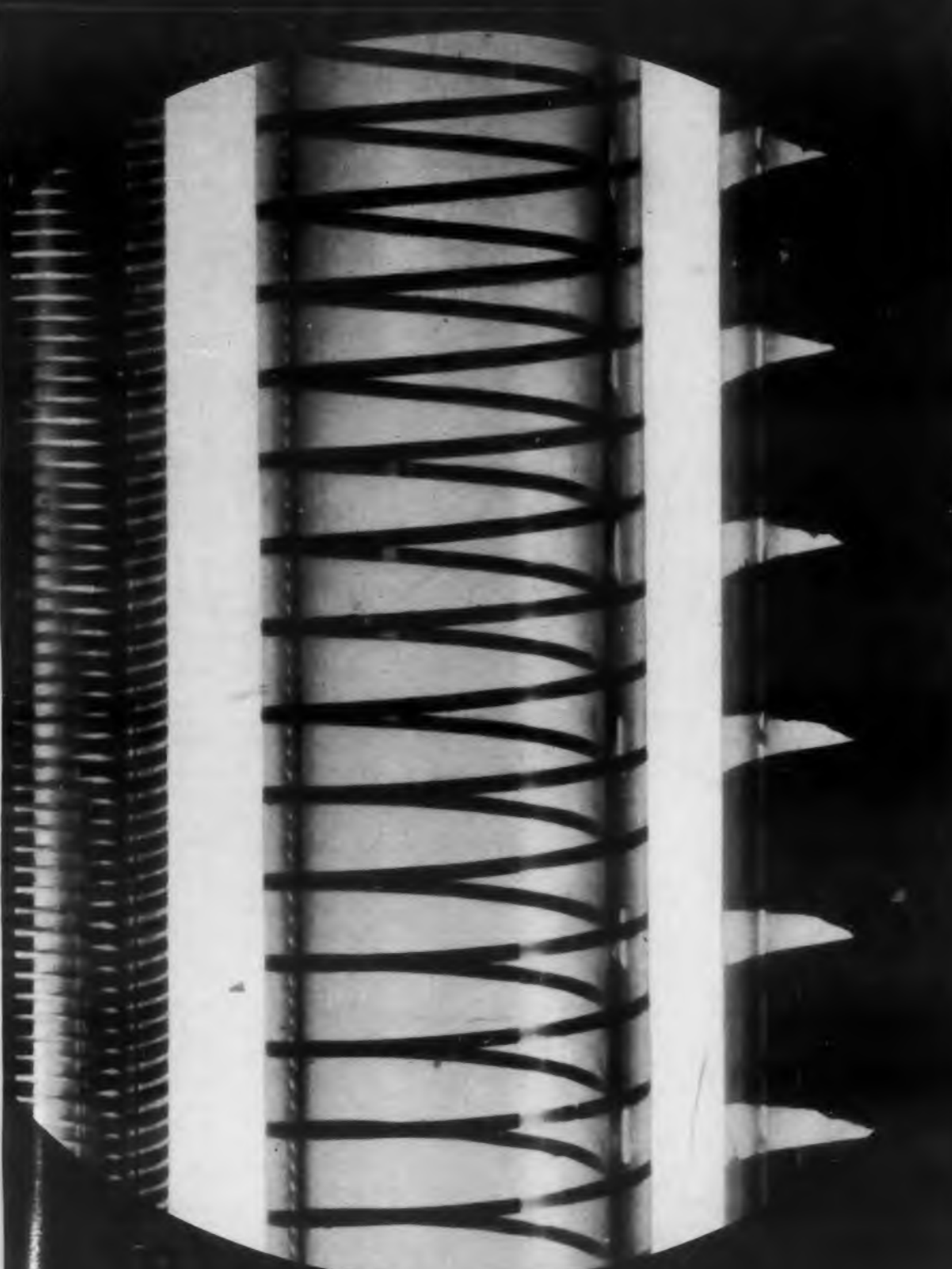


ELECTRONIC

design

ELECTRONIC



THE EDITOR OF
ELECTRONIC DESIGN
NOV 1954



Depositing metallic resistance film on the inside surface of the glass-tube body of a new line of precision resistors results in these interesting patterns. A one watt unit, approximately actual size, is shown above.

November 1954

FREED Instruments & Transformers

Famous For

QUALITY • DEPENDABILITY • ACCURACY

FREED MINIATURE AUDIO TRANSFORMERS

PROFESSIONAL MINIATURE AUDIO TRANSFORMERS

These high quality, miniature transformers feature hermetic sealing for maximum protection from moisture penetration with subsequent electrolysis and corrosion of fine wires. While primarily intended for non-military equipment, these units are constructed in accordance with MIL-T-27 Specifications.

CATALOG NO.	APPLICATION	IMPEDANCE LEVEL OHMS		MAXIMUM POWER LEVEL V.U. ²	RATIO	MAX PRI DC PER SIDE Ma.	D.C. UNBAL. Ma.	FREQ. RESPONSE C.P.S.	CASE NUMBER
		PRIMARY	SECONDARY						
PMA 1	Line or microphone to single or push-pull grids	50/200/500	60,000 C.T.	+8	1:11	0	0	±2.0 DB 30-20000	DM-12
PMA 2	Dynamic microphone or speaker voice coil to single or P.P. grid	4/8	60,000 C.T.	+8	1:86.6	0	0	±2.0 DB 30-20000	DM-12
PMA 3	Line or microphone to single or push-pull grids. Magnetically shielded.	50/200/500	60,000 C.T.	+8	1:11	0	0	±2.0 DB 30-20000	DM-12
PMA 4	Single triode plate to single or push-pull grids	15,000	60,000 C.T.	+8	1:2	0	0	±2 DB 30-10000	DM-12
PMA 5	Single triode plate to push-pull grids	15,000	60,000 C.T.	+8	1:2	2	2	±2 DB 200-10000	DM-12
PMA 6	Single triode plate to multiple line	15,000	50/200/500	+8	5.48:1	0	0	±2 DB 30-20000	DM-12
PMA 7	Single triode plate to multiple line	15,000	50/200/500	+8	5.48:1	2	2	±1 DB 200-10000	DM-12
PMA 8	Push-pull triode plates to multiple line	30,000 C.T.	50/200/500	+8	7.75:1	2	0.25	±2 DB 30-20000	DM-12
PMA 9	Crystal mike or pickup to multiple line	60,000	50/200/500	+8	11:1	0	0	±2 DB 30-20000	DM-12
PMA 10	Mixing or matching	50/200	50/200/500	+8	1:1.50	0	0	±2 DB 30-20000	DM-12
PMA 11	Parallel Feed Reactor 1 mw. reference level.	40 hy.	3 ma dc,		3500 ohms D.C. resistance				DM-12



DM-12 CASE DIMENSIONS

FL - 1 1/2
FD - 1 1/32
W - 15/16
H - 1 15/32
M - 1 7/32

Screws - 4-40
Cut out - 7/8
Wgt. - 1.5oz.

Send for complete catalog on
Freed Instruments and Transformers



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Low Frequency
"Q" Indicator



No. 1020B
Megohmmeter



Decade
Inductors



No. 1040
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No. 1210
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Vacuum Tube Voltmeter



No. 1010
Comparison Bridge



No. 1110A
Incremental Inductance
Bridge

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ELECTRONIC

design

Vol. 2
No. 11
November 1954

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

B 506405



Here's a low-cost solution to your high-precision timing problems

The New Potter Model 432 Interval Timer is a general-purpose instrument for timing relays, camera shutters, high-speed machine operations, and for calibrating electrical and mechanical timing devices. It is simple to operate—even an unskilled operator can make interval measurements to within 0.00001 second.

Versatile Input Circuits permit measurement of time between any combination of voltage changes, contact opening, or contact closure, thus accommodating a wide variety of timing problems.

Timing Is Achieved by Electronically Counting the number of pulses produced by a high-frequency crystal-controlled time-base oscillator during the unknown interval. Three time-base frequencies (1, 10, and 100 kc) are provided for making measurements in increments of 0.01, 0.1, and 1 millisecond. Results are displayed directly in milliseconds with an illuminated decimal point—misinterpretation of readings is virtually impossible.

Maximum Timing Range of the 432 is 1 second; this can be extended to 1,000,000 seconds by addition of a mechanical register (available as an optional feature). The 432 also serves as a totalizing counter (can be used to count relay contact bounces) and as a secondary frequency standard with outputs of 100 kc, 10 kc, 1 kc, 100 cps, 10 cps, and 1 cps for general laboratory use.

Descriptive Literature Is Yours for the asking. Write today and see how this compact, low-cost instrument can solve your timing problems with greater accuracy and convenience.



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

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Ruggedness
Reliability
make the**



MACHLETT 2C39A

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

**New Standard for
Electrical Uniformity**

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

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

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

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

400% More Rugged

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

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

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

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

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

*Manufactured to JAN specifications.

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

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Over 55 years of electron tube experience!

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Editorial

The Components Engineer

We would like to endorse a very valuable suggestion proposed recently at the Electronics Components Symposium in Washington, D. C. This concept, if implemented, can be of great help to electronic design engineers.

R. C. Sprague, of Sprague Electric Company, proposed the creation of a new type of engineer, the "components engineer" who would have a very special function in the design department of electronic manufacturing firms. His would be the responsibility of testing, selecting, and procuring electronic components for his company. He would have to know all about those components that were being incorporated into his company's products—their merits, limitations, performance, costs, availability, etc. He would be consulted by designers whenever a component problem arose, and would be expected to propose some practical solutions based on sound engineering and business principles.

It is pretty obvious that such an individual would be very handy to have around. It is also easy to see that such a man could save his company many hundreds of man-hours by eliminating the necessity for each designer to do his own component testing and selecting. One central source for this type of information would be established, and the components engineer would have to see that his information was up to date.

This function cannot be filled by merely assigning a title to a man. It requires special training. Probably the most important part of the components engineer's training would be in working as a design or development engineer for several years. Then with this background of solid practical experience, he would be ready to specialize in components. He would take formal courses in such topics as manufacturing techniques, testing, chemistry and physics of materials, statistics, and business practices. These subjects could very readily be organized into an excellent university graduate program. Where practical, the entire graduate program could be given in the evening or in intensive summer programs to accommodate working engineers.

We think this excellent idea can be successfully carried out in many engineering schools with the cooperation of local components manufacturers. The result would be a trained man who could fill a badly needed function in the industry. The components engineer can do much to help electronic design engineers fulfill their design functions more effectively.

Engineering Review . . .

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

Another Atomic Battery . . . An atomic battery that uses heat from radioactivity to produce electrical energy has been developed by John H. Birden and Kenneth C. Jordan of Mound Laboratory, Miamisburg, Ohio. It produces power comparable to that of the ordinary dry cells.

The new atomic battery utilizes polonium, while previously announced atomic batteries (*ED, February,*

1954, p. 15; May, p. 8; and September, p. 15) employ strontium-90 or tritium. One hundred and fifty curies of polonium is sealed in a small capsule, the surface of which is in contact with the hot junctions of 40 thermocouples. The capsule is thermally insulated with a silica aerogel and is mounted within a surrounding container on the surface of which are the cold thermocouple junctions. A temperature difference of about 450°F is maintained between the thermocouple junctions, producing a current flow.

The voltage-current rating of the battery can be varied by proper choice of wire size and the number of thermocouples. In this cell, the polonium capsule supplies 4.65w in heat, and the unit's output is 9.4mv.

Electronic Stinger

The elongated tail of this U. S. Navy hunter-killer aircraft contains a "Magnetic Airborne Detector" for finding submerged submarines. This electronic weapon registers disturbances in the earth's magnetic field due to the presence of large metal bodies. The plane is a P2V-7 "Neptune", made by the Lockheed Aircraft Corporation, Burbank, Calif.

for an efficiency of 0.2%. It has an internal resistance of 15 ohms, a no-load voltage of 0.75v, and a current at maximum power of 25ma. Its output is not affected by extreme variations in the temperature of surroundings as is a flashlight cell.

Although such a battery has many obvious applications, large-scale production of the units is not economical. The Mound Laboratory is operated for the Atomic Energy Commission by Monsanto Chemical Co., St. Louis, Mo.

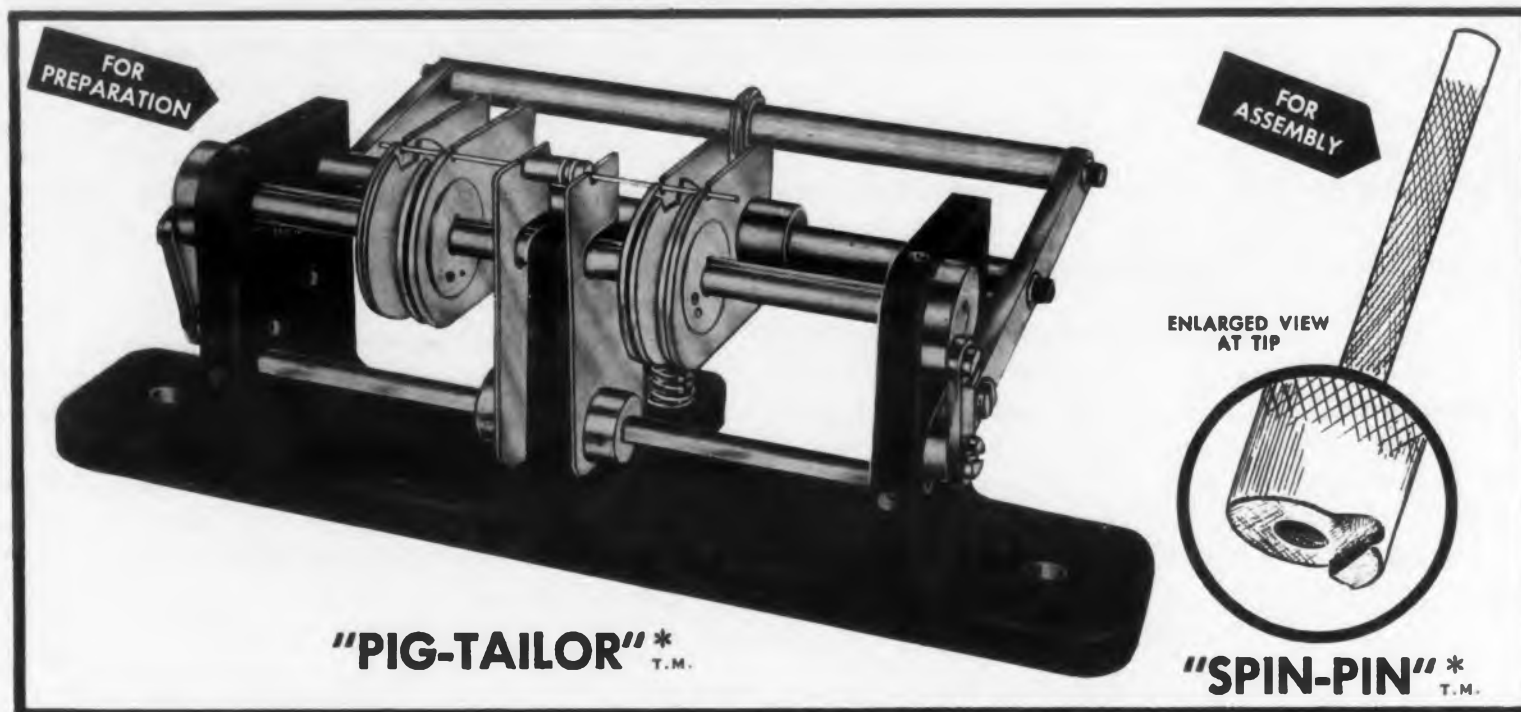
Faster Patenting . . . A committee has been appointed to seek new ways to speed up the processing of patent applications. Known as the Advisory Committee on Application of Machines to Patent Office Operations, it was appointed by Secretary of Commerce Sinclair Weeks. Its chairman is Dr. Vannevar Bush, President, Carnegie Institution of Washington, and Director of the wartime Office of Scientific Research and Development. It is hoped that the committee can recommend means of applying high-speed electronic devices to the time-consuming process of searching for previously granted patents in order to compare them with patent applications.

The Committee welcomes any suggestions for applying computers and other electronic devices to patent operations from professional men and industrial and research organizations. They should be sent to the executive secretary of the Committee: Norman T. Ball, Room 2322, Department of Commerce, Washington 25, D. C. Any speedup of patent operations should be an important stimulus to technological progress in the United States.



"PIG-TAILORING"

... a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.



The "PIG-TAILOR" plus "SPIN-PIN" — Accurately Measures, Cuts, Bends, Ejects and Assembles both leads simultaneously to individual lengths and shapes — 3 minute set-up — No accessories — Foot operated — 1 hour training time.

PIG-TAILORING provides:

1. Uniform component position.
2. Uniform marking exposure.
3. Miniaturization spacing control.
4. "S" leads for terminals.
5. "U" leads for printed circuits.
6. Individual cut and bend lengths.
7. Better time/rate analysis.
8. Closer cost control.
9. Invaluable labor saving.
10. Immediate cost recovery.

PIG-TAILORING eliminates:

1. Diagonal cutters!
2. Long-nose pliers!
3. Operator judgment!
4. 90% operator training time!
5. Broken components!
6. Broken leads!
7. Short circuits from clippings!
8. 65% chassis handling!
9. Excessive lead tautness!
10. Haphazard assembly methods!

* PATENT
PENDING

Write for illustrated, descriptive text on "PIG-TAILORING" to Dept. ED-11

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DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT
460 WEST 34th STREET • NEW YORK 1, N. Y.



CIRCLE ED-4 ON READER-SERVICE CARD FOR MORE INFORMATION

Engineering Review . . .

NEC Award . . . The First National Electronics Conference Award was presented to two General Electric Company men at the tenth anniversary-session of the conference held at Chicago last month. Recipients of the \$250 award were E. D. McArthur, manager of the electron tube section, General Electric Research Laboratory, Schenectady, N. Y., and E. F. Peterson, manager of marketing for the firm's radio and TV department, Syracuse, N. Y.

The new award will be presented annually to "the author or authors of a paper presented at a previous conference which introduced developments of a new and revolutionary character. . . ." McArthur and Peterson were co-authors of a paper entitled "The Lighthouse Tube; A Pioneer Ultra-High-Frequency Development" presented at the first NEC conference in 1944. It described the then-new development of disk-seal tubes, which played an important part in World War II radar defense.

Improved Investment Casting . . . The design of parts of greater complexity is now possible through the frozen-mercury process of investment casting because of a new feature known as "booking". This feature permits two or more pieces of frozen mercury to be almost instantly joined with only the slightest pressure. Therefore, complex patterns possessing interior coring so intricate as to make them very difficult or impractical to cast by other methods can be economically produced by the improved frozen-mercury method. This process is offered by Mercast Corp., 295 Madison Ave., New York 17, N. Y.

In the improved process, the original die is made in two identical halves, separated as a completed unit by a match-plate that is perfectly smooth on both sides. The two halves are linked with dowel pins extending through the match-plate. The liquid mercury is poured into the two die halves. When the material is frozen, the die is opened and the match-plate removed. Then the two sides of the die, aligned by dowels, are placed together, bringing the opposing smooth surfaces of the two halves of the frozen mercury pattern into a face-to-face contact.

When the halves are in contact, a slight squeeze or a gentle tapping against the die is enough to cause the frozen mercury to weld its surfaces to and unite the two halves into a single pattern.

"Booking" is not limited to the joining of two frozen sections only. Patterns have been made with as many as 12 separate "booking" operations producing large and intricate patterns. Lowered assembly and inventory costs could result from use of this process due to the elimination of small parts and the hardware necessary to attach them to larger parts or assemblies.

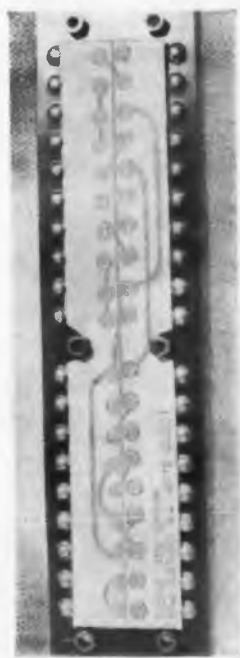


Rectangular Color Tube

This is the first model of a 21" rectangular color tube developed by Allen B. Du Mont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N. J. An experimental unit, it has a metal-cone construction. Development of 21" and 22" tubes with glass envelopes is now in progress.

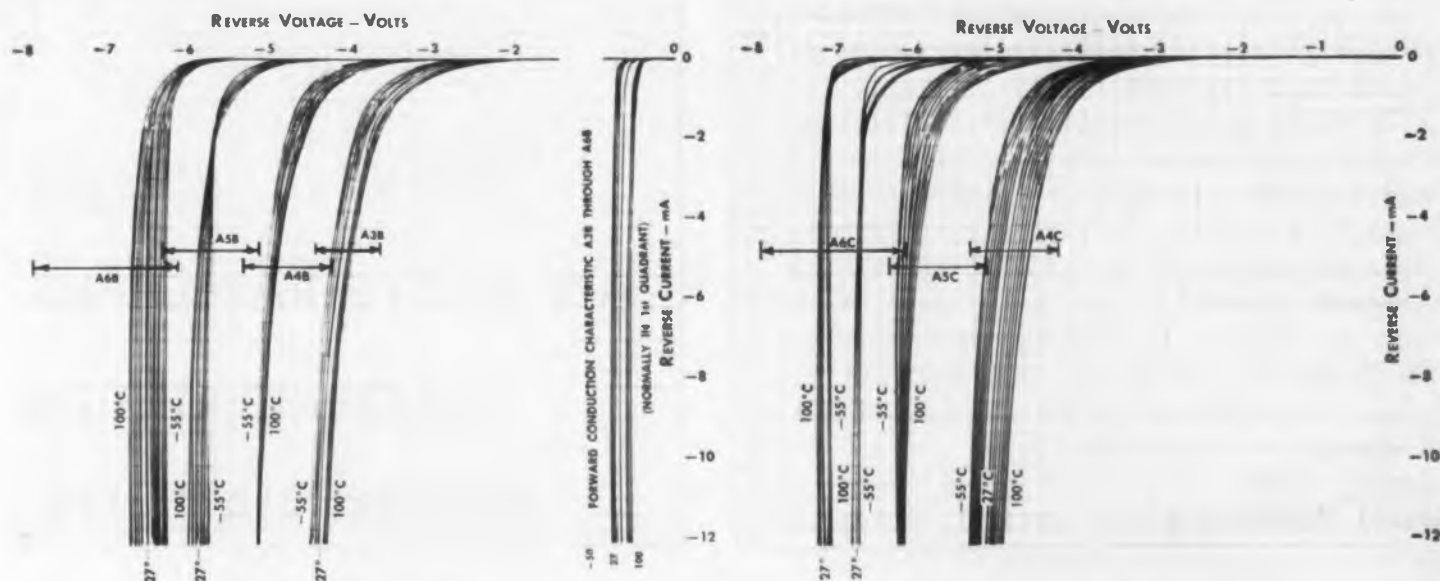
Wiring Aid

Wiring jumper wires to resistor boards is simplified by taping these removable paper wiring templates to the board. This production aid was developed at Martin Aircraft Co., Baltimore, Md.



Electronically Insured Coffee Breaks . . . Radio telephone service is now being used to speed servicemen to inoperative coffee vending machines in one of the latest applications of radio communications to industry. In one instance, a coffee machine was operating again just five minutes after it was jammed. This unique use of radio telephones in service trucks was conceived by Coffee Vending Service of Oak Park, Ill. The method could be profitably applied to other services such as air conditioning repairs.

SILICONDUCTORS*



SAMPLE CURVES: SILICON JUNCTION DIODES:

A3B: 3.7 to 4.5 V @ -5 mA
A4B: 4.3 to 5.4 V @ -5 mA
A5B: 5.2 to 6.4 V @ -5 mA
A6B: 6.2 to 8.0 V @ -5 mA
NO SPECIFICATION LIMITS IMPLIED

SAMPLE CURVES: DOUBLE ANODE DIODES

A4C: 4.3 to 5.4 V @ -5 mA
A5C: 5.2 to 6.4 V @ -5 mA
A6C: 6.2 to 8.0 V @ -5 mA
NO SPECIFICATION LIMITS IMPLIED

LOW VOLTAGE TYPES FOR USE AS VOLTAGE REFERENCE DEVICES

To supply the growing demand for low zener voltage SILICONDUCTORS as voltage reference devices, four new Type numbers are now available in production quantities. The voltage-current-temperature characteristic curve of a typical SILICONDUCTOR of the new Types A3B, A4B, A5B, and A6B are shown above. All diodes of one Type do not have identical curves; these data only demonstrate the general trend from a negative temperature coefficient of zener voltage for the A3B to a positive coefficient for the A6B, with both negative and positive coefficients possible at different current levels among individual diodes of Types A4B and A5B. Note that in the region of intersection between positive and negative temperature coefficients it is possible to realize extremely low coefficients. The forward conduction characteristics shown are typical of all of the A3B to A6B types. If two diodes of these types are conducted in parallel with polarities reversed, they will serve effectively as a limiter at a level of approximately 0.7 volts. Two

diodes in series with opposite polarities will clip or limit at a level corresponding to their Zener breakdown characteristics.

Our types A3C through A6C are effectively two diodes in series in the same size envelope used for normal diodes. Besides being useful as balanced limiters, they also are applicable as voltage reference units. Note that the voltage-current-temperature curves shown above for one of the A6C types shows a low temperature coefficient combined with low dynamic or ac impedance at a current level of only 3 mA.

Application engineers will find it possible to make many interesting series combinations of units having temperature coefficient of opposite sign so that they tend to cancel. NATIONAL SEMICONDUCTOR PRODUCTS expects to offer shortly one or two additional Types which will carry firm specification limits on dynamic impedance and temperature coefficient.

SILICONDUCTOR TYPE NO.		REVERSE VOLTAGE RANGE @ 5.0 mA OF BACK CURRENT
Single Anode	Double Anode	
A3B	A3C	3.7 to 4.5 Volts
A4B	A4C	4.3 to 5.4 Volts
A5B	A5C	5.2 to 6.4 Volts
A6B	A6C	6.2 to 8.0 Volts
Maximum dissipation 150 mW @ 25°C Derate 1mW per °C. 150°C max. ambient		

All of the above Types are available in production quantities, in addition to SILICONDUCTORS 1N200 to 1N222 inclusive with maximum reverse working voltage ratings to 470 volts.

NATIONAL SEMICONDUCTOR PRODUCTS

DIVISION OF NATIONAL FABRICATED PRODUCTS, INC.

930 PITNER AVENUE

DAVIS 8-0800

EVANSTON, ILLINOIS

CIRCLE ED-6 ON READER-SERVICE CARD FOR MORE INFORMATION

Engineering Review . . .

Miniature Receiver . . . A newly developed miniature radio can receive either a-m or f-m signals over its reception range. Weighing less than 5oz, it is designed for use over the standard f-m range of 88 to 110Mc, but this range can be easily expanded to 20 to 174Mc.

By means of its circuitry, the receiver automatically discriminates the f-m signal or demodulates the a-m signal, as needed, without requiring any action by the listener. The earphone is a hearing-aid type, and the 3" antenna sticks out of the 3" x 2-1/4" x 3/4" case. Developed by Richard R. Florac, Ultra-Miniature Electronics Co., 246 E. 46th St., New York 17, N. Y., the radio utilizes the Raytheon Types 5676 and 6088 subminiature tubes.

Liquid Metal Pump . . . A newly developed pump for liquid metals operates on an electromagnetic principle and thereby does not require any moving parts. Designed to force liquid metal into forms in die-casting, it should have applications in industrial atomic energy installations.

When current is passed through the liquid metal in a direction perpendicular to the magnetic field that surrounds the metal, it produces a force that sets the metal in motion. A pump of this type will effectively pump those fluid metals that have a higher conductivity than the pumping section's walls. Produced by Callery Chemical Co., Callery, Pa., the direction of flow in the pump may be reversed by reversing the direction of the magnetic field. The unit operates on single-phase 60cy power.

Improved Solar Battery . . . The efficiency of the solar battery has been increased by one-third since it was announced (*ED, May, 1954, p. 5*) by Bell Telephone Laboratories, 463 West St., New York 14, N. Y. An efficiency of 6% had been achieved when the semiconductor cell was first demonstrated.

Experimental cells now convert 8% of the radiant energy striking the cell into electrical power. With maximum theoretical efficiency estimated at 22%, Bell scientists hope to gain an efficiency of 10 to 15%. The increase in efficiency has resulted from a reduction in the amount of energy reflected from the silicon wafer's surface and reduced losses inside the p-n junction cell itself.







Soluble Ceramic Coatings . . . Non-brittle ceramic coatings can be applied by spraying to a variety of materials in a new process available for licensing. When a thin sheet of metal is properly coated with a soluble ceramic, it can

NOW . . . FROM AN OUTSTANDING ADVANCE IN SUBMINIATURE GLASS DIODES

GOLD BONDED CONSTRUCTION

which gives superior electrical characteristics has been combined by Transistron with hermetic sealing in glass to produce a subminiature diode with unsurpassed performance.

These diodes offer the following advantages:

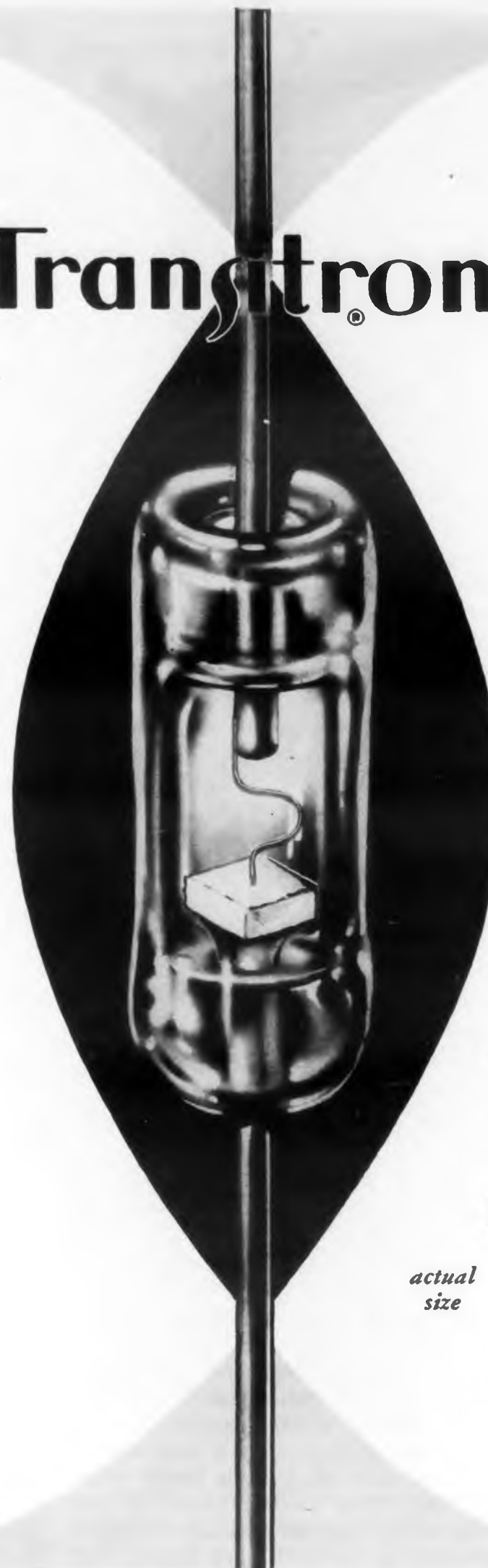
-  — SUPERIOR FORWARD CONDUCTANCE
-  — HIGHER INVERSE RESISTANCE
-  — GREATER RUGGEDNESS
-  — MORE UNIFORM CHARACTERISTICS
-  — GREATER POWER HANDLING
-  — COMPLETE RELIABILITY

All Transistron diodes must pass rigid tests, including shock, vibration, and temperature and humidity cycling between +135°C and -78°C. Strict conformance to all specifications is insured through 100% final electrical testing.

T.

"The MARK of Quality in Electronics"

Transistron[®]



actual
size

CIRCLE ED-7 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1954

WHAT IS GOLD BONDING?

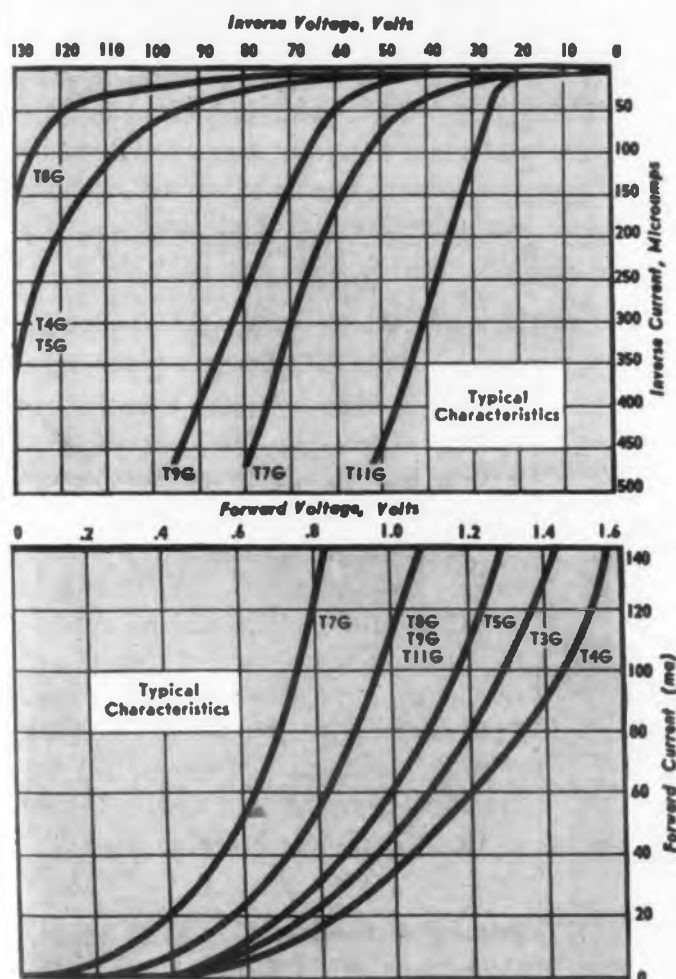
Gold bonding is a process in which a gold whisker is alloyed by low temperature fusion to germanium. At the contact point both the whisker tip and the germanium are melted to form a eutectic alloy. This results in a rectifying subminiature P-N junction. Because the gold wire is dead soft, pressure cannot be transmitted, and mechanical isolation of the junction is achieved. Permanent electrical and mechanical stability is thus assured.

In contrast, the point contact "welded" diode uses a firm whisker wire such as tungsten or platinum ruthenium which does not alloy with the germanium in the forming process. Therefore, rectification depends upon the pressure of the whisker on the germanium. Variations in this pressure can cause variations in diode performance.

WHY ARE GOLD BONDED DIODES BETTER?

Electrically they are many times superior. The subminiature P-N junction formed at the bond provides electrical characteristics that approach those of an ideal diode. The typical Transitron diode offers forward conductance averaging more than five times higher than point contact types. In addition, types such as the T8G feature more than 100 milliamperes forward at +1 Volt, and over 5 megohms at -100 Volts inverse.

Mechanically they are more rugged. The eutectic alloy bond between the gold whisker and the germanium has a strength that is equal to that of the whisker itself. It is virtually impossible to affect the performance of these diodes by shock or vibration.



HIGH CONDUCTANCE DIODES

SPECIFICATIONS (At 25°C except as noted)

TYPE	Forward Current at +1V (ma Min.)	Inverse Current at Specified V (ua Max.)	Max. Inv.† Voltage (Volts)	DESCRIPTION
T7G	200	100 @ -50V	75	200 MA TYPES
T25G	200	20 @ -10V	25	
T8G	100	20 @ -100V	125	100 MA TYPES
T9G	100	5 @ -10V	75	
T11G	100	2 @ -10V	35	
T6G	100	200 @ -20V	35	
T5G	40	100 @ -100V	125	40 MA TYPES
1N100A	40	50 @ -50V	100	
1N98A	40	5 @ -5V	100	
1N118A	40	100 @ -50V	75	
T2G	40	300 @ -50V	75	
T13G	40	2 @ -10V	25	
T14G	40	5 @ -10V	25	
1N99A	20	50 @ -50V	100	20 MA TYPES
T3G	20	5 @ -5V	75	
1N97A	20	50 @ -50V	100	
1N117A	20	8 @ -5V	75	
T12G	20	100 @ -50V	75	
	20	500 @ -50V	75	

HIGH RESISTANCE DIODES

1N55B	5	500 @ -150V	190	100 VOLT TYPES
T8G	100	20 @ -100V	125	
		5 @ -10V		
T5G	40	100 @ -100V	125	50 VOLT TYPES
T4G	5	100 @ -100V	125	
T9G	100	20 @ -50V	75	10 VOLT TYPES
		2 @ -10V		
1N67A	5	50 @ -50V	100	
T3G	20	50 @ -50V	75	20 VOLT TYPE
T11G	100	20 @ -20V	35	
T13G	40	2 @ -10V	25	10 VOLT TYPES
T14G	40	5 @ -10V	25	
1N128	5	10 @ -10V	50	

HIGH TEMPERATURE DIODES

T18G	20	125 @ -50V	50	ALL SPECIFICATIONS AND RATINGS ARE AT 75°C
1N198	5	250 @ -50V	50	
T19G	200	75 @ -10V	40V RMS	(T20G at 75°C is electrically equivalent to 1N34A at 25°C)
T20G	20	180K avg. @ 40V RMS	50	
		500 @ -50V		
		30 @ -10V		
T21G	20	50 @ -20V	25	ALL SPECIFICATIONS AND RATINGS ARE AT 60°C
T22G	40	20 @ -10V	15	
T23G	20	200 @ -50V†	50	
T24G	20	300 @ -30V‡	35	

COMPUTER DIODES

T15G	125	500K between -20 and -90V	125	Inverse Recovery Time Tested.
T16G	40	500K between -10 and -50V	75	
1N191	5	400K between -10 and -50V	75	Forward and Inverse Recovery Time Tested.
1N192	5	200K between -10 and -50V	75	
		@ 55°C †		Inverse Recovery Time Tested.
		@ 55°C ‡		
T7G	200	100 @ -50V	75	LOW IMPEDANCE FAST FORWARD SWITCHING TIME. (These types are particularly useful for magnetic core switching)
T25G	200	20 @ -10V	25	
T11G	100	20 @ -20V	35	
T6G	100	200 @ -20V	35	

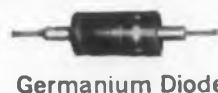
JAN TYPE DIODES

1N126	5	800 @ -50V	75	The above is a partial list of available types. Send for complete details in Bulletin T1319.
1N127	5	50 @ -10V	125	
		300 @ -50V		
		25 @ -10V		
		10 @ -10V		
1N128	5	250 @ -50V	50	
1N198	5	75 @ -10V		

ADDITIONAL SPECIFICATIONS

Ambient Temperature Range -78°C to +90°C
 Absolute Maximum Storage & Handling Temperature Range -78°C to +150°C
 Avg. Power Dissipation @ 25°C 80 Milliwatts
 Derating above 25°C 10mw/10°C
 Average Shunt Capacitance 0.5 uufd
 † Measured at 0.1 Watt
 ‡ Measured with 60 CPS sweep.

Transitron electronic corporation • melrose 76, massachusetts



Germanium Diodes



Transistors



Quads



Silicon Diodes



Power Transistors

CIRCLE ED-7 ON READER-SERVICE CARD FOR MORE INFORMATION

be moderately bent, twisted, or even elongated without apparent damage to the coating. The highly adherent coatings have possible uses as insulations and protective coatings for resistor wire and tape, capacitors, and other electronic components and hardware.

Many different "solution ceramics" have been developed by Armour Research Foundation, Illinois Institute of Technology, 10 W. 35th St., Chicago 16, Ill. The coatings most intensively studied so far are refractory metal oxides such as zirconia, chromia, titania, ceria, and magnesia. Certain phosphates, silicates, fluosilicates, oxyhalides, and even metals can be deposited, and two or more materials may be co-deposited or applied in separate layers.

For most of the solutions tested, the temperature of the material onto which the solution is sprayed is 400 to 700°F, but adherent coatings have been obtained at temperatures as low as 300°F and as high as 1200°F. There is reason to believe that some ceramics can be deposited from chilled solutions at room temperatures.

Since solution ceramics are deposited from true solutions, the rate at which they are applied can be controlled accurately to produce extremely thin coatings. Coatings only a few millionths of an inch thick have been used to separate magnetic laminates without significantly increasing their packing factor.

Fiftieth Anniversary . . . The 50th anniversary convention of Eta Kappa Nu, electrical engineering honor society, was held at the University of Illinois, Urbana, Ill., on October 15 and 16. Founded in 1904, the association now includes nearly 23,000 members. Dr. Jesse E. Hobson, director of Stanford Research Institute and national president of Eta Kappa Nu, delivered the keynote address on the need for technical manpower in the United States.

Automatic Offices . . . Electronic mechanization of clerical work in offices will be the greatest growth area of electronics in the coming ten years, according to William J. Morlock, General Manager, Commercial Equipment Dept., General Electric Co., Syracuse, N. Y.

In his address before the Engineering Dept., RETMA, and the Professional Groups Committee, IRE, at Syracuse on October 19, Mr. Morlock also said that sales of electronic equipment, exclusive of military gear, is expected to increase to five million dollars yearly in the next ten years. He predicted that industrial electronic equipment would account for over half of the commercial sales, and marketing research indicates that this field will expand 700% while the older fields of electronics will expand 50%.



SMALLER AND LIGHTER: typical unit from new line of General Electric subminiature transformers weighs 30 grams, is 1 1/8 in. high.

GENERAL ELECTRIC ANNOUNCES . . .

New line of subminiature transformers tailored to meet customer requirements

Wide range of ratings available in five matching case designs, 1-1/8" to 1-7/16" high

General Electric is now producing subminiature transformers to meet the wide variety of applications found in the electronic industry. As a result of our continuing program of research and development, G.E. has extended the new subminiature transformer sizes downward to serve the range of equipments utilizing printed circuits.

G-E engineers, with their extensive research and development facilities, have successfully designed units for guided missiles, servo-mechanisms, and computing systems, as well as printed circuits.

Metal-clad and hermetically sealed, the new subminiature transformers can be designed to withstand high potential test voltages of 1000 volts d-c. They are capable of operating in ambient temperatures of 125°C. and at altitudes up to 70,000 feet above sea level.

Other outstanding features:

Rectangular cases reduce cubic volume and weight to a minimum.

Base dimensions neatly fit chassis punched for standard tube sockets.

Uniform case designs enhance chassis appearance.

Compression glass bushings withstand severe thermal shock.

Hook-type terminals make installation easier.

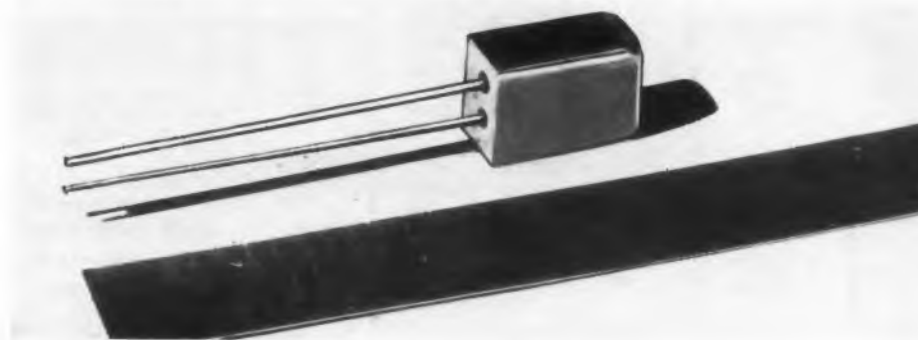
Tin dip provides better protection against corrosion.

Experienced G-E engineers are eager to accept the challenge to produce the subminiature transformer you specify. For additional information call upon your nearest G-E Apparatus Sales Office. General Electric Company, Schenectady 5, New York.

412-116

Approximate case dimensions in inches

Height	Width	Depth	Case Designation	Tube Socket Punch
1 1/8	1/8	3/8	BD	(For printed Circuit Applications)
3/8	1/8	1/8	BE	Miniature
1 1/4	3/4	3/4	AF	Noval
1 7/8	1 1/8	1 1/8	BG	Noval
1 3/4	1	1	AG	Octal



SMALLEST UNIT, designed for printed circuits, has solid wire conductors two inches long for easy, direct connection to the other components.

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GENERAL  **ELECTRIC**

Engineering Review . . .

Engineering Talent . . . Many of the Naval Reserve officers being released to inactive duty for budgetary reasons have valuable engineering and technical experience. Among a group of 860 officers being released in the Chicago area, 43 have electronics training, 50 have manufacturing experience, 18 were once draftsmen, 14 have mathematical and statistical backgrounds, and 4 are metallurgists. Interested employers can contact the Chief of Naval Air Reserve Training, Naval Air Station, Glenview, Ill., for the names, addresses, and resumes of these officers.

Ultrasonic Machining . . . By subjecting a brass or unhardened steel cutting tool to ultrasonic vibration, it can be used to cut materials as hard as tungsten carbide in a newly developed machining method known as "impact grinding". The tool is vibrated at 25,000 strokes per second.

In use, the tool is lowered until it is lightly in contact with the surface of the work. An abrasive suspended in liquid is flowed over the work in a continuous stream. The tool, moving up and down at high speed, drives the abrasive particles into the work. Owing to the great deceleration, the particles strike the material being cut with forces up to 10,000 times their normal weight, cutting it away.

Dimensions can be controlled to within half of one-thousandth of an inch, and finishes may be measured in microinches. Developed by Raytheon Manufacturing Co., Waltham 54, Mass., the method can be applied to alnico, quartz, optical glass, and precious and semi-precious stones. The work material need not be electrically conductive. The method has been incorporated in a device known as the "Ultrasonic Machine Tool."

Record Attendance . . . A record attendance of 7323 was recorded at the tenth annual National Electronics Conference held from October 4-6 at Chicago, Ill. Eighty-six technical papers were presented, and there were 158 exhibition booths.

◀ CIRCLE ED-9 ON READER-SERVICE CARD

Irradiated Plastic . . . By exposing polyethylene to radioactive bombardment in a newly developed process, the modified plastic is able to withstand temperatures as high as 350°F. Other improved characteristics of the irradiated plastic, which is known as "Agilene-HT", are tensile strength, elongation, and solvent resistance.

The modified polyethylene will be made available to the electrical, chemical, and food industries by American Agile Corp., 5461 Dunham Rd., Maple Heights, Ohio. Another method of producing irradiated polyethylene utilizes high-energy cathode rays from million-volt electron guns (*ED, April, 1954, p. 6*).

Linear Accelerator . . . A 15-million electron-volt travelling wave linear accelerator has been completed for use in medical research and treatment. Produced by Mullard Research Laboratories, Salfords, Surrey, England, it will be installed at the Physics Dept. of St. Bartholemew's Hospital College, London, England.

In the device, short bursts of electrons are projected from a high-voltage electron gun at a velocity of 0.4 times the speed of light into an evacuated waveguide of special design. The electrons are then accelerated by the electrical field produced by v-h-f waves fed into the waveguide from a magnetron. Leaving the waveguide at very nearly the speed of light, the electrons will be turned 90° by a magnetic field to strike either X-ray or neutron targets or the patient.

Acquired for therapeutic purposes, the accelerator will be used entirely during the next few years for research on the effect of radiation on living tissue and to determine the best methods of treating cancer. This instrument is the second 15Mev machine produced by Mullard. The other accelerator is used for nuclear physics research.

Selenium Rectifiers . . . Selenium rectifiers that show no indication of failure or decrease in output after more than 1000hr at 150°C are now being built experimentally by Bradley Laboratories, Inc., 168 Columbus Avenue, New Haven, Conn.

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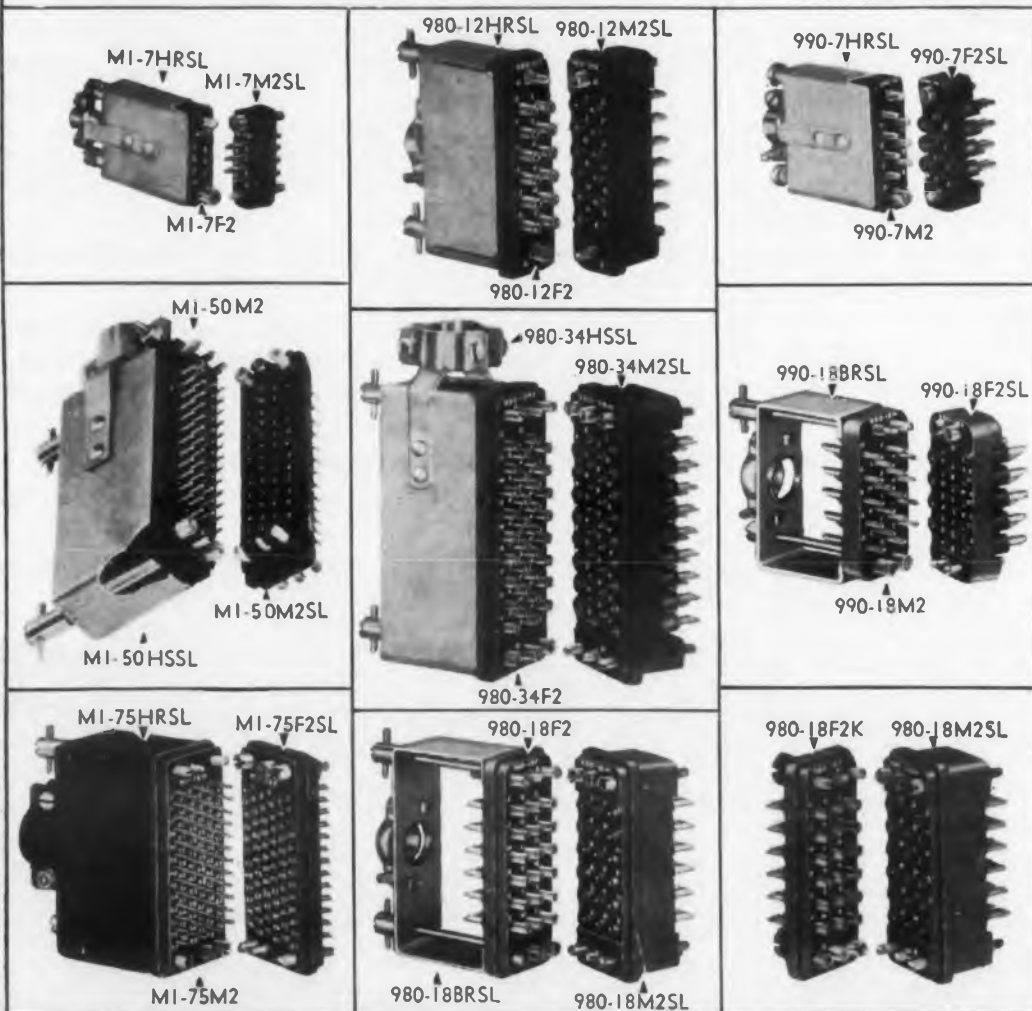
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YOU NO LONGER NEED A STRONG MAN TO PLUG IN OR PRY APART MULTI-CONTACT CONNECTORS

USC's NEW DOUBLE LEAD SCREW LOCKING CONNECTORS[†] PROVIDE EASY AND SPEEDY ENGAGEMENT AND DISENGAGEMENT WITH MAXIMUM PROTECTION OF CONTACTS AND POSITIVE LOCKING UNDER VIBRA-SHOCK CONDITIONS.

† PAT. APPLIED FOR



- *Preserves performance of sensitively adjusted contacts
- *Accessibility to wire junctions with simple disassembly of hood
- *Insured electrical and mechanical performance
- *No limitations on number of contacts
- *Vibrashock hood construction
- *Screw Lock Hood Assembly independent of connector

AVAILABILITY

MI-SL series (Miniature)
AVAILABLE 7, 14, 18, 20, 21, 26, 34, 41, 50, 75 contacts

980-SL series (Power)
AVAILABLE 12, 18, 24, 34 contacts

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AVAILABLE 7, 10, 15, 18 contacts



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Engineering Review . . .

Magnetic Recording Standards . . . Four sub-committees to study standardization problems and recommend procedures to be adopted have been set up by the Standards and Engineering Committee of the Magnetic Recording Industries Association, 444 Madison Ave., New York, N. Y.

Specific standardization problems to be studied are the general order of procedure to be adopted in setting standards and cooperation with allied organizations; a preliminary survey of playback standards for all tape speeds; review of the status of dimensional specifications, tapes, and reels; and investigating the preparation of industry wide standards on recording heads and track placements.



Repackaged Radar

As part of a program to reduce the weight of jet aircraft, the 172 lbs of radar gear in the foreground were repackaged into the 136-lb unit shown beside Edward H. Heinemann, Chief Engineer, El Segundo, Calif., Division, Douglas Aircraft Co., Inc.

Tactical TV Demonstration . . . A demonstration of the recently developed battle-control TV system of the Signal Corps (*ED*, p. 9, June, 1954) was held recently in which cameras were mounted in an airplane as well as on mobile units. High-ranking officers and industrialists in a command post observed the signals from each camera scanning a simulated amphibious and armored attack at Fort George G. Meade, Md.

Each of the monochrome cameras fed back to its transmitter mounted on a 3/4 ton truck. From each truck the signal was transmitted by microwave relay

to a larger monitoring truck located near the command post. Two cameras were mounted in an L-20 reconnaissance plane. One was fixed to cover terrain directly below the plane, and the other was flexibly mounted to permit oblique views of the surrounding areas. The signals from these airborne cameras were transmitted directly to the monitoring truck. Two-way radio facilities permitted instructions to be sent from headquarters or the monitoring truck to the camera locations.

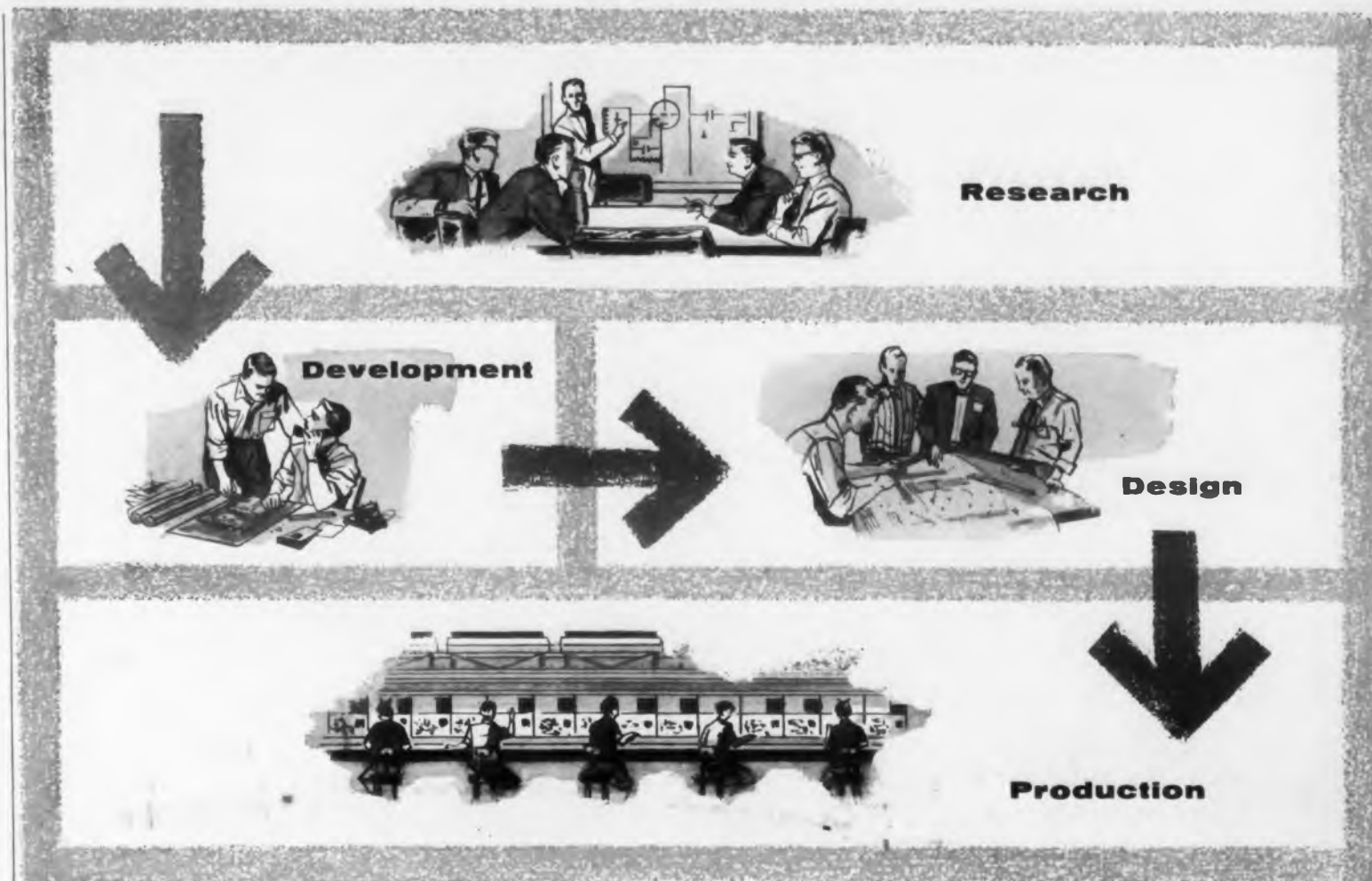
During the action, carried out by units of the 3rd Armored Cavalry Regiment, the combat cameras on the ground followed a tank-infantry attack across open terrain, followed troops on a water crossing, and covered a skirmish and an assault on a fortified position at the beachhead. During one stage in the action, an "enemy" officer was captured and brought before a camera for interrogation as the regimental intelligence officer watched and interpreted the information at the command post. The airborne cameras followed the progress of the attack and spotted "enemy" concentrations. The television equipment employed was supplied by the Radio Corporation of America, 30 Rockefeller Plaza, New York 20, N. Y.

To demonstrate the usefulness of color TV for this purpose, a phase of the action was covered by color TV cameras of the National Broadcasting System for a nationwide color telecast that was viewed at the White House and the Pentagon. A comparison of the monochrome and color images showed that observers were able to distinguish more clearly the nature of the foliage and terrain and were able to follow more easily the movement of troops and equipment in wooded areas by means of the color broadcasts.



"Loopless" Direction Finder

The knob-like antenna on this direction-finder radio replaces the usual loop. The antenna projects only 2". Made by Raytheon Manufacturing Co., Waltham, Mass., this portable radio weighs only 13 lb with batteries. A boat owner can take fixes on standard broadcast or special "beacon" transmitters by means of this unit.



AN INTEGRATED ELECTRONICS OPERATION

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 Counter Measures
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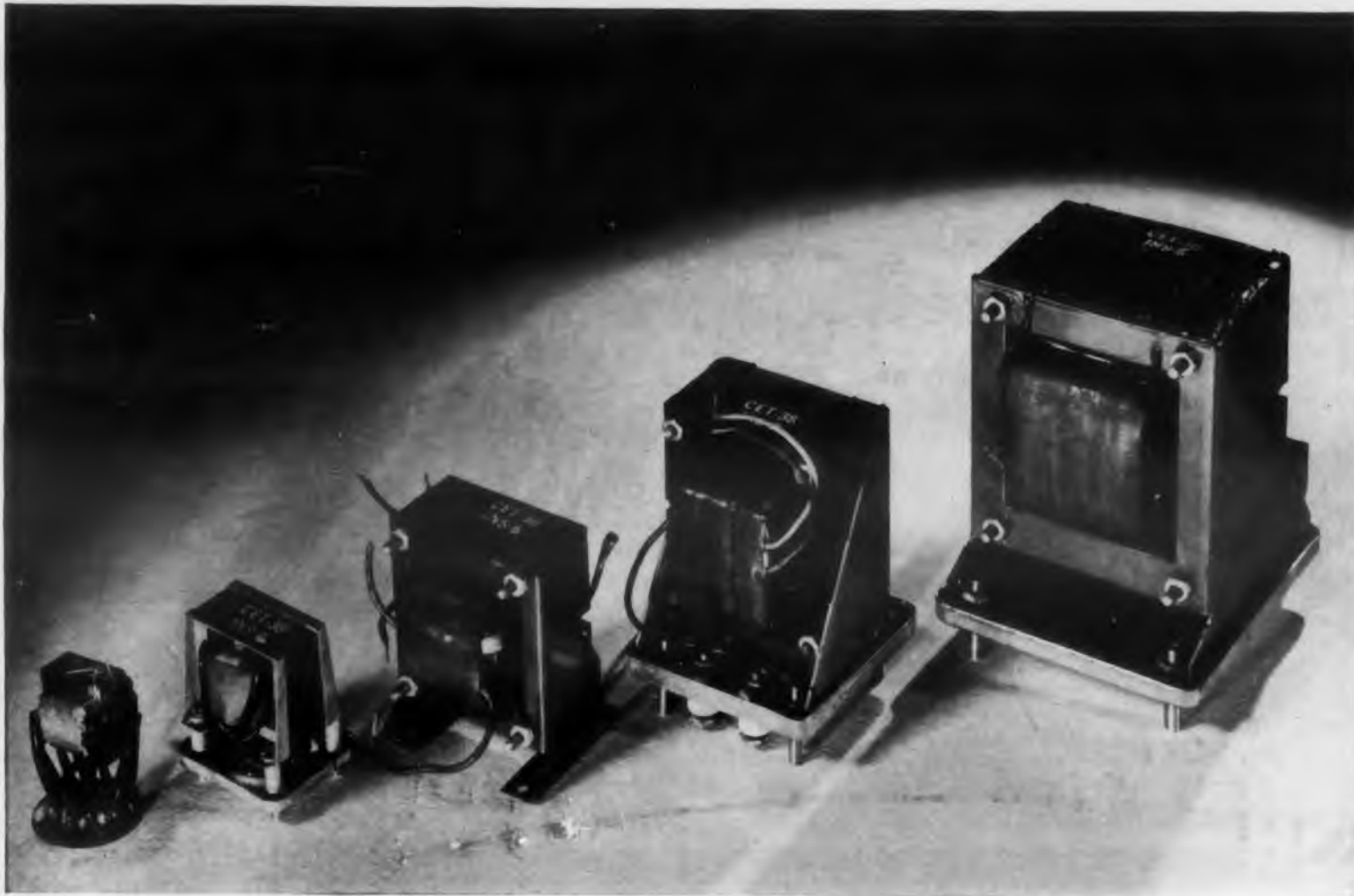


Hoffman's reputation for getting things done is due, in part, to the unification of Research-Development-Design-Production into one closely integrated electronics operation. At Hoffman — instead of the usual four completely separate operations — one technical director is assigned to co-ordinate each new project from start to finish. Every new project is developed in close cooperation with the divisions ahead, including the practical problems of quantity production. This integration practically eliminates the all-too-common duplications and overlapping of functions, the errors and re-work caused by poor liaison, and materially cuts down the usual time lag between the testing of the prototype and actual production. Hoffman has become a leader in electronics by doing progressively complex jobs — to specifications — to cost estimates — and on schedule.

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A Transformer becomes a precision device with Allegheny Magnetic Materials in the core



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84 pages of valuable technical data on standard and custom-made laminations from all grades of Allegheny Ludlum magnetic core materials. Prepared from carefully checked and certified laboratory and service tests —includes standard dimensions, specifications, weights, etc. Sent free on request . . . ask for your copy.

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- ★ ALLEGHENY SILICON STEEL
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The operation of a transformer is no better than the magnetic core around which it is built. With Allegheny magnetic materials in the core, you get the *best*—uniformly and consistently.

Sure there are reasons why! For one thing, there's the long experience of a pioneer in development and quality control of electrical alloys. But most important, the A-L line offers complete coverage of any requirement you may have, any service specification. It includes all grades of silicon steel sheets or coil strip, as well as Allegheny Silectron (grain-

oriented silicon steel), and a wide selection of special high-permeability alloys such as Allegheny 4750, Mumetal, etc.

In addition, our service on magnetic materials includes complete lamination fabrication and heat treatment facilities. What's more, this extensive experience in our own lamination stamping department is a bonus value for all users of A-L electrical sheets or strip. ● Let us supply *your* needs. *Allegheny Ludlum Steel Corporation, Oliver Bldg., Pittsburgh 22, Pa.*

STEELMAKERS to the Electrical Industry
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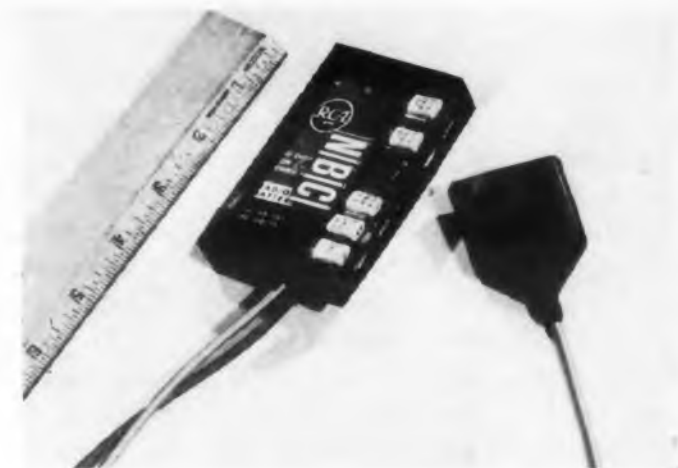


Engineering Review . . .

"Wireless" Microphone . . . Microphone booms and cables in TV studios have been made obsolete by the transmitter-microphone illustrated below. Hidden in the performer's costume, the transistorized assembly permits complete freedom of movement.

The transmitter's antenna is worn around the performer's waist, and the signal is picked up by a loop encircling the stage area. The signal is then demodulated for broadcast in the usual manner. The transmitter incorporates eight transistors, and it is powered by an alkaline battery. The assembly was developed by the National Broadcasting System, division of Radio Corp. of America, 30 Rockefeller Plaza, New York, N. Y.

The dimensions of the transmitter shown are 5/8" x 2" x 3-3/4". It develops about 50mw of power at approximately 530kc, but radiates less than 100-micromicrowatts.



Automatic Transformer Production . . . Transformer coils can be produced automatically by a new method of slicing rolls of metal foil and insulating paper into thin wafers. The technique was evolved by the Lighting Division Laboratories of Sylvania Electric Products, Inc., at Ipswich, Mass., at the request of the United States Air Force.

The wafer-type transformer coils are made by rolling together wide sheets of very thin metal foil and similarly thin sheets of insulating paper. The rolls are then sliced into thin wafers resembling miniature life preservers. For audio applications, a core is inserted in the hole, but at radio frequencies, the wafer can be the complete transformer. The technique can also be used also to make inductive elements.

Printed Circuit Inventor Honored . . . The British Institution of Radio Engineers has presented its Marconi Award to Dr. Paul Eisler, noted Austrian-born British physicist and the inventor of the "Technograph" process of printing electrical circuits. Dr. Eisler heads the Research Laboratories of Technograph Printed Circuits, Ltd., London, England.

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CIRCLE ED-398 ON READER-SERVICE CARD ➤

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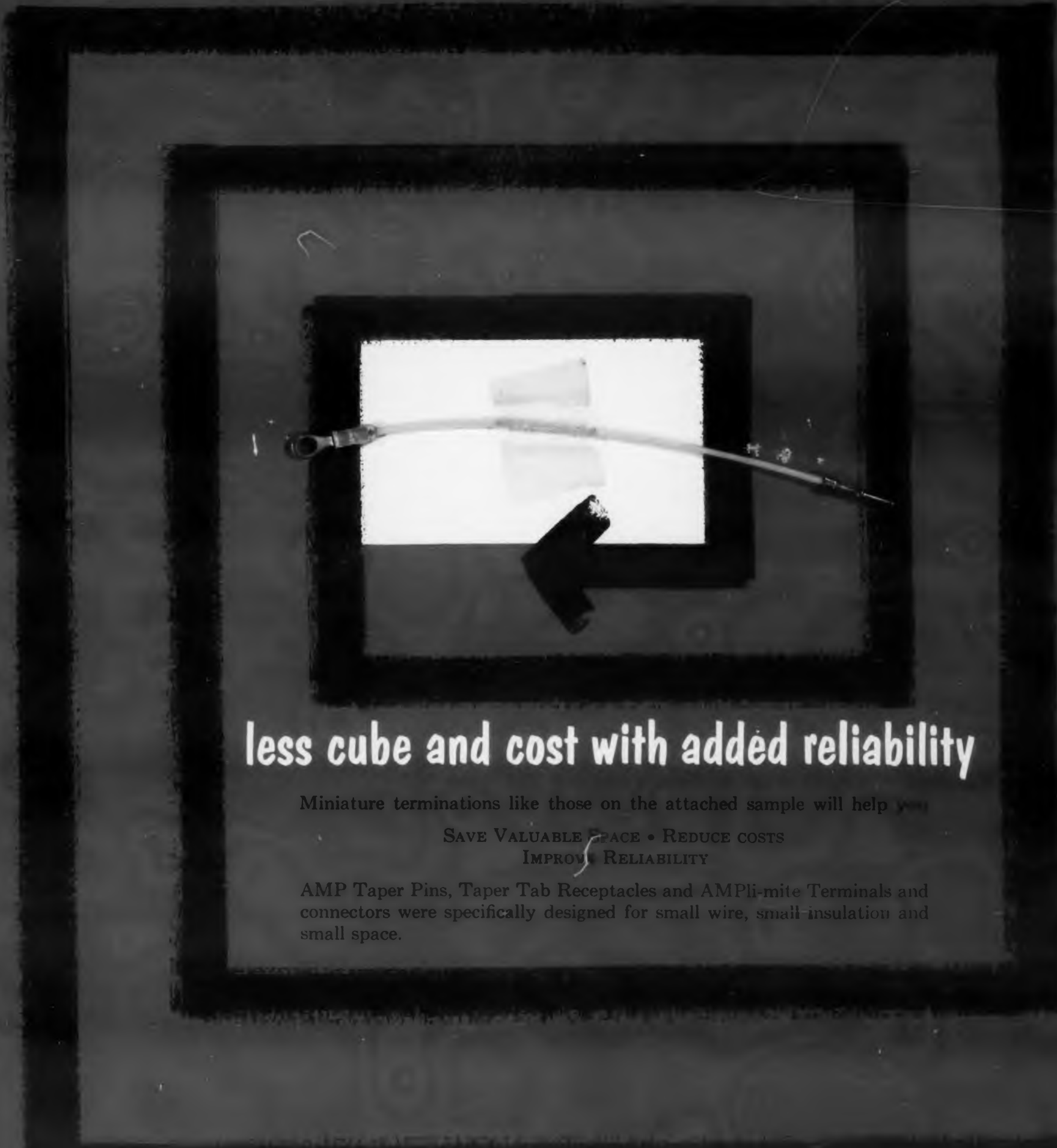
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AMP Taper Pins, Taper Tab Receptacles and AMPli-mite Terminals and connectors were specifically designed for small wire, small insulation and small space.

ABOUT THE SAMPLE:
The gold plated AMP Taper Pin is for AWG 24-22. On the other end is a P.I.D.G. Ring Tongue terminal for 26-22 wire.

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Photo courtesy of International Business Machines Corp., manufacturers of Electronic Business Machines.

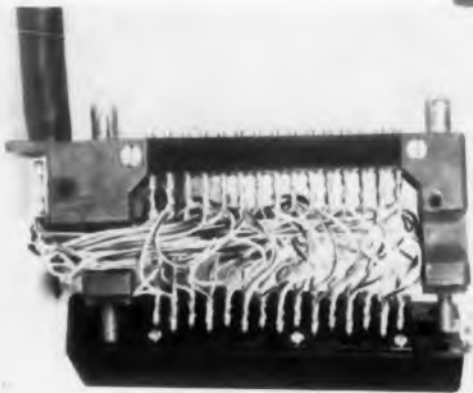


Photo courtesy of Stromberg Carlson, manufacturers of Commercial Electronic and Telephone equipment.



Photo courtesy of Remington-Rand Inc., manufacturers of electronic business machines.



Photo courtesy of Glenn L. Martin Co., manufacturers of aircraft and missiles.



AMP wire terminations are available for both smaller and larger wires—from #26 through 600 MCM. The new AMPli-mite and Taper Terminations for small wires provide the same ultra-reliability as our large terminals and connectors.

AMP also provides many special services to help you with design and production problems. One of these is AMP's Creative Approach to better wiring survey. AMP Consulting Engineers are available to you without cost or obligation.

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Find out about the New AMP "CREATIVE APPROACH TO BETTER WIRING"



An evaluation survey without cost or obligation.

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Photo courtesy of Reeves Instrument Corp., manufacturers of electronic analog computers.



Photo courtesy of E.R.A., manufacturers of electronic computers equipment

Color Measured Electronically . . . Colors of leather samples can be accurately reproduced in mass production of leather by means of a newly developed electronic instrument known as the "Hunter Color and Color-Difference Meter". The device is far more accurate than the human eye.

Technically the meter is a tristimulus colorimeter, measuring color on three scales that give uniform measures of the visual perceptibility of differences between colors. The apparatus is divided into two parts. The upper part is the exposure unit containing a light source and the means for viewing specimens with different photocells. The lower part is a measuring unit containing electronic instruments and other components for recording the values of the photocell current based on scales proportional to color.

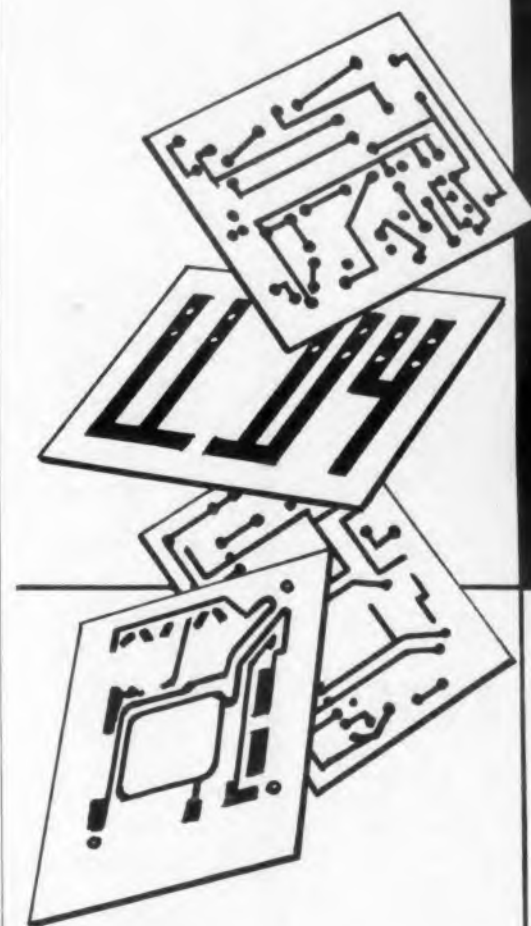
The meter is not only used by the Ashtabula Hide and Leather Company to match samples, but also during the production run to insure uniformity. The formula for color difference is based on the unit of color difference devised at the National Bureau of Standards, Washington 25, D. C. The meter itself is produced by Henry A. Gardner Laboratory, Inc., Bethesda, Md. In addition to this application, the color-difference meter could conceivably be employed in the textile, printing, and paint industries.

Process Redesign Tester . . . An electronic testing system that will permit engineers to estimate the effect of the addition of new equipment to an industrial operation without actually test-installing such equipment has been developed by Industrial Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa.

Known as servo analyzer, the new system automatically translates behavior characteristics of equipment into a chart record. This record, in turn, is analyzed to determine how such a component will affect the over-all behavior of the operation. It is claimed that the new system can save 30 to 60% of the research time involved in redesigning a process.

In operation, the system puts a control or a group of controls into an operating situation to see if they perform correctly when specific conditions are altered. This is accomplished by automatically introducing a rhythmic change into a process. The analyzer then automatically measures and plots the results. It can test a unit in as little as eight minutes.

The system, which is portable, is made up of four components, a signal generator, a potentiometer, a control box, and a function plotter. It provides three forms of test energy: pneumatic, mechanical, and electrical. In addition to measuring frequency response characteristics of servomechanisms, piping, tanks, valves, actuators, and control instruments, the analyzer is also used for analog tests and in the development of precision controls, pipelines, refineries, air foils, and jet engine components. This instrument could find wide application in field tests, in addition to its obvious use in the design laboratory.



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and T-812
plastic laminates**



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INSUROK T-725 and T-812 have high physical strength and low cold flow, and are readily punched into intricate shapes. Richardson also furnishes copper-clad INSUROK in many other grades, in addition to T-725 and T-812.

Experienced Richardson engineers will gladly assist you in the selection and application of copper-clad INSUROK . . . write or phone your nearest Richardson sales office today.

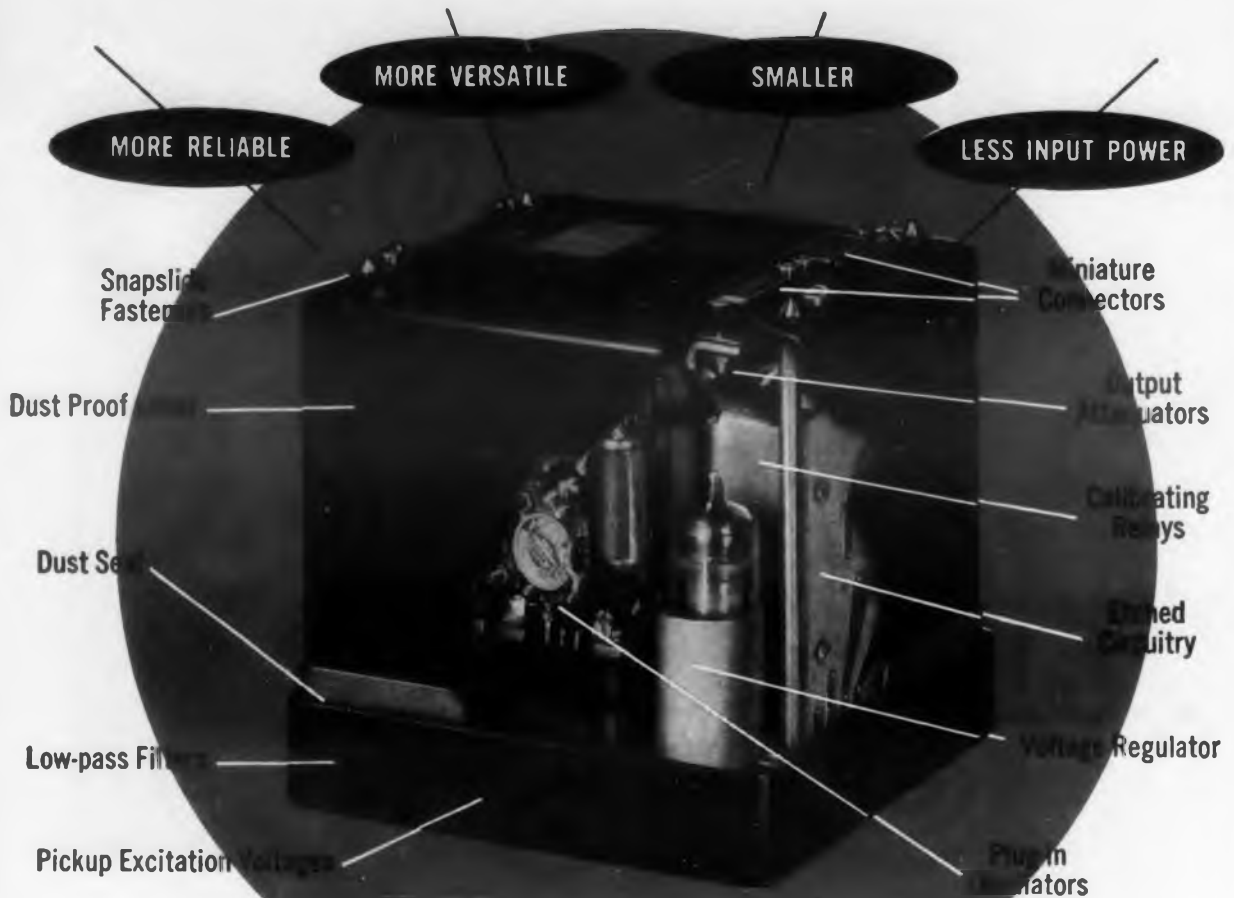
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A NEW TELEMETER STANDARD



BENDIX-PACIFIC TATP-4 & 5 PACKAGES

These compact Bendix-Pacific Telemetering Packages offer users of telemetering systems a better means to instrument such quantities as pressure, force, temperature, voltage, acceleration and vibration.

The units are smaller and various combinations may be used to provide compact multi-channel systems of up to 18 subcarrier bands. Each unit operates on unregulated +150 VDC and 28 VDC since it contains its own voltage regulating circuits. Each unit may be provided with individual relays for switching oscillator inputs from signal to calibrate position. Model TATP-4 contains four and Model TATP-5 contains six separate and independent regulated +5 VDC excitation voltage

pickups for use with resistance type pickups.

No vacuum tubes are required in mixing the outputs of the individual subcarrier oscillators to the composite audio signal for direct modulation of the RF transmitter, thus greatly improving the reliability of the system at a point where a tube failure would affect all subcarrier channels.

Standard Bendix Model TPP-6 Power Supplies are available to handle from one to three of these telemeter packages plus a 2 watt crystal controlled RF transmitter. Many types of interchangeable subcarrier oscillators are also available. RF amplifiers are available for increased power outputs up to 100 watts.

CHARACTERISTICS

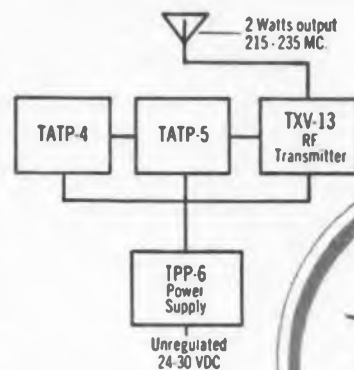
	TATP-4	TATP-5
No. of bands	4	5
Subcarrier bands	1.7 kc. to 70 kc.	1.7 kc. to 70.0 kc.
Oscillator Types	TOE-30V, TOE-31V, TOR-8V, TOR-9V, TOL-9V	Same as TATP-4
Input Voltages	5, 12, or 24 VDC $\pm 10\%$ 150 VDC $\pm 10\%$ 5%	5, 12, or 24 VDC $\pm 10\%$ 150 VDC $\pm 10\%$ 5%
Weight (Less Oscillators)	Approx. 2 lbs.	Approx. 3 lbs.
Dimensions	3.0" x 5.0" x 4.5"	3.0" x 7.5" x 4.5"

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The new survey will provide data on research spending and research manpower in every major industry. The Department will seek information on the cost of research performed by the companies themselves and on the amounts spent by companies to purchase outside research. Besides dollar figures, the survey will determine the number of engineers and scientists employed in research.

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Meetings

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

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

November 19-20: *Fall Meeting, Operations Research Society*, Sheraton-Park Hotel, Washington, D. C., For information, write to D. A. Katcher, 7100 Connecticut Ave., Chevy Chase 15, Md.

November 29-December 3: *First International Automation Exposition*, 242nd Coast Artillery Armory, N.Y.C. Write to First International Automation Exposition, 845 Ridge Ave., Pittsburgh 12, Pa.

December 8-10: *Eastern Computer Conference*, Bellevue-Stratford Hotel, Philadelphia, Pa. The theme of the Conference is, "Design and Application of Small Digital Computers". For information, write to Eastern Joint Computer Conference, P. O. Box 7825, Phila. 1, Pa.

December 27-29: *The Society for Industrial and Applied Mathematics* will hold its first national meeting in conjunction with the annual meetings of American Mathematical Society, the Mathematical Association of America, and the Association for Symbolic Logic, Univ. of Pittsburgh. Write to H. W. Kuhn, Dalton Hall, Bryn Mawr College, Bryn Mawr, Pa.

January 17-19: *High Frequency Measurements Conference*, Hotel Statler, Washington, D. C. Sponsored by AIEE and IRE. One-hundred-word abstracts of papers to be submitted should be sent to the chairman of the appropriate session listed as follows: Frequency and Time Measurements, Dr. B. M. Oliver, Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif.; Power and Attenuation Measurements, E. W. Houghton, Bell Telephone Laboratories, Murray Hill, N. J.; Impedance Measurements, Dr. D. D. King, Johns Hopkins Univ., Baltimore, Md.; and Measurements in Transmission and Reception, B. Parzen, Olympic Television and Radio Co., 34-01 38th Ave., Long Island City 1, N. Y. For information, write to AIEE, 33 West 39th St., New York 19, N. Y.

January 20-21: *Printed Circuit Symposium*, University of Pennsylvania, Philadelphia, Pa. Sponsored by the Engineering Dept., Radio-Electronics-Television Manufacturers Association. Tentative subjects of the six sessions are: "Product Design Applications"; "Reliability and Servicability"; "Management Considerations"; "Techniques of Producing Printed Wiring Boards" (panel session); "Printed Components and Components For Use With Printed Wiring"; and "Production Techniques and Manufacturing Methods". Submit papers to and request information from Donald E. Cottle, General Electric Co., Electronics Park, Syracuse, N. Y.

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1AD4	RF Pentode	1.50	.285-.385	1.25	100	45	45	Rg=2meg.	2.8	0.8	2000		0.5
1AG5	Diode-Pentode	1.50	.285-.385	1.25	30	45	45	Rg=5meg.	0.8	0.25	350		0.26
CK512AX	Ampl.-Pentode	1.25	.285-.385	0.625	20	22.5	22.5	Rg = 5meg. Rl = 1meg. Rc2=2.7meg.				37	
CK5676/6050	UHF Triode	1.50	.285-.385	1.25	120	135		-5.0	4.0		1600		
CK5678	RF Pentode	1.50	.285-.385	1.25	50	45	45	Rg=5meg.	0.8	0.22	820		1.2
CK6088	AF-RF Pentode	1.50	.285-.385	1.25	20	45	-1.25	0.65	0.15	625		†10.5	0.7
CK6092	AF Pentode	1.50	.285-.385	1.25	50	45	45	-4.5	1.4	0.4	600	†25	
CK6286	UHF Triode	1.50	.285-.385	1.25	125	67.5		-2.0	6.0		2100		
CK6397	RF Pur. Pentode	1.625	0.40	1.25	125	125	125	-7.5	7.0	1.1	1800		
CK6418	AF Pentode	1.25	.235-.290	1.25	10	22.5	22.5	-1.2	0.24	0.06	300	†2.2	0.42
CK6419	Ampl. Pentode	1.00	.235-.290	0.625	10	15	15	-0.625	Rl = 2.2meg. Rc2=3.3meg.			27	

†Power output — milliwatts

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Design of Optimum Horns for Rectangular Waveguide

by Helmut E. Schrank

Bendix Radio Div., Bendix Aviation Corp.,
Baltimore, Md.

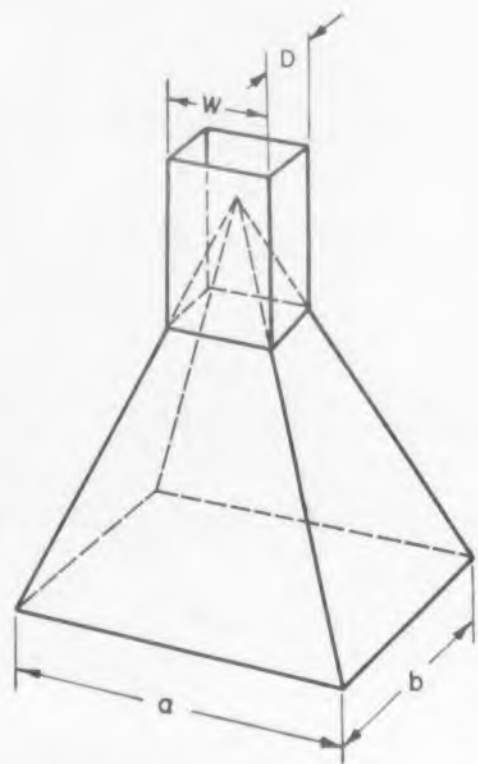


Fig. 1. A true pyramidal horn. The best ratio of a to b does not correspond to standard waveguide proportions.

OPTIMUM design horns are desirable not only for their provision of maximum gain for a fixed horn length, but also because their apparent source of radiation is known to be located at the throat, i.e., in the plane where the flare begins¹. This latter fact, which does not hold for horns in general, is helpful in making accurate gain measurement of the horns after their design and construction.

It can be noted that the available design curves^{2, 3} provide the dimensions of true pyramidal horns, illustrated by Fig. 1. For this type of horn, the ratio of the aperture dimensions a/b must equal the ratio of the waveguide dimensions W/D . The available design curves give a ratio of 1.23 to 1, which unfortunately does not correspond to standard waveguide proportions. Attempts to use the dimensional data

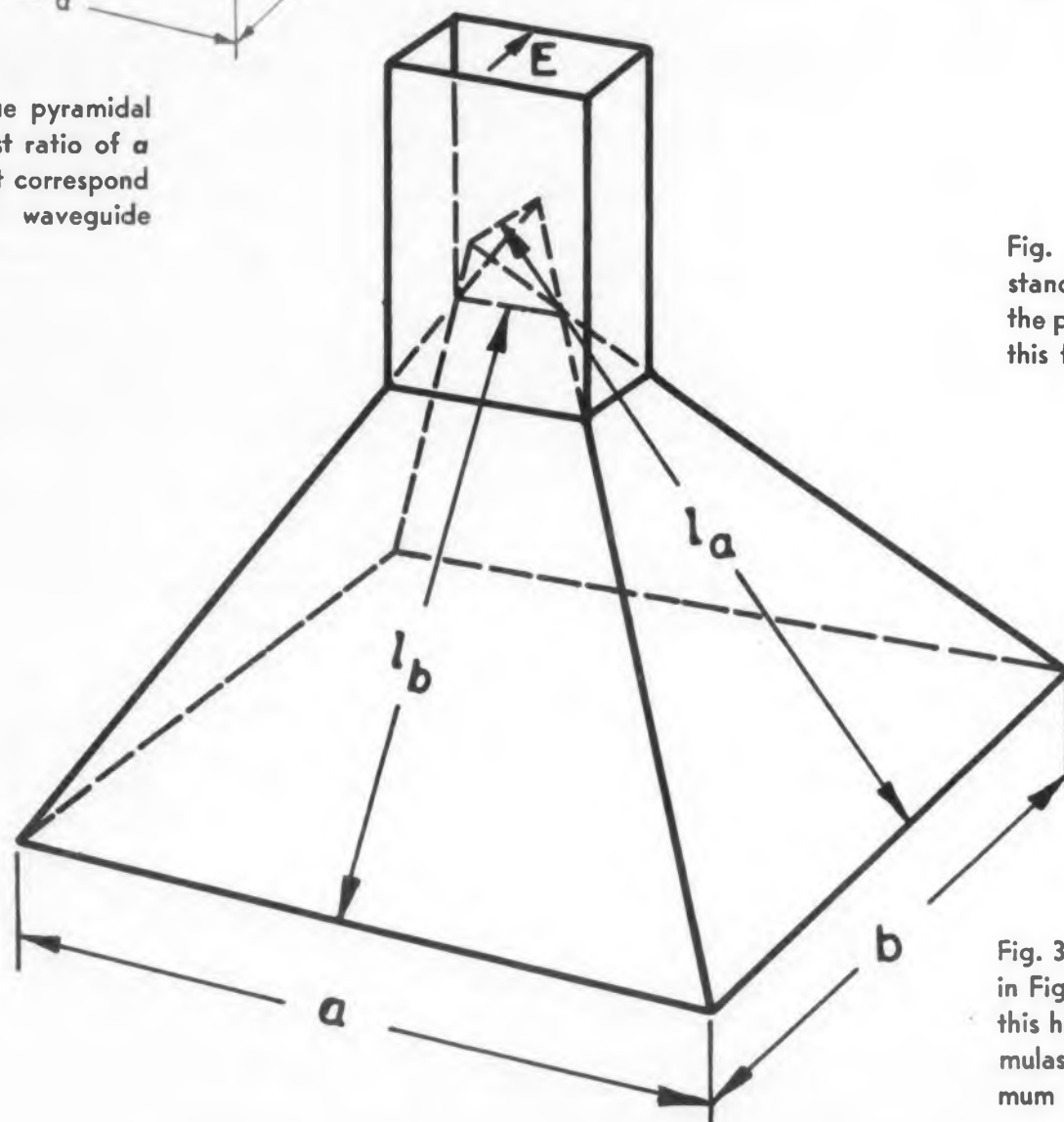


Fig. 2. To obtain the standard ratio of W/D , the pyramid is modified to this form.

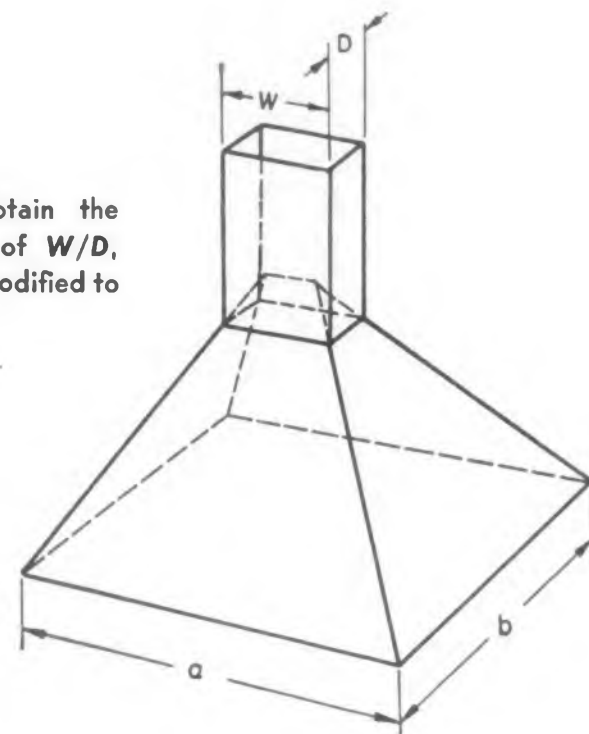


Fig. 3. The same as the horn in Fig. 2, the slant lengths of this horn are used in the formulas to determine the optimum horn.

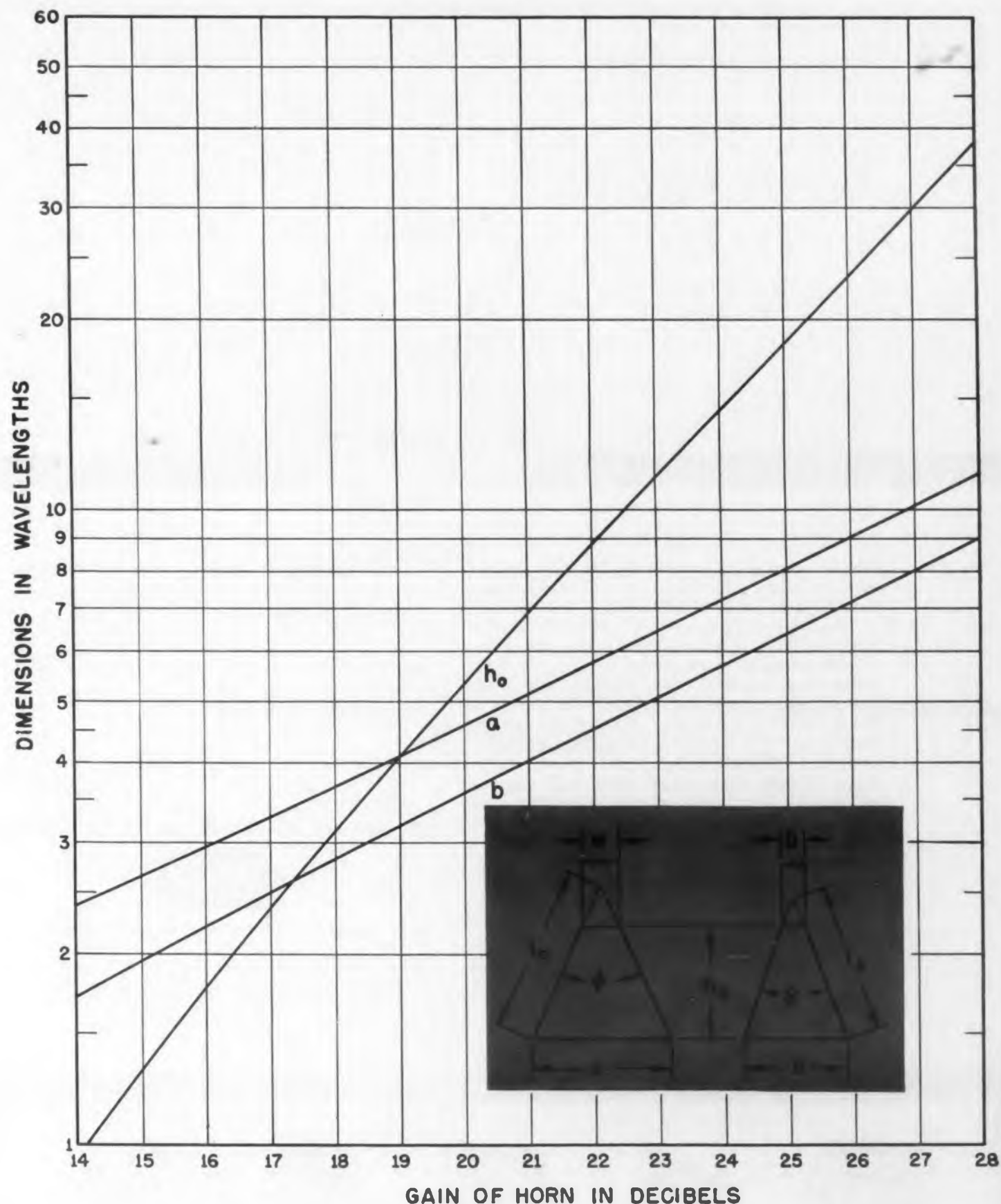
Fig. 4. The normalized aperture dimensions and axial height for optimum horns can be determined from these plots, which are derived on pp. 20 and 21.

from these design curves with standard waveguides shows that dimension "L" becomes ambiguous, which makes the calculation of horn dimensions somewhat awkward. When this is done, it is reasonable to wonder whether the resulting horn still has optimum gain. It can be shown that for horns having gains greater than about 24db, the results are still optimum, but for lower gain horns the differences are appreciable.

Modified Design Curves

To facilitate the design, a modified set of design curves was developed, using the results of Schelkunoff's horn antenna theory^{1, 6}, and similar information in other references⁷. When this theoretical data was combined with the geometrical condition that the horn fit standard waveguide proportions (as described in the next section) the resulting horn was found to be no longer of true pyramidal form, but of the form illustrated in Fig. 2. It is to be noted that the four planes forming the horn do not intersect at a common point, and that there are therefore two different slant length dimensions l_a and l_b as shown in Fig. 3. The modified design curves, shown in Fig. 4, provide the normalized aperture dimensions a and b and the normalized axial height h_o for horns having optimum gain in both the electric and magnetic planes.

Although these curves were computed for X-band waveguide (RG-52/U) at a single frequency (9,050-Mc), they are equally accurate for any waveguide at a frequency at which $W = 0.689$ wavelengths and $D = 0.306$ wavelengths. At other frequencies, the horn dimensions a , b , and h_o will result in a gain slightly different from the value given by the curves



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of Fig. 4. As computed from theory, this difference amounts to about ± 0.1 db when the frequency varies $\pm 10\%$, for a 14.5db gain horn. The difference is less for higher gain horns. In terms of X-band, if the curves are used to design a 14.5db horn for use at 8,200Mc, the dimensions will produce a horn having an actual gain of 14.4db. Similarly, if the curves are used to design a 14.5db horn for use at 10,000Mc, the gain will actually be 14.6db. Thus the design curves (Fig. 4) give results well within a reasonable gain tolerance over a 20% band of frequencies. In terms of wavelengths, the curves are valid to within a ± 0.1 db theoretical gain tolerance for the following range:

$$1.31W \leq \lambda \leq 1.60W$$

corresponding to

$$2.95D \leq \lambda \leq 3.60D.$$

At the extreme upper end of the waveguide operating band (12,400Mc for RG-52/U) the computed gain error is +0.3db for a 14.5db horn, and less for higher gain horns.

Derivation of Design Curves

The curves of gain versus aperture dimensions given in the figures of references 4, 6, and 7 show that for a constant slant length l (in either plane) there is a corresponding aperture dimension which maximizes the gain. In other words an optimum horn is one for which the flare angles in both the electric and magnetic planes are so chosen that for a given length of horn the gain is a maximum⁵. Plotting the slant lengths l_a and l_b against their corresponding optimum aperture dimensions a and b results in straight parallel lines on log-log paper. From these graphs the following relations for optimum gain were determined:

$$(a/\lambda)^2 = 3.18(l_a/\lambda) \quad (1)$$

$$(b/\lambda)^2 = 2.10(l_b/\lambda) \quad (2)$$

This represents a more exact development of footnote 2 in Jakes' paper¹.

From the triangles in Fig. x, it can be seen that

$$l_a = (a/2)/\sin(\phi/2) \quad (3)$$

and

$$l_b = (b/2)/\sin(\theta/2) \quad (4)$$

Combining equations (3) with (1), and (4) with (2), gives the conditions for optimum gain in terms of the flare angles:

$$(a/\lambda) = 1.59/\sin(\phi/2) \quad (5)$$

$$(b/\lambda) = 1.05/\sin(\theta/2) \quad (6)$$

Again using Fig. 4, the axial height of the horn h_a can be expressed in terms of either the E or H plane dimensions as follows:

$$h_a = (a-W)/2 \tan(\phi/2) = (b-D)/2 \tan(\theta/2) \quad (7)$$

This equation relates the optimum dimensions in the H plane to those in the E plane for any given waveguide dimensions W and D . Thus, if either a or b

dependable operation up to 125° C



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is specified, all other horn dimensions can be obtained from equations (5), (6), and (7). A direct relation between a and b from equation (7) is most readily found graphically by plotting each versus h_0 .

From the data in references 4, 6, and 7, the values of the "partial" optimum gains (i.e., gains of sectoral horns) in each plane were also plotted against the respective aperture dimensions. This again resulted in straight parallel lines on log-log paper, from which the following relations for optimum conditions were determined:

$$g_H = 7.86(a/\lambda) \quad (8)$$

$$g_E = 7.96(b/\lambda) \quad (9)$$

The total gain G of optimum rectangular horns was found by substituting equations (8) and (9) into equation (50), p. 587 of reference 7:

$$G = \pi(g_H)(g_E)/32$$

so that

$$G = 6.14(a/\lambda)(b/\lambda) \quad (10)$$

The curves of Fig. 4 were constructed by choosing convenient values of (a/λ) and calculating all other parameters from the above equations. The results were then plotted against the total gain G , which is the most convenient starting point in most horn design problems. Note that all dimensions are normalized in terms of wavelength λ .

Experimental Verification

The curves of Fig. 4 were used to design a standard optimum horn for RG-52/U waveguide, with a gain of 20db at 9,000Mc. Two such horns were built and the gain was measured using the distance between the throats, rather than the distance between apertures, as recommended by Jakes¹. The measured gain was found to be 19.9db at the design frequency. This is an average of several measurements made at various distances.

Acknowledgement—This work was done under U. S. Navy contract NORD-11299 at the Johns Hopkins University Radiation Laboratory, Baltimore, Md.

References

1. Jakes, W. C., Jr., "Gain of Electromagnetic Horns", *Proceedings of I.R.E.*, Vol. 39, No. 2, 1951, p. 160.
2. *Reference Data for Radio Engineers*. Third Edition, New York. Federal Telephone and Radio Corp., 1949. Fig. 23, p. 389.
3. Southworth, George C., *Principles and Applications of Waveguide Transmissions*. New York: Van Nostrand, 1950. *ibid* Fig. 10.1-13, p. 413.
4. *ibid* Fig. 10.1-10, p. 410 and Fig. 10.1-11, p. 411.
5. *ibid* Footnote 18, p. 410.
6. Schelkunoff, Sergei A., *Electromagnetic Waves*. New York: Van Nostrand, 1943. Fig. 9.20, p. 363 and Fig. 9.21, p. 365.
7. Silver, Samuel (ed.), *Microwave Antenna Theory and Design* (M.I.T. Radiation Laboratory Series, Vol. 12). New York: McGraw-Hill, 1949. Fig. 15.20, p. 588 and Fig. 15.21, p. 589.

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Attenuation Constant Measurement With a Lossy Variable Short Circuit

Helmut M. Altschuler

Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Editor's Note: This article is also based on material (see ED, pp. 24-27, September, 1954) from the Handbook of Microwave Measurements, edited by Moe Wind, Research Assistant Professor, and Harold Rapaport, Research Associate, Polytechnic Institute of Brooklyn. It is taken from the chapter on "Measurement of Propagation Constant". The Handbook, recently published by the Institute, is available from the Microwave Research Institute, 55 Johnson St., Brooklyn 1, N. Y. It is printed in two volumes and is priced at \$12.00.

SPECIAL instrumentation is not required for the method of measuring attenuation constant of waveguides at microwave frequencies described here. Although the measurement of this constant is conceptually quite simple and can be carried out in a variety of ways, the numerical values obtained may be in large error unless great care is exercised. The possibility of large error is inherent in the relative smallness of the dissipation which must be measured when samples of reasonable length are tested. It can generally be overcome by the use of special instrumentation not readily available to most workers. Since the expense and time involved in such an approach is often not justifiable, methods that promise good accuracy and which are based on the equipment to be found in even the smaller microwave laboratories become of particular interest.

Basically, in the method described here, the magnitude of the reflection coefficient of a lossy short circuit is measured with and without the sample line in place. The attenuation constant of the sample line is then computed directly from the ratio of these reflection coefficient magnitudes. The detailed reasoning, however, is more complex than this statement implies.

Apart from a power source and a detector, the present method requires only the use of a slotted line and of a variable short circuit which has been deliberately made lossy. Good accuracy is achieved since the loss introduced in the short circuit reduces the otherwise high values of VSWR (voltage standing wave ratio) to a lower range where they can be measured more readily. In addition, the method of analysis is not based on a

single data point, but on a number of distinctly different datum points which are effectively averaged. Moreover, since the method automatically takes into account any discontinuities that are located between the slotted line probe and the sample, the slotted line and the sample may, but need not be, of different cross-sections. The cross-sections of the sample and the short circuit, however, must be identical and the connector between these components (if any) must have a negligible VSWR.

The measurement components, as assembled for the

some dissipative material to the shorting plunger. Two examples of how this may be done are shown in Fig. 2. It is to be noted that the plunger and the lossy material are an integral unit, and that the lossy material may be of relatively arbitrary value (in regard to amount of loss) and shape.

Measurement Procedure

1. With the equipment connected as shown in Fig. 1, (top), and with the lossy shorting plunger set at some arbitrary point, carefully measure the corresponding VSWR in the slotted line and the position of the voltage minimum, D . The plane $D = 0$ is any arbitrary, but fixed reference plane.
2. Repeat step 1 for a number (for example, 10) of arbitrary, but spaced, positions of the lossy shorting plunger.
3. Remove the sample line and connect the lossy variable short circuit directly to the slotted line (see Fig. 1, bottom).
4. Repeat steps 1 and 2 (without the sample line).
5. Determine $\lambda_g/2$, the distance between adjacent voltage minima in the slotted line. λ_g is defined as the guide wavelength in the slotted line.

Analysis of Data

6. From each measured point (VSWR, D) compute $\theta = 720D/\lambda_g$ degrees, and $|\Gamma| = (\text{VSWR} - 1)/(\text{VSWR} + 1)$
7. Using the values of θ and $|\Gamma|$ obtained by steps 1, 2 and 6, plot θ vs $|\Gamma|$ on polar coordinate paper ($0 < |\Gamma| < 1$; $0^\circ < \theta < 360^\circ$).
8. Carefully draw that circle (which best fits the distribution of points) through the plotted points. Theoretically the points must fall on a circle.
9. Determine ρ_a , the radius of the circle, and r_{oa} the radial coordinate of the center of the circle (see Fig. 3).
10. Repeat steps 7, 8, and 9 using the values of θ and $|\Gamma|$ obtained by following steps 4 and 6. Designate the radius of this second circle as ρ_b and the radial coordinate of its center as r_{ob} .

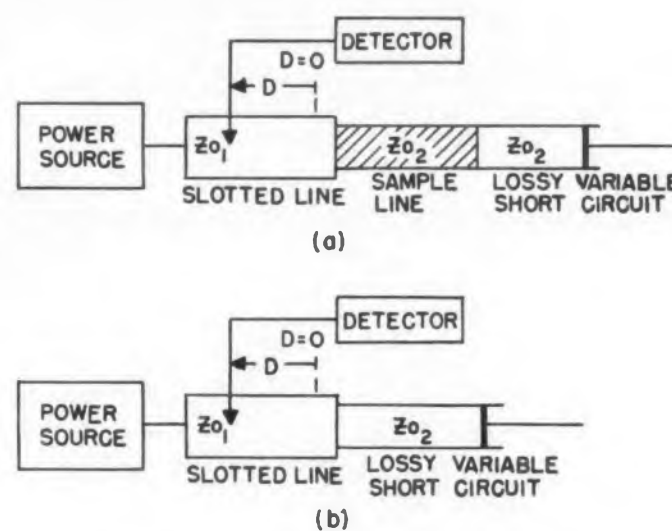
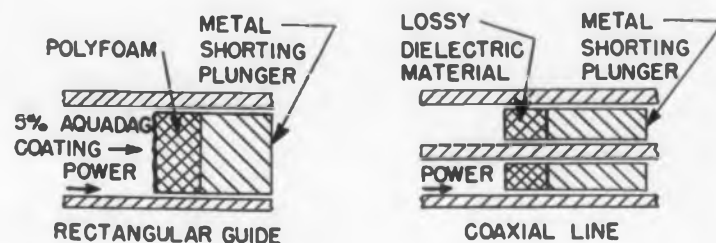


Fig. 1. Two arrangements of equipment for measuring attenuation constant.

two main steps of the measurement, are shown in Fig. 1. All these, save the lossy short circuit, are standard items. The slotted line on one hand, and the short circuit and sample line on the other, are shown as guides of different cross-sections (and of characteristic impedances Z_{01} and Z_{02}) to underline the method's applicability to this situation.

Although the short circuit must be variable, no accurate position scale need be associated with it. Any good standard variable short circuit may be made "artificially" (i.e., deliberately) lossy by attaching

Fig. 2. Two shorting plungers with deliberately introduced losses.



11. The attenuation constant, α , is then given by

$$\alpha = \frac{1}{2L} \log_e \frac{(A_a + B_a)(A_b - B_b)}{(A_a - B_a)(A_b + B_b)} \text{ nepers/unit length}$$

where L is the length of the sample line and where

$$A_a = [(1 + \rho_a)^2 - r_{oa}^2]^{1/2}, \quad B_a = [(1 - \rho_a)^2 + r_{oa}^2]^{1/2}$$

and

$$A_b = [(1 + \rho_b)^2 - r_{ob}^2]^{1/2}, \quad B_b = [(1 - \rho_b)^2 + r_{ob}^2]^{1/2}$$

The quantities ρ_a , r_{oa} , ρ_b and r_{ob} found in steps 9 and 10 above can, when accuracy requires it, be obtained in a precision fashion. ρ , r_o and the angle θ_o (i.e., θ_{oa} and θ_{ob}), which is defined as the angular coordinate of the center of the data circle as shown in Fig. 3, must first be read directly from the circle. The quantities obtained in this manner serve as first order values in an analytical correction procedure which yields the values of the parameters ρ , r_o and θ_o more precisely. Space does not permit the presentation of the general correction procedure, which is given completely in the *Handbook*, section 6, pp 40-42. However, the special case given below is applicable when r_o is small. This is the situation when, as often happens, the discontinuity between the probe and the sample waveguide under test is small.

Correction Procedure for r_o Small

It is assumed that ρ and r_o , for the particular circle in question have, been found via steps 9 and 10 and that r_o is very small.

12. From the values of $|\Gamma|$ determined in step 6 compute the differences Δd for each $|\Gamma|$ from

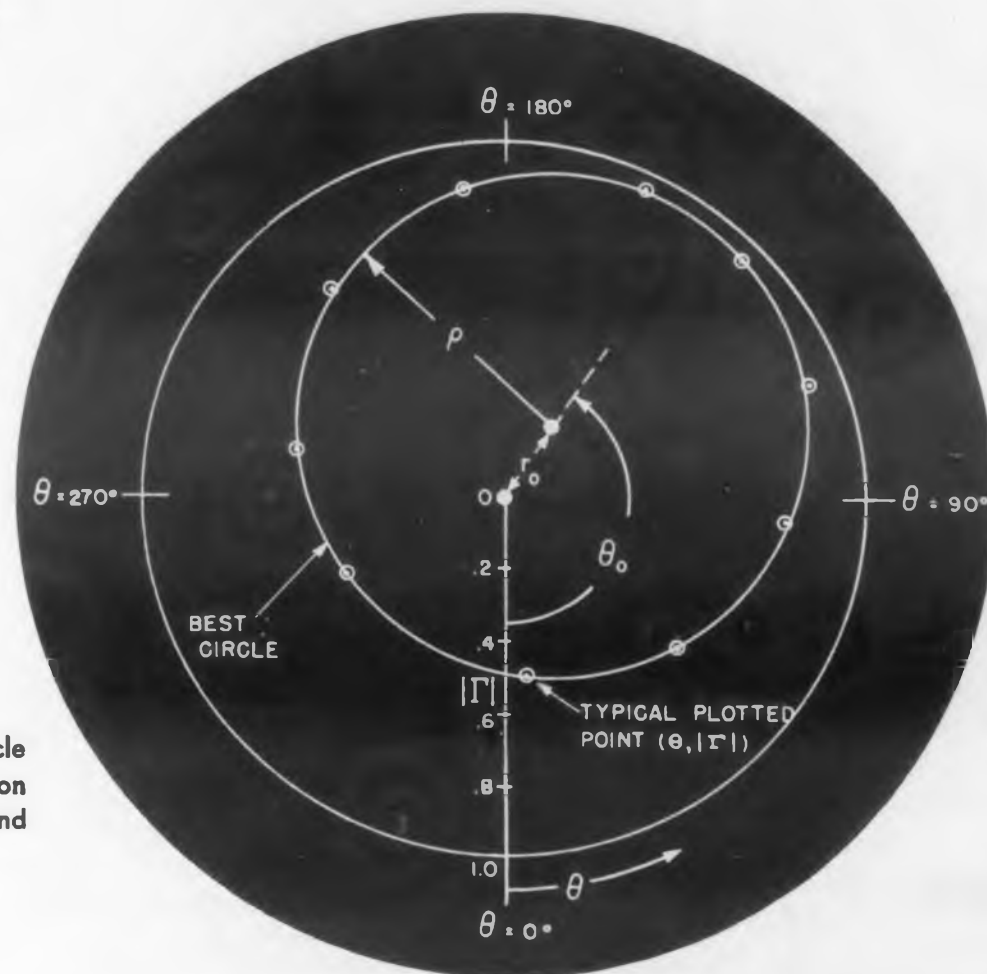
$$\Delta d = |\Gamma| - \rho$$

13. Plot the small differences Δd found in step 12 against the corresponding values of θ found in step 6. Plot these points on rectilinear graph paper, as shown in Fig. 4.

14. Draw the best sine curve, with a periodicity of 360° in θ , through the plotted points. Determine the center axis (or average level) of the sine curve.

15. Determine $\Delta\rho$, the distance between the center axis and the ordinate axis ($\Delta d = 0$) and Δr_o , the amplitude of the sine curve. Note: $\Delta\rho$ is positive if the center

Fig. 3. By drawing the best circle through the plotted points on polar-coordinate paper, ρ , r_o , and θ can be determined.



axis lies above $\Delta d = 0$ (as in Fig. 4) and negative if the center axis lies below $\Delta d = 0$. On the other hand, Δr_o is always taken to be positive in this case.

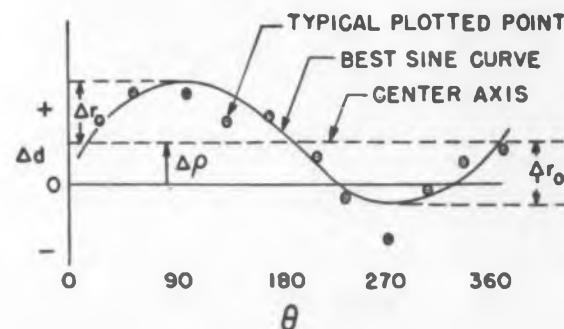
16. The corrected circle parameters, ρ' and r'_o , are obtained from

$$\rho' = \rho + \Delta\rho, \quad r'_o = |\Delta r_o|$$

If (by inspection) r'_{oa} and r'_{ob} are both sufficiently small to be judged negligible in step 11, the attenuation constant is given directly by

$$\alpha = \frac{1}{2L} \log_e \frac{\rho_b}{\rho_a} \text{ nepers/unit length}$$

Fig. 4. The correction procedure for ρ and r_o is based on this plot.



The procedures described above are also applicable when, instead of a lossy variable short circuit, an open-ended sample line of "variable length" is employed. Since, in general, the open end of a transmission line radiates, it constitutes a lossy termination comparable to a lossy shorting plunger. When small lengths of this line are then cut from the end in a systematic fashion, the motion of the lossy variable short circuit is simulated. (The assumption has been made that the loss in a half wavelength of the sample line is so small that it can be neglected.) This procedure is useful when applied to such guides as coaxial cable or strip line where no proper lossy variable short circuits constructed of the same type of guide as the sample are possible.

The measurement procedure already given is followed exactly in this case except for the following changes: Step 1—the sample line and the lossy variable short circuit together must now be taken as an open-ended length of sample line; Step 2—short lengths are cut from the end of the sample line to simulate the plunger motion; Step 3—most of the sample line is cut off; a sufficient length must remain so that small cuts can again be made in step 4. One must be careful that the open end, as well as the surrounding space, is similar after each cut so that the lossy termination always retains the same reflection factor.

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reliability*



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Teflon Wire



Temprex Extruded
Teflon Wire-
Shielded (Metal)



Temprex Extruded
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Coaxial Cable
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● Insulated with a smooth sheath of extruded Teflon, Hitemp's new TEMPREX hook-up wire is unaffected by commercial solvents, temperatures from -90° to $+260^{\circ}\text{C}$ (Class H or better), fungus growth, moisture, or weathering. Retains its excellent electrical properties over a wide range of frequencies, conforms to MIL-W-16878A (Navy) E and EE constructions, and to MIL Standard 104.

Furnished in 14 solid colors extruded over silver-plated, stranded copper wire, or a solid conductor. Sizes 26—10 AWG in production lengths. Delivery within 10—14 days . . .

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NEBROC TEFLON-FIBERGLAS LACING CORD
TEMPTUBE TEFLON-FIBERGLAS TUBING

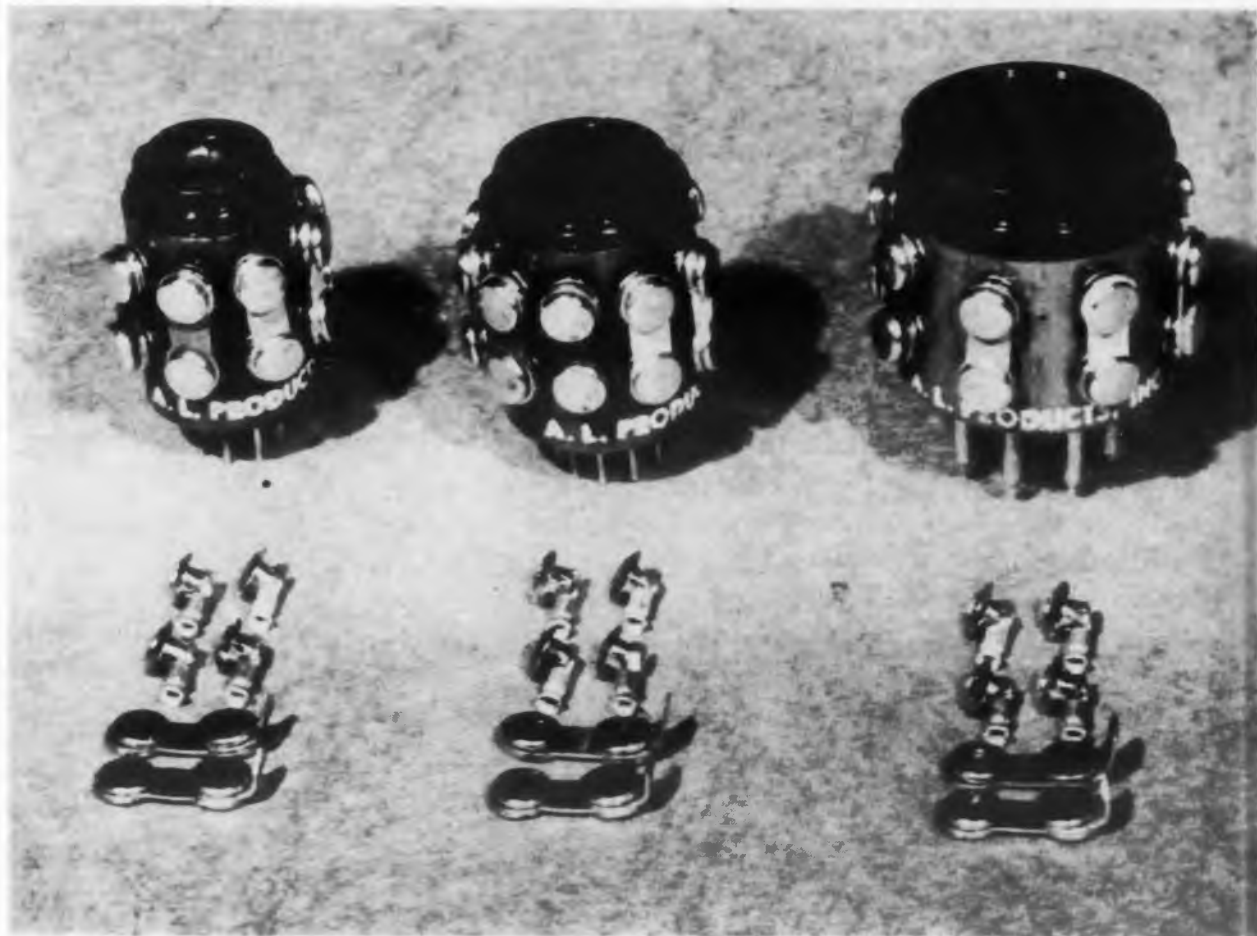
*Du Pont's Trade Name for Polytetrafluoroethylene

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

Tube Socket Test Adapters

OVER 90% of the characteristics of most circuits can be controlled by means of the Tube Socket Test Adapters shown on these pages without unsoldering a single connection. The electronic engineer can utilize these design aids to quickly modify a circuit to obtain desired performance, or to test a newly developed circuit by removing a tube, inserting the adapter in its socket, and then replacing the tube in the adapter.

In addition to making test points readily available, resistors or capacitors can be inserted into a circuit by replacing the unit's "straps" between test points with the special jacks, shown at the



Each type of adapter is furnished with four "jacks" for inserting components and two special "straps" with lugs for alligator clips.

left. The jacks are made to receive leads of the diameter generally furnished with components. In addition to the four jacks supplied with each adapter, two special straps with lugs are furnished for use with alligator clips connected to ammeters or decade boxes, as shown below. These adapters are made by A. L. Products, Inc., 311 Hickory St., Kearny, N. J.

The adapters are made in three types, for 7-pin and 9-pin subminiatures, and octal base tubes, respectively. The terminals are color coded according to the RETMA standard. For more data, turn to Reader's Service card and circle **ED-19**.

Two types of the adapters in use showing how the jacks and special straps are employed.



Another G-E Capacitor First for the Electronics Industry



DRAWN-RECTANGULAR CASE has no soldered seams, does not depend on solder for mechanical strength and effective sealing.

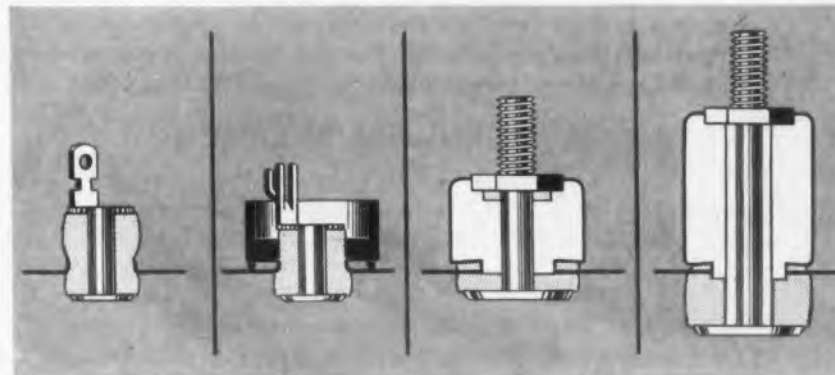
new... G-E CAPACITORS IN DRAWN-RECTANGULAR CASES

- Solderless, double-rolled cover seam
- Seamless case with standard dimensions

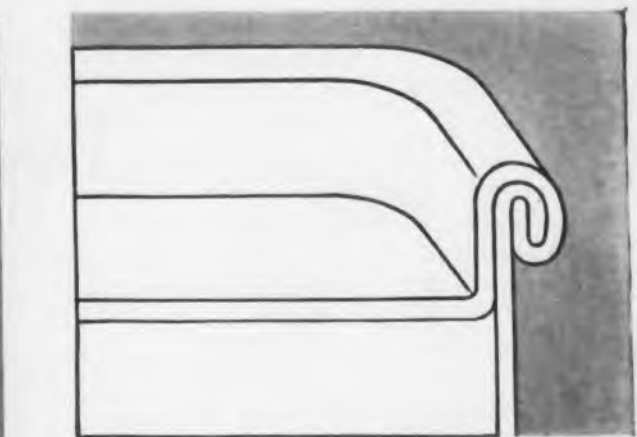
General Electric is now producing fixed paper-dielectric capacitors in seamless, solderless cases with standard dimensions that comply with or exceed MIL specifications. For complete information contact your G-E Apparatus Sales Office or write for Bulletin GEC-809A to Section 442-24, General Electric Co., Schenectady 5, N. Y.

Progress Is Our Most Important Product

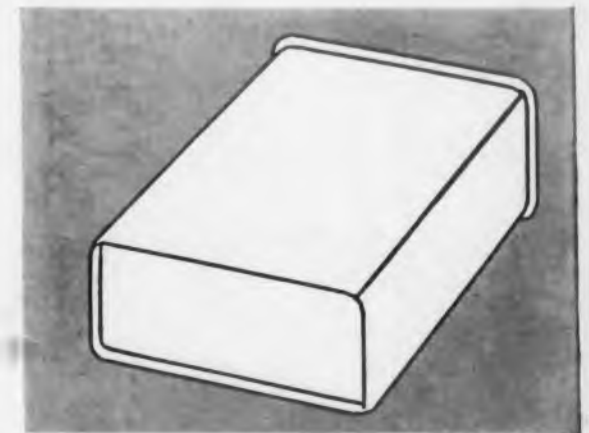
GENERAL  ELECTRIC



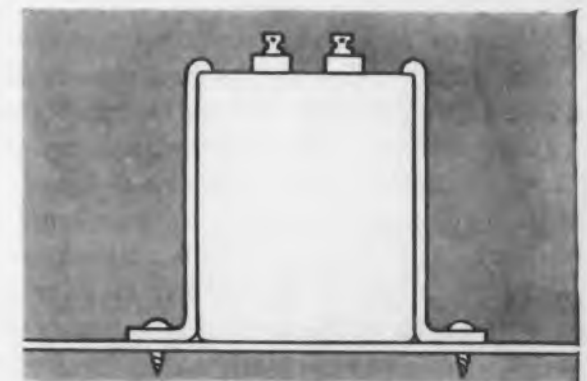
FOUR BUSHINGS STYLES are available for applications below 2000 volts d-c, special skirted bushings for higher voltages.



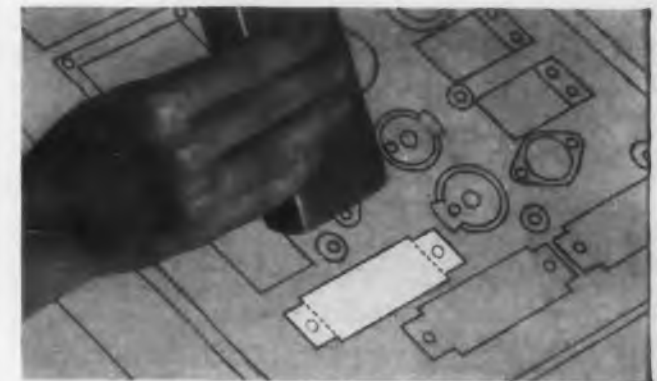
SOLDERLESS DOUBLE-ROLLED COVER SEAM makes a mechanically strong, hermetic seal.



BOTTOM OF CASE IS INDENTED to permit mounting in inverted position.



UPRIGHT OR INVERTED MOUNTING is possible using either spade lug, or footed brackets (above)



STANDARD CASE SIZES are interchangeable, making it unnecessary to change drawings or circuit layouts.

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

Technical Problems Affecting National Defense

Ideas for Design

THE NATIONAL Inventors Council has published a new list for 1954 of "Technical Problems Affecting National Defense". Those problems listed below are of interest to electronic design engineers and allied professional personnel. Actual or suggested solutions to any of the problems are welcomed.

No special forms are required for submitting proposals to the Council, and the services of an attorney are not necessary. The description should be as nearly complete as the inventor can make it and might well include: (1) some reference to underlying principles; (2) any experimental work or tests that have been conducted; and (3) the particular points of novelty or superiority of the invention as compared to existing devices. The written material may be supplemented by sketches or diagrams, but these need not be professionally prepared.

These problems include a number taken from earlier lists that have not been solved satisfactorily. Copies of the list will be supplied free of charge to any individual or organization. The address of the Council is as follows:

National Inventors Council
U. S. Department of Commerce
Washington 25, D. C.

Components

Gas-Driven Servo. A rugged, compact, high-power gas-driven servo capable of operating in a severe environment.

Quick Disconnect. Jam-proof, ice-proof, dust-proof, quick disconnect, multi-contact umbilical plugs.

Long-Life Batteries. Batteries with a long "shelf life" and a constant power output over a widely varying temperature range.

Coaxial r-f Switch. Coaxial r-f switch of broadbank characteristics to handle 1 to 10kw of power.

Frequency Insensitive Rotating Joint for Coaxial and Waveguide Circuitry.

Hermetically Sealed Cartridges. Develop miniature hermetically sealed cartridges for transistors and crystal diodes which may be sealed off at a temperature below 100°C.

Underwater Acoustic Transducer. Underwater acoustic transducers with directional discrimination at low sonic frequencies, and consistent with low weight and small size.

Improved or New Type Commutating and Decommutating for Telemetering.

Simple, Light-Weight, and Producibile Inertial Components; Gyros, Accelerometers, Computers, etc.

Supersonic Radome. Supersonic radome with minimum aberration and reflection, and immune to dust, rain, and ice erosion.

Improved Magnetostriction Units or Other Frequency Control Devices for Use in Communication Equipment. To develop magnetostriction units or other frequency control devices which can be used in lieu of quartz crystal units for frequency control in communication equipment. Because of the diminishing supply of natural quartz it is necessary that other means of frequency control for communication equipment be investigated. Two items which offer possibility are: (1) magnetostriction units and (2) frequency stabilized electrically controlled oscillators.

Miniature Batteries. Initial production of RM cells was spotty and while some batteries gave good performance, other batteries did not provide any life at all because of open circuits, short circuits and other defects. Low temperature dry batteries, while affording some service life at temperatures as low as -40°F, have not provided sufficient life at these temperatures. (1) Batteries should be as small and light as possible, (2) Require as little as possible, or no effort to put them into operation, (3) Keep indefinitely in storage, whether at low temperatures or high temperatures, such as encountered in arctic or tropical climatic areas, (4) Provide relatively even service life over a range of temperatures from -100°F to +160°F.

High-Power Electron Tubes. High-power electron tubes with negligible current drain.

Cathode-Ray Tube. Large-screen (12") cathode ray tubes in which the glass envelope is much lighter in weight, shorter and more rugged.

High-Voltage Power Supply and Components. To develop a high voltage power supply that is lightweight and extremely small in size. Need exists for a high voltage power supply (20,000-40,000v) with dimensions and weight that will permit its use as a component of man-carried electronic equipment. The power supply must be small, lightweight and conveniently packaged so as not to restrict the movements of or cause

premature fatigue to the individual carrying and operating the electronic device. Design studies are now being made on the following: (a) Low cathode power, high voltage (20,000v and higher), rectifier tube for direct current not exceeding 50μamps; (b) Capacitors for filtering pack from 10,000 to 40,000v; (c) Insulating material to withstand 10-40kv.

Electronic Equipment

Microwave Oscillator. There is a need for a microwave oscillator suitable for continuous wave or pulsed applications of 1kw or higher power output.

Efficient, Compact, Light, Quiet Power Source. There is a continuing need for an efficient, compact, light, quiet power source for mobile and man-portable field applications. Existing sources such as batteries have limitations in that they require frequent charging or, in the case of throw-aways, heavy logistic support. They are also considered too heavy for many uses. Internal combustion engines are in general too noisy for front-line operations. The recently announced solar and atomic batteries are still in the developmental stage.

Recorder for High-Frequency Range. Recorder for the frequency range of 5 to 1000Mc with immediate playback or long time storage before playback.

Microwave Direct Storage or Memory Circuit. Microwave direct storage or memory circuit in which the frequency and/or modulation may be read off after a time delay of 1 to 100sec.

Non-Heterodyning Type of Frequency Divider. A non-heterodyning type of frequency divider for microwave frequencies.

Instruments

Ambient Temperature Measurement. Presentation is desired for one or more methods of measuring the ambient temperature of the atmosphere through which an aircraft is passing. This project has as its primary objective the methods which may be employed to nullify the effects of frictional heating on the sampling or measuring instrumentality. The method presented should be capable of being incorporated into an instrument which will have the minimum time lag and provide direct readings. Two speed ranges are under consideration: 200-600 and 200-1000mph.

Ambient Humidity Measurement. Presentation is desired of one or more methods of measuring the relative (or absolute) humidity of the atmosphere through which an aircraft is passing. Nullification of the effects of frictional heating is a primary objective. The method(s) presented should be capable of being incorporated into an instrument which will be direct reading and have minimum time lag. Two speed ranges are under consideration, 200-600 and 200-1000mph.

Rugged Portable Lightweight Ammeter. A rugged portable lightweight ammeter with a sensitivity 20 to 100 times that of the conventional D'Arsonval type. Device should be simple, requiring no external power supply or electron tube amplifiers.

Flux Meter. A means of measuring small changes in the earth's magnetic field that does not require the measuring device to maintain a fixed position relative to the direction of the earth's field.

Pre-Stress Measurement in Nut and Bolt Assemblies. A portable device (sonic, electrical or otherwise) is needed to measure the pre-stresses set up in nut and bolt assemblies.

Non-Destructive Tester. The problem is to develop a simple reliable device or technique for non-destructive testing of adhesion in bonded joints.

Helicopter Attitude Indicator. A relatively simple, lightweight instrument that will indicate the correct attitude of the helicopter fuselage in the hover condition as well as in flight and which will indicate drift in any direction.

Helicopter Airspeed Indicator. A simple, dependable, lightweight device is required to measure and indicate the forward speed of a helicopter through the surrounding air at very low speeds (0-20 mph) involved in hovering. Ordinary airspeed measurement is ineffective due to the great disturbance of the air mass by the motor downwash.

True Vertical Indicator. A simple means of determining true vertical, not employing a gyroscope, that will not be affected by accelerations in the horizontal plane.

Non-Magnetic Compass. A simple directional device capable of being carried by a foot-soldier which can determine true north within an accuracy of 5 mils, independent of the earth's magnetic field.

Detection of Defects in or General Inadequacies of Structural Sandwich Materials. To develop non-destructive means for determining the presence of defects or inadequate bonding of sandwich materials, which can be used by relatively unskilled personnel. Rapid means of inspection of structural sandwich assemblies as used in aircraft are required to determine if adequate strength is provided. Increasing use of sandwich construction in aircraft makes this problem increasingly important.

Special Devices

Concealment Studies for Combat Vehicles. Development of a device or devices applicable to vehicles to permit combat operation of vehicles under cover of darkness without disclosing the location of the vehicles through the usual means of radiation, light, and noise.

Detection of Buried Explosives. A device or technique capable of positively detecting and locating explosives, as such, buried at shallow depths.

Presenting Three-Dimensional Information. There is a need in the radar display field for a means of presenting three-dimensional information. Stereoptical techniques are considered inadequate particularly where reasonable high accuracy of all three quantities must be retained.

Homing Navigation System. Simple homing navigation systems, including homing heads, gyros, etc. Rugged and light.

Artillery Orientation System. Development of a system of orientation of artillery to a reference independent of line of sight, earth's magnetic field, or earth's rotation, with azimuth accuracy of 1/4 mil.

Ultra-Light-Weight Collapsible Field Antenna Masts or Vertical Radiators. To develop a structure, usable as an antenna support mast or as a vertical radiator, which is much lighter and more portable than present types, and capable of rapid installation by a small crew. Mobility of military radio communication equipment is often limited primarily by the portability of its antenna system. New masts of the collapsible

type are required to increase effectiveness by enhancing portability of equipment and, when used as radiators, to afford increased efficiency in that the antenna can be readily adjusted to resonance at a particular frequency.

Desired characteristics of the structure include: (a) Maximum height, 100'; minimum, not more than 10'; readily adjustable to any intermediate height. (b) Minimum weight and bulk consistent with requisite mechanical strength; preferably portable by one or two men. (c) Minimum of guys; preferably none for lower masts and radiators. (d) Completely weatherproof. All components to be capable of outside storage in any climate, and usable in the Arctic and in the tropics.

New Methods of Converting Light Energy into Electrical Energy. An equipment that could convert light energy into electrical energy for power applications should be capable of operating on a minimum amount of light; should be capable of producing electrical energy at a reasonably efficient rate of conversion, and, if possible, the electrical output should have a constant curve to insure good voltage regulation; equipment should be rugged and not affected by atmospheric conditions; should be capable of operating from -65°F to $+165^{\circ}\text{F}$; should be of minimum weight and size and should not be difficult to operate.

Equipment for Converting Heat Energy into Electrical Energy. Equipment for converting heat energy into electrical energy should have efficient and fool-proof heating and heat transfer mechanism; should be capable of using several types of fuel such as gasoline, diesel oil, kerosene, alcohol, etc.; should be portable; thermocouples should be of such construction and composition as to provide efficiency above 5 or 10%, if possible; equipment should have good voltage regulation and should have reasonably constant power output during variation of temperature.

Electronic Telegraph Printer. To provide a telegraph printing device in which the functions of translating the transmitted signals and the operation of the printing elements are accomplished by electronic circuits. The equipment shall be light in weight and capable of efficiently operating at speeds greater than the conventional mechanical teletypewriter. Combat military operations require a lightweight telegraph printer that is capable of man-pack and installation by small battle units. The equipment shall also be suitable for aircraft installation.

Measurement of Ballistic Data. A simple means of getting ballistic wind and ballistic air density data from surface measurements and observations which will continuously furnish data sufficiently accurate for AA fire control purposes.

Destructive Ray. To develop equipment of usable size capable of producing destructive or death rays effective at 500 yards without excessive power input. Investigations to date indicate that tremendous amounts of power would be required using present techniques and that a completely new approach is indicated.

Weather Observation Apparatus. Development of an economical automatic weather observation apparatus that records weather elements (including humidity, wind speed, wind direction, etc.) and makes a permanent record or broadcasts weather conditions under extreme cold or heat situations.

Lightweight Equipment for Translating Speech into Writing. To develop equipment of size suitable for general use, capable of translating ordinary speech into the written word. All approaches to date show that apparatus required using existing techniques would be extremely complicated and bulky.

Trajectory Indicator. Indicator to indicate trajectory of a missile with respect to a target aircraft.

System of Transmitting Fire Control Data. A method of automatically transmitting and receiving three elements of

data over a twisted pair of field wires with an accuracy of one part in twelve thousand. The transmission of all three elements of data need not be carried on simultaneously, provided that each element is transmitted at least twice per second.

New Type of Communication. The development of a revolutionary new method of transmitting intelligence to augment or replace present systems. Present systems in general depend on electrical impulses, electromagnetic waves, sound waves, etc. A system utilizing completely new concepts is desired.

Materials

Semi-Conductor Material. Develop a semi-conductor material suitable for use in transistors, the color of which is to depend upon its conductivity type, that is, n type material one color, p type material a different color.

High Resistance Material. Discover an insulating material which has a resistance of at least 10^{11} ohms per centimeter. The material recommended for this application should have a low temperature coefficient, good resistance to vibration and shock, but need have only limited external mechanical strength. This material is required in providing very high resistance elements for use in radiation detection instruments. The resistors must be producible within 20% accuracy.

Casting Resins. Potting or casting plastic compounds for protecting electronic components and sub-assemblies. Such compounds are required to have low viscosity at relatively low temperatures, should set up and cure quickly with a minimum cracking over a wide temperature range, (-55°C to 200°C .)

High-Temperature Molding Compound. Molding compound having resistance to high temperatures, (200°C), low dielectric loss, and good mechanical properties. The material will be a plastic, preferably thermosetting, with good dimensional stability, and a short molding cycle.

Coil Impregnants. A low cost, easily applied r-f coil impregnant, which will satisfy general military service conditions such as high temperature, (125°C), high humidity, low temperature storage, (-62°C), with minimum effect on physical or electrical performance. Such impregnant may be a wax, varnish, or resin. The impregnant must be such that the "Q" of a coil which it protects must be maintained after exposure to the adverse environmental conditions mentioned.

High Quality Synthetic Quartz or Other Piezoelectric Crystals. Development of high quality synthetic quartz or other piezoelectric crystals which can be used in lieu of natural quartz in frequency control devices. Because of the diminishing supply of natural quartz, it is necessary that synthetic materials be developed for frequency control devices. The following types of materials are being investigated: (a) synthetic quartz; (b) aluminum phosphate crystals; (c) various types of water soluble crystals; (d) nepheline and (e) tourmaline.

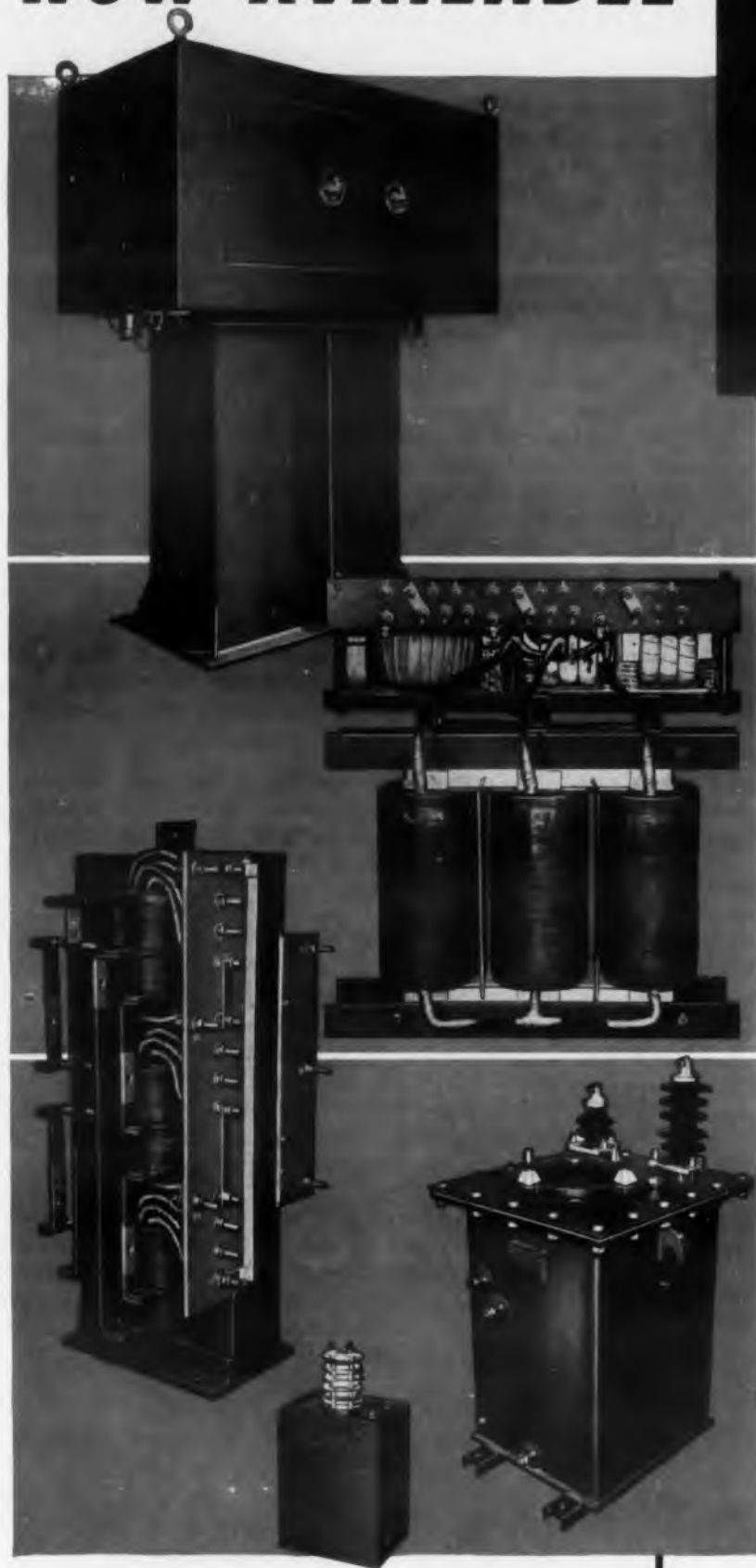
Methods

Growth of Large Single Crystals. Develop a simple and economical method for the growth of large single crystals of silicon with desired resistivity and lifetime.

Electro-Chemical Stability. Develop a method of achieving electro-chemical stability of semi-conductor surfaces especially in the case of germanium and silicon.

New Miniature Radio Equipment Construction Methods. Utilization of miniature equivalents of standard size component parts in the development of subassemblies which will permit construction of ultra-compact radio equipment, and simplify maintenance; and design of miniature components not already available. Weight and volume are all-important considerations in the design of military electronic equipment.

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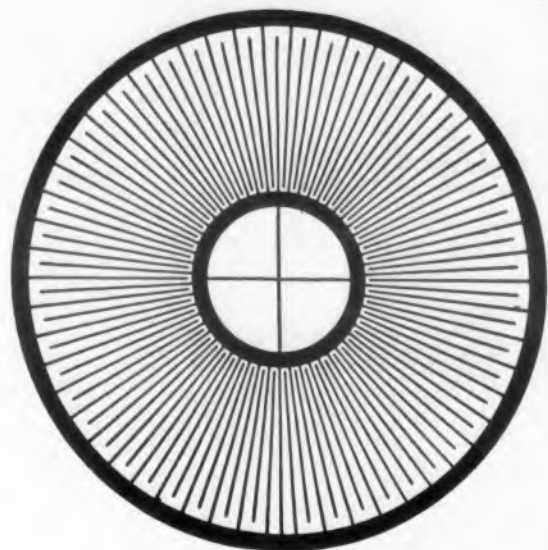
Precision Synchro Element

FUNCTIONALLY similar to a resolver, the "Inductosyn" is an angular data transmission device of high accuracy. This synchro element can serve in automatic machine controls, as a position servo, an analog-to-digital converter, an electro-mechanical transducer, a high-speed phase shifter, an electronic back-lash-free gear ratio, a distance measuring device, an angular pickoff, and in many other applications, one of which is illustrated.

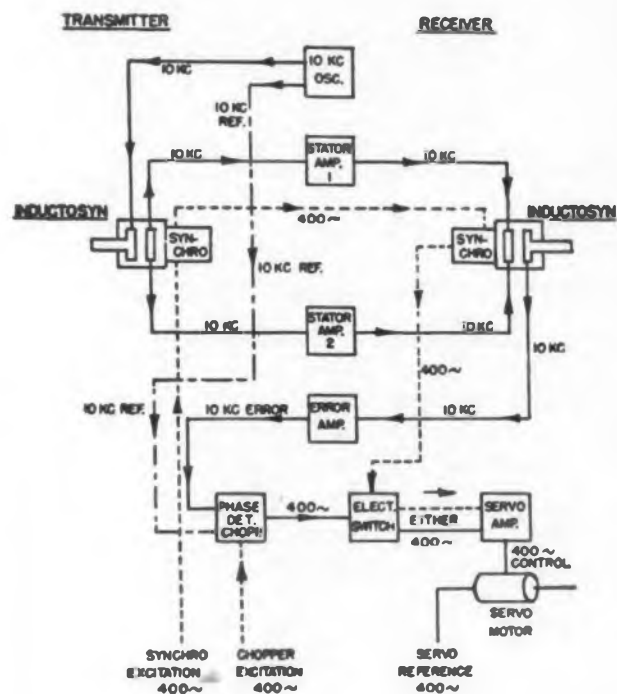
The conductors of the unit are etched silver on glass discs, one of which is illustrated. The single rotor disc is arranged in space quadrature with the two stator discs without any magnetic cores. Because of this construction, the electrical coupling between the rotor and stators is very low. To improve coupling, the rotor is energized at a higher frequency, typically 10kc. The oscillator supplies about 0.25v to the 0.5-ohm impedance rotor. The Inductosyn is manufactured by Farrand Optical Co., Inc., Bronx Blvd. and East 238th St., New York 70, N. Y.

The unit illustrated has 108 poles for 54 synchronous points per revolution, but the Inductosyn can be constructed with varying numbers of poles depending on the particular application. For more information on these high precision synchros, turn to the Reader's Service Card and circle **ED-22**.





The "printed" conductors of this 108-pole rotor are etched silver on a glass disc.



In this closed servo loop the amplifiers offset rotor-to-stator coupling losses.

Only 3" in diameter, the Inductosyne has the angular accuracy of precision mechanical devices many times larger.



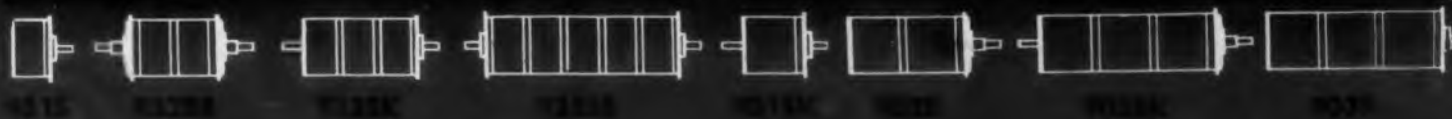
BORG MICROPOTS

the
NEW STANDARD
of precision
multi-turn
potentiometers

BORG 900 SERIES 3-TURN AND 10-TURN MICROPOTS

3-TURN MODELS 931-935

10-TURN MODELS 901-903



Standard models of Borg 900 Series Micropots offer such reliability and long life span that they are the choice of many users. Borg has created a new standard in high precision potentiometers.

Advantages of the Borg 900 Series include: precision accuracy, long life span, low torque, long life, better performance under stress and constant

operation, precise assembly and availability of replacement parts.

Standard models include: 10 turn potentiometer Model 901 to 3 at 1 gram torque, 3 turn to 1 at 1 gram torque, single or double shaft, some at locking position, available in both inch and metric diameters and lengths up to 200 ohms.

SYNCHRONOUS AND INDUCTION BORG-MOTORS

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

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



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For Complete Engineering Data



SERVO-CONTROL Borg-Motors

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

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JANESVILLE, WISCONSIN

NAME.....

TITLE.....

Please send complete information and engineering data on items checked.

Precision Multi-Turn Potentiometers, 900 Series

Borg Standard Potentiometers, 1100 Series

Precision Multi-Turn Constant Drifts

Servo Control Motors

Frequency Standards

Instrument Motors

Contract Manufacturing

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



PHOTOGRAPH ANY SCOPE PATTERN

with the

FAIRCHILD

Oscillo-Record Camera

The Fairchild Oscillo-Record camera will accurately record continuously varying phenomena as well as single transients and stationary patterns. Continuously variable electronic control of the film speed from 1 to 3600 inches per minute allows you to select the optimum speed for the greatest clarity and detail, without film waste. The entire length of the 35 mm. film (100, 400 or 1,000 feet) can be run off continuously at any speed. The film is sprocket-driven so there is no slippage at any speed.

The Oscillo-Record camera mounts directly on the top of the scope. No tripod is needed and the oscilloscope controls are always accessible.

FOR IMMEDIATE EVALUATION of individual exposures the Fairchild-Polaroid® Oscilloscope Camera is economical, fast, and convenient. The trace reads from left to right, and is exactly one-half size. Each 3¼" x 4¼" Polaroid print (available in only 60 seconds) records two separate images.

For more information, write *Fairchild Camera and Instrument Corporation, Robbins Lane, Syosset, L. I., N. Y., Department 120-21G2.*

FAIRCHILD

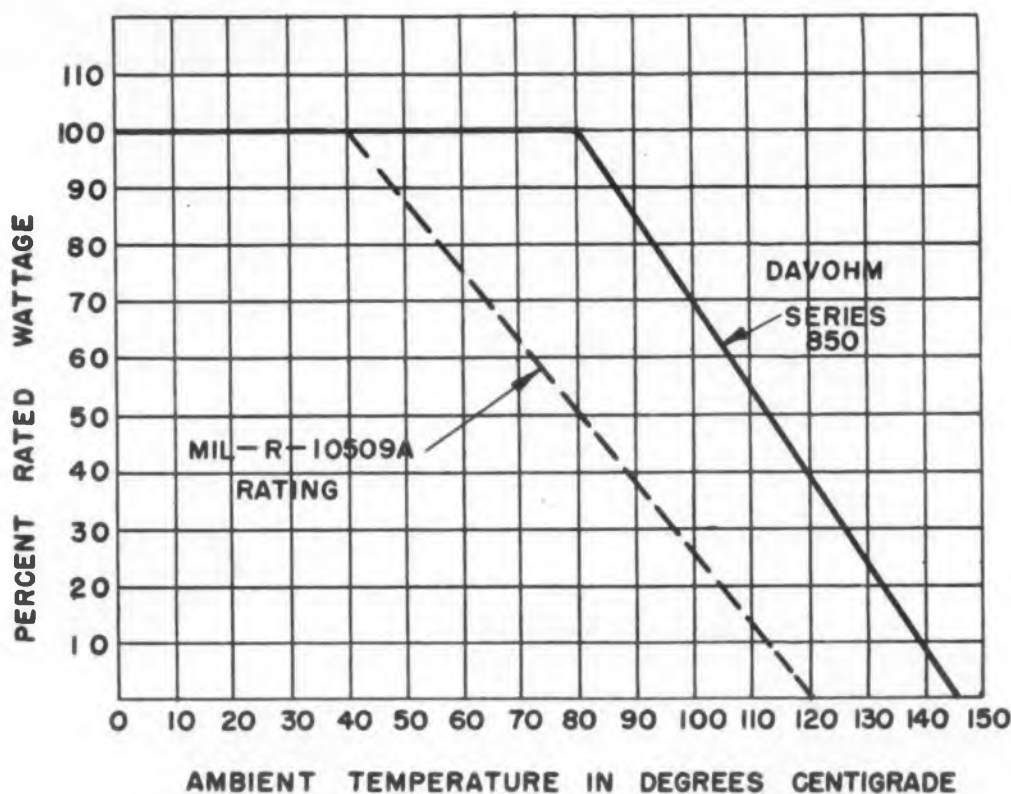
OSCILLOSCOPE RECORDING CAMERAS

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

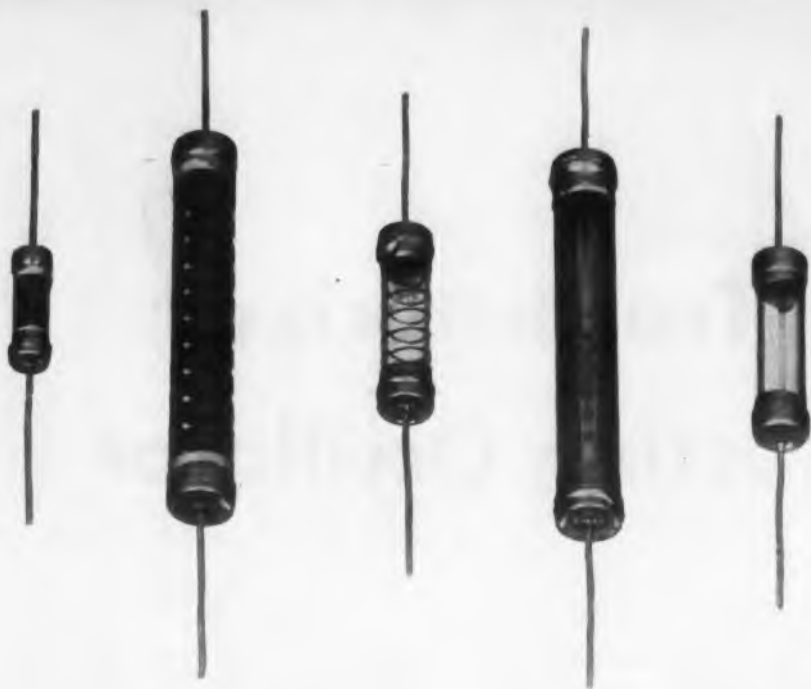
Metal-Film Precision Resistors

COMPARABLE in cost to metal-film precision resistors with ceramic bases, the Series 850 Metal-Film-Type Precision Resistors shown at the right and on the cover feature a design in which the glass tube that

forms the body of the resistor has the resistive element deposited on its inside surface. This construction makes for simple hermetic sealing, high stability, and good mechanical strength. By depositing the



The temperature derating curve for metal-film resistors compared with allowable derating under Government specifications.



The resistive film covers the entire inside glass surface of the resistor at the left. The right-hand unit has parallel strips of film for low inductance.

resistive lines with good uniformity, a low-noise characteristic is achieved.

Resistance variations are obtained by making the resistive film in different shapes as illustrated. Electrical connections are made to the resistive element by silver bands fused to both it and the glass. The end seals are applied with true metal-to-glass seals providing hermetic sealing to more than 60psi.

The noble metal resistance film has the same resistivity and temperature coefficients as the bulk base material, and do not vary with thickness of film. In a 1000hr load-life test, the resistance of units varied less than 0.2%, compared to an allowable change of 1% according to Specification MIL-R-10509A. The units tested showed comparable high performance for the other tests required by this specification. The resistors exhibit a linear and positive change in resistance with change in temperature, with a very low variation in temperature coefficient from one resistor to another.

The resistors are available in the three sizes illustrated with wattage ratings of 1/2w, 1w, and 2w, respectively, and dimensions of 5/8" long x 13/64" diam, 1" long x 1/4" diam, and 2-1/16" long x 21/64" diam, respectively. All three sizes are available in resistance values 10 to 100,000 ohms. Standard accuracies are $\pm 1\%$, $\pm 1/2\%$, and

$\pm 1/4\%$. An accuracy of $\pm 0.1\%$ and other resistance values can be specified. All leads are No. 20 AWG tinned copper wire, 1-1/2" long. By specifying sealing of the end caps to the glass with high-temperature solder, units can be used at full rated power up to 150°C. Where there is the danger of the metal end caps shorting to some other component, these resistors can be supplied with plastic covers over the end caps. These covers add about 1/16" to the diameter and 3/32" to the length of the resistors.

Manufactured by the Daven Co., 191 Central Ave., Newark 4, N. J., the resistors have a very low reactive component of impedance. For units with resistances above 1000 ohms, this component is inherently capacitive with a shunt capacity of about 0.6 to 0.8 μfd . Below 1000 ohms, they tend to become inductive. If high frequency characteristics are important in a certain application, the resistors with metal film covering the entire inner surface of the glass tube are recommended. They can be furnished with resistances to about 50 ohms. If higher resistances are required for the application, the types with metal-film lines that run parallel to the tube's axis can be specified with resistances up to 1000 ohms in all three wattage ratings. For more data on these resistors, turn to the Reader's Service Card and circle **ED-25**.

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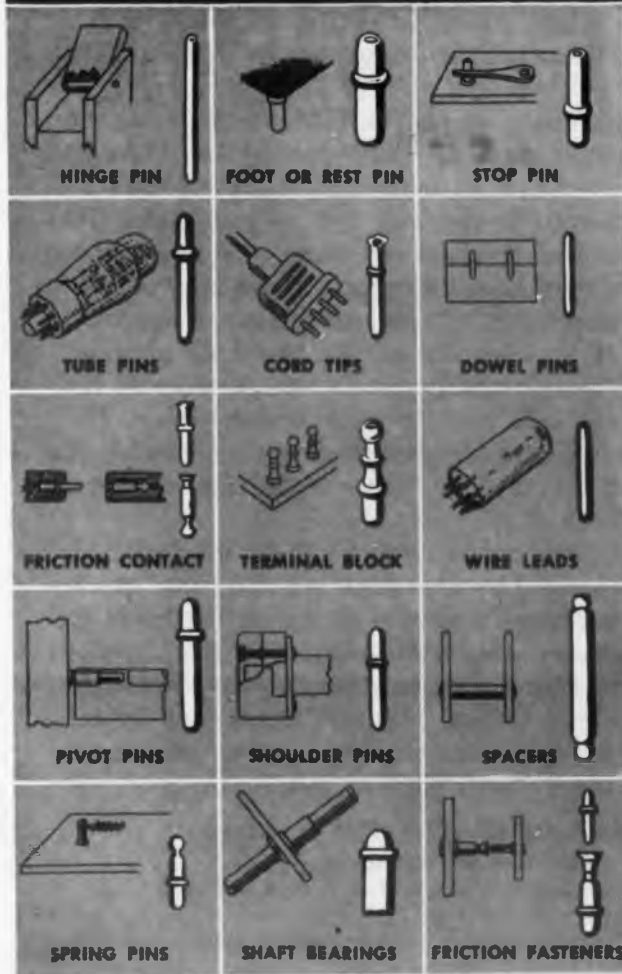
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CIRCLE ED-27 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistorized Testing Oscillator

WEIGHING only 30 oz, the Type 1307-A Transistor Oscillator shown in the photograph is a highly compact source of 400 and 1000cy signals. Useful for making continuity checks of audio equipment, setting operating levels, checking the sensitivity of oscillographs, and as a power source for bridge measurements, it can be held easily in one's hand.

The unit uses a Raytheon Type 721 p-n-p junction transistor in the Hartley circuit illustrated. The inductor of this tuned circuit is an iron-cored coil with an air gap. The germanium diode helps set the bias

voltage for the base. The operating characteristics of this diode approximate those of the transistor emitter-base junction so that oscillations will start for a wider range of temperature, battery voltage, or transistor employed that is obtainable with a linear resistor in the bias circuit. The small resistance in the emitter circuit provides degenerative feedback to improve the waveform.

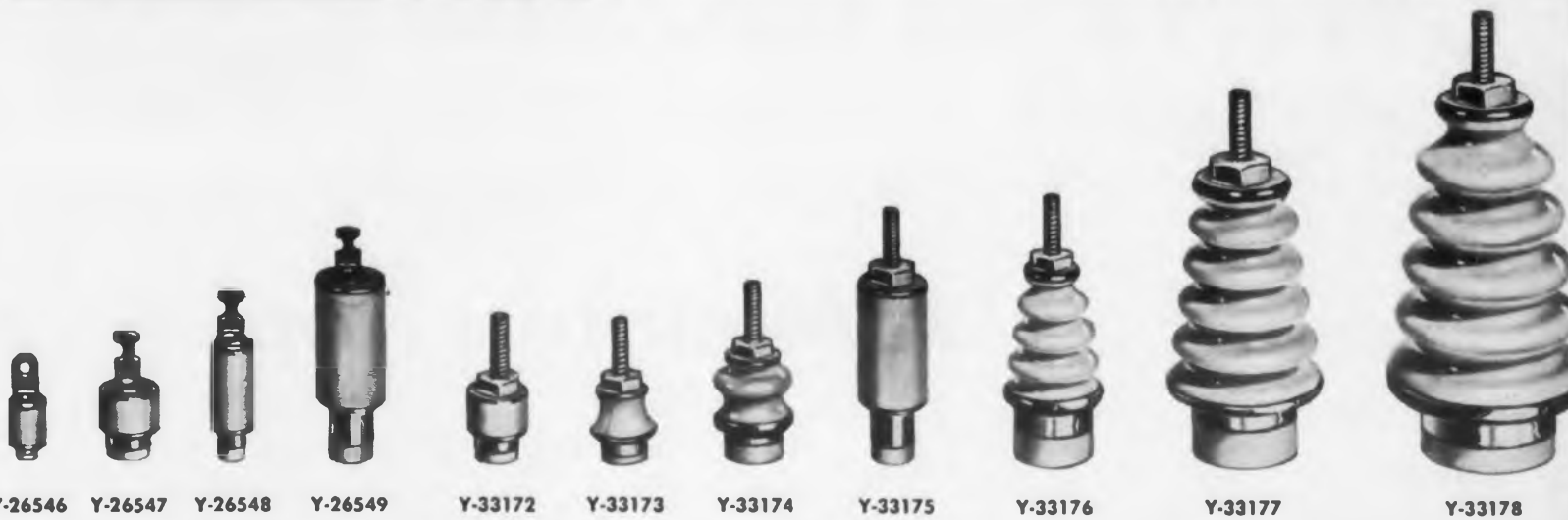
The outputs of the oscillator are 400 and 1000cy accurate to $\pm 3\%$ at 2v output into a 600-ohm resistor. Distortion is less than 5% at 400cy, full output. It may be slightly higher at

The Type 1307-A Oscillator requires no warm-up time, thereby greatly increasing battery life.



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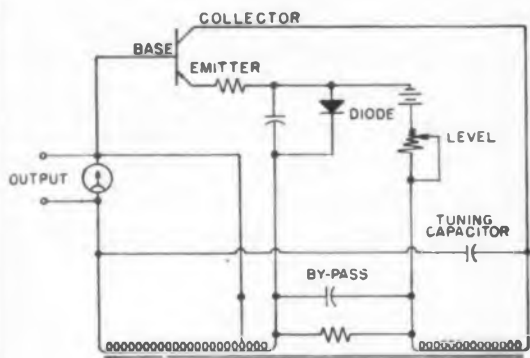
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1000cy. The 2-1/2" output meter reads 3v, full scale. The unit is powered by three mercury "A" batteries, which have an average life of 100hr. No warm-up time is required for the oscillator, which is manufactured by General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Packaged in a 6" x 3-1/8" x 2-1/2" aluminum enclosure, the oscillator is



The Hartley circuit for the oscillator incorporates one transistor and one type 1N34-A diode.

also provided with a leather carrying case. The output is terminated in a 274-MB double plug. Other uses for the unit include standardizing sound measuring equipment and in making preliminary calibrations of electronic systems. For more information on this device, turn to the Reader-Service Card and circle **ED-28**.

- High strength Alumina ceramic
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- Will not deteriorate with time
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- Metal permanently bonded to ceramic
- Reduce "leaker" troubles



Y-25707 Y-26541 Y-26542 Y-26543 Y-26544 Y-26545

The standard terminals shown here are in stock for immediate shipment. Bulletin No. 5410, sent on request, gives complete data. If you cannot use one of our many standards, special sizes or types can be custom made to your drawing. (Delivery on specials will take longer, of course.) Send sample or sketch for price and delivery information.

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CIRCLE ED-29 ON READER-SERVICE CARD ➤

A Miniature Tape Recorder

All parts are readily accessible by removing the enclosure from the "Tapette".



SETTING forth clear-cut design objectives and working towards these goals is a consistently tried-and-true way of producing a well designed product. This was the way in which the "Tapette", a miniature portable tape recorder, was created.

The objectives were to design a unit about the size of a foreign wire recorder known as the "Minifon" whose general features had gained some acceptance in the American market; to use tape instead of wire to avoid the problem of fragility; to make editing easy; and, to give the user a ready means of knowing how much tape had been used and how much was left (a difficult problem with wire). Reels that could be played back in any standard tape reproducer were

to be used, and all the standard operating functions common to tape recorders were to be employed. Finally, the unit was to be constructed for ready servicing by the average technician.

These objectives were cleverly achieved by A. C. Pravis, Jr., who designed the "Tapette", a product of Broadcast Equipment Specialties Co., 135-01 Liberty Ave., Richmond Hill, L. I., N. Y.

This compact unit measures about 6-1/2" x 4-1/2" x 1-1/2", weighs about 2 lb. and can be easily carried about in a coat pocket. Since tape is bulkier than wire, stacked reels are employed as well as 1/2mil "Mylar" based tape, which is about 0.0011" thick compared with ordinary 0.0022" thick tape. The reel

Tape time can be estimated by observing the reel through the window. The wristwatch contains a microphone.

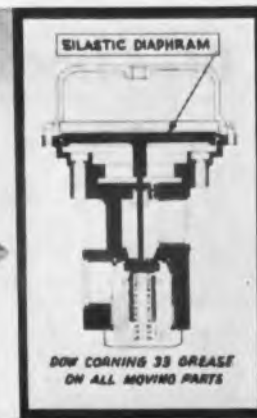


The reels are stacked for a more compact design. The entire unit only weighs 2 lb.

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Silicone News

FOR DESIGN ENGINEERS



DOW CORNING SILICONES SOLVE DESIGN PROBLEM IN FUEL SYSTEM OF WORLD'S FASTEST AIRPLANE

The 1650 mph rocket-powered Bell X-1A is fueled with a mixture of alcohol-water and liquid oxygen. The oxygen supply is held near its boiling point of -297°F and a belt of frost nearly an inch thick collects around the fuel tanks.

The oxygen passes from the supply tanks to the rocket engine through a regulator valve which is controlled by nitrogen gas under pressure. This type of valve works well under normal conditions. At such extremely low temperatures, however, conventional valve diaphragms stiffen and become inoperative. Under certain

conditions oxygen is present in the regulator valve and could, in contact with conventional organic lubricants, cause a violent explosion.

Bell engineers successfully solved these two problems with the aid of Dow Corning silicone products. Silastic 250 was specified for the valve diaphragms. Designed to meet AMS 3302B, Silastic 250 retains its rubber-like properties from below -100 to over 500°F .

The explosion hazard was reduced by using Dow Corning 33, a semi-inorganic silicone grease with a serviceable temperature span of -100 to 300°F . Bell's engineers report that this silicone grease "... is compatible with oxygen and therefore can be used as a lubricant in valves which may be exposed to oxygen. Ordinary grease, when used in such places, would be an explosive hazard." No. 10

Ready to use Dow Corning Silicone Foaming Powders produce heat-stable, nonflammable, easily machined, low density foam structures for electrical and thermal insulation. Can be foamed in place and often cured in service. Recently published data sheet describes applications, properties and foaming characteristics. No. 13

"What's a Silicone?" is the title of a 32 page booklet which answers that often asked question in semi-technical terms. Indexed and illustrated, this booklet has earned an international reputation as the most interesting and informative description of silicones ever published. No. 14

Silicone-glass Laminates Offer Product Designers New Freedom



Silicone and its chemical cousin glass combine here in lightweight structural parts for hot jobs. Dow Corning 2106 is used to bond glass cloth to form laminated tubes, ducts, plates and honeycomb structures. Light, strong and arc-resistant, these parts stand 500°F continuously and short time exposures as high as 700°F . No. 12

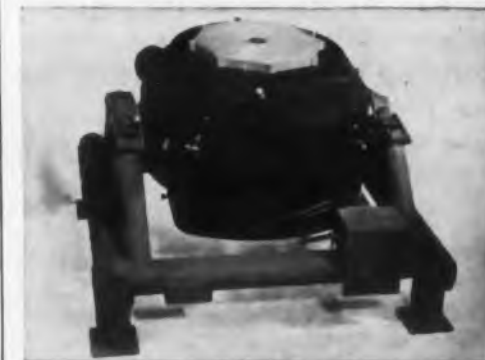
ATLANTA • CHICAGO • CLEVELAND • DALLAS • DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D. C. (Silver Spring, Md.)
Canada: Dow Corning Silicones Ltd., Toronto; England: Midland Silicones Ltd., London; France: St. Gobain, Paris
CIRCLE ED-30 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicone Insulation Protects Shake-Tester Against Overloads

The success of manufacturers producing highly specialized electrical equipment frequently hinges on the trouble free performance of their units. That's why more and more of these manufacturers are building silicone (Class H) insulation into their products.

Take the Calidyne Co. of Winchester, Mass., for example. For six years Calidyne has been manufacturing a line of electro-dynamic "shakers" used to determine the vibration resistance of various assemblies, machines and equipment.

Units to be tested are fastened to a shaker table which is then connected to the armature coil. Vibratory motion is achieved and controlled by the simultaneous passage of an AC current through the armature coil and field of the electromagnet.



No Calidyne shaker has ever been reported burned out, although some are occasionally operated for days at top load. Built in blowers keep the coils cool enough when operated under standard loads. But it's the Dow Corning Silicone Insulation that provides the necessary protection against accidental overloads. No. 11

Design Edition 3

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carries 625' of tape providing 1/2hr in each of two tracks for a total of 1hr of recording time. Tape speed is 3-3/4" sec, which is standard in most home recorders. The 3-13/16" diam reels have a 1" hub. They are designed with a detent to snap into the "Tapette", and a key and hole to fit standard players.

To provide all the standard functions of a tape recorder (record, erase, monitor, reverse at high speed, and playback) only three controls are employed: one for "Forward", "Off", & "Rewind"; one for "Record" and "Play"; and the third for volume. The controls are recessed to eliminate projections from the case.

An interlock arrangement is provided so that the machine cannot be started in the "Record" position until after forward tape motion is stopped. This prevents accidental erasure of the tape. Dialing the "Rewind" function causes the "Play-Record" switch to come to the "Playback" position, where it remains until the forward motion is initiated and the switch is placed in the "Record" position.

To provide economy of manufacture and easy interchangeability, standard parts are employed. The recording head is a standard Brush unit and the amplifier is a standard Centralab "Ampec" Model 3 printed circuit unit, which includes tube sockets for two type CK538DX and one type CK548DX Raytheon sub-miniature tubes. A U.T.C. "Sub-Ounceer" choke is used as well as 22-1/2v batteries for the "B" supply and a pen light cell for the "A" supply.

Stacked Mallory M1 cells (two stacks of 5 cells each with about 15 hrs of life) furnish power for the permanent-magnet field 7/8" diam x 1-1/2" length Globe Industries motor. Use of "Miniature Precision Ball Bearings" helps to reduce the load on the motor.

Provision can be made to operate the "Tapette" from the cigarette lighter outlet in an automobile, or, with a special adapter, it can be run directly from a 110v a-c line. Other accessories such as the "wristwatch" microphone also can be furnished.

Printed Circuit Design

III—Choosing Components for Printed Circuits

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

INCREASING availability of circuit components designed or adapted for use in printed circuit assemblies is making the printed circuit designer's job much easier. Component manufacturers as a group have recognized the need and the large potential market for such items and are responding to it. The purpose of this article is to bring the designer as nearly up to date as possible on the products of this type presently on the market. In addition, components such as inductors and capacitors that can be

Conventional components that do not require modification for use with printed circuits.

Component	Description
Resistors	Carbon composition—up to and including 2w sizes Wire wound types
Capacitors	Tubular paper Tubular electrolytic Mica and silvered mica Ceramic disc Metallized ceramic tubular
Capacitors	(Semi-adjustable) Tubular trimmers Mica trimmers and padders
Coils and transformers	Unshielded wound on paper tube or similar types
Chokes	Radio frequency types
Hardware	Stamped lugs Machined lugs Hollow pins Eyelets Rivets Threaded bushings
Diodes	Semiconductor crystal

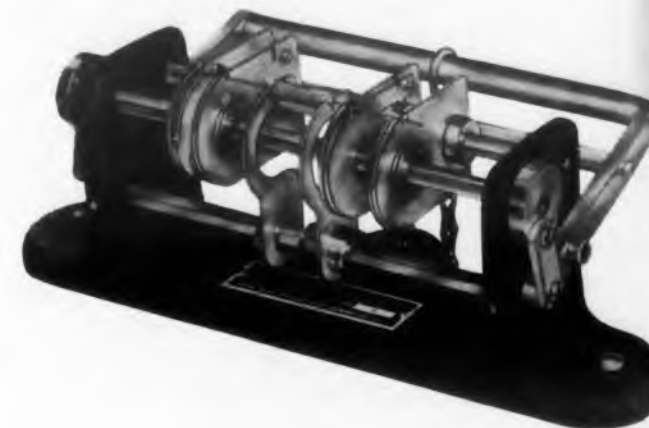
printed by the etched-foil method and included in the conductor pattern will be discussed.

In general, components for printed circuits fall into three categories:

1. Components originally intended for conventional assembly methods that may be used with no modification of design.
2. Components that have been designed or modified specifically for printed circuits (some examples are shown on p. 38).
3. Components that are actually a part of the printed circuit pattern design.

In the first category are such components as resistors, capacitors, coils, chokes, diodes, transistors, subminiature tubes, etc., which have pig tail leads or tabs protruding from the component in such a fashion that they may be easily formed to pass through holes or slots in the printed boards prior to dip soldering. Some manufacturers, such as International Resistance Corp., supply resistors with leads preformed and precut for insertion in printed boards. In the cutting of the resistor leads they are flattened in such a way that they "snap" into the board and are held in position until permanently secured by soldering. Special pliers, which flatten the lead at the point where it emerges from the board and cut it to the proper length, are available. The tool is limited in use because of the limitation on minimum hole diameters in circuit fabrication. Sufficient flattening of the leads to prevent the component from falling out of its lead holes during handling is difficult to obtain.

Most printed circuit assemblers processing large numbers of components with wire lead terminations have constructed machines or fixtures for bending and cutting the leads to the proper size and shape. The various automatic assembly systems now under development (*ED*, September, 1954, pp. 12, 13, 32, and 33) usually provide for hopper feeding of wire

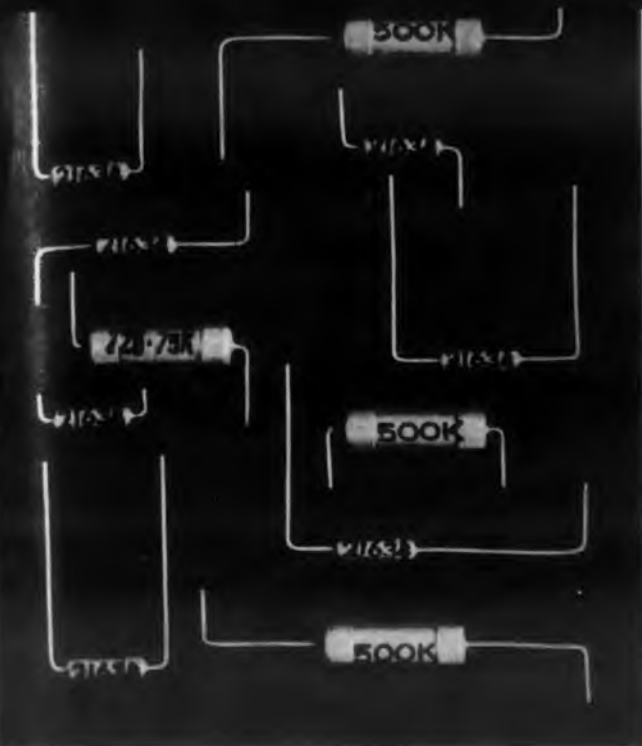


lead components in their presently available form. Such machines would cut, shape, and insert the leads automatically.

The second category includes those components such as tube sockets, i-f cans, volume controls, etc., which were previously mounted on the metal chassis and then connected by wires to other circuit elements. The terminations of these units are usually solder lugs. The approach of the manufacturers has been to adapt existing designs to printed circuits by replacing the former terminations with tabs, wires or other devices which make possible the mounting of the component on the printed circuit board and the dip soldering of all connections. If possible, a "snap on" feature utilizing some spring metal extension is added so that the component is held securely on the board during any handling before dip soldering.

From the assembler's viewpoint the most important component to have been adapted is the tube socket. First to appear were molded sockets whose contacts were modified so that they could be inserted in the board and dip soldered as shown on p. 38. They are made with a key to orient the socket if desired. These sockets are obtainable in various plastic mould materials to suit a variety of applications.

Of particular interest is the appearance of a laminated wafer socket for printed circuit assembly. In addition to a price advantage, the socket offers pattern design flexibility in that shorting bars are un-



Known as the "Pig-Tailor", this production machine shapes the leads of components with axial-leads, as shown above, for insertion in printed circuit boards (Bruno-New York Industries).

necessary since the conductor pattern may be continued across socket terminals. Each socket terminal is inserted into a separate hole into which a component lead may be included.

Connectors are an example of components designed specifically for printed circuits. By designing the printed circuit so that conductors terminating in the connector are brought to a common edge, the circuit board becomes the male portion of the connectors. These connectors are available in varying numbers of contacts for one side or both sides of the printed circuit board. Connecting devices which permit stacking boards in parallel planes or at 90° angles are available (H. H. Buggie, Circon). Other types of connectors where the male portion of the connector is attached to the printed circuit are also available (Cinch, Buggie, Circon).

A switch wafer, for dip soldering into a circuit pattern, otherwise similar to rotary wafer switches and using standard detents, has been designed by Oak Manufacturing Co., Chicago, Ill. Little tabs extending from each contact fit into a circular pattern of slots punched in the laminate.

The table at the right lists all of the components for printed circuitry presently known to the writer.

"Printed" Components

The third group of components are those which are a part of the printed circuit pattern. Small inductors,

These components have been modified for use with printed circuits. Some examples are shown on p. 38.

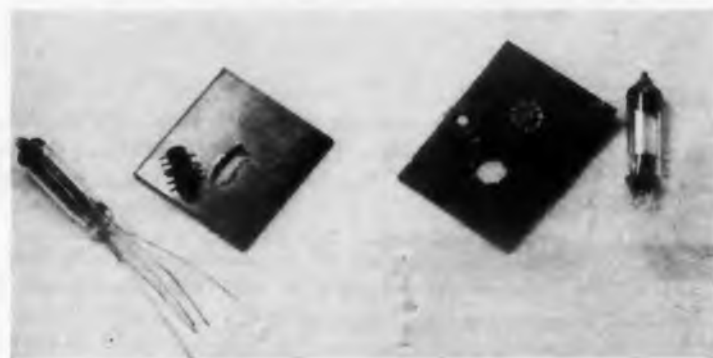
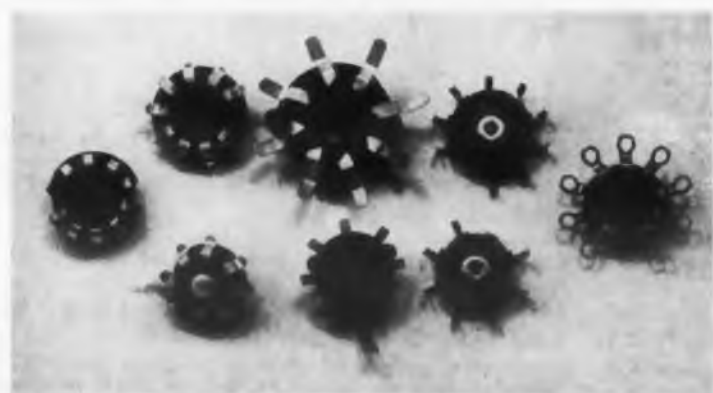
Component	Supplier	Method of Installation
Tube socket, 7- and 9-contact moulded	Cinch Mfg. Co., Chicago, Ill. Hugh H. Eby, Phila., Pa. Methode Mfg. Corp., Chicago, Ill. National Fabricated Products, Inc., Chicago, Ill. Elco Corp., Phila., Pa.	Press into round hole. Design of lugs hold socket in printed circuit. Contact secured by fillet of solder between contact and circuit. Socket supplied with key, if desired, for positioning.
	Mycalex Corp., Clifton, N. J.	Similar to above but contacts secured by eyelets.
	Sylvania Electric Products, Warren, Pa.	Has tabs to penetrate slots in circuit. Designed for mechanical insertion.
Tube socket, moulded-octal	Methode Mfg. Corp.	Mounting same as for 7- and 9-contact types.
Tube socket, laminated wafer 7- and 9-contact	Cinch Mfg. Corp. Industrial Hardware, New York, N. Y.	Fits into circular configurations of round holes. Lugs holds socket in place until soldered.
Tube socket - subminiature types for horizontal and perpendicular tube positioning	Cinch Mfg. Corp.	Extended lugs on socket fit through holes in circuit board.
Variable resistors, volume controls, etc. with or without on-off switch	Centralab Corp., Milwaukee, Wis. Chicago Telephone Supply, Chicago, Ill.	Terminals on controls passed through slots in circuit board held in place by soldered connections. Obtainable with shaft parallel or perpendicular to circuit pattern.
Transformers—i-f types or similar in cans	Automatic Mfg. Corp., Newark, N. J. Raypar, Inc., Chicago, Ill. Radio Corp. of America, Camden, N. J.	Metal tabs in base of transformer penetrate circuit pattern. Snap feature in tabs hold transformer in place pending soldering.
Pulse Transformers	Gudeman Co., Los Angeles, Calif.	Leads in base fit into holes in laminate; dip soldered.
Selenium Rectifiers	Federal Telephone & Radio, Clifton, N. J.	Rectifiers have tabs designed to snap into slots in circuit pattern.
Tuning Condensers	Radio Condenser Corp., Camden, N. J. All Star Products, Defiance, Ohio	Tabs or lugs attached to frame and stator sections penetrate holes in circuit pattern. Held into place by soldering.
Capacitors-electrolytic	Sprague Electric Co., North Adams, Mass. P. R. Mallory, Indianapolis, Ind. Planet Mfg. Corp., Bloomfield, N. J.	Can types. Lugs modified to penetrate circuit board. Modification of tubular electrolytic. Lugs from one end penetrate pattern. Lead from other end passed alongside of container into hole in circuit pattern.
Capacitors-ceramic disc	Centralab Corp., Milwaukee, Wisc.	Short leads or tabs to penetrate circuit pattern. Similar to regular ceramic disc types.
Coupling devices (audio coupling units)	Centralab Corp.	Metal tabs arranged along common edge to penetrate circuit pattern. Held in place by soldering operation.
Rotary switches, wafer type	Oak Mfg. Corp., Chicago, Ill.	Tabs attached to lugs of switch for soldering to printed circuit through holes in pattern. Switch uses some detent and hardware as regular line of switches.
Resistors	Cinema Engineering Corp., Burbank, Calif.	Both leads extend from the same end of the resistor anticipating eventual automatic insertion techniques. (See pp. 40 and 41.)
Connectors	DeJur-Amsco Corp., Long Island City, N. Y. Cinch Mfg. Corp. Winchester Electronics, Glenbrook, Conn. Circon Component Co., Northridge, Calif. Richardson Co., Hollywood, Calif. H. H. Buggie, Toledo, Ohio. (Angular connectors and cord stocking devices are also available from this firm). Viking Electric Co., Los Angeles, Calif.	Connectors consist of a receptacle designed to accept a printed circuit having all conductors terminating in the connector brought to a common edge at right angles to the edge. The circuit board is shaped to fit the connector and is the male portion of the connector. Connectors fit 1/16" and 3/32" thickness boards and polarizing keys may be obtained.

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The spring-metal contacts on this electrolytic capacitor hold the unit in position until dip-soldered (Sprague Electric).



Examples of tube sockets designed for use with printed circuits. The lower photo shows the shapes of holes required in the laminate to receive these subminiature electron tube sockets.

This selenium rectifier "snaps" into the printed circuit board (Federal Telephone and Radio).



An i-f transformer modified for use with printed circuits (Raypar Corp.).



The shaft of this volume control extends through and is perpendicular to the board after mounting (Centralab).



As shown, the printed circuit is the male connector that fits into these connectors (DeJur-Amsco).

capacitors and a variety of wiping contact switches are included in this group. (The subject of printed switches is so broad that space does not permit a discussion here: they will be considered in a later article detailed in this series.)

Capacitors are readily included in the circuit pattern by using the pattern on both sides of the circuit board. The pattern on one side is made slightly larger than the corresponding pattern on the other side to allow for small errors in front-to-back registry in printing.

The formula for parallel plate capacitors may be readily applied:

Capacitance (in micromicrofarad) = $(0.2244KA)/d$
 where: K = Dielectric constant
 A = Area of smallest plate in square inches
 d = Thickness of circuit board in inches

Since etched circuits are usually on materials of 1/16" and 1/32" thickness, these thicknesses are of greatest interest. In terms of these thicknesses for plastics where K equals approximately 5, the 1/16" thickness will result in a capacitance of 20 $\mu\mu$ fd per square inch. Greater capacitance can be obtained in a smaller area through the use of thinner materials. For example, parallel capacitors etched on opposite sides of 0.006" thickness phenolic-impregnated glass cloth have a capacity of about 200 $\mu\mu$ fd per sq-in.

A method of obtaining small capacitance values by interweaving or meshing conductors on a single side of a circuit pattern has been used. The relatively large amount of distributed inductance derived from this method has resulted in little use of this system. Capacitance between adjacent conductors spaced at a distance of 1/32" is less than 1 $\mu\mu$ fd per linear inch of pattern.

Capacitors placed in the central portion of spiral inductors provide the capacitive element of a resonant circuit and, in addition, provide an electrical "feed-through" to avoid the use of an eyelet or other means of "feeding through" the laminate at this point. When this is done, a double space must be provided between the disc and the first turn of the spiral to avoid a lower Q caused by the disc acting as a shorted turn in the coil. This system is particularly useful in L-C resonant circuits such as traps or filters. The plastics used in printed circuits have a high loss factor, as compared to the low-loss ceramic and mica capacitors. Considering the economies in their manufacture however, etched capacitors are a valuable characteristic of the printed circuit.

Inductors

Low value inductors are commonly printed as part of the etched pattern. These inductors are in the form of spirals of varying shapes having a certain mean radius. Small line widths and spacings are desirable

in order to get the maximum number of turns in a small area. There is a limitation, however, in etching a pattern of fine lines and spaces. Line widths and spaces of 0.010" can be printed, but it is recommended that wider lines and spaces be used wherever possible. A common line width and space is 0.015".

As examples of sizes in a spiral coil for a certain inductance, the following are typical:

Inductance (Microhenries)	OD (See nomograph for illustration of OD and ID)	ID	Widths of Lines & Spaces
0.75	7/8"	5/8"	0.020"
1.75	3/4"	3/8"	0.010"
3.50	1-1/4"	1/2"	0.015"

Where two circuits are to be coupled via a mutual coupling design, two spirals are wound about a common center. This method is used in the design of i-f transformers in television receivers and in elements where the capacitance and inductance in such an arrangement is utilized to develop a characteristic impedance. These have been used in connection with transmission line accessories such as baluns.

The Q obtainable in a printed inductance may vary from 50 to 200. The determining factors here are the same as in conventional windings, i.e., the base on which the coil is printed, the size of wire, and surrounding conditions. Coils on paper phenolic laminates display lower Q values than coils on glass fiber-epoxy, phenolic, silicone, and melamine laminates.

The nomograph at the right is useful in the design of spiral coils. The use of the nomograph is demonstrated by the following procedure:

1. Assume a winding pitch of 30 mils (one line width plus one space) and a ratio of average radius to winding depth, "A/C Ratio", of 2.
2. Draw a line through the pitch and A/C Ratio values intersecting the "reflect axis".
3. Draw a second line from this point on the reflect axis to the desired inductance value.
4. Read the number of turns required at the point of intersection with the "turns" scale.

The following formulas derived from the nomograph are helpful to the electronic designer, if other variables are fixed:

$$C(\text{Winding Depth}) = P(\text{pitch}) \times N(\text{turns})$$

$$C(\text{Winding Depth}) = (\text{Outside diam} - \text{Inside diam}) / 2$$

$$A(\text{Average Radius}) = (\text{Outside diam} - \text{Inside diam}) / 4$$

As printed circuitry comes into more general use, standards for lead diameter, hole spacing, and other factors in the design and fabrication of printed circuits will undoubtedly be adopted. In the meantime, the electronic designer must carefully follow the announcements of new products designed for use in printed circuits in order to achieve the best or most economical design.

As this recently discovered letter indicates, printed circuits were being investigated 50 years ago. From Frank Julian Sprague to his business associate, Thomas A. Edison, the letter reads as follows:

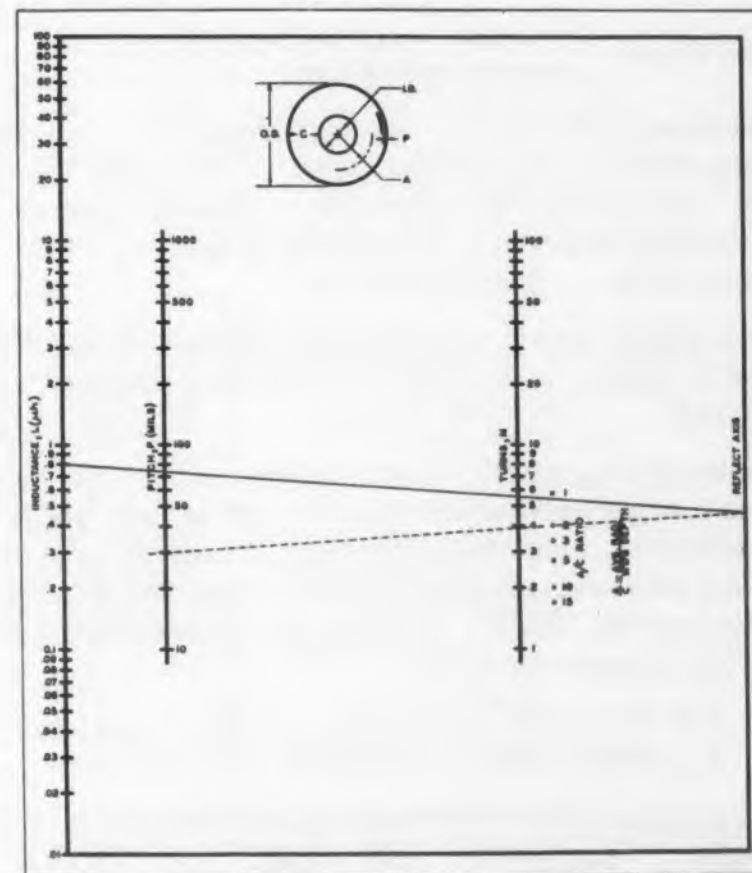
"Dear Edison: As the boss chemist—tell me something. I want to draw a line on a piece of brown paper which will be a fairly good conductor. There are several preparations—of course— but I have an idea you can tell me the best. Sincerely, Sprague."

Edison's pencilled reply on the letter reads:

"Sprague—I really don't know the best thing. Ink thickened with gum and dust over with electrotypers' graphite is one way—ditto gold leaf—strong solution nitrate of silver and reduced to silver by fumes of phosphorus. Also bronze powder made from copper—E."



The upper unit is a high-pass filter combining printed capacitors and inductors. The lower unit is a matching inductive impedance. The inductances are bifilar wound.



A nomograph for designing printed inductors.

Your future's on the rise when you're an
aviation electronics engineer
with **RCA!**



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COMMUNICATIONS

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Specialize in: Radar . . . Analog Computers . . . Digital Computers . . . Servo Mechanisms . . . Shock & Vibration . . . Circuitry . . . Heat Transfer . . . Remote Controls . . . Sub-Miniaturization . . . Automatic Flight . . . Design for Automation . . . Transistorization.

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In these positions at RCA, there's a real engineering challenge. You'll enjoy professional status . . . recognition for accomplishment . . . unexcelled facilities . . . engineering *graduate* study with company-paid tuition . . . plus *many* company-paid benefits. Pleasant suburban and country living. Relocation assistance available.

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Mr. John R. Weld, Employment Manager
Dept. B-506K, Radio Corporation of America
Camden 2, New Jersey



Trms. 96

RADIO CORPORATION OF AMERICA

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

Resistors for Printed Circuits

DESIGNED for automatic assembly on printed circuit boards, the "PW" Series of Precision Wire-Wound Resistors features an indexing key along one side. Entirely encapsulated in an epoxy resin, these units meet the humidity resistance and aging requirements of Specification MIL-R-93A. A group of these resistors is shown mounted on a printed circuit board at the right.

The two terminal leads extend from one side of the cylindrical body, as shown below. One lead is located in the center of the cylinder, while the other is located at the center of the key. The leads for all sizes of the resistors are 1/4" long. The distance between the centers of the wires vary in multiples of 0.025".

Where machinery for the automatic insertion of the resistors into printed circuit boards is not available or undeveloped, the units can be installed manually with special tools. Designers can, therefore, utilize the resistors in present printed

The resistors have a key along one side to facilitate insertion by automatic machinery.



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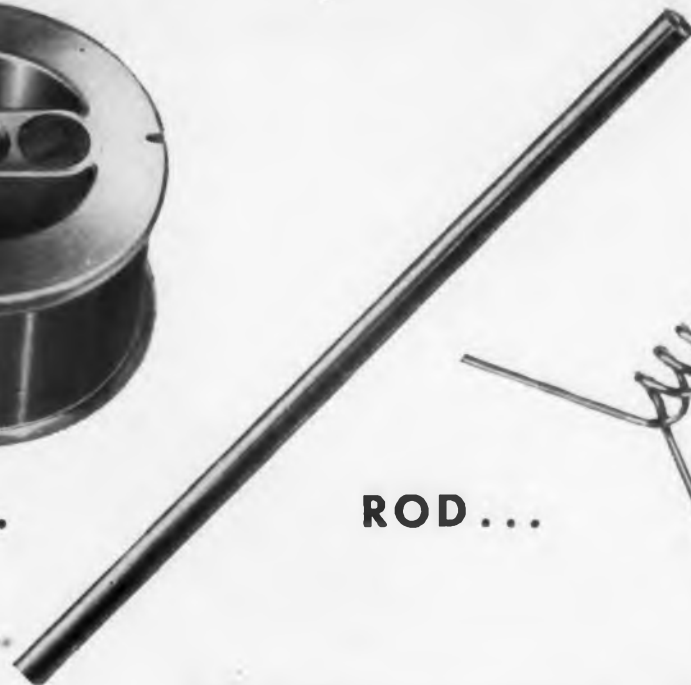
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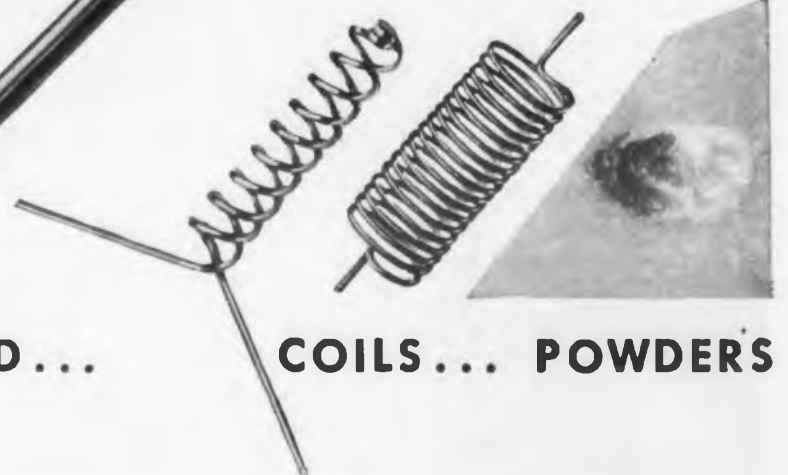
TUNGSTEN AND CHEMICAL PRODUCTS



WIRE ...



ROD ...

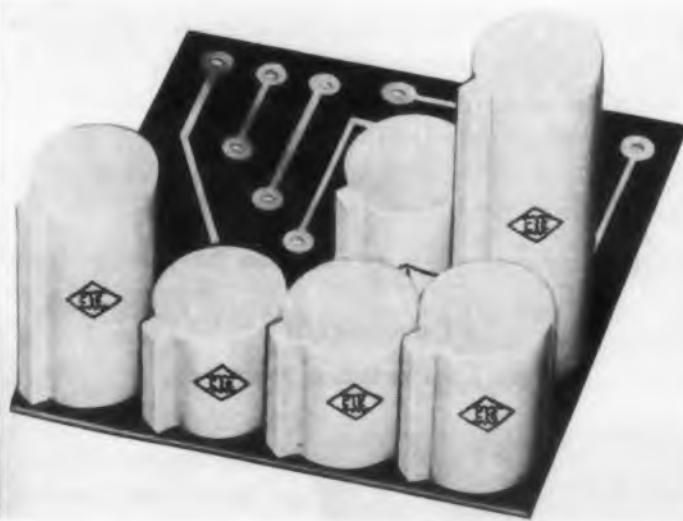


COILS ... POWDERS

circuit designs pending the development of automatic insertion devices.

Manufactured by Cinema Engineering Co., 1100 Chestnut St., Burbank, Calif., the resistors are furnished with ratings from 1/8w to 2w in a wide range of resistances. The units are available in tolerances 1% to 0.05%. The PW100 Series is

A group of PW Resistors mounted in a printed-wire board that was designed with the proper spacing between lead holes.



rated at an ambient temperature of 100°C, while the PW200 Series is rated at an ambient temperature of 125°C.

Body lengths of the resistors, exclusive of leads, vary from 1/2" to 2", with weights of 1gr and 1oz, respectively. The resistance wire is known as "Alloy E", and has a temperature coefficient of resistance of ± 25 parts per million per degree centigrade. For more data on these resistors, turn to the Reader's Service Card and circle **ED-33**.

Sylvania Tungsten wire, rod, and components are quality controlled from ore to finished products and tested in the laboratory and in the field. Suppliers to all leading manufacturers in the radio and television industry, Sylvania offers you tungsten and chemical products that meet the highest standards of purity, precision, and uniformity.

Let Sylvania help you

Sylvania maintains large diversified metallurgical and chemical laboratories for the development and perfection of its many products. Today,

these facilities are also available to help you. Sylvania engineers, Sylvania "know-how," and Sylvania equipment will aid you in product development or in the solution of tough manufacturing problems.

If it's a question concerning anything . . . from a precision, custom-made tungsten wire to a specially-ground tungsten part, or from a high-purity phosphor to germanium dioxide for your crystals . . . put it up to Sylvania. A note on your letterhead will bring you the information you require. Address: Department 4T-1411, Sylvania Electric Products, Inc., 1740 Broadway, N. Y. 19, N. Y.



Initial sintering of a tungsten ingot formed by high compression of tungsten metal powder.



Section of metallurgical laboratory of Sylvania engineering department.

HIGH PURITY SYLVANIA TUNGSTEN and CHEMICAL PRODUCTS NOW AVAILABLE INCLUDE:

Tungsten

Radio Heater and Grid Wire
Support Wire and Rod
Gold Plated Wire
Ground Seal Rod
Formed or Ground Parts
Cut and Bevelled Pieces
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Phosphors

Cathode Ray Tube Phosphors



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

New Products...

Ceramic Capacitor

Rugged, Subminiature Component



The Style "S-3", u-h-f stand-off subminiature ceramic capacitor has rugged characteristics which enable it to be handled in production without the precautions normally used in assembling subminiature parts. It incorporates a tin-plated copper mounting

which almost completely encloses the dielectric material, thus allowing the supporting member to take most of the stress placed upon the wiring terminal and avoiding strain upon the ceramic body that causes failure in less rugged units.

The capacitor may be had in any one of the various types of ceramic dielectric materials, in capacitance values ranging from 2mmfd to 3300mmfd, depending on material used and working voltage rating. Overall height above chassis is approximately 9/16" and mounting area is 5/16" x 1/4", with a 0.127" hole to accommodate a No. 4 or No. 5 screw. The low inherent series inductance of Style "S-3" units makes them especially useful in ultra-high frequency designs. Mucon Corp., Dept. ED, 9, St. Francis St., Newark 5, N. J.

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

Tube Characteristics Sheets

Includes 48 Types

Calculations of tube parameters for circuit design are implemented by the 8-1/2" x 11" tube characteristic curve sheets in the second edition of "Vacuum Tube Characteristics and Design Sheets". Forty-eight of the most popular standard, miniature, and subminiature types are included. Each sheet is removable for use on a drafting table, and it can be kept for record purposes. A short explanation of how to use the design sheets is given. Single sheets are also available for each of the types in the tablet. Vacuum Tube Research, 4624 W. Rosalie St., St. Louis 15, Mo.

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

Potentiometer

1" diam Multi-Turn Design



Eighth in a series of new potentiometers, the Type 920 is designed to offer optimum accuracy, reliability, and versatility in a multi-turn potentiometer with small size, high mechanical rigidity, and electrical stability. With a size of 1" diam x 2-1/2" long, it has 26-1/2" of coil length, making it possible to guarantee an accuracy of $\pm 0.25\%$ standard in a resistance range of 4,000 ohms to 200,000 ohms, with an accuracy of $\pm 0.1\%$ for special applications. Mechanical and electrical rotations are $3600^\circ + 5^\circ - 0^\circ$ standard.

The type 920 is available with three mountings: standard 3-hole mounting, servo mounting, and threaded bushing mounting. The unit is gangable. Single wire all-welded taps can be provided, and it has a 1/4" diam shaft.

Starting torque of 1 oz-in and running torque of 1/2 oz-in make it possible to utilize small servo motors with low power, thus reducing size requirements in equipment. Despite its small size, the unit incorporates all-metal construction throughout the body and supporting members. Fairchild Camera & Instrument Corp., Potentiometer Div., Dept. ED, 225 Park Ave., Hicksville, L. I., N. Y.

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

Potting Compound

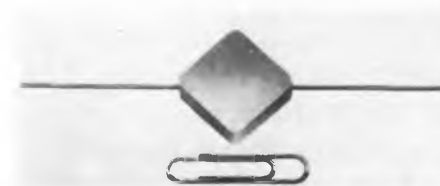
Heat Distortion Temperature of 120°C

"Hysol 6040" is the designation of a new potting compound with a heat distortion temperature of 120°C. It is supplied with Hardener AN, and is for use in potting resistors, capacitors, etc. Heat distortion temperatures were determined in accordance with ASTM D648-45T. Houghton Laboratories, Inc., Dept. ED, 322 Bush Street, Olean, N. Y.

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

Toroid Coil

Postage Stamp Size



This "postage stamp" Toroid Coil consists of a subminiature molybdenum permalloy toroid core with a winding having a residual hole as small as 1/16". Windings are impregnated with a special compound, and the finished coil is encased in a tough epoxy plastic. Tinned No. 20 AWG wire leads are provided. Dimensions are 13/16" x 13/16" x 3/8" thick.

The coil is available in any inductance up to 1h. The useful frequency range covers 1500cy to 150kc, depending upon inductance value. The unit is capable of withstanding temperatures from -55° to $+125^\circ\text{C}$, plus extreme environmental conditions. These coils are also available in the un-encapsulated form, with the winding ends exposed for making direct connections. Un-encapsulated dimensions are only 5/8" OD x 9/32" thick. Hycor Company, Inc., Dept. ED, 11423 Vanowen St., North Hollywood, Calif.

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

Connector

With 15 Pressure Switches



No. 3372 female mating strip is designed for permanent base mounting, and to be used with this firm's

male connectors, Nos. 3367 and 3369. Fifteen pressure type sockets of beryllium copper are provided.

Nominal creep in the design is 3/32". Solder tabs are supplied for No. 20 wire. Plating is gold over silver. Standard insulating material is 3700 green mineral filled phenolic. The strip is also available in mineral filled phenolic type MFE, diallyl phthalate MDG, or general purpose phenolic CFG. H. H. Buggie, Inc., Dept. ED, 726 Stanton St., Toledo 4, Ohio.

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

ELECTRONIC DESIGN • November 1954

Solenoids

Available in 300 Variations



Three hundred different types of custom solenoids may be assembled from 20 standard parts in the Series 100 and 300 lines of d-c solenoids. This feature means that exact requirements of custom-type solenoids can be met without sacrificing economy and interchangeability.

Another unusual feature of the line is simplified change-over to push or pull type by adding a threaded 3/32" diam push rod to any plunger. Other features include miniature, lightweight, compact design; maximum power for minimum size; and a wide variety of mountings, coils and wire sizes. Joseph Pollak Corp., Dept. ED, 81 Freeport St., Boston 22, Mass.

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

Toggle Switches

Can Control Four Circuits



Each assembly in this series of 3-position, panel-mounting, sub-miniature toggle switches has two spdt basic switching units, providing control of as many as four circuits. One basic switching unit is actuated in each extreme toggle position. Neither unit is actuated in the center toggle position. However, due to the fact that there are two spdt switching elements, it

is possible to have three different combinations of two circuits open and two circuits closed at any time.

The maintained toggle positions are detented to provide a positive feel of the position, and momentary positions are spring loaded to return to the center "off" position. The catalog listings and their toggle positions are: 13AT1, "momentary on, maintained off, momentary on;" 13AT2, "maintained on, maintained off, maintained on;" and 13AT3, "momentary on, maintained off, maintained on."

The electrical rating of the switches used in each assembly is: 125/250v a-c, 5amp; 30v d-c, 3amp, inductive at sea level, 2.5amp inductive at 50,000 feet, 4amp resistive at sea level, and 4amp resistive at 50,000 feet. Switches have a standard (AN and/or JAN type) bushing and bat handle. Micro Switch, Dept. ED, Freeport, Ill.

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

PERKIN

WIDE VOLTAGE RANGE
TUBELESS MAGNETIC
AMPLIFIER REGULATED DC

POWER SUPPLIES

ORDER
NOW

IMMEDIATE
DELIVERY!

NO TUBES
TO REPLACE

LOWER
MAINTENANCE
COST

LONGER LIFE

GUARANTEED

CONTINUOUSLY VARIABLE
WITHOUT SWITCHING

MAGNETIC COMPONENTS
UTILIZE HYPERSIL CORES



MODEL MR532-15
5 to 32 VOLTS @ 15 AMPS. (CONT.)

REGULATION: $\pm 1\%$ (a) from 5-32 Volts D.C. (b) from 1.5 to 15 amps. (c) from 105-125 Volts A.C. (Single phase, 60 cps.)

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

RESPONSE: 0.2 Seconds

METERS: 4 1/2" AM and VM

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

MOUNTING: Cabinet or 19" Rack Panel

FINISH: Baked Grey Wrinkle

WEIGHT: 150 lbs.

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

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

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

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

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

WEIGHT: 130 lbs.

FINISH: Baked Grey Wrinkle

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

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

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



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

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

RIPPLE: 1% rms

MOUNTING: Cabinet (or 19" rack panel)

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

FINISH: Baked Grey Enamel

RESPONSE: 0.2 Sec.

WEIGHT: 200 lbs.

METERS: 4 1/2" AM and VM

DIMENSIONS: 22" x 15" x 23"

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

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

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

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

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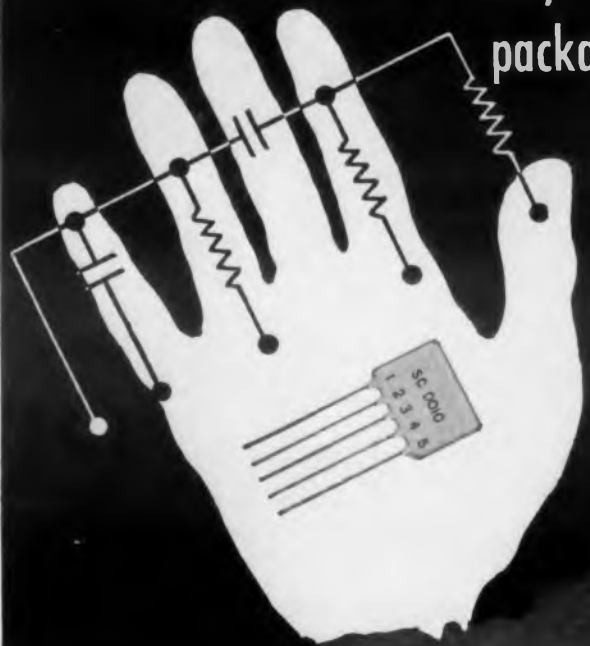
343 E. 11th St., El Segundo, Calif. - Phone 4-3111



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

a handful of components

in one
tiny
package



Stupakoff
Printed Circuits

Space is saved, assembly time reduced and errors eliminated when sturdy, compact Stupakoff Printed Circuits are used. In one tiny package—half the size of a book of matches—few or many accurately rated components—resistors and capacitors—are permanently assembled according to specifications. The only connections to be made are the external leads.

Stupakoff excels in the development and manufacture of Printed Circuits, and today is equipped with modern facilities for the mass-production of dependable units made to your specifications. Write for Bulletin 1151-A.

STUPAKOFF CERAMIC & MFG. CO.
LATROBE, PENNSYLVANIA
DIVISION OF THE CARBORUNDUM COMPANY

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

New Products . . .

Time Delay Relay

In Two Easily Adjustable Ranges



The MEK-2110 is an electronic time delay relay designed for use wherever a dependable, easily adjustable time delay is required. Incorporated are such advantages as ease of installation, long life, and timing accuracy. Two timing ranges are available, 1.5-120sec or 0.75-

60sec. Dpdt load contacts are provided for control of external circuits. Load contacts are rated at 5amp 115v a-c.

Repetitive accuracy, with constant line voltage, is better than $\pm 2\%$. Variations in line voltage will cause a slight increase or decrease in the preset time. Reset time of 3% of set time must be allowed between operations.

The timer allows a choice of two sequences of operation. In Sequence A, load contacts are de-energized during "Reset" and "Timing", and energized when "Timed Out". In Sequence B, load contacts are energized during "Reset", de-energized during "Timing", and energized when "Timed Out". Sequences are obtained by interchanging terminal strip connections. The unit is recommended for interval timing or time limiting operations. Two or more units may be connected together for complex timing sequences. Open or enclosed forms are available, as well as remotely adjustable units. Machinery Electrification, Dept. ED, Northboro, Mass.

CIRCLE ED-98 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supplies With Three Outputs



"Power in a Package" units are designed to give the research man, technician, or designer a wide range of power outputs from one compact cabinet.

The unit illustrated provides regulated power, simultaneously, as follows: 0-600v d-c at 0-500 mls, regulated $\pm 0.25\%$; 6v or 7v d-c at 1.5-15amp, regulated $\pm 0.2\%$; 110-120v a-c, 0-1000va load range, regulated $\pm 0.1\%$. Practical single-cabinet combinations can include a variety of other outputs. Sorensen & Co., Inc. Dept. ED, 375 Fairfield Ave., Stamford, Conn.

CIRCLE ED-99 ON READER-SERVICE CARD FOR MORE INFORMATION

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



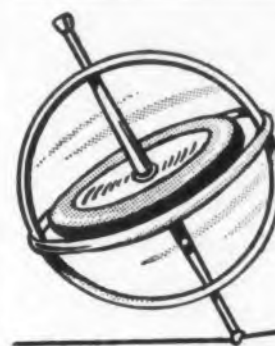
The inspection tool that *lights* and *magnifies*—FLASH-O-LENS—is in daily use at The B. F. Goodrich Company in making laboratory checks on the dispersion of pigments in milled rubber stocks.

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 \$10.95. Write for free literature on applications, types, prices.

E. W. PIKE & COMPANY

492 NORTH AVENUE ELIZABETH 3, N. J.
CIRCLE ED-100 ON READER-SERVICE CARD FOR MORE INFORMATION



CASTELL
push button
LOCKTITE
lead holder has
PERFECT BALANCE

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

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

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

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

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

AW. FABER-CASTELL
PENCIL COMPANY, INC., NEWARK 3, N. J.

CIRCLE ED-101 ON READER-SERVICE CARD FOR MORE INFORMATION

Galvanometer Amplifier Extends Usefulness of Pickups



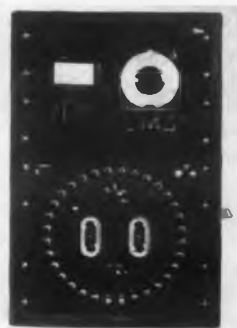
This high input impedance galvanometer amplifier, Model 2609, extends the usefulness of piezo-electric accelerometers, and pressure, force, and other pickups by providing sufficient output current to drive high-frequency galvanometers and magnetic recording heads. The input impedance of 1000 megohms permits useable operation with piezo-electric pickups to below 1cy.

Sensitivity is flat to within $\pm 1\%$ over the frequency range from 1cy to 20,000cy (without transformer) and from 5cy to 5000cy with this firm's Model 2609.1 output transformer. This output transformer will be available as an accessory package, providing a low source impedance for use with high frequency galvanometers and an output of 50ma peak to peak into a 17-ohm load. Without the accessory transformer, an output of 14ma peak to peak into 1000 ohms is available.

The small physical size of the amplifier (1" x 3" x 5-1/2", including the special shockmount) permits its use in close proximity to the pickup, thus reducing the length of high impedance cable required. It will withstand extreme environments of temperature, vibration, shock, etc. The amplifier is applicable for use with gages other than the piezo-electric types, such as strain gages, photocells, and inductive generators. Endeveo Corp., Dept. ED, 689 S. Fair Oaks Ave., Pasadena 2, Calif.

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

Impedance Bridge Handles Multiple Circuits



This automatic impedance bridge was originally developed to test a specific multi-circuit electronic assembly. It checked all circuits completely, including extraneous wiring. It has a built-in audio oscillator to furnish bridge excitation. Provision is made for front panel selection of percentage limit tolerance. It can be readily adapted to test similar electronic assemblies.

The unit illustrated accommodates 30 circuits; it can be re-designed to handle any required number of circuits. Cal-Tronics Corp., Dept. ED, 11307 Hindry Ave., Los Angeles 45, Calif.

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

NOW AVAILABLE! BROADBAND POWER METERS THE CHOICE OF ALL ARMED SERVICES FOR MICROWAVE POWER MEASUREMENTS

POWER { PULSE and CW
5 μ W to 5W average
FREQUENCY { 20MC — 10,000MC
ACCURACY { 5% Absolute at all ranges,
frequencies, temperatures



- ... **INDICATIONS:** Direct Reading
- ... **CALIBRATION:** Compensates for All Variables
- ... **R-F COMPONENTS:** Included, 3, 6, 10 and 20db Attenuators, Bolometer Mount and Elements, R-F Cable
- ... **BOLOMETER:** Broadband, High Overload Capacity
- ... **PLUMBING:** 3/8" and 7/8" 50-ohm Coaxial
- ... **POWER SOURCE:** 115VAC $\pm 15\%$, 50-1000 cps
- ... **CONSTRUCTION:** Rugged, meets all JAN, MIL requirements

**The Standard Item of Test Equipment for
All Broadband R-F Power Measurements . . .**

TYPICAL APPLICATIONS

Microwave Links . . . Television . . . Communications . . .
Radar . . . Telemetry . . . Signal Generators . . .
Laboratory Standards.

Write for descriptive literature to Department BD-11

Bruno - New York Industries Corporation

DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT
460 WEST 34th STREET • NEW YORK 1, N. Y.

CIRCLE ED-104 ON READER-SERVICE CARD FOR MORE INFORMATION

High Resolution Laboratory Standard DC Voltmeters



For most applications these rugged portable, self-contained nulling voltmeters replace a potentiometer, voltbox, galvanometer and standard cell combination. They are suitable for laboratory use, production line testing and field service.

Model LVM-5

Voltage Range: 0-100 Volts DC
Resolution: At least 50 microvolts between 0 and 1 volt
500 microvolts between 1 and 10 volts
5 millivolts between 10 and 100 volts
Absolute Accuracy: $\pm 0.1\%$ of reading
Input Impedance: Infinite at null

Model PVM-4

Voltage Range: 0-600 Volts DC
Resolution: At least 5 millivolts between 0 and 10 volts
50 millivolts between 10 and 600 volts
Absolute Accuracy: $\pm 0.1\%$ of reading
Input Impedance: Infinite at null

Catalog PL-3 describes these instruments completely, including their use as deflection potentiometers, null indicators and millimicroammeters. Copy on request.

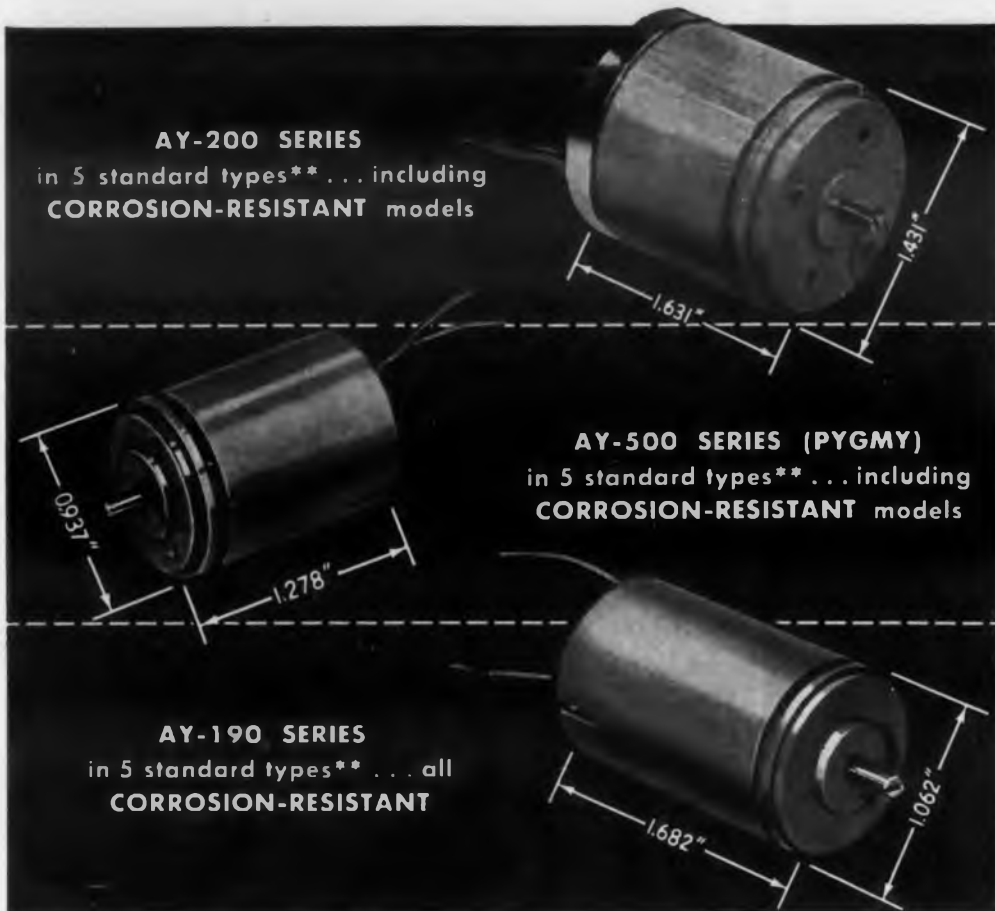
IDA analog computers and accessories are manufactured by Computer Company of America, Division of Bruno-New York Industries Corp. Their usefulness in the field of dynamics has been proven over the years.

A complete line of standard computers, instruments and regulated power supplies is supplemented by the ability to design and manufacture specialized equipment for your particular applications. Your inquiries are invited.

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in 5 standard types** . . . including
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in 5 standard types** . . . including
CORROSION-RESISTANT models

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in 5 standard types** . . . all
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experience, facilities, and production techniques that make possible all these important advantages. So, *whatever* your synchro requirements, it will pay you to see Eclipse-Pioneer.

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TETERBORO, NEW JERSEY

West Coast Office: 117 E. Providencia Ave., Burbank, Calif.
Export Sales: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.



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

New Products . . .

Probe Light Combines Three Functions



With the mirror and plastic probe removed, the handle of this instrument provides a powerful insulated-top flashlight. When the probe is inserted, the light is beamed to the probe tip, which offers a flood of light at the tip end. When the 1-1/2x mirror is slid onto the probe, a powerful illuminated reflection permits ready inspection of tight wiring. In electronic instrumentation, the probe provides a handy light inspection instrument that can be readily carried by an engineer to provide light at the exact desired spot. Moore Manufacturing Co., Dept. ED, Swedesboro, N. J.

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

Noise Figure Meter For Use With Transistors



The Model NFT Transistor Noise Figure Meter is a noise measuring instrument that automatically and accurately measures noise figures of transistors, transistor amplifiers, and related devices. The instrument

eliminates manual, step-by-step noise figure measurement. By automatically comparing the internal noise of the transistor with a calibrated noise source, a continuous direct reading of noise figure is obtained, which reduces the measurement to the status of a simple meter reading.

The noise figure measurement is made to IRE standards and is proportional to one cycle bandwidth at 1000cy. Noise figure range for both transistors and transistor amplifiers is 5-60db ± 1 db accuracy. Noise figure is presented directly on a 4-1/2" indicating meter, and is divided into three ranges for convenience and accuracy in reading. As an aid in simplifying transistor measurement, an internal power supply for supplying both emitter and collector biases is incorporated into the instrument. These biases can be varied over a wide range for optimizing the parameters for minimum noise figure.

The unit is self-contained in a hardwood cabinet, 19" x 8" panel, 13" deep, and operates from an input source of 115v a-c, 60cy. Electronic Research Associates, Inc., Dept. ED, 715 Main St., No. Caldwell, N. J.

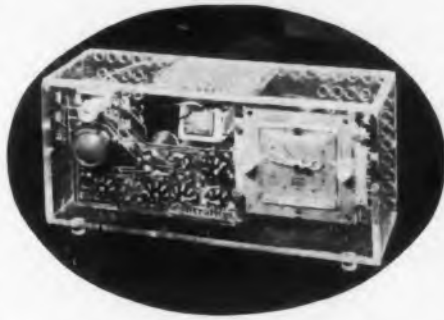
CIRCLE ED-42 ON READER-SERVICE CARD FOR MORE INFORMATION

IN PRINTED CIRCUITS



EXPERIENCE COUNTS!

Experience, more specifically *High Production Experience*, in applicable graphic arts techniques, plastic and metal fabricating methods and precision electro-mechanical component manufacture are important factors in a smooth conversion to use of prefabricated wiring. METHODE places such experience at the service of receiver and equipment manufacturers.



Demonstration model of one of the first commercially successful radios utilizing a prefabricated wiring board furnished by METHODE. Courtesy Hallicrafters Co.

Many of the early leaders (names on request) in the utilization of prefabricated wiring have employed the fortunate combination of equipment and know-how offered by METHODE's established position in the wiring device field. As with other wiring devices utilized in electronics, specialization by a component manufacturer offers producers advantage in quality and economy while permitting concentration on the applications of this new and basic component product.

Write for our new "Printed Circuit Handbook — UTILIZATION OF PREFABRICATED WIRING"



METHODE Manufacturing Company

2021 W. Churchill St.
Chicago 47, Ill.

CIRCLE ED-43 ON READER-SERVICE CARD

Picture Tubes

Feature 72° or 90° Deflection

A 90-degree magnetic deflection 17" picture tube designated the 17AVP4 is supplied with an external conductive coating. Not aluminized, it has a grey spherical face. The tube is electrostatically focused and requires a single-field ion trap magnet. It is only 15-5/8" long. These tubes are for black-and-white reception only.

The new 21" aluminized TV picture tubes are now available. They offer 265 sq in of useful picture area. One of the types is electrostatically focused. The other is magnetically focused, but both use a single-field ion trap. They feature a deflection angle of 72°. They are supplied with an external conductive coating of 750 to 1500 μ fd capacitance. Sylvania Electric Products, Inc., Dept. ED, 1740 Broadway, New York 19, N. Y.

CIRCLE ED-105 ON READER-SERVICE CARD

Powdered Iron Cores

Available from Stock

Known as the "EE" Series, standardized "preferred-type" powdered iron cores designed to meet many radio, TV, and communication needs are available from this firm's stock at substantial savings over custom-made cores. The cores meet the mechanical specifications of the Metal Powder Association. Available types include conventional round cores with threaded brass inserts and threaded cores with either hex holes or screwdriver slots. Electronic Components Div., Dept. ED, Stackpole Carbon Co., St. Marys, Pa.

CIRCLE ED-106 ON READER-SERVICE CARD

More Positions

The sub-headline of a new product notice published on p. 87 of last month's ELECTRONIC DESIGN incorrectly stated that this pushbutton switch has "7 to 12 positions". As correctly stated in the text, the switch, made by General Control Co., Boston, Mass., is made with from 2 to 12 positions.

CIRCLE ED-107 ON READER-SERVICE CARD

Bomac

Band	Type	Freq. (MC)	Max. Conversion Loss db	Noise Ratio (Times)	Max. VSWR	IF Impedance (Ohms)
S	1N21B	3060	6.5	2.0	—	—
S	1N21BR	3060	6.5	2.0	—	—
S	1N21C	3060	5.5	1.5	—	—
S	1N21CR	3060	5.5	1.5	—	—
X	1N23B	9375	6.5	2.7	—	—
X	1N23BR	9375	6.5	2.7	—	—
X	1N23C	9375	6.0	2.0	1.50	325-475
X	1N23CR	9375	6.0	2.0	1.50	325-475
X	1N149	9375	5.5	1.5	1.25	325-475
X	1N23D	9375	5.0	1.7	1.25	350-450
X	1N23DR	9375	5.0	1.7	1.25	350-450

The above diodes may be supplied in pairs wherever their characteristics are matched as follows:

Conversion Loss	± 10%
IF Impedance	± 15 ohms
Rectified Current	± 10%
RF Impedance (VSWR)	Such that unbalance ≤ 10% of available power

SILICON DIODES

Bomac Silicon Diodes are manufactured to exceptionally high standards to assure electrical uniformity and mechanical stability. New design considerations and improved manufacturing techniques have resulted in X- and S-band crystals of increased burnout resistance and higher humidity resistance.

- TOP PERFORMANCE
- UNIFORMITY
- STABILITY



UNIQUE PACKAGE PROTECTION

For complete protection during shipment and storage Bomac has designed a reusable RF Protective Package* which conforms with MIL-E1B specification. Diodes stored in this package are completely protected no matter how many times they are handled after the original seal is broken.

*Pat. applied for



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- DEVELOPMENT
- PRODUCTION

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MODULATORS · CAVITIES

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Write (on your company letterhead)
Dept. ED-11 BOMAC
Laboratories, Inc.
Beverly, Mass.

LOWER YOUR SET COSTS WITH THIS LOWER-PRICED DEPENDABLE SPEAKER

A line of 4" and 5" speakers designed for peak performance. Break off or cast magnet may be used.

Low priced only because of unusually efficient manufacturing techniques.

Produced under rigid quality control. Metal stampings completely manufactured in our own Tool, Die and Punch Press Departments. Exceptionally thorough final inspection.

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Lower your set costs with this dependable speaker. Write for further information TODAY.



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Alvarado St., Los Angeles, Calif. • JOHN J. KOPPLE, 60 E. 42nd St., New York 17, N. Y.

CIRCLE ED-108 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Magnetic Servo Amplifier

Features One Cycle Response



The R40G10W1 magnetic servo amplifier will deliver up to 10w reversible phase a-c output into the control phase of MK7 and MK8 servo motors for reversible phase

a-c or reversible polarity d-c input. Design emphasis has been to achieve minimum size and weight compatible with operation at high temperatures in control or servo systems where one cycle response is mandatory. The reactor unit is only 2-1/2" high x 2-1/4" diam. It weighs less than 12 oz.

The R40G10W1 is completely encased in a molded resin except for the moisture and fungus proofed rectifier, which is supplied for external mounting. It is rated for operation at temperatures up to 85°C with normal servo duty cycles. Containing a minimum number of components, it is designed for ruggedness and long, trouble-free life at minimum cost.

The amplifier can be supplied either as illustrated or with a built-in magnetic, transistor, or vacuum tube preamplifier. In all cases, the only power supply required is 115v 400cy, single-phase. Polytechnic Research & Development Co., Inc., Dept. ED, 202 Tillary St., Brooklyn 1, N. Y.

CIRCLE ED-109 ON READER-SERVICE CARD FOR MORE INFORMATION

Peakpower Meter

For Measurements in X-Band



The "Model 100X" Microwave Peakpower Meter is used with an external synchroscope and standard wattmeter bridge. It provides direct-reading measurements of peak power in X-band transmission systems.

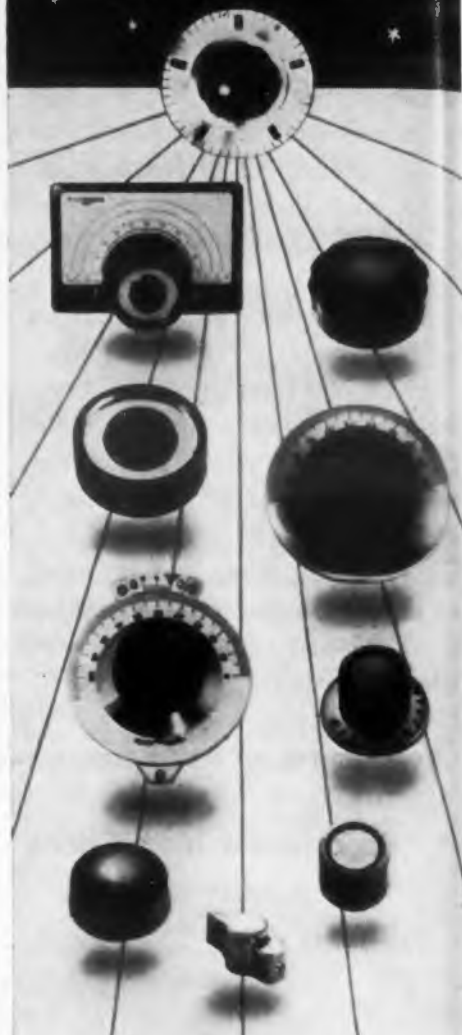
Direct-reading peak power measurements accurate to 0.2db are made of any amplitude-modulated wave train having

the following variables: pulse repetition rate, 10-20,000pps; pulse width, 0.1-10 μ sec; pulse minimum power level, 10 μ w; maximum power level, 3mw. Through the use of directional couplers or attenuators of known characteristics in the transmission system, direct-reading peak power measurements at any level up to the megawatt region are quickly and accurately accomplished. Cubic Corp., Dept. ED, 2841 Cannon St., San Diego 6, Calif.

CIRCLE ED-110 ON READER-SERVICE CARD FOR MORE INFORMATION

PRECISION components

tuned to tomorrow



POPULAR DIALS AND KNOBS

For years, NATIONAL dials and knobs have been the popular choice of amateurs, experimenters, and commercial users.

NATIONAL dials feature smooth, velvety action, easily-read scales and quality construction. Many dials, like the N and ACN dials shown, can be specially calibrated or supplied with blank scales for commercial applications.

NATIONAL knobs — distinguished by their clean, functional, chrome and plastic styling and sturdy construction — are the most popular of their type ever produced. All fit 1/4" shafts. For commercial applications, they can be supplied in special colors and with special calibrations.

Write for new NATIONAL catalog of dials and knobs to Dept. ED-1154

 **National** 

NATIONAL COMPANY, INC.
61 SHERMAN ST.
MALDEN 48, MASS.

CIRCLE ED-111 ON READER-SERVICE CARD

The Model TC-2 Temperature Test Chamber is a portable, self-contained, easy-to-operate unit ideal for laboratory and production line use. Write for literature.

Temperature Range: -65°F to $+350^{\circ}\text{F}$.
 Holding Accuracy: $\pm 2^{\circ}\text{F}$.
 Coolant: Dry ice, 15 lbs. capacity.
 Dry Ice Loading Port.
 Heater: Electric Strip Heater.
 Controls: Thermostat, balancing heat against dry ice evaporation. Permanent Thermometer.
 Test Load Access: Removable tray, with 15 through ports.
 Test Load Capacity: 600 cubic inches.
 Power Requirements: 115 volts, 5 amperes, 50-60 cycles, single phase.

STATHAM DEVELOPMENT CORPORATION
 12411 W. Olympic Blvd., Los Angeles 64, Calif.

MODEL
TC-2

FOR RAPID AMBIENT
 TEMPERATURE TESTS

**PORTABLE
 TEMPERATURE
 TEST CHAMBER**

PRICE \$550.00

F.O.B. LOS ANGELES

CIRCLE ED-44 ON READER-SERVICE CARD

Voltmeter

Measures Short Duty Cycle Pulses



Model VM-1 is a portable, true peak reading, vacuum tube voltmeter capable of measuring pulses with very short duty cycles. Designed to operate over a wide bandwidth (50-

cy to over 100Mc), it can be used to measure positive peak, negative peak, or the peak-to-peak voltage of a waveform. Voltage range is 100v full scale, with multipliers available to 30kv, designed to permit rapid selection of voltage ranges. The actual measuring elements are housed in a probe, to allow direct connection to the voltage source with a minimum of shunt capacity and series inductance. A convenient probe storage compartment is included.

Circuitry consists of a pair of diodes, housed in the probe, which are arranged to give a positive d-c output voltage equal to the peak positive, peak negative, or peak-to-peak voltage being measured. This voltage is fed to a stabilized feedback amplifier utilizing an electrometer tube which drives the indicating meter. The detector and amplifier circuits and components are of such a nature that the back resistance of the diode detector is greater than 10^{12} ohms, giving an exceptionally long discharge time constant to the whole circuit. All critical voltages, including the electrometer tube filament and diode filaments, are regulated. Gertsch Products, Inc., Dept. ED, 11846 Mississippi Ave., Los Angeles 25, Calif.

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

Header

Crack-Proof, Hermetic Unit



This hermetic seal header entirely eliminates the use of glass or ceramics as well as thermal shock and expansion problems. It meets the MIL-T-27 Moisture Resistance

Test with polarizing voltage, and is the smallest compression seal available from this firm. It is being made in production quantities with any number of terminals from 2 to 16. Industrial Accessories, Inc., Dept. ED, Long Branch, N. J.

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

WIDE-BAND ELECTRONIC SWITCH

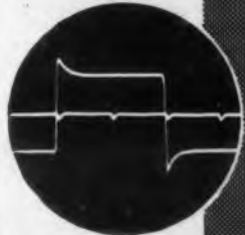
DC to 15 MC

Dual Trace

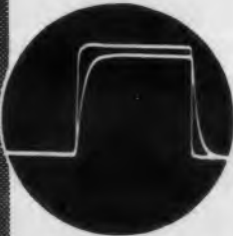
Oscilloscope Presentations



Model ES-180



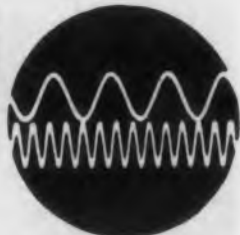
Overshoot,
Rise-Time Duration
Measurements



Accurate Shape, Time,
Amplitude Comparisons



Simultaneous Display
of Related Waveforms



Simultaneous Display
of Non-Sync. Signals

- Signals displayed on alternate sweeps, switched at sweep-end, rate to 100 kc
- Amplifier rise-time .023 microseconds, megohm input, 93 ohms load impedance
- Unity-gain, feedback, regulated power supplies for linearity and stability
- Index trace calibrated in volts and % amplitude eliminates parallax errors
- Time-signal input allows accurate and rapid measurement of pulse parameters

TELETRONICS LABORATORY, INC.

54 Kinkel St., Westbury, L. I., N. Y.

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

Type 1 for steel
Type 23 for die castings

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THREAD-CUTTING SCREWS

They actually cut their own mating thread in metal or plastic... just drill and drive! Because each screw remains in its own self-cut thread... fighter, stronger fastenings are certain!

SEND FOR
FREE TEST KIT OF TYPE 1
OR TYPE 23 AND 25 NOW!

Type 25 for plastics

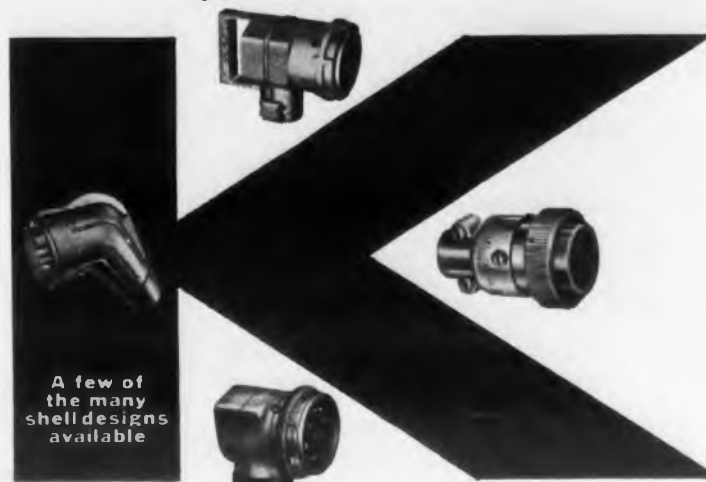
SHAKEPROOF
"Fastening Headquarters"

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

CIRCLE ED-322 ON READER-SERVICE CARD FOR MORE INFORMATION

Specify Cannon **K** Connectors!

All-Purpose • Versatile • Stable Design



A few of the many shell designs available

- You'll find—
- Special Acme thread for rapid disconnect
 - Improved insulating materials
 - 10 to 200 amp. contacts
 - Thermocouple contacts
 - Integral clamps
 - Miniatures
 - Hermetic sealed units
 - High temperature types
 - Widest variety of circuitry
 - Complete line of fittings and accessories
 - Shielded single and twin co-axial contacts

Popular groups of K units are available near you from many Cannon distributors

CANNON PLUGS

Please refer to Dept. 143 in requesting K-5 Bulletin
CANNON ELECTRIC COMPANY 3209 Humboldt St., Los Angeles 31, Calif.
Factories in Los Angeles; East Haven; Toronto, Canada; London, England
Representatives and distributors in all principal cities.

CIRCLE ED-323 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Rejection Filter

With Attenuation Over 50db



The use of high-stability, accurate, precision wire-wound resistors, coupled with selected silver mica condensers, has resulted in the development of a stable twin "T" bridge type 60cy rejection filter, with attenuation greater than 50db. Known as the "T-100 CW", it is encased in a plug-in type can, measuring 2" x 2" x 3", with a tube socket base for easy mounting. This rejection filter can be made with mechanical design variations. It is also available for rejection of other frequencies on special order. Eastern Precision Resistor Corp., Dept. ED, 130-11 90th Ave., Richmond Hill, N. Y.

CIRCLE ED-325 ON READER'S SERVICE CARD FOR MORE DATA

Oscilloscope

For the TV Laboratory



The Model 104, a 7" oscilloscope, is an exceptionally high-gain, wide-band instrument created especially for designing and servicing TV receivers. Its vertical sensitivity is 10mv per inch, and vertical response is flat from 10cy to 2Mc, and useful to 4Mc. A faithful square wave response is available to 500kc, and the instrument has excellent tilt, rise-time, and overshoot characteristics. A four-position frequency-compensated step attenuator and a low-impedance, distortion-free smooth attenuator insure undistorted wave shapes at any gain setting.

The instrument has low internal hum level, and an input impedance of 5.0 megohms and 26mmfd for negligible circuit loading. High voltage and demodulator probes are included as accessories. It is supplied with a Type 7VP1A (green trace) tube and can use a standard 7" picture tube, Type 7JP4 (white trace). Weight is 50 lb. Color is grey with wrinkle finish. Sylvania Electric Products, Inc., Dept. ED, 1221 W. 3rd St., Williamsport, Pa.

CIRCLE ED-326 ON READER'S SERVICE CARD FOR MORE DATA

Here is a pair of "Problem-Solvers"
For Designers of Electrical Control Systems

FRAHM REED RELAYS

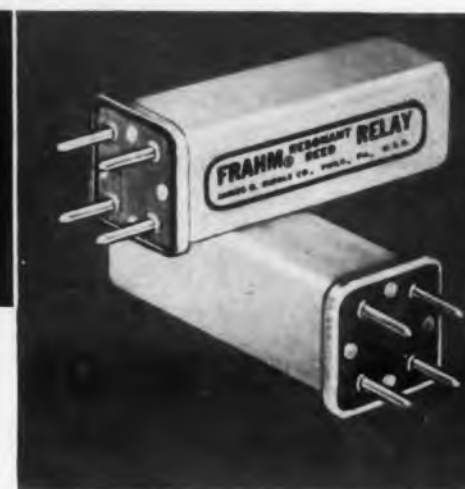
FRAHM OSCILLATORS



Frahm Resonant Reed Relay is an electro mechanical device which responds to an alternating signal having frequency and amplitude values that lie within specified bands. A number of control signals over a single circuit is possible with all types of communication circuits, including radio. A signal is transmitted either on a wire line, or as a modulated carrier to some remote location

where it operates a reed relay to indicate the control function at that point. Since each reed relay will respond only to a narrow band of frequencies, it is possible to operate a number of relays simultaneously by making use of an equal number of source generators arranged so that none of the operating frequency bands overlaps. In a range of 200 to 500 cycles it is possible to operate up to 16 channels with no interference.

Frahm Oscillator controls are miniature tuning forks for use in electronic oscillators to provide stable output frequencies. By their use good sine wave signals with output better than 1 volt can be obtained. They are available for any frequency in the range of 50 to 1000 cps with accuracies better than 0.2%. A series of standard units is available to match the standard Frahm Reed Relays.



Frahm Reed Relay and Oscillator combinations may be used for controlling, signalling, monitoring, and protection and frequency matching. Check coupon for new bulletin on Frahm Relays and Frahm Oscillator Controls.

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1316 Arch St., Phila. 7, Pa.
Gentlemen:
Please send me Bulletin 33-ED—
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Oscillators

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CIRCLE ED-324 ON READER-SERVICE CARD FOR MORE INFORMATION



What Makes A Good Industrial Housing?

A good industrial housing is made to solve *your* particular need! Its shape, size, metal, and finish meet *your* requirements for future usage. It consists of the *finest* quality in design and workmanship, yet is *inexpensive* and *quickly* available.

These are exactly the advantages of ordering OLYMPIC Metal Housings because OLYMPIC offers you:

PROMPT DELIVERY at Mass Production Prices from a stock of over 3000 Sizes and Shapes.

FABRICATED & DRAWN—ASSEMBLY & MODIFICATION SERVICE.

COMPLETE Sample Shop, Design, Engineering & Production Facilities.

For more information write for illustrated folder RE-4 Today!



STANDARDIZE WITH
OLYMPIC

METAL PRODUCTS COMPANY, INC.
ALPHA, NEW JERSEY

CIRCLE ED-112 ON READER-SERVICE CARD

Capacitors

Require No Derating at 130°C



This series of "Miniroc" tubular sub-miniature capacitors requires no voltage derating at +130°C, and provides maximum moisture resistance, exceeding MIL-C-91 requirements. These improved characteristics are made possible through the use of steatite-tubular cases, "Mylar" polyester dielectric, and special processing techniques. Exceptionally high insulation resistance is achieved throughout the entire temperature range.

To insure low r-f impedance, the non-inductively wound extended foils are firmly soldered to the wire leads. The capacitor ends are sealed with "Polykane" fill, which tightly bonds to the steatite walls and to the lead wires to prevent the entrance of moisture, thus enabling the units to withstand extremes of handling, soldering temperature, and vibration. Cornell-Dubilier Electric Corp., Dept. ED, S. Plainfield, N. J.

CIRCLE ED-113 ON READER-SERVICE CARD FOR MORE INFORMATION

Toroid Inductors

In Values from 1.5mh to 4.7h



TYPE SL-II

TYPE SL-14

These inductors are particularly suited to applications requiring small size, wide range of inductance values, high Q, and high astaticism. They are ideally suited for use as inductor

elements in vacuum tube and transistor circuits, as well as in wide-range filter networks and other applications requiring a compact and durable inductor.

Coils are toroidally wound on "Ferroxcube 3C" cores with coated wire. Wound coils are checked for inductance and Q and then vacuum impregnated with tropicalized r-f wax. These inductors combine the inherently efficient structure of the toroid with the excellent characteristics of these high permeability cores.

Inductors are compact and occupy a minimum volume of space, and operate over a wide frequency range (5-500kc). They are offered in values of inductance from 1.5mh to 4.7h. Nominal tolerance is $\pm 5\%$, with other tolerances available on special order. Sizes range from 1-5/8" to 2-7/8" OD and 7/16" to 11/16" high. Mico Instrument Co., Dept. ED, 80 Trowbridge St., Cambridge 38, Mass.

CIRCLE ED-114 ON READER-SERVICE CARD FOR MORE INFORMATION

It takes more than parts to make an

ARGA RESOLVER



15 size 23 size
Uncompensated
Resistor compensated
Feedback winding compensated

maximum error

Grade 1 — .05%
Grade 2 — .10%
Grade 3 — .20%

Null voltage less than
1 millivolt per volt
Built to military
specifications

Write for data file, 10-11



Arga division

BECKMAN INSTRUMENTS, INC.

220 PASADENA AVE., SOUTH PASADENA, CALIFORNIA

CIRCLE ED-115 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Porous Carbon Has High Conductivity

A highly porous yet extremely fine grain carbon is 75% air, but retains the usual desirable characteristics of carbon, such as high electrical conductivity, resistance to chemicals, and stability at high temperatures.

Its extremely fine grain results in a large carbon surface despite the high porosity. The product is available in blocks or sheets up to approximately 10" x 10", and comes in practically any thickness to 1-1/2". Stackpole Carbon Co., Dept. ED, St. Marys, Pa.

CIRCLE ED-116 ON READER-SERVICE CARD

Casting Resin

Has Wide Temperature Range

"Stycast" 2850 GT casting resin can be used from -100°F to +400°F. For short periods it can be used at 500°F. The cured plastic has a low thermal coefficient of expansion, approximately the same as that of aluminum and brass. This means that even large metallic inserts can be embedded without cracking on temperature cycling. Another important feature is low shrinkage during cure. It has a dielectric strength of 455v/mil. Emerson & Cuming, Inc., Dept. ED, 869 Washington St., Canton, Mass.

CIRCLE ED-117 ON READER-SERVICE CARD

Magnetic Tapes

On High-Strength Backing

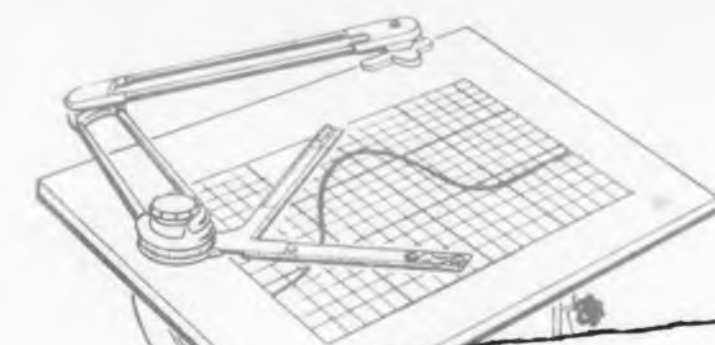
Magnetic tapes No. 111AM and No. 120AM are now available with high-strength polyester backing as well as conventional acetate backing.

The backing has a tensile strength enabling the 1/4" wide tape to withstand a 9-lb pull. The tapes, which are silicone "dry-lubricated", are available in standard 1/4" width on 1-1/2mil backing in 600-, 1200-, 2400-, and 4800-ft lengths. Minnesota Mining and Manufacturing Co., 900 Fauquier St., St. Paul 6, Minn.

CIRCLE ED-118 ON READER-SERVICE CARD

CIRCLE ED-119 ON READER-SERVICE CARD ➤

DESIGN IS OUR BUSINESS



TYPE X-80 SHUNT DIODE & RECTIFIER

Featuring—
1. Bonded thorium tungsten core filament for ruggedness and high electron emissivity.
2. Graphite anode for maximum dissipation.
3. Isolated getter traps for hard vacuum.

MAX. DIMENSIONS:
Ht. 9.75"
Diam. 3.36"

RATINGS:
Ef 11.5 volts
If 15.5 amps
shunt diode
epx 40 kv
ib 80 amps
Ib 75 mAdc
rectifier
epx 40 kv
ib 2.5 amps
Ib 800 mAdc



TYPE 576 SHUNT DIODE AND RECTIFIER

Designed for radar applications, radio and TV transmitter high voltage supply.

MAX. DIMENSIONS:
Ht. 7.75"
Diam. 2.312"

RATINGS:
shunt diode
Ef 5.4 volts
If 15 amps
epx 25 kv
ib 12 amps
Ib 30 mAdc
rectifier
Ef 5 volts
If 14 amps
epx 25 kv
ib 2.5 amps
Ib 500 mAdc



TYPE 583 CLIPPER DIODE RECTIFIER

A powered-up and ruggedized recast of World War II JAN type 3B26.

MAX. DIMENSIONS:
Ht. 5.12"
Diam. 1.445"

RATINGS:
Ef 2.5 volts
If 4.9 amps
clipper diode
epx 15 kv
ib 8 amps
Ib 20 mAdc
rectifier
epx 17 kv
ib .250 amps
Ib 65 mAdc
Altitude rating—35,000 ft.
Shock rating—375 G



TYPE 577 HALF-WAVE RECTIFIER

Revised size version of JAN type 577B, designed for use in radio and other applications where compact size is important.

MAX. DIMENSIONS:
Ht. 7.5"
Diam. 2.06"

RATINGS:
Ef 5 volts
If 10.3 amps
Ib 25 kv
Ib 1.5 c
Ib 300 mAdc



TYPE 590 WAVE RECTIFIER

High altitude version of JAN type 590A.

MAX. DIMENSIONS:
Ht. 5.5"
Diam. 1.5"

RATINGS:
Ef 5 volts
If 10.3 amps
Ib 25 kv
Ib 1.5 c
Ib 300 mAdc

cond. in p
epx
ib
Ib
choke in
epx
ib
Ib
Altitude
conditi

Design is the vital industrial element from which all progress stems. It is that *something* which makes an electronic component move smoothly through its own production processes, and perform faithfully in its service environment.

We at UNITED ELECTRONICS are singularly devoted to design. Our facilities are designed to serve efficiently a modest but important segment of a great market. Our tubes are designed for outstandingly reliable use in special purpose devices.

Indeed, DESIGN IS OUR BUSINESS.

Since World War II we have specialized in electron power tubes of improved and modernized design. This program has been channelled toward two general objectives:

- (a) The re-design of existing types to make them smaller, more rugged and more reliable without diminution of original power ratings.

- (b) The creation of new tubes—many of which have been officially adopted by the government as military types.

The very largest manufacturers of electronic equipment absorb a major portion of our production. We work in close liaison with them as to new performance objectives and new tube needs for commercial as well as military applications.

All tubes illustrated above are high vacuum types developed by UNITED ELECTRONICS for exacting duties which no previous tubes of comparable size could handle.

We shall be glad to have your inquiries.

OUR BUSINESS

TYPE 577 HIGH-WAVE RECTIFIER

Reduced size version of JAN 718, designed for use in other installations where compactness is important.

MAX. DIMENSIONS:
Ht. 7.5"
Diam. 2.06"

RATINGS:
Ef 5 volts
If 10.3 amps
Ib 25 kv
Ic 1.5 amps
Ib 300 mAdc



TYPE 578 HALF-WAVE RECTIFIER & SURGE LIMITING DIODE

Reduced size version of JAN 8020 designed for airborne and other installations where compactness is important.

MAX. DIMENSIONS:
Ht. 6.5"
Diam. 2.07"

RATINGS:
rectifier
Ef 5 volts
If 6 amps
Ib 40 kv
epx 750 ma
Ib 100 mAdc
surge limiting diode
Ef 5.8 volts
If 6 amps
Ib 12.5 kv
epy



TYPE 582 HALF-WAVE RECTIFIER

High vacuum tube for use in lieu of gas tubes in airborne equipment.

MAX. DIMENSIONS:
Ht. 5.75"
Diam. 1.57"

RATINGS:
Ef 2.5 volts
If 5 amps
Ib at 60,000 ft. alt. 7 kv
epx 1 amp
Ib 250 mAdc
Ic 40 (min.) sec.
Ic surge 5 amps
Ib at 55,000 ft. alt. 9 kv
epx 210 mAdc
Ib Full ratings apply for supply frequencies up to 500 cps.

TYPE 596 FULL WAVE RECTIFIER

High altitude version of JAN 1641.

MAX. DIMENSIONS:
Ht. 5.75"
Diam. 2.250"

RATINGS:
Ef 5 volts
If 3 amps
cond. input
epx 2300 volts
Ib 825 ma
Ic 275 mAdc
Ib i-surge- 2.75 amps

epx 4500 volts
Ib 165 ma
Ic 55 mAdc
Eo 2000 Vdc

choke input
epx 2750 volts
Ib 360 ma
Ic 275 mAdc
Ib Altitude rating under above conditions—60,000 ft.



TYPE 3B24WA HALF-WAVE RECTIFIER

Ruggedized version of JAN 3B24W.

MAX. DIMENSIONS:
Ht. 4.8125"
Diam. 1.5625"

RATINGS:
Ef 5 volts
If 3 amps
Ib 20 kv
epx 300 ma
Ib 60mAdc
with 1/2 filament
Ef 2.5 volts
If 3 amps
Ib 20 kv
epx 150 ma
Ib 30 mAdc
Shock Rating 450 G

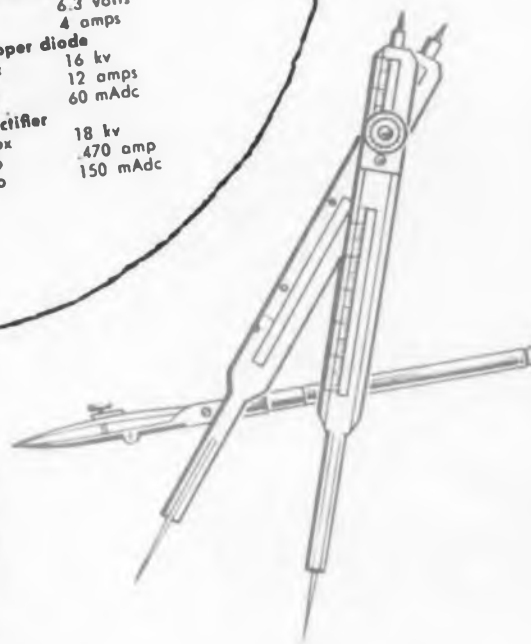


TYPE 591 CLIPPER DIODE RECTIFIER

Designed for oil immersed operation in airborne radar.

MAX. DIMENSIONS:
Ht. 2.875"
Diam. 2.0625"

RATINGS:
Ef 6.3 volts
If 4 amps
Ib clipper diode 16 kv
epx 12 amps
Ib 60 mAdc
rectifier
epx 18 kv
Ib 470 amp
Ic 150 mAdc



Since 1934

UNITED ELECTRONICS

UNITED ELECTRONICS COMPANY, 42 Spring Street, Newark 4, New Jersey

Perforated Sheets

Have No Resonant Frequency

Offering virtually no obstruction to the output of loudspeakers over the entire audio frequency range, "Standard Acouperf", a line of perforated non-metallic sheet materials can be fabricated by a number of means. The materials have no resonant frequency. They can be used as decorative grills and as a retaining wall for fiber glass and other sound-deadening blankets.

The materials can be outline-diecut with very low cost tooling, stapled, nailed, glued, screwed, or cut with shears, knife, or scissors. They are made in 10 perforating patterns, 10 colors, and four gages (0.010", 0.030", 0.050", and 0.080"). Furnished in flexible or rigid grades. A sample kit is available to designers. Pearson Industries, Dept. ED, 4624 N. Sheridan Rd., Chicago 40, Ill.

CIRCLE ED-120 ON READER-SERVICE CARD

Three Picture Tubes

Feature 90° Deflection

Two new monochrome TV picture tubes feature 90° deflection and are also shorter than comparable 70° deflection types. The tubes are the 17" 17AVP4, which measures only 16" in maximum overall length, and the 21" 21ALP4-A, which has a maximum length of 20-7/16". Both are rectangular, glass types with low-voltage electrostatic focus and magnetic deflection.

The 21" 90° deflection 21AMP4-A monochrome picture tube is only 20-3/8" long. The rectangular, aluminumized screen is 19-1/8" x 15". It provides a screen area of 263 sq in. The tube has both internal and external conductive coatings forming a supplementary filter capacitor.

The 17AVP4 has a screen area of 14-1/4" x 10-3/4", with slightly curved sides and rounded corners, and a nominal screen area of 145 sq in. The 21" type features a metal-back screen measuring 19-1/8" x 15". It has a nominal area of 263 sq in. Tube Div., Dept. ED, Radio Corporation of America, Harrison, N. J.

CIRCLE ED-121 ON READER-SERVICE CARD

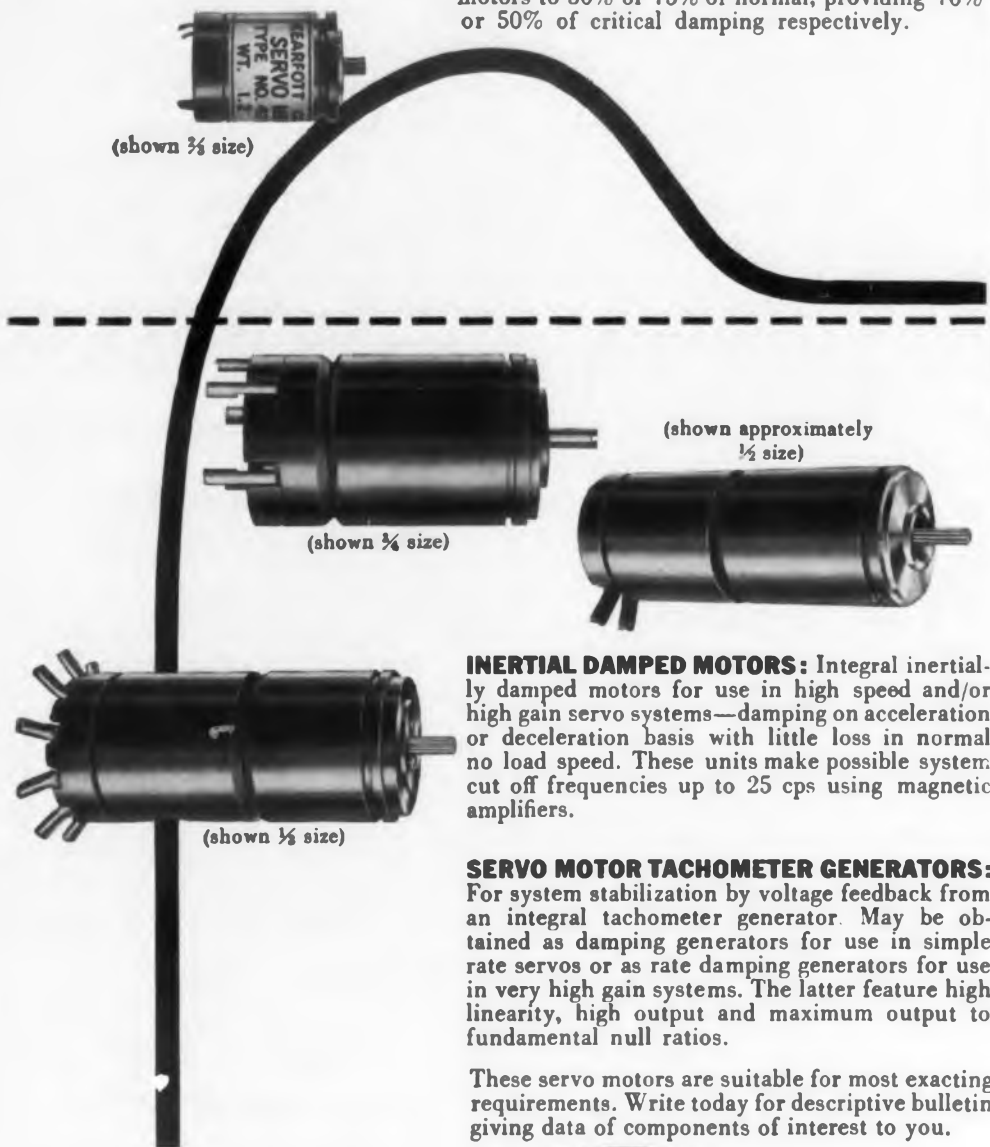
◀ CIRCLE ED-119 ON READER-SERVICE CARD

There is no one "cure all" for system instability. The desired stability of a servo loop is attained through the proper selection of components that satisfy the various conditions under which the loop will operate. Kearfott offers four basic motors and combinations for providing system stability. All feature high speed of response; low inertia and high stall torque.

SYSTEM STABILITY

SERVO MOTORS: Servo motors with high torque to inertia characteristics possessing (built-in) inherent damping ranging in size from $\frac{1}{8}$ " to $1\frac{1}{4}$ " diameter are available. Low speed, low power motors for use in simple instrument servos where high damping and/or low time constant is required can also be provided.

VISCOUS DAMPED SERVO MOTORS: Provide integral viscous damping for simple instrument servos. Any degree of damping can be provided. These units reduce no load speed of standard motors to 50% or 75% of normal, providing 70% or 50% of critical damping respectively.



(shown $\frac{1}{4}$ size)

(shown $\frac{1}{4}$ size)

(shown approximately $\frac{1}{2}$ size)

(shown $\frac{1}{2}$ size)

INERTIAL DAMPED MOTORS: Integral inertially damped motors for use in high speed and/or high gain servo systems—damping on acceleration or deceleration basis with little loss in normal no load speed. These units make possible system cut off frequencies up to 25 cps using magnetic amplifiers.

SERVO MOTOR TACHOMETER GENERATORS: For system stabilization by voltage feedback from an integral tachometer generator. May be obtained as damping generators for use in simple rate servos or as rate damping generators for use in very high gain systems. The latter feature high linearity, high output and maximum output to fundamental null ratios.

These servo motors are suitable for most exacting requirements. Write today for descriptive bulletin giving data of components of interest to you.

KEARFOTT COMPONENTS INCLUDE:

Gyros, Servo Motors, Synchros, Servo and Magnetic Amplifiers, Tachometer Generators, Hermetic Rotary Seals, Aircraft Navigational Systems, and other high accuracy mechanical, electrical and electronic components.



A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

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

Sales and Engineering Offices: 1378 Main Avenue, Clifton, N. J.
 Midwest Office: 188 W. Randolph Street, Chicago, Ill. South Central Office: 6115 Denton Drive, Dallas, Texas
 West Coast Office: 253 N. Vinado Avenue, Pasadena, Calif.

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

New Products . . .

Rotary Switch

Weights Less Than 1/4 oz



This subminiature rotary switch is 0.908" long x 0.875" maximum diam. It weighs less than 1/4 oz, including the knob. For use in low-current applications, it is manufactured

in 1-pole, 2-pole, and 3-pole types (15 terminals per switch). It is also available in 2-gang, 3-gang, and 4-gang models. Specifications include: maximum working voltage, 300v rms; maximum working current, 1amp; maximum working power, 100w; maximum contact resistance, 0.05 ohm; breakdown voltage, 1500v rms. Electro Development Co., Dept. ED, 6006 W. Washington Blvd., Culver City, Calif.

CIRCLE ED-36 ON READER'S SERVICE CARD FOR MORE DATA

Electromagnetic Counter

Takes 1200 Counts per Minute



The Model F 106 Electrical Impulse Counter, is specifically designed for panel mounting. It is a long-lived, accurate, high - speed,

heavy-duty electrical counter for use where space is restricted, or where a large number of counters must be mounted on a panel. Life is approximately eight times that of previous models of the same size made by this firm.

Current consumption is 8w. Speed is 1200 counts per minute. The number of digits is five. The counter is supplied with or without knob reset (one turn resets all digits to zero). Size of digits is 3/16".

Overall size of the counter, exclusive of face plate and screw terminals is 1-3/4" wide x 1-3/16" high x 2-1/2" long. It is available for operation from 6v to 220v a-c or d-c. Machined throughout, it has all parts subject to heavy wear made of case-hardened steel. Made by Irion & Vosseler, Germany. Available from Presin Co., Dept. ED, 5225 Wilshire Blvd., Los Angeles 36, Calif.

CIRCLE ED-37 ON READER'S SERVICE CARD FOR MORE DATA

It pays to choose crystals from the world's most complete line!

Whether your crystal requirement involves extreme miniaturization, stability, unusual frequencies, weight reduction or maximum protection against moisture, temperature changes, shock or vibration, Standard Piezo has the answer . . . fully tested and proved in the world's most critical military, aviation, commercial, and industrial services.

STANDARD PIEZO COMPANY
Carlisle, Pa.



NEW 20-PAGE CATALOG ON REQUEST

STANDARD PIEZO CRYSTALS

by the Pioneers of Modern
Crystal Development



CIRCLE ED-38 ON READER-SERVICE CARD

Analog Computer Service Available on a Rental Basis

The "MILAC" Analog Computer is now available on a rental basis for solving a wide variety of general industrial and engineering problems. The service is particularly valuable to organizations faced with analyzing a dynamic system on a point-by-point calculation basis but whose continuing engineering load does not justify purchase of a computer.

It is valuable for both linear and non-linear systems. This computing service permits "testing" of a system, device, or component while it is literally still on the drawing board. A change in design parameters is accomplished simply by changing coefficient settings on the computer. MILAC Computer Laboratory, Dept. ED, Wm. Miller Instruments, Inc., 325 N. Halstead Ave., Pasadena 8, Calif.

CIRCLE ED-39 ON READER-SERVICE CARD

TV Picture Tube

Features Shorter Length

Designated the type 17AVP4, a 17" monochrome picture tube features an overall length of only 15-5/8" $\pm 3/8$ ". A 90° deflection type, it has electrostatic focus and magnetic deflection. Receiving Tube Div., Raytheon Manufacturing Co., Dept. ED, 55 Chapel St., Newton 58, Mass.

CIRCLE ED-48 ON READER-SERVICE CARD

Anti-Static Solution

Harmless to Most Materials

"Anstac-2M", an anti-static and cleaning solution renders treated articles anti-static. It is harmless to vinyls, polystyrene and many other plastics and materials.

It is relatively fast drying and may be applied by dipping, spraying or wetting the article with a cloth dampened in the solution. Only a microscopic amount is necessary. Chemical Development Corp., Dept. ED, Danvers, Mass.

CIRCLE ED-49 ON READER-SERVICE CARD

CIRCLE ED-50 ON READER-SERVICE CARD >

THESE ARE THE

REASONS

WHY **DAVEN** IS THE LEADER IN THE AUDIO ATTENUATOR FIELD



- 1
- 2
- 3
- 4
- 5

Greatly expanded production facilities enable Daven to make delivery from stock on a large number of standard attenuator types.



THE **DAVEN** CO.

C-D-F makes it!

Silicone TAPES and SHEETS

VARNISHED FIBERGLAS

High temperature resistance
High dielectric strength
Low dielectric loss
Resistant to moisture
High tensile strength
Good flexibility

SILICONE RUBBER FIBERGLAS

High temperature resistance
High dielectric strength
Low dielectric loss
Resistant to moisture
High tensile strength
Extreme flexibility



C-D-F Silicone Varnished Fiberglass cloth, and Silicone Rubber-coated Fiberglass cloth meet A.I.E.E. Class H electrical insulation requirements. They resist mild alkalis, non-oxidizing acids, mineral oils, oxygenated solvents. Silicone Rubber Fiberglass is recommended for many applications where a flexible material with good thermal conductivity is required. C-D-F Silicone tapes and sheets are available in a wide range of sizes in continuous rolls. For complete details, write for Technical Bulletin #107.



Continental-Diamond Fibre

CONTINENTAL-DIAMOND FIBRE COMPANY • NEWARK DELAWARE

CIRCLE ED-310 ON READER-SERVICE CARD FOR MORE INFORMATION



Bridge Oscillator



type 1330-A

- ★ **Three Fixed Audio Frequencies:**
Power Line, 400 c and 1,000 c
- ★ **Continuous Radio-Frequency Coverage:**
5 kc to 50 Mc in 8 direct-reading ranges
- ★ **Incremental Frequency Dial:**
0.1% per division 5 kc to 15 Mc
- ★ **Adequate Output:**
One watt over most of r-f range
- ★ **Excellent Shielding:**
Leakage at 1 Mc about 50 μ v per meter
2 feet from oscillator
- ★ **Modulation:** Internal only at 400 c or 1,000 c over
r-f range with levels of 30% and 60%
- ★ **Covers frequency range of many of G-R's radio
and audio-frequency and vacuum-tube bridges**
Prompt Shipment. Price: \$525, net,
f.o.b. Cambridge or W. Concord, Mass.

GENERAL RADIO Company 275 Massachusetts Ave.
Cambridge 39, Mass.

90 West St. NEW YORK 6 8055 13th St., Silver Spring, Md. WASHINGTON, D.C.
520 South Michigan Ave. CHICAGO 3 1000 North Seward St. LOS ANGELES 38

CIRCLE ED-311 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Phase Meter Features Expanded Scale



Phase angle indications from 0 to 360° are presented directly on a large meter with an absolute accuracy of $\pm 1^\circ$ on the Type 322-A Precision Phase

Meter. Incremental changes in relative phase angles are read with an accuracy of $\pm 0.1^\circ$ on a 30° expanded scale. This expanded scale may be made to cover any 30° increment of the range.

Although frequency range is 20 to 20,000cy, readings may be obtained at frequencies up to 1Mc with slightly decreased accuracy. Principles of operation are similar to this firm's Type 320-AB Phase Meter, with additional circuitry providing faster response time. Input range is 2 to 30v. Input impedance on each channel is 4.7 megohms in shunt with 13 μ fd. Available in relay rack mount or aluminum cabinet. Technology Instrument Corp., Dept. ED, Acton, Mass.

CIRCLE ED-312 ON READER'S SERVICE CARD FOR MORE DATA

Holding Coil Switch Acts as Relay and 2 Switches



Known as the A1200 Series Holding Coil Switch, this unit performs the functions of a relay plus

two conventional switches. The device has a built-in solenoid that holds the switch on contact until the solenoid coil circuit is externally interrupted. This circuit as well as the external switch circuit may also be broken manually by pulling the knob.

Weighing only 3 oz, it has a body diameter of 15/16" x 3-3/8" overall length. The case is fitted with a threaded bushing for mounting in a 5/8" diam panel hole. Knobs are available with built-in lights to indicate when the holding coil circuit is energized. The 240-ohm coils operate on 30v, d-c. Contacts are rated for a 5amp inductive load at 30v, d-c. For additional humidity protection, the unit can be fitted with a silicone rubber boot. Modifications can be specified. Hetherington, Inc., Dept. ED, Sharon Hill, Pa.

CIRCLE ED-313 ON READER'S SERVICE CARD FOR MORE DATA

Jennings RADIO
VACUUM ELECTRONIC COMPONENTS

HIGHER CAPACITY
OR
HIGHER FREQUENCY

WHATEVER THE DESIGN REQUIREMENT
for vacuum fixed or variable capacitors, JENNINGS can meet the need with a large selection of capacities, sizes and voltage ratings.

High capacity units up to 5000 mmfd at 10 kv and 1000 mmfd at 45 kv are now being made in both variable and fixed types.

Small vacuum capacitors such as the one shown above are currently being used in VHF and UHF applications. The ECS, for example, has capacity ranges of either 2 to 8 mmfd or 3 to 30 mmfd and a voltage rating up to 15 kv.

Send for our catalog summary describing over 300 types, sizes, and ratings of vacuum capacitors and switches.

JENNINGS RADIO MANUFACTURING CO. • 970 McLAUGHLIN AVE. • P.O. BOX 1278 • SAN JOSE 8, CAL.

CIRCLE ED-314 ON READER-SERVICE CARD FOR MORE INFORMATION

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copy of this Technical Paper.

ask for data file

1107

The Precision Potentiometer as a Voltage Divider

BY H. A. SCHMIDT

Sales Engineer, Helipot Corporation

Reprinted from PRODUCT ENGINEERING:
Annual Handbook of Product Design for 1954

389

Helipot first in precision potentiometers
Helipot Corporation / South Pasadena, California
a division of BECKMAN INSTRUMENTS, INC.

CIRCLE ED-315 ON READER-SERVICE CARD FOR MORE INFORMATION

WHY DEGREASE?

"BURN-OFF" WITH GRIEVE-HENDRY BATCH TYPE OVENS

GAS OR ELECTRIC STANDARD MODELS

One oven does both — (1) prepares the metal for finishing (2) bakes the finish. No dangerous, messy or costly degreasing fluid to buy or degreaser to maintain, plus protection from immediate rusting.

- High temperature range for handling the latest processes.
- Designed for long, hard, continuous use.
- Uniform temperatures — air circulation both horizontal and vertical completely surrounds the work.
- Standard sizes. Capacities, exhausts and temperature ranges to requirements.
- Latest convenience features and safety devices.
- Shipped set-up — requires only service connection.

Write for bulletin 10-54.



Standard models
to 1000° F.

\$8950
and up

Immediate Delivery
Ovens designed and
built for your particular application.
Prompt quotations.



GRIEVE-HENDRY CO., Inc.

Export Dept. 306 W. Washington Blvd., Chicago 6, Illinois
1419 W. Carroll Ave., Chicago 7, Ill.

CIRCLE ED-316 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision INSTRUMENT SWITCHES

STOCK MODELS FOR *YOUR* JOB

There's nothing like stock models of Shallcross Instrument Switches for cutting equipment cost and design problems. For over 20 years Shallcross has made scores of basic switch types with countless variations for practically every electric-electronic application. Many unique types—usually "Special items" with other manufacturers—can quickly be supplied by Shallcross from stock. For a fast solution to any problem involving rotary switches, drop a line to SHALLCROSS MANUFACTURING CO., 526 Pusey Ave., Collingdale, Pa.

Shallcross

CIRCLE ED-317 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1954

Servo Motor

Lightweight, Highly Applicable



The Type M-130 Servo Motor is designed to give maximum flexibility for ready adaptation to many military and commercial applications. Built in the popular 1.062" diam size, it features a hermetically sealed stator providing high operating stability, and a high torque-to-inertia ratio for rapid acceleration and deceleration service as encountered in servomechanism

and computing applications. The unit is designed to be inoperative under single-phase conditions, and a sloping speed-torque characteristic provides viscous damping in control applications.

Motor characteristics include: voltage, 115v (fixed phase), 115/57.5v (control phase); frequency, 400cy; phases, 2; poles, 6; no load speed, 6200rpm; stalled torque, 0.63 oz-in; rotor inertia, 1.1 gr-cm²; weight, 4.5 oz. Infra Electronic Corp., Dept. ED, 553 Eagle Rock Ave., Roseland, N. J.

CIRCLE ED-318 ON READER-SERVICE CARD FOR MORE INFORMATION

Cabinet Rack

For Multiple Installations



This heavy-duty cabinet rack for multiple installations is constructed of heavy gauge steel and welded throughout. It has detachable sides, permitting multiple assembly of cabinets in double, triple, or larger units by bolting together.

Equipped with handle and lock, the front and rear doors are hung on

loose jointed hinges that may be hinged for right or left hand opening by rotating the door 180°. Perforations are furnished if desired. Panel-mounting angles are 3/16" thick, tapped 12/24 on universal spacings, and are adjustable to any position. Tops supplied either solid or with cut-out. Rectangular cut-out is also provided in the bottom for leads, etc.

Racks are 22" wide, 18" deep, and come in three heights: 67-3/8", 76-1/8", and 83-1/8". They are furnished in black or gray wrinkle, with brown or gray hammertone slightly extra. Premier Metal Products Co., Dept. ED, 3160 Webster Ave., Bronx, New York.

CIRCLE ED-319 ON READER-SERVICE CARD FOR MORE INFORMATION

Do you have this handy catalog?



You'll find it mighty useful. It covers the whole standard line of Speer Resistor Division Products:

FIXED COMPOSITION RESISTORS • MOLDED WINDING FORMS
IRON CORES • SLEEVE CORES • COIL FORMS

It tells everything you'll want to know about these products — their specifications, their characteristics, their applications.

If you don't already have a copy, send for yours today.

OTHER SPEER PRODUCTS FOR THE ELECTRONICS INDUSTRY

anodes • contacts • fixed carbon resistors • coil forms • discs • brushes
battery carbon • graphite plates and rods

also R.F. Coils • ceramic capacitors • capristors • high voltage condensers • disc capacitors • chokes made by Jeffers Electronics



SPEER RESISTOR DIVISION SPEER CARBON COMPANY

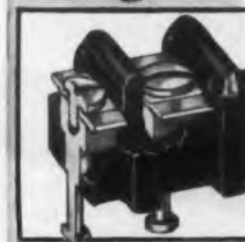
St. Marys, Pennsylvania
Other Divisions: Jeffers Electronics
International Graphite & Electrode

CIRCLE ED-320 ON READER-SERVICE CARD FOR MORE INFORMATION

New

CURTIS Type "EFT" Feed-Thru Terminal Blocks

Curtis
Terminal Blocks
Make Better
Connections —
Economically —
Quickly.
A Type
for Every Purpose.



Write for Bulletin DS
125. Also ask about
wide selection of
other Curtis Blocks
available.

- Soldered Internal Connections
- Screw Terminals Externally

The Curtis Type "EFT" is an unusually compact, barrier type, feed-thru terminal block, which is available (factory assembled) in any number of terminals per block from 1 to 22. The Type "EFT" is molded in solid block form of electrical grade Thermo-setting materials. Specially designed pins are sufficiently sturdy for AWG 18 wire and have minimum thermal mass for quick soldering of small wires.

CURTIS DEVELOPMENT & MFG. CO.

3236 North 33rd Street, Milwaukee 16, Wisconsin

CIRCLE ED-321 ON READER-SERVICE CARD FOR MORE INFORMATION

Voltage Regulation

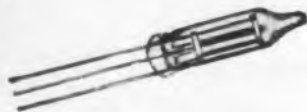
IS A VICTOREEN SPECIALTY

Whenever electronic designs involve a voltage regulating problem, call upon Victoreen for the proper voltage regulator to give maximum performance and long life.

Here are a few of the Victoreen voltage regulators which can be manufactured in quality quantities at economical costs.



Victoreen Very High Voltage Regulators are sturdily designed for regulation of potentials of 18,000, 20,000, 30,000 volts.



Victoreen subminiature voltage regulators are only $\frac{3}{8}$ " diameter x $1\frac{1}{8}$ " long plus leads. Available in ratings for regulating potentials of 400 to 2500 volts.



This Victoreen glass enveloped regulator can be produced in quantities of uniform high quality for applications requiring potential regulation from 500 to 5000 volts.



The VXR 6000 series regulator is typical of Victoreen metal case designs for potential regulation from 6000 to 15,000 volts.

Our engineering department is available to help solve your voltage regulation problems.



The Victoreen Instrument Co.

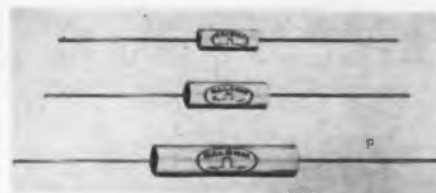
COMPONENTS DIVISION: 3810 Perkins Ave. • Cleveland 14, O.

CIRCLE ED-160 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Resistors

With 1% Standard Tolerance



Type HC hermetic sealed-ruggedized deposited carbon resistors are completely solder-sealed in a newly developed envelope of non-hygroscopic ceramic, and are ruggedized for incorporation into "snap-in" component clips. They are production tested for resistance to thermal shock, salt water immersion, and humidity.

The resistors are available in three wattage ranges (1/2w, 1w, and 2w) and in resistance ranges to 200 megohms. Standard tolerance is 1%. Dale Products, Inc., Dept. ED, Columbus, Neb.

CIRCLE ED-161 ON READER-SERVICE CARD FOR MORE INFORMATION

Synchronous Motors For Magnetic Tape Drives



This series of low and high speed direct-drive synchronous motors features synchronous speeds from 300rpm to 1800-rpm. Combining a high torque rotor with flywheel and precision ground

capstan, these motors provide accurate and constant tape velocities for magnetic recorders without gear reductions.

Standard capstans presently available and the large variety of motor speeds provide tape velocities of 1-7/8, 3-3/4, 7-1/2, 15, and 30 inches per second. Special features, such as extended or double-ended shafts, and variations in mounting details, direction of rotation, line voltage, and frequency, are available.

All motors are supplied with a magnetic shield eliminating the high-torque flux field from the region of the capstan. Twelve cooling impellers located on the flywheel-rotor provide ventilation. Motors are reversible and supplied with single or dual-speed windings. A series of 50cy motors, as well as the standard 115v, 60cy line, is also available. Motors measure approximately 5-7/16" diam and extend 4-19/32" from the mounting surface. Mounting is simply accomplished by a four-hole flange. Technical Development Corp., Dept. ED, 4060 Ince Blvd., Culver City, Calif.

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



SQUARE PULSE GENERATORS by EPIC



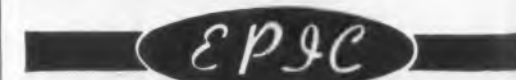
Model 100: Single Pulse Generator, Model 200: Double Pulse Generator, Model 300: Three or more pulse outputs. Rise time .001 usec. Pulse width .001 usec. to several usec. Pulse amplitude from 0.006 to 100 volts into low impedance cables (50 ohms or more).

A new, more accurate method of pulse generation for Nuclear, Radar, TV, UHF and other fields where fast pulse circuits are employed. EPIC pulse shaping provides practically ideal square pulses of rise time of one millimicrosecond and of widths which can be varied from one millimicrosecond to several microseconds. A push button control is included for single pulse operation. Double, triple and multiple pulse output generators or adaptations are available to meet your individual requirements.

EPIC FAST PULSE GENERATORS ARE USEFUL IN THE FOLLOWING APPLICATIONS:

- As a basic test instrument for use in development, design, calibration and servicing of fast pulse circuits.
- Testing nuclear counting systems, analyzers, scalars, and amplifiers.
- Calibrating fast oscilloscopes and timing equipment.
- EPIC multiple output Pulse Generators are of immeasurable value, where one or more trigger impulses of definite amplitude and timing relative to signal pulse are required, or in testing resolution and dead time of counting equipment.

Write for detailed engineering bulletin No. 302. Inquire also about our 10 mc counting and timing equipment, and custom designs.



**ELECTRICAL AND PHYSICAL
INSTRUMENT CORP.**
42-19 27th Street • Long Island City, N. Y.
CIRCLE ED-163 ON READER-SERVICE CARD

Aerohm Precision Potentiometers



**"HOT-
POT"**

Designed for
high-temperature use

Dissipates 1 watt at 200°C

Dissipates 5 watts at 80°C

Resistances - 1000 to 25,000 ohms

Compact - 1 in. diameter
x 11/16" depth behind panel

Stainless steel case and shaft

Teflon insulated terminals

**"LO-
TORK"
POT**



Designed for
minimum-torque uses

0.01 inch-ounce maximum torque

Dissipates 1 watt at 80°C

Resistances - 100 to 100,000 ohms

Compact - 7/8 in. dia., 4/5 in. depth

Weights only 1/2 oz.

Ganging up to 6 sections,
internal clamps maintain 7/8" dia.

Stainless steel ball bearings

Anodized aluminum case

These potentiometers have
standard linearity of .5%—on special
order .25%; precision toroidal wind-
ing allows winding angles up to 360°
—standard is 354 degrees.



Write today for
data sheets and
price information.

WATERS MANUFACTURING, inc.

Waltham 54, Massachusetts

APPLICATION ENGINEERING OFFICES IN PRINCIPAL CITIES

CIRCLE ED-164 ON READER-SERVICE CARD

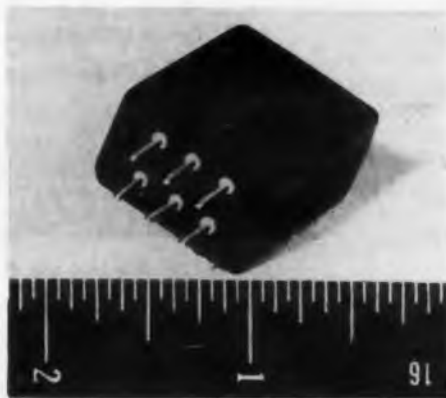
Epoxy Resin Has Low Viscosity

Called "Scotchcast" electrical insulation resin No. 3, this product has a usable life of from 3 to 5 days before setting up. Yet cure time for the resin, which comes in a two-part liquid form, is from two to four hours at 250°F. The product should be useful where production techniques call for a resin that can be mixed in large quantities for use over a period of days rather than for minutes or hours.

Because of its low viscosity, it could be used for impregnation of coils instead of conventional varnish-impregnated paper and cloth impregnation. It has excellent electrical and physical properties. Minnesota Mining & Manufacturing Co., 900 Fauquier St., Dept. ED, St. Paul 6, Minn.

CIRCLE ED-165 ON READER-SERVICE CARD FOR MORE INFORMATION

Subminiature Relay High Sensitivity, Stable Unit



The P-100 sub-miniature relay is designed for applications requiring small size, light weight, high sensitivity, thermal and shock stability, and fast reaction time. It weighs only 1 oz and has overall dimensions

of 1-3/16" x 7/8" x 11/16". The relay is of the polarized type and has a resistance of 3500 ohms with tolerances from 25% to 5% as required. Sensitivity is less than 20mw, and the relay can be adjusted to make contact at 1ma and to break at 0.8ma. The balanced movement employed in the unit is unaffected by mounting position or movement of the relay.

Reaction time is 1/200sec, and the relay may be operated at rates as high as 90cy. Spst changeover contacts are used with contact materials available in standard silver, palladium, or platinum. Contacts can handle up to 0.25amp at 250v. Contact adjustments are not normally required, but may be made without removing the protective case.

The relay is housed in a protective plastic case which helps provide high thermal and shock resistance. It is equipped with a six-pin plug which fits a molded or laminated socket supplied with the relay. Polarity may be reversed by simply reversing the relay in its socket. Pins and socket are both heavily silver plated. It can be produced in a wide number of modified models to meet individual specifications. Made by Telecommander, Ltd. of England. Available from American Telasco Ltd., Dept. ED, Huntington, N. Y.

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



Eimac HR Connectors

HEAT TRANSFERRING ELECTRICAL CONNECTORS FOR EIMAC TUBE TYPES

Eimac HR connectors are especially designed to give proper electrical connections with the plate and/or grid terminals of Eimac tube types while providing efficient transfer of heat to the air from the tube element and glass seal. Machined from solid dural rod, these heat radiating connectors are available in ten types to accommodate Eimac internal anode type tubes — rectifiers, triodes, tetrodes or pentodes.

*For further information on Eimac HR connectors,
contact our Application Engineering department.*



EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA

The World's Largest Manufacturer of Transmitting Tubes

CIRCLE ED-167 ON READER-SERVICE CARD FOR MORE INFORMATION

TRANSFORMERS . . .

. . . specified for the usual
. . . demanded for the
unusual



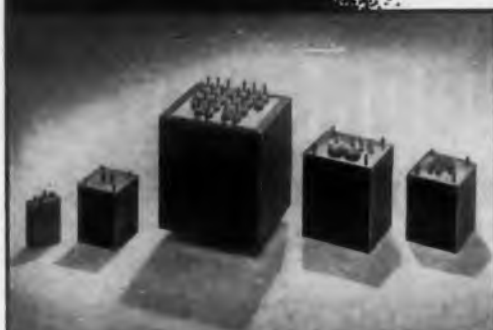
"GTC" Transformers for television receiver applications . . . custom designed for high quality at minimum cost.



"GTC" Transformers for industrial and commercial applications . . . accurately engineered and fully recognized for finest quality.



Manufacturers specify "GTC" . . . for audio uses, communication, radar devices, test equipment, transmitters, and various other electronic controlled devices.



"GTC" Military Transformers . . . designed to meet rigid government specifications and to perform under the most severe and continuous operating conditions, MIL-T-27 and IAN-T-27.

Skilled engineering techniques make GTC a source for transformers in highly specialized and extremely unusual applications. Utilization of these techniques results in greater dependability, quality and better construction.

Our completely self-contained plant's modern equipment guarantees transformer production in any quantity, to meet your requirements. We welcome your inquiry and will supply production samples where desired.



GENERAL TRANSFORMER COMPANY

serving industry since 1928

18240 Harwood Avenue, Homewood, Illinois
(Suburb of Chicago)

CIRCLE ED-141 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Tantalum Capacitors For Low-Voltage Applications



Trademarked "Tantalex", these Series 103D sub-miniature capacitors employ tantalum as the anode. They are valuable for low-voltage use where they provide relatively large values of capacitance in a minimum of space. Typical applications are for by-pass, coupling, and filter requirements in low-voltage transistor circuits, including hearing aids and amplifiers for military needs.

Use of tantalum, a most stable anodic film-forming material, gives them great stability of performance. They exhibit no shelf aging under long periods of test and have extremely low leakage current. They are only 5/16" long x 1/8" diam. Sprague Electric Co., 347 Marshall St., North Adams, Mass.

CIRCLE ED-142 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistors

Economical Card-Wound Units



For many precision wire-wound resistor applications where space is at a premium, these flat, card-wound resistors provide a workable, economical solution in place of the usual spool or bobbin type. The cards are 1/8" thick and 5/8" wide. The length is determined by the number of individual resistance sections required for a particular application. Normal power rating is 0.6w. Up to 5,000 ohms per section may be obtained. Accuracies to 0.1% are available.

Card-wound resistors can be Ayrton-Perry wound where frequency response is a factor and inductance must be kept to a minimum. The cards can be furnished bent into circles for mounting on a round switch and are used in many printed-wire applications. Miniature designs can be mounted on ceramic wafers such as Project "Tinkertoy" types. The card design is an economical way of obtaining multi-section precision resistors in the smallest size. Up to 40 sections can be furnished. Cards can be impregnated to withstand severe military or industrial environmental tests. Daven Co., Dept. ED, 191 Central Ave., Newark 4, N. J.

CIRCLE ED-143 ON READER-SERVICE CARD FOR MORE INFORMATION

Metron MINIATURE components for VARIABLE SPEED in SMALL SPACE



now in use

in countless precision devices where continuously variable speed is required. . . If small space and variable speed is your problem, investigate Metron Miniature Variable Speed Drives TODAY!

- ▶ Extremely small
- ▶ Up to .025 HP and 10,000 RPM
- ▶ Choice of 6 speed controls
- ▶ Complete, ready-to-go
- ▶ Compact, adaptable
- ▶ Quick delivery

Write for Bulletin 99 for details. . .

Metron

INSTRUMENT COMPANY

450 Lincoln St., Denver 3, Colo.

CIRCLE ED-144 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-145 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1954

Radomes

Fiberglass Resin Laminates

Sandwich Structures with **Foam Cores**
Honeycomb Cores

Excellent design and manufacturing facilities for the production of the very best fiberglass laminates are available here at Emerson & Cuming. Matched metal, vacuum bag and contact pressure molding are usual production techniques. Both fiberglass mat and woven fabrics are used with epoxide, polyester and phenolic materials to build laminates to the most exacting specifications. Ask us to quote on your requirements — for delivery when you want it.

Write for Bulletin on properties of selected Laminates

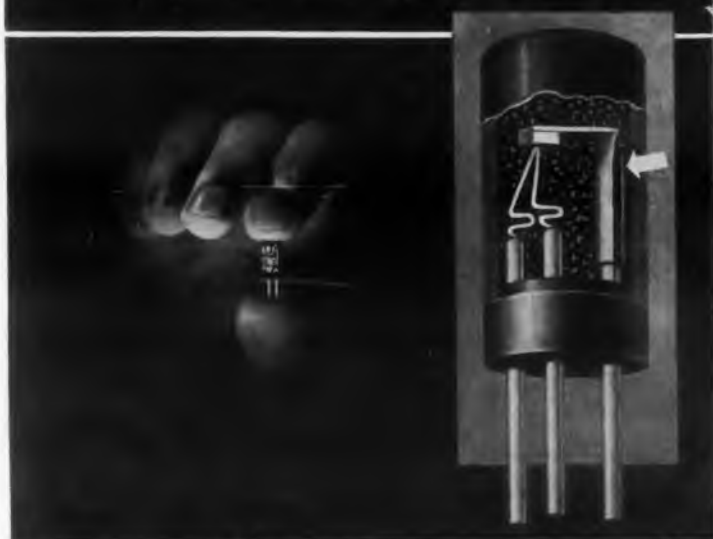
High Flexural Strength 85,000 psi
Energy Transmission to 99%
Temperature Range -100°F to +500°F
Water Absorption less than 0.1%



Emerson & Cuming, Inc.
PLASTICS for ELECTRONICS
869 Washington Street, Canton, Mass.

CIRCLE ED-146 ON READER-SERVICE CARD FOR MORE INFORMATION

SMALL TUBING—BIG NEWS ...THAT'S THE TRANSISTOR



Top news in radio and television is the Transistor—possible successor to many vacuum tubes.

The Transistor shown above is made by CBS-Hytron, division of Columbia Broadcasting System, Inc. The L-shaped crystal support is formed from Superior seamless nickel tubing. It's .032" I.D., .003" wall, .193" long with a 90° bend. CBS-Hytron relies upon Superior close tolerances and formability for this fussy small-tube application. Why don't you? Superior Tube Company, 2050 Germantown Ave., Norristown, Pa.

Superior
THE BIG NAME IN SMALL TUBING

All analyses .010" to 3/8" O.D.
Certain analyses in Light Walls up to 2 1/2"

CIRCLE ED-147 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1954

Template

With JIC Standard Symbols



The No. 311 Electronic JIC Symbols Template contains JIC standard symbols for the use of designers and draftsmen. Designed for industrial use, it

is made of 0.030" matte finish plastic. All cut-outs are milled, not punched, for precision smoothness. Overall size of the template is 7" x 5". Rapidesign, Inc., Dept. ED, Box 592, Glendale, Calif.

CIRCLE ED-148 ON READER'S SERVICE CARD FOR MORE DATA

Stripping Tool

Cuts and Strips Coaxial Cable



Coaxial Cable Stripping Tool No. 400 strips RG8U, RG11U, and smaller sizes of coaxial cable in a matter of seconds. A smaller tool,

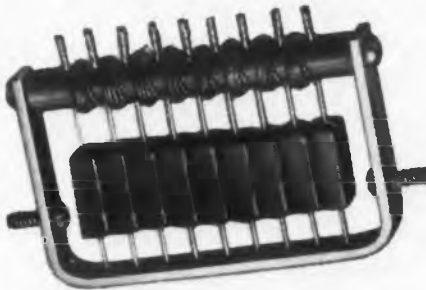
the No. 300, has also been developed to take RG59U and smaller-sized coaxial cable.

The cable is inserted in the holes, the handles squeezed shut against the stops, and the tool is rotated 180°. Three such twists prepare the cable for the connector. The cutting blades are adjustable for various sizes of coaxial cable. K. Miller Tool & Mfg. Co., Inc., Dept. ED, 6 Cass St., Springfield 4, Mass.

CIRCLE ED-149 ON READER'S SERVICE CARD FOR MORE DATA

Delay Line

Lumped or Distributed Types



These encapsulated and open-style lumped parameter delay lines can be specified for use as compensating delays for color

TV, signal delays for TV, synchronizing generators and as coupling elements for wideband distributed type amplifiers. Many other styles, including distributed parameter types, can be specified. Shallcross Mfg. Co., Dept. ED, Collingdale, Pa.

CIRCLE ED-150 ON READER'S SERVICE CARD FOR MORE DATA

...El Menco First Again
Announces Production
of the..

Smallest
Mica
Capacitor
the
"DuraMike"
dm15...

does more jobs — in less space — better!
the first and only MINIATURE MICA
CAPACITOR with PARALLEL LEADS
the DuraMike gives you:



1. SUPERIOR PERFORMANCE:

The DuraMike El Menco Capacitors range from 1 to 390 mmf. at 500vDCw. 1 to 510 mmf. at 300 vDCw.

Made to meet all the humidity, temperature and electrical requirements of MIL-C-5 Specifications.

2. SUPERIOR CONSTRUCTION

The DuraMike El Menco Capacitor is phenolic coated, durable and tough. Temperature co-efficient and stability equal to or better than characteristic F. Will operate efficiently at temperatures as high as 125° Centigrade.

To solve your
space problems—to
bit your needs!

3. GREATER VERSATILITY:

The DuraMike El Menco Capacitor is ideally suited for all military as well as civilian electronic applications. Parallel leads means that the El Menco DuraMike can be used in positions heretofore impractical. Has wide application in transistor circuits and other miniature electronic equipment. The DuraMike El Menco Capacitor is ideal for use in printed wiring circuits.

Test the El Menco
DuraMike capacitor
for yourself! Write
for free samples and
catalog on your firm's
letterhead.

Jobbers and distributors write
to Arco Electronics, Inc.,
103 Lafayette St.,
New York, N. Y. —

4. GREATER ECONOMY:

The DuraMike El Menco Miniature silvered mica capacitor sells at prices even lower than our famous CM-15. Provides economy of size with maximum performance and widest application.

El-Menco
Capacitors

**THE ELECTRO MOTIVE
MFG. CO., INC.**
WILLIMANTIC, CONNECTICUT
molded mica-mica trimmer

CIRCLE ED-151 ON READER-SERVICE CARD FOR MORE INFORMATION

sealed ... ruggedized instruments by DeJUR

Simplify your panel meter problems



RUGGEDIZED METERS



STANDARD AND POWER
POTENTIOMETERS



SEALED MODEL 150

SEALED MODEL 152



New DeJUR 1½" sealed meters

Built to MIL M-3823 specifications

Here are new, high precision panel instruments designed for use in a wide variety of environmental applications. They're sealed, waterproof and have high resistance to shock. Even damage to the scale window will not destroy the watertight seal to the panel. Featured also are the DeJUR miniaturized external pivot D'Arsonval movements for high stability and accuracy, and high flux density Alnico magnets.

These meters are also available as self-contained AC rectifier types, and with various scales and ranges to meet your prototype or production requirements. In addition, we manufacture sealed and ruggedized meters in 1", 1½", 2½", 3½" and 4½", round or square. For detailed engineering literature write Dept. ED, DeJUR-Amsco Corporation, 45-01 Northern Blvd., Long Island City 1, N. Y.

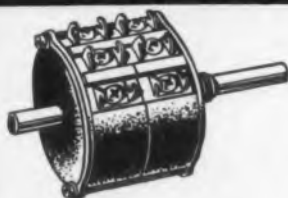
Electronic
Sales
Division

DeJUR

45-01 NORTHERN BLVD., LONG ISLAND CITY 1, N. Y.



SEALED METERS
SQUARE AND ROUND



FULLY ENCLOSED
POTENTIOMETERS



HIGH RESOLUTION
POTENTIOMETERS

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

New Products . . .

Compound Delay Packages Store Digital Pulses



This firm offers miniature plug-in compound delay packages. Two designs already available are "Distributed Constant Lines", used as

pulse storage elements in digital computers.

Each of the two distributed constant lines consists of a plug-in brass can, hermetically sealed, with maximum dimensions of 7/8" thick x 1-5/8" wide x 4" long, and a standard Amphenol Type 26 base.

Unit No. 1 contains delay times of 3.65, 3.75, 4.00, and 4.25 μ sec. Unit No. 2 covers 0.25, 0.50, 0.75, 1.00, 1.25, 1.50, and 1.75 μ sec. The tolerance on any delay is $\pm 0.05\mu$ sec. Both designs have 1000 ohm impedance. In both cases, maximum attenuation is 6db, and spurious response is 20db. Each unit is completely encapsulated and potted to operate over a wide temperature range. PCA Electronics, Dept. ED, 2180 Colorado Ave., Santa Monica, Calif.

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

Yoke

For High Speed Writing



Designed for 2-1/8" neck diameter tubes, this magnetic deflection yoke is for high speed writing, data presentation, and other military and commercial oscilloscope applications.

Deflection angle is up to 70°. It fits any 2-1/8" maximum neck diameter cathode ray tube. The yoke is especially suited to push-pull applications requiring maximum resolution, negligible yoke distortion, and high efficiency.

Five advanced design features give optimum performance at any impedance level. These are: 1) exceptionally low astigmatism; 2) minimum non-orthogonality (angular error between deflection areas is reduced to less than 1/3°); 3) spot shift due to residual magnetism eliminated; 4) fast recovery and minimum starting delay; 5) compensation provided to achieve fast, accurate settling. Syntronic Instruments, Inc., Dept. ED, 100 Industrial Rd., Addison, Illinois.

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

Complicated Electronic Parts Now



INVESTMENT CASTINGS



Base plate for super-sensitive measuring device which must be dimensionally stable at wide variations in temperature.

Material—Invar



Wave Guide

Material—Aluminum #356T6



Lever arm for an Electronic Computer

Material—Stainless Steel type 303

Send Us Your Drawings For
Quotations On Parts Where
**EXTRA QUALITY Must Be
Maintained.**



ENGINEERED
PRECISION CASTING CO.

MATAWAN-FREEHOLD ROAD
MORGANVILLE, N. J.

CIRCLE ED-72 ON READER-SERVICE CARD

Rivet Contacts

Stocked in 70 Designs

These fine-silver headed rivet contacts are available from stock in 70 standard designs, which represent the efforts of this firm's engineers to standardize from thousands of different customer specifications. Use of these rivets is intended to eliminate the need for designing new rivets for each application. They include flat-faced and radius-faced types in head diameters from 0.062" to 0.375". P. R. Mallory & Co., Dept. ED, 3029 East Washington St., Indianapolis 6, Ind.

CIRCLE ED-197 ON READER-SERVICE CARD

Ceramic Parts

For High-Temperature Uses

Extremely small ceramic parts made of a high-temperature, high-strength alumina material designated "AlSiMag 576" are available on special order. The material is imperious, chemically inert, non-magnetic, and has excellent resistance to heat shock. It can be used safely under continuous heat as high as 2000°F. It does not rust, corrode or deteriorate with time. It has superior electrical insulation qualities.

As an example of the parts that can be produced, tubes one inch in length with an OD of 0.030" were fabricated with two holes 0.006" in diam evenly spaced. The parts are made with close tolerances. American Lava Corp., Dept. ED, Chattanooga 5, Tenn.

CIRCLE ED-198 ON READER-SERVICE CARD

Ferrites

Stock and Custom-Made

In addition to offering a line of ferrite cores for use in TV-receiver components and other applications, this manufacturer will also make ferrites to customer specification. These products can be utilized for i-f transformers, r-f chokes, radio coils, etc. Tube Div., Dept. ED, Radio Corporation of America, Harrison, N. J.

CIRCLE ED-199 ON READER-SERVICE CARD

CIRCLE ED-200 ON READER-SERVICE CARD

When pennies make production sense...

Check your problems

E-I

MINIATURE CLOSURES & TERMINALS

 <p>TWO ELECTRODE TERMINAL FOR MINIATURE ASSEMBLIES (SUPPLIED WITH CASE)</p>	 <p>MINIATURE THREE ELECTRODE COMPONENTS (AVAILABLE WITH CASE)</p>	 <p>SINGLE WIRE COMPRESSION TYPE MINIATURE SEALED TERMINALS</p>
 <p>HERMETICALLY SEALED TERMINAL WITH CUSHIONED GLASS CONSTRUCTION</p>	 <p>COMPLETELY STRAIN-FREE END SEALS FOR CONDENSERS, RESISTORS, TUBULAR ASSEMBLIES</p>	 <p>OCTAL HEADERS WITH SOLID METAL BLANKS FOR MAXIMUM RIGIDITY AND MECHANICAL STRENGTH</p>
 <p>SUPER DURABLE COMPRESSION TYPE HEADERS OFFER MAXIMUM RESISTANCE TO SHOCK AND VIBRATION</p>	 <p>SILICONE TREATED, STRAIN-FREE, VACUUM TIGHT MULTIPLE HEADER</p>	 <p>LUG TYPE, LEAD THRU INSULATORS FOR VOLTAGE RATINGS FROM 2,000 TO 4,000 (rms.)</p>

DIVISION OF AMPEREX ELECTRONIC CORP.



ELECTRICAL INDUSTRIES

44 SUMMER AVENUE, NEWARK 4, NEW JERSEY

MEMO

E-I... Headquarters for Multiple Headers, Sealed Terminals, Octal Headers, End Seals, Compression Type Headers, Lug-Type Lead-thru Insulators, Miniature Closures, etc.

**COMPACT
DEPENDABLE
LONG LIFE**



AMRECON[®] RELAYS

ALL-PURPOSE

In Current Ratings up to 25 amp a-c or d-c, and in All Standard Voltages

Amrecon relays are small, compact units that can handle power loads usually demanded of larger, heavier relays. Careful design and construction make them an *exceptionally dependable* line for such diverse applications as industrial controls, aircraft controls, etc. When the wire size permits, cellulose-acetate sealed coils, which give a high degree of protection from ambient conditions, are used.

Amrecon relays are available with screw, plug, or solder-wire terminals; with five standard contact arrangements; and with hermetically sealed or dust-protective enclosures. Thirty different types now available from stock. Amrecon's engineers will also be glad to help you work out special relay applications.

WRITE FOR
FREE CATALOG AND
DESCRIPTIVE BULLETIN R-10



**AMERICAN
RELAY & CONTROLS, Inc.**

3643 Howard St., Skokie, Illinois
(Suburb of Chicago)

A Subsidiary of **OHMITE[®]** MANUFACTURING COMPANY

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

New Products . . .

Variable Transformers For Laboratory Use



The Model PA-3 Variable Auto-Transformer is a low-cost unit adaptable for work bench or other applications such as line voltage control for power supplies and instruments,

and control of heat, motor speeds, light intensity, and other phenomena.

The design features a toroidally wound variable transformer with the new "Lo Res" commutator surface and a new brush assembly which maintains almost constant pressure from full brush to no-brush. Dimensionally small and compact, the unit is 6-1/2" x 6-1/8" x 6-1/2" in size. It is equipped with jeweled pilot light, on-off switch, convenient fuse, cord, plug, and receptacle. It has a gray wrinkle finish.

Input is 115v 50-60cy; output is 0-135v. Maximum load rating is 0.4kva. Maximum output current is 3.0amp. The Standard Electrical Products Co., Dept. ED, 2240 E. 3rd St. Dayton, Ohio.

CIRCLE ED-126 ON READER-SERVICE CARD FOR MORE INFORMATION

A-C Voltmeters

Employ Expanded Scale Principle



Portable Expanded Scale A-C Voltmeters use the meter movement for just the top 5% to 10% of the range, permitting these instruments to obtain high accuracies from a rugged, low-accuracy meter movement. Only the voltage range of interest is expanded full scale—by a circuit without electron tubes. Guaranteed accuracy is

$\pm 0.5\%$ of input voltage.

The voltmeters offer overvoltage protection, wide frequency range (50-2000cy) and voltage expansions of $\pm 5v$, $\pm 10v$ or $\pm 15v$ at 115v or 230v. They are designed for applications where exceptional ruggedness and reading ease are required.

Additional features include a ruggedized, hermetically sealed meter and hermetically sealed circuit elements. Temperature range is 0-60°C. Input power required is 0.5w max. Dimensions are 8" x 5" x 3" depth. Weight is 2-1/2 lb. Arga Division, Beckman Instruments, Inc., Dept. ED, 220 Pasadena Ave., South Pasadena, Calif.

CIRCLE ED-127 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW

Type USM

ACTUAL SIZE

SUB-MINIATURE UNIMAX[®] SWITCH

for easy wiring
in miniaturized apparatus.

- Sturdy, standard flat terminals are widely spaced for rapid wiring and easy soldering.
- Case size 25/32" x 23/64" x 1/4".
- Long life.
- In plain or leaf-actuator styles.
- Rated 5 amps. at 125/250 volts a-c, or 2 amps. at 30 volts d-c; SPDT.

Write for data sheet.

UNIMAX

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

CIRCLE ED-128 ON READER-SERVICE CARD FOR MORE INFORMATION

WORLD'S smallest...



the
ORYX-6

precision
soldering
instrument

Now! An unbelievably small and light miniature soldering tool for the production line or laboratory. Specifically designed for precision pin-point soldering, the ORYX-6 is recommended for use on delicate instruments and electronic devices, hearing aids, hair-spring movements, transistors, and germanium diodes. Test the ORYX-6 in your laboratory—determine for yourself its many outstanding advantages.

Length: 6"
Weight: 1/4 oz.
Tip Diameter: 1/16"
Heating Time: 20 sec.

Investigate this complete line of miniature soldering tools!

Model	Voltage	Length	Weight	Tip	Spare Tip Style
6	6	6"	1/4 oz.	1/16"	fixed
6A	6	6"	1/4 oz.	3/32"	"B"
12	6, 12, 24 or 50	6 1/4"	1/2 oz.	3/16"	"C"

Write today for catalog sheet and price information!

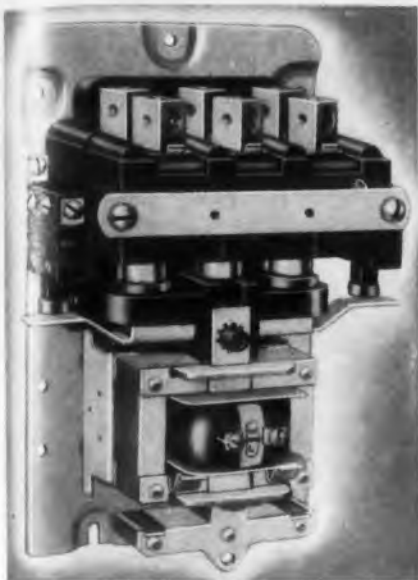
TELEVISION ACCESSORIES COMPANY

Dept. 1-T

Box 6001

Arlington 6, Va.

CIRCLE ED-129 ON READER-SERVICE CARD FOR MORE INFORMATION



1000 contactors in 1

You're looking at the most versatile solenoid contactor ever developed for building electrical controls.

This Ward Leonard Size 2 contactor is available in three basic models, six major variations, one thousand combinations.

Your savings: reduced stock, minimum panel space, lower assembly costs, less layout and drafting time. Write for Bulletin 4450 to Ward Leonard Electric Co., 77 South St., Mount Vernon, N.Y.

4.15

WARD LEONARD ELECTRIC CO.

Result-Engineered Controls Since 1892

RESISTORS • RELAYS • MOTOR CONTROLS • CHROMASTER



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

Laboratory Testing of Electronic and Electro-Mechanical Components

Qualification Under All
Environmental Conditions!

YOUR GUARANTEE
that your product
will meet all
SERVICE REQUIREMENTS



The prime purpose of General Testing Laboratories is to provide a complete service in the field of environmental testing. Our reliability record is attested to by our many customers who continually receive accurate and dependable test data relative to their product's performance under all possible combinations of anticipated service conditions.

The services of General Testing Laboratories are divided into two basic categories, namely research and development testing, and complete qualification (type or brand approval) testing. All tests are performed in strict conformance to specification requirements. All test data and evaluations of any product are kept in strict confidence and become the property of the customer. A certified test report is provided with each project.

Write for Illustrated Brochure.

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

ELECTRONIC DESIGN • November 1954

Input Transformer Gives 200:1 Impedance Step-Up



The Type 0-16, a new addition to the "Ouncer" Series, is a highly shielded input transformer. A high-fidelity unit, it is designed to operate from a low impedance microphone or line to grid, and provides a 200:1 step-up impedance ratio. Frequency response is within 1db from 30cy to 20,000cy.

The primary of this transformer is center-tapped, balanced to 1%, and is suitable for sources of 150, 200, 250, 500 or 600 ohms. With a 250-ohm source, secondary impedance is 50,000 ohms. Very high shielding for minimum hum pickup is effected through the use of two heavy gauge "Hipermalloy" shields. Overall dimensions are only 1-1/16" x 1-1/2" x 1-1/2", including the orientable mounting bracket. United Transformer Co., Dept. ED, 150 Varick St., New York 13, N. Y.

CIRCLE ED-86 ON READER'S SERVICE CARD FOR MORE DATA

Capacitors

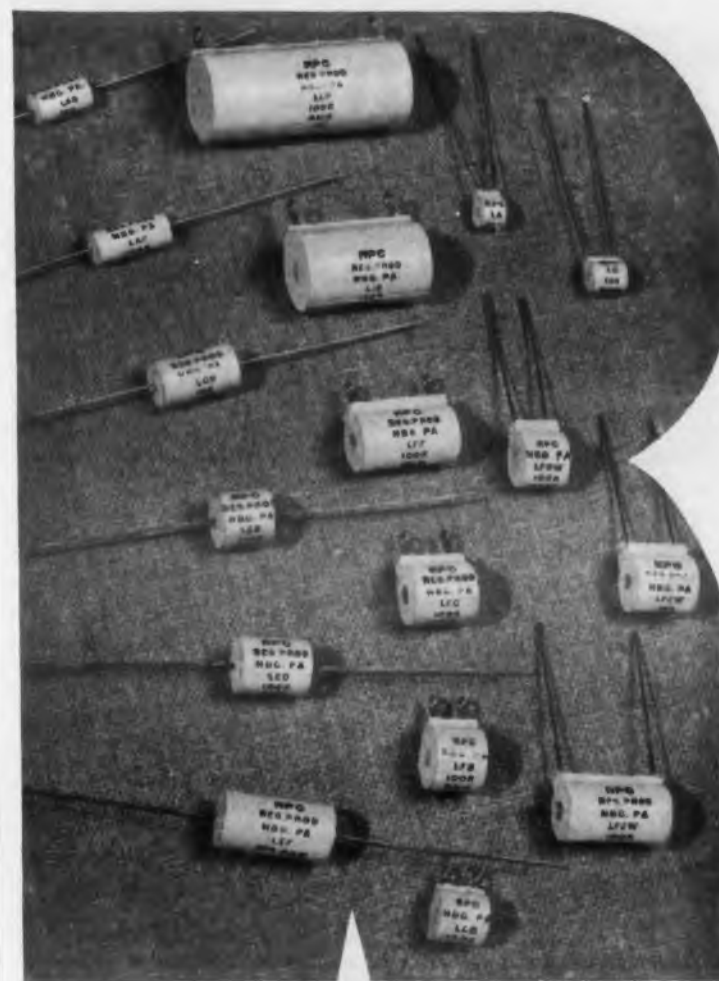
Feature Leakage Protection



the soldered seams common to fabricated cases provides the added protection.

The units have the same base area as comparable types in fabricated cases and are interchangeable with them, allowing users to convert to the new capacitors without even changing blueprints. The capacitors can be mounted upright or inverted. They have welded bushing studs, welded taps, aluminum foil, low-loss kraft paper, and "Pyranol" dielectric. They are available in capacities from 0.05 μ f to 16 μ f, and with voltage ratings of 400 to 12,500v, d-c, and 236 to 660v, a-c. Capacitor Dept., Dept. ED, General Electric Co., Hudson Falls, N. Y.

CIRCLE ED-87 ON READER'S SERVICE CARD FOR MORE DATA



Encapsulated Precision Wire Wound Resistors Defy Shock, Vibration and Extreme Changes

Completely sealed in epoxy resin and wound on steatite bobbins, RPC has engineered Type L Resistors that are protected against extreme humidity, temperature and altitude conditions, mechanical damage, while maintaining dimensional stability.

Type L Resistors, in many tests, have withstood 30 humidity cycles of MIL-R-93A moisture resistance tests without deterioration. They fully meet the requirements of U.S. Govt. Specifications MIL-R-93A. Not affected by extremes in humidity, altitudes, and corrosive influences; protected against outside elements.

RPC can supply Type L on short notice with lug type terminals or wire leads; in a complete line of standard, midsize and sub-miniature sizes. Wide range of performance! Write for catalog or additional details.

Sales representatives in all principal cities of the U.S.

RESISTANCE PRODUCTS CO.

714 RACE STREET • HARRISBURG, PENNA.

Makers of Resistors—High Megohm, High Voltage, High Frequency, Precision Wire Wound

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

RESINITE

...can increase efficiency of your iron core insertion production by 20%

EMBOSSED COIL FORMS



Special embossed construction eliminates torque control problems and stripping. Custom fabrication to your exact specification assures correct dimensions to within the most critical tolerances.

We will furnish — without charge — a pilot production run of custom-made embossed forms to fit your particular application.

Contact us now for full details about this special offer. Request technical bulletin, *Use of Threaded Tubes, Threaded Iron Cores VS. Torque Control.*

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Cleveland, Ohio, Atlantic 1-1060

Indiana, Southern Ohio:
Logansport, Indiana, Logansport 2555

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St. Louis, Missouri, Sterling 2318

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Pasadena, California, Sycamore 8-3919

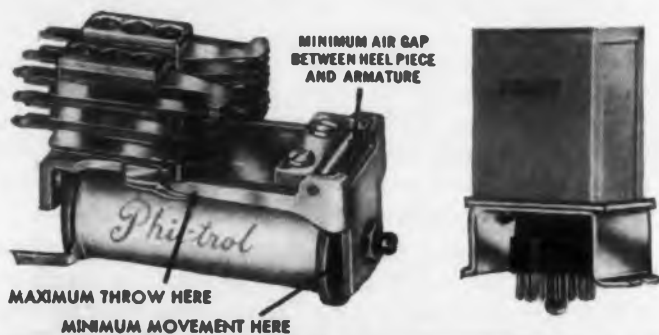
Canada: Montreal, Quebec, Canada, Walnut 2715



PRECISION PAPER TUBE COMPANY

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CIRCLE ED-168 ON READER-SERVICE CARD FOR MORE INFORMATION



New 6QA Phil-trol Relay

Adds Sales Appeal and Top Performance to Your Product

● The new Phil-Trol 6QA Relay has found wide acceptance in a variety of products because of its extreme compactness, capacity and exceptional sensitivity.

The 6QA is only 2 1/4" long by 1 1/8" wide, yet it provides large cubic area for winding (maximum 20,000 ohm coil) Armature ratio and electro magnetic features assure high sensitivity.

Phil-Trol 6QA performance equals that of larger telephone type relays. Its construction makes possible mounting and wiring from under the chassis, using less space and saving assembly time and costs.

The Phil-Trol 6QA Relay is available with a plug-in adaptation for use in panels and annunciator racks.

Phil-trol

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CIRCLE ED-169 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Capacitor

For High Temperature Uses



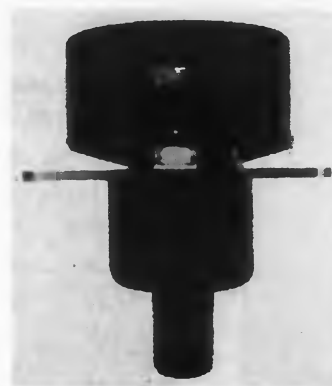
The "Hy-Therm" sub-miniature capacitor, a hermetically sealed and metal encased unit, is

available in all standard values and tolerances, for all applications requiring exceptionally high insulation resistance and unusual stability at high temperatures. Insulation resistance quality exceeds military requirements (MIL-C-25A). A variety of bracket designs is also offered. In addition, special designs to meet customer requirements are furnished. Hopkins Engineering Co., Dept. ED, 2082 Lincoln Ave., Altadena, Calif.

CIRCLE ED-170 ON READER'S SERVICE CARD FOR MORE DATA

Magnetic Recording Systems

With 60,000 Impulse Capacity



These magnetic recording systems are designed for the efficient handling of problems involving large amounts of information in a wide variety of recording and memory applications. The systems employ drums which rotate on bearings operated at a small fraction

of their normal rated load. Present systems have a medium storage capacity up to 60,000 impulses or binary digits on their magnetic oxide coated drums. (The 60,000 impulse drum has 1-1/2" diam).

The recording heads in the systems are designed to record and reproduce frequencies up to 1Mc. Their all-ferrite magnetic circuits have multiple shielding, allowing information to be read on any one channel while other information is being written on any other channel at the same time. In conjunction with suitable write-and-read amplifiers, information can be read out of one cell and new information recorded in the same cell during a single pass beneath the head.

Information can be stored permanently or erased so the drums can be reused. The magnetic drums need no developing or processing for use as permanent records. Kollsman Instrument Corp., Dept. ED, 80-08 45th Ave., Elmhurst, N. Y.

CIRCLE ED-171 ON READER'S SERVICE CARD FOR MORE DATA

Now Constant Stability of Tolerances at

1,500,000 CYCLES!

ELECTRO SNAP

Type S2
STANDARD

BASIC SWITCH

Gives You More Than Just Long Life

- Maintains accurate repeatability and positive snap-action . . . even at 1,500,000 cycles and over!
- Long life lowers switch costs . . . minimizes "down-time" and increases efficiency of operation.

● Durable, compact plastic case permits great flexibility of application. Available in a wide selection of models, including "reset". Rated at 10 amps 125/250 v. AC; 30 v. DC inductive.

WRITE FOR DETAILS IN DATA SHEET STS-9

see our catalog in



or write for copy

ELECTRO-SNAP SWITCH AND MFG. CO.
4224 West Lake Street, Chicago 24, Illinois



CIRCLE ED-172 ON READER-SERVICE CARD FOR MORE INFORMATION



SAVE with MILWAUKEE

ECONOMY RESISTORS



RESISTORS MUST BE GOOD before they can bear the "Milwaukee" name! That's what we said when we set about developing these ECONOMY resistors. Our engineers checked many materials and worked with factory production to assure top ranking performance. THE RESULT — resistors embodying more costly raw materials but greatly reduced in cost by the new manufacturing techniques these materials afford. They are available in the same sizes and ohmages as our vitreous enameled resistor. Write, wire or phone for quotations — samples!

MILWAUKEE RESISTOR COMPANY

702 W VIRGINIA ST, MILWAUKEE 4, WIS.

CIRCLE ED-173 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE ED-399 ON READER-SERVICE CARD

DESIGN and PRODUCTION NEWS

FOR ELECTRICAL AND ELECTRONIC ENGINEERS

Published by TECHNICAL SERVICE, Chemical Manufacturing Division, The M. W. KELLOGG Company

OCT.-NOV. 1954

Hermetic-Seal, Shock-Resistant Tube Sockets of Kel-F® Polymer Cut Heat, Moisture "Fade-Outs" at High Altitudes

KEL-F polymer plastic, molded into a special metal base permitting complete enclosure of an electronic tube, provides this premium socket with a hermetic seal that defies heavy shock loads, extreme thermal cycling and aging. Tube "fade-outs", due to moisture condensation and collection, are eliminated, tube altitude "ceilings" have been raised significantly.

Positive electrical insulation is maintained under all thermal and moisture service conditions because of the high dielectric strength and low RF loss characteristics of KEL-F polymer.

The high impact and compressive strength of KEL-F polymer helps the socket withstand shock loads up to 100 G's without cracking or chipping of vital insulation.

The Elco Corporation, Philadelphia, Pa., injection-molds the complex socket from KEL-F polymer Grade 300. A metal tube cover with a silicone rubber gasket completes the assembly.

For further information ask for Application Report E-128



Electronic "Memory" Drum Insulated with Kel-F® to Eliminate Carbonization, Wear Damage... Extend Service Life

Two obstacles to efficient operation—carbonization shorting and insulation "wiping" onto vital contacts—are eliminated through the use of KEL-F plastic as insulation in this special commutator.

High dielectric strength and heat resistance assure positive insulation under all operating temperature and humidity conditions, prevent formation of carbonization tracks between

drum contact points. Zero water absorption cuts moisture "shorts", arcing.

W. S. Shamban & Company of Culver City, Calif., transfer-molded this new commutator of unplasticized KEL-F polymer Grade 300 for use in a special digital-type converter manufactured by Genisco, Inc., Los Angeles, California.

For further information ask for Application Report E-128



KEL-F

TRIFLUORO
CHLORO
ETHYLENE
POLYMERS

KEL-F

MOLDING
POWDERS

KEL-F

FLUORO
CHLORO
CARBON
PLASTIC

KEL-F

DISPERSION
COATINGS

KEL-F

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CHLORO
ETHYLENE
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KEL-F

OILS
WAXES
GREASES

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CARBON
PLASTIC

KEL-F

DISPERSION
COATINGS

KEL-F

TRIFLUORO
CHLORO
ETHYLENE
POLYMERS

KEL-F

OILS
WAXES
GREASES

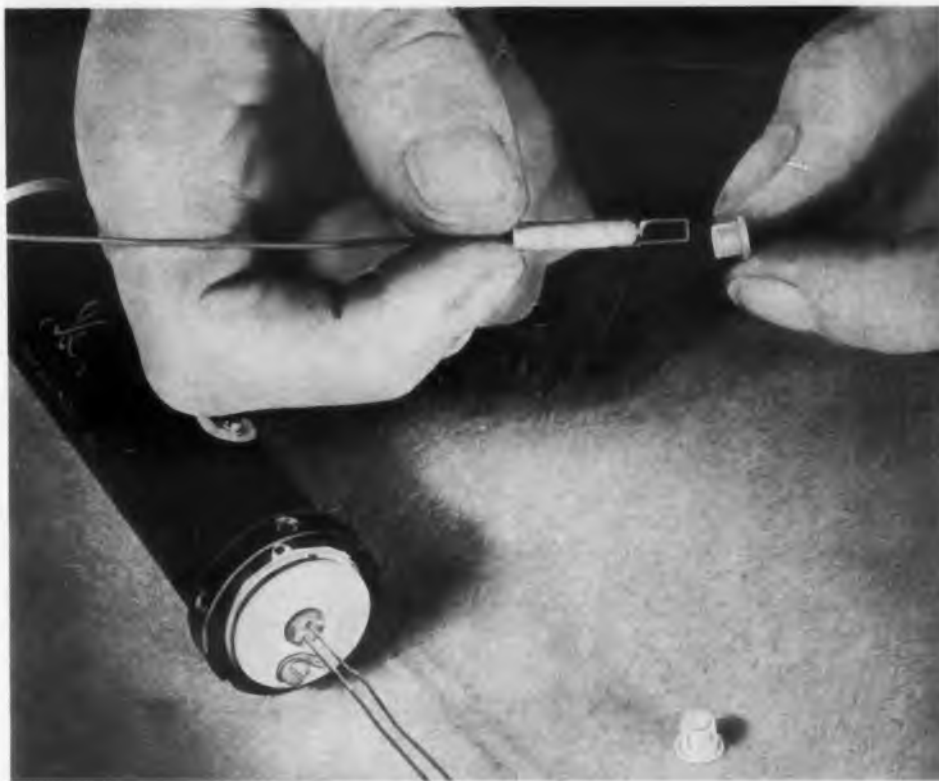
Paper-Thin Insulator of KEL-F[®] Polymer Solves Space, Precision "Specs" Problem in Microwave Cavity

Found to be the *only* high-frequency dielectric capable of being machined to close tolerances in this .009" thick insulator, KEL-F plastic effectively prevents pulse leaks between cavity and probe. These units, producing hundreds of watts peak power output, depend largely on the insulator for their 0.0005% per °C temperature coefficient.

The fluorocarbon's high dielectric strength over a wide temperature range and its dimensional stability assure complete insulation in the limited space provided. Zero water absorption of this fluorocarbon guards the insulator against any changes caused by moisture.

The precision insulator is machined from KEL-F polymer rod and installed in microwave oscillator assemblies by C.G.S. Laboratories, Inc. of Stamford, Conn. C.G.S. obtains its rod stock from the Resistoflex Corporation, Belleville, N. J. who extrude it from unplasticized KEL-F polymer.

For further information ask for Application Report E-127



Recent Significant KEL-F Polymer Developments...

Blending equipment is now coated with "baked-on" KEL-F polymer dispersions to eliminate wasteful sticking of special plastics during processing. Chemical inertness and non-stick qualities of coating have cut maintenance and contamination.

Switch seals of the plunger type are now molded of fluorocarbon polymer to provide a hermetic seal that will withstand high altitudes and temperatures.

Valve seats machined from KEL-F polymer rod stock are used in a special valve required in nuclear research. Non-porous, tough plastic effectively keeps active Helium isotope from diffusing through the seat. Low "cold flow" keeps seats smooth and undamaged even after many "high torque" closings.

Covers for high-frequency components are compression molded of fluorocarbon polymer for electrical insulation as well as maximum visibility of contained parts. High impact strength and resistance to aging eliminates need for special protective or reinforcing shields or guards.

OFF THE PRESS...
Revised "BUYERS GUIDE"
listing KEL-F polymer
products, molders and fabri-
cators.

For complete information regarding any item mentioned in DESIGN AND PRODUCTION NEWS, ask for detailed APPLICATION REPORTS, write

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Los Angeles and New York



Molders & Fabricators of the Month

Leading molders, extruders and fabricators specialize in the production of materials and parts made of "Kel-F" ... each month this column will spotlight several of these companies with their principal services and products.

Booker & Wallestead, Inc.

Minneapolis, Minn.
Injection molding
Compression & transfer molding
(Specialize in short runs)

H & R Industries

Nazareth, Pa.
Extrusion & injection molding
Machining & forming
Rod, tube, tape & strip
Resistor sleeving

Electronic Wave Products, Inc.

New York, N. Y.
Sealing of film
Forming
Container liners; gaskets

Reiss Manufacturing Corporation

(Ray Synthetic Products Div.)
New York, N. Y.
Extrusion, compression & transfer
molding
Machining & forming
Rod, tube & sheet
Gaskets & diaphragms
Valve seats

is this your
timing
problem?



Sorry...
A. W. HAYDON CO.
can't help you.

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you may save time, trouble and money by investigating what our timing engineers have done for others. Our A.C. and D.C. achievements may already include the solution of your most complex problem. Why not find out?

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Design and Manufacturer of Electrical Timing Devices

CIRCLE ED-174 ON READER-SERVICE CARD FOR MORE INFORMATION

the **NEW**
miniature **ALL-METL**

BARRY B MOUNT

for all-temperature vibration protection
of airborne equipment

These new isolators are the latest addition to the famous Barry ALL-METL line. They are specifically designed to help you meet miniaturization demands under toughest environmental conditions.

- Excellent performance at extreme temperatures.
- Weight only 1/2 ounce per unit isolator.
- Free height only 1 1/4"—bottomed height 25/32".
- Load ratings from 0.1 to 3.0 lb. per unit.
- Meet all relevant requirements of JAN-C-172A.
- Ruggedized models for equipment to meet shock tests under AN-E-19, MIL-E-5272, MIL-T-5422.
- Available for 2 or 4-hole mounting.

For complete information, ask for your free copy of the new Barry Product Bulletin 542, containing full installation and performance data. And for greatest benefits with these new isolators, let our Field Engineering Service help in the early stages of your equipment design. Write directly to The Barry Corporation, 775 Pleasant Street, Watertown, Massachusetts, or get in touch with your nearby Barry representative.



CIRCLE ED-175 ON READER-SERVICE CARD FOR MORE INFORMATION

◀ CIRCLE ED-399 ON READER SERVICE CARD

Power Supply Utility Unit for Designers



In the Model 701 adjustable power supply, emphasis has been placed on convenient packaging of a utility unit, useful in electronic design. The Model 701 is an unregulated supply, providing d-c voltages from 0 to 250v at maximum load of 90ma (360v open circuit), and a-c filament

power, 6.3v at 3amp, center tapped. Ripple has been kept to the low value of 20mv rms by use of a two-section choke input filter.

An auto transformer in the primary permits the adjustment of d-c output to any desired value from zero to maximum. The output voltage is constantly monitored by a front panel meter, which can be switched to indicate current when desired. Separate terminals for positive, negative and ground are provided. Shasta Division, Beckman Instruments, Inc., Dept. ED, P. O. Box 296, Richmond, Calif.

CIRCLE ED-176 ON READER'S SERVICE CARD FOR MORE DATA

Strain-Gage Transducers For Fluctuating Pressures



In the redesigned "Sierra Brand" strain-gage transducers, the reference pressure tube has been brought directly out the

rear together with the electrical terminals, permitting the unit to be threaded into its flush-mounting position from either direction.

The transducers provide a resistance change that is a true representation of pressure fluctuations. Electrically, the units coordinate with the general practices of dynamic strain-gage work; usually the transducer is installed as an active arm of a 120-ohm bridge. Standard units have 1/2" diam and are available in two lengths: 1/4" and 3/8". Seven pressure ratings are supplied: 2-1/2, 5, 10, 25, 50, 100 and 200psi. Linearity is 2%; operating temperature range is -40° to +250°F; acceleration effect is 0.02% per g; and resonant frequency of the diaphragm is 8000cy. Electronic Engineering Associates, Ltd., Dept. ED, 959 Brittan Ave., San Carlos, Calif.

CIRCLE ED-177 ON READER'S SERVICE CARD FOR MORE DATA

Versatility

with a
GREEN ENGRAVER

ENGRAVES
PANELS
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PLATES

Mark your own symbols, numbers, lettering, on your small parts, tools, identification and name plates . . . easily, simply, quickly . . . tracing from a master with the GREEN ENGRAVER. Widely used in electronic and plastic fields, in machine tool shops and wherever permanent marking is needed. The GREEN ENGRAVER engraves equally well on metals, plastic, wood, hard rubber and glass. Routs Models Profiles Engraves Etching attachment and other special equipment for industrial uses are available. Fact-filled folder on request showing how economies in costs, labor and time are achieved with the GREEN ENGRAVER.

GREEN
INSTRUMENT COMPANY
361 PUTNAM AVE., CAMBRIDGE, MASS

CIRCLE ED-178 ON READER-SERVICE CARD FOR MORE INFORMATION

RING
A BELL

LIGHT
A LIGHT

STOP or
START a
MACHINE

COUNTS
ELECTRICALLY

DURANT
Electric 'SP' **PREDETERMINED COUNTER**

(COUNTS ELECTRICALLY and CLOSES SWITCH AT END OF PRE-SET COUNT) Eliminates costly over-runs or time consuming under-runs. Actuated by Photo Electric Cell, Tube, Relay, or Contact Switch. Counter can be located where desired. Predetermined count may be set at any figure to 99,999. Hundreds of applications in all phases of production and instrument work.

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CIRCLE ED-179 ON READER-SERVICE CARD FOR MORE INFORMATION

electromechanical

ENGINEERS

for research in and development of electro-mechanical radar and computing equipment.

THE MOST ADVANCED DEVELOPMENTS IN ELECTRONICS ARE BEING MADE IN THE SPHERE OF AIRBORNE RADAR AND ALLIED FIRE CONTROL SYSTEMS BECAUSE OF MILITARY EMPHASIS. FURTHER APPLICATIONS OF ELECTROMECHANICAL TECHNIQUES IN THESE FIELDS ARE CREATING NEW OPENINGS IN THE RADAR DIVISION OF HUGHES RESEARCH AND DEVELOPMENT LABORATORIES.

Engineers who have demonstrated ingenuity and inventive ability will find interest in the areas of work that call for devising reliable, maintainable, manufacturable designs for precision equipment developed in the Hughes Radar Division.

Equipment includes mechanical, electronic and microwave devices and systems to be manufactured in quantity. The equipment designs require 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 military specifications is useful.

ENGINEERS EXPERIENCED IN THE FIELD OF ELECTROMECHANICAL DESIGN FOR PRODUCTION. OR THOSE INTERESTED IN ENTERING THIS ORBIT. WILL FIND OUTLETS FOR THEIR ABILITIES AND IMAGINATION IN THESE ACTIVE AREAS.

Scientific and Engineering Staff

HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES

Culver City, Los Angeles County, California

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

New Products . . .

Panel Meters

In 300amp to 800ma Ranges



These sealed, ruggedized panel meters are to be offered with d-c ranges showing any practical scale from 300amp to 800ma. Meters are available in two sizes: 2-1/2" and 3-1/2". Simpson Electric Co., Division American Gage & Machine Co., Dept. ED, 5200 W. Kinzie St., Chicago 44, Ill.

CIRCLE ED-80 ON READER'S SERVICE CARD FOR MORE DATA

Voltage Standard

For Measuring and Calibrating



The Model A-23 "Calivolt" provides a means of accurately measuring the emf of voltage - producing vibration, pressure, and seismic pickups, as well as strain measuring devices. It can be used to precisely

calibrate voltage detectors and voltage-sensitive devices; for over-all calibrations of recording systems; and to measure the frequency response of amplifiers, recording systems, transformers, high impedance meters, etc.

Accuracy is $\pm 1/2\%$, and the instrument will operate on any 12v battery or any oscillator (of suitable frequency range) capable of delivering 100mw into a 1000-ohm load. Voltage range runs from $10\mu\text{v}$ to 10v in five continuous ranges. Current range goes from $1\mu\text{amp}$ to 10ma in five decade steps. Frequency ranges from d-c up to 10kc at $\pm 1/2\%$ accuracy—useful to at least 20kc. There is no waveform error, because the thermocouple monitor indicates true rms value regardless of waveform. Max output impedance is 1000 ohms.

The unit is extremely portable. The instrument weighs only 6-1/4 lb, measures 8" x 8-1/2" x 4", and comes equipped with carrying handle, protective rubber feet, and plastic dust cover. The cast-aluminum case provides complete shielding. Calidyne Co., Dept. ED, Winchester, Mass.

CIRCLE ED-81 ON READER'S SERVICE CARD FOR MORE DATA

A-C INDUCTION TYPE SERVO MOTORS and MOTOR GENERATORS

G-M Miniature Servo Motors are available in various sizes, down to .980-inch diameter and in various speeds and electrical characteristics; principally for 60- and 400-cps. circuits. They can be supplied to meet rigid military specifications with regard to humidity, salt spray, temperature, vibration and altitude. All stators are completely embedded in an insulating compound of extreme dielectric strength, high temperature stability, and low temperature coefficient of expansion. The low mechanical coefficient of expansion and great stability of this material at high temperature permits the use of



G-M Servo Motors at high ambient temperatures. All stator windings are treated with an effective fungicide. All motor laminations are of high nickel steel which provides corrosion resistance of the surface adjacent to the air gap. Available with stainless steel or aluminum housings and with stainless steel or SAE 52100 steel ball bearings. Write for Servo Catalog No. 4.

G-M LABORATORIES, INC.
4284 N. Knox Ave., Chicago 41, Ill.

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



★ Reduced cost distinguishes the Series 47 composition-element, twist-lug-mounted, control. Twist-lug mounting eliminates the usual bushing, lock washer and nut, thus effecting considerable economy. Electrically, it is the same as the standard 15/16" dia. composition-element controls.

Lugs slip through slots in chassis and are twisted to hold firmly in place.

☆

Resistance range, 500 ohms to 5 megohms, 0.5 watt rating.

☆

Choice of tapers and taps. Metal or plastic shafts.

☆

Shown actual size. Measures 15/16" in dia.

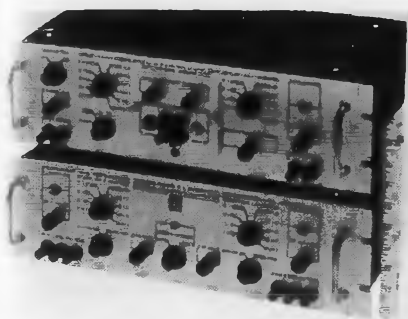


CIRCLE ED-83 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1954

Amplifiers

For Instrumentation Purposes



Two amplifiers, the Model BL-520 Universal Amplifier and the Model BL-530 Dual Channel D-C Amplifier have many laboratory and instrumentation applications. The

Model BL-520 is a very high gain carrier amplifier that accepts signals from both resistive and inductive transducers. It will measure and record on a direct writing oscillograph a wide range of physical phenomena. The unit has a maximum sensitivity equivalent to 1/2 microv per chart millimeter, or, for strain measurements, 0.25 microinches per inch.

The Model BL-530 will accept both single-ended and differential signals with a 50mv sensitivity and provides for accurate calibration of the recorded signals. Both amplifiers provide for balancing out voltages up to 10 times full scale at input signal levels up to 500v. Both amplifiers are furnished for 19" rack mounting. Panel height is 5-1/4". The panels are finished in aluminum. Brush Electronics Co., Dept. ED, 3405 Perkins Ave., Cleveland 14, Ohio.

CIRCLE ED-122 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supplies

Magnetic-Amplifier Regulated



A complete new line of wide voltage range d-c power supplies utilizes selenium rectifier stacks and magnetic amplifier regulation circuitry with no moving parts or contacts.

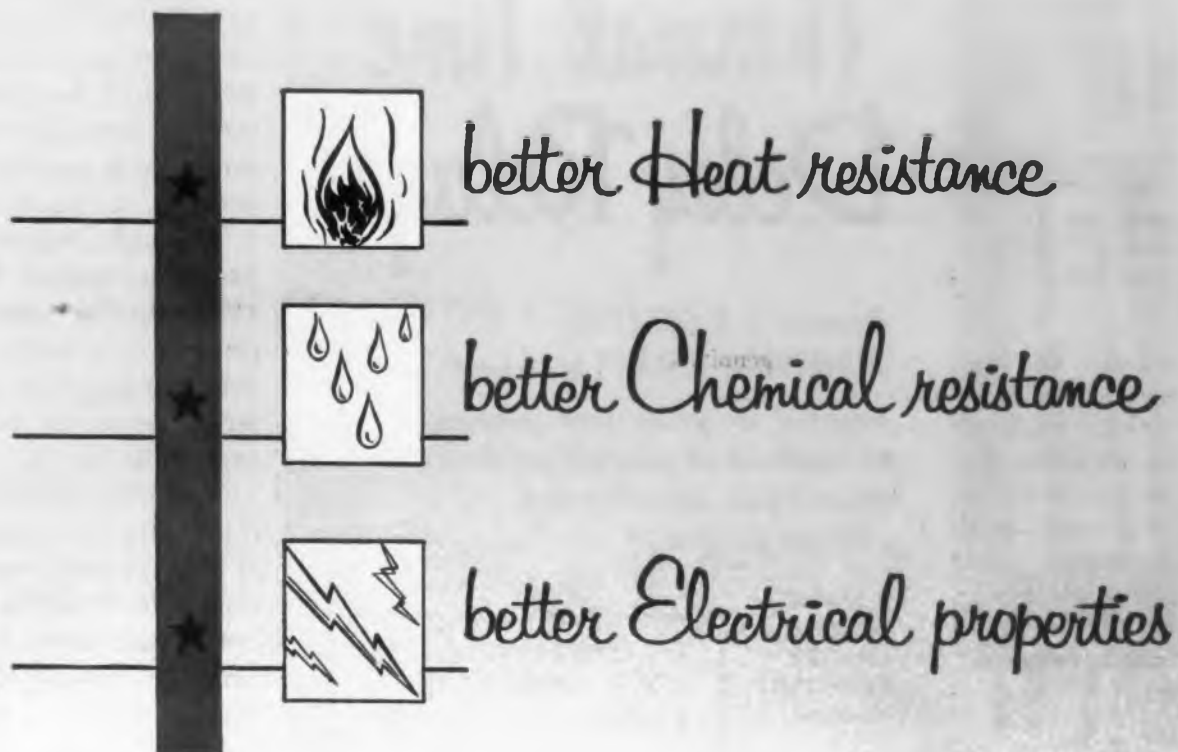
The unit illustrated is rated 5-32v at 15amp, with a 1% regulation over this entire d-c output voltage range and a 1% ripple.

All units of the line, identified as the "MR Series", have these similar characteristics in addition to a 0.2sec response time. Other standard catalog units are rated at 10-40v at 30amp, 10-32v at 50amp, 24-30v at 100amp, 24-32v at 200amp, and 22-32v at 300amp. Units in this series are also stabilized for a-c input voltages of 105-125v, except for the 50, 100, 200 and 300amp units, which are stabilized for 230/460v $\pm 10\%$. Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.

CIRCLE ED-123 ON READER-SERVICE CARD FOR MORE INFORMATION

Important news!

EPON[®] resin 828 with new Curing Agent CL gives



If you are among the many users of Epon resin 828 for casting, laminating or other structural applications—you will welcome this new development of Shell Chemical's continuing research program.

Curing Agent CL* produces Epon resin polymers with improved mechanical and electrical properties at temperatures as high as 300° F. After three hours' immersion in boiling water or acetone, glass cloth laminates of

Epon resin 828 and Curing Agent CL retained more than 95% of their initial dry flexural strength. And with Curing Agent CL you can use the "B-stage," or pre-curing, process—permitting dry layups and specialized casting techniques.

Your request will bring you a sample of Epon resin 828 and Curing Agent CL for evaluation, as well as a copy of Technical Bulletin SC:54-10. Write for them—today.

Curing Agent CL is Shell Chemical Corporation's name for metaphenylene diamine. We do not manufacture Curing Agent CL. It is available in commercial quantities from E. I. du Pont de Nemours & Company and National Aniline Division, Allied Chemical & Dye Corp.

*A development of Shell Chemical laboratories. Patent applied for.

SHELL CHEMICAL CORPORATION

CHEMICAL PARTNER OF INDUSTRY AND AGRICULTURE

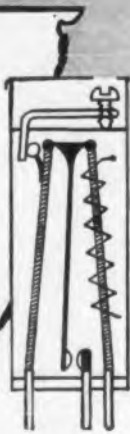
380 Madison Avenue, New York 17, New York

Atlanta • Boston • Chicago • Cleveland • Detroit • Houston • Los Angeles • Newark • New York • San Francisco • St. Louis
IN CANADA: Chemical Division, Shell Oil Company of Canada, Limited • Montreal • Toronto • Vancouver



CIRCLE ED-124 ON READER-SERVICE CARD FOR MORE INFORMATION

Why has G-V in
3 Years Become the
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Thermal Time Delay Relays?

Because G-V OCTAL & MINIATURE RELAYS have been... adopted as production components by hundreds of principal producers of electronic, electrical and aviation equipment.

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

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- Heater built inside expanding member for maximum efficiency and protection
- Rolling contact action for positive operation
- Easy adjustability where desired
- Precise operation never before available in thermal relays
- Time ranges: 3 seconds to 5 minutes
- Hermetically sealed in metal shell
- Heater voltages up to 230 volts
- Fully temperature compensated
- Suitable for military and industrial use
- Unequalled for ruggedness and precision

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G-V CONTROLS INC.
18 Hollywood Plaza
East Orange, New Jersey

Greatly expanded production facilities assure prompt deliveries.

CIRCLE ED-130 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Slide Screw Tuner Incorporates Choking Sections



These economically priced slide screw tuners operate over the entire X-band frequency range: 8,200Mc to 12,400Mc. They are used primarily for "flattening" lines and cancelling the vswr's inherent in the other elements of a system. Loads, terminations, attenuators, antennas, bolometer mounts, adaptors, and other components can be matched to the characteristic impedance of the waveguide.

The unit consists of a slotted waveguide and a precision carriage to which an adjustable probe is attached. The longitudinal position of the probe is controlled through a rack and pinion drive, and the depth of insertion is varied by means of a knurled screw. Locks are provided for both carriage position and probe depth.

Carefully designed "choke" sections are incorporated into the unit; they insure that any radiation or contact losses are negligible. Values of vswr to 20 can be corrected to 1.02 or less, and small reflections can be completely cancelled. The entire unit is silver plated. Transline Associates, Dept. ED, 57 State St., Newark 4, N. J.

CIRCLE ED-131 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse Magnetron Operates at High Altitudes

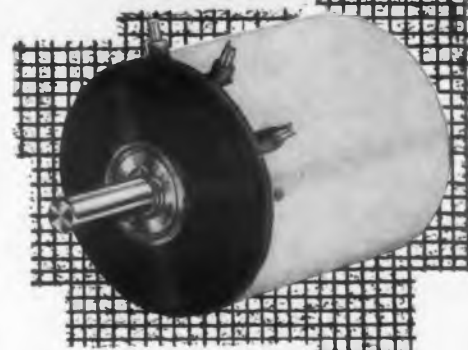
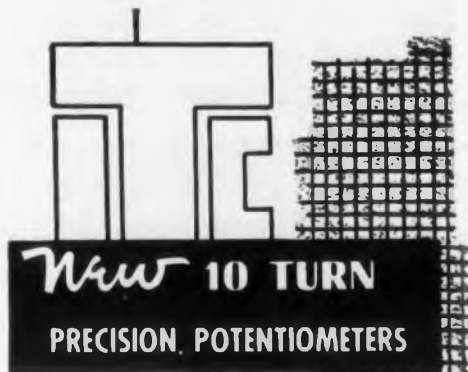


This 3cm pulse magnetron, Type 6527, is designed for reliable operation without pressurization up to 60,000'. Primarily

for use in airborne radar gunsights, it provides weight saving. The tube is a forced-air cooled, fixed-frequency, pulsed-type oscillator, with 9kw peak power output. It operates at frequencies between 9345Mc and 9405Mc.

Weight is 3 lb. Electrically and mechanically, the tube is interchangeable with the type 2J42 magnetron. The feature of the 6527 which allows non-pressurized reliable operation at high altitudes is its evacuated wave-guide. General Electric Company, Tube Department, Dept. ED, Schenectady 5, N. Y.

CIRCLE ED-132 ON READER-SERVICE CARD FOR MORE INFORMATION



- > .025% Linearity at Low Cost
- > High Resolution
- > Extreme Mechanical Precision
- > High Electrical Accuracy

Type MIOT SERVO POTS

. . . wound coil, multiturn potentiometer design is integrated with system aspects of precision computers, servomechanisms and electro-mechanical instrumentation. Extremely precise mechanical tolerances shaft diameter, concentricity, and perpendicularity assure complete transfer of potentiometer accuracy to external systems. Universal mounting surface offers a choice of servo-mount or precision pilot and tapped holes. SERVO POT resistance elements are wound under control of an electronic servomechanism* by a unique method based on the output accuracy of the potentiometer as the controlling factor. Gold-flashed connector-type terminals permit ease of connection where accessibility is limited. *Based upon a method originated by IBM Corporation under U. S. Government Contract.

Mechanical Specifications

Base and Bearings: One piece machined aluminum base houses spring loaded ball bearings in a single through hole for greater accuracy and rigidity.
Finish: Red Alumite, corrosion resistant per AN QQ 8 696A
Mounting: The stainless steel register or pilot formed by the outer race of the bearings is as accurate as the bearing with respect to concentricity and diameter. For synchro type mounting, a high precision outer register used for assembly with gear, pre-ground to the half.
Shaft: Centerless ground stainless steel 2500 0000 0001 diameter.
Mechanical Rotation: Angle between steps 16A0 7 S
Steps: Mechanical steps of lead screw type texture to withstand torque exceeding 100 inch pounds, assure reliability and ruggedness.
Dimensions: Diameter 1.620 Length 2.1 1A

Electrical Specifications

Resistance Range: 1,000 ohms to 10,000 ohms 5%
Independent Linearity: .05% std. .025% or better, special
Effective Electrical Angle: 3600 1 0
Ambient Temperature Range: 55 C. to 80 C.

For further details on the new advanced performance multiturn potentiometers write, wire or call

TECHNOLOGY INSTRUMENT CORP.

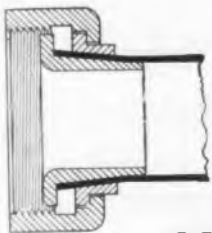
555 Main St., Acton, Mass. COlonial 3-7711
West Coast Eng'g. Facility, P.O. Box 3941,
No. Hollywood, Calif. Poplar 5-8620

CIRCLE ED-133 ON READER-SERVICE CARD



presents

A NEW IDEA IN Flexible Plastic TUBING CLAMPS



for use with AN TYPE CONNECTORS

This unique tubing clamp provides an inexpensive method to protect open wiring used in connection with a standard AN TYPE CONNECTOR.

It is an *easy* and *quick* way to attach flexible plastic tubing to a connector—*without the use of hand tools*. When used in conjunction with a gasketed adapter, a water-proof joint is provided between connector and tubing.

Material—aluminum. Sizes to accommodate tubing from 1/4-in. I.D. to 2-in. I.D. AN plug sizes 12S to 48.

Write for Catalog data.



H. H. BUGGIE, Inc.
726 STANTON STREET
TOLEDO 4, OHIO

CIRCLE ED-73 ON READER-SERVICE CARD

Plate Circuit Relay

Low Cost, Long Life Design



The Series "LB" low-cost, long-life, plate-circuit relay is available in coil resistances up to 34,000 ohms with a pull-in rating of 3ma (approximately

0.09w). The relay is equipped with a one-piece back spring and contact arm which can be adjusted for desired pull-in. A permanent air armature gap eliminates residual sticking.

Contacts are silver, (1 Form C), rated 5amp (3/4hp) 115v a-c non-inductive load. The coil is varnish impregnated centrifugally. Insulation will withstand 500v rms breakdown. The base is laminated phenolic, easily adapted to screw or rivet mounting. Terminals are tinned for easy soldering. Dimensions of the relay are 2-5/8" x 1" x 1-3/8" high, with 2-1/4" mounting centers. Potter & Brumfield, Dept. ED, Princeton, Ind.

CIRCLE ED-74 ON READER'S SERVICE CARD FOR MORE DATA

400cy Circuit Breaker

For Polyphase Circuits



These 400cy circuit breakers are available in one, two, or three-pole models. Polyphase operation of the units is accomplished by linking them together externally at the handles. Tripping out of

any one phase causes simultaneous interruption of all phases. A special kick spring within each pole makes the force available for tripping far in excess of requirements.

The units operate on the hydraulic-magnetic principle in which current capacity, minimum and instantaneous trip points are constant regardless of ambient temperature (*ED, May, 1954, pp 14-15*). No thermal elements are employed. Ratings from 100ma to 50amp are available. Heinemann Electric Co., Dept. ED, 449 Plum St., Trenton 2, N. J.

CIRCLE ED-75 ON READER'S SERVICE CARD FOR MORE DATA

*a new achievement in
fast-print oscilloscope
recording.*

Simple to Operate. Uses standard
Polaroid* magazine and fast
developing film. Delivers finished
black field print in 60 seconds.
Automatically Records 3 to 16 traces
per print. Provides full size image
on 3" scope, half-size image
on 5" scope. No reversal of image.

The Aremac Automatic

RECORDOSCOPE 1185

A fully automatic oscilloscope camera that reduces
engineering time and costs ... increases results.

Sturdy Camera Mount with swing-a-way adapter. Camera easily swung aside when not in use.

Provision for data card exposure.

Versatile — one camera can service several 3" and 5" scopes of different makes which provides with adapter mounts and rods.

Can be interchanged in seconds.

Exposure plus automatic magazine to next frame

provision can be accomplished in three ways:

(1) manual shutter release (2) cable release
(3) remote operating switch.

Manual

RECORDOSCOPE

The manually operated version of the
RECORDOSCOPE 1185

offers many of the precision engineered advantages found in the companion automatic model. Though basically designed for manual release and advance of film, this camera can be factory modified for automatic operation.



*RECORDOSCOPE 1185 features a new
type of lens.*

The Aremac

RECORDOSCOPE 1073

*a 35 MM Synchronous Camera
for Continuous Motion or Single
Frame Oscilloscope Recording*

The Aremac 1073 Recordoscope is a compact self-contained unit mounting an f/2 six-element 50 mm lens and special 400 foot Aremac powered magazine.

Shutter interlock system prevents film motion when shutter is closed.

Synchronous film speeds range from 256"/sec. to 1/8"/sec. in 12 steps of 2:1 ratio. The camera can be stopped and restarted with practically

instantaneous speed synchronization. Periscope mounts camera vertically. Provision for automatically illuminated data cards and strobe contacts.

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THE MALAYAN TIN BUREAU

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Please send me a copy of your free booklet on new uses for Straits Tin.

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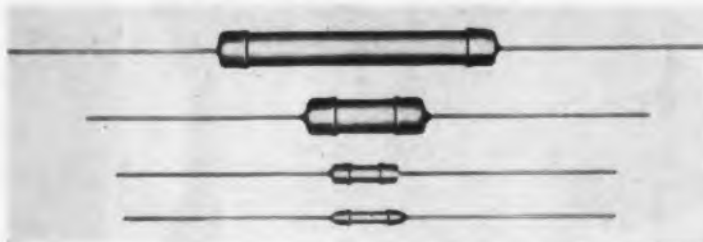
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City _____ Zone _____ State _____

CIRCLE ED-135 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Resistors Deposited Carbon Types



"Stemag Chemo-Carbon" Resistors offer the advantages of small temperature coefficients, greater stability when exposed to humidity, stable resistance values, greatly reduced noise level, extremely low frequency characteristics, and high uniformity on large production runs.

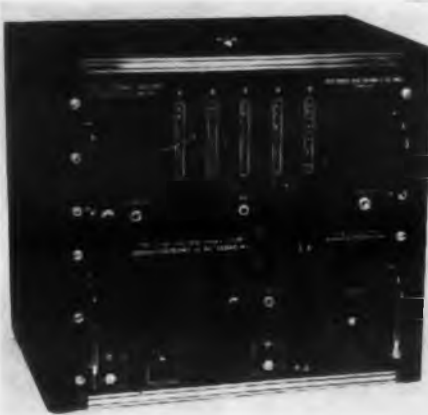
The resistors are available in two types. Type "A", an economical capless type, is made to 5% tolerance. It is comparable in price and size to fixed composition types and is available in ratings of 1/2w, 1w, and 2w.

Precision cap type "D" is available in 1% to 0.5% tolerance. It is manufactured to meet MIL-R-10509A requirements, and is available in wattage ratings of 1/4w, 1/w, 1w, and 2w. Arnhold Ceramics, Inc., Dept. ED, 1 East 57th St., New York 22, N. Y.

CIRCLE ED-420 ON READER-SERVICE CARD FOR MORE INFORMATION

Phase Counter

For Ultra-Low Frequencies

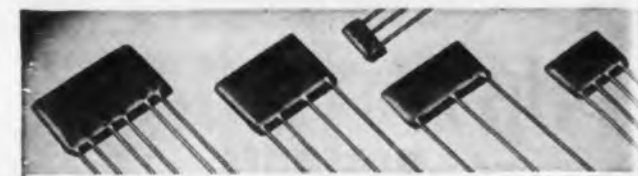


The Ultra-Low Frequency Counter consists of three plug-in units, a decade counter and switching circuit, a timing unit, and a function unit. The function unit can be replaced by another unit manufactured by the same firm

and thereby convert the instrument into a frequency counter, a time interval counter, or a universal time interval and frequency counter.

The instrument measure frequencies from 0.0001cy to 1000cy, but the lower limit can be extended to +0cy with an external timing unit. For measuring phase angle, the input sensitivity is 1v peak minimum, and the input impedance is about 24,000 ohms shunted with 30mmfd. Power requirements are 200w, at 115v ±10%, a-c. The unit is 20-3/4" wide x 18" high x 15" deep. Accuracy is ±1 count per 100,000, or ±0.5°. Advance Electronics Co., Inc., Dept. ED, 451 Highland Ave., Passaic, N. J.

CIRCLE ED-136 ON READER-SERVICE CARD FOR MORE INFORMATION



save money, time, trouble, with Bulplate® Printed Circuits and Multiple Capacitors

With Sprague Bulplates, you have fewer parts to purchase, inspect, handle, and stock . . . fewer soldering operations, faster assembly with less chance of wiring errors. They're more compact, lighter in weight, and Bulplates frequently cost less than the conventional components they replace.

Bulplate Multiple Capacitors with integral connecting circuitry are available in both general application and temperature compensating ceramic bodies. Bulplate Printed Circuits have highly stable resistor elements added to the capacitor elements of Bulplate Multiple Capacitors. In addition to the many standard designs shown in Engineering Bulletins 600 and 650C, Sprague will engineer specials to fit your needs.

SPRAGUE ELECTRIC COMPANY

347 Marshall Street

North Adams, Mass.

SPRAGUE

CIRCLE ED-137 ON READER-SERVICE CARD FOR MORE INFORMATION

...KULKA TERMINAL BLOCKS

CUT COSTS . . . SPEED PRODUCTION



- SIMPLIFY WIRING •
- NO SPLICING
- NO LEAKS OR SHORTS

Molded Barrier-type Terminal Blocks in approved materials and several styles, ranging in size from miniature to jumbo (90 amps.). With or without plain or printed Marker Strips in fibre or bakelite.

Catalog on Request

KULKA ELECTRIC MFG. CO., Inc.

Manufacturers of Electrical Wiring Devices
MOUNT VERNON, N. Y.

CIRCLE ED-138 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1954



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SAN DIEGO 12, CALIFORNIA



New Products . . .

Connector Pressure-Tight Miniature



Designed to provide continued and dependable service under adverse operating conditions, the

CM5-2 miniature electrical connector is pressure-tight, with die-cast aluminum shells for maximum mechanical protection. Individual synthetic rubber O-rings around each contact provide pressure sealing while allowing the contacts to "float", thereby precluding alignment difficulties. Air leakage is less than 1 cu in/hr at 30psi pressure differential.

Outstanding features include: easy removal of the knurled cap at the back of the plug for soldering cable wires to contacts; coupling lock ring for quick engagement and disengagement; and positive polarization of mating parts.

Mineral-filled melamine insulator bodies for high dielectric and mechanical strength house five No. 20 AWG contacts (5amp) and two No. 18 AWG contacts (7amp). Contacts are gold plated over silver. One-piece molded bodies eliminate unnecessary creepage paths and reduce the number of moisture and dust pockets. The shells are cadmium plated with an olive drab iridite finish. Other platings and finishes are available on special request. Winchester Electronics, Inc., Dept. F., Glenbrook, Conn.

CIRCLE ED-222 ON READER'S SERVICE CARD FOR MORE DATA

Rectifier Tube Long-Life Type



This mercury vapor rectifier tube, the Type 6508, is designed to meet the demand for a comparatively inexpensive, long-life rectifier for relatively high voltage and current operation. It is intended to be used instead of standard tubes, which have not been used in many communications and industrial power and control applications because of

initial and replacement cost.

The rectifier has a peak inverse voltage rating of 21kv and a voltage drop of 14v. The cathode is directly heated, oxide coated. Amperex Electronic Corp., Dept. ED, 230 Duffy Ave., Hicksville, L. I., New York.

CIRCLE ED-223 ON READER'S SERVICE CARD FOR MORE DATA

YOU CAN'T SHAKE 'EM LOOSE!



BIRTCHE TUBE CLAMPS



BIRTCHE TYPE 22 TUBE CLAMP

... will securely hold tubes throughout the entire range of JAN base tolerances.

Even *unusual* jarring or vibration will not shake a tube loose when secured by a BIRTCHE CLAMP! Made of *stainless steel*, BIRTCHE CLAMPS are wear-and-weather resistant, made for all types of tubes: glass or metal—chassis or sub-chassis mounted.

*There's a Birtcher Clamp
For Every Purpose*

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Los Angeles 32 California

Dept. EL 11-54

Please send Bulletin which describes and illustrates Tube Clamps in detail.

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At FLEXROCK we have licked this problem. New TEFLON producing equipment has been added. We have substantially increased capacity. We can't take on all things just yet. But soon we will be ready to "throw the book at you" with a complete range of TEFLON services. RIGHT NOW we are set to ship you TEFLON Rod and Tube, extruded or molded, Sheets, and small parts — no matter how intricate — machined from Rod and Tube. We can promise good delivery — yes, FAST DELIVERY . . . with closest possible tolerances on your small parts. Tell us your needs — we will be happy to quote delivery and price.

*DuPont trade-mark
for tetrafluoro-
ethylene resin



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- We are enclosing sample, specs, and quantity for our TEFLON requirements. Please furnish quotation.
- Please send us your TEFLON Bulletin including stock list.

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Company

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CIRCLE ED-225 ON READER-SERVICE CARD

Miniature Pentode

Withstands Cut-Off Conditions



The CK6485 is a heater-cathode type, high transconductance, sharp cut-off pentode of miniature construction designed for use as a wide band or i-f amplifier. It will maintain its emission and freedom from excessive cathode interface resistance even after long periods of operation under cut-off conditions. The tube is otherwise identical with the 6AH6.

The unit has a miniature button seven-pin base. Design center maximum ratings are: heater voltage, 6.4v; plate voltage, 300v; Grid No. 2 voltage, 150v; plate dissipation, 3.2w; grid No. 2 dissipation, 0.6w; cathode current, 25ma. Raytheon Manufacturing Co., Dept. ED, 55 Chapel St., Newton 58, Mass.

CIRCLE ED-227 ON READER'S SERVICE CARD FOR MORE DATA

Pressure Potentiometer

Withstands High Shocks



Capable of withstanding 50g longitudinal acceleration with less than 1% error, Bourns Model 408 Absolute

Pressure Potentiometer is designed to measure altitude, fuel pressure, throat pressure, and static pressure in aircraft, missile, and industrial applications. An evacuated aneroid-type bellows provides the absolute reference pressure.

Compact and lightweight, this rugged precision instrument features an electrical contact arm with counter-balanced linkage that pivots in a miniature ball bearing assembly, thereby providing accurate and dependable performance even during conditions of extreme temperature, shock, vibration and acceleration. Simplified circuitry is possible, because the electrical output of 1/2w requires no amplification and may be fed directly into telemetering transmitters and control systems.

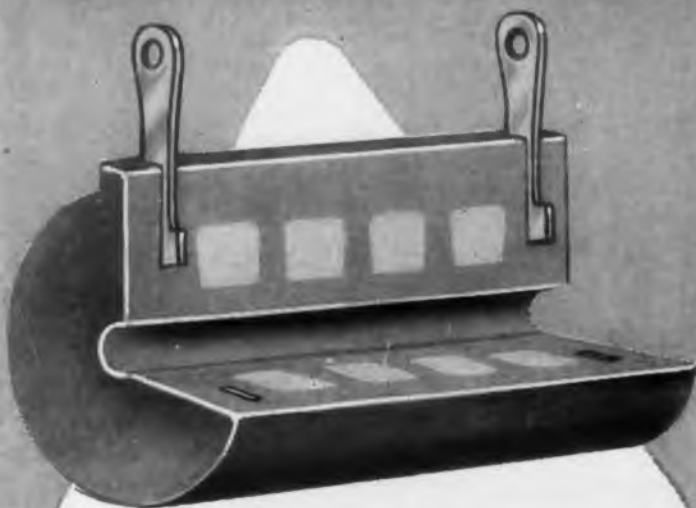
Performance characteristics include resolution of 0.25% to 0.50% for resistances from 1000 ohms to 10,000 ohms. Weight is 7 oz, and size is 2-1/4" diam x 2-3/8" long. Power rating is 1/2w at 160°F. Typical pressure ranges are: 0-2, 0-4, 0-8, 0-11, 0-15, 0-20, 0-30, 5-10, 3-14psia, and others. Bourns Laboratories, Dept. ED, 6135 Magnolia Ave., Riverside, Calif.

CIRCLE ED-226 ON READER'S SERVICE CARD FOR MORE DATA



EPR

N-CAPS[®]



**HERMETICALLY SEALED
SURPASSES SPEC. MIL-R-93A**

Amendment #2 Characteristic B

Withstands Effects
of Salt Water

Resistance to
Mechanical Shock

Maximum Stability
for
Longest Periods

All Military Styles Available

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Precision

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Richmond Hill 18, New York

EPR

CIRCLE ED-228 ON READER-SERVICE CARD FOR MORE INFORMATION

Save Time, Reduce Errors...
 Determine and Record Data
 Automatically with These Two
 Versatile **Berkeley** Instruments



Model 5510 Universal Counter and Timer offers direct-reading digital display of count, frequency or microsecond time interval. Time bases from 1 mc. to 1 cps; gate times from .00001 to 10 sec. Accuracy ± 1 count, \pm crystal stability (1 part in 10^6). Price \$1,100.00 f.o.b. factory.

1. UNIVERSAL COUNTER AND TIMER, Model 5510, combines the functions of four instruments in one single, compact unit. It will:

- a. Count at speeds to 1 million per second.
- b. Count events occurring during a selectable, precise time interval.
- c. Measure time intervals in 1 microsecond increments, from 3 microseconds to 1 million seconds.
- d. Determine frequencies or frequency ratios from 0 cps to 1 megacycle.
- e. Operate directly the BERKELEY printer (below), BERKELEY digital-to-analog converter, or BERKELEY data processor to drive IBM card punches, typewriters or teletype systems.

2. BERKELEY DIGITAL RECORDER, Model 1452, combines scanner and high speed printer in a single unit; prints up to 10 digits on standard adding machine tape. Can be modified to print "Time" or "Code" information simultaneously with count data on same tape.

Model 1452 prints 6 digits (8 or 10 on special order) on standard adding machine tape. Is only 19" wide x 10 1/2" high x 14" deep, weighs 60 lbs. Price, \$750.00 f.o.b. factory.



Write for complete specifications and data; please address Dept. D 11

M-43

Berkeley *division*
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 1750 WRIGHT AVE., RICHMOND, CALIF.

INDUSTRIAL INSTRUMENTATION AND CONTROL SYSTEMS • COMPUTERS • COUNTERS • TEST INSTRUMENTS • NUCLEAR SCALERS

CIRCLE ED-180 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Twin Triode Tube

Increases Speed of Computers

The *GL-6463* miniature twin-triode tube has high perveance and plate current to allow the design of faster speed electronic computers. Developed primarily for amplifier or counter service in digital computers, it fills a need for a moderately high current rating tube designed specifically for computers.

In order to increase computer speeds appreciably, the tube plate load resistance must be lowered. This reduction in turn calls for a higher plate

current, which the tube is designed to supply. Plate dissipation (4w per plate and 7w total for the tube) assures long and dependable operation. The tube incorporates a special heater-cathode construction for dependability under frequent "on-off" switching conditions. When used in "on-off" control applications, it will maintain its emission capabilities after long period of operation under cutoff conditions. General Electric Tube Department, Section ED, Schenectady 5, N. Y.

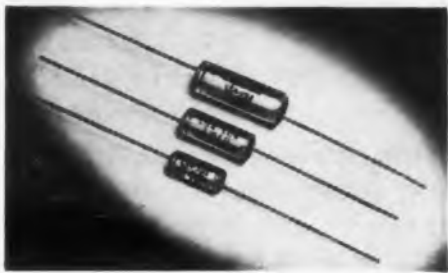


current, which the tube is designed to supply. Plate dissipation (4w per plate and 7w total for the tube) assures long and dependable operation. The tube incorporates a special heater-cathode construction for dependability under frequent "on-off" switching conditions. When used in "on-off" control applications, it will maintain its emission capabilities after long period of operation under cutoff conditions. General Electric Tube Department, Section ED, Schenectady 5, N. Y.

CIRCLE ED-181 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Capacitor

Uses Plastic Film Dielectric



Type LS miniature capacitors incorporate plastic film as the solid dielectric. They feature small size and light weight coupled with the

excellent electrical characteristics. Temperature range is from -70° to $+140^{\circ}\text{C}$. Suitable derating must be used for temperatures greater than 85°C .

Three types are available: LS1 has a maximum voltage of 150v, d-c, at 85°C , 100v at 125°C , and 75v at 140°C ; available in 17 ratings from 0.01-0.5mfd. Type LS4 has maximum voltages of 400v (85°C), 300v (125°C), 150v (140°C); 40 ratings from 0.0033-1.0mfd. Type LS-10 has maximum voltages of 1000v (85°C), 700v (125°C), 350v (140°C); 44 ratings from 0.001-0.5mfd.

Capacitors are capable of passing the 30-day humidity test as described in MIL-E-5272A, paragraph 4.4.2. They meet all applicable environmental requirements of MIL-C-25A. Standard capacitance tolerance available is $\pm 20\%$. Other tolerances available are $\pm 10\%$, $\pm 5\%$, and $\pm 2\%$. Plastic Capacitors, Inc., Dept. ED, 2511 W. Moffat St., Chicago 47, Ill.

CIRCLE ED-182 ON READER-SERVICE CARD FOR MORE INFORMATION



MINIATURE



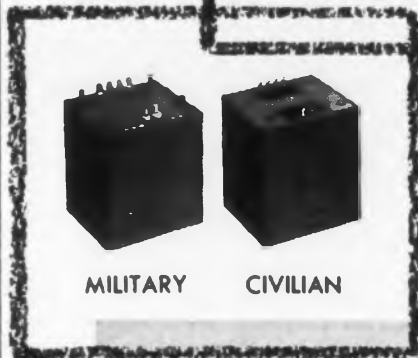
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TOROIDS



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TRANSFORMERS
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Commercial Requirements
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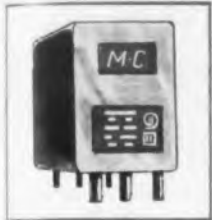
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*T.M. Reg. U.S. Pat. Off.

CIRCLE ED-184 ON READER-SERVICE CARD

Transistor Sockets For RETMA 3E15 Base



Designed to accommodate transistors having the standard RETMA 3E15 base, these sockets are furnished mounted on phenolic strips in

groups of 10. Other models are under development will hold 30 or more sockets in a single strip. The transistor contacts are of phosphor bronze, and the solder contacts are copper. Internal connections are handled by a printed circuit. Dimensions of the 10-socket model are 6" x 1" x 1/4". Electronics Div., Dept. ED, Hydro-Aire, Inc., 3000 Winona Ave., Burbank, Calif.

CIRCLE ED-185 ON READER-SERVICE CARD FOR MORE INFORMATION

Nylon Bearing

Eliminates Lubrication



"Nyliner" flange-type Nylon bearings, which are used primarily to eliminate lubrication and to increase bearing life, incorporate the compensation gap principle which permits circumferential expansion

and contraction of the Nylon material without appreciably affecting the bore diameter.

The flange on the "Nyliner" has two main purposes. One is to permit the bearing to carry end thrust against a shoulder in addition to radial loads. The other purpose is to afford a simple, inexpensive means of axial retention of the bearing in at least one, and in some cases both directions. For relatively heavy thrust loads, a continuous flange can be provided which is interrupted only at the compensation gap. This affords a surface of maximum bearing area. In most cases an interrupted or clover leaf flange is used which precludes slight distortion of the bearing that might result from gradual release of internal stresses in the flange.

Either type of flanged bearing can be provided with an anti-rotation boss or lug under the flange which engages a notch or slot in the bearing housing. This is particularly desirable when the bearings are used in die-cast metal or other relatively soft housing materials which could wear under intermittent rotation of the mounting in the housing. Thomson Industries, Inc., Dept. ED, Manhasset, N. Y.

CIRCLE ED-186 ON READER-SERVICE CARD FOR MORE INFORMATION



The New Edison Control Relay Amplifies Power 500,000 Times

New Edison Control Relay Amplifies Power 500,000 Times

New Edison Control Relay Amplifies Power 500,000 Times

New Edison Control Relay Amplifies Power 500,000 Times

New Edison Control Relay Amplifies Power 500,000 Times

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Control Relay Amplifies Power 500,000 Times

Relay Amplifies Power 500,000 Times

Amplifies Power 500,000 Times

Because there is an amplification factor of approximately 500,000 between the input power to the operating coils and the load capacity of its own contacts, Edison's Magnetic Control Relay actually eliminates the need for electronic boosting—operates *directly* from a thermocouple, photocell, or from vacuum tube currents. Yet this precision instrument stands up even under the shock and vibration of aircraft service.

Designed and developed in the world-famous Edison Laboratory, this small relay has features of particular interest to designers of electronic equipment.

Low power operation—Standard types operate at as low as 30 microamperes—do not drain

power from other circuit components, such as gyro motors.

Versatility—Coils can be supplied with resistances from 0.5 to 20,000 ohms. Differential operation is made possible by separate connections from each coil with polarized operation as an inherent characteristic.

Stability—Test relays have exceeded 8,000,000 cycles without calibration change.

Rugged Movement—Dissipates overloads up to 10,000 times normal operating input—withstands 50 g shock in all planes (unenergized).

Contacts—Platinum-iridium wire, either SPST or SPDT, with capacity of 1/2 ampere at 28 volts d.c. non-inductive.

Write us—especially if you are now using a single-stage electronic amplifier—for more complete information.

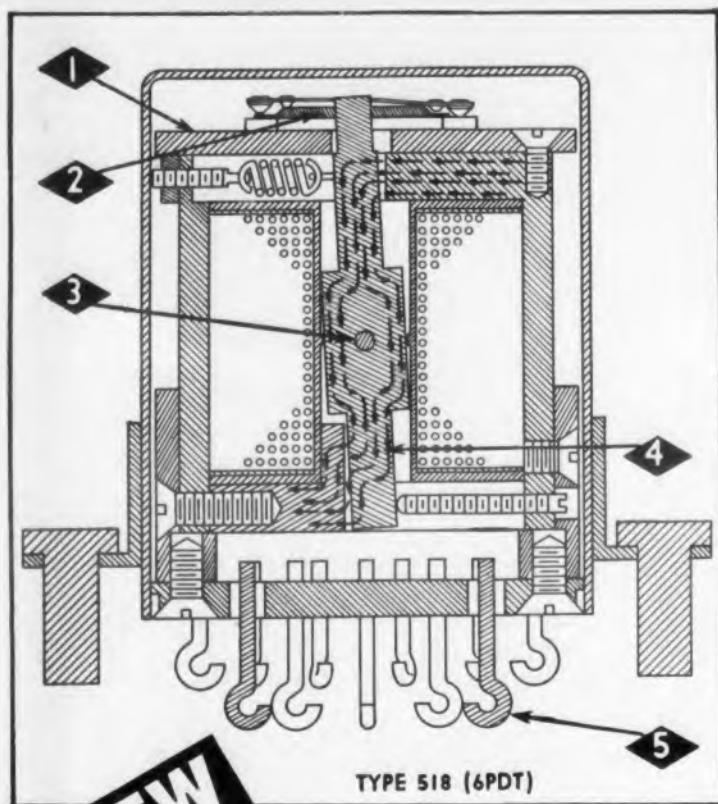
Thomas A. Edison

A GREAT NAME CONTINUES GREAT NEW ACHIEVEMENTS

Thomas A. Edison, Inc.

INSTRUMENT DIVISION • 55 LAKESIDE AVENUE • WEST ORANGE, NEW JERSEY

CIRCLE ED-167 ON READER-SERVICE CARD FOR MORE INFORMATION



NEW SUB-MINIATURE RELAY DESIGN with Patented Features!

Withstands up
to 50 G's Operating
Shock and 250 G's
Mechanical Shock.



DESIGN FEATURES

1. Printed circuit contact carrier. Saves space and simplifies wiring.
2. Sliding interrupter leaf opens contacts, assures ultimate resistance to shock and vibration. This achieves high insulation resistance and contributes toward increased arc suppression and diminishing contact "bounce".
3. Balanced armature, center-pivoted, prevents failures due to shock, vibration and acceleration.
4. Powerful magnetic circuit.
5. Terminal location not dependent on contact arrangement. Can be adapted to any customer requirement.
6. Unique contact circuits.
7. Exceeds requirements of latest military specifications.

Price Electric
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CIRCLE ED-402 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Turret Tuner

Handles V-H-F and U-H-F Channels



The Type TV 99 82-channel turret tuner switches stations, whether v-h-f or u-h-f, with the same ease as v-h-f tuners. It features automatic switching, im-

proved performance over the entire spectrum, electrical and mechanical simplicity, compactness, non-radiation, and low cost.

The tuner may be mounted in the same space devoted to any v-h-f turret tuner, or it may be mounted on the side of the cabinet, if desired. The heightened performance is achieved with the use of 6AN4 tubes. One 6AN4 is employed as an r-f amplifier that functions on all 82 channels; it improves picture quality and functions to reduce radiation to a negligible value. The other 6AN4 is used in place of a crystal mixer. Instead of a conversion loss, an actual gain is realized in this circuit.

Low cost is achieved by a design whereby pretuned fixed-frequency channel segments can be simply snapped into the rotor. These segments are inexpensive tuned circuits individually mounted. Shipping boxes contain three segments and one marked with correct channel numbers. Anchor Radio Co., Dept. ED, Chicago, Ill.

CIRCLE ED-403 ON READER-SERVICE CARD FOR MORE INFORMATION

D-C Solenoids

For Remote Control



The No. 1700 Series of miniature solenoids is for applications requiring the use of d-c solenoids smaller in size and lighter in weight than standard

They may be used for operation of keyboards, control board signal flags, light springs, and similar remote control applications.

The solenoids measure just 1/2" diam x 1-3/8" long. Weight is 0.06 lb. They can be produced for a wide range of current and voltage requirements. An example of pull characteristics is the 24v, 1.4amp type, which is operated on intermittent duty at a 25°C ambient to pull 75lb through a 1/16" stroke. Carruthers & Fernandez, Inc., Dept. ED, 1501 Colorado Ave., Santa Monica, Calif.

CIRCLE ED-404 ON READER-SERVICE CARD FOR MORE INFORMATION

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Electronic Supply Guide

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COMPLETE 308-PAGE
1955 CATALOG

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

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Chicago 80, Illinois

CIRCLE ED-405 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW!

PRINTED
CIRCUIT
LOWERS
COST on . . .

Dectron

DECIMAL DECADE TOTALIZER

Incorporating printed circuitry into the TU-100P makes it possible to reduce the selling price by producing more uniform units, faster and more efficiently. Greater operating stability through better heat dissipation made possible by improved physical layout. Standard octal plugs assure adaptability to most existing high speed counting equipment.

Direct illuminated read-out;
pulse pair resolution —
5 microseconds; maximum
counting rate —
100,000 per sec.

A Complete
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Division of THE *Dectron* CORP.
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CIRCLE ED-406 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1954

Pulse Generator

With Continuously Variable Waveforms



The Model PG-200A Pulse Generator is now housed in a new cabinet that provides greater cooling. In addition, the stability of the instrument has been

improved by the utilization of components that were not available at the time of original design.

The generator is a medium power, precision instrument for generating adjustable rectangular waveforms having fast rise and decay times. Wide ranges of pulse duration, amplitude, recurrence rate, and positioning are provided. It may be operated self-synchronous or driven by an external signal.

Pulse width and pulse position with respect to the sync output trigger are continuously variable by means of calibrated controls from $0.05\mu\text{sec}$ to $50\mu\text{sec}$. Both ranges may be extended to $1000\mu\text{sec}$ by means of an auxiliary unit. Rise and decay times of pulse are constant and equal to $0.03\mu\text{sec}$ or less from $0.05\mu\text{sec}$ to $1000\mu\text{sec}$ pulse width. Pulse repetition rate is from single pulse to 20,000 pulses/sec. Output is 100v open circuit, with 50 ohms driving impedance.

The waveshape is rectangular, with crest and baseline overshoot or ripple less than 5% of average pulse amplitude. Teletronics Laboratory, Inc., Dept. ED, 54 Kinkel St., Westbury, L. I., N. Y.

CIRCLE ED-407 ON READER-SERVICE CARD FOR MORE INFORMATION

Rotary Actuators

For Capacities to 2000 oz-in

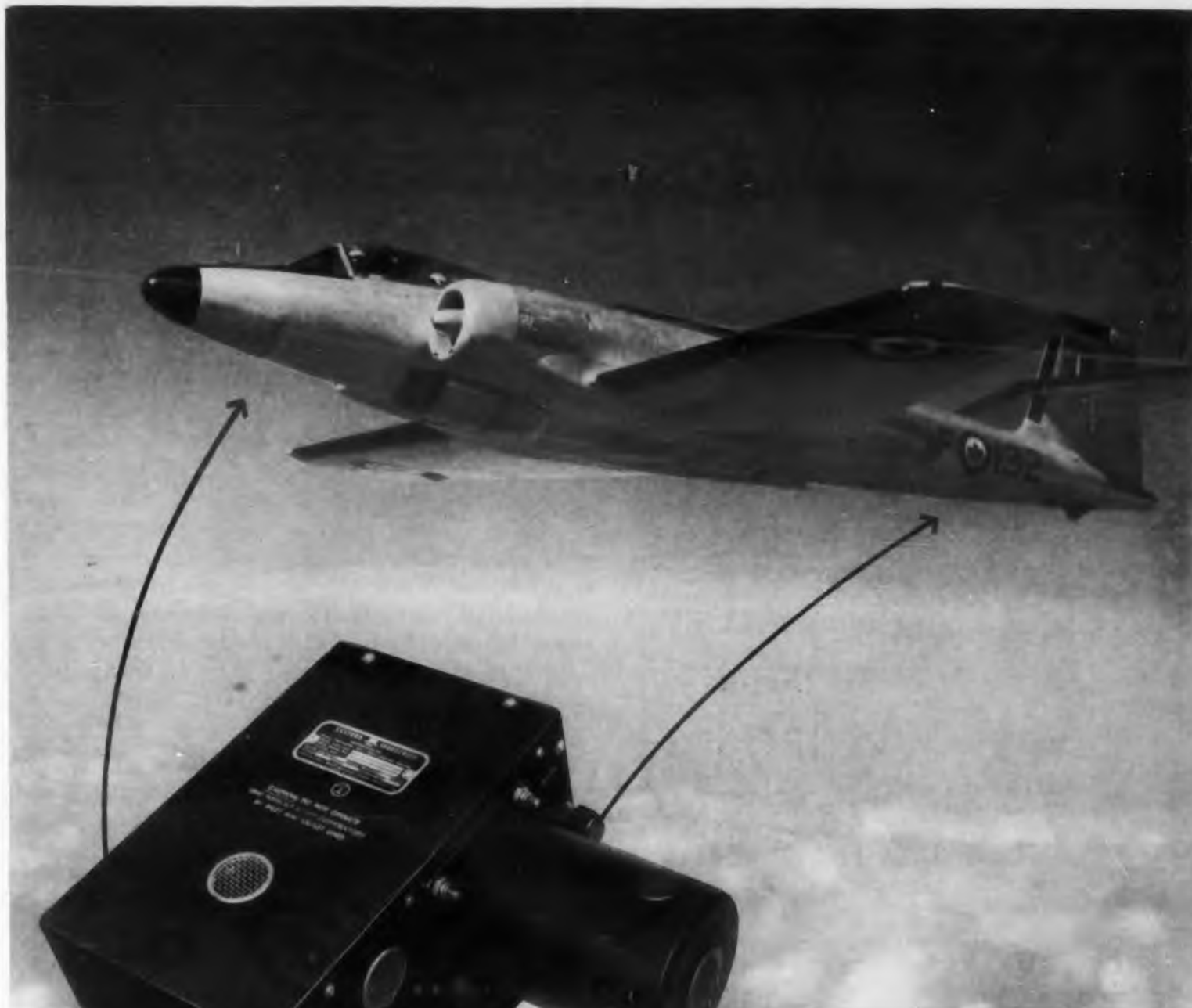


These miniature, high-torque rotary actuators are small, lightweight packages. Custom-made units can be developed for possible applications, including low backlash, water proofing, limit switches, dynamic braking, slip clutches, follow-up potentiometer, speed governors, etc.

The design has the dimensions of $2'' \times 5-1/16''$ maximum, and capacities up to 2000 oz-in, with torque depending on output speed.

Voltage ranges vary from 6v to 100v. The unit can also be arranged for different speeds, torques, angular rotation, and to include reversing relays, if desired. Units consist basically of this firm's permanent magnet "Moto-Mite" and planetary gear reduction. Globe Industries, Inc., Dept. ED, 1784 Stanley Ave., Dayton 4, Ohio.

CIRCLE ED-408 ON READER-SERVICE CARD FOR MORE INFORMATION



RELIABLE PRESSURIZATION

for aircraft equipment

The custom job of supplying pressurization units for airborne electronic equipment is Eastern's specialty. Meeting all appropriate government specifications, units can be furnished within the limits shown at right. Dehydrators available. We invite inquiries and specific requests concerning your specifications.

General Requirements:

Altitude: 0-70,000 ft.

Delivery: 0-3600 cu.in./min. free delivery

Discharge Pressure: 0-60 p.s.i.

Temperature: -65°F to $+160^{\circ}\text{F}$

Voltages: any standard voltage.



Eastern



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New Aviation Products Catalog covering Electronic Tube Cooling Units, Hydraulic Equipment, and Pressurization Units sent on request.

CIRCLE ED-409 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW SUBMINIATURE FILTERS

FOR TELEMETERING
AND AIRBORNE
EQUIPMENT

3 db AT 6% Band
Width

40 db/octave

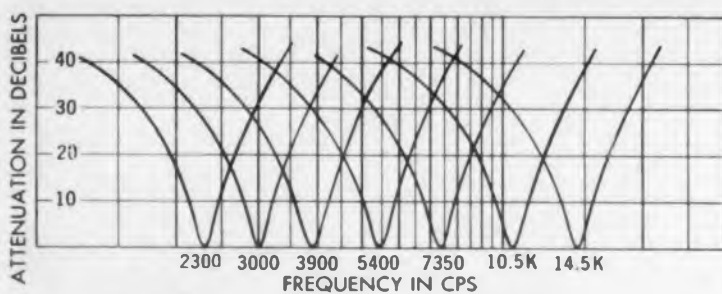
FREQUENCY
2.3-35Kc

IMPEDANCE IN
600-10K
OHMS

IMPEDANCE
OUT-GRID



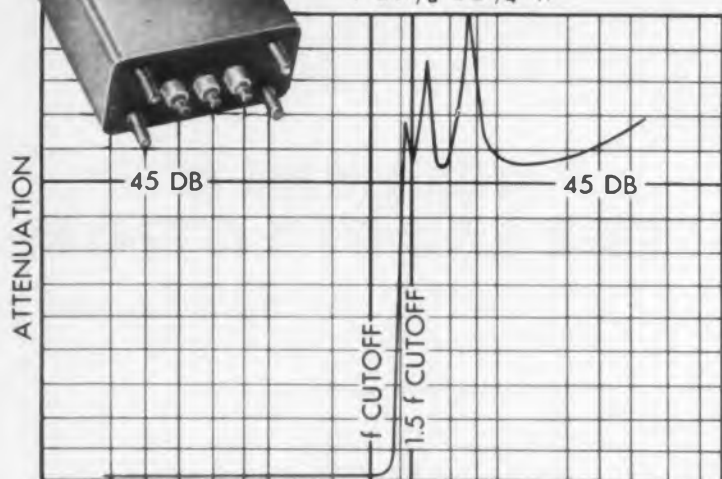
23/32" x 23/32" x 11/16" (Pictured Actual Size)



STANDARD LOW PASS FILTER SERIES

OVER 45 DB ABOVE 1.5 f CUTOFF
ALSO AVAILABLE IN SUBMINIATURE VERSION

1" x 17/8" x 23/4" H



FREQUENCY

STANDARD FILTERS

PART NO.	IMPEDANCE	f-CUTOFF	PART NO.	IMPEDANCE	f-CUTOFF
90115	600	3000	90438	600	10000
90433	5000	3000	90439	5000	10000
90434	10000	3000	90440	10000	10000
90435	600	6000	90441	600	15000
90436	5000	6000	90442	5000	15000
90437	10000	6000	90443	10000	15000

FOR ADDITIONAL INFORMATION CONTACT

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CIRCLE ED-411 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Saturable Reactors

Control Pulse or Sine-Wave Power



A series of "Magnestats", small saturable reactors, is available to control pulse or sine wave power ranging from microwatts to deciwatts at frequencies from 100kc to 20Mc. The units are as stable as transformers and do not depend on resonance. The control and the

controlled circuits are electrically independent.

"Magnestats" are made for use in computers and other complex systems such as amplifiers, gates, flip-flops, switches, and arithmetic elements. For example, Type AH 25 is an amplifier which operates on 15Mc power. It will drive two other similar amplifiers with a signal rise time of less than 1/2μsec. Snyder Laboratories, Dept. ED, 601 Chapel Ave., Merchantville 10, N. J.

CIRCLE ED-412 ON READER-SERVICE CARD FOR MORE INFORMATION

SIMPLIFY CIRCUIT TRIMMING with

**BOURNS sub-miniature
TRIMPOTS**

- Resolution: As low as 0.25%
- Power Rating: 0.25 watt at 100° F.
- Weight: Only 0.1 oz.

BOURNS TRIMPOT is a 25 turn, fully adjustable wire-wound potentiometer, designed and manufactured exclusively by BOURNS LABORATORIES. This rugged, precision instrument, developed expressly for trimming or balancing electrical circuits in miniaturized equipment, is accepted as a standard component by aircraft and missile manufacturers and major industrial organizations.

Accurate electrical adjustments are easily made by turning the exposed slotted shaft with a screw driver. Self-locking feature of the shaft eliminates awkward lock-nuts. Electrical settings are securely maintained during vibration of 20 G's up to 2,000 cps or sustained acceleration of 100 G's. BOURNS TRIMPOTS may be mounted individually or in stacked assemblies with two standard screws through the body eyelets. Immediate delivery is available in standard resistance values from 10 ohms to 20,000 ohms. BOURNS TRIMPOTS can also be furnished with various modifications including dual outputs, special resistances and extended shafts.



BOURNS also manufactures precision potentiometers to measure Linear Motion; Gage, Absolute, and Differential Pressure and Acceleration.

BOURNS LABORATORIES

6135 MAGNOLIA AVENUE, RIVERSIDE, CALIFORNIA

3. L. PATENTS PENDING

Technical Bulletin On Request, Dept. 232

CIRCLE ED-413 ON READER-SERVICE CARD FOR MORE INFORMATION

DC-AC CHOPPERS

For 60 Cycle Use

Built to rigid
commercial
specifications.

Twenty-two types,
both single and
double pole.

Long life.

Low noise level.

Extreme reliability.

Write for
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CIRCLE ED-414 ON READER-SERVICE CARD FOR MORE INFORMATION

Linde synthetic sapphire

... for excellent optical transmission

PLUS physical strength and chemical inertness

Sapphire is hard, strong, chemically inert and transmits a high percentage of radiation in the important ultra-violet and infra-red regions. At 1750A forty per cent of the radiation is transmitted by a .059 inch section; at 5.7 microns forty per cent is transmitted by a .100 inch section. This unique combination of properties makes it ideal for optical systems that require resistance to abrasion and corrosion and high temperature strength as well as excellent optical transmission.

Now single-crystal sapphire windows are available in diameters up to 2 inches in several finishes. For further information, call or write your nearest LINDE office.

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CIRCLE ED-415 ON READER-SERVICE CARD FOR MORE INFORMATION

Strain Scanner-Recorder Can Handle 50 Gages



Records from SR-4 strain gages at 50 points can be taken continuously and automatically in a total of 30sec to 90sec with these strain scanning and recording instruments. The equipment greatly reduces the time and skill required during any testing project requiring numbers of SR-4 strain gages.

The recorder provides three ranges of measurement; 0-2000, 0-5000, and 0-10,000 microinches, and can handle gages with mixed resistances ranging from 60 ohms to 500 ohms. A gage factor control is included to accommodate strain gages with gage factors ranging from 1.7 to 2.25. On each range, zero can be set at left, center, or right of the recorder chart.

The scanner unit contains the electrical circuits and controls for switching. In addition to full automatic operation of the system, it can be manually advanced through each of the 50 strain gage channels, one at a time. A rapid advance pushbutton permits advancing the system at the rate of at least two channels per second without recording. The channel in use at any given instant is indicated by a rotating hand on the face of the strain scanner unit. Strain gage output can be indicated without recording by means of a pen-lifting mechanism. No d-c standardizing circuit or associated components are required. Baldwin-Lima-Hamilton Corp., Dept. ED, Philadelphia 42, Pa.

CIRCLE ED-416 ON READER-SERVICE CARD FOR MORE INFORMATION

Earphones

Clip-Ons for Many Uses



This line of hearing-aid quality, clip-on miniature earphones is designed to meet a wide variety of requirements. Some suggested uses for

"Fen-Tone" clip-ons are: dictating machine transcribing, monitoring phone order desks, simultaneous listening, radio communication, factory communication and control, and private sampling of recordings of important meetings.

The clip-ons are available in 128 ohm, 100 ohm, and 2000 ohm models, with flesh colored plastic clasp or earmold, complete with 5' cord and standard coaxial phone plug. Fenton Company, Dept. ED, 15 Morre St., New York 4, N. Y.

CIRCLE ED-417 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1954

In a nutshell



JUNCTION TRANSISTORS

G-E engineering consistently aimed for and achieved second-to-none quality in this transistor product. During the past year we refused time after time, to sacrifice quality to the urgency of orders on hand. The thousands of hours invested in development and test laboratories, in field testing and application, earned this most heartening response—every one of our customers has applauded the extreme reliability, the over-all superb quality of these General Electric transistors.

The facts on delivery today are as follows: We're swamped with orders. We can only handle your minimum requirements. Larger orders will be filled as promptly as General Electric's greatly-expanded production lines swing into "high". So place your order promptly. A shipment of G-E junction transistors applied in *your circuits* will save space and power, and reduce weight . . . as they deliver the important design advantages listed at the right.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

CIRCLE ED-418 ON READER-SERVICE CARD FOR MORE INFORMATION

TOP QUALITY UNITS
ARE NOW BEING SHIPPED

DESIGN FEATURES:

SEALED JUNCTION...contaminating gases permanently eliminated!

WELDED SEAM CONSTRUCTION...free from solder-flux contamination.

HIGH POWER OUTPUT...case design makes possible a collector dissipation of 150 MW.

HIGH FREQUENCY PERFORMANCE...specifications cover operation at audio and supersonic frequencies.

HERMETIC SEAL...unaffected by moisture.

HIGH TEMPERATURE OPERATION...rated for a maximum junction temperature of 100°C.

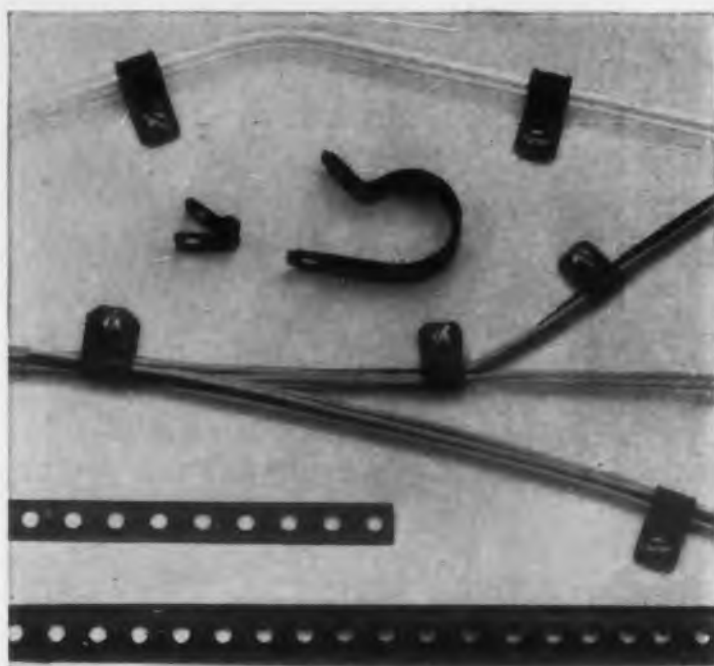
LONG LIFE...designed for long-term, stable performance.

SMALL SIZE...extremely compact design provides added flexibility for all applications.

G-E recommends these germanium-fused junction transistor triodes (P-N-P units) for low-to-medium power applications, for gains as follows:

2N43 . . . HIGH 2N45 . . . MEDIUM
2N44 . . . INTERMEDIATE

We can't tell all in a nutshell — so write today for complete specifications and delivery details. Section X74114, General Electric Company, Electronics Park, Syracuse, N. Y.



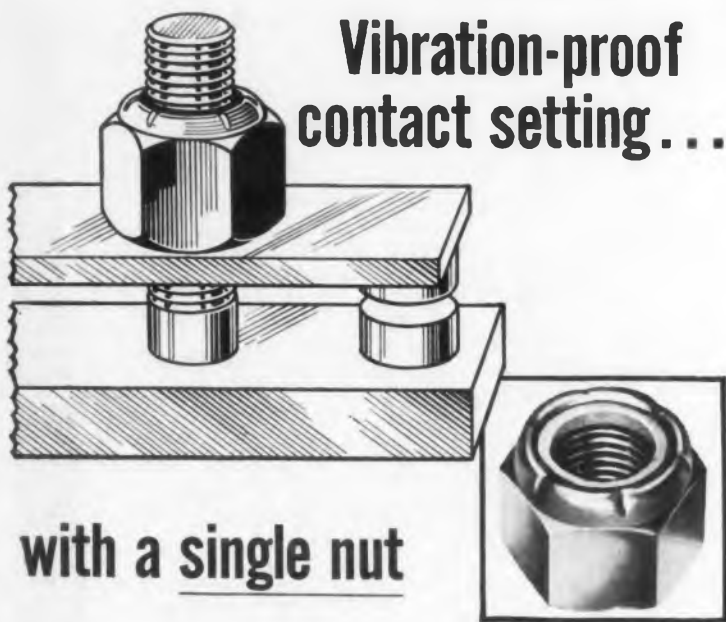
HOLD—wiring—fragile glass tubing—mercury switches—components—etc. with these **NyGrip*** (all Nylon) plastic cable clips and perforated strapping—light weight—tough—flexible—strong—chemically resistant—use from -60 to 250°F—send for free samples and literature. *TM

WECKESSER CO.

5253 N. Avondale Ave.

Chicago 30, Ill.

CIRCLE ED-419 ON READER-SERVICE CARD FOR MORE INFORMATION



Vibration-proof contact setting...

with a single nut

Easily wrenched on to an exact setting, the one-piece, self-locking Elastic Stop® nut won't shake loose. The red elastic locking collar grips the stud threads tightly . . . maintains a precision adjustment without any secondary locking devices. Usable over and over again. Many types available in miniature sizes for electronic and instrument assemblies—hex nuts as small as .109 across flats!

For information and help with electronic fastener problems, write Dept. N70-1157.



ELASTIC STOP NUT CORPORATION OF AMERICA

2330 Vauxhall Road, Union, N. J.

DESIGN HEADQUARTERS FOR SELF-LOCKING FASTENERS

CIRCLE ED-421 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Communications Receiver Has Continuous Calibrated Band



"Pro-130" Communications Receiver has a precision differential tuning system which makes it possible to read the exact frequency

to which the receiver is set, anywhere from 550kc to 35.5Mc. The rotary turret construction for selecting any one of the six bands permits extremely short leads between the circuits and tubes, and makes possible the separate removal of individual circuit sections. The WWV standard frequency signals can be received on this set.

The set is double conversion from 2.2Mc to 35.5Mc, the top four bands, for high image rejection. High stability is achieved because of the crystal-controlled sound conversion oscillator. Improved front-end selectivity is obtained with a single tube, triple-tuned, r-f section. Hammerlund Manufacturing Co., Dept. ED, 460 W. 34th St., New York 1, N. Y.

CIRCLE ED-422 ON READER-SERVICE CARD FOR MORE INFORMATION



Fielden TEKTOLOG

ELECTRONIC RECORDER

- * Accurate to $\pm 1\%$ of Full Scale
- * Operates directly from Low Energy Sources
- * Simplified Design—Only 4 Principal Units
- * Available with Electric or Pneumatic Controls

The Fielden TEKTOLOG has a sensitivity of $\pm 0.1\%$, mechanical reproducibility of $\pm 0.5\%$, yet because of its simplified design, circuitry and construction is priced substantially lower than other types. Various recording speeds to suit applications. Pen equipped with non-clogging capillary tip suitable for high or low speed recording auxiliary control apparatus. Available with dust-tight, weather-proof cast aluminum housing. Easily installed . . . flush or surface mounted. Can be supplied with portable carrying case for mobility since critical leveling is not needed. Designed for accurate recording at low cost. Write today for details to Dept. M.

Robertshaw-Fulton

CONTROLS COMPANY



FIELDEN INSTRUMENT DIVISION
2920 N. 4th St., Dept. Q, Philadelphia 33, Pa.

Dollar for Dollar—Your Best Instrument Value

CIRCLE ED-424 ON READER-SERVICE CARD FOR MORE INFORMATION

3 Soldering Operations in 1 Easy as ABC

with KESTER "SOLDERFORMS"



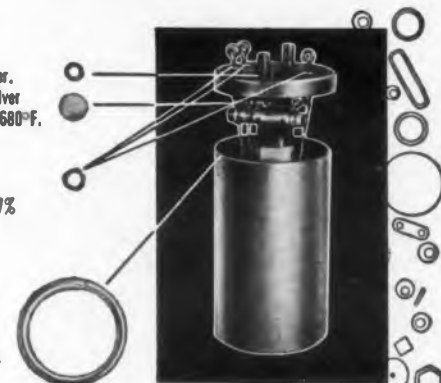
- 1 Glasseal hermetically sealed sub-miniature paper tubulars. Manufactured to the highest commercial standards and engineered to the exacting performance requirements of Military Specification MIL-C-25-A.
- 2 Oil paper capacitors of finest possible commercial quality, meeting MIL-C-25A and Jan-C-25 standards of precision.
- 3 Electrolytics of superior commercial performance characteristics, meeting Jan-C-62.

Write for Catalog J-8 for further detailed information. Or call your local Pyramid Sales Representative or write to:

PYRAMID ELECTRIC COMPANY
Dept. 123, 1445 North Hudson Blvd., North Bergen, New Jersey

CIRCLE ED-423 ON READER-SERVICE CARD FOR MORE INFORMATION

- A Solder screws and stud to can cover. "Solderform" Disc & Rings 5% Silver—95% Lead Alloy. Melting Point 680°F.
- B Solder glass terminals to cover. "Solderform" Rings 63% Tin—37% Lead Alloy. Melting Point 361°F.
- C Hermetically seal cover on can. "Solderform" Ring 28.5% Bismuth—28.5% Tin—43% Lead Alloy. Softening Point 250°F.



Here's a typical example of a tough resistance soldering job involving progressively lower melting temperatures. Kester "Solderforms" made sure this high precision oscillator coil came through every test successfully.

WRITE TODAY for free "Solderform" samples and literature.

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SOLDER COMPANY
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ELECTRONIC DESIGN • November 1954

"Vasco" Petite Iron



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THE RIGHT HEAT • THE RIGHT TIP



**For Service and Manufacture
of Printed Circuits**

CONTACT OUR
REPRESENTATIVE IN MAJOR CITIES

OR

Mitchell Industries

Mineral Wells, Texas

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**MINIATURE
SPEED CHANGERS**
★
**COMPLETE
COMPACT
ADAPTABLE**

- Over 400 different Standard ratios! 10:9 to 531,441:1
- SMALL! 1.050" Diameter. Overall lengths: Class A, 3-1/8" Class B, 3-15/16" Class C, 4-3/4"
- Transmit power either way to 100:1 ratios!
- Concentric ball-bearing input and output shafts.
- Hardened steel spur gears.
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- Prompt deliveries on production or experimental quantities.

BULLETIN No. 100

Gives complete details - Write for it today to METRON INSTRUMENT COMPANY, 450 Lincoln Street, Denver 3, Colorado

BUILT BY **Metron** MAKERS OF INSTRUMENTS FOR PRECISION MEASUREMENTS

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ELECTRONIC DESIGN • November 1954

Amplifier

For Examining of Circuits



The Model 60 "Video Probe Amplifier" is an electronic instrument designed to facilitate circuit examinations with all types of oscilloscopes. Because of its low input capacity, its use with any oscilloscope permits observation of the circuit under study without loading, detuning, or other adverse effects on

normal performance of the circuit. The unit's video probe system introduces no attenuation, so oscilloscope may be used at full gain for accurate observation of small signals.

The amplifier has uniform frequency response from 50cy to 12Mc within ± 3 db. It also serves as an excellent general-purpose amplifier with gain of 40 and more than 12v peak-to-peak output. Each instrument is supplied with a clip-on type probe for use as an oscilloscope accessory, and an RG/62U cable input with u-h-f connectors for use with the instrument as an amplifier. Donner Scientific Co., Dept. ED, 2829 7th St., Berkeley 10, Calif.

CIRCLE ED-243 ON READER-SERVICE CARD FOR MORE INFORMATION

MICROWAVE SIGNAL GENERATORS

Complete coverage of the
range 950-11,500 mcs/sec.

with Polarad single dial operation

Four new Microwave Signal Generators covering the range 950-11,500 mcs/sec. All with famous Polarad single dial operation. Each provides the maximum working range possible in one compact signal generator.

These features assure fast and simple operation: direct reading, single dial frequency control that tracks reflector voltages automatically . . . direct reading attenuator dial . . . complete internal pulse and FM modulation as well as provisions for external modulation . . . conveniently placed controls, in logical sequence . . . high visibility on the face of each instrument.

Practical for laboratory or factory assembly line. Engineered ventilation assures continuous and stable operation. Additional Polarad Microwave Signal Generators are available to cover 12.8 to 39.7 kmc.

Write directly to Polarad or your nearest Polarad representative for details.



MSG-1, 950-2400 mc

MSG-2, 2150-4600 mc

MSG-3, 4450-8000 mc

MSG-4A, 7000-11,500 mc



"The finest Signal Generators
of their kind"

ELECTRONICS CORPORATION

100 METROPOLITAN AVENUE, BROOKLYN 11, NEW YORK

CIRCLE ED-245 ON READER-SERVICE CARD FOR MORE INFORMATION

Stop Corrosion with

RHODIUM PLATING

New uses for Rhodium Plating are constantly being found by electronic design engineers where hard, corrosion resistant electrical contact surfaces are required.

RHODIUM PLATE offers these advantages:

- assures low and stable contact resistance
- allows higher pressures to be used in sliding contacts
- not affected by atmospheric changes
- oxide-free contacts eliminate partial rectification and unwanted signals
- provides low noise level for moving contacts
- extremely long-wearing

These properties are particularly well-suited to electrical and electronic applications. RHODIUM plate affords excellent protection against atmospheric corrosion for printed circuits and permits incorporation of sliding contacts as part of the circuit.

Write for Free, detailed booklet on RHODIUM PLATING.

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CIRCLE ED-246 ON READER-SERVICE CARD FOR MORE INFORMATION

MIL-T-27 Power and Audio
 MS (Military Standard)
 MIL-T-27 400 Cycle
 Pulse Transformers
 Molded Toroidal Inductors
 High Fidelity Transformers
 Transistor Transformers
 Link Replacements



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CATALOG
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the World's Toughest Transformers

These are just a few of the popular types of transformers for military, new equipment, general replacement, control and power circuit applications listed in CHICAGO'S new Catalog . . . over 500 transformers, with complete physical and electrical specifications on each unit.

And more important—they are all *in stock* for quick delivery from your local CHICAGO distributor.

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

CIRCLE ED-251 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature ...

Electron Tubes

252

This valuable reference guide (Seventh Edition) lists all miniature tubes, regardless of make. It includes pertinent data for 329 types, of which 79 are new, 135 basing diagrams, numerous operating conditions, and indicates larger prototypes. CBS-Hytron, Div. of Columbia Broadcasting System, Inc., Danvers, Mass.

Magnetic Electrodes

253

A newly developed magnetic electrode, designed for packaging-machine applications and permitting the unobstructed high-frequency welding of large area plastic sheets, is described in this leaflet designated Form E654. Described in the literature is the general arrangement, which demonstrates how the high-frequency electrode is completely enclosed by the steel magnetic structure and keeper bar. This, at the same time, applies welding pressure to the plastic sheet. A close-up cross-section of the unit makes clear the manner in which its construction completely eliminates the overhead interference of conventional hydraulic and pneumatic presses, and provides optimum r-f shielding. Electronic Processes Corp., 1076 San Antonio Road., Los Altos, Calif.

Scale Models

254

Scale models, their application and manufacture are described in a 4-page, 2-color brochure. Precision models of any product, prototype design, or piece of equipment are made to user specifications to aid in development and research work. The booklet illustrates a number of models produced by the company in metal, wood, and plastics, and outlines services available. Arthur B. Johnson & Co., Inc., 392 East 201 Street, New York 58, N. Y.

Color TV System

255

The G-E "Chromacoder" color TV system is described in this 4-page brochure. It explains what it is, how it functions, and what advantages it has over other live systems. The booklet includes a detailed explanation of the use of the Chromacoder with color-modified black-and-white cameras to obtain an NTSC color signal. A simplified block diagram of the equipment illustrates how the simultaneous color signal is obtained from the sequential signal produced by the pick-up cameras in the studios. General Electric Co., Broadcast Equipment Div., Electronics Park, Syracuse, N. Y.

A-C Rate Generator

256

A 4-page illustrated bulletin illustrates and describes a line of extremely stable, linear, a-c rate generators with high functional voltage output. The units covered are offered in 60cy and 400cy models and are available with temperature compensation for a wide environmental operating range. Information on construction, applications and design features and characteristics and specifications are provided. Also included is a section on rate generator-servo motor packages which combine in single shaft units, rate generators and high-precision servo motors. Ford Instrument Co., 31-10 Thomson Ave., Long Island City 1, N. Y.

Laboratory Ovens

257

Catalog No. 331 describes a wide range of precision laboratory ovens, incubators, and related equipment. Fifty-four models are discussed with dimensions, temperature range, power requirements, weight, accessories, and other pertinent information given in convenient tabular form. Precision Scientific Co., 3737 West Cortland St., Chicago 47, Ill.

Tube

Deser
vacuum
ray tub
are list
manual
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appear
circuits
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Inc., 9

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Co.,

Tube Manual

Descriptions and characteristics of this firm's 600 vacuum tubes, 110 premium tube types, 170 cathode ray tubes, 85 crystal diodes, and a line of dial lamps are listed in the 20th edition of this 200-page tube manual. Drawings of bases, contacts, and tube outlines, including obsolete types, are given. The color codes for resistors, capacitors, and transformers, as well as a 15-page tube substitution chart are included. An explanation of the ballast tube numbering code appears on pages 173 and 174. Six typical electronic circuits are included among the many illustrations. Price: \$0.75. Write directly to Tung-Sol Electric, Inc., 95 Eighth Ave., Newark 4, N. J.

255 Metallized Paper Capacitors 258

Technical data and operating characteristics of this firm's "Hy-Met" high temperature paper capacitors are described in folder No. AB-19A. It contains information on types of "Hy-Met" available, their capacitance stability, voltage rating and derating, insulation resistance, sizes, etc. Designed for operation over a wide temperature range, these units feature the unique self-healing characteristics of metallized paper capacitors and have good capacitance vs temperature stability, low power factor, and long life. Astron Corporation, 255 Grant Ave., East Newark, N. J.

256 Pulse Transformers 259

This 8-page catalog (Section No. 44-250) of pulse transformers for radar applications lists both high- and low-power types. Construction, applications, ratings, list prices, and mounting illustrations are included. Ordering data for d-c charging reactors is also given. Westinghouse Electric Corporation, Transformer Division, P. O. Box 231, Greenville, Pa.

"Mylar" Properties 260

The physical, electrical, chemical, and thermal properties of "Mylar" polyester film are listed in this 8-page brochure. Each electrical property is given for at least two different conditions. A list of proposed applications and a table of types and gages currently available are also given. E. I. Du Pont Nemours & Co., Inc., Film Department, Wilmington 98, Del.

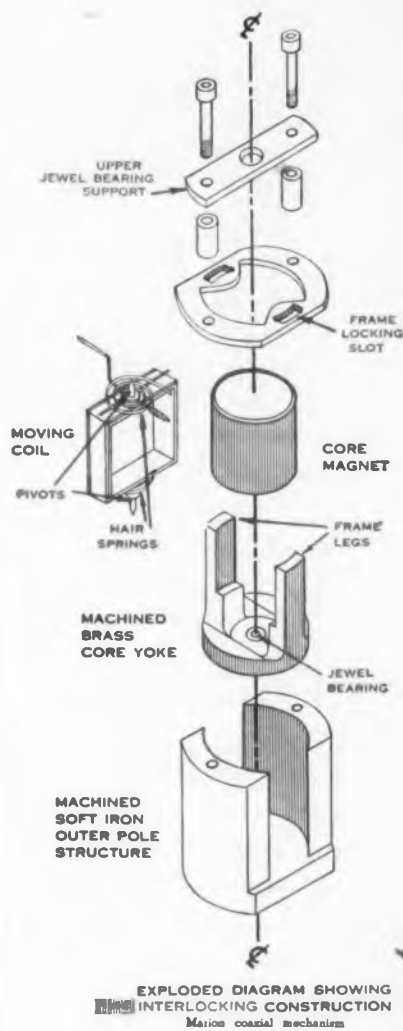
257 Laminate 261

Valuable information for the designer of printed circuitry is included in this 12-page booklet (No. 457) on copper-clad laminates. The various methods of manufacturing printed circuits and a chart of the overload currents for the various widths and thicknesses of copper foil are also given. The laminates are available with nylon and silicone bases. Formica Co., 4614 Spring Grove Ave., Cincinnati 25, Ohio.

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



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advancement
in instrument
design



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

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

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

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

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"L" BAND WAVEMETER



Newest in a series of precision-manufactured wavemeters, the Model #228 "L" Band Wavemeter is a coaxial line instrument covering the frequency range from 900mc to 2400mc, by either the absorption or transmission method.

— FEATURES —

- High frequency stability through the temperature range 10° C to 40° C.
- Extreme mechanical stability.
- High accuracy of measurement ($\pm .02\%$).
- Sloping panel for easy observation.
- Tri-plating of all surfaces.
- Direct reading frequency control dial.
- Frequency control dial has knob for speedy operation.
- Counter-to-frequency graph is provided for extremely accurate readings.
- Rugged components, for long service life.
- Golden anodized aluminum panel and cabinet of fine hand-rubbed walnut, for pleasing appearance.

SPECIFICATIONS

Type N constant impedance input connectors.
 BNC or UHF co-axial fitting
 for external video connection.
 Power handling capability
 (absorption)—0.5mw to 1 watt.
 Power handling capability
 (transmission)—1mw to 1 watt.
 Peak power—up to 25 watts (transmission).
 Approximate loaded Q 1000.
 Cabinet size—15" wide, 9 $\frac{3}{4}$ " deep, 7 $\frac{3}{4}$ " high.
 Net weight 13 $\frac{1}{2}$ pounds.

This unit can be modified for your own specific requirements. Send for bulletin ED.



Amerac, Incorporated

116 TOPSFIELD ROAD
 WENHAM, MASSACHUSETTS

CIRCLE ED-264 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature . . .

Quartz Crystals 265

A 4-page bulletin on quartz crystals describes the most used units in this company's line. They range in frequency from 16ke to 100Mc and include the RII-7B TV designed specifically for use in color TV. Comprehensive data pertaining to dimensions, frequency range, and corresponding military specifications are given. Reeves-Hoffman Corp., Cherry and North Sts., Carlisle, Pa.

Protective Coatings 266

"Check List of Metal Protective and Paint Bonding Chemicals and Processes" is the title of this 8-page brochure. It lists metal-protective and paint-bonding chemicals for steel, zinc, aluminum, and other metals having industrial applications. American Chemical Paint Company, Ambler, Pa.

Valves 267

A 16-page bulletin, designated No. 1010, covers a complete line of standard 4-way hand, foot, power and solenoid operated valves, as well as a new line of pilot valves. Dimensions and weights, application diagrams, circuit diagrams, parts lists, and accessories are also included. Ledeen Manufacturing Co., 1600 South San Pedro St., Los Angeles 15, Calif.

Coil Winders 268

Bobbin, repeater, solenoid, resistor, armature, variable pitch, spacewound, lattice-wound universal, and filed coils are described in the firm's 46-page Catalog (No. 54). Several accessories also are covered, and one page is devoted to winding formulas. Geo. Stevens Manufacturing Co., Inc., Pulaski Rd. at Peterson, Chicago 30, Ill.

Relays 269

An attractive 18-page booklet (GS) illustrates and describes this company's complete line of standard relays. A complete list of uses, special features, specifications, and a dimensional drawing are given for each relay illustrated. Additional features are also available for special applications. Kurman Electric Co., Inc., 35-18 37th Street., Long Island City 1, N. Y.

Coaxial Connectors 270

A 24-page illustrated catalog lists this firm's latest connectors for both government and commercial use. Designed for efficient use by the design engineer, the booklet also includes allied components for use in u-h-f through microwave frequencies. Tru-Connector Corp., 416 Union St., Lynn, Mass.

Data Processing 271

"Data Processing Instruments" is the title of a 12-page catalog which furnishes information on a complete line of data-processing equipment ranging from miniature transducers to entire instrumentation systems. Photographs, technical specifications and functional diagrams accompany the text. Consolidated Engineering Corp., 300 North Sierra Madre Villa., Pasadena 8, Calif.

Crystals 272

A 12-page illustrated brochure, designated Catalog No. 354, incorporates a military chart designed for the user's guidance in selecting proper crystal types for particular requirements. The booklet features the company's complete line of crystals, from subminiature, hermetically sealed, plated units to crystal ovens. Standard Crystal Company, 1714 Locust, Kansas City, Mo.

Servomechanism Parts 273

This well-illustrated brochure covers the company's line of precision gear heads, gear trains, and speed reducers. The technical information, specifications, electrical and mechanical data given should be of interest to all those engaged in instrumentation, automation, and analog computer design. All illustrations are actual size. Feedback Controls, Inc., 1332 North Henry St., Alexandria, Va.

Custom Wire Leads 274

This 4-page brochure covers the manufacturer's available services. These include end and center stripping, counterstripping, stripping of shielded wire and multiple conductors, coding, terminating, solder dipping, straightening, and wire supply. The custom wire leads are made to civilian and military specifications, and adherence to specified tolerances is assured. Manger Electric Co., Miller St., Stamford, Conn.

ELECTRONIC DESIGN • November 1954

Soldering

275

Entitled *Solder—Its Fundamentals and Usage*, this 80-page, paper-bound book by Dr. Clifford L. Barber, Research Director, Kester Solder Company, is inclusive enough to serve as a reference book or textbook on soldering. It is divided into six main sections: "The Nature of Solder", "The Soldering Flux", "Flux-Core Wire Solder", "External Soldering Fluxes", "Solid and Special-Type Solders", and "The Application of Solder". The various types of soldering methods, including the soldering of printed circuits, are discussed. A number of charts, tables, and photographs are included. Kester Solder Company, 88 Ferguson St., Newark 5, N. J.

Tinkertoy Kit

276

A kit for making Project "Tinkertoy" modular units is included among a wide variety of laboratory equipment such as variable-frequency generators, regulated power supplies, and oscillators described and illustrated in this 16-page catalog. Enough parts to make over 200 modular assemblies are included in the kit. Communication Measurements Laboratory, Inc., 350 Leland Ave., Plainfield, N. J.

Temperature Measurement

277

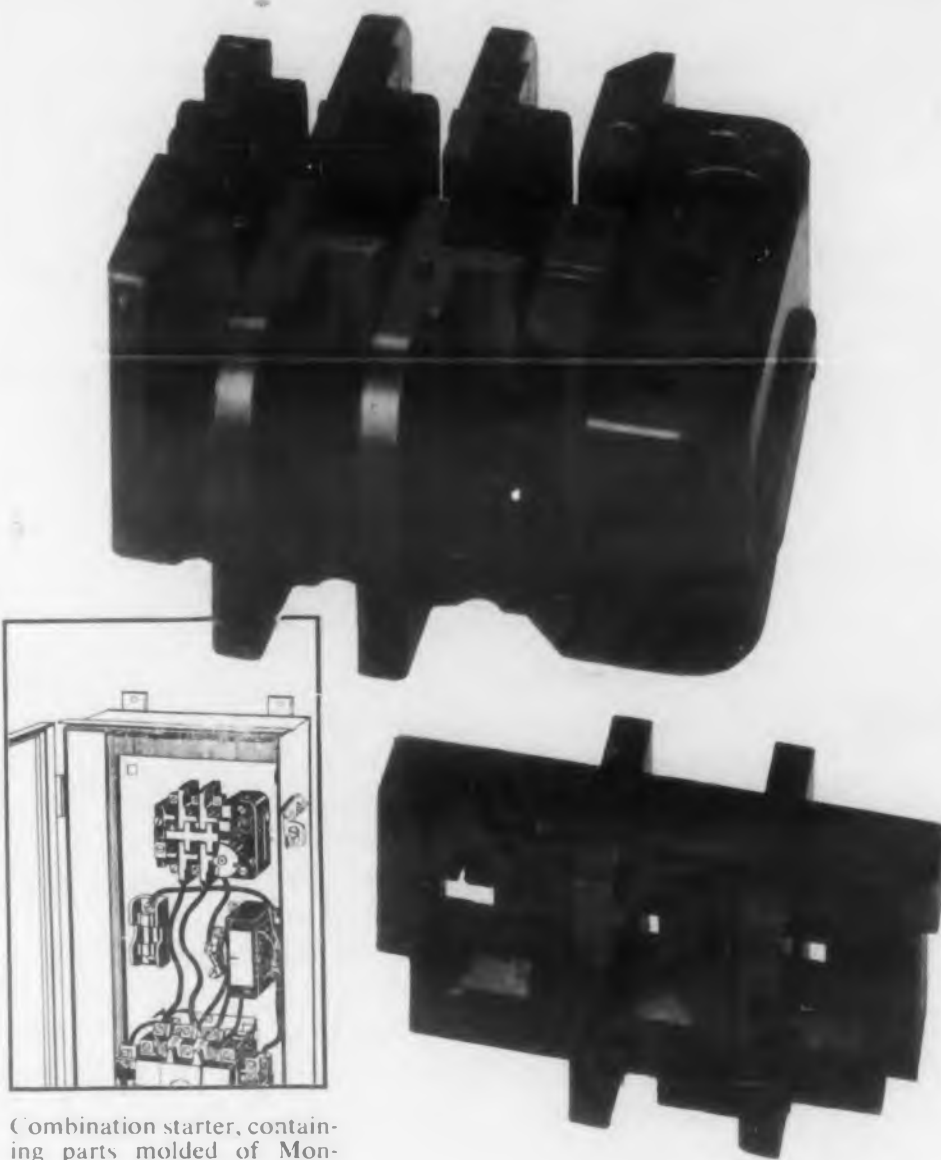
"How Temperatures Are Measured", by Dr. G. M. Wolten, is an informative booklet about a subject in which there is a great deal of misunderstanding and confusion, even among technical personnel. Selectively illustrated, some of the topics covered are: heat and temperature as separate concepts; the history of the commonly used scales for measuring temperature; physical effects associated with a rise in temperature and how thermometers and pyrometers utilize some of these effects; and monitoring surface temperature by means of changes in color or physical state. Tempil Corporation, 132 West 22 St., New York 11, N. Y.

Precision Resistors

278

This 32-page catalog is intended as a guide to basic data on resistors for the application and design engineer. It also presents in concise, usable form, information on the firm's line of precision, wire-wound resistors in such a way to permit their accurate selection and application for any specific purpose. It contains basic design information on these resistors and includes new charts and data on resistance wire, "Seald-Ohm", hermetically sealed, and encapsulated types. Divided into sections starting with broad general data and continuing into detailed specifications of each type, the book is well illustrated with engineering drawings and photographs. MIL and other government ratings are listed. Where applicable, government specifications are cross-referenced. The Daven Company, 191 Central Ave., Newark, N. J.

How would you handle this electrical parts problem?



Combination starter, containing parts molded of Monsanto's Resinox 3700 thermosetting material, manufactured by Arrow-Hart & Hegeman Electrical Co.

Arrow-Hart

solved it with

new

RESINOX 3700

Arrow-Hart & Hegeman Electrical Company of Hartford, Conn. needed a strong, stable, electrical-grade material with high arc-resistance for important parts of their combination starter shown here. They specified Monsanto's new thermosetting molding powder, Resinox 3700. Result: Complete satisfaction!

Resinox 3700 is the ideal all-around material for magneto ignition, motor control and electronic circuits, and other electrical applications.

- 1 It combines high arc-resistance with outstanding dimensional stability. Eliminates undesirable after-shrinkage.
- 2 It has excellent moldability and relatively good impact resistance, plus good transfer molding properties.
- 3 It offers superior heat resistance.

Perhaps Resinox 3700 is exactly what *you* need to solve an electrical equipment problem. Write today for full information!

Resinox: Reg. U. S. Pat. Off.



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WHICH SERVES MANKIND

MONSANTO CHEMICAL COMPANY, Plastics Division, Room Springfield 2, Mass.
Please send me complete information on Monsanto's new Resinox 3700 arc-resistant material.

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Company _____

Address _____

City, Zone, State _____

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CIRCLE ED-280 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature . . .

Electrical Insulation

281

Designers and developers of electronic equipment will find a good source of information on silicone materials in this 32-page, illustrated catalog. Complete technical data, descriptions, and information on applications, sizes, stocks, and uses of silicone materials for high temperature Class H electrical insulation is included. In addition the booklet covers silicone laminated glass cloth plastics; silicone bonded mica products; silicone rubber and resin coated glass cloth and tape; silicone treated glass cord; Silastic pastes and Silastic R tape and cloth; and silicone varnishes, resins, adhesives, compounds, and grease. Publications Dept., Insulation Manufacturers Corp., 565 West Washington Blvd., Chicago 6, Ill.

Instruments

282

Many highly accurate instruments and recording devices are illustrated and discussed in this handsome 22-page booklet. The devices are employed to detect and record a variety of physical and electrical phenomena of interest to design and development engineers. Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif.

Precision Fabrication

283

A 12-page illustrated catalog covers this firm's line of Swiss automatic screw machine products made in a range from 0.5 to 25mm diam. Showing a cross-section of their manufacturing facilities, the catalog emphasizes the firm's additional facilities for custom made precision parts for electronic industries. American Laubseher Corp., 333 W. 52 St., New York 19, N. Y.

Transformers

284

Over 500 stock transformers for use in original equipment or as replacements in all types of electronic devices are listed in this 24-page catalog (No. S-654). Complete electrical and physical specifications are given. An ultra-linear output transformer No. A-8072 for adapting a Williamson circuit to ultra-linear operation is featured on the back cover. A line of filter chokes is also given. Chicago Standard Transformer Corporation, Addison and Elston Streets, Chicago 18, Ill.

Components

285

Subminiature resistors, precision and power resistors, camera- and receiver-type deflection yokes, focus coils, and i-f and r-f transformers and coils are listed in this 36-page catalog (No. R200). Charts, tables, drawings, as well as selection and application information are included. I-T-E Circuit Breaker Co., 19th and Hamilton Sts., Philadelphia 30, Pa.

PRINTED CIRCUITS

can simplify your design . . .
speed output . . . cut costs

Eliminate wires! With Du Pont Conductive Coatings, you can print circuits for capacitors and couplings; for static shielding to replace foils and cans; for resistors and solder seals. Streamline your designs in television sets and radios, electronic equipment, meters and switchboards.

Coatings are easily applied by spray, brush, dip or stencil on metals or non-conductors. Fit right into high-speed assembly-line operation. Save you money. For up-to-date, descriptive bulletin write to: E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Department, Wilmington 98, Delaware.

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...THROUGH CHEMISTRY

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ANOTHER NEW FAIRCHILD POTENTIOMETER



**TYPE 754
2" LINEAR**

New internal clamp ring design of the Type 754 permits ganging up to eight cups on a single shaft without increasing the 2" over-all diameter. All metal case construction. Depth is 1" with .594" added for each cup section ganged. Supplied with standard AIA servo mount. Resistance range from 800 to 100,000 ohms. Standard linearity of the Type 754 is $\pm 0.15\%$. Terminals are gold-plated for easy soldering and resistance to corrosion.

SAMPLES AVAILABLE

The Type 754 is another reason why Fairchild can help you solve all your precision potentiometer problems. For more information, write Fairchild Camera & Instrument Corp., Potentiometer Division, 225 Park Avenue, Hicksville, L. I., N. Y., Department 140-48N1.

FAIRCHILD

PRECISION POTENTIOMETERS

CIRCLE ED-287 ON READER-SERVICE CARD FOR MORE INFORMATION

It's the Principle ...

Relay Basic Unit
A-1105



This structure is the principle contained in 3 AN approved Hermetically Sealed type relays, manufactured by Electrical Products Corporation.

Used for control of vital airborne electronic equipment, it is unusually rugged and provides exceptional resistance to shock, vibration and acceleration.

Has balanced rotary armature with unique, close-coupled contact linkage for speedy, low-inertia operation.



A-1104
(AN-3306-1)



A-51-108
(AN-3311-1)



A-1106
(AN-3307-1)

SPECIFICATIONS:

Nominal Coil Voltage.....24-28 VDC
Dimensions.....1 1/8" x 1 3/8" x 1 1/8" inches
Weight.....3 ozs.
Contacts.....DPDT
Rated (Resistive and Inductive).....10 amps.
Also available in other enclosures.

Electrical Products offers:

*Uniformly high quality by rigid inspection and testing.

*Extra rugged construction on all type Relays.

Send for Brochure and Specifications on our complete line.



Electrical Products CORP.

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Precision Extruders and Fabricators



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ELECTRONIC DESIGN • November 1954

SIZES AVAILABLE RODS

1/8"	9/16"
3/16"	5/8"
1/4"	3/4"
5/16"	7/8"
3/8"	1"
7/16"	1-1/8"
1/2"	1-1/4"

TUBES

1/16" wall	1/8" wall
1/4" O.D.	1/2" O.D.
5/16" "	5/8" "
3/8" "	3/4" "
1/2" "	7/8" "
5/8" "	1" "
3/4" "	1-1/4" "
7/8" "	1-1/2" "
1" "	1-3/4" "
1-1/4" "	2" "

Special sizes to order

Capacitors 290

This 20-page catalog (No. X-100) illustrates and describes the company's complete line of miniature hermetically sealed high temperature (-55°C to $+125^{\circ}\text{C}$) tubular paper capacitors. Dimensional drawings, electrical characteristics, engineering data and tables of voltages, capacitance values, and tolerances are presented, and information for ordering is included. Gudeman Company, 340 West Huron St., Chicago 10, Ill.

Catalog 291

A wide variety of instruments, recording devices, gages, industrial thermometers, valves, relays, and switches, etc., suitable for installation in industrial control systems are described in this 24-page composite catalog (No. 5001). Various industrial control systems are also depicted. Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa.

Zirconium Facts 292

"Facts About Zirconium" is a concise 64-page booklet about the history and production of zirconium. Mechanical and physical properties, chemical characteristics, and facts about fabrication of the metal are discussed in detail. One section of the booklet is devoted to zirconium chemicals such as zirconium tetrachloride, dioxide, sulphate, and Carbo-Cast-Aid. Low neutron absorption and high corrosion resistance have made zirconium metal important in atomic energy applications, and its growing value in chemical, electronic, and metallurgical fields is considered extensively in this informative publication. An appendix gives data on crystallographic features, atomic, and nuclear properties. The Carborundum Metals Co., Inc., Akron, N. Y.

Iron Core Materials 293

Data sheets No. PMS-12-A-R2 and B-R2 list the composition and characteristics of electronic iron core materials as submitted to the Metal Powder Association by this company. Engineers will find useful the coverage of particle size, apparent density, frequency range, relative permeability, and "Q" value, and the itemized list of electronic uses for various iron powders. Plastic Metals Div. The National Radiator Co., Johnstown, Pa.

Printed-Circuit Laminate 294

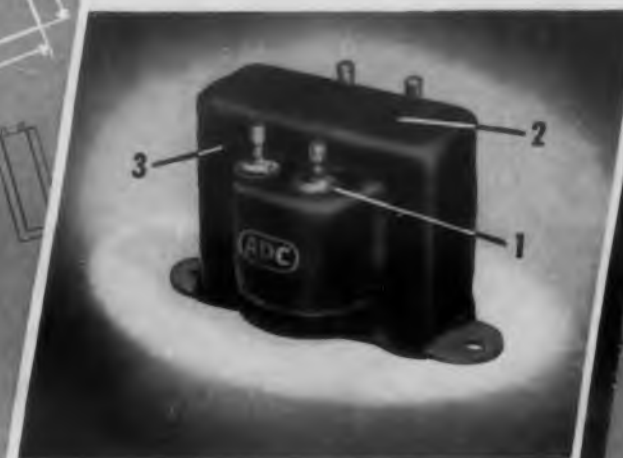
Technical information on two grades of copper-clad "Insulrok" laminates for printed circuitry is given in this 4-page bulletin. The laminate is a paper-base phenolic to which copper foil of 0.0014" or 0.0028" thickness is applied. Richardson Co., 2734 Lake St., Melrose Park, Ill.

n e w

encapsulating resin developed!

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SPEEDS UP PRODUCTION, LOWERS COSTS, IMPROVES PRODUCT RELIABILITY AND PERFORMANCE!



1. No chipping or cracking at these vital points—ADSeal will not shrink or pull away.
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CIRCLE ED-296 ON READER-SERVICE CARD FOR MORE INFORMATION

90

New Literature . . .

Resistors 297

Specifications for many different types of resistors are given in tabular form on this large chart, which is suitable for wall mounting. Lines of chokes, capacitors, selenium rectifiers, and germanium diodes are also listed. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Transformers 298

Five hundred transformers for every purpose plus related inductance and coil products are listed and described in this 28-page catalog (No. TR-54). Two photo-flash transformers are included in the list of new items. Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif.

Tin 299

The many industrial uses of tin are described and illustrated in this handsome 20-page booklet. The story of the mining and processing of this useful metal are also given. The Malayan Tin Bureau, 1028 Connecticut Ave., Washington 6, D. C.

Marking Machines 300

A wide variety of fully automatic, motorized, and hand-operated "Rejafix" marking machines are listed and described in this 8-page catalog. The machines can mark on many different types of surfaces. Popper & Sons, Inc., 300 Fourth Ave., New York, N. Y.

Aluminum Coating 301

"Alondine" No. 1200, a protective coating for aluminum that is also a good paint bond, is described in this 4-page bulletin. The process for applying the coating is also depicted. American Chemical Paint Co., Ambler, Pa.

Reference Cavities 302

Three fixed-frequency, vacuum-sealed, transmission-type reference cavities are described in this 12-page bulletin. They have a maximum drift of only ± 0.4 Mc. Applications and complete technical data are included. Tube Department, General Electric Co., Schenectady 5, N. Y.

Potentiometer 303

The high-resolution rotational potentiometer discussed in this technical bulletin has been tested successfully for over 15 million revolutions at 600rpm. The resistance element is a conductive plastic. The unit is furnished in standard resistances of 2000 to 100,000 ohms. Markite Corp., 155 Waverly Pl., New York 14, N. Y.



GUIDE TO VOLTAGE SPEED CURRENT SERVO CONTROL

ON REQUEST

This new 12-page illustrated bulletin describes the wide variety of control situations to which the REGOHM electro-mechanical controller is adaptable.

Learn how REGOHM will provide sensitivity, speed of response and system stabilization under severe operating conditions in your control system.

Circuit diagrams illustrating the many applications of this versatile, automatic controller, are given.

Text and illustrations describe the functions, design advantages, operation and control characteristics of this small size, lightweight, plug-in device.

Write for Bulletin 505.00. Address Dept. G, Electric Regulator Corporation, Norwalk, Conn.

REGOHM



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TECHNICAL LITERATURE
AVAILABLE:

Bulletin No. 47—Crystals,
Ovens, Frequency Standards,
MIL-type Specification
Index

Bulletin No. 45-A—Solid
Ultrasonic Delay Lines

Bulletin No. 46-A—"Bantam
BX" Crystals

Bulletin No. 44-B—Amateur,
Standard Frequency, Ship-
To-Shore, and TV Service
Crystals

The BANTAM BX is precision in pint-size! Meets all of the demanding specifications dictated by space limitations in portable and pocket size gear.

In design, if the sub-miniature assembly calls for multi-channel operation, BANTAM BX crystals with wire leads may be conveniently mounted in a sub-miniature selector switch. Or, the BANTAM BX can be directly wired into printed circuitry.

BANTAM BX crystals meet all performance requirements of larger units such as the Biley BH6A. Supplied in frequency ranges: 10 mc - 100 mc. Hermetically sealed.

More technical information may be secured by requesting our Bulletin No. 46-A. Send your prints for a prompt quotation.

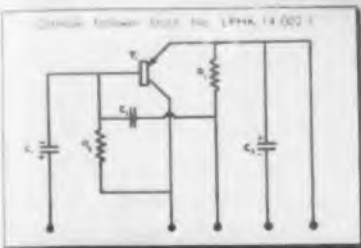
BILEY ELECTRIC CO., UNION STATION BUILDING, ERIE, PA.

CIRCLE ED-305 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1954

LEE PAC**FUNCTIONAL UNIT**

LEE-PAC offers a new CONCEPT in transistorized circuits, to the Electronic industry. Each LEE-PAC is a complete and standardized circuit, self contained and ready to plug in.



AN EXAMPLE OF ONE OF THE MANY CIRCUITS AVAILABLE

Write today for further information. If we don't have what you specifically want, it's quite possible we can build it to your specifications.



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CIRCLE ED-330 ON READER-SERVICE CARD FOR MORE INFORMATION



**pull it...
stretch it...
bend it...**

Electro Bi-Glas is the first and only Class B insulation that keeps its superior electrical properties after elongation. Stands high ambients and resists oils, acids, moisture and fungus. Available in convenient tape form for wrapping coils, spiral windings, cable splices and terminal connections. For data sheet and prices, write Dept. E7-1169.

Division of  Chemical Corporation



Electro-Technical Products

Nutley 10, N. J.

CIRCLE ED-331 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1954

Printed-Circuit Connectors 332

The printed-circuit connectors described in this 4-page bulletin are made in miniature and subminiature sizes. Both types are available in 2-, 4-, 6-, and 12-contact sizes and in three gages to accommodate 1/32", 3/64", 1/16" thick printed circuits. Circon Component Co., 17544 Raymer St., Northridge, Calif.

Wave Analyzer 333

The automatic wave analyzer described in this 10-page brochure (No. 54-C) performs automatically plotted analyses of complex signals having components in the range of 3 to 2000cy. It has two channels. Davies Laboratories, Inc., 4705 Queensbury Rd., Riverdale, Md.

Capacitors 334

This 31-page catalog (No. 800B) describes lines of electrolytic, molded paper, oil-filled paper, and mica capacitors. Many capacities, sizes, shapes, and mounting arrangements are available in each type. A line of "button" mica capacitors for high-frequency applications is included. The color codes according to RETMA and Specifications JAN-C-5 and MIL-C-5-A are given. Each class of capacitor is illustrated. Sangamo Electric Co., Capacitor Div., Marion, Ill.

Wires and Cables 335

Wires and cables for every application in the electronics industry are covered in this 32-page catalog (No. 104). A line of plugs, outlets, and connectors is also described and illustrated. The last page is a table of cross-section area and weight in pounds per 1000' of copper wire for each AWG size. Columbia Wire & Supply Co., 2850 Irving Park Rd., Chicago 18, Ill.

Wire Handles 336

The full-size illustrations of 73 different styles and sizes of standard wire handles and clips in this catalog should aid the designer in choosing the proper handle for a particular application. Each style is available in a range of wire-gage sizes. A series of photographs showing the firm's production methods is given. E. H. Tiehener & Co., Binghamton, N. Y.

Solenoids 337

This handsomely bound catalog (No. 2) consists of blue prints of this firm's line of solenoids for aircraft applications. The physical and electrical characteristics of each solenoid are given on the blueprints. West Coast Electrical Mfg. Corp., 233 W. 116th Place, Los Angeles 61, Calif.

Shock Absorbers 338

A line of shock absorbing mountings, bearings, and bushings for instruments and machinery are described in this two-color catalog (No. 701). Tables of loads each size of shock absorber can carry are given along with a design nomograph to facilitate selection. General Tire Co., Industrial Products Div., Akron, Ohio.

NEW LOWCOST Miniature Capacitors



- Plastic film dielectric
- Very High resistance
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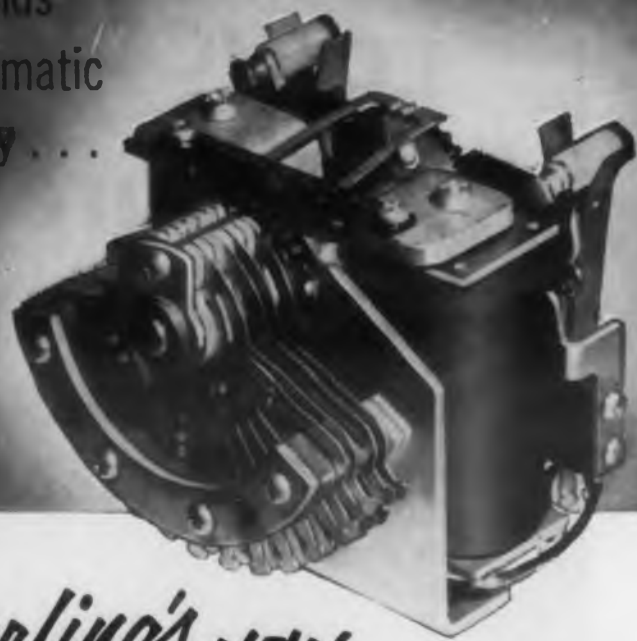


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Sterling's **NEW**

BI-DIRECTIONAL STEPPING SWITCH

GOING FAR BEYOND the limitations of stepping switches that operate in only one direction, STERLING'S new Type SS Stepping Switch operates in *both* directions!

This *bi-directional* stepping switch, having *two* driving magnets, is normally equipped with a 4-level, 12-position bank and wipers. The wiper shaft is rotated—either clockwise or counterclockwise, in 10° increments—by an intermittent ratchet-and-pawl action, depending on which of the electro-magnets is energized. Interrupter contacts act as an interlock to protect against partial steps and to permit self-stepping. Limit switches stop rotation at the end of the bank travel. Coils are available for DC currents up to 120 volts.

The range of possibilities of Model SS as a stepping switch alone is extremely wide . . . differential counting, remote selection of circuits under control of impulses, as a digit-storage register in automatic computers, etc.

Without wipers, the impulse-operated "motor" may be adapted to position servo-motors or potentiometers. Designers of automatic machinery will undoubtedly find many more uses for this versatile, new STERLING product.

For further details, write STERLING ENGINEERING COMPANY, INC., 54 Mill Street, Laconia, N. H. (Subsidiary of American Machine & Foundry Company).



CIRCLE ED-341 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature . . .

Computers 342

This 12-page illustrated product brochure describes the company's line of electronic computers and plug-in components and, in addition, provides a summary of the company's design philosophy and available services. An informative description covers many of the company's latest developments in machine computers, master air data computers, accelerometers, positioning mechanisms, etc. Servomechanisms, Inc. Westbury Div., Post and Stewart Aves., Westbury, N. Y.

Allloys 343

Properties of "Ternalloy", an aluminum base alloy series for high strength castings without heat treatment, are available in a new file folder brochure. The booklet includes complete information on the alloy series' mechanical and physical properties together with a discussion of its castability and machinability. Apex Smelting Co., 2537 West Taylor St., Chicago 12, Ill.

Radiation Equipment 344

A well illustrated, 2-color, 40-page catalog describes this company's complete line of radiation measuring equipment. The line includes scalers, count rate meters, Geiger, proportional and scintillation counters, complete radioisotope laboratories, etc. A price list is included. Nuclear Instrument and Chemical Corp., 229 West Erie St., Chicago 10, Ill.

Panel Instruments 345

A 12-page bulletin, designated GEC-368F, describes the company's line of panel instruments and gives description, construction, and application details of both d-c and a-c instruments. Well illustrated, it also contains complete dimensional and price information, and physical, operational, and electrical data. General Electric Co., Schenectady 5, N. Y.

Counting and Timing 346

Bound in loose-leaf form, this catalog includes a group of counters and timers along with applications. Each device is illustrated. Potter Instrument Co., Inc., 115 Cutter Mill Rd., Great Neck, N. Y.

AN Connectors 353

This 30-page catalog gives complete information on the line of connectors. Organized into two sections, the first provides full information on the various types of connectors—their application, advantages, construction and assembly details, and mechanical dimensions. The second section consists of selection tables, ordering information, insert arrangements, electrical data, available shell types, and other pertinent material. General Electric Co., Wiring Device Dept., Construction Materials Div., 95 Hathaway St., Providence 7, R. I.

Miniature Rigid Controls 354

Among the uses for the miniature rigid push-pull controls described in this 2-page bulletin are manual reset operation of inaccessible controls, direct transmission of motion in compact mechanism, power transmission through confined areas, and remote indication. Engineering drawings of these applications and general specifications for the controls are also given. Arens Controls, Inc., 2017 Greenleaf St., Evanston, Ill.

Test Instruments 355

This 4-page illustrated folder describes high precision test instruments which include recording oscillographs, galvanometers, instrument amplifiers and bridge balances, analog computers, function generators, and related equipment. William Miller Instruments Inc., 325 North Halstead Ave., Pasadena 8, Calif.

Components 356

A 24-page illustrated booklet (No. 55) lists a complete line of plugs, jacks, connectors, switches, terminals, panel fasteners, linen and nylon cable, nylon plastic cable clamps and many other electronic components and accessories. Schematic dimensional diagrams are found throughout. Herman H. Smith, Inc., 2326 Nostrand Ave., Brooklyn 10, N. Y.

High Frequency Resistors 357

Comprehensive data on 43 types of MP high frequency resistors, their characteristics, construction, individual specifications, applications, and installations are given in this 8-page brochure. Charts, graphs, and photographs, as well as ordering information is also included. International Resistance Co., 401 No. Broad St., Philadelphia 8, Pa.

Signal Generators

347

This organization's complete line of instrument and signal source generators is presented in a brochure designated No. EI-1A. It is clip-bound for easy inclusion of supplementary data. Detailed electrical and physical specifications are listed along with performance curves and dimensional drawings for all "Elineco" permanent-magnet and wound-field d-c, a-c, and sine wave generator types. Electric Indicator Co., Inc., Springdale, Conn.

Control Knobs

348

In this catalog, (No. E) the company presents their line of standard control and electronic knobs, available without additional mold charges. Among those shown are pointers, indicators, and rounds in a variety of design treatments, and most models shown are available in matched sets. Featured in the catalog are actual size photographs of each knob with full scale engineering drawings with all essential data to make knob selection easier. Romar Plastics, Inc., 1317 East Main St., St. Charles, Ill.

Tube Clamping Shields


350

This catalog on miniature and subminiature electron tube clamping shields is attractively printed in two colors with contents arranged for easy reference. A wide range of miniature and subminiature tube shield types and sizes are illustrated and keyed to appropriate dimensional drawings. Information on pure silver, beryllium copper, aluminum alloy and special purpose tube shields is also presented. International Electronic Research Corp., 177 W. Magnolia Blvd., Burbank, Calif.

Interval Timers

351

Data sheet No. 400 describes techniques and equipment for measuring time intervals from a fraction of a microsecond to 1sec or longer, if desired. Accuracies as high as $\pm 1/8$ microsec are obtained by electronically counting the exact number of pulses produced by a highly stable, crystal-controlled, high-frequency oscillator during the unknown interval. Potter Instrument Co., 115 Cutter Mill Road, Great Neck, N. Y.



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- USED BY
- CHANCE VOUGHT AIRCRAFT

• TEST REPORT


SUBJECT: CHANCE VOUGHT AIRCRAFT, INC. RELIABILITY QUALIFICATION report of EMS RELAYS for Regulus and the F7U-3 per AVO ED #357, March 24, 1954.

SUMMARY: VIBRATION, TEMPERATURE AND LOAD-LIFE TESTS ON EMS 10 AMPERE RELAYS REVEAL THE EMS TYPE TO BE SATISFACTORY FOR USE IN REGULUS AND THE F7U-3.

1. Relay was vibrated at 12 inches or 20 g's, whichever is less. The results are as follows:
Planes #1 and #2 energized, no chatter through 500 CPS at 20 g level. Plane #3 energized, first chatter occurred at 370 CPS at the 20 g level through 420 CPS. No chatter from 420 CPS through 500 CPS. NOTE: Chatter from 370 through 420 occurred only above 14 g level.
Planes #1, #2 and #3 de-energized, no chatter through 375 CPS at 20 g level. From 375 CPS through 500 CPS, no contact chatter below 15 g level.
2. Two samples of each type were operated 100,000 times under rated load at approximately 110°C.
3. One sample of each type was used to actuate a Saval solenoid valve for 5,000 operations. This valve has an inrush current of 20 amperes, and is widely used in REGULUS. Both relays completed the test satisfactorily.

CONCLUSION: "When the characteristics of the EMS relay were observed, a standard (CVC5860) was set up in cooperation with the Aircraft Standards Group" . . . "The EMS relays are used, and have proven satisfactory in REGULUS."

CHANCE VOUGHT AIRCRAFT, INCORPORATED



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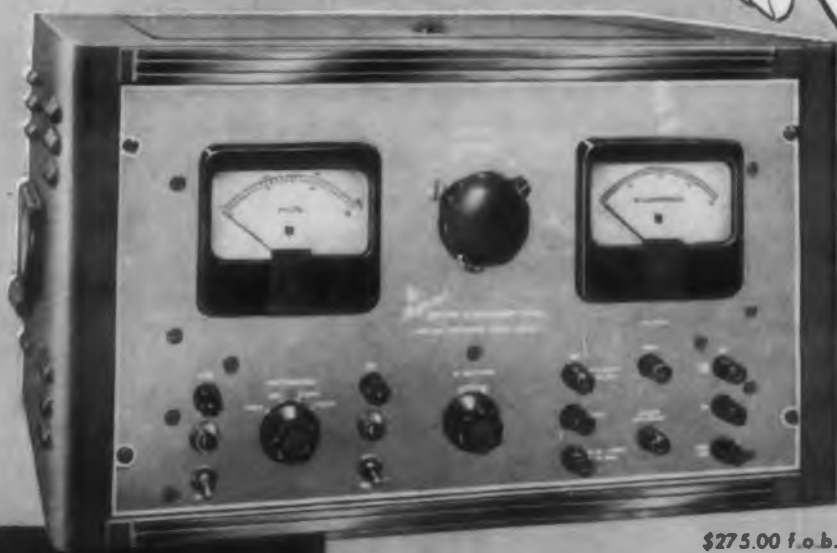
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- power supply for many low voltage klystrons



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Features:

- Wider than usual output range:
"B" supply 0 to $\pm 600V$. at 200 ma.
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- Additional fixed supply $-250V$. at 50 ma.
- Unregulated 6.3V., 10A. C.T. filament supply
- Excellent voltage regulation (only $\pm .25V$.)
- Low ripple (less than 4 mv.)
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50/60 cps, single phase

The PRD Type 807 is a general purpose, constant voltage power supply, competitively priced to fit any instrument budget. It is conservatively rated for continuous service. Panel voltmeter monitors either supply voltage; milliammeter indicates "B" supply current. Write for bulletin.

Flexible ground permits stacking of supplies to provide up to $-600V$ cathode voltage and an additional 0 to $-250V$ for the reflector of low voltage klystrons

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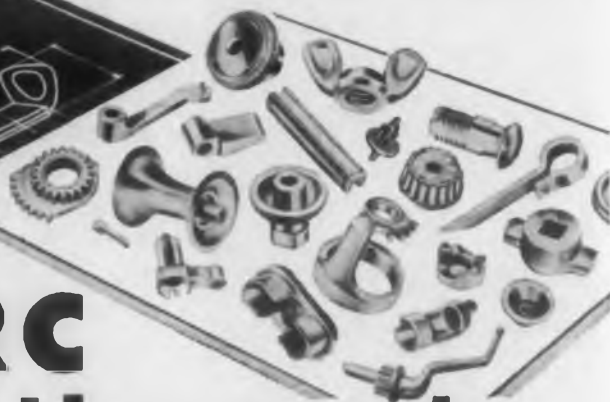
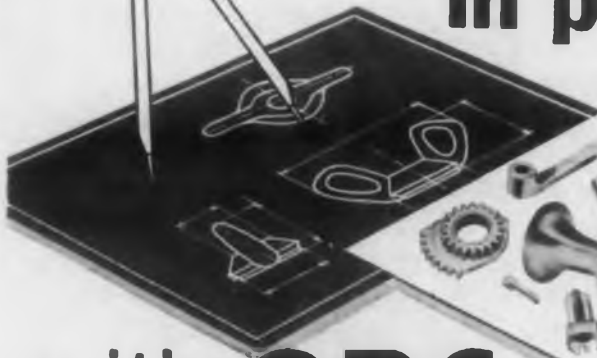
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New Literature . . .

Deflection Yokes 361

A catalog page pictures and describes new rotating coil deflection yokes with deflection angle up to 52° or 70° . Complete data includes four advanced design features, three dimensional drawings, and tables of electrical and mechanical characteristics with full explanations to assist electronic design engineers. A table listing a wide variety of coil inductance combinations is also shown. Syntronic Instruments, Inc., 100 Industrial Road., Addison, Ill.

Cables and Components 362

This catalog contains 44 pages of electronic wires, cables and components available from the manufacturer. It lists every type of wire and cable now in use for microphone, intercom, broadcast and other electronic uses with detailed technical information on each type. The section on plugs, jacks, and connectors carries full descriptions of every item. Birnbach Radio Co., Inc., 145 Hudson St., New York 13, N. Y.

Toroids 364

This booklet describes a cross-section of the type of service this organization offers to users of toroidal coils and components. Among them are fine wire winding, miniature magnetic amplifier coils, coils for high temperature applications, balanced C.T. High-Q choke, and large coils. Finished components discussed include a miniature choke presented as a complete miniature, hermetically sealed unit with a locking feature that prevents turning when mounted on a chassis. Others shown are a stable oscillator coil, and a 50,000-ohm low pass filter flat within 1db to 6ke with a maximum loss of 1db. Torwico Electronics, Inc., 961 Frelinghuysen Ave., Newark, 5, N. J.

Ultrasonic Delay Lines 365

Solid ultrasonic delay lines with particular reference to the superiority of quartz to mercury and metal lines are the subject of this 12-page Technical Bulletin 54. Theory, performance, circuitry, and specification data are included. Andersen Laboratories, Inc., 39 Talcott Road, West Hartford 10, Conn.

Die Cast

Die Cast of an imp describes Starting goes on to trimming, and inspec illustration sion Cas

Contact

This 5 to electri bles, con firm's cor drawings ing featu Guide, w tact mate advantag reference the select for any assistanc contact a Inc., Cor Indianap

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A-C Rate
Generators

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33

CIRCLE ED-363 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 1954

ELECTR

Die Castings

366

"Die Castings . . . Unlimited" is the title of an impressive 24-page brochure which describes all the die-casting processes. Starting with the design of dies, it then goes on to die building, alloying, casting, trimming, machining, plating, finishing, and inspection. The booklet contains over 75 illustrations, drawings, and charts. Precision Castings Co., Inc., Fayetteville, N. Y.

Contact Assemblies

367

This 59-page catalog, devoted entirely to electrical contacts and contact assemblies, contains detailed specifications of this firm's contact materials, plus sketches, line drawings, charts, and tables. An outstanding feature is a Contact Material Selector Guide, which contains descriptions of contact materials, and the applications for and advantages of each. Designed for easy reference, the booklet is intended to aid in the selection of the proper contact material for any application, and presents detailed assistance toward design of contacts and contact assemblies. P. R. Mallory & Co., Inc., Contact Div., 3029 E. Washington St., Indianapolis, Ind.

Power Drives

369

A line of combination power, and, speed needs of fractional horsepower drives is detailed in this 8-page bulletin, designated FAS. Known as "Adjusto-Spede" drives, the units are an integral combination of a-c constant speed induction motors, eddy-current couplings, and electronic speed controls. They are readily adaptable to many and varied applications requiring closely controlled adjustable speeds. The numerous photographs in the booklet detail various aspects of the equipment together with charts, graphs, and line drawings. The brochure also covers fundamentals of operations, capacity of units available, mechanical construction features, control, etc. Eaton Mfg. Co., Dynamatic Div., Kenosha, Wis.

O-Rings

371

Detailed information on compounds, groove dimensions and sizes is given in this 12-page brochure on O-rings. The booklet contains diagrams of typical applications and should be useful to designers and to users of O-ring seals for many types of applications. Goshen Rubber Co., Inc., Goshen, Ind.

for all applications
requiring exceptionally
high insulation
resistance and unusual
stability at high
temperature



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Hermetically sealed and metal encased, new HY-THERM capacitors have been designed to meet or exceed military requirements (Mil-C-25A). Example: At 125°C the minimum insulation resistance is 20 megohm-microfarads and maximum insulation resistance is 500 megohms. Available in all standard values and tolerances. Variety of mounting and circuit combinations. Special units designed to meet individual requirements.

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CIRCLE ED-368 ON READER-SERVICE CARD FOR MORE INFORMATION

SIGMA INSTRUMENTS

THIS IS T/SCT [REDACTED] [REDACTED] COMMUNICATIONS CENTER MAINTENANCE
[REDACTED] AFD [REDACTED] WOULD LIKE TO SPEAK
SOME ONE IN YOUR RESEARCH AND DEVELOPMENT SECTION PLS

WITH REGARD TO WHAT TZEV

IN REGARDS TO SIGMA RELAYS I WHICH WE REC THIS STATION
THE ARE NUMBERS 197 198 AND 199

MIN PLS

RITE

SORRY TO KEEP YOU WAITING SO LONG WILL BE HERE IN A SEC
RITE THAT IS OK

OK I HAVE A MAN HERE NOW WHAT IS YOUR QUESTION

WELT WE HAD A MISFORTUNE ON ONE OF TE RELAYS

WE WERE USING IT CA

YOU ARE WRITING ON THE END OF LINE AND I XXXX DIDNT GET
ANYTHING AFTER WE WERE USING IT

CA PLS

WE WERE USING IT ON A 75 WPM CIRCUIT AND THE MARKING CONTACT
SPRING BROKE

HE WAS WONDERING IF WE COULD GET A COUPLE FR YOU
AS WE HAVE NO STOCK NUMBERS OR ANY WAY TO ORDER ANY THING AIR FORCE CHA

EPT AIR FORCE SUPPLY CHANNELS

MIN PLS

DO YOU KNOW THE TYPE OF RELAY THAT YOU HAVE

RCR THEY ARE US NEW TYPE ADJUSTABLE

RELAY THAT REPLACED THE SEALED OCT BASE

DID YOU RECEIVE THEM FROM [REDACTED] A F D AND ARE THEY SERIES 72 RELAYS

MIN PLS I KNOW WE GOT THEM FR [REDACTED] A F D

AND THE SERIAL NUMBERS OF THE RELAYS ARE 197 198 AND 199

OK THAT IS ALL WE NEED TO KNOW

WE WILL SEND YOU THE 2 CONTACTS THAT YOU WANT

CA

WILL THERE BE ANY CHARGE ON THEM AS WE HAVE NO

OPERATING ACCOUNT THIS TATION

THEY WILL GO OUT TO YOU NO CHARGE

RITE CAN YOU SEND A ME A LIST OF STOCK NUMBERS

FOR THAT TYPE RELAY SO WE CAN ORDER THEM THRU

NORMAL AIR FORCE SUPPLY CHANNELS ALSO

A MORE DETAILED INSTRUCTION ON THEM AS

ALL [REDACTED] GAVE US WERE THE

MECH ADJUSTMENTS ON THEM CA

YES WE WILL DO THAT WE WILL GET IT OUT TO YOU BY NEXT WEEK

CA

RITE THEY HAVE TE OLD RELAY BEAT BY ABOUT 1000 PERCENT

WE WERE HAVING A LOT OF TROUBLE ON 75 AND 100 WPM TILL THESE
IN AND NOW NO BIAS OR DISTORTION ON THE CRT AT ALL.

CHERY WOULD YOU LIKE TO HAVE A PERFORMANCE REPORT ON THESE RELAYS
IN OPERATION AT 75 AND 100 WORD SPEED

CA

YES WE WOULD LIKE TO HAVE A PERFORMANCE REPORT

JUST TO GET THE RECORDS STRAIGHT THE OLD XXXX RELAYS WERE NOT

INTENDED FOR MORE THAN 60 WPM

CA PLS

RITE WILL DO WHERE CAN WE SEND THE REPORT

PLEASE SEND IT TO

MR LAURENCE B STEIN

SIGMA INSTRUMENTS INC

RITE WILL DO AND NOW ON THE PARTS IF YOU WILL

PLS END THEM TO

T/SCT [REDACTED] [REDACTED] [REDACTED] [REDACTED]

OK [REDACTED] WILL DO AND THX FOR THE COMPLIMENTS ON OUR 72 RELAYS

WE THINK THAT THEY ARE PRETTY GOOD TOO

WELL FR THE EXPERIENCE I HAVE TH HAD WITH THEM I KNOW THEY BE GOOD

AND HES A MILLION AND WILL GET THE REPORT OUT BEFORE 1 OCTOBER

THIS IS [REDACTED] [REDACTED] OUT

OK THE END AND BYE

Tech. Sgts., though obviously not so hot at operating teletype machines, are, in our opinion, the ones who keep the military wheels going around. We wish there were more of them using our relays (Tech. Sgts. and teletype machines).



This is a picture of the Sigma Series 72 polar telegraph relay to which the Sgt. referred. Neither major carrier of telegraph traffic regularly use it. They should not however be criticized for this. Each makes, or is responsible for someone else making, one of their own design, and although there is nothing "modern" about either, each has the virtue of thirty or so years of service proof. Like the DC3 Airplane, against which let nothing be said!

What we hope is that by making a pulse relay that can "copy" at 500 cps (1200 wpm) and "rattle" at 1500 cps, we may succeed rather well at normal speeds. Also, while service life of these admittedly new relays seems to be exceptionally good, we have even this aspect well hedged. All vital parts can be changed by the user like phonograph needles.

SIGMA

SIGMA INSTRUMENTS, INC.
81 PEARL STREET
SO. BRAintree, BOSTON 85, MASS.

CIRCLE ED-372 ON READER-SERVICE CARD FOR MORE INFORMATION

Ten-Count Mono Relay



- RUGGED • COMPACT
- SAVES SPACE AND MONEY

WIDE SPEED RANGE
PLUS RELIABILITY

KELLOGG

Magnetic Impulse Counter

Countless Applications Include Electrical Impulse Registration and Storage, Cyclic Process Control, Sequential Operations

Actuated armatures held magnetically with *no* consumption of power — reset independent of the number of actuated armatures. For complete facts on its revolutionary design and performance, write for your copy of the Kellogg Magnetic Impulse Counter Bulletin *today!* Dept. 68-K.

KELLOGG



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CIRCLE ED-380 ON READER-SERVICE CARD FOR MORE INFORMATION

New FOR STILL *FASTER* COMPUTERS

G.E.'s high-perveance, high-capacity twin triode . . .

HIGH CURRENT OUTPUT enables the GL-6463 to maintain voltage when tube plate resistance is lowered for extra-fast computer circuits now being developed. Ample plate dissipation assures long and dependable tube performance under high-output conditions.

Get ratings, performance curves, and prices on this newest G-E tube to be designed, built, and life-tested for computer service! *Tube Department, General Electric Company, Schenectady 5, N. Y.*

Three special twin triodes are the first types in General Electric's extensive program of computer-tube development. Step-up in capacity gives you a choice for different circuit needs.

GL-5844	GL-5965	GL-6463
.5 w dissip. per plate	2.2 w dissip. per plate	4 w dissip. per plate
1 w tube dissipation	4 w tube dissipation	7 w tube dissipation
.3 amp heater current	.45 amp heater current	.6 amp heater current

GL-6463

- Per plate: 28 ma avg current, 4 w dissipation.
- On-off dependability assured by special cathode design.
- Life-tested under cutoff conditions.



GENERAL ELECTRIC

162-1B12

CIRCLE ED-381 ON READER-SERVICE CARD FOR MORE INFORMATION

Patents . . .

Beam Shift Electron Tube . . . Patent No. 2,672,573. Paul W. Charton (Assigned to National Union Radio Corp., Orange, N. J.)

Variable transconductance tubes are well known, their characteristic being a gradual cut-off of the current through the tube as the control grid becomes more negative. The characteristic curve of such tubes is well rounded over a considerable portion of the curve. This effect is secured by making the control grid with progressively increased spacing between the grid wires.

The results and effects that can be se-

cured from a variable-mu tube can be considerably extended by providing a pair of control grids (18 and 19, Fig. 1) Grid 18 has narrow spacing between the wires at the top or at one end of the cathode (13) with progressively increased spacing between the wires towards the other end. The control grid (19) is similarly made, but its more closely spaced wires begin at the bottom or the other end of the cathode. By controlling the grid bias on control grid 18, the electron beam from the cathode can be made to be narrow at the bottom.

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CLOSELY-REGULATED
PRECISION
DC POWER SUPPLIES
HIGH VOLTAGE—HIGH CURRENT



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CONTROL: Magnetic Amplifier.

OUTPUT: 6 to 500 VDC at 5 to 200 Amps. continuous.

RIPPLE: As low as 0.01% RMS.—or to customer's specification.

REGULATION—Steady State: $\pm 0.15\%$ no load to full load.

Dynamic, $\pm 0.2\%$ under extreme load or line change.

PRECISE REGULATION . . . for Laboratory or Production work.

Designed to meet the most exacting requirements of the Electronics industry, INET Precision Power Supplies combine the long-life performance of selenium rectifiers with the rugged dependability of magnetic amplifier controls.

PROTECTED . . . Engineered for long, trouble-free operation, Units are fully protected against overloads and static elements eliminate maintenance.

COMPACT—Simple to Install and Operate . . .

Requires minimum space, housed in steel cabinets with meters and controls mounted for quick visibility and operation. Available in wall, floor-standing or caster mounted models.



Division of
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Los Angeles 58,
California

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ELECTRONIC DESIGN • November 1954

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Upon decreasing the negative bias, the width of the beam increases. Similarly, the same effect is secured by decreasing the bias on control grid 19. In this case, the beam is first narrow at the top of the cathode because of the wider spacing of the grid wires and the beam progressively widens downwardly. By varying the bias on both control grids, a beam of uniform width may be made to shift from the top to the bottom of the cathode. The beam can also be made wider or narrower. By applying alternating voltages to the grids, these beam effects may be made to travel continuously along the cathode.

The tube may have a single plate anode; however, greater usefulness is secured by providing a plurality of anodes or target electrodes (22). In a circular tube, such as the one illustrated, these anodes may be rings circling the cathode and grids. As the beam shifts or travels along the cathode, the anode in the path of the beam carries current. By changing the width of the beam through control of the bias on the two control grids, the beam may be made to impinge on more than one anode

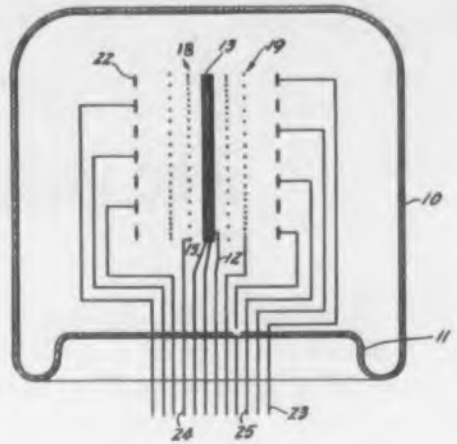


Fig. 1. One form of a beam-shift tube.

as it shifts along the cathode. Many other effects can be secured with the tube.

The concept of the variable-mu tube has been expanded into many other forms in order to produce additional results. These modifications are illustrated and described in the patent. The most unusual forms of these modifications are a tube in which the beam is rotated so that the target or targets are scanned in a circular area as well and a tube in which the target or anode is scanned in two directions.

ANALOG-DIGITAL CONVERTER



NO AMBIGUITY FAST RESPONSE

A shaft position to digital conversion component for data handling systems and digital computers. Multi-brush pick-offs eliminate ambiguity. Adapted to be used in digital to analog conversion systems and closed loop systems. Standard unit handles 13 digits; 7, 17, and 19 digit models also available. Multi-channel converters designed to be time-shared with one scan network. Custom models may be ordered to your specifications.

SPECIFICATIONS:

Dia. 2 in. Wt. 8 oz.
Length: 2-3/4 to 5", according to model
Torque: Under 0.2 oz. in.
Meets applicable military specifications

Write for catalog information.

Computers and Controls

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RAYONIC CATHODE RAY TUBES

by

Waterman

TYPE 3XP

ANOTHER
EXAMPLE OF

Waterman
PIONEERING



3XP RAYONIC CATHODE RAY TUBE provides a brilliant and sharply-defined trace and high deflection sensitivity at medium anode potentials. When comparing 3RP operating at 1000 volts second anode against 3XP operating at 2000 volts, the results are astonishing. For the same spot size, 3XP light output is improved by a factor greater than 4, vertical deflection sensitivity improved by a factor of 2, while the horizontal sensitivity remains unchanged. Because 3XP is enclosed in a short envelope and has half the inter-electrode capacities of the 3RP, the tube lends itself admirably to high frequency video work as well as for low repetitive operation.

TECHNICAL DATA The basic properties of the cathode ray tube that concern the designer or the user are: deflection sensitivity, unit line brightness, line width, static voltage requirements and physical size. A comparison between cathode ray tubes manufactured by Waterman Products Company is shown in the table below. These tubes are available in P1, P2, P7 and P11 phosphors. 3JP1, 3JP7, 3SP1 and 3XP1 are available as JAN tubes.

TUBE	PHYSICAL DATA			STATIC VOLTAGE			DEFLECTION*		LIGHT OUTPUT**
	Face	Length	Base	A3	A2	A2 Max.	Vert	Hor	
3JP1	3"	10"	Med Diheptal	3000	1500	2000	111	150	352
3MP1	3"	8"	Sm Duodecal		750	2500	99	104	33
3RP1	3"	9 1/8"	Sm Duodecal		1000	2750	61	86	44
3SP1	1.5x3"	9 1/8"	Sm Duodecal		1000	2750	61	86	44
3XP1	1.5x3"	8 7/8"	Loctal		2000	2750	33	80	218

*Deflection in volts per inch.

**Light output of an element of a raster line (one mm long and not exceeding .65mm in width) in microlumens.

All heaters 6.3 V AC, .6 AMP.

WATERMAN PRODUCTS CO., INC.

PHILADELPHIA 25, PA.

CABLE ADDRESS: POKETSCOPE

WATERMAN PRODUCTS INCLUDE

3JP1, 3JP7, 3SP1, 3XP1 JAN RAYONIC®

Cathode Ray Tubes

3JP-3MP-3RP-3SP-3XP RAYONIC

CATHODE RAY TUBES

Available in P1, P2, P7, and

P11 Phosphors

POCKETSCOPES® PULSCOPES®

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And Other Associated Equipment

MEMO...
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WATERMAN PRODUCTS

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Specifications.



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**METER MULTIPLIER
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RESISTORS**

Designed specifically for panel instrument circuits, Welwyn Meter Multipliers offer definite advantages in both size and economy over previously employed, bulkier and costlier, wire wound units.

Welwyn Meter Multipliers find their greatest application where circuit performance permits stability limits in the order of .25% to .5%. Physically, these resistors are ideally suited for mounting in restricted space, yet they provide ample, convenient tie-in points for connecting other circuit components.

Welwyn Meter Multiplier values range from 20 ohms to 1 megohm.

*Manufactured in
England and Canada*

For complete data
and specifications
write to Dept. LI-1



ROCKBAR CORPORATION 215 East 37th Street, New York 16, N. Y.
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AEC Patents For Industry

Additional patents owned by the Atomic Energy Commission have been made available for licensing. Licenses will be granted to applicants on a non-exclusive, royalty-free basis. Applicants should apply to the Chief, Patent Branch, Office of the General Counsel, U.S. Atomic Energy Commission, Washington 25, D. C., identifying the subject matter by patent number and title. Of the 20 patents released, the following ones are particularly interesting to electronic design and development engineers.

Contacting Device (Patent No. 2,682,583); F. R. Shonka and R. F. Selman, inventors. The patent pertains to electrical switches that are adapted to be used in radiation dosimeters. The device eliminates the electrical leakage caused by physically separating an electrode of the ionization chamber from its terminal on the outer surface of the casing of the dosimeter. This is accom-

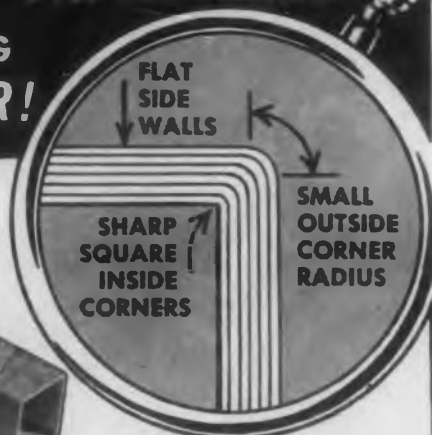
plished entirely within a sealed moistureproof chamber by means of a magnetic switch, thus providing a highly precise instrument for the measurement of radiation.

Radioactivity Measurement (Patent No. 2,685,027); L. W. Alvarez, inventor. The patent relates to a method and means for measuring and analyzing radioactivity that decays rapidly. The irradiated samples are placed in a counter, pulses from which and timing pulses 1/4 sec apart are amplified and fed into a coil. The pulses are transferred as magnetic domains on a wire passing through the magnetic circuit of the coil. The wire is wound on a reel and may be played back to obtain data for determining the decay rate.

Speed Regulating Circuit for Generators (Patent No. 2,685,670); M. W. Horrell, inventor. The invention relates to circuits for regulating the speed of an alternator so that the frequency of the voltage from the alternator will be substantially constant. The current through the resonant inductance and capacitance of the circuit varies

NEW "PARAFORMED" PAPER TUBES

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ANY SIZE—SQUARE OR RECTANGULAR

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in one phase as the speed of the alternator changes from the desired value. This shift in phase is employed to vary the conduction period of a thyatron tube that conducts the current through the field winding of the motor driving the alternator.

Radioactive Logging Apparatus (Patent No. 2,683,703); H. J. DiGiovanni, R. T. Graveson, & I. H. Yoli, inventors. The present invention relates to radiation measuring apparatus for use with drill hole boring apparatus, which includes a sub-surface unit and a surface unit connected by a coaxial cable. The sub-surface unit includes a radiation responsive means for developing voltage pulses proportional to the impinging radiation. These pulses are transmitted along the coaxial cable to the surface unit. The surface unit includes means for amplifying the output pulses, oscillating means responsive to the output pulses for developing a rectangular pulse of predetermined height and width for every amplified output pulse, a rate-meter circuit responsive to the rectangular pulses for detecting the rate of arrival and amplitude thereof, and a power supply providing operating voltages to the sub-surface unit.

Translating, Rotating Bearing Device (Patent No. 2,689,753); J. J. Wechsler, inventor. The patent relates to translating, rotating, bearing devices and more particularly to a device that allows translating and rotation, or any combination thereof, in parallel planes, of bodies under load.

The device utilizes three parallel plate members separated from one another by ball bearings and interconnected so that the first plate moves with respect to the second plate only in translating, and the second plate moves with respect to the third only in rotation, whereby a body affixed to or mounted upon the first plate may be moved in a plane parallel to a second body affixed to or mounted upon the third plate through any combination of straight lines and curves with no precessing of the ball bearings.

Telemetry System (Patent No. 2,689,949); J. F. Kalbach and C. W. Johnstone, inventors. The patent relates to a multi function telemetry system for controlling and observing a large number of items in the high voltage electrodes of Van de Graaff generators. The system utilizes a light beam link between the transmitter and receiver and employs only one carrier in each direction while reliably communicating a plurality of items of information.

Ion Source Units (Patent No. 2,690,521); C. M. Turner, inventor. The patent relates to a gaseous electric discharge device and especially to an electric-arc discharge device capable of producing in quantity a substantially continuous supply of gaseous ions under vacuum such as those required in procedures and apparatus for separating or concentrating isotopes by appropriate selective operations upon the ions of different mass contained in an ion beam.

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CHATHAM

Twin Power Triodes!



CHATHAM TYPE 6336

New, High Plate Dissipation, Twin Power Triode

PER TRIODE SECTION

- PLATE DISSIPATION: 30 Watts
- AMPLIFICATION FACTOR: 2.7
- TRANSCONDUCTANCE: 11,000 Micromhos
- PLATE RESISTANCE: 250 Ohms

A twin power triode for voltage regulation. Used as a series tube, it will "pass" a minimum of 150 ma. per section at 40 V. DC plate voltage. Features a hard glass envelope and 8-pin button stem. Pin connections are the same as type 6AS7G.

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CHATHAM TYPE 6AS7G

Improved Twin Power Triode for Voltage Regulation

Features include absence of grid current, plate current and GM characteristics held within $\pm 10\%$, very low microphonics, improved triode balance and reduction of plate current drift.

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- PLATE DISSIPATION: 13 Watts
- AMPLIFICATION FACTOR: 2.0
- TRANSCONDUCTANCE: 7000 Micromhos
- PLATE RESISTANCE: 280 Ohms
- PLATE CURRENT: 125 Ma. at 40 V. Plate Voltage



CHATHAM ELECTRONICS CORP.

Executive and General Offices: LIVINGSTON, NEW JERSEY
Plants and Laboratories: NEWARK and LIVINGSTON, NEW JERSEY

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INTERNATIONAL RECTIFIER

C O R P O R A T I O N



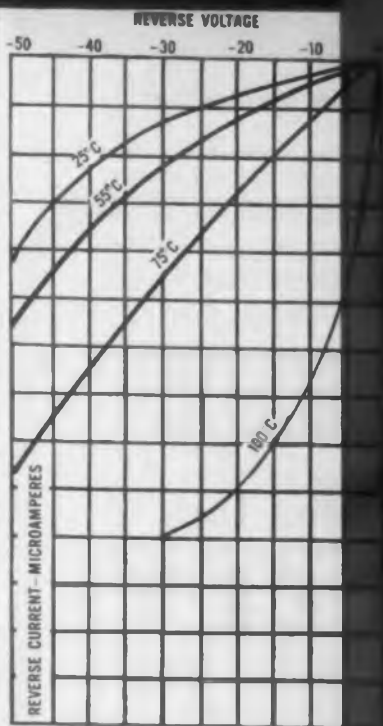
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HIGH TEMPERATURE



Germanium Diodes

100° C



● TYPE G44

REVERSE CURRENT (MAX.)
300 μ a AT -30 V
FORWARD CURRENT (MIN.)
5 MA AT +1 V

75°

50°

25°

Note These
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Characteristics
at 100° C . . .

● TYPE G66

REVERSE CURRENT (MAX.)
12 μ a AT -2 V
FORWARD CURRENT (MIN.)
5 MA AT +1 V

● TYPE G71

REVERSE CURRENT (MAX.)
50 μ a AT -10 V
FORWARD CURRENT (MIN.)
5 MA AT +1 V

● TYPE G75

(85° C)
REVERSE CURRENT (MAX.)
300 μ a AT -60 V
FORWARD CURRENT (MIN.)
4 MA AT +1 V

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MODEL	CAP. MM	TEMP. COEFF. PPM PER °C	DIEL.	ROTOR ELECTRODE	TEMP. RANGE
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VC 11	1 to 10	approx. zero	Quartz	Invar	-55°C to +200°C
VC 12	10 to 20	approx. zero	Quartz	Invar	-55°C to +200°C
VC 10	.5 to 8	+50 ± 100	Glass	Invar	-55°C to +125°C
VC 30	.7 to 8	+600 ± 100	Glass	Brass	-55°C to +125°C
VC 40	1 to 18	+600 ± 100	Glass	Brass	-55°C to +125°C
VC 110	.7 to 12	+100 ± 50	Glass	Invar	-55°C to +125°C
VC 110RB	.7 to 10	+750 ± 100	Glass	Brass	-55°C to +125°C
VC 110RC	.7 to 10	+275 ± 100	Glass	Invar Brass Screw	-55°C to +125°C
VC 130	1 to 10	+100 ± 50	Glass	Special Alloy	-55°C to +125°C

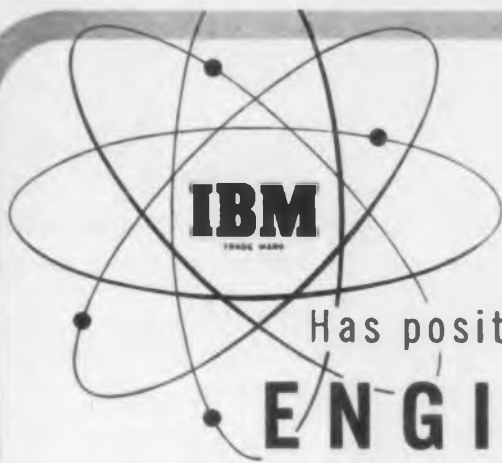
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Books . . .

The Technical Report . . . Edited by B. H. Weil. 485 pages. Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. \$12.00.

Technical developments that remain locked in their inventors' brains might as well never have been conceived as far as the rest of the technical community is concerned. Often one of the first steps in communicating knowledge of scientific and technical progress is the technical report that is distributed within a company. On the basis of such reports management or the sponsoring government agency will grant additional research funds and encouragement, or grant permission to publicize the development.

This handbook-style work covers all of the steps in the preparation, duplication, distribution, and utilization of the technical report. It is the work of 23 experts edited

by the Manager of Information Services, Research and Engineering Dept., Ethyl Corp., Detroit, Mich., himself the author of numerous books and articles. The book is the outgrowth of a symposium on the research report sponsored by the American Chemical Society, but it applies, of course, to all branches of science and engineering.

The volume is divided into five parts: "Functions", "Preparing and Processing", "Distributing", "Filing", and "Using". Part I is made up of two chapters on the technical report in industry and government, respectively. The longest section, and rightly so, is the second one on preparation. It includes chapters on the oral report, processing the report (including many illustrations of duplicating and binding machinery), and a chapter entitled, "Making Graphs and Tables More Effective". This chapter includes many examples

DELAY LINES

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- ★ VERY COMPACT
- ★ CHOICE OF MOUNTINGS
- ★ TUBULAR OR PACKAGE
- ★ ECONOMICALLY PRICED



All Technitrol Delay Lines are continuously wound for minimum pulse distortion . . .
are covered and impregnated to protect the winding . . .
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TECHNITROL

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of both informative and poor graphs.

Part 3 on distributing includes a chapter on security of government reports. The best methods of filing reports for maximum utilization are discussed in part 4. The last part tells how to put the reports to work, including the use of industry survey reports as market research tools. One of the two appendices is an example of a style book to aid those who wish to prepare such a book for their respective firms.

All of the personnel who are concerned with the technical report, those who write, process, read, and finally take custody of them, will find this volume of interest. The designer interested in the best possible presentation of his work to a remote and often non-technical management will find it to be of great value.

Dielectric Materials and Applications

... Edited by Arthur R. Von Hippel, 138 pages. Technology Press and John Wiley & Sons, Inc., 410 Fourth Ave., New York 16, N. Y. \$17.50.

Edited by the director of the Laboratory for Insulation Research, Massachusetts Institute of Technology, this definitive vol-

ume includes the laboratory's Tables of Dielectric Materials covering more than 600 dielectrics in a 144-page section. Twenty-two experts in the field contributed to the work.

The study is divided into five sections. The first, on theory, is split into two parts on microscopic and molecular properties, respectively, of dielectrics. Measuring techniques are considered in the second section. The title of the third section is "Dielectric Materials and Their Applications". It includes four chapters on the use of dielectrics as rectifiers; piezoelectric transducers and resonators; magnetic and dielectric amplifiers; and memory devices, respectively. The shorter fourth section deals with "Dielectric Requirements of the Armed Services". The last section is the Tables. Tabulated dielectric data for inorganic and organic solids and liquids and graphs of dielectric constant and loss tangent versus temperature for many classes of dielectric make up the last section.

Exceptionally well illustrated with drawings, tables and charts this treatise makes a valuable addition to the design department library.

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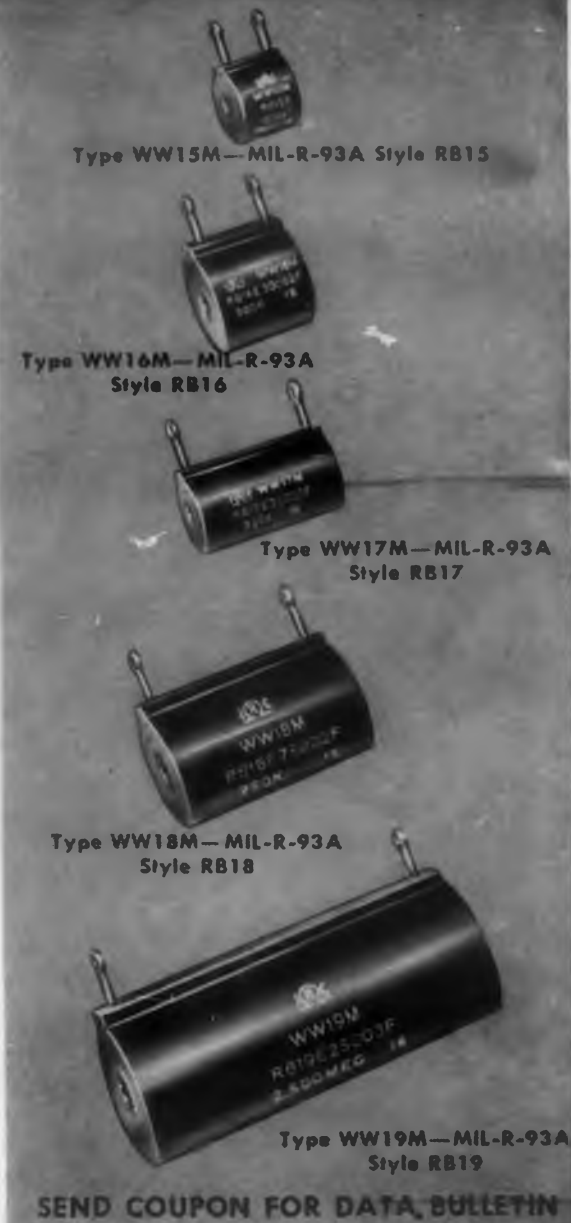
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