volts

High power transformers suitable for operating relays, sirens, horns, gongs, etc. from 115 V. 50/60 cycle line. These units have four secondary terminals providing 4, 8, 12, 16, 20 and 24 volt output. The volt ampere rating is based on the 24 volt secondary tap with corresponding reduction at the lower voltages. Underwriters' approved primary leads are employed, and screw-type binding posts.

TYPE	WATTS	OVERALL DIMENSIONS	MTG. DIM.	WEIGHT LBS.
SC-3	50	3 x 3 $\frac{1}{2}$ x 3-9/16	1 $\frac{7}{8}$ x 2 $\frac{1}{4}$	3
SC-4	100	3 $\frac{1}{4}$ x 4 x 4	2 $\frac{1}{8}$ x 2 $\frac{1}{2}$	5
SC-5	250	4 x 5 x 4 $\frac{3}{4}$	3 $\frac{1}{4}$ x 3	10



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# ELECTRONIC

DESIGN

Vol. 1  
No. 10  
October 1953

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able in concentric shaft tandem  
construction.



**TYPE 20, (JAN-R-94, Type R44)**  
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concentric shaft tandem construction.  
Attached switch can be supplied.

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## Editorial . . .

### Formula for Design

Given the task of creating a suitable design for a piece of electronic equipment, a designer can solve his problem in many ways. How he goes about doing the job depends upon temperament, training, judgment, skill, etc., . . . all rather intangible factors. Two men given the same assignment might come up with two entirely different designs arrived at by different procedures, yet equally good in performance.

One designer we know has an interesting approach to the job of designing electronic equipment. His procedure consists of six steps:

First, what will be the end use of the equipment, who will use it, and what is expected of the device to be designed?

Second, in what kind of environment is the equipment expected to perform its function, where will it be used, what will be the temperature and humidity conditions, who will do the maintenance, and what kind of test equipment will be employed? Will the equipment be transported frequently and, if so, by what means? In the case of military equipment will the operating personnel be trained?

Third, what are the special features dictated by sales considerations such as color, shape, appearance, etc.? (These are often important considerations in military devices).

Fourth, what are the economics involved in the design? Will the device be produced in quantity, is it adaptable to mass production, and are there any special cost problems?

Fifth, with all the previously gathered information in mind, formulate the design specifications.

Sixth, design the equipment.

This procedure seems straightforward and logical, and adaptable to almost any design problem. Are there any others? Readers are invited to send in their ideas on these matters. If there is a sufficient amount of interest in the subject, it will receive editorial treatment in a future issue.

◀ CIRCLE ED-3 ON READER-SERVICE CARD

# Engineering Review . . .

**Project "Tinkertoy"** . . . An automatic production line for the manufacture of electronic equipment and a new system of electronic design which makes this possible have been developed by the National Bureau of Standards (Washington 25, D. C.) under the sponsorship of the Navy Bureau of Aeronautics. The program is known by the code name "Project Tinkertoy", and promises to have widespread application for industrial and commercial equipment as well as for military devices.

The system starts with raw or semi-processed materials, and machines automatically manufacture ceramic materials and adhesive carboe resistors, print conducting circuits, and mount resistors, capacitors, and other miniaturized component parts on standard uniform steatite wafers. The wafers are stacked like building blocks to form a module that performs all the functions of one or more electronic stages. Auto-

matic inspection machines check physical and electrical characteristics of the wafer units at several stages along the production line. The completed module is a standardized, interchangeable electronic subassembly that is rugged, reliable, and compact.

The design system that makes this automatic production possible is known as the MDE (Modular Design of Electronics) system. It establishes a series

of mechanically standardized and uniform modules which can be produced to have a wide range of electrical characteristics.

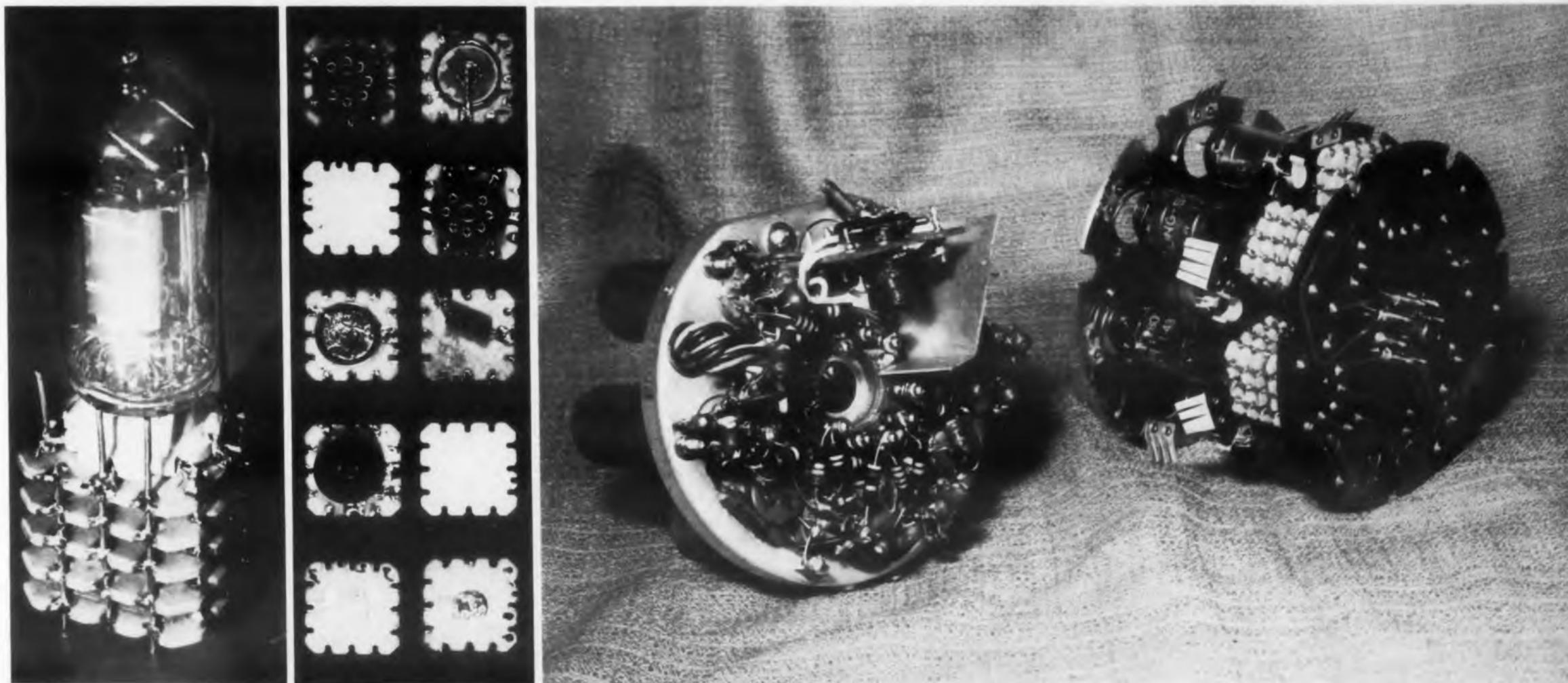
Each module usually consists of four to six thin ceramic wafers bearing various circuits associated with an electronic stage. A number of these modules are combined to form a major subassembly.

The illustrations below show one of the subassemblies (left), made up of ceramic wafers containing various printed and subminiature electronic components (center). At the right is an example of electronic equipment produced by conventional hand methods employing conventional component parts (left) and an MPE version of the same equipment.

A major advantage of the "Tinkertoy" system is that it makes possible a rapid conversion from civilian to military products (and back again) on short notice. At the same time, it allows for greatly expanded production capacity. Performance of equipment made by this new system is generally equivalent to that made by conventional methods. Equipments produced on an experimental basis meet military specifications.

Several companies cooperated with the NBS in the project, including Kaiser Electronics Division of Willys Motor Co., the Doughnut Corp. of America (Ellicott City, Md.), Communication Measurements Laboratory, Inc. (Plainfield, N. J.), and Sanders Associates, Inc. (Nashua, N. H.). The Davis Laboratories (Riverdale, Md.) and the Navy Post Graduate School (Monterey, Calif.) also assisted in the work.

**Fig. 1.** A single electronic stage made by the "Tinkertoy" automatic production system looks like the illustration at the left. It is made up of thin ceramic wafers (which carry all the components) shown in the center. The other photo shows equipment made by conventional methods (left) and the MDE version (right).



**1000kw Navy Transmitter . . .** The United States Navy keeps in touch with its air and sea units by means of a very powerful radio-telegraph transmitter. It is conservatively rated at 1000kw output over the 15kc to 35kc frequency range. Low frequencies are employed to insure reliable communications with the U. S. Fleet even when high frequency services are interrupted by magnetic disturbances.

Unusual features of the transmitter include the first use of super-power electron tubes having a power gain of at least 250; 10 $\mu$ sec fault protection; a variable master oscillator with 0.001% frequency stability; and frequency-shift teletype shifting.

The technical aspects of the transmitter are described in two AIEE technical papers (No. 53-198 and No. 53-199) by J. C. Walter and D. G. Robertson of the Radio Corp. of America, Camden, N. J.

**Decimal Computer . . .** Completion of the Model CRC 105 Decimal Digital Differential Analyzer, the first to operate in the decimal number system, has been announced by Computer Research Corp. (3348 W. El Segundo Blvd., Hawthorne, Calif.). This computer greatly reduces the time necessary to solve complex ordinary and partial differential equations. It has provisions for initial condition storage which makes the machine as easy to fill as operating a standard, 10-key adding machine and cuts filling time 75% over analyzers employing binary number systems.

The machine's high speed permits 60 increments of the independent variable to be computed every second. A recently discovered application is the solution of partial differential equations with boundary conditions by relaxation methods.

The computer has a very large capacity, being provided with 60 integrators having a maximum accuracy of six digits and sign in each integrator. Input and output media include automatic typewriter and graph plotter and follower. Govern

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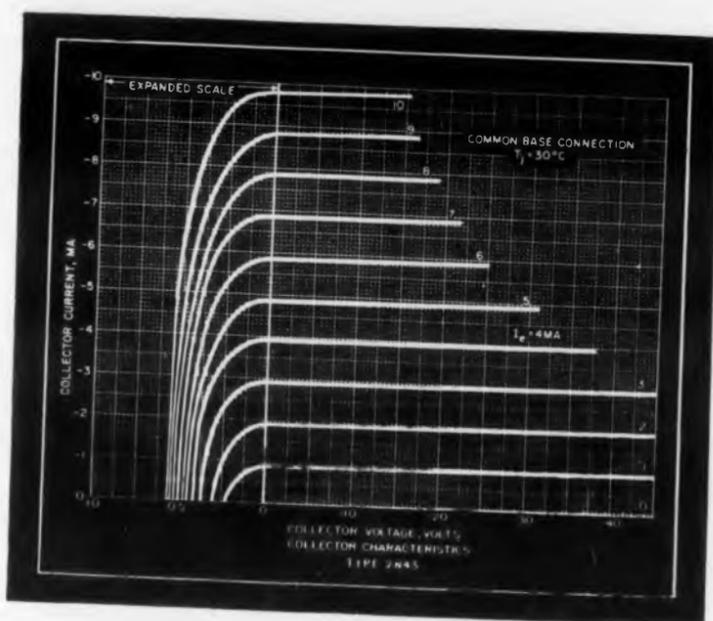
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ABSOLUTE MAXIMUM RATINGS:				
Collector Voltage (referred to base), $V_c$	-45 volts			
Collector Current, $I_c$	-10 ma			
Emitter Current, $I_e$	10 ma			
Junction Temperature, $T_j$	100°C			
AVERAGE CHARACTERISTICS: (Common Base, $T_j = 30^\circ\text{C}$ , $f = 270$ cps)				
	2N43	2N44	2N45	
Collector Voltage	-5.0	-5.0	-5.0	volts
Emitter Current	1.0	1.0	1.0	ma
Current Amplification (output short circuit), $h_{fe}$	-0.98	-0.955	-0.92	
Collector Cutoff Current, $I_{c0}$	10	10	10	$\mu\text{a}$
Noise Figure ( $V_c = -1.5\text{V}$ , $I_e = 0.5$ ma, $f = 1$ kc, BW, 1%), NF	22	22	22	db
Maximum Power Gain (Common Emitter)	40	39	38	db
Frequency Cutoff, $f_{\beta}$	1.0	1.0	1.0	mc
Output Capacitance, $C_o$	40	40	40	mmf

## NEWS FROM OUR ADVANCED DEVELOPMENT LABORATORIES

● Double-base junction diodes are semi-conductor devices having thyatron-like properties. Lab units have been used successfully in low-voltage circuits to switch currents larger than  $\frac{1}{2}$  ampere.

ment and military organizations will use five such machines for work on trajectory, net relaxation, interior ballistics and aerodynamic problems, and dynamic system analysis.

**Embossed Printed Circuits . . .** Development of a new method of producing copper foil embossed printed circuits has been announced by the Erie Resistor Corp. (Erie, Pa.). The process involves embossing copper foil in laminated bakelite sheets with the depressed portions representing the wiring form desired. This operation is performed during the curing process of the bakelite. Then the unwanted part of the copper foil is removed mechanically. Advantages of this new method include economy of production and no chemical contact with the insulating material during the manufacturing process.

**Company Grants-in-Aid . . .** A financial assistance program designed to help working engineers and technical personnel to further their college educations by graduate study has been instituted by Raytheon Manufacturing Company, Waltham 54, Mass. Recognizing that additional study makes the men more valuable in their work, and the great interest in such study (several hundred of the men register for evening courses each year), the company has adopted a policy of tuition support directed at encouraging graduate study by engineering and scientific employees.

**Longest Neutron Counters . . .** What are believed to be the longest neutron counters ever made have been manufactured by Radiation Laboratories, Inc. (5122 West Grove Street, Skokie, Ill.). The units are more than six feet long, of all aluminum construction, and are filled with enriched boron trifluoride gas to a pressure of 120cm of mercury.

Twenty-two of these counters are being used by a southern university for maximum efficiency in detecting neutrons. Similar but shorter counters have been found to have a transit time of only  $1/2\mu\text{sec}$ , important in neutron time-of-flight studies.

◀ CIRCLE ED-4 ON READER SERVICE CARD

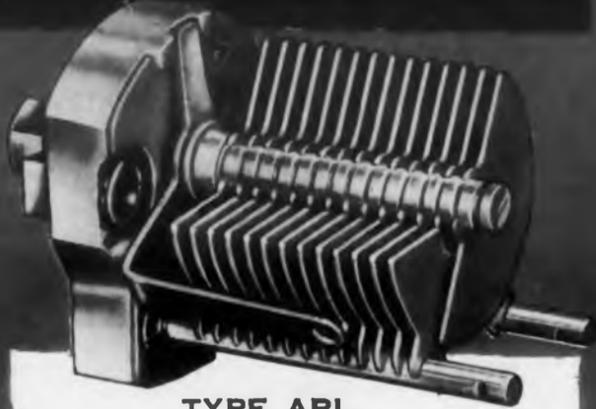
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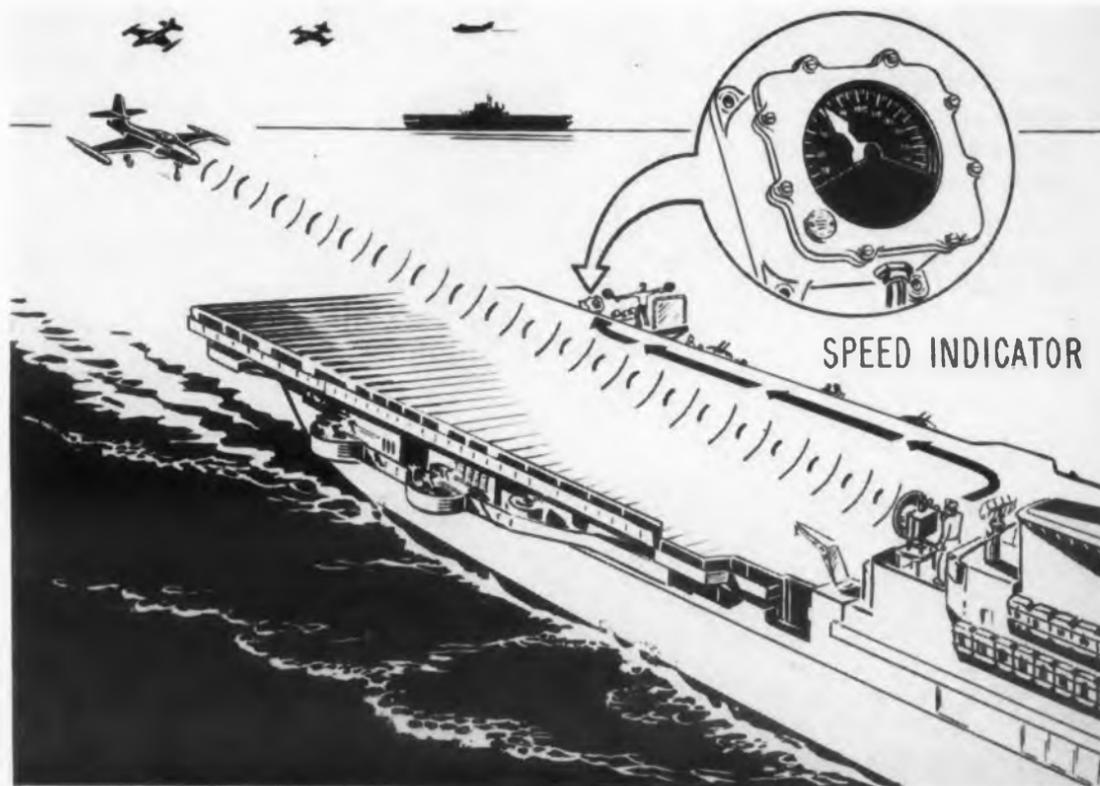
## Engineering Review . . .

**Color TV Tube Screens . . .** Commercially available materials and relatively inexpensive equipment can be used in an improved method of producing the multi-phosphor screens for color TV tubes. The process, described in a paper by Sidney Levey (Physics Laboratories, Sylvania Electric Products Inc., Bay-side, N. Y.) and Dr. Albert K. Levine (assistant professor of physical chemistry, Brooklyn College, Brooklyn, N. Y.), presented before the Electrochemical Society, is photographic in nature and is known as the "photo-binder process".

The perforated shadow mask located in the tube a short distance behind the screen and parallel to it, or a photographic reproduction of it, is used as the master pattern. A photosensitive resin binder is blended into a paste with the phosphor to be deposited. The paste is applied to the glass screen plate in

## Radar Speed Measurer

A new radar speed measuring equipment developed by Raytheon Manufacturing Co., Waltham, Mass., is used to help jet aircraft land safely on aircraft carriers. RADAR waves are trained on the plane coming in for a landing. The reflected waves, picked up by the antenna serve as the basis for the speed indicator to compute the plane's true air speed and warn the landing officer if the speed is too fast or too slow for a safe landing.



## TV Tuner Drive

This belt drive for TV tuners is made of nonkinking, low friction bead chain (manufactured by the Bead Chain Manufacturing Co., Bridgeport, Conn.). Specially designed sprockets fit the individual beads and eliminate slippage and backlash. Tensile strength of bead chain ranges from 15 lb to 200 lb, depending upon the size of the bead and metal used.

a thin film. The photosensitive film is exposed through the master pattern in an exposure device by the light from a suitable small area source, and the unexposed areas are then washed away by a solvent.

This procedure is repeated for each of the phosphors to be applied and the exposure device is adjusted to position the pattern in the desired location. When the dots of all three colors have been com-

puted, the light-fixed photosensitive binder is removed by baking and a permanent silicate binder is applied by spraying. The new method is more precise than the older silk screen method, and is also applicable to the production of other mosaic surfaces such as those used in memory tubes.

**Conductivity Meter . . .** Conductivity is an important physical property of materials that often can indicate certain characteristics of materials. For example, the conductivity of aged aluminum alloys varies with temper. Therefore, once standard comparisons are made in the laboratory, the conductivity of a sample can be used to indicate its temper. An instrument has been developed by the Magnaflex Corp. (7300 West Lawrence Ave., Chicago 31, Ill.) which provides absolute conductivity measurements of nonferrous conducting materials directly on a large dial.

The instrument, known as the "Magnatest FM-100" Conductivity Meter, is provided with a simple hand probe which the operator places on a part and then the dial is read. The device is portable and it operates from any 110v-120v a-c supply. All that is required is a relatively flat area about  $\frac{3}{8}$ " diam on which to place the probe.

**Nucleonics Conference . . .** The sixth annual Conference on Electronic Instrumentation in Nucleonics and Medicine, sponsored jointly by the AIEE, IRE, and ISA (Instrument Society of America), will be held at the New Yorker Hotel in New York City on November 19-20, 1953. As usual, this gathering promises to be of great interest to electronic designers because of the opportunity for exchange of ideas between the users (doctors and other medical personnel) and the designers of electronic and nucleonic instruments. An interesting group of sessions is scheduled, including one on X-ray techniques, applications of new instruments in medicine, and uses of the analog computer in biological problems.

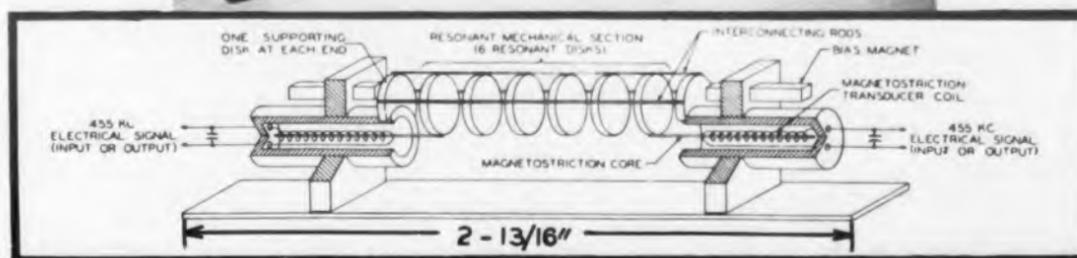
**ETAC . . .** An electronic thermal analog computer (ETAC) has been developed to solve thermal problems in small motors. Devised by the General Electric Company's Advanced Engineering Development Section, the instrument operates within an accuracy of 3% and is used to solve one-mesh to four-mesh thermal problems involving intermittent duty cycles, forced convections, and vapor cooling.

The thermal problem is set up on the computer in terms of its electrical analog and results appear in the form of temperature-time curves displayed on a calibrated cathode-ray tube. The instrument does in half an hour the job previously done in several weeks by an expert mathematician using differential equations.

# Mechanical Filters For Industry

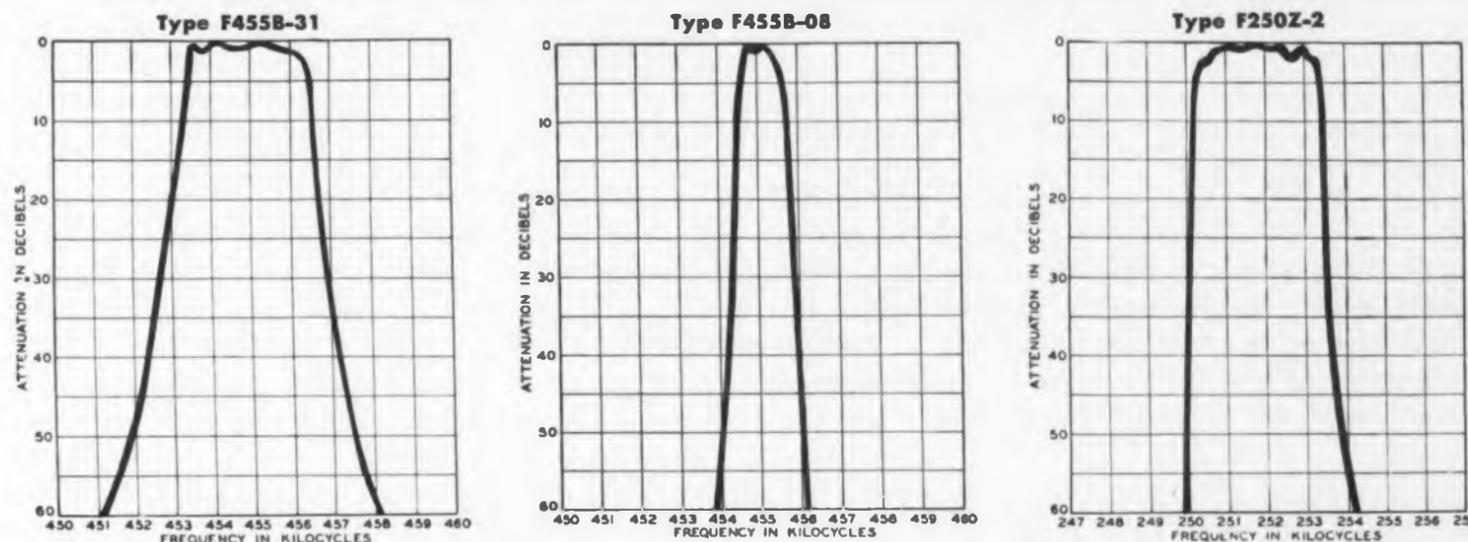


Collins Mechanical Filter with hermetically sealed shield removed. Compare size with matchbook.



Engineers' drawing of 455 kc Mechanical Filter interior.

## SELECTIVITY CURVES FOR THREE TYPICAL MECHANICAL FILTERS



THE COLLINS Mechanical Filter was first revealed to the Radio Industry during the 1952 IRE Convention. Since that time the original Mechanical Filter Type F455B-31 has become available in production quantities. Other Collins Mechanical Filters, designed to operate at various bandwidths in the intermediate frequencies, are also available in engineering sample quantities. All of the Mechanical Filters listed here offer a close approach to the ideal rectangular selectivity curve. Consult the chart of available Mechanical Filters (right) for the solution to your selectivity problem.

A request on your letterhead will bring full technical specifications, price and delivery information.

Type No.	Center Frequency	Bandwidth	Terminal Arrangement
F250A-60	250 kc	6.0 kc	Solder
F250Z-1	248.7 kc	3.0 kc	Solder
F250Z-2	251.3 kc	3.0 kc	Solder
F455A-08	455 kc	800 cycle	Solder
F455A-31	455 kc	3.1 kc	Solder
F455A-60	455 kc	6.0 kc	Solder
F455B-08	455 kc	800 cycle	Plug-In
F455B-31	455 kc	3.1 kc	Plug-In
F455B-60	455 kc	6.0 kc	Plug-In
F500A-14	500 kc	1.4 kc	Solder
F500A-31	500 kc	3.1 kc	Solder
F500B-31	500 kc	3.1 kc	Plug-In
F500B-14	500 kc	1.4 kc	Plug-In

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IN the design of computers and switching systems, there are many logic circuits where gating and level restoration is required. In particular, "threshold-two gates" (circuits in which the simultaneous presence of two input signals is necessary to produce an output signal), are usually required in large numbers. When dealing with digital information, or control signals using pulse techniques, the output signal may not need to be a replica of any input. In addition, gain or level restoration also may be desired.

The circuit to be described consists essentially of a regenerative amplifier, employing a transistor as an active element. Additional passive circuit components and biasing voltages may be applied to this basic circuit to permit multi-functional usage.

### Circuit Description

The basic circuit configuration and emitter input negative resistance characteristic are shown in Fig. 1. A point contact transistor employing n type germanium (WE1698) is used. Transistors of this type have current gain factors in excess of unity in the positive emitter current region. If an external resistor is connected in series with the base electrode a negative resistance characteristic will be obtained looking into the emitter terminal.

This characteristic may be explained in terms of the electrode current flow and current multiplication properties of the transistor. The current flowing into the base electrode is the algebraic sum of the emitter and collector currents. Since the collector current is negative, and larger in magnitude than the emitter current in the positive emitter current region, the normal base current will also be positive. A positive increment of emitter current, therefore, will result in a larger increment of positive base current which, by

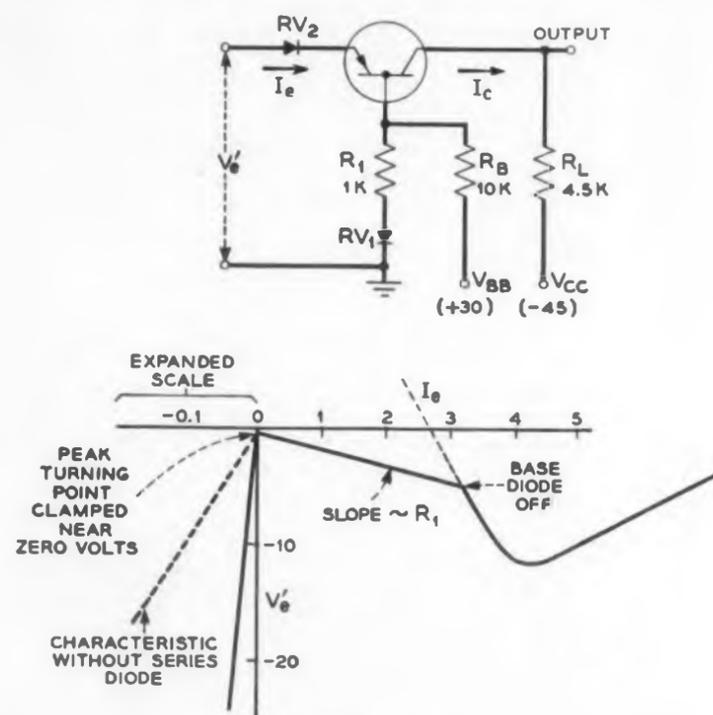


Fig. 1. Basic circuit configuration and the emitter input negative resistance characteristic.

# Gating and Switching Circuits Employing Transistors

R. L. Trent

Bell Telephone Laboratories, Inc., Murray Hill, N. J.

flowing through the external base impedance makes the base more negative with respect to the emitter electrode. This causes an additional increment of emitter current to flow, inducing an even larger positive base current.

It is this regenerative action which gives rise to the negative resistance portion of the characteristic. This process will continue until, as determined by the external circuit parameters, the transistor enters the collector current saturation region, and the characteristic slope again becomes positive. The d-c stability of such a characteristic, however, leaves much to be desired. In particular, we are interested in obtaining a stable peak turning point, which occurs in the vicinity of zero emitter current.

One of the more troublesome variations which occur between present day point-contact transistors is the fact that the collector current which flows for a given impressed collector potential at zero emitter current, (designated  $I_c(O, -V_c)$ ), may vary from 0.3ma to 3.0ma for acceptable units. If the base resistor which is introduced to obtain negative resistance is of the order of 5000 ohms, the peak turning point may then vary from 1.5v to 15v. In order to overcome such undesirable d-c changes, a stabilization feature due to A. J. Rack<sup>1</sup> has been used.

A diode is inserted in the base circuit, biased by the positive potential  $V_{BB}$ , through resistor  $R_B$ . The biasing current is adjusted to equal the maximum value of  $I_c(O, -V_c)$  for which compensation is desired. When the transistor is OFF, the diode is conducting, providing a low impedance to ground. As soon as the transistor begins to conduct, current amplification occurs, and for some positive value of emitter current, the sum of the emitter and stabilizing currents will just equal the collector current. At this point, the diode becomes a high resistance, and the external base resistance becomes  $R_B$ , shunted by the high back resistance of the base diode. The peak turning point in the emitter input characteristic is thus clamped very close to zero volts for all acceptable transistors, and over a useful temperature range.

A diode is also placed in series with the emitter to insure obtaining an extremely high resistance in the negative emitter current region, with the characteristic clamped close to the voltage axis.

Equations completely defining all of the critical portions of the input characteristic have been derived and illustrated in the literature.<sup>2</sup>

### Application to Pulse Amplification

An emitter load resistor may be connected in the circuit as shown in Fig. 2 to derive a monostable multivibrator useful for pulse regeneration. The slope of the d-c load line is determined primarily by the value of  $R_E$ . The circuit is monostable, with a single intersection between load line and characteristic at point A. The input impedance to the triggering source may be made high, of the order of 100,000 ohms, until triggering occurs.

The device will then follow an approximate operating path designated *a-b-c-d* in Fig 2, resulting in a positive output pulse at the collector terminal. During excursions *a* and *c*, the dynamic load line is provided by the capacitor *C* and the driving source impedance *Z*. With the circuit constants as shown, the positive output pulse will have an amplitude in the order of 30v, and a duration of 2 to 5 $\mu$ sec.

### Application of Basic Circuit to "AND" Gating

*Step Voltage Input and Coincident Positive Input Pulse.* The basic circuit may be connected as shown in Fig. 3 to provide for AND gating, using step voltage input and a coincident positive pulse. The step voltage is adjusted to vary between the negative potentials  $V_1$  and  $V_2$ , with corresponding intersections between emitter load line  $R_E$  and characteristic at points A and B respectively.

We may assume that the input pulse amplitude is sufficient to enable the circuit to be triggered when the step voltage value is  $V_1$  and the d-c stable intersection of load line and characteristic is at A.

However, when the step voltage value is  $V_2$ , and the d-c stable intersection of load line and characteristic is at B, the triggering pulse amplitude will be insufficient to trigger the circuit, and no pulse will appear in the collector circuit.

1. Member of Technical Staff, Bell Telephone Laboratories, Inc., Murray Hill, N. J.
2. *Transistors in Switching Circuits*, A. E. Anderson, *Proc. IRE*, Vol. 40, No. 11—pp. 1541-1559

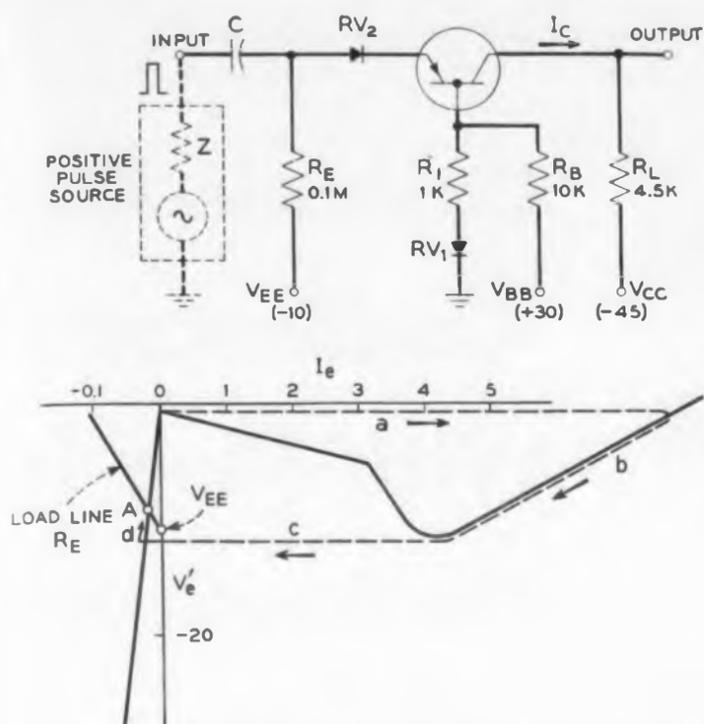


Fig. 2. An emitter load resistor produces a mono-stable multivibrator for pulse regeneration.

Some of the advantages of this gated amplifier circuit are:

- The step voltage input signal source sees a high impedance of at least the emitter load resistance value,  $R_E$ . This permits many of these gated amplifiers to be operated in parallel by the same signal source without adverse loading effects.
- The pulse input source also sees a high impedance except during a triggering interval.
- Pulse regeneration occurs; the output pulse in the collector circuit will have a very sharp positive going pulse wavefront.
- The output pulse amplitude is independent of the input

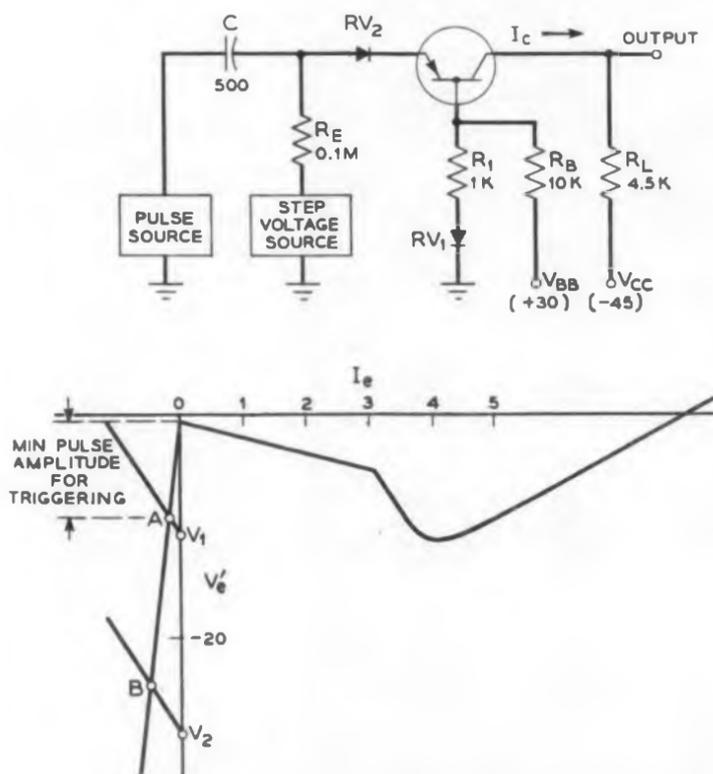


Fig. 3. The circuit modified for AND gating, using step voltage input and a coincident positive pulse.

pulse amplitude, and is fixed by the gated amplifier circuit constants. Voltage gains in the order of 10 to 20db are obtainable.

**Two Coincident Positive Pulses.** Modification of the basic circuit configuration and characteristic as illustrated in Fig. 4 permits the function of AND gating, using two coincident positive pulses, to be performed. The emitter load voltage divider  $R_1$  and  $R_2$  is connected to a source of negative biasing potential  $V_{EE}$ .

The timing requirements and amplitude limitations placed upon the input pulses are fairly stringent. The amplitude of the pulses applied at either terminal  $X$  or  $Y$  must not be sufficient to trigger the amplifier, but the summed effect of the input pulses must be such as to cause the device to be triggered.

Assuming equal pulse amplitudes at  $X$  and  $Y$ , the following elementary requirements may be formulated. The notation follows that used by Anderson<sup>2</sup>:  $r_{11}'$  is the slope of the emitter  $V_e - I_e$  curve in the negative emitter current region; and  $RV_2'$  is the reverse resistance of the emitter diode.

$$V_{EE} \left[ \frac{r_{11}' + RV_2'}{r_{11}' + RV_2' + R_1 + R_2} \right] > X$$

$$= Y > \frac{V_{EE}}{2} \left[ \frac{r_{11}' + RV_2'}{r_{11}' + RV_2' + R_1} \right] \quad (1)$$

For the constants as shown in Fig. 4, the amplitude limits for pulses at  $X$  and  $Y$  are:

$$17 > X = Y > 9v \text{ peak approximately.}$$

Then if pulses meeting the above amplitude limitations are impressed at either  $X$  or  $Y$  alone, no output pulse will be obtained. However, if we assume that a positive pulse appears at input  $Y$ , the load line

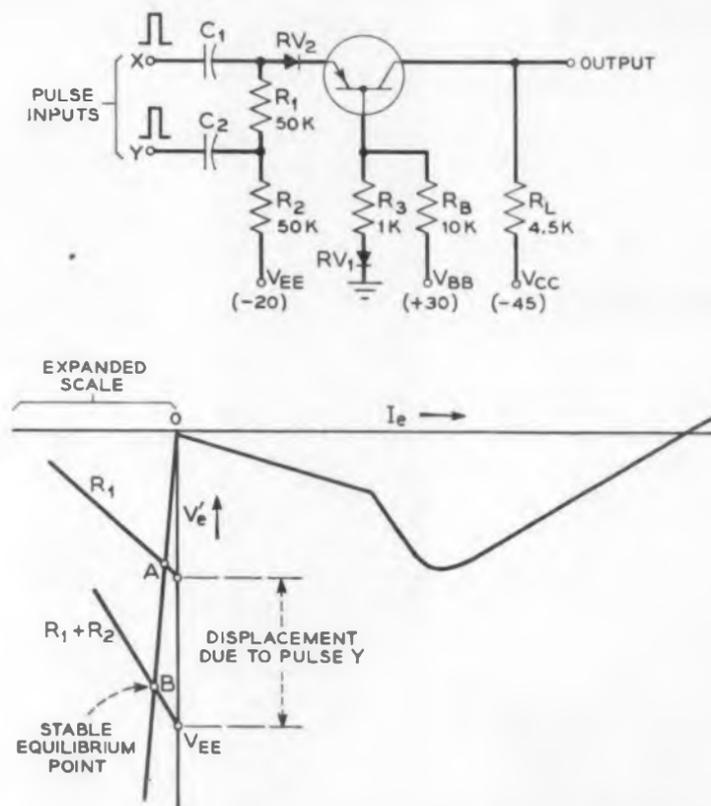


Fig. 4. This circuit permits AND gating using two coincident positive pulses, to be performed.

will be rapidly displaced along the vertical axis to achieve intersection with the characteristic at point  $A$ .

The slope of the load line is halved if we assume that  $R_1$  and  $R_2$  are equal. If, simultaneously, a pulse is impressed at input  $X$ , the device will be triggered and a pulse will be obtained at the output terminal.

### "BUT NOT" Gating—Two Coincident Signals

The system function of *BUT NOT* gating may be accomplished by a gate having two inputs and an output, so arranged that if inputs  $X$  and  $Y$  are impressed simultaneously, no pulse appears at the output. However, if one of the signals, say  $X$ , is present but not  $Y$ , then an output pulse will be obtained. This type of control exhibited by the  $Y$  input has also been termed an "inhibit" function.

The circuit arrangement shown in Fig. 5 will perform this function, as well as AND pulse gating. The emitter load potentiometer is connected to a small negative biasing potential  $V_{EE}$ , establishing a d-c stable OFF d-c equilibrium point designated  $A$ . With no pulse impressed at input  $Y$ , a positive pulse impressed at  $X$ , of amplitude greater than  $a$ , will trigger the circuit as previously described.

However, if a negative pulse appears simultaneously at input  $Y$ , causing the load line to be rapidly depressed along the vertical axis, the stable equilibrium point will be at point  $B$  instead of  $A$ . If the positive pulse impressed at  $X$  is less than the amplitude  $b$  now required for triggering, no pulse output will be obtained. If we assume that the source impedance of the  $Y$  input is low with respect to  $R_2$ , and that  $R_1$  and  $R_2$  are equal, the slope of the emitter load line at point  $B$  will be half that of point  $A$ .

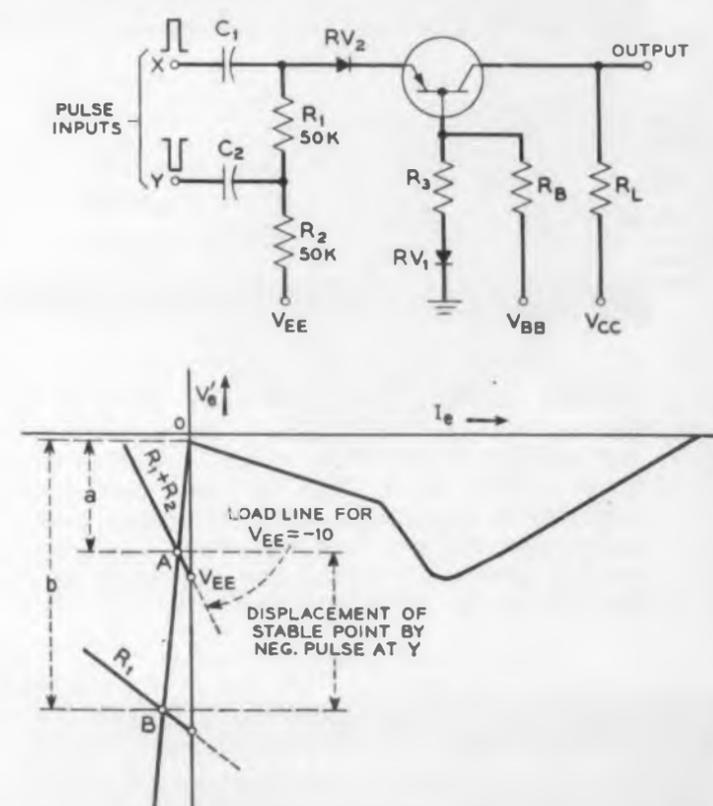


Fig. 5. BUT NOT as well as AND pulse gating is possible with this circuit arrangement.

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# Eclipse-Pioneer



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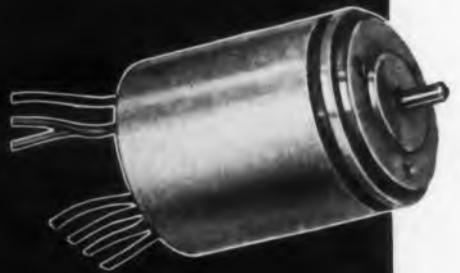
(AY-200 SERIES)

TYPICAL ELECTRICAL CHARACTERISTICS

	Type Number	Input Voltage Nominal Excitation	Input Current Milliamperes	Input Power Watts	Input Impedance Ohms	Stator Output Voltages Line to Line	Rotor Resistance (DC) Ohms	Stator Resistance (DC) Ohms	Maximum Error Spread Minutes	
Transmitters	AY201S-2S	28V, 400~, 1 ph.	125	0.8	40+ $\pm$ 230	11.8	12	5.0	18	
Control Transformers	AY201S-2S	From Trans. Autosyn	Dependent Upon Circuit Design					49	10.2	30
Differentials	AY201S-2S	From Trans. Autosyn	Dependent Upon Circuit Design					14	10.2	30
Receivers	AY221S-2S	28V, 400~, 1 ph.	70	0.4	108+ $\pm$ 448	11.8	80	11.4	24	

**PYGMY  
AUTOSYN  
SYNCHROS**

(AY-500 SERIES)



TYPICAL ELECTRICAL CHARACTERISTICS

	Type Number	Input Voltage Nominal Excitation	Input Current Milliamperes	Input Power Watts	Input Impedance Ohms	Stator Output Voltages Line to Line	Rotor Resistance (DC) Ohms	Stator Resistance (DC) Ohms	Maximum Error Spread Minutes	
Transmitters	AY503-4	28V, 400~, 1 ph.	220	2.5	45+ $\pm$ 100	11.8	23.0	11.0	24	
Receivers	AY503-2	28V, 400~, 1 ph.	220	2.5	45+ $\pm$ 100	11.8	23.0	11.0	75	
Control Transformers	AY503-3	From Trans. Autosyn	Dependent Upon Circuit Design					170.0	45.0	24
	AY503-5	From Trans. Autosyn	Dependent Upon Circuit Design					550.0	188.0	30
Differentials	AY533-3	From Trans. Autosyn	Dependent Upon Circuit Design					83.0	45.0	30
Receivers	AY523-3	28V, 400~, 1 ph.	85	0.8	290+ $\pm$ 480	11.8	210.0	42.0	30	
	AY543-5	28V, 400~, 1 ph.	11	0.12	800+ $\pm$ 2200	11.8	580.0	165.0	30	

Available for all applications is the new, *corrosion-resistant* AY-200 Series of Eclipse-Pioneer Autosyn Synchros (1.431" dia. x 1.631" lg.). Where space and weight are prime considerations, Eclipse-Pioneer offers the AY-500 Pygmy Autosyn Synchro Series (0.937" dia. x 1.278" lg.) with corrosion-resistant models available in sample quantities. Whatever your synchro requirements may be, our long experience, modern facilities and advanced production techniques can work to your advantage. For full details, write Department I.

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# Cathode-Ray Oscilloscope With Plug-In Preamplifiers



Fig. 1. Two of the plug-in preamplifiers which greatly increase the usefulness of the Type 535 Cathode-Ray Oscilloscope.

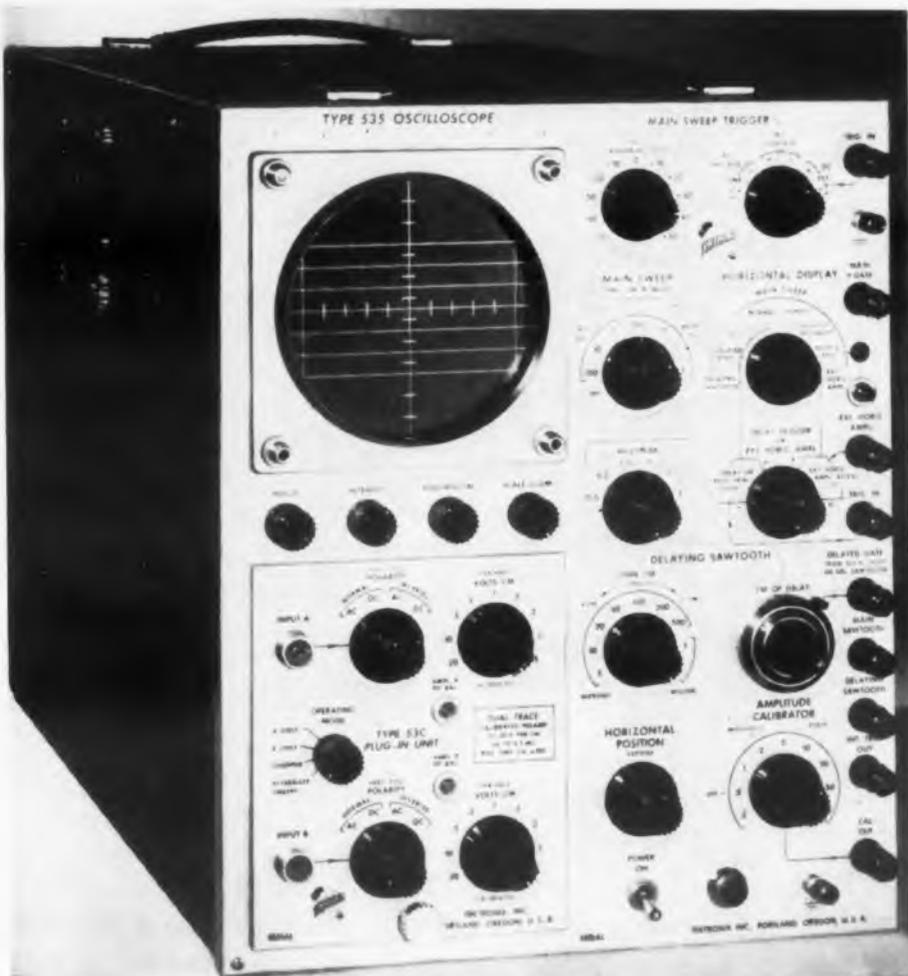


Fig. 2. This cathode-ray oscilloscope makes use of plug-in preamplifiers to adapt it for many types of precise measurements. One of the preamplifiers (a dual trace unit), is shown in plugged-in position. The other units include a differential high gain d-c unit and a wide-band d-c unit.

**P**ROVIDING the Type 535 Cathode-Ray Oscilloscope with plug-in preamplifiers has resulted in a versatile instrument capable of covering the complete range of facilities which formerly required the use of three or more separate high quality laboratory scopes. The unit (shown in Fig. 1 and on the front cover), also has a new accurate sweep delay circuit, a wide time-base range, and high accelerating potential, making it adaptable to almost any phase of laboratory development investigation.

The sweep circuit provides 24 calibrated sweeps from  $0.1\mu\text{sec}/\text{cm}$  to  $5\text{sec}/\text{cm}$  with accurate 5x magnification on all ranges, and continuously variable uncalibrated sweeps from  $0.1\mu\text{sec}/\text{cm}$  to  $10\text{sec}/\text{cm}$ . Automatic main sweep lockout with controllable reset permits accurate delay of the start of the main sweep from  $10\mu\text{sec}$  to  $20,000\mu\text{sec}$ . A 10kv accelerating potential is provided for the Type 51P2 metallized 5" cathode-ray tube, and the square wave amplitude calibrator covers a range of 0.2mv to 100v.

Three different plug-in preamplifiers are available for use with the instrument, which is a product of Techtronix, Inc. (P. O. Box 831, Portland 7, Ore.). Additional plug-in units are being developed.

The Type 53C Dual Trace Unit has two identical amplifier channels, activated on alternate sweeps, or nonsynchronously, at about 100kc. Both channels have a  $0.04\mu\text{sec}$  rise time, d-c to 8.5Mc bandpass, and 0.05v/cm to 20v/cm sensitivity in nine calibrated steps. Sensitivity is continuously variable between steps and extends to 50v/cm. A four-position a-c/d-c and polarity reversal switch is provided for each channel.

The Type 53D Differential High Gain d-c Unit has a sensitivity of 1mv/cm to 50v/cm in 24 calibrated steps, with variable sensitivity between steps. Bandpass is d-c to 250kc at maximum sensitivity, extending to 750kc at 50mv and lower. A six-position a-c/d-c input selector switch is provided.

The Type 53A Wide-Band d-c Unit has a  $0.035\mu\text{sec}$  rise time, d-c to 10Mc bandpass, and 0.05v/cm to 20v/cm sensitivity in nine calibrated steps. Sensitivity is continuously variable between steps and extends to 50v/cm. Two signal inputs with 60db isolation are provided, as well as a four-position a-c/d-c and input selector switch.

Waveforms available from the front panel include positive gate, delayed gate, main sawtooth, internal trigger, and a calibrating square wave. The instrument also has a beam position indicator in which indicator lights show the location of the cathode-ray electron beam when it is positioned off the screen.

The horizontal input amplifier has a sensitivity of 0.2v/cm to 20v/cm which is continuously variable. Direct-coupled unblanking assures constant unblanking level when changing sweep rates and duty cycle. A new balanced delay network ( $0.25\mu\text{sec}$  signal delay) to provide superior transient response and a 50cy to 50kc repetition rate source are other features.



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**C**OMBINED electrical insulation abilities, are resistance, structural strength, dimensional stability, and thermal resistance are properties that make "Mycalex" Glass-Bonded Mica useful in many electronic applications. In addition, it is practically the only machinable ceramic material, a factor which greatly increases its applicability in electronic devices.

Although it can be machined on ordinary machine tools (if tungsten carbide is used), skillful and careful methods must be followed, and several design precautions have to be exercised to avoid production difficulties. There are a number of simple design rules to follow that will insure an economical and mechanically feasible specification.

### Dielectric Considerations

The design of an electrical circuit involves problems other than dimensions and tolerances of a mechanical nature. Circuit characteristics and losses are determined by a number of properties and among these, the dielectric constant and dissipation factor are very important. From data such as that listed in Table 1, it is possible to choose a material with a low dissipation factor and a dielectric constant in the desired range. Note the wide range of properties afforded by the various types of Mycalex.

If the electronic equipment always operated at room temperature, the choice of material made initially could be the final one. However, when the operating temperature reaches higher levels, a certain amount of "drift" occurs in the circuit, particularly at the higher frequencies. Therefore, a knowledge of the change of dielectric constant with temperature increase is important. The last column in Table 1 lists the average temperature in coefficients for the dielectric constants of a number of insulating materials.

Once the electrical, structural, and thermal requirements for a particular application have been considered, the general shape to which the Mycalex glass-bonded mica will be machined is established. However, the final design of the piece is not fixed until several other factors have been considered.

### Tolerance Considerations

In the first place, there is no need to provide extra fine dimensional tolerances to compensate for warping and creeping. For example, if a tolerance no closer than 0.007" is required, it is not necessary to specify  $\pm 0.001\%$  in anticipation of warping. Since no warping takes place, considerable economies can be realized by designing to extremely coarse tolerances.

Unlike metal, the complete dimensional stability of Mycalex prevents distortion under the most extreme pressures. It cannot be bent by pulling on it with bolts, or expanded by forcing taper or oversized parts through it; nor can its frictional grip be increased by placing it under plastic compression.

Planning of hardware and all other metal parts should be done first. Every effort should be made to

# Machined Mycalex Design

Alfred S. Backus

Plant Manager, Mycalex Corporation of America, Clifton, N. J.

design them to fit the simplest machined shapes of the glass-bonded mica. Because all warping, bending and springing action will be done by the metal, precautions should be taken so that undue stress is not transmitted to the insulator.

Thus, there is one reason for designing to coarse dimensions and another for designing to close ones. Coarse dimensions are permissible because Mycalex will not warp or creep into closer tolerances than those to which it was originally machined. On the other hand, the material cannot be forced or distorted to fit parts that do not properly mate with it.

### Incorporating Metal Parts

Metal parts can be cemented to the exterior of Mycalex glass-bonded mica, and Mycalex sections can be cemented to each other. Metal parts can also be cemented into holes or slots cut into the material—an attribute which, if used to full advantage, simplifies the shapes to which the Mycalex must be machined. This also compensates somewhat for the material's inability to change contours during assembly. Where the metal and Mycalex components do not mate properly, the cement can frequently fill the intervening spaces and make a satisfactorily assembly without the need for force.

All electroplating should be completed before metal is assembled to the Mycalex. Where precious metals are to be plated onto base metals, the plating can often be stopped-off at the point where the metal part will penetrate the Mycalex surface, an advantage which reduces the amount of precious metal required. Plating is possible after assembling, but only by special methods and under particular instructions. (These can be obtained on request from the Mycalex Corp. of America).

Soldering can be done after assembly if methods which will not overheat the material are employed. This may prohibit the use of torch soldering, but most other methods can be used.

### Economical Shapes

In selecting the geometrical shapes from which pieces are to be machined, it is well to keep in mind that machinable Mycalex is made in sheets of 14" x

18" and in thicknesses from 1/8" to 1" in increments of 1/8". The thicknesses can be as small as 3/32", but the use of such thin sheets is best avoided except for very special cases. Intermediate thicknesses can be obtained at an extra cost.

The most economically sized shape is a straight-sided, square-edged piece measuring 18" x 14" x a standard thickness (mentioned above); or even divisions of the length and width (making allowances for saw kerf). Although not all "beginning shapes" can be specified, the designer can, with a little thought, work out a number of them this way. Any other shape automatically has an additional machining or excess material cost.

The second most desirable shape has straight sides, but is of dimensions which do not necessarily divide evenly into the standards; or one that has mildly curved sides which can be cut easily on a band saw.

Bars, rods, and even tubes may be obtained. Their cost, however, is higher because they have to be cut from standard sheets, and some types involve additional grinding operations. In addition, the tubes are not always desirable if over 1" long.

### Machining Considerations

The original shapes must be selected with an eye to their eventual functions. Here, differences between the applicability of machining processes can be so great that, unless the designer is thoroughly familiar with machining processes, he ought to talk with his machinist before completing his design.

The easier operations on Mycalex include band-sawing, wheel cutting or grinding, machine filing, and drilling. Milling is more difficult, hence more expensive. Threading is feasible, but it is possible only by slow and somewhat costly methods. Lathe work, one of the easiest operations on metals, requires special methods that make it more difficult on Mycalex. Shaping is not too difficult, but broaching and planing should not be considered.

Exterior corners should be specified to be sharp. They can be chamfered or broken, but at an extra machining cost. Corners at the bottom of notches should be specified to have 1/32" radius unless there is a mandatory reason for having them sharp.

It is advisable to leave at least 1/8" wall thickness between one hole and another or the exterior surface. This is done to provide a structural strength which may be needed when the part is in service, when it is handled prior to or during assembly, or when the machining takes place. This 1/8" rule can be violated only at the expense of more careful machining methods and at the risk of breakage.

### Holes, Threads, and Keyways

Through holes are preferable to blind holes. However, circular blind holes with "drill point shapes" at the bottom, and with at least 1/8" of solid material beneath are not difficult. Round holes are less costly than square ones or other shapes. Whatever the shape of a blind hole, rounded internal corners where the hole wall meets the hole bottom are preferable to any sharp angled ones. Round holes into which metal or other parts are to be cemented should be generated with standard drill sizes, which come closest to being 0.002" larger than the diameters of the inserts. Similarly, where holes are not round, they should be made 0.002" larger than the inserts to provide space for the cement. Designing for force-fitting pieces into Mycalex definitely should be avoided.

Excellent assemblies with threads in Mycalex have been made, but threading this material is costlier than threading metal. The threads for Mycalex gen-

erally must be coarser than those required for metal and a poorer tightness of fit results.

Keyways should seldom, if ever, be specified for holes generated into Mycalex. The material should carry no torque load by means of a keyway. Cement or simple friction pins should be used instead.

### Grinding Mycalex

It is advisable for the designer to work to coarse tolerances because the functioning and the assembly of Mycalex parts rarely justify the higher cost of finer tolerances. Despite the fact that Mycalex is generally more difficult to machine than metals, once the basic shape of the material has been determined, it is possible to obtain a finely ground tolerance with relatively less expense.

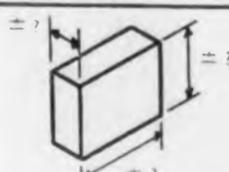
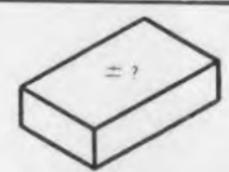
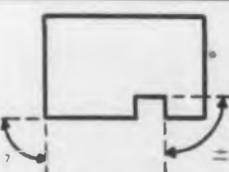
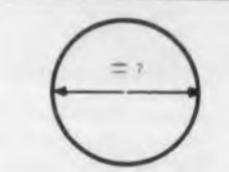
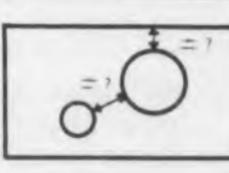
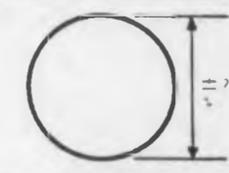
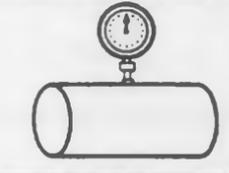
Fig. 1. The chart at the right lists the most desirable tolerances to specify for various configuration when designing with Mycalex. If the tolerances "standards" listed in the second column are specified, machining costs will be held to a minimum. As tighter tolerances are specified, costs increase very rapidly, and in some instances the mechanical strength is seriously affected.

This is possible because Mycalex behaves exceptionally well in grinding machines. It does not spring back, season warp, or manifest any of the unfavorable behavior that is so often found in ordinary materials having less dimensional stability. This does not apply to all ground dimensions: it applies chiefly to ones that can be produced on surface grinders or on centerless grinders. Avoiding unnecessarily close tolerances is still a good design rule to follow.

The Mycalex family of glass-bonded micas offers the electronic design engineer a combination of properties which fills the important area between the conventional organic plastics and the usual ceramics. By following the suggestions mentioned, the designer can realize the full capabilities of this material for his application at the lowest cost.

Table 1. Dielectric Properties of Various Insulating Materials

Material	Dielectric Constant (70°F., 1Mc)	Dissipation Factor (70°F., 1Mc)	Temperature Coefficient of Dielectric Constant (parts per million per °F.)
Mycalex 400	7.4	0.0018	110 (7.5Mc, 0-500°F)
Mycalex 400	7.4	0.0018	175 (150kc, 0-500°F)
Mycalex 500	7.3	0.0010	125 (7.5Mc, 0-500°F)
Mycalex 500	7.3	0.0010	150 (150kc, 0-500°F)
Mycalex 410	9.2	0.0015	120 (1Mc, 32°-575°F)
Mycalex K-10	10.8	0.0020	100 (1Mc, 32°-450°F)
Mycalex K-15	15.1	0.0025	55 (1Mc, 32°-450°F)
Mycalex K-20	20.0	0.0028	45 (1Mc, 32°-450°F)
Mycalex 555	9.2	0.0015	70 (1Mc, 70°-450°F)
Steatite (L-4)	5.2	0.0025	70 (1Mc, 70°-575°F)
Steatite (L-5)	5.9	0.0005	50 (1Mc, 70°-575°F)
Zircon Porcelain	8.0	0.0008	45 (1Mc, 32°-450°F)
Kel-F	2.5	0.010	730 (60cps, 32°-320°F)
Porcelain	4.4-6.8	0.0050	90 (1Mc, 32°-200°F)
Mica	5.4	0.0002	30 (1Mc, 32°-200°F)
Phenolic	4.8	0.01-0.05	1800 (1Mc, 32°-200°F)
Quartz	4.5	0.0001	20 (1Mc, 32°-200°F)
Fused Silica	3.8	0.0002	20 (1Mc, 32°-200°F)
Corning 0080 Glass	7.2	0.0090	680 (1Mc, 32°-400°F)
Corning 0120 Glass	6.6	0.0016	240 (1Mc, 32°-575°F)
Corning 7720 Glass	4.7	0.0027	192 (1Mc, 32°-575°F)
Corning 7740 Glass	4.6	0.0046	392 (1Mc, 32°-575°F)
Corning 7070 Glass	4.0	0.0006	45 (1Mc, 32°-575°F)
Corning 8870 Glass	9.5	0.0009	97 (1Mc, 32°-575°F)
Corning 7052 Glass	5.1	0.0026	290 (1Mc, 32°-575°F)

DIMENSION	STANDARD TOLERANCE	FAIR TOLERANCE	HIGHLY SPECIAL TOLERANCE	
Length, Width & Thickness	± 1/64"	± .005"	± .0025" or finer	
Surface Flatness	± .0015 in./in.	± .001 in./in.	Superfinish to 1/8 light wave, or finer	
Angles	± 1 degree	± 6 minutes	Any tolerance that precision grinding can generate.	
Hole Diameter	± .005"	± .003" - .000"	± .0005" or finer	
Hole Location	± .007"	± .005"	± .0015" or finer	
Peripheral Diameter	± .005"	± .001"	± .0001" or finer	
Peripheral Circularity, Runout on Full Indicator Reading	± .005"	± .001"	± .0001" or finer	



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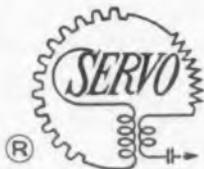
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# Experimental Chassis For Breadboard Assembly

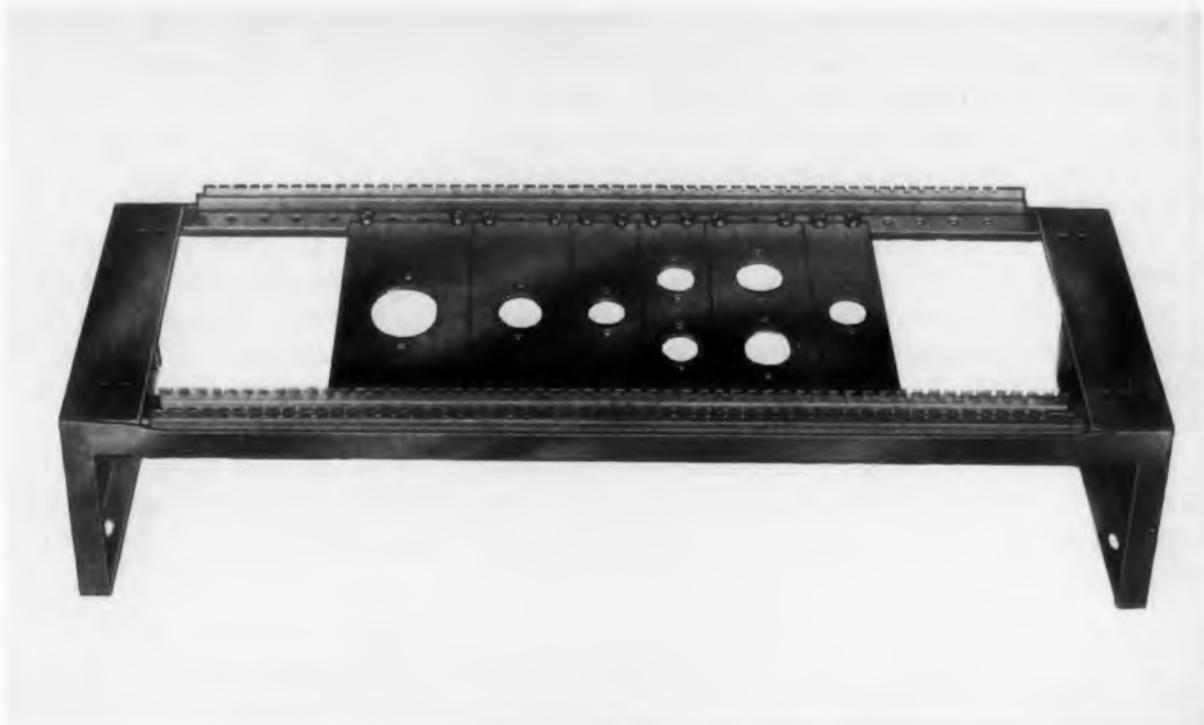
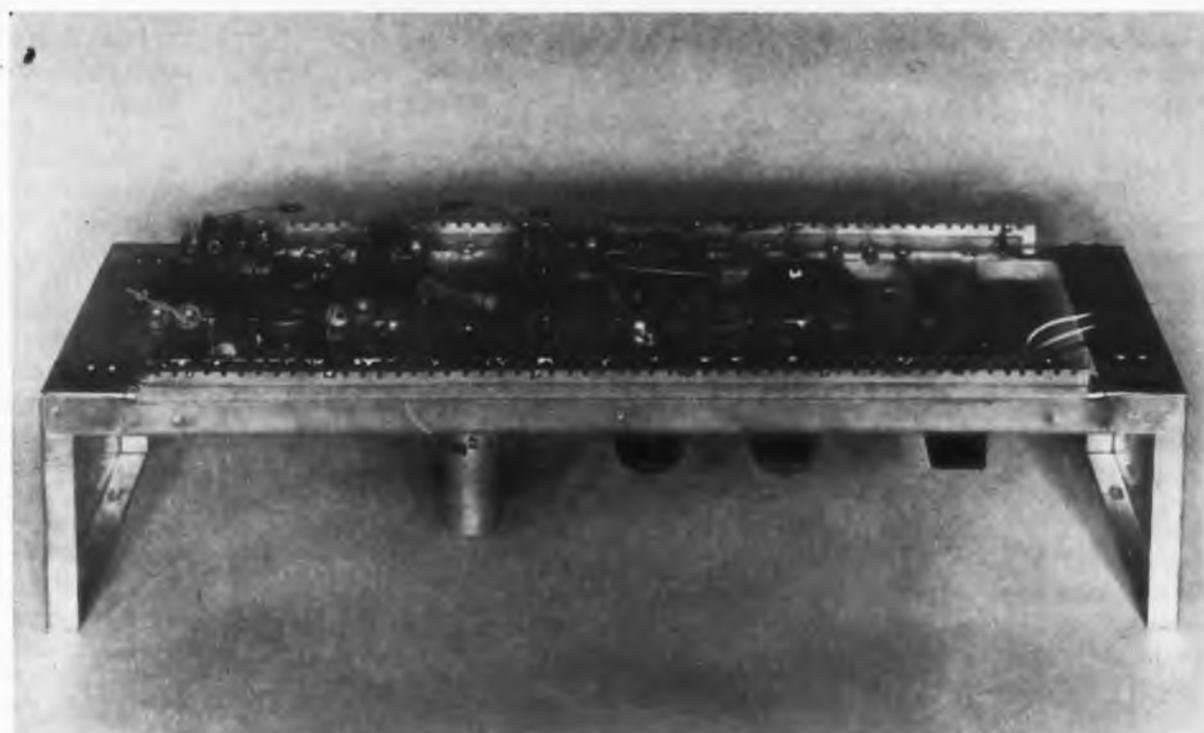


Fig. 1. The experimental chassis shown above is designed to permit rapid and easy circuit changes as they are required. Appearance of the unit with components in place is illustrated below.



**M**AKING changes in developmental circuits is no problem when they are mounted on the "Speed-Chassis" illustrated in Fig. 1. This experimental chassis is designed for breadboard assembly of electronic components, and also can be used for permanent rack installation if desired.

Simple and rugged in construction, it consists of a heavily cadmium plated 20ga steel framework which measures 5" wide x 4-3/8" deep x 16-7/8" long. Two insulated tie-point strips and one grounded tie-point strip (each 14" long) are placed at the front and back of the chassis. Drilled and tapped holes are provided at each end for mounting Jones 8-point terminal strips (No. 8-140).

At the front and back of the chassis are strips with drilled and tapped holes to take 6-32 plate-holding screws. Mounting plates made of 20ga cadmium plated steel (for easy soldering) fit into the open top of the chassis. These plates are punched to accommodate a variety of electronic components and are held in place by the plate-holding screws.

With this arrangement it is possible to wire an electronic circuit and then make any changes required with very little trouble. Fig. 1 also illustrates the appearance of the chassis with components wired in place. By using turret type sockets a designer can wire a complicated circuit in "blocks" on several mounting plates and then slip them into place on the chassis where coupling and power connections can be quickly made. If he should want to change the circuit, the power and coupling connections are disconnected and the entire stage (tube components, and mounting plate) is easily removed to make way for a different circuit. The unit is manufactured by Specific Products, 5864 Hollywood Boulevard, Los Angeles 28, Calif.

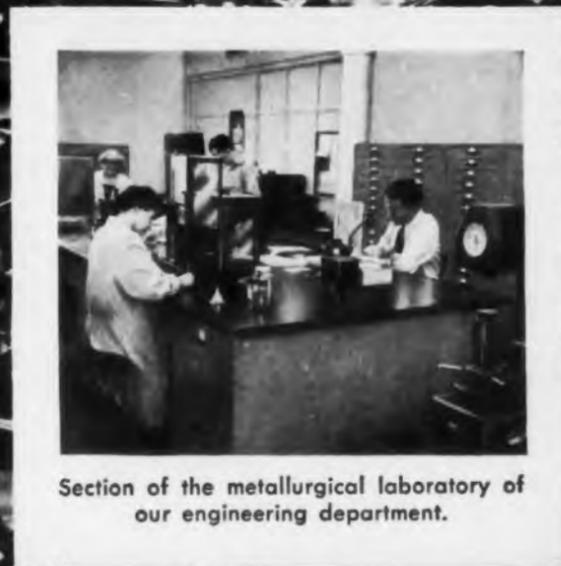
Mounting plates for the chassis are available in a variety of sizes and punchings to accept the following components: single or double 7-pin miniature tube sockets (1-1/8" x 4-3/16"), single or double 9-pin miniature tube sockets (1-5/8" x 4-3/16"), and a single octal tube socket with either 1-5/16" or 1-1/2" mounting centers (2-1/8" x 4-3/16"). Universal transformer mounting plates (1-1/8" x 4-3/16"), and a volume control mounting plate (1-1/8" x 4-3/16") also can be furnished as well as blank plates (1-1/8" x 4-3/16", 1-5/8", or 2-1/8" x 4-3/16") for mounting special components also can be furnished.

Where permanent installation is desired, the chassis can be mounted on a relay rack by means of a 5-1/4" x 19" x 0.064" aluminum panel notched for commercial standard rack mounting and two rack brackets. A sturdy shield can is available to make successful breadboard assemblies both permanent and neat in appearance.

The flexibility of the "Speed-Chassis" with its many circuit arrangement possibilities and ease of changing circuits will be especially appreciated by electronic designers working on prototype circuits.

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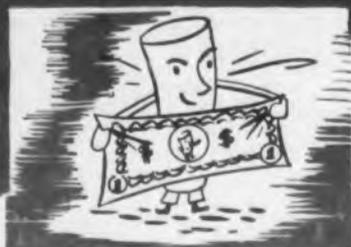
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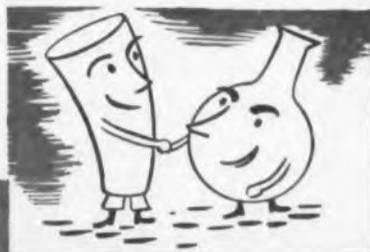


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# Transistorized Subminiature High Voltage Supplies

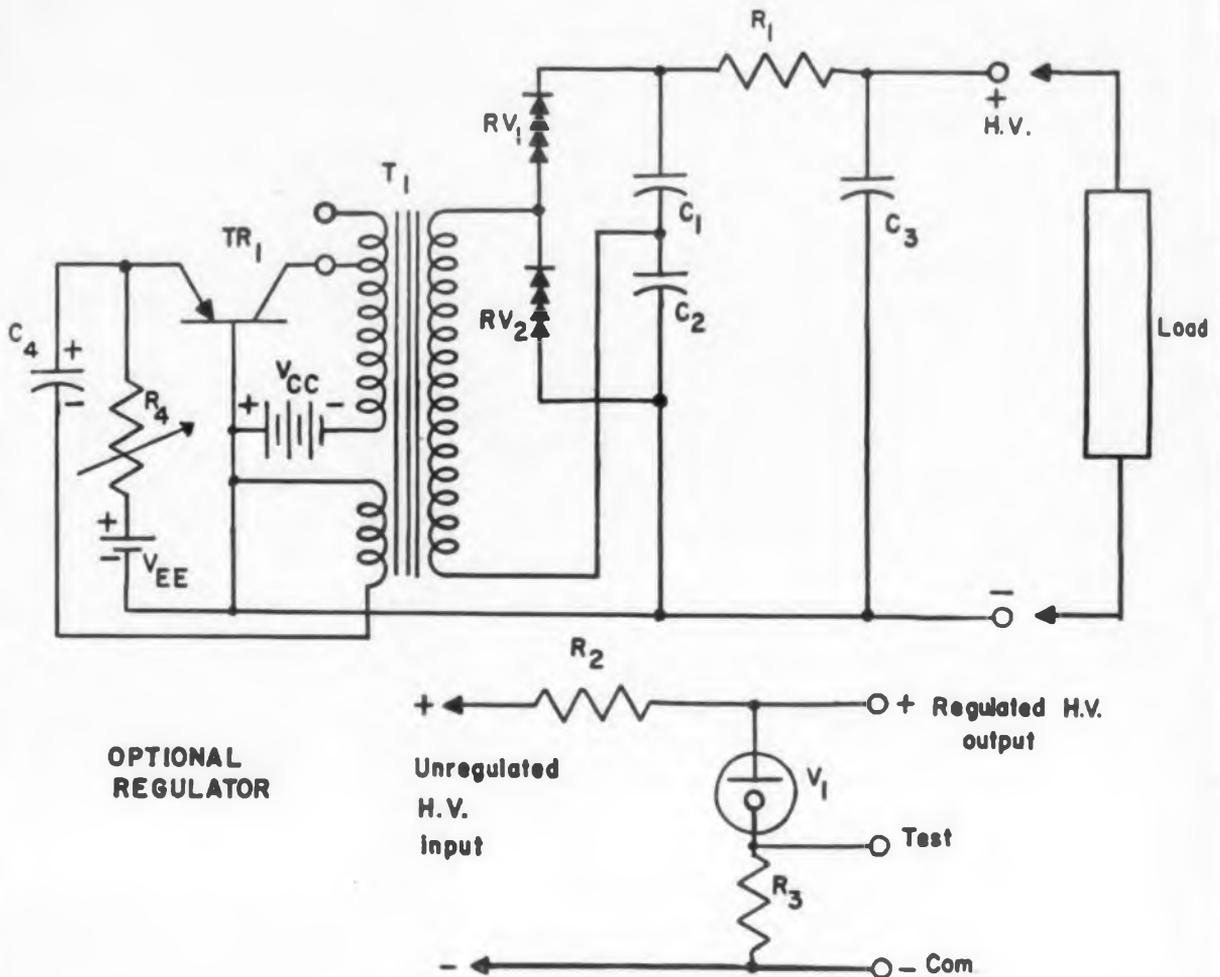


Fig. 1 (above). Circuit diagram of a typical transistorized high voltage power supply. An optional voltage regulator circuit appears below.

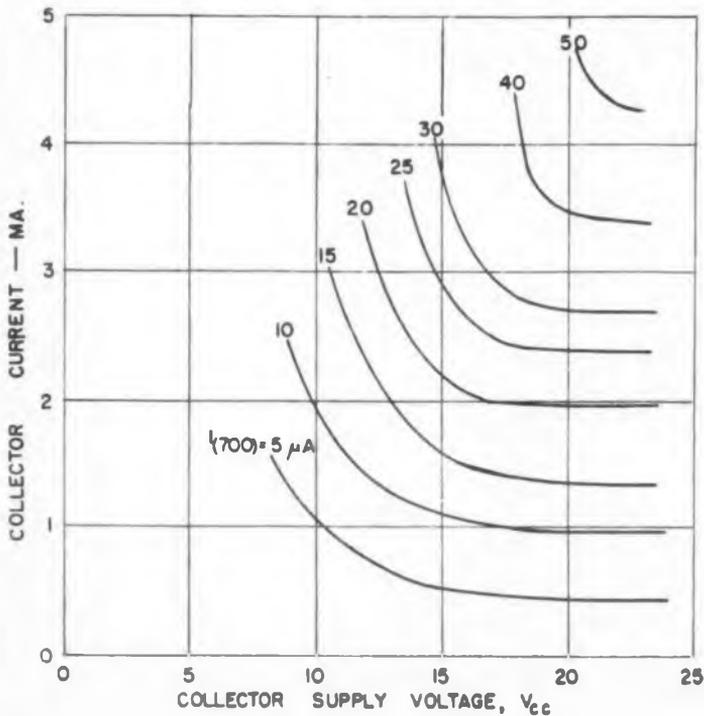


Fig. 2 (left). A family of collector characteristics for a Model BD-700 regulated 700v power supply unit.

**S**MALL size, light weight, high d-c energy conversion efficiencies, and reliable operation over long periods are features which make the Series PS Transistorized Subminiature High Voltage Supplies especially useful as components in portable, high-voltage, low-current applications. They are transistor oscillator-rectifier-regulator units which convert small amounts of d-c power to high voltage d-c, which can be used to power such devices as Geiger counters, insulation testers, ionization chambers, photomultiplier tubes, and image converters.

Circuit diagram of a typical supply is shown in Fig. 1 along with an optional regulator. The unit can be operated on voltages from 3v to 22.5v, and the d-c energy conversion efficiency ranges from 30% to 50%



Fig. 3. A typical power supply unit like the one above can be powered by the four pen-light batteries shown.

depending upon the operating point and input voltage. Fig. 2 shows a family of collector characteristics for a Model BD-700 regulated 700v supply.

Hermetically sealed junction transistors are employed in the conversion unit, and supplies can be furnished with output voltages from several hundred to several thousand volts, depending on customers' requirements. Standard models have outputs of 700v or 900v, regulated to  $\pm 15v$ . Both have a maximum current output of 50 $\mu$ amp and a very low a-c ripple voltage. Units are available from Technical Operations Inc., 6 Schouler Court, Arlington 74, Mass.

The supply is contained in a steel case measuring 2-3/4" x 1-3/4" x 1-7/8", and weighs only 7-1/2 oz. It is shown in Fig. 3 next to four penlight batteries which can be used to power the units.

In addition to the applications mentioned, the unit has other interesting possibilities. It can charge small energy storage capacitors, and maintain the charge on large energy storage capacitors. It can also be used to polarize capacitor type microphones, and electrostatic transducers as well as for biasing nonlinear dielectric materials in dielectric amplifiers.

ELECTRONIC DESIGN • October 1953

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# TUNG-SOL ELECTRON TUBES

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**A**BILITY to handle high frequencies, extremely low crosstalk level, and the compactness of the Cunningham Crossbar Switch (Fig. 1), make it useful for a wide range of multiple switching applications. Developed by James Cunningham, Son & Co., Inc. (113 Canal Street, Rochester 8, N. Y.), it is designed for rapid reliable operation and long life.

The unit's function is to permit each circuit of a group of circuits to be connected to a circuit or circuits in another group of circuits in any combination. Each circuit may have up to three wires, and the switch can be furnished with four or ten link levels, and either 10 or 25 line levels. The flexibility inherent in the design of the unit permits easy multiplication in length, width, and height.

Excellent transmission is achieved at frequencies as high as 70Mc. Bridging capacitance between adjacent conductors is 15mmfd. The crosstalk level between two circuits with common ground, and adjacent in both line and link levels, is down more than 65db at 10Mc.

The switch functions by action of electromagnets which set up and hold the connections. This operation is completed in less than 14 milliseconds and the release is effected in 2 milliseconds. Any number of connections up to the maximum number of line circuits can be made to one link circuit by the operation of any of the line hold magnets. The switch is available either with or without cutoff contacts. The 10 x 10 unit is 8" x 11" x 3-1/2", weighs 10 lb, and can be mounted in any position.

Each of the electromagnets requires 200 ampere-turns, equivalent to 2.5w. The coils will dissipate 3w continuously, and can be furnished for 12v, 24v, or 48v operation. Contacts are rated at 1amp, noninductive load. Control of the switch may be either by manually-operated keys, automatic control circuits, or dialed impulses. Circuits are available for channeling circuit paths through the switch and preventing simultaneous seizure.

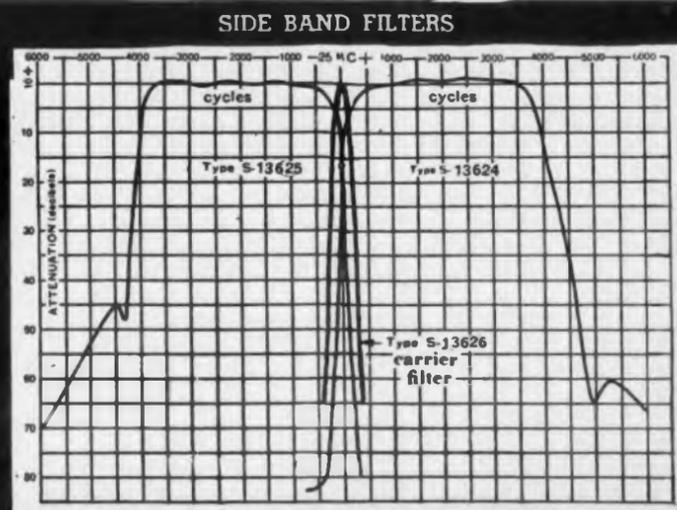
The most common applications for the switch are in audio circuits, telephony, telemetering, and telegraphy. Because of its high frequency capabilities, it can be used for video switching. Fig. 2 shows a typical application for the switch. It is part of a master control for TV and broadcasting facilities which can handle as many as 50 program lines with switching facilities to 40 transmitters. Two switches, each with 25 line levels and 10 link levels are shown, and the pattern is repeated four times in this application.

The good frequency characteristics also make it possible to use the unit for radar monitoring. The switch can be modified for feeding information into computer memory systems as well as for taking information out of the machine.

Another interesting application is its use as a variable delay line. This is done by using a 1 x 10 switch and hooking different lengths of coaxial cable to the circuit wires of the ten links.

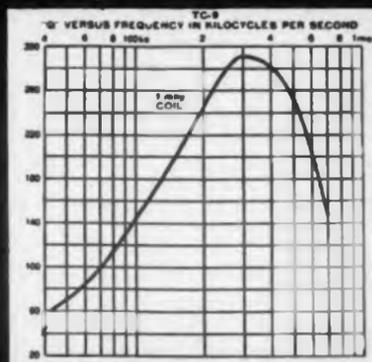
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The keyboard can be wired to provide zero pulse if no keys are depressed. Depression of any control key will operate a normally open contact. The keyboard comes in seven to eleven column sizes. A solenoid may be provided for clearing from a feed-back pulse.

The seven-column Basic Model No. 1207 illustrated has an input capacity of 9,999,999. Keys latch down when depressed until another key in the same column is depressed. A "clear" key provides manual release. There are eight nonlatching control keys marked as requested. Contact rating of the keyboard is 1.5amp at 115v, a-c, with non-inductive load. Clary Multiplier Corp., Dept. ED, San Gabriel, Calif.

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## V-H-F Crystal Converter

Compact, Easy to Mount



The Cascode Crystal Converter employs only three tubes and measures only 3" x 3" x 5". It is small enough to be mounted inside a communications receiver cabinet, and as many as five units can be

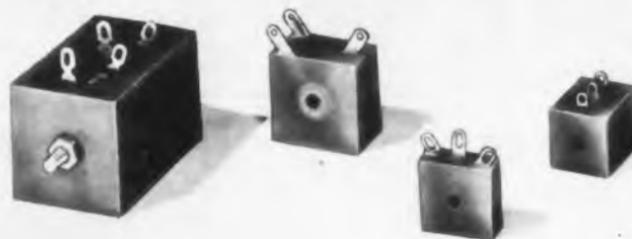
mounted on a standard 7" x 19" relay rack panel.

A 6BQ7-A tube is employed as a cascode r-f amplifier. One 6J6 combines the functions of crystal oscillator and frequency multiplier, while another 6J6 is used as a combined mixer and multiplier. Usable average sensitivity is better than  $0.5\mu\text{v}$ , and noise figure averages 5db. Bandwidth is flat over a 6Mc range but may be peaked to favor any portion desired. The standard i-f output frequency is 14Mc to 20Mc. Other frequencies are available on special order. Units also can be furnished to cover any 6Mc segment of the v-h-f spectrum between 50Mc and 250Mc. Mohawk Electronic Research Laboratories, Inc., Dept. ED, R.D. #4, Amsterdam, N.Y.

CIRCLE ED-18 ON READER-SERVICE CARD FOR MORE INFORMATION

## Encapsulated Rectifiers

Withstand Extreme Environments



This new line of encapsulated selenium rectifiers will operate under extreme environmental and other unusual conditions. A casting resin is employed which makes it possible to encapsulate rectifiers as complete, self-contained units operating at normal voltage and current ratings. The resin enables the stack to be exposed to temperatures from  $-55^\circ$  to over  $\pm 150^\circ\text{C}$ .

Encapsulation in many cases acts as a satisfactory substitute for hermetically sealing in oil; in this way size is kept at a minimum while protection is provided against high humidity and corrosive atmospheric conditions. Where a combination of rectifiers is involved, several rectifiers can be encapsulated in a single unit, giving compactness of design.

These rectifiers can be provided to meet any mounting specification. The casting resin has excellent dielectric properties plus a high mechanical strength which permits the rectifiers to take abuse in handling. Seletron Division, Radio Receptor Co., Inc., Dept. ED, 251 W. 19th St., New York 11, N. Y.

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

## Subminiature Receiving Tubes

With Stability of Operation

These two Subminiature Receiving Tubes, particularly suitable for military applications, are characterized by their small size, stability of operating characteristics, and performance dependability. Part of the company's "5-star" line, they are both designated for service under severe mechanical shock and vibration conditions and high ambient temperatures.



The Type GL-6111 is a medium-mu triode for general purpose amplifier applications. Each section has an individual cathode and is electrically independent. The unit also may be used as a combined oscillator and mixer in high frequency circuits. Typical operating characteristics for the unit in use as a class A1 amplifier include a plate voltage of 100v, a cathode bias resistor of 220 ohms, an amplification factor of 20, a plate resistance of 4000 ohms, and a transconductance of  $500\mu\text{mhos}$ .

The Type GL-6112, is a high-mu twin triode for use as an audio-frequency voltage amplifier or phase inverter. As a result of its low microphonic characteristics the unit can be employed at relatively low signal levels. Typical operating characteristics for each section as a class A1 amplifier with 100v on the plate include a cathode bias resistor of 1500 ohms, an amplification factor of 70, a plate resistance of 39,000 ohms, a transconductance of  $1800\mu\text{mhos}$ , and a plate current of 0.8ma. General Electric Co., Tube Dept., Dept. ED, Schenectady 5, N. Y.

CIRCLE ED-20 ON READER-SERVICE CARD FOR MORE INFORMATION

## Miniature Synchros

Transmitters and Transformers



These Synchro Transmitters and Control Transformers have maximum error limits of only 7 minutes.

Miniature units, they measure 1.062" diam x 1-23/32" long. Models for either 26v or 155v 400cy excitation can be furnished.

They are designed to assure performance under extreme conditions of humidity, temperature, altitude, and vibration. Kearfott Co., Inc., Dept. ED, Little Falls, N. J.

CIRCLE ED-21 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1953

## Midget Battery

### For Portable Radios



The VS086 45v alkaline-type "B" Battery weighs approximately 3 oz and measures 3-9/16" x 1-1/16" x 11/16" deep. It is intended for use in current personal portable radios designed to operate from a 45v "B" battery and a separate "A" cell.

The alkaline cells used in the battery deliver a large amount of energy per unit of volume, making it practical to reduce the size of both the cell and the battery. RCA Victor Div., Radio Corporation of America, Dept. ED, Camden, N. J.

CIRCLE ED-22 ON READER-SERVICE CARD FOR MORE INFORMATION

## Photo Transistor

### Output Can Operate Relay



This unit can be considered as a light-sensitive device with an incorporated amplifier. Known as the Type X-25 Germanium n-p-n Junction Photo Transistor, it has sufficient power output to operate such devices as relays.

Among the many possible applications are automatic brilliance controls on television receivers, automatic dimmers for automobiles, and use in automatic punch card accounting machines. Maximum operating power is 60mw, and maximum non-destructive power is 400mw. Transistor Products, Inc., Dept. ED, Snow and Union Sts., Boston, Mass.

CIRCLE ED-23 ON READER-SERVICE CARD FOR MORE INFORMATION

## Ultrasonic Delay Lines

### Utilize Fused Quartz



These solid ultrasonic delay lines utilize fused quartz as a delay medium. Delay times of 1-300 $\mu$ sec can be provided with a

high degree of accuracy. Frequency range specifications are 5Mc to 100Mc, and spurious response is up to 60db below desired signal. Pulse delay is 1-db to 1-1/2db average.

Applications include video integration, computers, time markers, moving target indication, and many others. The delay lines are designed for minimum size and weight. Laboratory for Electronics, Inc., Dept. ED, 75-4 Pitts St., Boston 14, Mass.

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

ELECTRONIC DESIGN • October 1953

# For Less Out-Gassing Here



## Try VACUUM-CAST METALS

Vacuum-melting removes gases and inclusions from metals. Tube elements made with vacuum-cast metals have a minimum of dissolved and trapped gases to spoil tube pressures.

Right now vacuum-cast metals are being evaluated to reduce pump-down time and to provide longer life for tubes like the thyatron pictured above.

Such improved properties are typical of vacuum-melted metals. Their better physical, chemical and electrical characteristics indicate that they can solve problems formerly considered difficult or impossible.

Commercial quantities of ferrous and non-ferrous metals and alloys are now being vacuum-cast at pressures as low as one millionth part of atmospheric by Vacuum Metals Corporation. Available in either billet or fabricated forms. Write for more information.

HIGH PURITY METALS  
HIGH VACUUM CASTING  
SPECIAL ALLOYS  
GF (Gas Free) METALS



## VACUUM METALS CORPORATION

Subsidiary of National Research Corporation

70 MEMORIAL DRIVE, CAMBRIDGE 42, MASSACHUSETTS

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



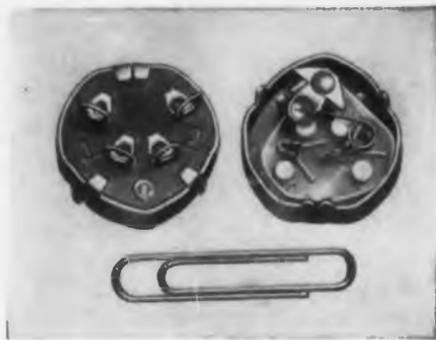
### VACUUM-MELTED METALS AVAILABLE FROM VMC:

CUPROVAC® E — Electronic grade copper.  
CUPROVAC® CR — Copper-chromium (85% Cr.) alloy.  
NIVAC® P — High purity, passive nickel.  
SEALVAC® A — Glass-to-metal sealing alloy.  
FERROVAC® 1020 — 20% carbon steel.  
FERROVAC® E — High purity, electronic grade iron.  
Other metals or alloys vacuum-cast to customer specifications.

## New Products . . .

### Line Switches

Rated 12amp at 12v d-c



Designed primarily for handling high currents at low voltages, as in auto radio and similar uses, the Type A-12 dpst Heavy Duty Line Switches are rated 12amp at 12v d-c. With only a 7/8"

diam and a depth of 9/32" (exclusive of terminals), the unit is designed for attachment to standard volume controls.

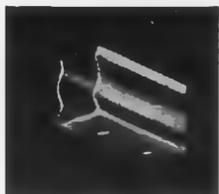
The terminals are hot tin dipped for easy soldering and are doubly locked in position with ears and rivets. In this way heavy wires can be attached to the terminals without danger of loosening. The design of the switch avoids the possibility of solder and flux flowing to the contact and impairing performance.

The Type A-13 is a spdt line switch designed for use on volume or tone controls and is rated 3amp at 125v a-c or d-c. Typical applications for this unit include use in large combination receivers to switch a common power supply from radio to TV, or to short circuit the power supply when a TV receiver is turned off, thus preventing the cathode ray tube beam spot from continuing long enough to burn the tube coating. All contact surfaces are silver plated. Stackpole Carbon Co., Electronic Components Div., Dept. ED, St. Marys, Pa.

CIRCLE ED-26 ON READER-SERVICE CARD FOR MORE INFORMATION

### Holding Clip

For Tubular Components



The "Component Holder" is designed to hold tubular capacitors, 1w and 2w resistors, miniature and subminiature tubes. It provides rigid mounting for conditions of heavy shock and vibration where space is limited, as in airborne electronic apparatus and guided missiles. It is made of cadmium-plated spring steel.

It affords a 180° contact surface the full length of the component. The following component diameter sizes are available: 0.175", 0.195", 0.235", 0.312", 0.375", 0.400", 0.562", 0.670", 0.750", and 1.00", with lengths to 2". Atlas E-E Corp., Dept. ED, Bedford Airport, Bedford, Mass.

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

# A NEW TERMINATION TECHNIQUE FOR . . .

- COMPUTERS
- SWITCHBOARDS AND INSIDE PLANT EQUIPMENT
- RELAYS, SWITCHES, AND MULTI-CIRCUIT COMPONENTS

# AMP

# FLAT\* TAPER

If you are concerned with the wiring of close spaced equipment, investigate the new AMP Solderless TAPER TAB RECEPTACLE for flat relay or switch tabs shown at right. It is self locking when installed on a male tab with matching 3 1/2° taper, yet can be removed and reconnected any number of times without solder or special tools. These terminals are supplied on reels in continuous strip. Customer crimps them on wires using AMP automatic machines at speeds up to 4,000 per hour!

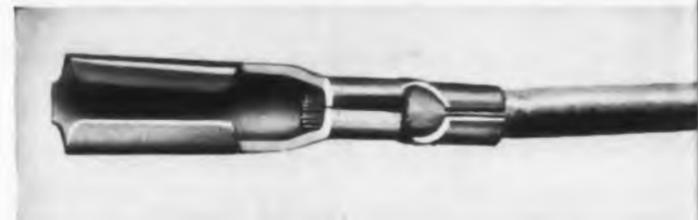
Performance of these miniature connectors meets exacting requirements for millivolt drop, corrosion resistance, and vibration. They are suited for critical low level circuits or power circuits up to several amperes.

Write to AMP Electronics Division for complete information concerning AMP TAPER TAB RECEPTACLES . . . you will receive data and samples by return mail.

An example of the savings possible with Taper Tabs and Receptacles. This disconnect block in Remington Rand's new electronic computer had more than 1,000 wires soldered to tabs in a space approximately 5" x 9"—an assembly operation requiring two weeks' time. After tabs were modified to taper shape (See picture insert), the same operator can now assemble two blocks per day—a 20 to 1 increase—using A-MP's Taper Tab Receptacle No. 41355. There are neither loose wire ends nor drops of solder in the assembly to cause shorts nor cold or rosin joints to open up in the field. Installation is simply a mechanical operation requiring little operator skill, resulting in greater uniformity.

\*For connector plugs and other applications where a round pin is more adaptable, see AMP taper pins.

PHOTO AT RIGHT SHOWS AMP SELF LOCKING TAPER TAB RECEPTACLES BEING APPLIED TO MATING TABS ON A STEPPING SWITCH. LOCKING ACTION GIVES MAXIMUM ELECTRICAL AND MECHANICAL SECURITY . . . CONNECTIONS ARE SUITABLE FOR CRITICAL LOW LEVEL CIRCUITS.



© AMP

AMP Trade-Mark Reg. U. S. Pat. Off.

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

ELECTRONIC DESIGN • October 1953



# TAB RECEPTACLES

**A-M-P**

AIRCRAFT-MARINE PRODUCTS, INC.

2100 Paxton Street, Harrisburg, Pa.

Aircraft-Marine Products of Canada, Ltd.

1764 Avenue Rd., Toronto 12, Ontario, Canada

Pat. Off.

1953

ELECTRONIC DESIGN • October 1953

## Toroids

### Molded in Plastic



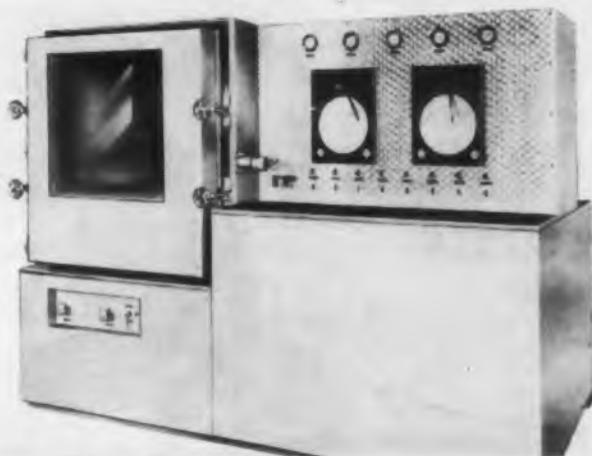
This firm has developed a method of compression molding toroids in plastic. The new toroids are sturdy, easily mounted units, with uniformity of dimension maintained by precision molds.

Two types of brass bushings in the center of the toroid are available: one is threaded for a 6-32 screw; the other provides a hole to clear a 6-32 hole. The center bushing keeps mounting pressure off the plastic and makes possible clean mountings. Communication Accessories Co., Dept. ED, Hickman Mills, Mo.

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

## Stratosphere Test Chambers

### Check Military Equipment



This line of high-altitude testing chambers, incorporating advanced heat transfer and control methods, is available in 5 cu ft to 48 cu ft sizes for determining equipment conformance to military specifications. Known as the "Strato-Chamber," each size is offered for operation between  $+200^{\circ}\text{F}$  and either  $-70^{\circ}$ ,  $-85^{\circ}$ , or  $-100^{\circ}\text{F}$ , at which point each standard model is capable of carrying a 200w "live" load.

The chamber also provides humidity control between 20 and 95%, and pressure control from atmospheric to 8 mm Hg absolute, (100,000 ft.).

The control panel is adjacent to the test chamber and incorporates separate electronic, thermocouple-type recording-controlling instruments for the dry and wet bulb functions. Hudson Bay Div., Refrigeration Systems, Inc., Dept. ED, 646 W. Washington Blvd., Chicago 6, Ill.

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

**ACE** **PRECISION**  
**NYLON BALLS**

**LIGHTER**  
**TOUGHER**  
**MORE STABLE**

fabricated of DUPONT NYLON  
FM No. 10001 to close tolerances  
SIZES 1/8" to 3/4" TOLERANCES ± .001

Mass-produced to  
close tolerances giving you tough-  
ness at low temperatures, form  
stability at high temperatures,  
light weight, chemical and abrasion  
resistance. Ace Nylon Balls offer  
greater design possibilities for hun-  
dreds of industrial applications.

**NOW AT LOWER PRICES!**  
Because of mass production Ace is now pro-  
ducing the same quality at lower costs . . .  
the savings are yours!

Write for Samples, Bulletin, Price List Today

**ACE PLASTIC COMPANY**  
Precision Plastic Fabricators and Extruders

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

**KEY MARK**  
QUALITY  
TRADE MARK

CIRCLE ED-31 ON READER-SERVICE CARD FOR MORE INFORMATION

the standard  
for its service . . .

**ESCO TYPE-A  
ROTARY  
MULTIPOLE  
SWITCH**

**RATINGS:**  
**Continuous**  
10 amp. 125 volts  
**Interrupting**  
AC—5 amp. 125  
volts (at 0.75  
PF)  
3 amp. 125  
volts (lamp  
load)  
DC—5 amp. 30  
volts (non-in-  
ductive load)  
1 amp. 125  
volts

**Overload**  
50 cycles—30 amp.  
125 volts (non-  
inductive load)

A compact, multipole switch for tap, transfer, and selector service at medium current ratings. Up to seven sections controlled from a single knob. Wide selection of switching actions. An exceptionally sturdy detent assures positive positioning at all steps. Write for FREE descriptive bulletin.



**ELECTRO SWITCH  
CORPORATION**  
167 King Avenue, Weymouth 88, Mass.

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

**New Products . . .**

**Continuous Rotation Potentiometer  
With Resistance Ranges to 100,000 ohms**



The Model L Series is a 360° continuous rotation, high precision Potentiometer with a 3"OD. Variations on the basic design include the Model L with bushing mounting and sleeve bearings, the Model LS with servo lid mounting and "Oilite" bearings, and the Model LSP with servo lid mounting and ball bearings.

Phasing is accomplished by means of an external ring clamp. The unit may be phased in the field, or, in the case of ganged assemblies, each section can be phased independently. Extra taps can be spotwelded accurately with a tolerance of ±1° for versatility. As many as 33 taps can be made in a single section. Up to eight sections can be ganged together on a common shaft.

Other features include double shaft extensions. All electrical connections are spotwelded for maximum dependability. No pressure-type connections are used.

The Model L Series supersede the company's Model F with which they are physically and electrically interchangeable. Models L and LS with standard linearities of ±0.5% in resistance are available in ranges from 10,000 ohms to 100,000 ohms. Helipot Corp., Dept. ED, South Pasadena, Calif.

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

**Coding Markers  
For Small Gage Wire**



Designed especially for coding small gage wires on electronic and electrical equipment, these small Coding Markers eliminate the older, time consuming method of trimming large markers to size. The devices are pressure-sensitive, require only finger-tip pressure to apply, and are positive sticking.

Only 3/4" long, the units are center die cut and

mounted on a handy pocket size backing card (2" x 10"), with easy to use speed tabs for quick removal. This tab arrangement makes it possible for any code to be stripped off without disturbing the remaining codes. The use of small size numerals makes wire identification fast and easy, and the complete code can be read without turning the wire. The backing card contains 68 individual markers.

Made of a tough fabric coated with special adhesive material, the units resist dirt, moisture, grime, etc. They are available in over 1000 codes including ASA and NEMA specifications. Westline Products Div., Western Lithograph Corp., Dept. ED, 600 E. Second St., Los Angeles 54, Calif.

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

**Banana Plug  
Styled for Easy Gripping**



Molded of mica-filled Bakelite in accordance with JAN specifications, the FWT Banana Plug is styled for easy gripping. Leads can be brought directly from the base of the prongs or through a hole at the bottom of the plug. The top of the plug is designed to take additional plugs. All contacts and screws are nickel-plated brass. Components Div., National Co., Inc., Dept. ED, 61 Sherman St., Malden, Mass.

CIRCLE ED-35 ON READER-SERVICE CARD FOR MORE INFORMATION

**Combination Blower-Turbine  
For Cooling High Power Tubes**

This Combination Blower will take care of all of the cooling requirements of the new G-E u-h-f tetrodes as well as other similar tubes. A Model-M multistage blower is mounted on one end of an induction-type driving motor to provide high pressure air for



cooling tube seals. On the other end of the motor is mounted a centrifugal blower for cooling the main transmitting tube anode.

Four different types of these combination blowers are available, and others can be assembled on order. In addition, the combinations are available with integrally mounted air cleaning filters. The filters are available in three different types to meet specific application requirements. Rotron Manufacturing Co., Dept. ED, Woodstock, N. Y.

CIRCLE ED-36 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • October 1953

## Engineering

# WRITERS

**ENGINEERS, E. E. or PHYSICS GRADUATES**, for preparation of technical manuals...

HUGHES RESEARCH AND DEVELOPMENT LABORATORIES' expanding program for production of radar, electronic digital computers, guided missiles and other military advanced electronic systems and devices requires the following:

**1 ELECTRICAL ENGINEERING AND PHYSICS GRADUATES** to prepare operating, servicing and overhauling instructions for complex electronic equipment. Those with previous maintenance experience on military equipment preferred. Writers will participate in a three-month program in our technical training school to become familiar with the latest Hughes equipment prior to writing assignments.

**2 ENGINEERS EXPERIENCED** in the writing and preparation of maintenance manuals for electronic equipment or guided missiles. These specialists will work step-by-step with the people designing, developing and manufacturing the products involved. Experience in the writing of engineering reports is of value.

### HOW TO APPLY

Write full details of your qualifications to

# HUGHES

Research and Development Laboratories

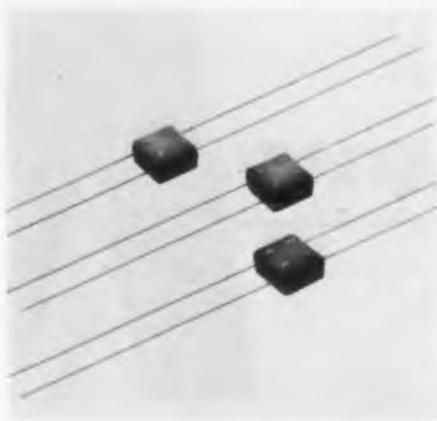
SCIENTIFIC AND ENGINEERING STAFF

Culver City, Los Angeles County California

Assurance is required that relocation of the applicant will not cause disruption of an urgent military project.

## Miniature Pulse Transformers

### Completely Encapsulated



These Miniature Pulse Transformers are capable of transferring pulses in the millimicrosecond to microsecond range and have wide application in digital computer, radar and telemetering systems. They have low capacity,

high inductance windings on a small ferrite core with high coefficient of coupling. They are encapsulated in a color-coded thermosetting resin which enables them to withstand severe mechanical shock and environmental conditions.

Coefficient of coupling between any two windings is 0.97. Pulse repetition rate is up to 5Mc. Static capacitance between any two windings is less than 2.0mmfd. Temperature range is  $-65^{\circ}$  to  $+125^{\circ}$ C. Voltage rating (between windings) is 1000v. Standard units are available with a primary inductance of  $150\mu\text{h}$ ,  $400\mu\text{h}$ ,  $1000\mu\text{h}$ , and  $2000\mu\text{h}$ , with a turns ratio of 1:1 or 3:1. These units will faithfully reproduce pulses with rise times as short as  $0.02\mu\text{sec}$  and widths as long as  $2\mu\text{sec}$ . Size is  $3/8'' \times 3/8'' \times 3/4''$ . Electronics Production Service Co., Dept. ED, 871 Washington St., P.O. Box 268, Canton, Mass.

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

## Miniature Transformers

### Cover A-F Range



The JAF Series is a line of miniature, magnetically shielded, hermetically sealed Transformers. Used with transistor or tube amplifying equipment, they cover the audio frequency range.

The units are available in standard MIL cases with mounting studs so arranged that transformers may be mounted in the closest possible proximity to each other. All essential information for each transformer is carried on a permanently attached decal. Triad Transformer Corp., Dept. ED, 4055 Redwood Ave., Venice, Calif.

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

*Eimac*

**QUALITY PRODUCTS**  
...for top performance!



**Preformed Contact Finger Stock** is an ideal electrical weather stripping around doors of equipment cabinets as well as being excellent for use with VHF and UHF circuitry. Silver plated, it comes in three widths— $\frac{3}{16}$ ,  $\frac{3}{8}$  and  $1\frac{7}{8}$  inches.

**Variable vacuum capacitors** come in three models, are lightweight, compact, eliminate the effects of dust and atmospheric conditions and have low inductance. Also available are eight types of fixed vacuum capacitors.

**Air-system sockets**, designed for Eimac tube types 4-400A, 4-1000A, 4X150A, and 4X150D, simplify cooling and assure adequate air-flow to various seals. The 4-400A socket can also be used with the 4-125A and 4-250A

radial-beam power tetrodes if desired.

**HR heat dissipating connectors** provide efficient heat transfer from the tube element and glass seal to the air while making electrical connections to plate and grid terminals. Precision machined from dural rod, HR connectors come in ten sizes to fit most of Eimac's internal anode tubes.

**High Vacuum Rectifiers** come in eight models, are instant heating, have radiation-cooled pyrovac\* plates and can be operated in a variety of rectifying and voltage multiplying circuits. Also available are four types of mercury-vapor rectifiers.

\* An Eimac trade name.

• For further information write our Application Engineering department

**EITEL-McCULLOUGH, INC.**  
SAN BRUNO • CALIFORNIA

Export Agents: Frazar & Hansen, 301 Clay St., San Francisco, California

*Eimac*

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

## New Products . . .

### Nonflammable Solvent

#### Less Toxic than Carbon

A Nonflammable Solvent, known as "Penolene 643", can be used to replace poisonous carbon tetrachloride. Retaining all the desirable qualities of carbon tetrachloride, such as nonflammability, 15sec drying time, and powerful solvent action, the solvent greatly reduces the toxic hazard.

Although the fluid contains no carbon tetrachloride, it evaporates as fast and is equally nonflammable. It will not leave a film or residue on the surfaces cleaned. Penetone Co., Box ED, 653, 74 Hudson Ave., Tenafly, New Jersey.

CIRCLE ED-40 ON READER-SERVICE CARD

### Tubing and Sleeving

#### Withstands High Temperatures

"BH 649" Insulation is a vinyl-chloride and plasticizer combination applied over heat-treated braided Fiberglas. The construction provides a high dielectric tubing and sleeving with permanent flexibility, high heat stability, and resistance to flow. It withstands temperatures of 130°C.

Sizes are available to fit AWG bare wire from No. 24 to No. 6/0, in nine colors. Special orders may be made up to 2" diam. Bentley, Harris Manufacturing Co., Dept. ED, Conshohocken, Penna.

CIRCLE ED-41 ON READER-SERVICE CARD

### Set Screw

#### Has High Holding Power

The "Nu-Cup" is a Set Screw designed so that the user can obtain greatly increased holding power with the same amount of setting torque. It is particularly suited to applications in which the shaft is soft, or small in relation to the contact arc of the screw cup (radio and TV, etc.).

Since the diameter of the cup circle is larger than that of the standard cup point, a fuller contact and deeper impression into the shaft are possible. Set Screw & Mfg. Co., Dept. ED, 265 Main St., Bartlett, Ill.

CIRCLE ED-42 ON READER-SERVICE CARD

## ALLIED CONTROL'S

# ME

- ✓ SIZE CUT 66%
- ✓ WEIGHT CUT 48%
- ✓ RELIABILITY DOUBLED
- ✓ WRIGHT FIELD APPROVED



Designed to withstand a shock of 50G, these new Allied Control double-throw miniature relays were developed to meet the rigid requirements of U.S.A.F. Specifications MIL-R-5757A.

Known as the Allied MH series, this new line of relays consists of the 6-pole MH-18, the 4-pole MH-12, and the 2-pole MH-6. Contacts are rated at 2 amps resistive or 1 amp inductive at 28 volts D. C.

The high performance of these relays has been achieved

in an extremely compact, unitized construction and parallels the most recent advances in airborne equipment design. The "actual size" photographs shown above highlight the 66% savings in overall size, the 48% savings in weight and the 30% reduction in chassis area.

For detailed specifications and drawings of these new relays, contact your local Allied Control Representative or write us for Bulletin 1002.

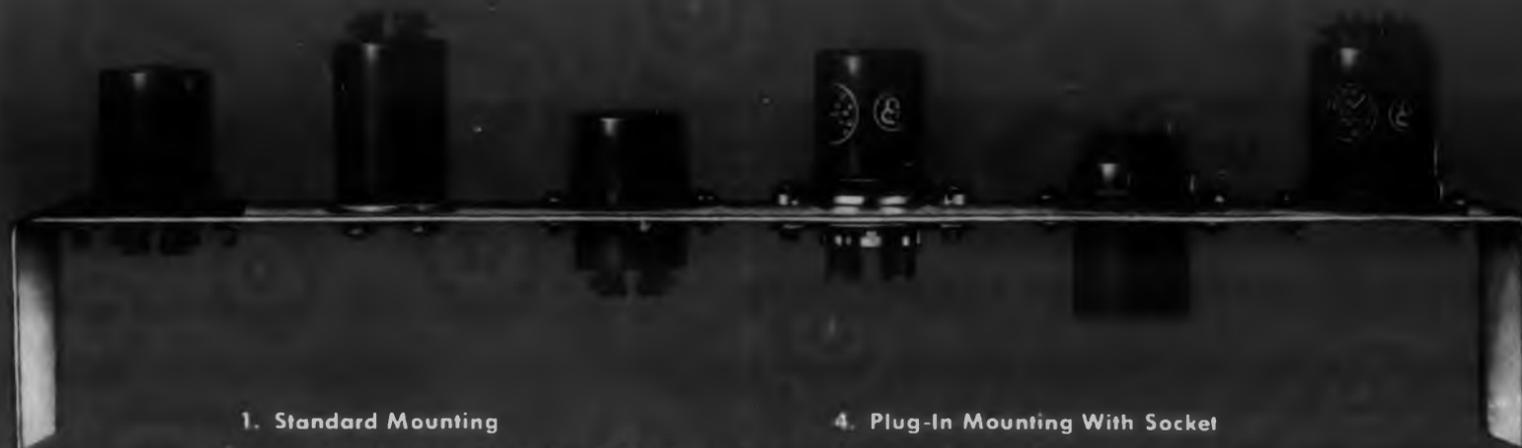
CIRCLE ED-43 ON READER-SERVICE CARD

# W

## 50 G MINIATURE RELAY

APPROVED MIL-R-5757A

### SIX DIFFERENT MOUNTINGS



1. Standard Mounting
2. Flush Mounting—2 Studs at  $\frac{3}{8}$ " Centers
3. Thru-Chassis Mounting—Terminals Down
4. Plug-In Mounting With Socket
5. Thru-Chassis Mounting—Terminal Up
6. Flush Ring Mounting



4-POLE  
MHB-11



1-POLE  
MHB-12



2-POLE  
MHB-4

### FEATURES

- Wide Ambient Temperature Range:** 55°C to 85°C standard—65°C to 125°C MHB-type
- Vibration Resistant:** 15G's vibration to 500 cycles • **Operating Shock:** no contact chatter to over 50G's
- High Altitude:** seal-tested to 70,000 feet
- Dependable Operation:** life expectancy of over 1 million operations at rated load
- High Speed:** operate-to-make time under 8 ms.  
release-to-make time under 4 ms.  
release-to-break time under 2 ms.

ALLIED CONTROL COMPANY, INC.

2 EAST END AVENUE, NEW YORK 21, N. Y.



READER-SERVICE CARD FOR MORE INFORMATION

### High Temperature Solder

Melts at 296°C

"Ersin Multicore" Solder with a melting point of 296°C has been added to the company's line. This solder is made with non-corrosive, extra-active "Ersin" flux, and is useful in electronic equipment likely to undergo relatively high temperatures.

This new solder has a high resistance to creep compared to tin/lead solders. Properties include a tensile strength of 2.5 tons/sq. in., an elongation of 40%, and an electrical conductivity of 8% IACS. Multicore Sales Corp., Dept. ED, 164 Duane St., New York 13, N. Y.

CIRCLE ED-44 ON READER-SERVICE CARD

### Coating for Styrene

Protects Against Solvents

Known as "Plastic Coating BE-40." this clear, transparent coating makes the surface of polystyrene immune to most common solvents. The coating is scratch and flame resistant. It resists physical abuse and has the features of high gloss and high adhesion.

The coating can be applied by brush, spray or dip. It air dries in about 15 minutes and then is cured in one hour at 150°F. When cured, it is immune to solvents such as ketones, aromatics, and alcohols; and it resists high heat. Schwartz Chemical Co., Inc., Dept. ED, 326 W. 70th St., New York, N. Y.

CIRCLE ED-45 ON READER-SERVICE CARD

### Titanium Castings

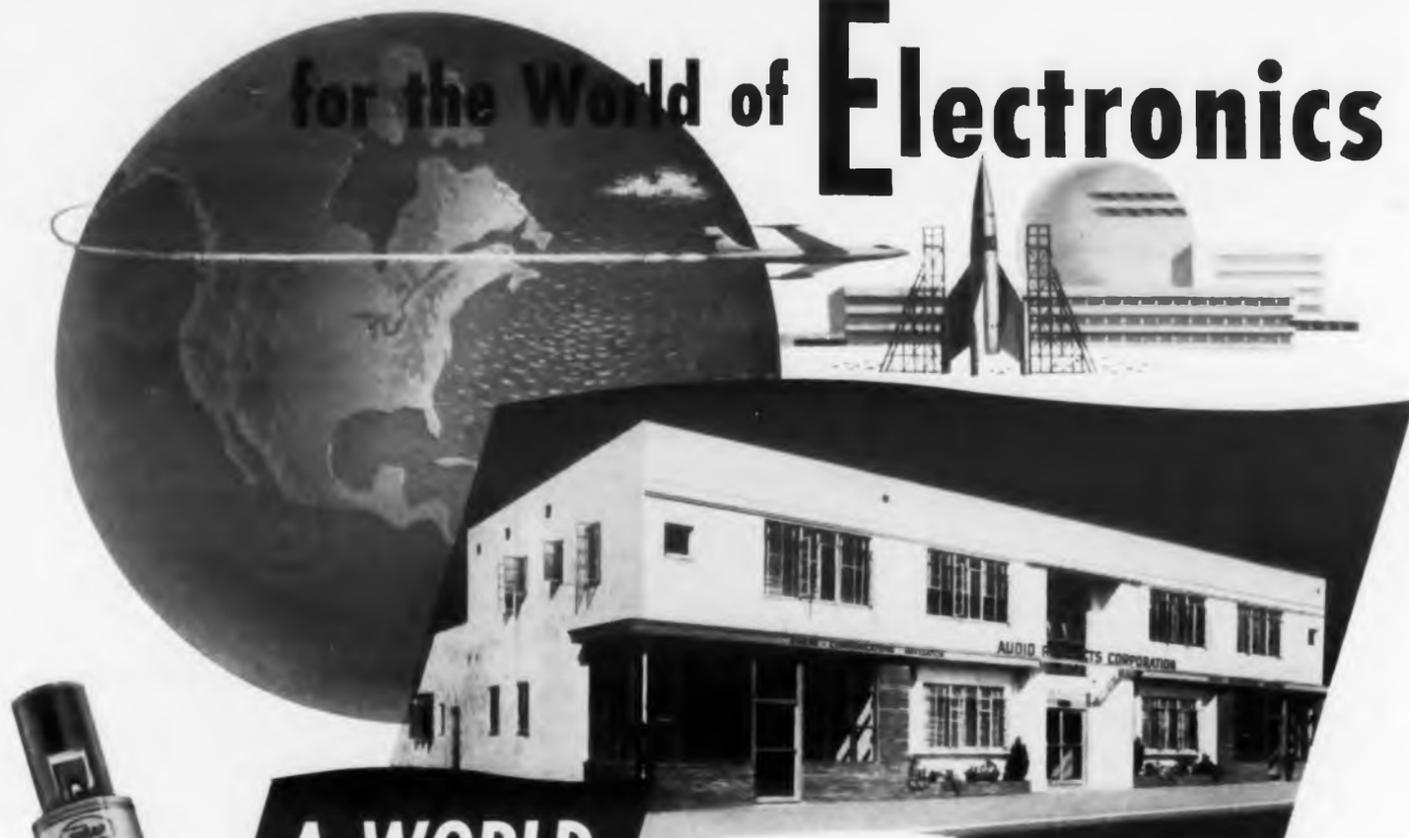
Pilot Quantities Produced

This firm has announced the development of a method for producing cast shapes of titanium metal.

With the method, it is possible to produce pilot quantities of cast shapes of both pure and alloyed titanium. Carbon, oxygen, and nitrogen content are reasonably comparable with commercial wrought titanium. The surface attainable is equal to that of good sandcast metals. National Research Corp., Dept. ED, 70 Memorial Dr., Cambridge, Mass.

CIRCLE ED-46 ON READER-SERVICE CARD

# for the World of **Electronics**



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### MINIATURIZED PACKAGED CIRCUITS

Plug-in circuitry in a compact unit. Custom-engineered to individual specifications based on circuit requirements or performance needs.

### THE MODULAR SYSTEM

A basic electronic tool of great flexibility to aid in the design and use of pulse methods for information transmission, storage and computation.



Do you have an application in the fields of radar, telemetry, communications, navigational aids or electronic miniaturization? If so, it will pay you to consult **AUDIO PRODUCTS CORPORATION**.

Here you'll find 35,000 square feet of modern production facilities and a staff of engineers accustomed to working in the more advanced phases of electronic development. From basic design to prototype, to final engineering tests—their knowledge, experience and facilities are applied to deliver a finished product to meet the highest standards of performance and reliability. A host of successful electronic units for military agencies and commercial organizations the world over is your proof. That is why we say—

*For the Best in Electronic Design, Development and Manufacture, Consult*



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The emphasis is on telemetry, radar relays, modulators and packaged circuitry



Highly skilled Audio Products technicians work with advanced production test facilities

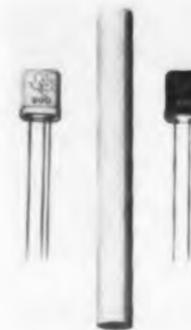


Ever-expanding plant facilities provide more than 35,000 square feet of production space

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

## New Products . . .

### Grown-Junction Transistors Hermetically Sealed



Types 200 and 201 Grown-Junction Transistors are both n-p-n triodes with glass-to-metal hermetic sealing. Their principal difference is in collector resistance and amplification factor. Both types are designed for high gain, low level audio applications where small size, long life, and operational economy are of prime importance.

Average characteristics at 30°C for both types include: collector voltage of 5v, emitter current of 1ma, base resistance of 150 ohms, emitter resistance of 30 ohms, collector cut-off current of 10μamp, collector capacitance of 12mmfd, and a noise factor of 22db. Current amplification factor is a minimum of 0.90 in the Type 200 and 0.95 in the Type 201; while minimum collector resistances are 0.2 megohms and 0.4 megohms, respectively. Texas Instruments, Inc., Dept. ED, 6000 Lemmon Ave., Dallas 9, Texas.

CIRCLE ED-48 ON READER-SERVICE CARD FOR MORE INFORMATION

### Front-End Tuner Assembly For U-H-F TV Reception



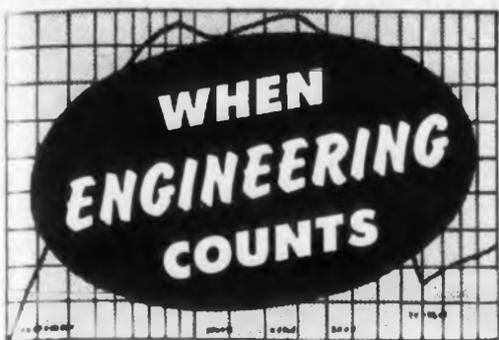
This Front-End Tuner Assembly for reception of u-h-f TV, will tune all channels from 14 through 83 in a continuous 180° sweep of the single tuning shaft. It may be used with any i-f strip capable of receiving its output frequencies

of 41.25Mc, sound, and 45.75Mc, video. The chassis proper measures only 2-3/4" x 2-1/4" x 1-1/2", and can be incorporated readily into compact TV designs.

Main components are an r-f preselector, oscillator, crystal mixer, and i-f coil. The preselector is double-tuned for greater selectivity. The oscillator range is 504-953Mc, with its normal operating frequency 43.5Mc above the incoming signal. Antenna input impedance is 300 ohms, balanced. Solder type terminals are provided. P. R. Mallory & Co., Inc., Tuner Div., Dept. ED, Indianapolis 6, Ind.

CIRCLE ED-49 ON READER-SERVICE CARD FOR MORE INFORMATION

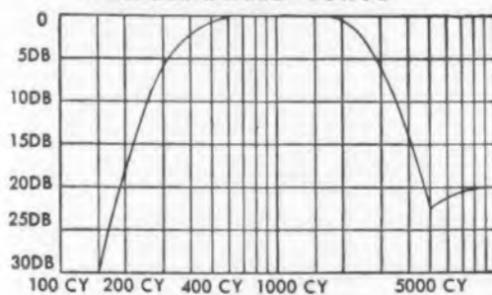
ELECTRONIC DESIGN • October 1953



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PERFORMANCE CURVE



Combination Low Pass, High Pass and Output Transformer Miniaturized, 1" x 2" x 2"

400 TO 800 CPS SATURABLE REACTORS



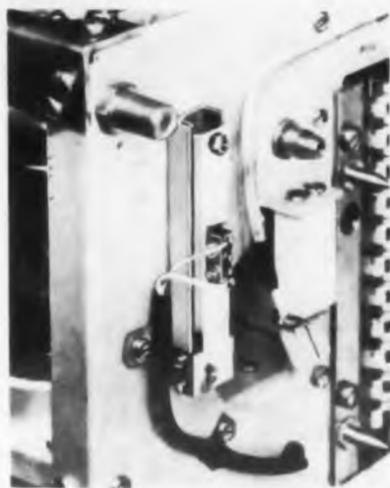
Miniaturized, 2" x 1-3/32" x 17/8" Hermetically sealed for Magnetic Amplifier control.

YOUR INQUIRIES INVITED

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*Engineering*  
CO. INC.

3223-9 West Armitage Avenue  
Chicago 47, Illinois  
CIRCLE ED-50 ON READER-SERVICE CARD

### Overload Radiation Switch Protects Tubes Against Heat



The Federal Overload Radiation Switch provides complete protection against tube failure due to anode overheating. It is designed especially to protect radiation-cooled transmitting tubes from damage caused by excessive plate dissipation. It will operate with any tube whose radiant

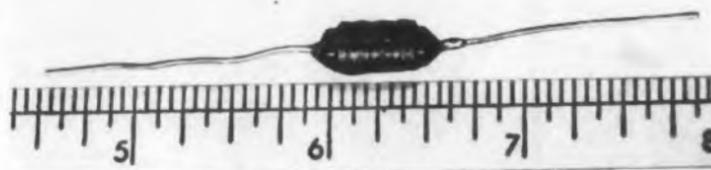
energy density at the bulb surface is greater than 1w/sq in. Rugged and easy to install, the switch is resistant to shock and vibration, has positive snap action, and can be readily adjusted to the desired operating level.

Unlike the commonly used thermostat, the switch is actuated entirely by direct radiant energy and is essentially unaffected by ambient temperature changes over the range  $-20^{\circ}$  to  $+100^{\circ}\text{C}$ . It can be used to actuate an alarm system, or to cut off plate power to the tube, or, with an appropriate power supply, reduce voltage applied to the tube during overloading. Use of the switch is not limited to protection of vacuum tubes; it can be applied wherever radiant heat has to be controlled. Federal Telephone and Radio Corp., Dept. ED, 100 Kingsland Rd., Clifton, N. J.

CIRCLE ED-51 ON READER-SERVICE CARD FOR MORE INFORMATION

### Miniature R-F Choke

25mh, 120ohm, 100ma Unit



The "P-Wee" choke is especially recommended for use in computer circuits and other applications where component size is a critical factor. It incorporates a high permeability core resulting in excellent electrical characteristics and extremely small size.

Electrical characteristics are as follows: d-c resistance is 120 ohms; induction is 25mh  $\pm 5\%$ ; distributed capacity is 8mmfd; Q at 100ke is 115; Q at 450ke is 80; and current carrying capacity is 100ma. Grayburne Corp., Dept. ED, 4-6 Radford Pl., Yonkers, N. Y.

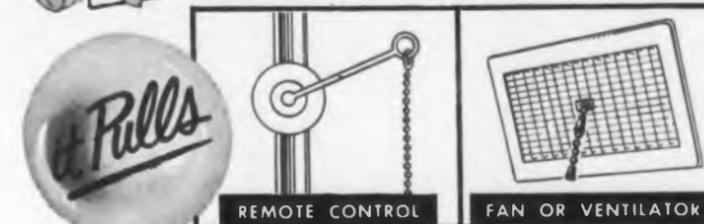
CIRCLE ED-52 ON READER-SERVICE CARD FOR MORE INFORMATION



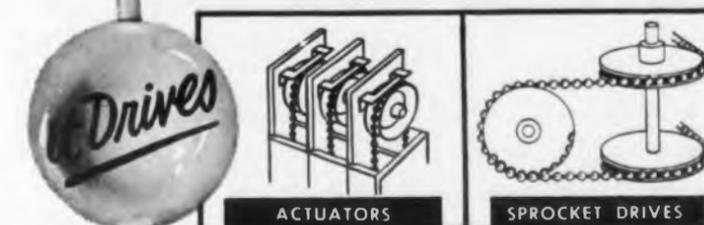
DOES SO MANY THINGS

...so much Better!

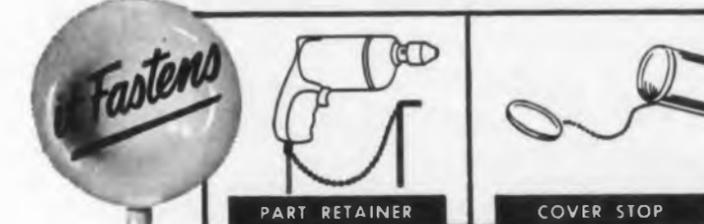
There are literally thousands of useful applications of BEAD CHAIN to all types of products, machines and tools! Consider how you may be able to take advantage of its versatility too! It pays dividends!



Bead Chain is available in 5 diameters from 3/32" to 3/8" with tensile strength ranging from 18 to 200 lbs. No matter what the requirement, our engineers can fill your need.



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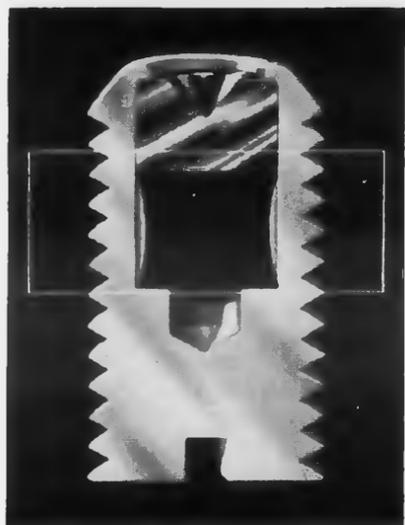


CIRCLE ED-53 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products . . .

### Cushion Mounting

#### Protects Jewel Assemblies



This mounting uses a resilient cushion of silicone rubber which absorbs vibration and serious shocks. It is especially designed to protect jewel assemblies in meters and other instruments where adverse conditions might put assemblies out of alignment and cause damage to jewel bearings. The rubber also with-

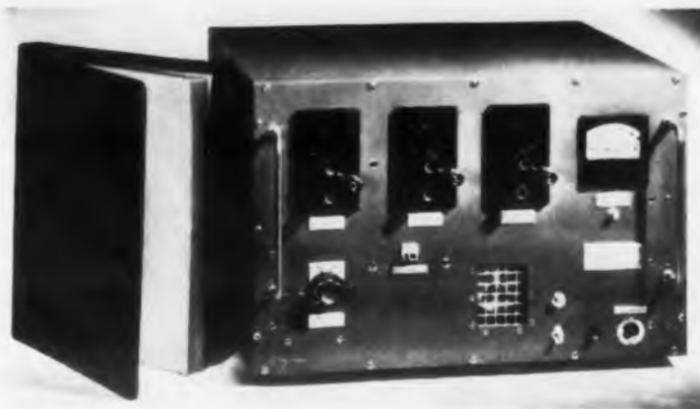
stands exposure to temperatures from  $-85^{\circ}\text{F}$  to  $+325^{\circ}\text{F}$ .

The mounting is available with various cushions to suit differing operating conditions. Richard H. Bird & Co., Inc., Dept. ED, Waltham, Mass.

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

### Variable Impedance Wattmeter

#### For Frequencies From 2 to 30Mc



The Model 141 Wattmeter makes fast, accurate power measurements between 2 and 30Mc. Designating input impedance as  $Z = R + jx$ ,  $R$  can be adjusted over a range of 5 to 500 ohms, and  $jx$  can be adjusted between  $-250$  and  $+250$  ohms. Up to 250w of power may be dissipated. Overall accuracy of the directly indicated power measurement is within 10%; accuracy of impedance magnitude is within 5%.

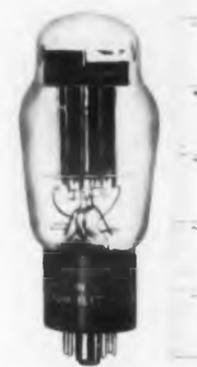
Correct impedance is established for each frequency by setting three counter-type dials in accordance with an easily-read calibration book. Power is read directly on the large front-panel meter. The

Model 141 is powered by a 110/115v 60 cy a-c source. Sierra Electronic Corporation, Dept. ED, 1049 Brittan Ave., San Carlos 2, Calif.

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

### Twin Power Triode

#### For Voltage Regulation



The Type 6AS7G high permeance, twin power triode, for voltage regulation, is used as a series or passing tube in regulated power supplies. It offers the following features: absence of grid current; plate current and GM characteristics held within  $\pm 10\%$ ; very low microphonics; and improved triode balance and reduction of plate current drift.

The tube can be furnished to meet the following additional specification (beyond the JAN quality level): plate voltage of 150v, grid voltage of  $-55\text{v}$ , cathode resistance of 100 ohms, grid resistance of 47 megohms, and plate current limits of 43ma to 73ma. Chatham Electronics Corp., Dept. ED, Livingston, N. J.

CIRCLE ED-58 ON READER-SERVICE CARD FOR MORE INFORMATION

*Top-liner*  
for Top Designers

PUSH BUTTON CASTELL  
LOCKTITE HOLDER AND  
CASTELL IMPORTED LEAD

- One-hand clutch operation avoids touching lead, smearing fingers or drawing.
- Exclusive collet holds lead in bulldog grip, prevents it slipping back into holder.
- Clean, balanced, efficient for every type of drawing, sketching, rendering, coloring.

**CASTELL Imported Lead**

18 degrees, 7B to 9H—gives more prints — cleaner and sharper prints — than any other drawing lead. Lasts 25% to 33½% longer. Black or colored. Your Drawing and Art Supply Dealer has them.

CASTELL  
the drawing pencil with the Master Degrees

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

REFIL IMPORTED FROM AMERICAN ZONE 1 DOZEN 2H

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

*IF* it's a problem in Precision Potentiometers

... Helipot HAS THE ANSWER!

World's largest manufacturer of precision potentiometers

HELIPOT offers a unique combination of unequalled "know-how", advanced manufacturing facilities and experienced personnel for solving your particular problems in the application of precision potentiometers to modern electronic circuits.

Suppliers to both Government and industry, HELIPOT has developed high speed winding, assembling and testing equipment that combine custom-built precision with mass-production economies. Multiple and single-turn designs . . . single and double shaft extensions . . . ganged assemblies . . . custom-spaced taps . . . multi-turn dials . . . these and many other special features are part of the daily output at HELIPOT!

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Write for Data File 1024

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division

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

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CIRCLE ED-59 ON READER-SERVICE CARD FOR MORE INFORMATION



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merly machined  
from solid stock.  
Only finish opera-  
tions required are  
reaming small dia. of  
counterbored hole and  
drilling and tapping for  
set screw.



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without costly machining.



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Matawan, N. J.

**CIRCLE ED-60 ON READER-SERVICE CARD**

**Capacitance Meter**

**Has 0-110mmfd Range**



The Model C102 "Capaciprobe" consists of a stable r-f oscillator, a current conversion buffer, a parallel tuned circuit, and a variable sensitivity resonance detector. It enables the user to accurately and rapidly measure total capacitance at any

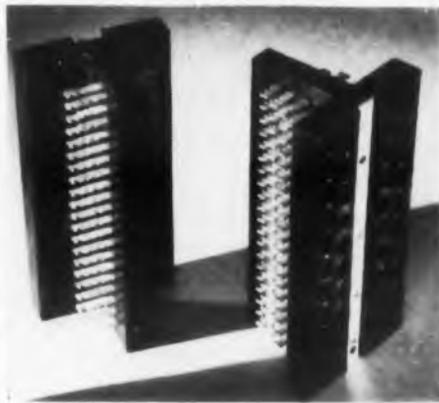
point in a circuit with that circuit operating under its normal d-c conditions.

No pre-zeroing is required. Operation merely requires placing the probe tip to the node in question and turning the direct-reading capacity dial until the tuning eye closes. The d-c levels present do not affect accuracy. The C102 covers the fundamental circuit range of 0-110mmfd (accuracy  $\pm 1\%$ ). It operates from 95-125v a-c. Electronics Production Service Co., Dept. ED, 871 Washington St., P. O. Box 268, Canton, Mass.

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

**Phenolic Terminal Blocks**

**40, 60, 80 or 100 Terminals**



These phenolic terminal blocks for electronic and communications equipment are offered in four different arrangements providing 40, 60, 80 or 100 pre-tinned, double-notched terminals securely fastened between

phenolic strips. The terminal assembly is fastened to a base of the same material. Advantages provided by the phenolic block construction are: excellent electrical characteristics, clean design, high structural stability and low water absorption.

Terminal block characteristics include (terminal to terminal or terminal to ground) a rated voltage of 1000v d-c, resistance of 10,000 megohms (minimum), and a capacity of less than 5mmfd. Overall dimensions of the 100-terminal block are 3" x 3-3/16" x 6-1/16". Lenkurt Electric Co., Dept. ED, County Rd., San Carlos, Calif.

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

**KNOW  
THESE IMPORTANT FACTS  
ABOUT  
PREDETERMINED  
COUNTERS!**

**Potter**



## WHEN SPECIFYING A PREDETERMINED COUNTER

for any application, check the reasons why a *Potter Instrument* is the only logical choice. There are important differences among predetermined counters—basic differences in simplicity of operation, in ease of maintenance, in reliability, and in versatility.

### THE SIMPLEST CIRCUIT

Potter Predetermined Counters use the "complement" circuit. Any count from one to ten can be set in the simple, straightforward four tube decade. A single output is operated when the predetermined count is reached. Other methods require the sensing of many "on" conditions. A typical three-sequence predetermined counter with four decades would require sensing 48 "on" conditions with separate tubes.

### THE GREATEST RELIABILITY

The Potter system provides automatic indication of tube

failure and stops automatically when failure occurs. Rugged, approved industrial tube types and switches, minimize maintenance, help assure trouble-free operation.

### MAXIMUM VERSATILITY

Potter Predetermined Counter Decades are especially adaptable to multiple-sequence counting. Only 12 tubes, for instance, are needed for counting in a dual-sequence, 0 to 1000 count, unit. Other systems need up to 24 tubes, yet do not equal the Potter method in performance, in space and power economy, and ease of maintenance.

### GET THE COMPLETE STORY

Get the complete story on Predetermined Counters for every application involving counting, sorting, batching, and measuring length, weight, volume, and speed. Along with it, let us prove, in detail, the superiority of Potter Instruments. For information on a unit or a system, write Department 10-F



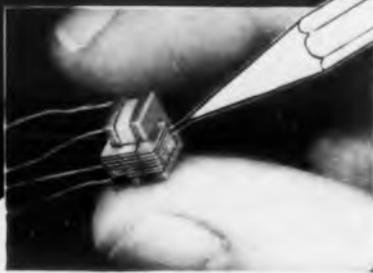
**POTTER INSTRUMENT CO., INC.**

118 CUTTER MILL ROAD

GREAT NECK, N. Y.

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

# STANCOR ULTRA-MINIATURE TRANSFORMERS for TRANSISTOR CIRCUITS ...



If you are having space problems with your transistor circuitry, consider these Stancor transformers as a means of solving your difficulties.

In addition to the units shown below, special transistor transformers, designed and built to your specifications by Stancor engineers, can be supplied in quantities of five or more.

CHICAGO STANDARD TRANSFORMER CORPORATION

These five Stancor ultra-miniature transformers, designed especially for transistor applications, are available through your local Stancor distributor. The smallest weighs 0.07 ounce and measures  $\frac{1}{4}$ " x  $\frac{3}{8}$ " x  $\frac{3}{8}$ ". The largest weighs only 0.10 ounce and measures  $\frac{3}{8}$ " x  $\frac{3}{8}$ " x  $\frac{3}{8}$ ".

Part No.	Application	Pri. Imp.	Sec. Imp.	Pri. DC Res.	Sec. DC Res.
UM-110	Interstage	20,000	1,000	1675	285
UM-111	Output or matching	1,000	50/60	120	9.0
UM-112	High imp. mic. input	200,000	1,000	4000	195
UM-113	Interstage	20,000	1,000	1350	205
UM-114	Output or matching	500	50/60	70	9.0

Write for Stancor Bulletin 462R listing complete data and performance curves on these units.



**CHICAGO STANDARD TRANSFORMER CORPORATION**

3576 ELSTON AVENUE • CHICAGO 18, ILLINOIS

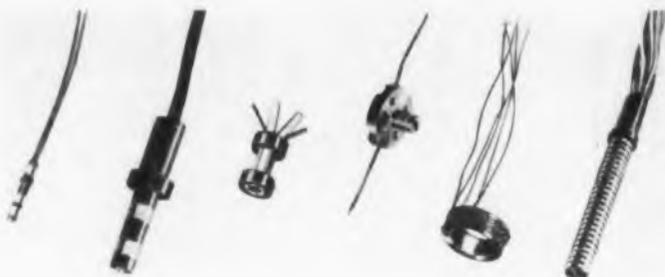
EXPORT SALES: Roburn Agencies, Inc., 39 Warren Street, New York 7, N. Y.

CIRCLE ED-64 ON READER-SERVICE CARD FOR MORE INFORMATION

# New Products . . .

## Miniature Slip Ring Assemblies

Made in One-Piece Units



A complete line of SCA (Slip Ring Company of America) subminiature injection-molded slip-ring assemblies, commutators and brush holders has been made available for such applications as gyroscopes, potentiometers, computers, motors, synchros, resolvers, and telemeters. These one-piece units employ a molding compound with 4000-4400psi tensile strength and 6000-6500psi flexural strength. A 0.001" insulator film withstands hipot tests in excess of 1000v, a-c.

Slip-ring assemblies resist distortion at temperatures to 225°F. Grooves of the V, square, or radius type can be supplied. Diameters are available from 0.062" to 4". Slip Ring Co. of America, Dept. ED, P.O. Box 108, South Gate, Calif.

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

## Wire-Wound Control

For Low-Cost Assemblies



The "Hum-dinger" Series 39 Wire-Wound Control is especially designed to meet the economy re-

quirements of low-cost radio-electronic and electrical assemblies. Highly compact, it has no shaft, but is screwdriver-adjusted by means of a slot in the rotor.

Mounting is by means of rivets or screws, while the mounting surface serves as a cover. The contact arm is grounded to the case, while the insulated terminal protrudes either parallel to or at right angles to the mounting surface. The control is available with two terminals for use as a potentiometer.

The Series 39 is intended either for factory-adjusted settings or for rare adjustments in actual use. It is available with resistance values from 4 ohms to 5000 ohms, linear only. Resistance tolerance is  $\pm 20\%$ . The insulation withstands 500v, a-c, between terminals and housing with the contact arm off the winding. Mechanical and electrical rotation is 245°, without bias resistor stop. Clarostat Mfg. Co., Inc., Dept. ED, Dover, N.H.

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

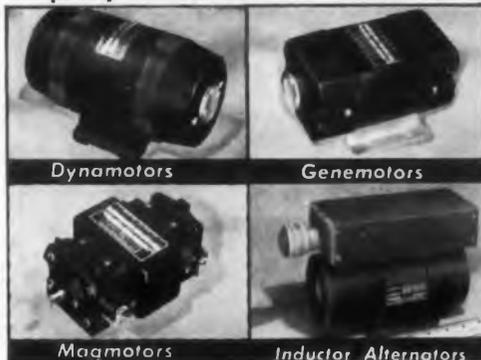


THE NEW

*Custom*

## DC-AC CONVERTER

These latest of all Carter DC to AC Converters are specially engineered for professional and commercial applications requiring a high capacity source of 60 cycle AC from a DC power supply. Operates from storage batteries, 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. Unequaled capacity for operating professional recording, sound movie equipment and large screen TV receivers. Available with or without manual frequency control feature.



## MAIL COUPON FOR CATALOG

Carter Rotary Power Supplies are made in a wide variety of types and capacities for communications, laboratory and industrial applications. Used in aircraft, marine, and mobile radio, geophysical instruments, ignition, timing, etc. MAIL COUPON NOW for complete Dynamotor and Converter Catalogs, with specifications and performance charts on the complete line.

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Please send new catalogs containing complete information on Carter "Custom" Converters and other Rotary Power Supplies.

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City \_\_\_\_\_ State \_\_\_\_\_

CIRCLE ED-67 ON READER-SERVICE CARD

## Magnetic Amplifier

### Miniature, High Gain Design



The M-21 Magnetic Amplifier can produce a usable d-c output from an input signal of only  $0.2\mu\text{amp}$ . It features a linear current gain of 200, up to  $30\mu\text{amp}$  input, and delivers 1ma with an input of  $5\mu\text{amp}$  into a load of 100 ohms.

Power gain has been measured as 50,000. Exceptionally stable, the M-21 has a zero drift of less than  $10^{-15}\text{w}$ .

Intended specifically for low-level applications with inputs ranging between  $1/5\mu\text{amp}$  and  $30\mu\text{amp}$ , the amplifier can be used as the main amplifier or pre-amplifier in controls featuring thermocouples, barrier-type photocells, thermistors, and other low-level sensing devices. The model for 60cy operation measures only  $2-1/4" \times 2-1/4" \times 3"$ . This small size is made possible by a push-pull circuit which has only two cores. The simplified design, plus the use of commercial grades of selenium rectifiers, make the unit low in cost. Rubissow Electron Research Laboratories, Dept. ED, 119 W. 63rd St., New York 23, N. Y.

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

## Ribwound Resistors

### In High Wattage Ratings



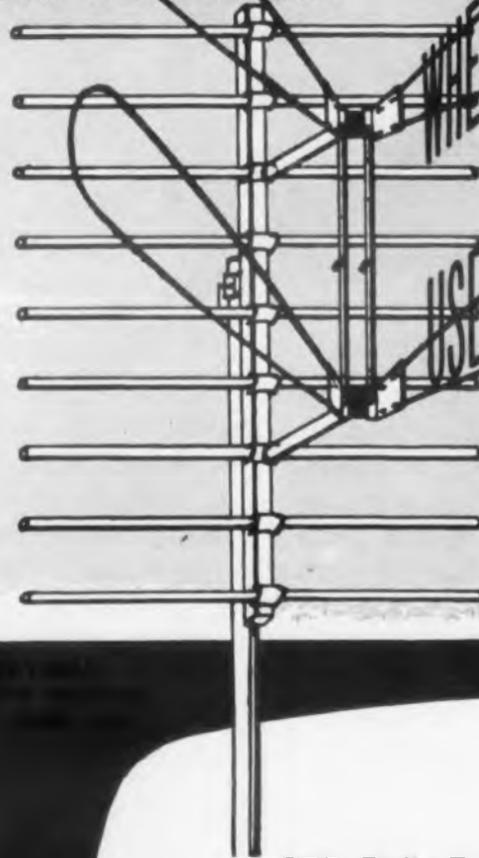
These resistors are available in ratings up to 2000w. They are wound with a specially designed resistance wire on high-temperature refractory cores, affording greater wattage dissipation in low resistance values. All connections are silver-soldered. Coating is

high grade enamel fired at high temperatures to assure freedom from moisture and complete heat dissipation.

The resistors can be furnished as fixed, adjustable, or with multi-taps where desired resistances are known. Milwaukee Resistor Co., Dept., ED, 708 W. Virginia St., Milwaukee 4, Wis.

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

# For VHF and UHF...



WHEN YOU TEST  
USE THE BEST

# PRD

## PRECISION TEST EQUIPMENT



PRD Radio Frequency Test Equipment is the most complete line available. It covers the entire frequency range from .01 to 40 kilomegacycles per second. All units are engineered and manufactured to the highest standards of the industry. PRD equipment excels in quality, accuracy and dependability... proven by its adoption in leading laboratories world-wide. For complete engineering assistance on standard or custom PRD equipment, contact our staff of experienced engineers, today. There is no obligation.

**MODEL 907 BROAD-BAND SWEEP FREQUENCY GENERATOR** - A fundamental oscillator which can be swept over a band not less than 10 Mc/s for center frequency of 40 Mc/s. Sweep width not less than 40 Mc/s over the UHF band. Output continually variable over voltage range of 10 mv to  $1/2$  volt.

**MODEL 904 NOISE GENERATOR** - A direct reading noise source permitting measurements of noise factors up to 20 db. for r-f amplifiers and receivers operating from 10 to 1000 Mc/s. The TT-1 coaxial diode has nominal input impedance of 50 ohms. VSWR Approx. 1.25.



*Polytechnic* **RESEARCH  
& DEVELOPMENT COMPANY, Inc**

55 JOHNSON STREET, BROOKLYN 1, NEW YORK

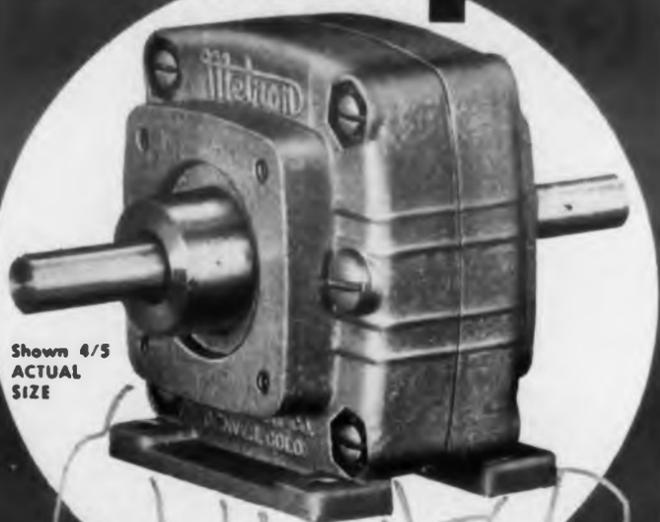
WESTERN SALES OFFICE: 741 1/2 NO. SEWARD ST., HOLLYWOOD 38, CALIFORNIA

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

ELECTRONIC DESIGN • October 1953

# NEW!

THE **Metron**  
**BANTAM**  
SPEED CHANGER



Shown 4/5  
ACTUAL  
SIZE

SAVE SPACE  
READILY AVAILABLE  
SEALED OIL-BATH LUBRICATION  
OPERATE IN ANY POSITION  
COMPACT, RUGGED OPERATION  
LOW POWER LOSS

**Metron** INSTRUMENT COMPANY  
450 Lincoln Street • Denver, Colo.

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

## New Products . . .

### R-F Power Supplies With Reversible Polarity



Four new models have been added to the company's line of High Voltage R-F Power Supplies. The polarity of these models can be reversed by a conveniently located lever on the front panel. The reversible feature

is of value where data are needed for both positive ground and negative ground hook-ups, or where quick reversing in polarity is desirable in the kilowatt range. A further advantage is the economy of a power supply with both positive and negative output.

The units include: Model R-22C (3-30kv, 2ma at 18kv, unregulated); Model R-22CR (5-30kv, 2ma at 18kv, regulated to 0.5%); Model R-22M (3-30kv, 3ma at 20kv, unregulated); and Model R-22MR (5-30kv, 3ma at 20kv, regulated to 0.5%). Neutronic Associates, Dept. ED, 83-56 Vietor Ave., Elmhurst 73, N.Y.

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

### Positioning Control Gives High Setting Accuracy



The "Multi-turn Microdual" Type 57-360 is designed for equipment requiring close angular setting, such as variable capacitors, inductances, wavemeters, and slide-wire potentiometers. It permits an unlimited number of 360° rotations. Up to 20 revolutions of the operating shaft are marked on the inset counting dial and the main dial shows 200 revolutions. The combination of the two dials permits positioning to 1 in 4000 divisions.

Effective scale length is 7.8". Each small division represents 5.4' of arc. Resetting accuracy is better than 2.7' of arc. Transradio, Ltd., Dept. ED, 138A Cromwell Rd., London SW7, England.

CIRCLE ED-73 ON READER-SERVICE CARD FOR MORE INFORMATION

## Eliminate Transformer Cases WITH **ACME STAR COMPOUND** For MIL-T-27, Grade 1, Class A Specifications

- Non-toxic
- Non-corrosive
- Eliminates voids
- Thorough impregnation
- Complete moisture-proof seal
- Simple one-phase molding process
- For Specification MIL-C-16923 (Ships) Compound, Embedding (Electronic Equipment) Type C



This is a Raytheon Transformer molded with Acme Star Compound

**Acme**  **Wire**

THE ACME WIRE CO., NEW HAVEN, CONN.  
Magnet Wire • Coils • Varnished Insulations • Varnishes

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

### PANEL HARDWARE



C.T.C.'s high quality panel hardware is precision made, of exceptionally fine finish, and meets applicable military specifications.

**PANEL SCREWS.** (X1786). Brass, with polished nickel plated head or black oxide finish. Panel sizes: 1/8"; 3/16"; 1/4".

**THUMB SCREWS.** (1120). Brass, with polished nickel plated head or black oxide finish. Thread sizes: 6-32; 8-32; 10-32.

**DIAL LOCKS.** (X1552). Brass, with nickel plate or black oxide finish. Captive assembly, no loose parts, positive locking.

**SHAFT LOCKS.** (X1774). Brass, with nickel plate or black oxide finish. Fit standard 1/4" shafts.

**HANDLES.** Brass, with nickel plate or black oxide finish, in sizes: 6 3/4" x 1 3/4"; 4 7/8" x 1 1/2"; 3-5/16" x 1-5/16". Aluminum (X1884) black aluminite or special colors in lacquer or enamel. One size: 4 3/8" x 1 7/8".

Order parts by number in bracket adding suffix BO for black oxide finish. Send for catalog 400 containing details of C.T.C.'s complete line of electrical and electronic hardware and ask for prices.

**CAMBRIDGE THERMIONIC CORPORATION**  
457 Concord Ave., Cambridge 38, Mass.

CIRCLE ED-75 ON READER-SERVICE CARD FOR MORE INFORMATION

**KULKA**

Single and Double Pole "Toggle" Handle Type  
**AIRCRAFT SWITCHES**  
 For Electronic and Communications Use



Made to JAN specs for DC, or AC circuits up to 1600 cycles. Available with screw terminals and with soldering lugs. Switching characteristics provide for changes in electric circuits by use of SPST, SPDT, DPST and DPDT. Has bakelite housing and only one mounting hole.

**TERMINAL BLOCKS**

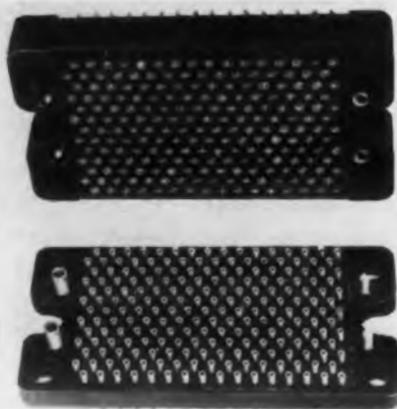
Barrier type, made of molded bakelite in varied styles & sizes up to 26 terminals. Send for catalogue.



**KULKA ELECTRIC MFG. CO., Inc.**  
 MOUNT VERNON, N. Y.

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

**Electrical Connector**  
**Quick-Disconnecting Type**



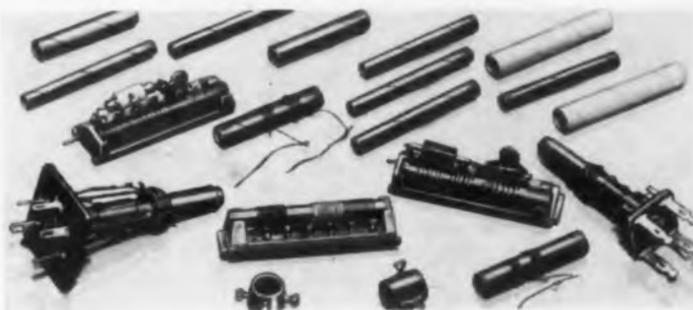
The QRE Quick-Disconnecting Connector has specially designed spring-loaded contacts (208 in number), which appreciably reduce engagement forces. The floating contacts have 0.073" diam solder cups for No. 16 AWG and assure

proper play for self-alignment. Four heavy guide pilots and sockets serve to polarize mating connector parts. The contacts and metal parts are plated gold over silver for low contact resistance, prevention of corrosion, and ease of soldering. Bodies are of molded melamine.

Four 5/16" holes are provided on both the plug and receptacle for mounting purposes. Voltage breakdown between contacts at sea level is 5700v d-c; at 60,000ft altitude it is 1200v d-c. Weight of the plug is 13.9oz and of the receptacle is 24.0oz. Winchester Electronics, Inc., Dept. F, Glenbrook, Conn.

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

**Corrosionproof Coil Forms**  
 Available in All Colors



Known as "Resinite AC" Coil Forms, these resin-impregnated units are available in all colors for color-coding of circuits and components. They combine the mechanical and dielectric advantages of phenolics with the high dielectric strength, moisture resistance, and non-corrosive properties of cellulose acetate. Their volume resistivity, power factor, and thermal characteristics make them well adapted to v-h-f, u-h-f, and other applications involving strenuous operating conditions.

The coil forms are available in any specification, threaded inside or out, slotted, punched, or embossed. Their colors simplify assembly and production, as well as circuit tracing and repairs. Resinite Corp., Dept. E12, 2035 W. Charleston St., Chicago 47, Ill.

CIRCLE ED-79 ON READER-SERVICE CARD FOR MORE INFORMATION

**New TAYLOR 6288**  
**Inert Gas Rectifier**

For power supply applications (up to 1000 cps. input) requiring unusual dependability and long life the new Taylor 6288 Inert Gas Rectifier is unsurpassed.

**FEATURES**

- High Shock Hard Glass Construction
- 5 Second Warm Up Time
- Ambient Temperature Limits  
 -55° to +75° C

**RATINGS**

The 6288 is rated at 10,000 volts peak inverse. Average current is 125 MA with a peak current of 2.5 A.



As always, Taylor is producing tubes of superior quality and outstanding performance for many industrial and commercial applications. We invite your inquiry on standard or special tube types.

COMPLETE DESCRIPTIVE LITERATURE ON REQUEST

*Taylor* HEAVY CUSTOM BUILT DUTY *Tubes*

TAYLOR TUBES INC., 2312-18 WABANSIA AVE., CHICAGO 47, ILL.

Canada: Atlas Radio Corp., Ltd.  
 560 King St., W., Toronto 2-B  
 Cable: ATRADCO

Export: Royal National Company  
 75 West St., New York 6, N. Y.  
 Cable: NATVARNCO

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

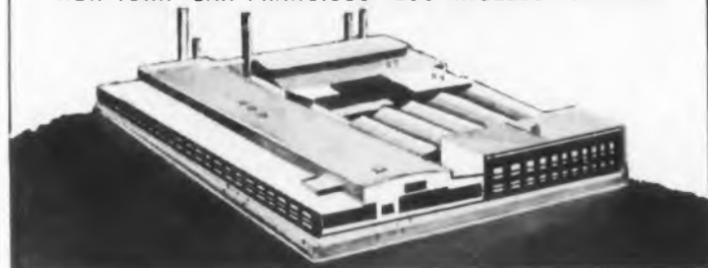
*Solve Your*  
**Corrosion Problems with**  
**RHODIUM PLATING**

Rhodium plating is finding increased use by electronic design engineers where hard, corrosion resistant electrical contact surfaces are required. Rhodium provides a stable contact resistance and allows use of higher pressures in sliding contacts... Rhodium is not affected by atmospheric changes, provides a low noise level and is particularly adapted to applications in the printed circuit field.

WRITE FOR BOOKLET 17

**BAKER & CO., INC.**

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ELECTRONIC DESIGN • October 1953

**NEW**  
*rectifier source*



Miniature IRC MICROSTAK Selenium Rectifiers are available in a wide variety of types. IRC processing provides low capacitance cells as small as .060" diameter.



HERMETICALLY SEALED • CELL THICKNESS TO ± .001 • LESS THAN 1% UNBALANCED VOLTAGE ON BRIDGE CIRCUITS

SEND FOR TECHNICAL DATA BULLETIN

**INTERNATIONAL RESISTANCE CO.**

Dept. D, 401 N. Broad St., Philadelphia 8, Pa.  
 In Canada: International Resistance Co., Ltd.,  
 Toronto, Licensee



Please send me Technical Bulletin SR-2.

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

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*Whenever the Circuit Says*

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1954 CATALOG**

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for everything  
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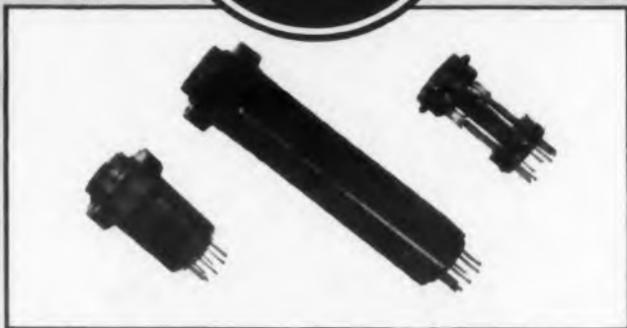


CIRCLE ED-82 ON READER-SERVICE CARD FOR MORE INFORMATION

**FOR  
EASY  
TUBE  
SIDE  
TESTS**



**SAVE  
TIME  
EFFORT  
MANY  
USES**



**TEST ADAPTERS**

Vector Test Adapters are ideal for making measurements from the tube side of electronic equipment. The adapter is inserted between tube and socket, completing the circuit and providing test tabs. The short type (left) is most popular, but for some hard-to-reach locations a long type with shielded leads is available (center). For breaking circuits or changing connections the open "experimenter" type is useful (right). All types are available for octal, 7-pin miniature and 9-pin naval sockets. Kit T-789 combines the three short types in handy carrying case. Available at most distributors.

Send for catalog showing complete line of adapters, socket-turrets, plugs and plug-in units.

**REPRESENTATIVES**

B. B. Taylor Co., 241 Sunrise Highway, Rockville Centre, N. Y.  
R. J. Magnuson, 4258 West Irving Park Road, Chicago 41, Ill.  
David H. Ross Company, 534 El Camino Real, San Carlos, Calif.

**Vector Electronic Co.**

3352 San Fernando Road

Los Angeles 65, California

CIRCLE ED-83 ON READER-SERVICE CARD FOR MORE INFORMATION

**New Products . . .**

**Multi-Waveform Generator**

**For Pulse and Complex Wave Work**

The Model E-10 "Synerogen" is a multi-waveform generator and pulse synchronization unit which supplies: sawtooth waves; square waves or square-top pulses of 1 $\mu$ sec to 1sec duration with a rise time of 0.15 $\mu$ sec; and integrated or differentiated versions of the square waves or pulses.



All outputs are simultaneously available and independently variable in amplitude. All outputs may be synchronized, triggered, or gated by sine waves, pulses, or other complex wave forms.

Other applications for the instrument include: oscilloscope sweep phases, delayed pulse generator, oscilloscope trace expander, frequency divider, and pulse time or pulse width modulator. Amplitronix, Inc., Dept. ED, 280 9th Ave., New York 1, N. Y.

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

**Test Point Jacks**

**Have High Flashover Value**



These new Test Point Jacks (also called terminal jacks) are known as the 45-E Series and are designed to accommodate standard 0.081" diameter phone tips.

They are used for patch boards, high-voltage disconnects, feed-throughs, stand-offs, switching range calibration and general laboratory applications.

With a 15/16" overall length, they have extended Nylon insulation at the rear of the fitting to afford high flashover values averaging 4000v rms at 60cy. Capacitance is 5 mmfd to 7 mmfd, and contact resistance is 6 to 8mv per amp. The nickel-plated brass body extends 13/32" toward the stud type terminal, providing a strong threaded portion with hex-locknut and shakeproof lockwasher. Seven insulator colors are available for identification purposes. Cannon Electric Co., Dept. ED, 3209 Humboldt St., Los Angeles 31, Calif.

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

**BRIDGE  
MEASUREMENTS**

for laboratory or production  
are made:

*faster  
easier  
more  
accurately*

with



**BRIDGE INDICATOR TYPE 615-A**

The 615-A Bridge Indicator is an approximately logarithmic voltmeter which permits very rapid, precise balancing of measuring bridges. With accessory filters it may be used as a tuned detector. The approximately logarithmic response permits bridge balancing from far out of balance to exact null without changing ranges. The indicating meter shows the direction of bridge adjustment for a null, even when far from balance, because the instrument's 80 db (10,000 to 1) range prevents overload at high levels.



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

*Pick* **'DIAMOND H' RELAYS**



**FOR HIGHER  
VIBRATION  
RESISTANCE**

Vibration resistance range of "Diamond H" Series R Relays has been more than doubled, extending now from 0 to well over 1,000 cycles per second at 15 "G's." Hermetically sealed, miniature aircraft relays, they are basically 4PDT but are also available in DPDT and 4PDT with two independent coils, either or both of which will operate the unit. They meet all requirements of USAF Spec. MIL-R-5757B . . . and far surpass many.

Operating shock resistance exceeds 50 "G's"; temperature range is from -65° to +200°C. They operate consistently over 400,000 cycles without failure at 5 A. and go 3,500 or more under 30 A. at 30 V., D. C. resistive. Voltages up to 300 D. C. at 4/10 A. are carried for more than 400,000 cycles. Coil resistances up to 50,000 ohms available. Operating time is 10 ms. or less; drop out time 3 ms. or less. Sensitivity approaches 100 mw. at 30 "G's" operational shock resistance. Inter-electrode capacitance is less than 5 mmf. contacts to case; less than 2½ mmf. between contacts. All standard mounting arrangements.

Bulletin R-150, giving basic performance data under varying conditions, is yours on request. Our engineers are prepared to work with you to develop variations to meet your specific requirements. Tell us your needs.

**THE HART MANUFACTURING COMPANY**  
210 Bartholomew Ave., Hartford, Conn.

CIRCLE ED-87 ON READER-SERVICE CARD FOR MORE INFORMATION

**Jennings**  
RADIO  
VACUUM ELECTRONIC COMPONENTS

# Vacuum

**FIXED  
CAPACITORS  
MINIATURIZED**

For applications involving:

- High frequency operation
- Low inductance
- High voltages and currents
- Temporary overloads
- Negligible power factor



Write us for information regarding your own Capacitor problem.  
Literature mailed on request.

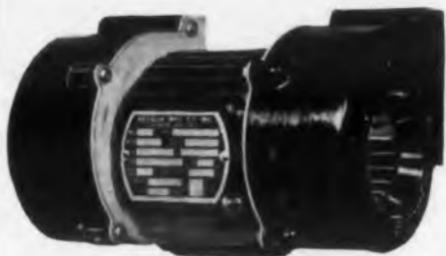
JENNINGS RADIO MANUFACTURING CORPORATION - 970 McLAUGHLIN AVE.  
P. O. BOX 1278 - SAN JOSE 8, CALIFORNIA

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

## AIRBORNE ELECTRONICS

ROTRON MODEL DRFP, TYPE 1504 Miniature centrifugal blowers (simplex and duplex) are a fine example of the PURPOSEFULLY DESIGNED airborne cooling components manufactured by ROTRON.

**TYPE 1504  
DUPLEX  
BLOWER  
•  
RA2  
MOTOR  
FRAME**



Available for the 50-60-400 CPS and VAR. FREQ., 1ϕ and 3ϕ, 115 and 208 volt, Class A and Class H insulation. ROTRON offers 12 DIFFERENT STANDARD MOTORS for driving this blower to suit all customer specifications. Ballbearings precisely aligned in stainless steel sleeves which are mounted in accurately machined aluminum cases, maintain alignment under continuous duty operation in ambients as high as 125°C. Exclusive ROTRON hi-temp, hi-shock type plastic blower housings are aerodynamically designed for maximum performance at the high shaft speeds of 400 CPS operation. The blower is the most compact on the market, featuring TAPPED MOUNTING HOLES and FLANGES at both inlet and outlet ports, allowing neat and sturdy mounting in tightly packed electronic assemblies WITHOUT any additional clamps, spacers, boots, etc. For HIGH ALTITUDE OPERATION ROTRON furnishes special variable speed driving motors whereby volume delivery increases substantially with decrease in density resulting from increase in altitude.

WRITE FOR LITERATURE AND PRICES  
**ROTRON MANUFACTURING CO.**

WOODSTOCK N. Y. 7 SCHOONMAKER LANE

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

ELECTRONIC DESIGN • October 1953

## Preamplifier

For Low Frequencies



The Model 1322 Servotherm Low Frequency Preamplifier is used to provide initial amplification for signals at sub audio and audio frequencies from extremely low input levels. It serves as a first amplifier in radiation measurement, subsonic, vibration, geophysical, electromechanical and many other applications.

A compact and rugged unit, the preamplifier utilizes a non-microphonic low-noise amplifier tube. It is potted in plastic within a metal shield can measuring 1-5/16" x 1-3/8" x 3-1/2". The bandwidth (down 3db) is 0.5 to 10,000cy with a source impedance of 100,000 ohms or less, and 0.5 to approximately 3,000cy with a source impedance of 1megohm. Servo Corporation of America, Dept. ED, 20-20 Jericho Turnpike, New Hyde Park, N. Y.

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

## Meter Calibrator

A Precision D-C Reference Source

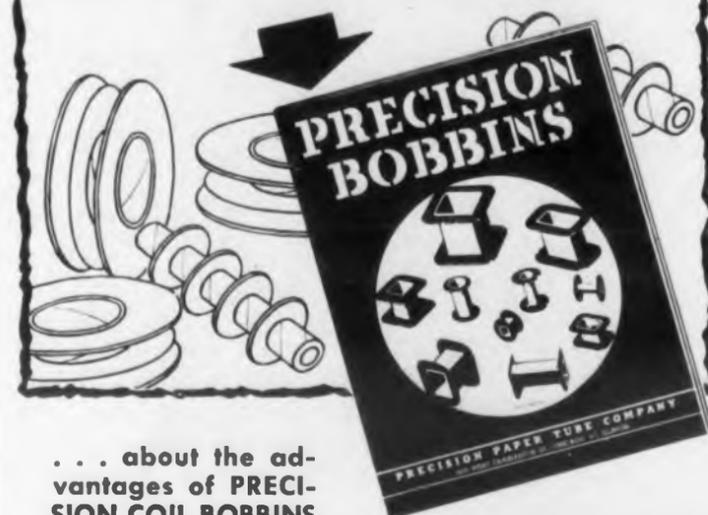


The Kay-Lab Model 123 Meter Calibrator produces a calibrated d-c voltage essentially independent of input line voltage and output load variations. It permits highly accurate and simple calibration of d-c meters. The circuit continuously compares the output voltage against an internal standard cell. The standard model affords absolute calibration to 0.1%, and the custom model calibration to 0.01%. Special models can be manufactured to meet any particular requirement.

Output voltage is 1v to 300v, variable in 1v steps. Output current is 5ma maximum. Power requirements are 105v to 125v, 75w. The enclosed cabinet measures 8-3/4" high x 13" deep and is suitable for mounting in a 19" relay rack. Kalbfell Laboratories, Inc., Dept. ED, P. O. Box 1578, 1090 Morena Blvd., San Diego 10, Calif.

CIRCLE ED-91 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.**

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Plant No. 2: 79 Chapel St., Hartford, Conn.  
Also Mfrs. of Precision Paper Tubes

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## NEW! BIGGER SELECTION!



NOW . . .

30 different sizes and shapes up to 3" diameter in stock. Use these plastic cable clips for safe, light weight, durable support of wiring, tubing, components.

Write **WECKESSER COMPANY**

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# Now Available



**NEW CATALOG on MIL-C-25A capacitors manufactured by Tobe. Write today for your FREE COPY**



**TOBE DEUTSCHMANN**

CORPORATION

NORWOOD, MASSACHUSETTS

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

Another **FLASH-O-LENS** at work  
...checking pigment dispersion at  
**B. F. Goodrich**



The inspection tool that *lights and magnifies*—FLASH-O-LENS—is in daily use at The B. F. Goodrich Company in making laboratory checks on the dispersion of pigments in milled rubber stocks.

The built-in bulb of a FLASH-O-LENS brightly illuminates the inspection area—the accurately ground lenses give sharp, detailed enlargement. Result: quick, simple inspection!

Battery and plug-in models from \$10.65. Write for free literature on applications, types, prices.

**E. W. PIKE & COMPANY**

492 NORTH AVENUE

ELIZABETH 3, N. J.

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

## New Products . . .

### Universal Standoff

Employs Polyethelene Support



The Universal Standoff employs a mechanical support member of heavy polyethelene, so constructed that the metal component is removed from the intense field of the transmission line.

In this manner it acts to provide a line with uniform characteristics which can be quite important in making many u-h-f and v-h-f tests such as on experimental TV set designs.

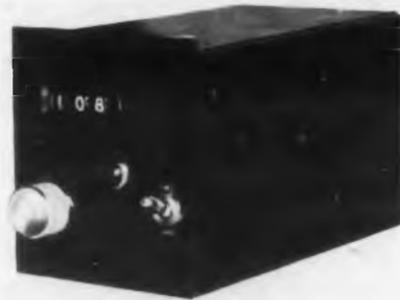
The polyethelene member is made to fit all types of line: tubular, oval, flat, open line, and special types, such as Anaconda. The standoff is made up in several forms to cover every installation situation, including wood screw and mast type singles, dual inlines and triple inlines.

The construction eliminates the need to thread the line into the insulator. After the support arm is mounted, the line is inserted into the polyethelene member which in turn is quickly snapped into the support arm. The member keeps the line electrically in the clear, yet provides rugged mechanical support. Argyle Electronics Co., Dept. ED, 8 W. 18th St., New York 11, N.Y.

CIRCLE ED-96 ON READER-SERVICE CARD FOR MORE INFORMATION

### Numerical Counter

Miniature, High Speed Unit



The Miniature Numerical Indicator provides accurate, direct reading on many analog measurements and no interpolation is necessary.

A high-speed unit, it is geared to a servo motor and can be installed long distances from the measuring point without lag difficulties.

The counter is designed for high readability. It is used to measure velocity, temperature, light, weight, length, and many other variables. It also can be used in conjunction with recording units in applications where continuous readings must be available. Streeter-Amet Co., Dept. ED, 4101 Ravenswood Ave., Chicago 13, Illinois.

CIRCLE ED-97 ON READER-SERVICE CARD FOR MORE INFORMATION

For Adverse Environmental Conditions . . . . . Specify HAYDON'S New Hermetically Sealed Precision Snap Switches

**POSITIVE ACTION UNDER ALL CLIMATIC CONDITIONS**

This hermetically sealed precision snap switch is the answer where sand, dust, ice, humidity, oil, grease, water or fungus cause ordinary switches to fail.

Here is the story on the Haydon hermetically sealed snap action switch:

1. Smallest hermetically sealed switch on the market
2. Longer life
3. High contact pressure — resistant to vibration
4. Actuator pin bonded in specially developed silicone (like a shock mount)
5. Available in single pole, double throw — two-circuit type or double pole, double throw. (DPDT is slightly larger.)
6. Interchangeable mounting-wise with certain other widely used unsealed switches.
7. Sealed construction assures positive operation under practically all climatic conditions (from  $-70^{\circ}\text{F}$  to  $+200^{\circ}\text{F}$ )



Currently Being Used in Aircraft Applications

Send for descriptive bulletin

**HAYDON SWITCH CO.** 232 NORTH ELM ST., WATERBURY, CONN.

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## Plastics Fabricating SPECIALISTS

The selection of plastics component parts should start at the design engineer's desk. When his product depends on prompt delivery of fabricated plastics, he looks to reputation for results.

For twenty-five years Insulating Fabricators, Inc. has been successfully producing plastics parts with the precision demanded by the exacting requirements of electronic industries. Machining plastics to close tolerances is our specialty.

Large inventories of all types of plastics material are constantly maintained. Complete equipment for every kind of machining operation makes prompt, efficient service on prototypes and production parts our criterion.

Let us work with you on your plastics fabricating problems.

### FABRICATORS and DISTRIBUTORS

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Complete price catalogue on request

**INSULATING FABRICATORS, INC.**

151 Union Avenue  
East Rutherford, N. J.

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# SHOCK - VIBRATION - NOISE ISOLATION NOTES



## Complete Engineering Data on All-Metl Barrymounts

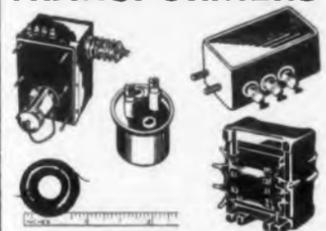
The first really comprehensive bulletins on knitted-wire vibration isolators, Barry Product Bulletins 534 and 536, are now available for distribution.

Full experimental data, all taken under explicitly stated test conditions and presented without alteration, cover the following important topics: transmissibility as a function of frequency, for all directions of motion; the effects of extremely high and extremely low temperatures on transmissibility; the effect of severe shock on isolation performance; variation of natural frequency and transmissibility with changing load; selection of identical isolators to carry asymmetrical loads. In addition, full information is given on dimensions, weights, construction details, load ratings, and catalog numbers.

Here, for the first time, is the complete story on JAN knitted-wire vibration isolators. For your FREE copies, write for Barry Product Bulletins 534 and 536, to The Barry Corporation, 775 Pleasant Street, Watertown 72, Mass.

CIRCLE ED-100 ON READER-SERVICE CARD FOR MORE INFORMATION

# FREED TRANSFORMERS INSTRUMENTS



MILITARY COMPONENTS TO SPECIFICATIONS MIL-T-27 & ANE-19 AND COMMERCIAL TYPES

Pulse Transformers  
Filter Reactors  
Charging Reactors  
Saturable Reactors  
Toroid Inductors  
Low Pass Filters  
High Pass Filters  
Band Pass Filters  
Discriminators  
Plate Transformers  
Power Transformers  
Filament Transformers  
Vibrator Transformers  
Input Transformers  
Interstage Transformers  
Driver Transformers  
Output Transformers  
Modulation Transformers  
Blocking Oscillator Transformers  
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Self-contained and A.C. operated with electronically regulated supply. 1 megohm to 2 million megohms.



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NO. 1150 Universal Bridge  
NO. 1170 D.C. Supply  
NO. 1210 Null Detector and Vacuum Tube Voltmeter  
NO. 1140 Null Detector Amplifier  
NO. 1040 A.C.—V.T. Voltmeter  
NO. 1250 Decade Condenser  
NO. 1410 Harmonic Distortion Meter and Decade Inductors

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**FREED TRANSFORMER CO., INC.**  
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CIRCLE ED-101 ON READER-SERVICE CARD FOR MORE INFORMATION

## Lettering Set

### Precision Milled Templets

The No. 900 Lettering Set consists of three individual lettering guides with letters of 1/8", 3/16", and 1/4", in a modern style of type. These guides or templets are available individually or can be purchased together in a durable folio container.



They are made of 0.030" double-cured mathematical quality plastic and are precision milled for uniformity and speed. Size of each templet is 6-7/8" x 1-7/8". Rapidesign, Inc., Dept. ED, Box 592, Glendale, Calif.

CIRCLE ED-102 ON READER-SERVICE CARD FOR MORE INFORMATION

## Miniature Vibration Pickup

Measures 1" x 1", Weighs 1.3 oz



The Type 4-118 Miniature Vibration Pickup measures only 1" x 1" and weighs 1.3 oz. This compact unit is designed for operation at the elevated temperatures encountered in testing many aircraft components. It can operate continuously at 300°F or as high as 500°F for intermittent periods of up to 100 hours.

The unit is self-generating, sending out electrical signals whose strength varies in proportion to the vibrational velocity of the object on which the pickup is mounted. The signals may be read on meters or oscilloscopes for visual monitoring of vibration, or they may be recorded by multi-channel recording oscillographs where permanent records are required.

Because of its small size, light weight, and self-generating features, the unit, which mounts in any position, may be located in many previously inaccessible areas. Damping effect of the instrument on the structure or device under test is negligible compared to that of heavier, larger instruments. Its high insensitivity to vibrations other than those directly along its axis permits use in isolating and measuring movement in any one direction. Consolidated Engineering Corp., Dept. ED, 300 N. Sierra Madre Villa, Pasadena 8, Calif.

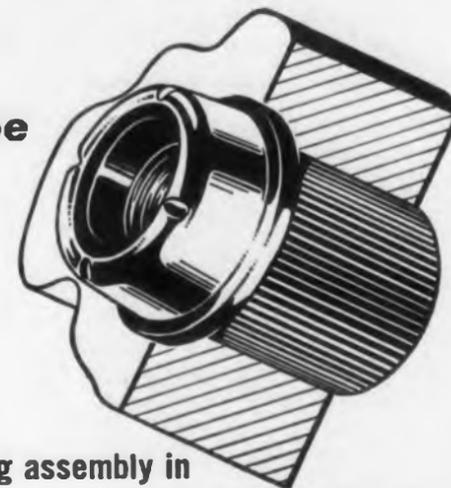
CIRCLE ED-103 ON READER-SERVICE CARD FOR MORE INFORMATION

## spline-type

### ELASTIC STOP nuts

for

self-broaching assembly in Aluminum, Magnesium or soft Ferrous Materials



- Driven into pre-formed or drilled holes, spline nuts broach a tight grip into the casting.
- Thread-tapping problems are avoided; the nut becomes a threaded steel insert as well as a fastener.
- Spline nuts remain permanently in place . . . save production and assembly time.

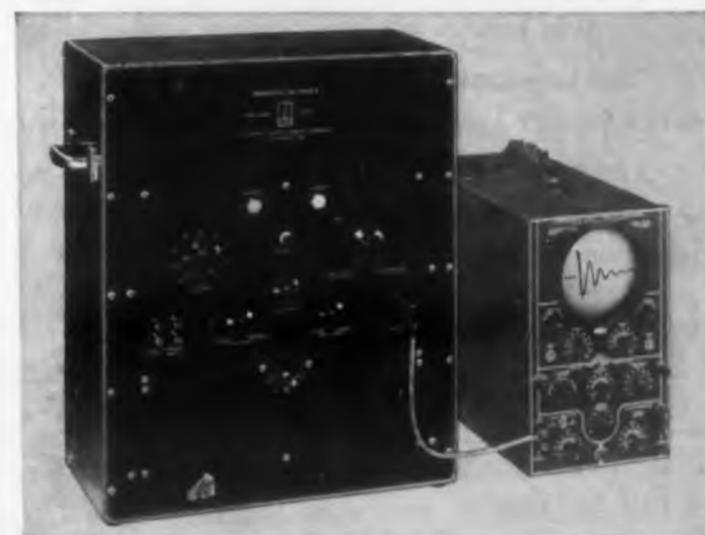
- WRITE FOR design information on self-locking, vibration-proof Spline Nuts and other standard ESNA fasteners. Address Dept. N37-1057.



## ELASTIC STOP NUT CORPORATION OF AMERICA

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DESIGN HEADQUARTERS FOR SELF-LOCKING FASTENERS  
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## SIMPLIFIES STUDY OF TRANSIENTS

The Brush Transient Recorder (Model BL-502) is designed to record transient phenomena of 1/5 second or less on tape, then reproduce them for visual inspection on an oscilloscope. Vibrations, explosion waves, light flashes, welding cycles, electrical signals and other transients can be recorded and analyzed. The signals can be shown complete, or expanded on the screen to show detail. A reset button clears the magnetic tape and prepares it for a new record. Write for literature on time-saving Brush instruments. Brush Electronics Company, Dept. J-10, 3405 Perkins Ave., Cleveland 14, Ohio.

**BRUSH ELECTRONICS COMPANY**

formerly  
The Brush Development Company.  
Brush Electronics Company  
is an operating unit of  
Clevite Corporation.



CIRCLE ED-105 ON READER-SERVICE CARD FOR MORE INFORMATION

# THE 10-MEGACYCLE SCOPE

for  
detailed  
waveform  
analysis

model **OL-23**

- Expansion of any image detail is possible up to the maximum writing rate of the 'scope.
- AND the sweep maintains its accurate calibration independent of the degree of expansion.

REALLY IMPORTANT  
image expansion  
by means of stable  
SWEEP DELAY



NORMAL PRESENTATION

X 10 EXPANSION

X 100 EXPANSION

By progressive sweep speed increase and delay, the back edge of the pulse has been opened up for analysis and measurement.

## "Sweep-Lok" synchronization

- easy to set - locks in and stays locked over broad ranges

### SPECIFICATIONS

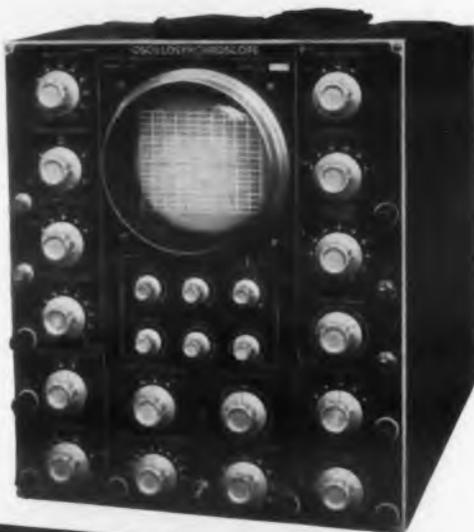
- 5 cycle to 10 mc vertical amplifier with signal delay line — .035  $\mu$ sec rise time
- Accurately calibrated triggered or recurrent sweeps 0.1  $\mu$ sec/cm to .011 sec/cm
- Vertical calibration voltage variable to 100 peak-to-peak
- Built-in trigger generator with positive and negative outputs
- Continuously variable sweep delays up to 10,000  $\mu$ sec without jitter

- 4000 volts accelerating potential on 5YP tube for bright, clear, trace
- Interior designed for accessibility and ruggedness, the exterior for that "Professional Appearance"

MODEL OL-23  
OSCILLOSYNCHROSCOPE

**\$890.00**

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# New Literature . . .

## **Magnetic Deflection Yokes 107**

Complete technical information on three new deflection yokes for military and oscilloscope applications is presented in this 2-page bulletin. Included are electrical and mechanical data, a dimensional drawing, and tables of push-pull and single-ended deflection coil data. Syntronic Instruments, Inc., 100 Industrial Rd., Addison, Ill.

## **Instrument Printing Systems 108**

This 22-page catalog is divided into two major sections on instrument printing systems and special instrumentation. It covers Automatic Data Logs (which convert signal inputs of pressure or voltage to a digital record), Temperature and Signal Scanners, Printalarms, Remote Thermocouple Readout Systems, Stepping Switch Assemblies, Analog-to-Digital Converters, Voltage-to-Digital Converters, and other instruments. Many pages open up into large diagrams of the equipment. Electrical Development Co., Inc., 40 E. 40th St., New York 16, N. Y.

## **Flexible Delay Lines 109**

Two types of distributed constant delay lines are described and specifications given in this catalog sheet. The two types are: Short Lines, in hermetically sealed stick form, with delays from  $0.1\mu\text{sec}$  to  $3\mu\text{sec}$ ; and Long Lines, in hermetically sealed cans, with delays from  $2\mu\text{sec}$  to  $10\mu\text{sec}$ . Richard D. Brew and Co., Inc., 106 Concord Ave., Belmont 78, Mass.

## **Oscillographic Recording 110**

"The Right Angle", a new periodical, provides technical information and articles of value to users of oscillographic recording systems. The first issue, eight pages long, contains two articles, as well as other data: "Factors Affecting Accuracy of Oscillographic Records", and "Use of Differential Transformers with Strain Gage Amplifiers". Sanborn Co., Industrial Div., Cambridge 39, Mass.

## **Rubber-Phenolics 111**

The purpose of this 24-page brochure is to supply design engineers with a handbook for the evaluation and use of this firm's rubber-phenolic molding materials. Advantages, properties, and design suggestions for these materials are presented. Many pages are devoted to case histories, showing how application requirements can be met. Some of the applications illustrated and described are: an electrical relay base for a tabulating machine, a solenoid ring for a water-tight starting motor, a bus bar, a collector ring assembly, and a binding post terminal strip. Chemical Division, General Electric Co., Pittsfield, Mass.

## **Cables 112**

This 24-page, 2-color catalog, "Federal Quality-Controlled Cables", covers a wide selection of coaxial cables and TV lead-ins. Charts permit selection by either characteristic impedance or Army-Navy number (for coaxial cables), or impedance or Federal number (for TV lead-ins). Many design data are included, and a number of pages are devoted to convenient tables of technical information and nomographs. Federal Telephone and Radio Co., Selenium-Intelin Dept., 100 Kingsland Rd., Clifton, N. J.

## **Structures for Circuitry 113**

Socket-Turrets, Plug-Ins and Adapters of many types are illustrated and described in this 12-page, 2-color catalog. These products are terminal structures on which the user may mount and wire circuit components in close proximity to associated electronic tubes. Single or multi-stage subassemblies can be readily formed and quickly installed, with a minimum of connections, in a multitude of applications. The components are of value both in production and in experimental set-ups. They come in plug-in or permanent types. Vector Electronic Co., Dept. ED, 3352 San Fernando Rd., Los Angeles 65, Calif.

## Voltage Stabilizers

114

An 8-page bulletin provides detailed data on the design, uses, principles of operation, and specifications of voltage stabilizers. Curves showing effect of overload, input power factor, output vs input voltage, effect of load power factor on output voltage at 115v input, effect of frequency on output voltage, and efficiency vs size of stabilizer, are provided. Raytheon Manufacturing Co., Equipment Div., 19 Rector St., New York 6, N.Y.

## Desiccant Calculator

This sturdy, 0.010", Vinylite calculator accurately indicates how many desiccant units are required per package in accordance with Formulas 1 or 2, as per Paragraph 3.5.7.1.2. of MIL-P-116B. It makes possible efficient protective packaging of electronic instruments and parts. One side is used for rigid and the other for flexible containers. The calculator is available for only \$2.00. Write direct to Greenwood Packaging Supply Co., 859-879 Summer Ave., Newark 4, N. J.

## Relays

116

An 8-page catalog (337) gives extensive information on "Millisecc" plug-in, factory-sealed relays. They are available in a wide variety of types, with either gold or platinum-rhodium contacts. Descriptions of characteristics and advantages of the two contact types, specifications, and many other data are included. Stevens-Arnold, Inc., 22 Elkins St., South Boston, Mass.

## Cathode-Ray Photography 117

"Techniques of Photo-Recording from Cathode-Ray Tubes", 3rd Edition, is a 36-page manual which serves as a complete review of the problems and associated solutions encountered in photographing cathode-ray patterns. In addition to numerous actual photo-recordings, scales, graphs, and diagrammatic sketches, it contains much technique information, as well as descriptions and specifications of a line of photo-recording equipment. The manual is available when requested on company letterhead. Write for Bulletin ED directly to Allen B. Du Mont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J.

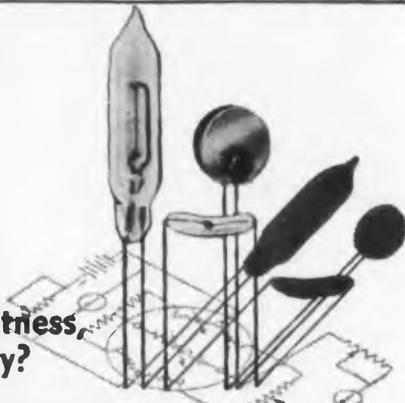


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**For research and development  
of electro-mechanical radar and  
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*Significant advancements  
in the fields of airborne radar and  
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of electro-mechanical techniques in the  
Hughes Radar Laboratory.*

## The company

Hughes Research and Development Laboratories, located in Southern California, form one of the nation's leading electronics organizations. The Laboratories are presently engaged in the development of advanced electronic systems and devices which are produced by the Hughes manufacturing divisions.

## Areas of work

The work calls for devising reliable, maintainable, manufacturable designs for precision equipment developed in the Hughes Radar Laboratory. The equipment consists of mechanical, electronic and microwave devices and systems to be manufactured in quantity. The equipment designs require the use of such advanced techniques as subminiaturization, unitized "plug-in" construction, with emphasis on design for volume production. Knowledge of electronic components, materials, finishes and specifications is useful.

## The future

Engineers experienced in the field of electro-mechanical design for production or those interested in entering this field will find outlets for their abilities and imagination in these activity areas. New electro-mechanical techniques are opening new applications for airborne electronic equipment. Hughes engineers will have the full benefit of working experience in these fundamental developments.

*Assurance is required  
that the relocation of the applicant  
will not cause the disruption of an urgent  
military project.*

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**Research and Development Laboratories**

*Culver City, Los Angeles County, California*

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**SYNCHRO  
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**SYNCHRO CONTROL  
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A pair with an established reputation.  
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**UNIVERSAL-FREQUENCY  
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Minimum noise, highest accuracy. Basic to all trigonometric operations.

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PRECISION POTENTIOMETER**  
Continuous rotation, induction type. Accuracy comparable to resolver.

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**SERVO COMPUTING  
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Companion to Model 172 Servomotor. Superior linearity and signal-to-noise ratio



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**SERVO CONTROL  
MOTORS**  
"Standard" in many modern computers and controls. Thousands in use

## FEATURES

- Maximum accuracy, signal-to-noise ratio, range of linear operation.
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- Total magnetic shielding.
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- High temperature resistant models.
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- Complete line of "packaged" compensating isolation driver-amplifiers.
- Reliable delivery commitments.

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**American Electronic Mfg., Inc.**  
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Heldor's assembly service is currently saving money for producers of electronic components. The components to be sealed are supplied . . . and Heldor does the rest . . . assembly of Heldor compression-type bushings in Heldor can covers (to military or your specifications) and filling and sealing the cans. These facilities are also available for partial assembly at substantial savings!

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insure quality

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• TRANSFORMERS • RECTIFIERS  
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ELECTRONIC PRODUCT REQUIRING  
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IT WILL PAY YOU TO USE

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**CANS, BUSHINGS and  
ASSEMBLY SERVICE**

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NEW CAN  
CATALOG!



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## New Literature ...

### Microtorque Potentiometer 121

A 4-page bulletin covers three models of the Ohmag Microtorque Potentiometer, and ultra-precision instrument with very low torque for telemetering, remote control and indicating, servomechanisms, and a host of other applications. Illustrations, dimensions, tables of specifications and standard resistances, wiring diagrams, and other valuable data are included. American British Electric Corporation, 57 Park Ave., New York 16, N. Y.

### Time Delay Switch 122

The "Agaswitch" Time Delay Switch is described and illustrated in a 4-page, 2-color bulletin. The switch is manually or mechanically actuated. Time delay is obtained pneumatically with a full delay range from 0.1sec up to 10 or more minutes. Electrical data, typical applications, features, operation, and other information are provided. A'G'A Div., Elastic Stop Nut Corp. of America, Elizabeth 3, N.J.

### Electrical Insulation 123

A 140-page catalog on electrical insulating materials provides complete price data, including information on standard purchases, terms, and aggregation policies. It covers such materials as: cords and twines, untreated woven tapes, sleeveings and tubings, paper and paper products, reinforced or laminated plastics, vulcanized fibre, plastic or resinous films, pressure-sensitive tapes, varnishes and compounds, mica products, varnished fabrics and paper combinations, and numerous other materials. Insulation Manufacturers Corp., 565 W. Washington Blvd., Chicago 6, Ill.

### Resistors 124

A 6-page data bulletin presents technical information on "Stablohm" Precision Microcrystalline Carbon Film Resistors. Sections are included on resistor types, stability of resistors, power ratings, physical characteristics, and dimensions for the convenience of engineering buyers, a price list also is provided. Chase Resistor Co., 9 River St., Morristown, N. J.

## RX METER TYPE 250-A

Frequency Range  
0.5 mc to 250 mc  
in eight ranges

The 250-A RX Meter is a completely self-contained instrument for use in measuring the equivalent parallel resistance and capacitance or induction of two terminal networks over a wide frequency range. It includes an accurate, continuously tuned oscillator, high frequency bridge, "unbalance" detector and null indicator.

### USES

The 250-A RX Meter can be used to measure the equivalent parallel resistance and capacitance of networks at high frequency. If the reactance is inductive the value can be determined. The characteristics of transmission lines can be determined.

### SPECIFICATIONS

FREQUENCY: 0.5 mc to 250 mc in eight ranges.  
R<sub>p</sub> RESISTANCE RANGE: 15 to 100,000 ohms.  
C<sub>p</sub> CAPACITANCE RANGE: +20 uuf to -100 uuf\*  
\*Capacitance range may be increased to ±120 uuf by use of external coils or condensers.

BOONTON RADIO

BOONTON · N.J. · U.S.A.

Corporation



### FEATURES

- Measures equivalent parallel resistance and capacitance or inductance of two terminal networks.
- Operates over a Wide Frequency Range.
- Includes self-contained oscillator, bridge, detector and null indicator.
- Null Indicating Meter has automatic gain control which maintains on scale readings under all conditions to avoid meter damage and to permit indication of proper direction of adjustment for reaching bridge balance.
- Wide spread resistance dial scale covering total of 28 inches.
- Power Supply Internally regulated.

CIRCLE ED-125 ON READER-SERVICE CARD FOR MORE INFORMATION

## Radiation Detector

126

The "Gamatek" Radiation Detector is described and illustrated in a 4-page folder (CEC-1008). Acting as a "dosimeter", this pocket-size instrument indicates on a direct-reading scale the total dosage of gamma and X-rays to which a body or area has been subjected. It can be used for monitoring, industrial research, and radioisotope applications. Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif.

## Multi-Speed Drives

127

An 8-page bulletin (No. 53) describes and provides schematic illustrations of some usual and some exceptionally unusual applications of standard Multi-Speed Drives. These drives are operated by a synchronous electric motor, with all-gear mechanism, and a wide range of speeds in each drive. Numerous applications in pressure, volume, temperature, motion, and operations recording, and power and timing are presented. Gorrell & Gorrell, Hawthorn, N. J.

## Recording Potentiometer

128

A 14-page, 2-color bulletin fully illustrates and describes all features of a recording potentiometer of completely new design. It incorporates a universal slide-wire that never needs changing and which permits chart speeds to be changed by a simple screwdriver adjustment. The bulletin opens up from the right and then from the left, taking up the various "layers" of the instrument one by one, covering their details and functions. Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.

## Transformers

129

This 4-page, 2-color brochure illustrates and describes a standard line of plate supply transformers and filter chokes, along with a general description of "Electro-seal" and hermetically sealed transformers, with specific examples of plate and modulation transformers. Specifications and text on construction and features are provided. Electro Engineering Works, 6021 College Ave., Oakland 18, Calif.

## CHATHAM ELECTRONICS ULTRA-STABLE REGULATED

# POWER SUPPLIES

**.002% REGULATION FOR  
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For those laboratories requiring the utmost in stability and regulation from D.C. power supplies, Chatham Electronics offers a group of ultra-stable regulated power supplies. The use of a driftless regulating circuit

and mercury cell batteries as a voltage reference provides the extreme stability attained. These units can be supplied to meet your power requirements. Some typical supplies are listed below:

D.C. VOLTAGE RANGE	CURRENT MILLIAMPERES	HUM MV	LINE REGULATION 110-120 VOLTS A.C.	LONG-TIME STABILITY*
400 to 1500	180	2	.002%	20
0 to 400	20	0.5	.005%	10
1500 to 3500	100	3	.005%	30
290 to 310	500	0.5	.002%	5
6.3 to 7.3	3 amps	10	.03%	1

\*Max. drift in millivolts over 10 min. period

### STANDARD REGULATED POWER SUPPLIES



These units are ruggedly built and designed to give long time, trouble free operation. Either positive or negative output may be grounded. All voltages and load currents are metered. Model E-50A (at left) also has a 6.3 volt 10 ampere output available. (Non-Regulated.)



MODEL	VOLTAGE RANGE	CURRENT MA	HUM	LINE VOLT. REG. 105-125 V.
EA-50A	0-500 Volts	0-300 MA	2 MV	1%
EA-48	160 to 1500 Volts	0-125 MA	Less than 20 MV	0.5%



## CHATHAM ELECTRONICS CORP.

Executive and General Offices: LIVINGSTON, NEW JERSEY  
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Communications Equipment  
Because of:

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Cathode and filament protection • Gyro Erection • Prevent surges and false starts in sensitive auxiliary equipment • Miscellaneous circuit switching

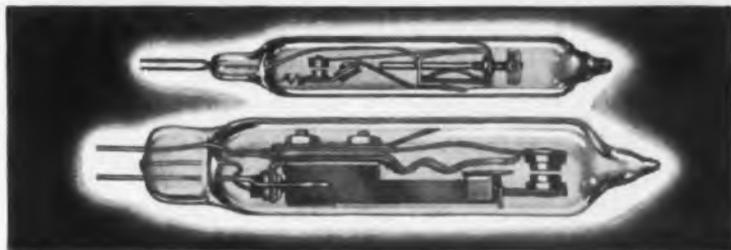
### SPECIFICATIONS

#### Standard Octal Base

Delays ... 2 seconds to 5 minutes  
Heater ... 5 watts nominal, continuous operation  
Voltages: 6.3, 26.5 and 117  
Contacts ... 6 amps maximum, 3 amps to 450 volts a.c. or d.c.  
Vibration ... 1/16" amplitude at 55 cps. 50g shock.  
Ambient ... -60 to +85°C Seated Height ... 3¼ max.

#### Miniature 7-Pin Base

Delays ... 5 seconds to 75 seconds  
Heater ... 2.5 watts nominal, continuous operation  
Voltages: 6.3 and 27.5  
Contacts ... 2.5 amps max. 1 amp at 125 volts d.c.  
Vibration ... 1/16" amplitude at 55 cps. 50g shock.  
Ambient ... -60 to +85°C Seated Height ... 2¼ max.



## SEALED THERMOSTATS

Ambient protection for frequency standards • Precision heat control for electronic laboratory instruments • Overheat detection and fire alarm

### SPECIFICATIONS

#### Heavy duty—type D8

Max. temp. ... 320°C  
Max. watts ... 1000  
Max. amps. ... 8.0 d.c.  
Calibration tolerance ... ± 2.5°C  
Length, 2¾"; dia., 9/16" (approx.)

#### Precision control—type S1

Max. temp. ... 190°C  
Max. watts ... 150  
Max. amps. ... 1.0  
Control differential at ¼ amp = 0.1°F  
Length, 2½"; dia., ⅜" (approx.)

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**ELECTRONIC  
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**For High Dielectric  
Strength, specify -**

## **TENSOLON** TEFLON-INSULATED **WIRE & CABLE**

- THIN WALL
- 14 COLORS
- FREE-STRIPPING
- EXTRA FLEXIBILITY
- TOUGH TEFLON INSULATION
- TEMPERATURE RATING:  
-90° to  
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For an extra margin of dependability at maximum operating temperatures, specify these rugged Teflon insulated hook-up wires. Available in stranded sizes from 20 to 30 AWG with shields and teflon jackets or lacquered braids. Constructed to meet highest government and commercial standards, Tensolon Wires feature the new Tensulated-Teflon covering that eliminates pin holes and other imperfections.

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An economical sample kit for designers, engineers, testing departments and development laboratories. Prices on request.

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International Business Machines  
590 Madison Avenue  
New York 22, N. Y.

## New Literature . . .

### Test Cabinets 134

A line of environmental test cabinets is described in this 2-color, 4-page bulletin. It includes chambers for altitude simulation between atmospheric pressure and 100,000ft, temperature control between  $-100^{\circ}$  and  $+200^{\circ}$ F, and humidity control between 20% and 90%. Each of these three types of units is illustrated, and specifications and other data on the numerous models are provided. Hudson Bay Division, Refrigeration Systems, Inc., 646 W. Washington Blvd. Chicago 6, Ill.

### Engineering Facilities 135

A 32-page brochure describes the personnel and facilities of this firm for research, development and production of electronic, electrical, pneumatic, hydraulic, and electro-mechanical systems and equipment. Laboratory and production facilities are illustrated, staffs and plant equipment are described. Numerous representative products also are shown. The W. L. Maxon Corp., 460 W. 34th St., New York 1, N.Y.

### Wires and Cables 136

A 16-page, 2-color bulletin gives descriptions of wires and cables for many applications. It also contains data on the types of strandings and protective coverings available. A large chart is provided to aid in wire and cable selection; it lists the wires and cables by service, such as communication, aerial, service, shipboard, shaft, portable, and many others. Detailed information on individual items is also available. Simplex Wire & Cable Co., 79 Sidney St., Cambridge 39, Mass.

### Portable Potentiometers 137

This 4-page, 2-color bulletin (1210) describes and illustrates two types of portable potentiometers for checking thermocouples, millivoltmeters, and other potentiometers. One unit has an extended scale range and is calibrated in millivolts, while the other is available in a variety of temperature range calibrations. Wiring diagrams, operating instructions, features, and specifications are provided. Industrial Division, Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa.

## Thoriated Tungsten Filament Tubes

### For R-F Heating Equipments of 2 to 150 kW Output Power



Machlett offers the designer a series of thoriated-tungsten filament tubes for industrial use in equipments having output powers from 2 to 150 kW. Providing high emission densities the thoriated tungsten filament delivers large tube currents with low filament powers; cost savings result through the use of smaller filament supply transformers and the very much lower operating powers. Thoriated tungsten filaments usually operate at about one-third the power requirement of pure tungsten filaments, given equal plate current ratings. Longer life potentialities are made possible by this filament type.

Machlett thoriated tungsten filament R-F power tubes include:

kW	Tube Type	Cooling	kW	Tube Type	Cooling
2-3	ML-6256; ML-6257	water	2-3	ML-6258	forced air
20-25	ML-356	water	5	ML-5530	forced air
50-75	ML-5681	water	10	ML-5541	forced air
100-150	ML-5682	water	15-20	ML-5531	forced air

Machlett Laboratories, Inc., 1063 Hope Street, Springdale, Conn.

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136

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## Transformer Cores

This 16-page bulletin (B-5402) describes Type C "Hipersil" cores for electronic and small electrical transformers. Characteristics and cost-savings advantages are discussed in detail. An illustrated section traces the manufacturing procedure from initial processing of the grain-oriented steel to the packaging of the completed core in a vapor-tight plastic coating. Sketches show how the cores can simplify assembly of three basic types of transformers. Westinghouse Electric Corporation, Box 2099, Pittsburgh 30, Pa.

138

## Component Shock Machine 140

The Type 20 VI Component Shock Machine, described in 4-page Product Bulletin 535, is specifically designed for developing and testing equipment components that must withstand shocks of the severity experienced in military service. The standard unit carries loads up to 20 pounds and produces shock tests to a maximum peak acceleration of 210g's. Performance curves and data on construction, operation, and installation are given. The Barry Corporation, Watertown 72, Mass.

## Test Equipment

A 24-page booklet illustrates, describes, and presents detailed specifications and application information on a variety of test equipments, including: 3" and 5" oscilloscopes; the "Circuit Master", a vacuum tube voltmeter; a circuit tester; a field strength meter; an alignment generator; a cross-dot linearity generator; a dynamic signal tracer; a u-h-f sweep signal generator; and other units. Accessory Div., Phileo Corporation, Philadelphia, Pa.

139

## Radiation Instruments

141

A 34-page catalog and price list cover a wide variety of radiation detecting and measuring instruments. Various sections are devoted to: basic laboratories, special purpose instruments, decimal scalers, binary scalers, counters, and accessories. Each of the many models covered are described and illustrated, with data on features, specifications, and other information provided. Radiation Instrument Development Laboratory, 2337 W. 67th St., Chicago 36, Ill.

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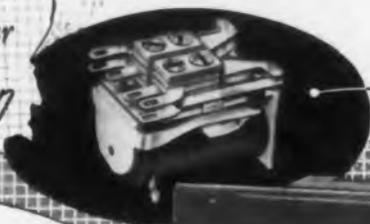
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# Patents . . . By John Montstream

**Electronic Switching Device . . . Patent No. 2,647,206.** Robert B. Trousdale, Rochester, New York. (Assigned to Stromberg-Carlson Company).

There are many situations where it is desirable to switch off anode potentials on electron discharge devices during idle periods in order to avoid needless current drain. One such situation is in a telephone system where it is desired to switch control potentials when a receiver is removed from its hook by the calling party, and switched off when the receiver is returned to its hook. It is essential too that the control potentials remain in effect for a predetermined period after the control signals cease in order to avoid premature switching off of the potentials due to delays.

The switching device (Fig. 1) includes a source (14) of positive switching or pulse signals connected in such a manner that when a receiver is removed from the hook,

the source supplies a potential to the utilization circuit (11). The switching device uses three gas tubes (13, 15, and 16), which are normally non-conducting until a positive pulse removes the negative bias on the control grid 19 of tube 13 provided by the negative potential source 26. Tube 13 fires and current flow through cathode resistor 32 provides a potential to the utilization circuit as well as plate potential for tubes 15 and 16. Positive signal pulses from source 14 also removes the bias on the control grid of tube 15 so that this tube fires practically at the same time as the firing of the tube 13. The plate (17) of tube 15 is connected with its potential source through a timing circuit (44, 45) so that when tube 15 fires, the plate potential falls below a potential to maintain the current flow through the tube and it is extinguished but plate potential builds up again and a pulse on the control grid

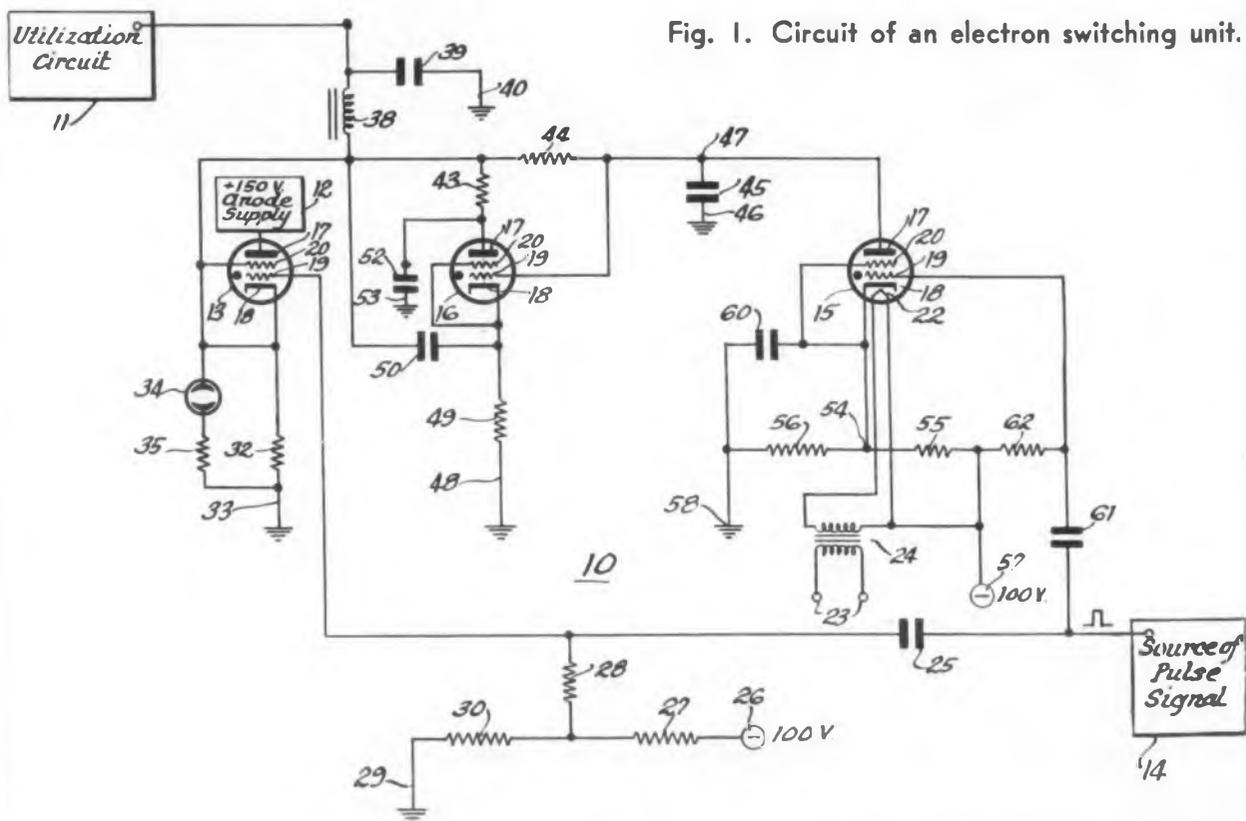


Fig. 1. Circuit of an electron switching unit.

again fires the tube. This firing and extinguishing continues so long as pulse source 14 is connected into the circuit. The cathode of tube 22 is at about  $-95v$ , and the plate potential and the bias on the control grid of tube 16 is about  $-80v$ .

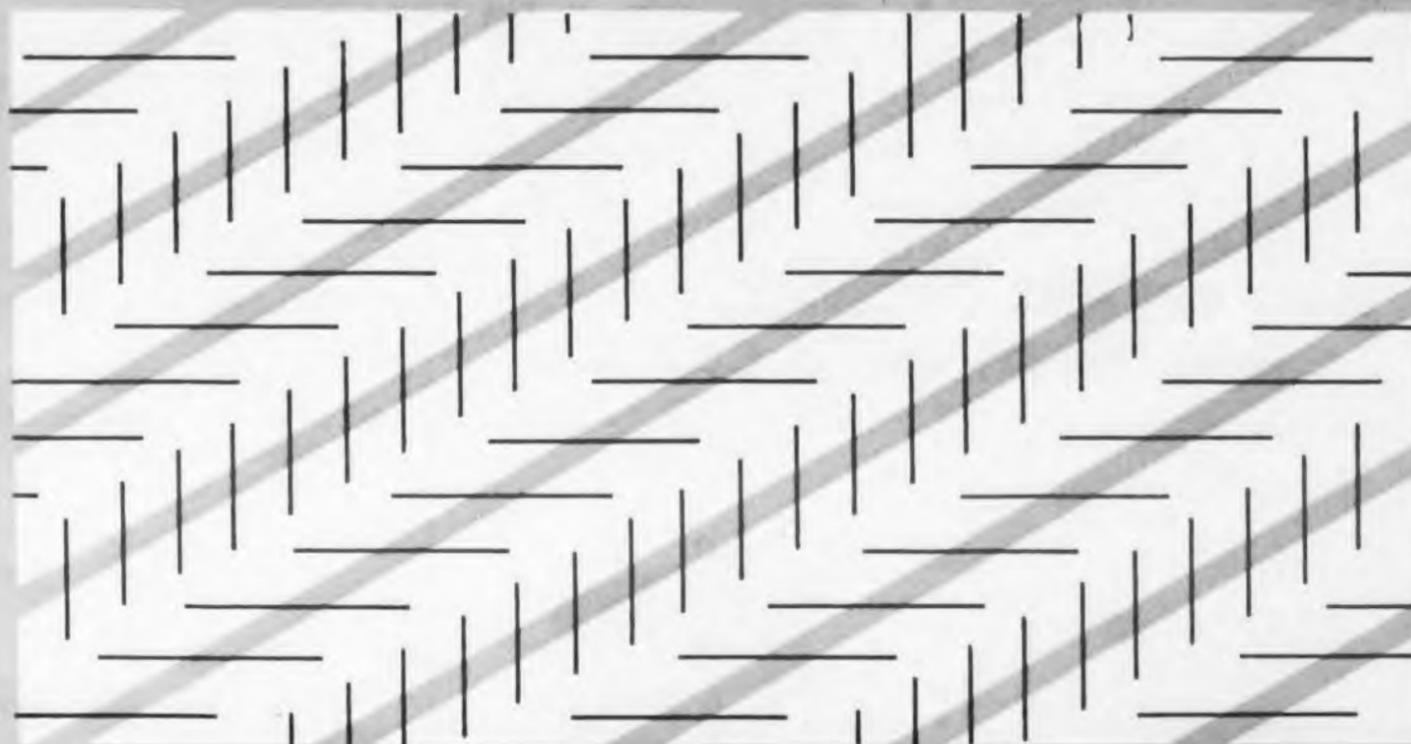
Should the pulse source 14 be disconnected, tube 15 is not fired and potential builds up on capacitor 45 through timing resistor 44 until the bias on control grid of tube 16 is removed whereupon this tube fires. This generates a positive pulse by virtue of potential stored in capacitor 50 and the development of potential across cathode resistor 49 when the tube fires. The pulse appears on cathode 18, extinguishes this tube and cuts off potential to the utilization circuit. It is apparent, therefore, that cessation of positive pulses from source 14 for short periods of time does not cut off potential to the utilization circuit until such delay is for a period determined by the timing circuit (44, 45).

**Stabilized Semiconductor Amplifier Circuits . . . Patent No. 2,644,859. Loy E. Barton, Princeton, N. J. (Assigned to Radio Corporation of America).**

The input signal for an amplifier circuit using a transistor or semiconductor may be impressed either on the emitter electrode or the base electrode; however, the gain is higher if the signal is applied to the latter. The amplifier has a tendency to oscillate and become unstable when the signal is applied to the base electrode, because under certain operating conditions the resistance looking into this electrode may become negative. The circuit in Fig. 2 stabilizes this type amplifier.

In the circuit, the input signal is impressed in push pull upon the transistor (10) through a transformer (20), the secondary winding of which is connected to the emitter (13) and the base (12). An intermediate tap (23) in the secondary winding is connected with a point of fixed potential which divides the secondary into two portions (28 and 29). A bias network (25) or battery in series between the base and the secondary winding develops a suitable potential in the forward direction between the emitter and base. The impedances of the windings of portions 28 and 29 of the secondary, are so proportioned that the equivalent negative resistance (looking into the base electrode) is counteracted by the equivalent positive resist-

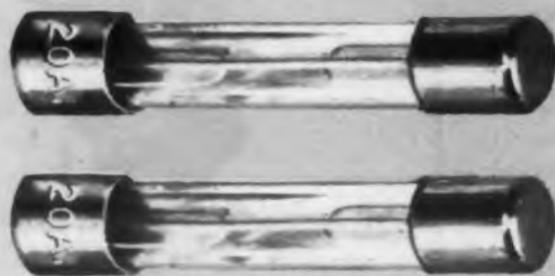
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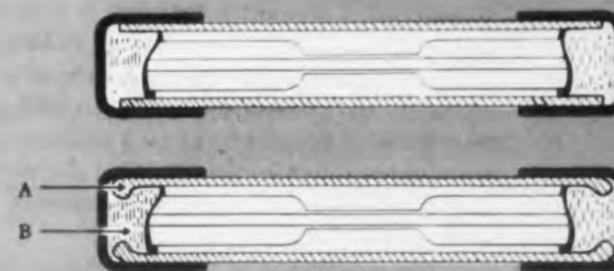
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Littelfuse leads all other fuse manufacturers in design patents on fuses. Lock-cap assembly patent no. 1922642

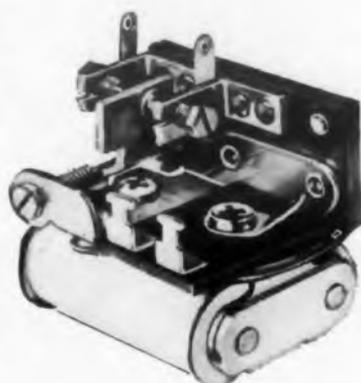
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the intervening years it has done us yeoman service and kept a charmingly large segment of our customers in a state of dithers. (Sometimes because they couldn't get Type 5's, other times because they wished they hadn't!)

But we had come to feel it was, if not obsolete, at least no longer newsworthy, so we don't often speak of it in our advertising. Perhaps we were wrong, because we now observe the very creditable effort of an esteemed competitor (left above) to which he is devoting prominent attention in publicity. His specifications are good, too. 60,000 ohms winding resistance is offered publicly. (We do that sort of thing only on special request. We hate to encourage the philosophy leading to such a requirement.) Maximum sensitivity is given as 1 to 2 milliwatts. We assume they are being conservative because we feel the design is appropriate for  $\frac{1}{2}$  milliwatt sensitivity when well executed and well applied (not when used on an airplane!).

The competitor is to be complimented, too, for designing around our patent, a feat he has probably achieved at little or no sacrifice in most applications. We are flattered that he should think our patent strong enough to worry about.

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## Patents . . .

ance (looking into the emitter electrode). A cascade-connected amplifier circuit for a modulated carrier wave is also illustrated and described.

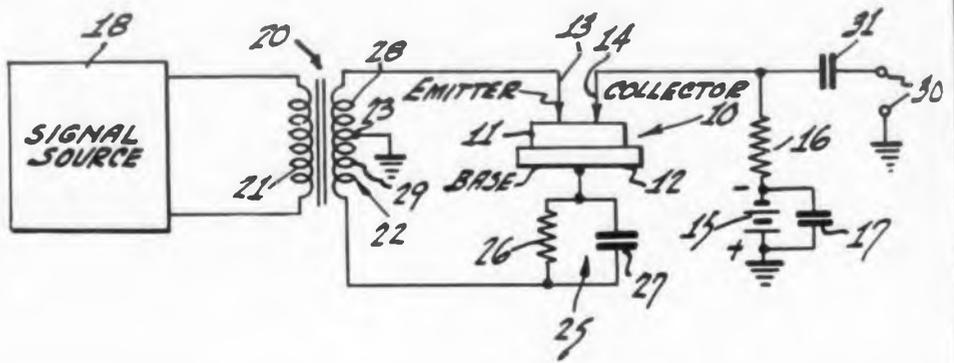
**Pulse Generator . . . Patent No. 2,644,094.** William S. Douglas, Astoria, New York. (Assigned to The M. W. Kellogg Company).

A simple and reliable circuit is described for producing a substantially rectangular wave form, the width of which is controllable while maintaining a predetermined

frequency. The circuit may be operated on a saw-tooth voltage and the rectangular wave will have the same frequency.

A conventional saw-tooth generator is provided (Fig. 3) using a thyatron (1), capacitor (4), load resistor (5), and a biasing potentiometer (6) which is adjusted to vary the frequency of the wave generated. The saw-tooth wave is applied through capacitors 7 and 8 to the control grid of a second thyatron (2) which is maintained non-conducting by the negative bias from potentiometer 10 until the bias is overcome by the superimposed saw-tooth pulse whereupon the tube fires, and continues to conduct at a steady value

Fig. 2. Circuit for stabilizing semiconductor amplifiers.



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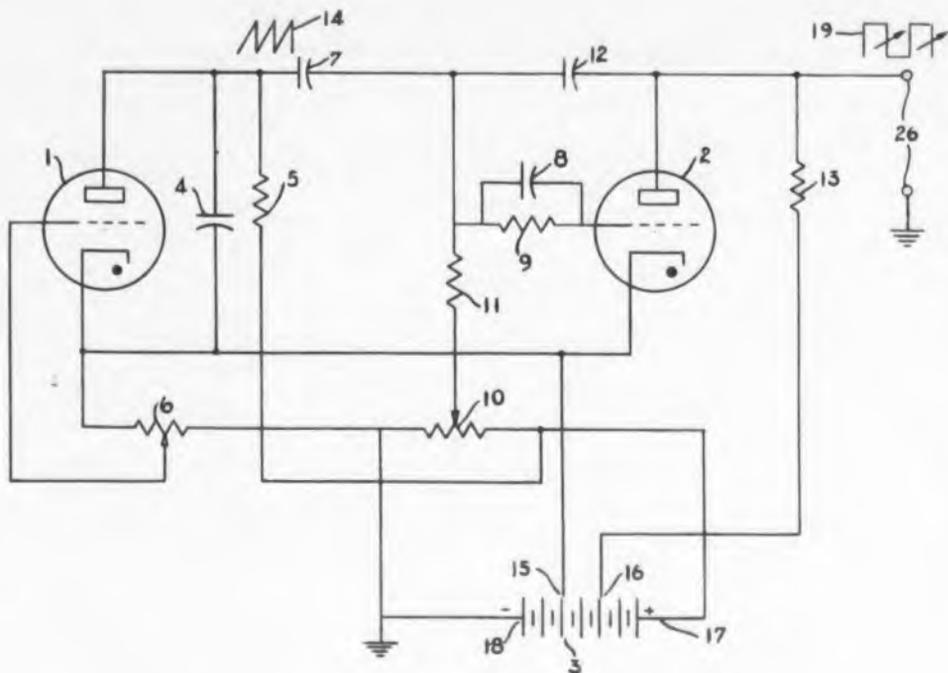
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Fig. 3. This pulse generator produces rectangular waveform output from a sawtooth input.



until it is cut off by a negative pulse on the plate produced by the action of a differentiating network on the sharp decay of the saw-tooth pulse. Potentiometer 10 determines the bias voltage and the point at which tube 2 begins to conduct and hence the width of the rectangular pulse.

The differentiating circuit consists of a capacitor (12) in series with the plate resistance of the tube (2) and plate load resistor (13) in parallel. Circuit components are saved by using elements in the differentiating network which also serve to perform other circuit functions.

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## New Books...

**Principles of Transistor Circuits . . . Edited by Richard F. Shea.** 535 pages. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. \$11.00.

This is a long awaited book. Ever since the development of the transistor was announced back in 1948, dozens of articles on the theory and application of the device have appeared. Until now, electronic engineers desiring a single reference source on the subject had to content themselves with saving back issues of periodicals. Now they have such a source.

The authors (all members of the engineering staff of the Electronics Laboratory of General Electric Company, Syracuse, N. Y.), have gathered together a large portion of the mass of research material that has accumulated on transistor circuits into a single, well planned, clearly written volume. The book is aimed at the graduate student and the practicing engineer.

For the practicing engineer, the authors have gone into considerable detail on the fundamental equivalent circuits for various configurations and for various frequency ranges, a chapter on duality has been included, and the resemblance to vacuum tube circuits is often cited so that the engineer familiar with the vacuum tube field can draw upon his experience. For the graduate student and those engineers who are comparatively well grounded in network theory, chapters on matrix methods of analysis and one on feedback, utilizing current network theory modified to fit transistor circuits has been provided.

Following a brief introduction covering semiconductor physics and the various types of transistors, the book is divided into three main parts which deal principally with low-frequency, high-frequency, and large-signal, nonlinear applications. In the low frequency section, operation with both small and large signal amplitudes is discussed as well as d-c, audio, and ultrasonic amplifiers. The second part of the book treats small-signal operation at higher frequencies (100ke to 10Mc) in amplifiers and oscillators. Circuits which show how transistors can be used in oscillators, i-f amplifiers, and r-f amplifiers are included. Applications such as flipflops, multivibrators, and pulse amplifiers are covered in the section on large-signal and nonlinear operation.

There are 22 chapters in all and they include such topics as basic principles of the amplifier stage; junction transistor multistage amplifiers; power amplifiers; basic principles of high-frequency operation; high frequency circuit design; video amplifiers; oscillators; circuit design by duality; matrix methods of circuit analysis; feedback amplifiers; transient analysis; large-signal operation; computer circuits; noise in transistors; associated semiconductor devices; and

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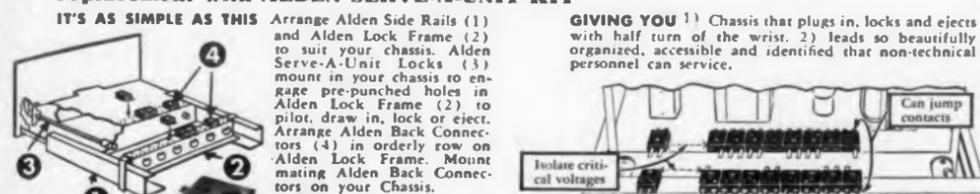
You can use Alden Terminal Mounting Card with Alden Miniature Terminals, Jumper Strip and Sockets staked to accommodate any circuitry—making complete units ready for housing. Components snap into unique Alden Terminals, are held ready for soldering.

**2. To mount this vertical circuitry, ALDEN PLUG-IN PACKAGES AND CHASSIS give tremendous variety with standard components**



Alden components provide standard plug-in or slide-in housings—with spares, your circuits become units replaceable in 30 seconds.

**3. Give chassis easily traceable interconnects and 30-second replacement with ALDEN SERVE-A-UNIT KIT**



**IT'S AS SIMPLE AS THIS**

Arrange Alden Side Rails (1) and Alden Lock Frame (2) to suit your chassis. Alden Serve-A-Unit Locks (3) mount in your chassis to engage pre-punched holes in Alden Lock Frame (2) to pilot, draw in, lock or eject. Arrange Alden Back Connectors (4) in orderly row on Alden Lock Frame. Mount mating Alden Back Connectors on your Chassis.

**GIVING YOU** 1) Chassis that plugs in, locks and ejects with half turn of the wrist. 2) Leads so beautifully organized, accessible and identified that non-technical personnel can service.

**4. Assign to each unit ALDEN SENSING ELEMENTS — to spot trouble instantly:**



139 N. Main St., Brockton 64, Mass.

**From Alden's Line of Ready-made Components for Utilized Plug-in Unit Construction.**

**CIRCLE ED-162 ON READER-SERVICE CARD FOR MORE INFORMATION**

small-signal parameter measurement. A comprehensive bibliography is included as well as a section on definitions of terms.

**Elements of the Theory of Functions . . .** By Konrad Knopp, translated by Frederick Bagemihl. 146 pages. Dover Publications, Inc. 1780 Broadway, New York 19, N. Y. \$1.25 (paper), \$2.25 (cloth).

For some time now, the publisher of this book has been issuing paper bound scientific books which contain all of the material in higher-priced cloth editions. Most of the books so published are classics in their fields, and many of them have been out of print. In this manner, many excellent books have been made available at a cost low enough to permit building a fine library covering many scientific fields.

This particular book is of interest to electronic engineers because more and more of their efforts are requiring a sound knowledge of mathematical techniques. It serves as an introduction to the theory of functions and provides the reader with a background for more advanced works.

It includes sections on foundations; the system of complex numbers and the Gaussian plane of numbers; the Reimann sphere of numbers; linear functions and circular transformations; mapping by means of linear functions; normal forms and particular linear mappings; sets and sequences (power series), analytic functions and conformal mapping; the elementary functions; exponential, trigonometric, and hyperbolic functions; and the logarithm, cyclometric functions, and the binomial series.

**Conference on Electrically Operated Recording and Controlling Instruments . . .** Paper bound, 191 pages. American Institute of Electrical Engineers, 33 West 39th Street, New York 18, N. Y. \$3.50.

The papers and discussions presented at the Conference on Electrically Operated Recording and Controlling Instruments in Philadelphia, November, 1952, sponsored by the subcommittee on Recording and Controlling Instruments of the AIEE Committee on Instruments and Measurements, have been compiled and made available in this booklet.

The conference was intended to educate and stimulate interest in the design, theory of operation, and application of electrically-operated recording and controlling instruments, and to familiarize engineers with recent advances in this field. The four sessions held covered new developments in the field of self-balancing recorders, electric controlling instruments, applications and systems, and new recording instruments. A total of 17 papers were presented.

The compilation is an excellent survey of the field and the material is neatly presented.

# STABILITY

in RESISTOR APPLICATIONS

Stability refers to the ability of a resistor to retain its ohmic value during its entire useful life, and under varying conditions. Tolerance, on the other hand, is simply a statement of the ohmic limits within which the resistor was selected.

**WELWYN Resistors** are formed by a pure, homogeneous carbon film. Through the development of special manufacturing techniques, and through the use of post-manufacture processes and controls, Welwyn has succeeded in producing resistors of  $\pm 1\%$  stability. **WELWYN High Stability Deposited Carbon Resistors** are recommended wherever value drift is to be avoided.

For further information and Test Data concerning . . .



Write to Dept. CK-1

**ROCKBAR CORPORATION, 215 East 37th Street, New York 16, N. Y.**

**CIRCLE ED-163 ON READER-SERVICE CARD FOR MORE INFORMATION**

**ELECTRONIC DESIGN • October 1953**

WHEN YOU NEED A

# "GO-NO-GO"

SIE

## MODEL E-1 COMPARISON BRIDGE IS YOUR ANSWER!



**SOUTHWESTERN INDUSTRIAL ELECTRONICS COMPANY**

**CIRCLE ED-164 ON READER-SERVICE CARD**



Photo  
enlargement  
six times  
actual  
size.

Hughes  
Diodes  
are  
**FUSION  
SEALED  
IN  
GLASS**  
for electrical  
stability

GLASS-TO-METAL fusion sealing for electrical stability is an exclusive feature of HUGHES GERMANIUM DIODES. The final seal in precision assembly operations is made at a temperature exceeding 700° C.

Proved in billions of vacuum tubes, the glass-to-metal seal has been incorporated to full advantage in diode manufacture for the first time by the Hughes-developed process of fusion sealing. The result is a unique germanium diode whose elements are encased in a rigid *one-piece* glass envelope, which assures permanent freedom from moisture penetration.

THE HUGHES GERMANIUM DIODE, developed by Hughes Research and Development Laboratories, employs no wax or solder, and has no mechanical joints or pressed-in parts to shift position.

To insure the satisfactory operation of HUGHES DIODES under adverse conditions of moisture, vibration, and severe shock, a 100 per cent testing procedure has been devised which *invites* instabilities to occur prior to shipment and assures rejection of every defective diode. Each HUGHES DIODE is humidity-cycled, temperature-cycled, and JAN shock-tested.

HUGHES GERMANIUM DIODES have proved consistently able to meet exacting requirements in airborne electronic equipment for navigation, fire control and guided missiles.

Volume orders for most types of HUGHES DIODES can be filled from stock. Diodes are also tested to special specifications, including high-temperature electrical requirements.

HUGHES GERMANIUM DIODE ELECTRICAL SPECIFICATIONS AT 25° C.

Description	RTMA Type	Test Peak Inverse Voltage* (volts)	Maximum Inverse Working Voltage (volts)	Minimum Forward Current @ +1 v (ma)	Maximum Inverse Current (ma)
High Peak	1N55B	190	150	5.0	0.500 @ -150 v
	1N68A	130	100	3.0	0.625 @ -100 v
High Back Resistance	1N67A	100	80	4.0	0.005 @ -5 v; 0.050 @ -50 v
	1N99	100	80	10.0	0.005 @ -5 v; 0.050 @ -50 v
	1N100	100	80	20.0	0.005 @ -5 v; 0.050 @ -50 v
High Back Resistance	1N89	100	80	3.5	0.008 @ -5 v; 0.100 @ -50 v
	1N97	100	80	10.0	0.008 @ -5 v; 0.100 @ -50 v
	1N98	100	80	20.0	0.008 @ -5 v; 0.100 @ -50 v
High Back Resistance	1N116	75	60	5.0	0.100 @ -50 v
	1N117	75	60	10.0	0.100 @ -50 v
	1N118	75	60	20.0	0.100 @ -50 v
General Purpose	1N90	75	60	5.0	0.800 @ -50 v
	1N95	75	60	10.0	0.800 @ -50 v
	1N96	75	60	20.0	0.800 @ -50 v
JAN Types	1N126**	75	60	5.0	0.050 @ -10 v; 0.850 @ -50 v
	1N127†	125	100	3.0	0.025 @ -10 v; 0.300 @ -50 v
	1N128‡	50	40	3.0	0.010 @ -10 v

\*That voltage at which dynamic resistance is zero under specified conditions. Each Hughes Diode is subjected to a voltage rising linearly at 90 volts per second.

\*\*Formerly 1N69A. †Formerly 1N70A. ‡Formerly 1N81A.

Semiconductor  
Sales Department

**Hughes**

AIRCRAFT COMPANY  
CULVER CITY  
CALIFORNIA

Address inquiries to Dept. D

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# to use Hermetic's New *Vac-tite*<sup>\*</sup> Compression Seals

and

The following styles of proven VAC-TITE compression seals are available:

Individual terminals and feed-throughs with a full range of hooked, flattened and pierced, turret and lug-type terminations for every application.

All-glass construction multi-terminal headers featuring larger leakage paths and an absence of moisture pockets.

Individually glassed plates available in a multiplicity of standard designs and easily adaptable to special designs in a variety of shapes and sizes for every requirement.

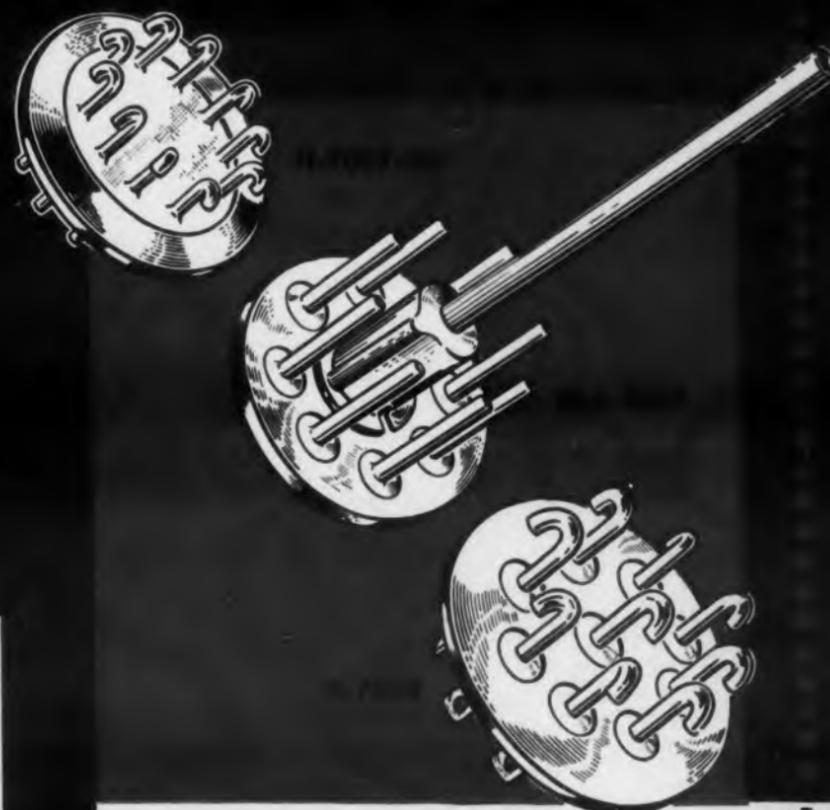
Plugs for standard sockets in several mounting types . . . such as octal, 7-pin miniature, noval as well as rectangular shapes.

Write for complete information on how HERMETIC engineers can apply "All-Glass" Compression Seals to your regular or special applications. Available, too, is HERMETIC's Brochure CS on Compression Seals, as well as a 32-page catalog on its standard line.

## HERMETIC SEAL PRODUCTS CO.,

vacuum tightness is a requisite, HERMETIC's proven compression seals are guaranteed to be vacuum tight, as evidenced by Mass Spectrometer Test.

a RUGGED seal is required for application under adverse design conditions, the massive compression construction resists destructive deflection and permits direct mounting of components on the metal body.



\*VAC-TITE is HERMETIC's new vacuum proof compression-construction glass to metal seal.



CIRCLE ED-166 ON READER-SERVICE CARD FOR MORE INFORMATION



## Why you can count on *RCA Transistors* for your designs

RCA is engaged in a program to provide the industry with transistors to meet equipment designers' needs now, and equipment manufacturing requirements in the future.

To achieve this goal, RCA is gearing transistor production to the progress being made in developing new manufacturing techniques and improved methods of production control.

As production volume grows with increasing demands, you can count on RCA to provide transistors of the highest quality consistent

with the best engineering practice known.

For technical data, or help on specific design problems using RCA transistors, write RCA, Commercial Engineering, Section 72-JR, Harrison, New Jersey. 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, Ill.

(WEST) Madison 9-3671  
420 S. San Pedro St.,  
Los Angeles, Cal.



FREE technical bulletin on RCA Transistors; includes circuits, characteristics, typical operating conditions, curves, connections. Write: RCA, Commercial Engineering, Section 72-JR, Harrison, N. J.

### APPLICATION GUIDE FOR RCA TRANSISTORS

RCA Type	Max. Ratings—Absolute Values		Characteristics at Ambient Temp. of 25°C			
	Collector Dissipation (mw)	Ambient Temperature (°C)	Power Gain (db)	Frequency for Alpha Cutoff (Mc)	Approx. Useful Power Output at 50 Mc (mw)	Current Amp. Factor (approx.)
RCA-2N32 Point-contact type—for pulse or switching applications	50	40	21*	2.7#	—	2.2†
RCA-2N33 Point-contact type—for oscillator applications up to 50 Mc	30	40	—	—	1.0	—
RCA-2N34 Junction p-n-p type—for low power, of amplifier applications	50	50	40**	—	—	40††
RCA-2N35 Junction n-p-n type—for low power, of amplifier applications	50	50	40**	—	—	40††

\* With collector load resistance of 10000 ohms, signal-source impedance of 500 ohms, and signal frequency of 5000 cps.

†† Between Base Connection and Collector.

# Measured at a point 3db down from its low-frequency value (100KC). Cutoff frequency is defined as the frequency at which the current amplification factor has dropped to 0.7 of its low-frequency value.

\*\* With collector load resistance of 30000 ohms, signal-source impedance of 500 ohms, and signal frequency of 5000 cps.

† Between Emitter and Collector.



**RADIO CORPORATION of AMERICA**  
TUBE DEPARTMENT  
HARRISON, N. J.

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