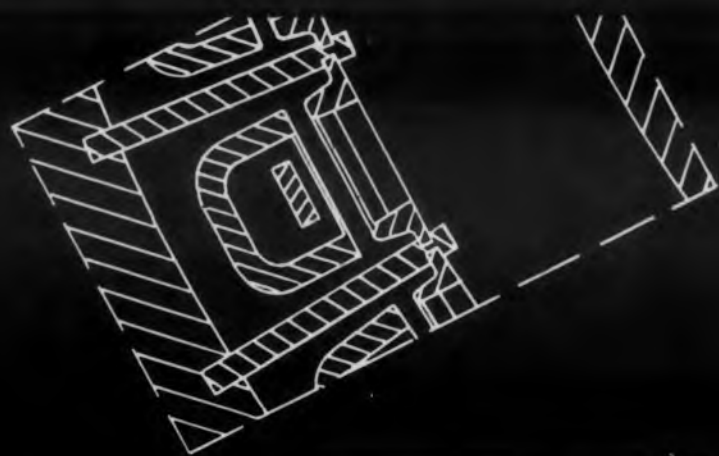


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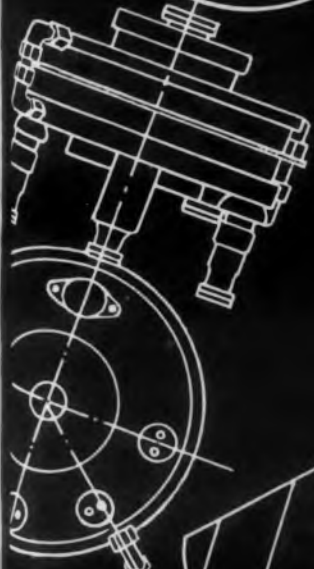
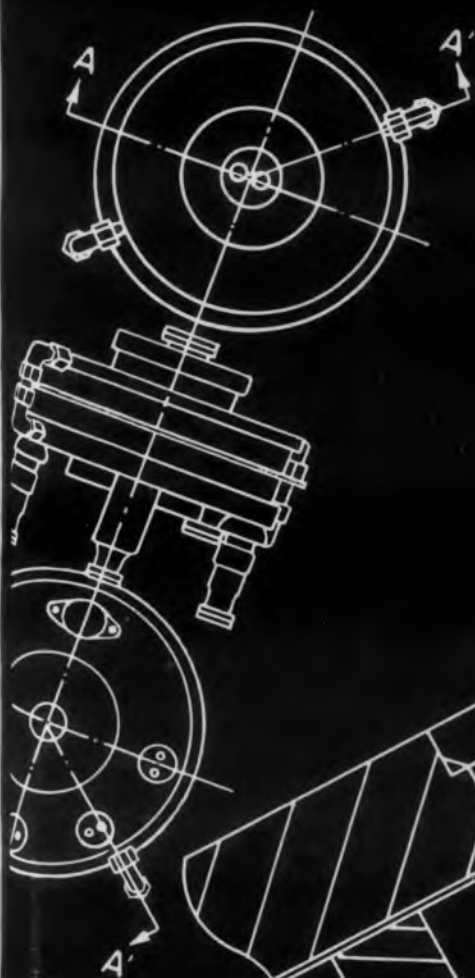


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APR 1 1954



This new water-cooled U-H-F Beam Power Tube is capable of delivering 12kw at 900Mc or 15kw at 500Mc. Its unusual construction and accurate element alignment affords high gain in TV broadcasting service without the need for neutralization.

March 1954



A New, Rugged, Disc-Sealed TETRODE
with...

LOW DRIVE
OF VHS...

**HIGH
PERFORMANCE
AT LOWER
COST PER
KILOWATT!**



AMPEREX

6076/AX-9907R — FORCED-AIR COOLED
6075/AX9907 — WATER COOLED

OPERATING DATA

R. F. POWER AMPLIFIER, CLASS B, LINEAR TV SERVICE

TYPICAL OPERATION AT 170-220 mc,
TWO TUBES, PUSH-PULL

	CCS	
D.C. Plate Voltage	4000	volts
D.C. Grid No. 2 Voltage	800	volts
D.C. Grid No. 1 Voltage	-150	volts
R.F. Grid No. 1 Voltage, peak to peak	850	volts
Synchronization Level	700	volts
Pedestal Level	700	volts
D.C. Plate Current	2.75	amps
Synchronization Level	2.1	amps
Pedestal Level	2.1	amps
D.C. Grid No. 2 Current	110	ma
Synchronization Level	50	ma
Pedestal Level	50	ma
D.C. Grid No. 1 Current	100	ma
Synchronization Level	50	ma
Pedestal Level	50	ma
Driving Power at Synchronization Level*	300-400	watts
Power Output	5	kw
Synchronization Level	2.8	kw
Pedestal Level	2.8	kw

*Driving power is accounted for largely by circuit losses.
The indicated driving power is required to take care of
losses in loading resistors, circuit losses and tube driv-
ing power.

OPERATING DATA

R. F. AMPLIFIER, CLASS C — TELEGRAPHY

TYPICAL OPERATION	CCS
Frequency	110 mc
D.C. Plate Voltage	5000 volts
D.C. Grid No. 2 Voltage	800 volts
D.C. Grid No. 1 Voltage	-250 volts
D.C. Plate Current	1.1 amp
D.C. Grid No. 2 Current	100 ma
D.C. Grid No. 1 Current	70 ma
Peak R.F. Grid No. 1 Voltage	480 volts
Driving Power	30 watts
Power Output	3.9 kw

LOW INTERELECTRODE CAPACITANCES

INPUT	23.5 μmf
OUTPUT	8.4 μmf
PLATE TO CONTROL GRID (Max.)	0.35 μmf

AIR-COOLED TUBE HEIGHT — 6 $\frac{3}{4}$ "

ACCESSORIES (Amperex Numbers)	Water Jacket	Grid Connector	Pin Connector	Air Flow Chamber
6076/AX-9907R		S-3706	S-3707	S-11882
6075/AX-9907	S-3737	S-3706	S-3707	

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11-19 Brentcliffe Road, Leaside (Toronto 17)

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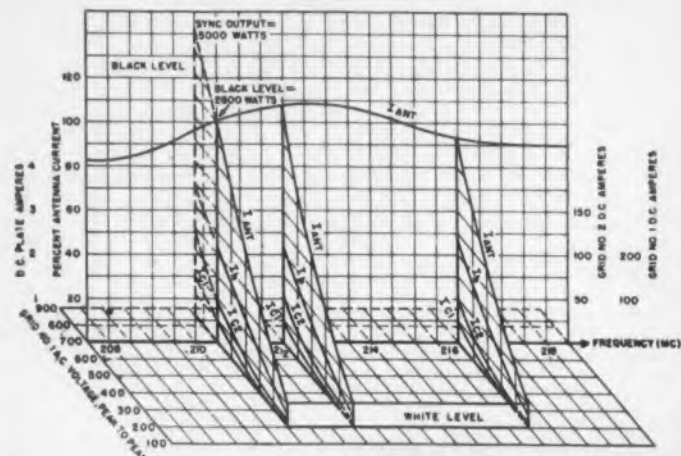
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PLATE VOLTAGE = 4000 VOLTS • GRID NO. 2 VOLTAGE = 800 VOLTS
GRID NO. 1 BIAS = 150 VOLTS



Complete Technical Data,
Including New 3-Dimen-
sional Curves Available
from our Application-
Engineering Department.



ELECTRONIC *design*

Vol. 2
No. 3
March 1954

Contents

Cover (See page 28)

Editorial 4

Engineering Review 5

Features

Cutting Costs of Chassis and Enclosures, by Daniel S. Karp. 12

True G_m Analyzer 14

Compact High Voltage Power Supply 18

Transparent Drawing Instrument 20

Typical Application of TV Receiver Tubes, by H. J. Shulman. 22

Picture Tube For Color TV 24

Tandem Mounted Potentiometers 26

Design Forum

Compact Computer Design 16

Departments

New Products 28

New Literature 60

Patents 68

Books 72

Advertisers' Index 74

BPA

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ELECTRONIC DESIGN • March 1954

PARTS • TIME INTERVAL •
 TEMPERATURE • VISCOSITY • RPM
 TURNS • VOLUME • WEIGHT
 FLOW • FREQUENCY • LENGTH
 PRESSURE • QUANTITY

3 STEPS TO Automation

- 1** Convert quantity to be controlled into electrical impulses
- 2** Apply impulses to counter set for desired number of counts
- 3** Connect counter output to control device

POTTER PREDETERMINED ELECTRONIC COUNTERS

- HIGH SPEED OPERATION
- INSTANTANEOUS AND AUTOMATIC RESET
- DIRECT DIAL SETTING OF DESIRED COUNT
- FAIL-SAFE OPERATION — NO FALSE COUNTS
- ABSOLUTE ACCURACY
- RUGGEDIZED INDUSTRIAL DESIGN

Let Potter engineers study your control problem.

Potter experience with a wide variety of pickup and control devices is at your disposal.

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VISIT US AT 346 COMPUTER AVE. IRE



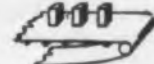
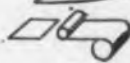





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- SOLENOIDS 
- CONVEYORS 
- CUTTERS 
- ALARMS 
- VALVES 
- PUMPS 
- OTHER ELECTRONIC EQUIPMENT

NOW AVAILABLE FROM STOCK

Model	Single	114	124	134	144	154	164
	Dual	214	224	234	244	254	264
No. of Decades		1	2	3	4	5	6
Count Capacity		16	100	1,000	10,000	100,000	1,000,000
		(available for each sequence in dual models)					
Count Rate		up to 60,000 per min. (higher rates are available)					
Inputs		2-volt sine wave, 2-volt negative pulse, contact closure. (A wide variety of count detectors is available)					
Outputs		Relay contact and 50-volt pulse					
Reset		Automatic, panel pushbutton, or remote contact closure					



POTTER INSTRUMENT CO., INC.
 115 CUTTER MILL ROAD
 GREAT NECK, N. Y.

122

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

DAVEN TURNS TO AIR



in a completely new approach

to the production of Encapsulated Seald-Ohm Wire Wound Resistors

Only DAVEN turns to air to keep the molding material absolutely separated from the resistance wire in its new line of Super Davohm Encapsulated Seald-Ohm Resistors. The wire is maintained in a slot filled with dry air . . . no external pressures are applied to it. These air pockets, between the wire and the plastic coating, guarantee absolute stability . . . eliminate shorted turns.

Only DAVEN matches the temperature coefficient of expansion of the molding compound with the ceramic bobbin, the resistance wire and the metal terminals. This removes the possibility of cracks or strains on the wire during cycling.

Because of the special construction used, Daven can furnish Encapsulated Wire Wound Resistors with temperature

coefficients below ± 20 P.P.M./°C. when required, and with accuracies to $\pm .05\%$.

These exclusive Daven precision, wire wound resistors are completely hermetically sealed . . . yet are no larger than standard lug-type resistors.

In addition, these units are made in accordance with MIL-R-93A specifications, and are substantially more rugged than conventional resistors. They will withstand the JAN-R-93, characteristic A, salt-water immersion test, and, in addition, temperature cycling from -65°C. to $+125^{\circ}\text{C.}$ The strong molding material will resist pressures equivalent to 75,000 ft. altitude, and will not cold flow at temperatures up to 150°C.

Write for latest Resistor Brochure

THE **DAVEN** CO. 169 Central Ave.
Newark 4, N. J.

WORLD'S LARGEST MANUFACTURERS OF ATTENUATORS

Editorial . . .

Design Forum

The article on pages 16 and 17 of this issue entitled "Compact Computer Design" is the first of a new series of stories which we plan to publish from time to time as the material becomes available. These stories will report on new ideas and new thinking in electronic equipment design. Identified by the label "Design Forum", they represent another step in a program of expanded editorial service to the readers of ELECTRONIC DESIGN.

Basically, the Design Forum article will tell how a design engineer solved a particular problem. All phases of electronic design problems will be explored. This month's story is concerned mainly with a packaging problem—how a designer managed to house all the components needed to make an efficient and reasonably flexible computer into a compact, attractive, easily serviced instrument. Such a story naturally lends itself to picture treatment to show the actual component placement. Other Design Forum stories will deal with circuit simplifications to reduce costs, panel layouts to improve ease of operation and appearance, and similar solutions to difficult design problems.

One object of these articles is to give credit to designers for their original and ingenious thinking, and to their companies for their business courage in marketing new design ideas. Another, perhaps even more important objective, is to stimulate and guide design thinking into new and more fruitful channels.

We feel that this is another way ELECTRONIC DESIGN can help to encourage the growth of the electronic industries.

Invitation

Nothing pleases an editor and his staff more than meeting readers in person to hear their comments, suggestions, and criticisms. The Radio Engineering Show affords us such an opportunity and we look forward to the experience. Our booth number is 872. Drop in and say hello.

Engineering Review ...

Project Tinkertoy Cost Study . . . Reductions of 44% in the manufacturing costs of an i-f amplifier by means of completely mechanized module construction were indicated by the first comparison and analysis of mechanized module construction, hand assembly of module elements, and conventional construction. The hand assembly method saved 38.5% over conventional methods. The cost survey was made by Mead Carney and Company, Inc., management consultants, for the National Bureau of Standards at the request of the Navy Bureau of Aeronautics, sponsor of "Project Tinkertoy."

The study had the double objective of determining the costs under the new methods and then comparing them with conventional construction. The costs by module methods were determined by operation of a pilot plant and model shop. Manufacturing costs for the conventional i-f amplifier were obtained from a Navy contractor who had produced a considerable quantity of the item. The accompanying table gives a cost breakdown and comparison.

Method	Materials	Direct Labor	Manufacturing Overhead	Totals
Conventional	\$35.85	\$5.60	\$5.44	\$46.89
Hand assembly of modules	20.56	5.99	2.27	28.82
Mechanized assembly of modules	20.56	2.83	2.86	26.25

Modular design of electronics is based on a standard building block, 7/8" square, notched ceramic wafer (see ED, Oct. '53, p. 5). Electronic components, such as resistors, capacitors, and the tube sockets are made integral with the ceramic wafer. These are assembled in skyscraper fashion to form a standard module that carries the elements for one or more electronic stages. Ceramic wafers, titanate capacitors, and adhesive tape resistors are produced directly in quantity from raw materials. These and other basic electronic parts are fed into a mechanized assembly line composed of 20 separate machines. Throughout the assembly line, automatic, 100% inspections are performed.

With the same machines producing module elements for both hand and mechanized assembly, it was possible to compare the two methods fairly closely

at 20 progressive steps. Manufacturing costs for the mechanized operation are lower than the hand assembly method in 13 of the 20 steps. The mechanized method produced the same complete unit 8.9% cheaper than by hand assembly. If lower-cost hand assembly of the modules could be substituted in any of its steps, hand assembly might become cheaper than mechanized.

An investment of about \$665,000 is required to create a facility to produce 405 modules per hour by machines, compared to \$82,000 for a hand assembly facility to produce 400 modules per hour. However, the difference in machine investment would be repaid from manufacturing cost savings in less than 17 months of operations at full capacity. Few savings would result from an increase in the size of the projected facilities.

Since little production experience for the mechanized method was available, its cost figures are largely estimated and subject to revision. Significant reductions in costs are likely with increasing experience. The cost figures for hand processing are based largely on time studies and are, therefore, less subject to revision. These indeterminables do not affect the conclusion of the consultant that ". . . Substantial reductions in electronic manufacturing costs appear to be possible . . ." through the use of these two new processes as compared with conventional methods.

The name "Project Tinkertoy" will no longer be used to describe the program developing these new processes. "Modular Design of Electronics" (MDE) and "Mechanized Production of Electronics" (MPE) will be used instead.

The report of the consultants, complete with tables and curves, is available as Volume V of a series of reports on MPE and MDE. Volume V, "Project Tinkertoy Manufacturing Cost Determination" PB 111315, may be purchased from the Office of Technical Services, Department of Commerce, Washington 25, D. C. The price is \$4.00.

Purifying Germanium . . . Germanium for transistors can now be refined to 99.99999999% purity in a new "zone-melting" process developed by W. G. Pfann of Bell Telephone Laboratories, New York, N. Y. The process is based on the fact that impurities

are not equally soluble in the solid and liquid states of a substance. Usually, impurities are more soluble in the liquid. To take advantage of this, a narrow molten zone produced by a circular induction heater is moved slowly along an ingot of relatively impure material to "sweep" the impurities to one end of the ingot. The molten zone tends to hold the impurities while the ingot solidifies into a purer state on the other side of the heater.

A series of circular heaters is used and each molten zone extracts its share of impurities from that left by the preceding zone. At the end of the run, substantially all the impurities have been "swept" to one end of the ingot. They are trapped in the tip of the ingot when it passes out of the heater and solidifies. This tip may then be cut off.

The behavior of germanium in transistors is affected critically by the presence of impurities, but the kind and amount of impurities must be rigidly controlled for efficient operation. This is accomplished by refining an ingot of germanium to a near-perfect state of purity by the zone-melting process. Then its electrical properties can be altered to the desired degree by the controlled addition of such impurities as arsenic and antimony.

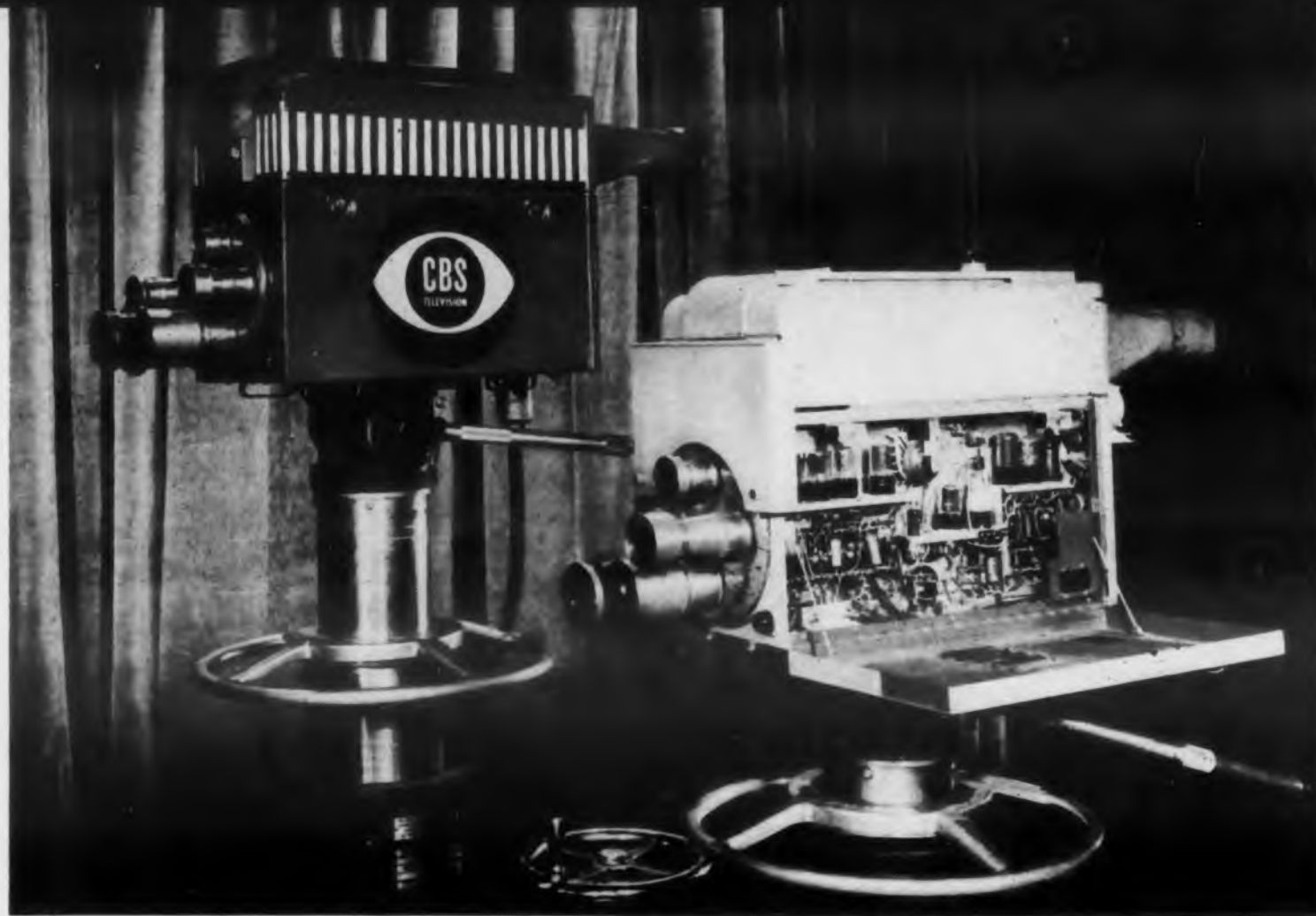
The process, which has already been adapted to production needs, can also purify other substances such as tin, antimony, and semiconductors. The method is also useful in identifying impurities in materials which cannot be detected by other means.

Thermocouple-Powered Fans . . . Banks of heated thermocouples that power the small fans in a newly invented space heater offer the possibility of sun- and heat-powered transistorized communication and telemetering devices. Devised by Frederick J. Bordt, Jr., associate professor of mechanical engineering at Rensselaer Polytechnic Institute, Troy, N. Y., the heater employs 2400 thermocouples which develop a total of 10w when heated by the fuel which also heats the warming air. The four fans circulate the warm air.

Mounted in eight, 4" x 7" ceramic panels, the thermocouples are about the length of a kitchen match, and set about 1/4" apart in horizontal rows about 1/4" apart. Each of the thermocouples extends 1/2" into the combustion chamber, runs through the 1/2" ceramic panel and extends 3/4" outside the chamber.

The hot end of the thermocouple is stainless steel, the cold end is copper, with the current flowing from the hot end to the cold end. The thermocouples are connected inside the ceramic panel with wires of chromel and constantan, and the accumulated current is collected at a bus.

The ceramic wall must be an insulator for both heat and electricity. It must also not shrink after pouring. In order to be economically practicable, a machine method of mounting the thermocouples in the ceramic panels has to be devised.



Color TV Camera

Engineering Review . . .

Human Engineering Institute . . . The increasing importance of human engineering is commanding the attention of more and more design engineers. Last year Dunlap and Associates, Inc., a management consultant firm, organized a 5-day "Human Engineering Institute" covering important phases of this subject.

This course was so successful that another one is planned for this year, which will incorporate the suggestions of last year's participants, as well as the most recent experience of their human engineering specialists. It will take place during the week of May 10 in Stamford, Conn.

Of particular interest to designers are lectures entitled "Body Response—How Controls Are Operated," "Proper Design of Controls" (handles, knobs, etc.), "Perception—How Information Is Obtained," "Proper Design of Instruments" (counters, dials, etc.), and "Human Engineering in Product Development." The program emphasizes practical design problems, and the 4-man laboratory sessions are designed to apply the principles discussed in the 16-man class meetings.

Enrollment is limited and the deadline for enrolling is April 15. The tuition is \$300.00. For application forms and more information, write to Dr. Bernard J. Covner, Director, Human Engineering Institute, Dunlap & Associates, Inc., 429 Atlantic St., Stamford, Conn.

The new Chromacoder color television camera (right) is comparable to the standard black-and-white camera (left) in ruggedness, flexibility, size and weight. Developed by CBS Laboratories Division, the camera has only one orthicon image tube instead of three. It is a further refinement of the field sequential camera.

Cold Metal Tests . . . The mechanical properties of beryllium copper are able to withstand extreme temperature conditions as low as -300°F according to a two-year study completed at the University of Pennsylvania, Philadelphia, Pa. Confined to commercial types of wrought and cast beryllium copper alloys, the tests show that the alloy in some respects displays improved performance in the subzero range.

Starting at room temperature, beryllium copper was tested at successive levels down to -300°F . Among the important properties measured were tensile and impact strengths, elongation, and elastic modulus. Results indicate that the alloy performs with unhampered and even heightened efficiency under subzero conditions that may cause failure in other standard design materials.

These findings should have important bearing on the materials used in equipment operating in extreme cold, such as aircraft accessories, radar, and refrigerating gear.

Details of the study, along with conclusions and interpretations, are available from the Beryllium Corporation, Reading, Pa., the sponsor of the study.

Dual Measuring and Plotting Instrument . . . A new electronic instrument which automatically measures two variable conditions and simultaneously plots their relationship to a third has been developed by the Industrial Division of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.

Known as the "Elektronik Duplex Function Plotter", the instrument is designed essentially as a research tool. It is expected to be useful in many industrial research activities from missile and engine testing to stress and nuclear engineering analysis.

The instrument incorporates three complete measuring and balancing circuits. While two circuits actuate recorder pens across a calibrated chart recording two conditions, the third motivates the instrument chart up or down as it measures the third variable. A continuous automatic plotting which evaluates the two initial variables in terms of the third is therefore achieved.

All three circuits can be actuated by any d-c source and can be calibrated for the same or entirely different ranges and actuations. One pen may record temperature and the second, speed, while the chart measuring circuit is calibrated in millivolts to represent a third variable, such as pressure.

The Duplex Function Plotter is expected to facilitate laboratory and industrial research involving interdependent, nonlinear variables. Its automatic compilation of measurements and continual plotting of curves will eliminate much tedious manual replotting and inaccuracies.

Ultrasound Measures Tanks . . . Ultrasonic pulse-ranging is the basis for a new liquid level indicator system, which has no moving mechanical parts. The petroleum, chemical, pharmaceutical and shipping industries can use the device to measure levels in tanks within 0.01ft. The equipment is also suited to applications requiring the precise location of the demarcation line existing between immiscible liquids.

Level readings are always correct due to the action of a self-contained automatic calibration system that compensates for any change in the velocity of sound propagation and similar differences between liquids. One common indicator can gage any number of transducer-equipped tanks within a radius of 2000ft. By using a remotely operated, rotary, coaxial-cable, tank-switching relay developed especially for this application, a large number of tanks may be gaged at a minimum of cost. The indicator can also feed level data to standard digital tape printers for use in automatic accounting systems.

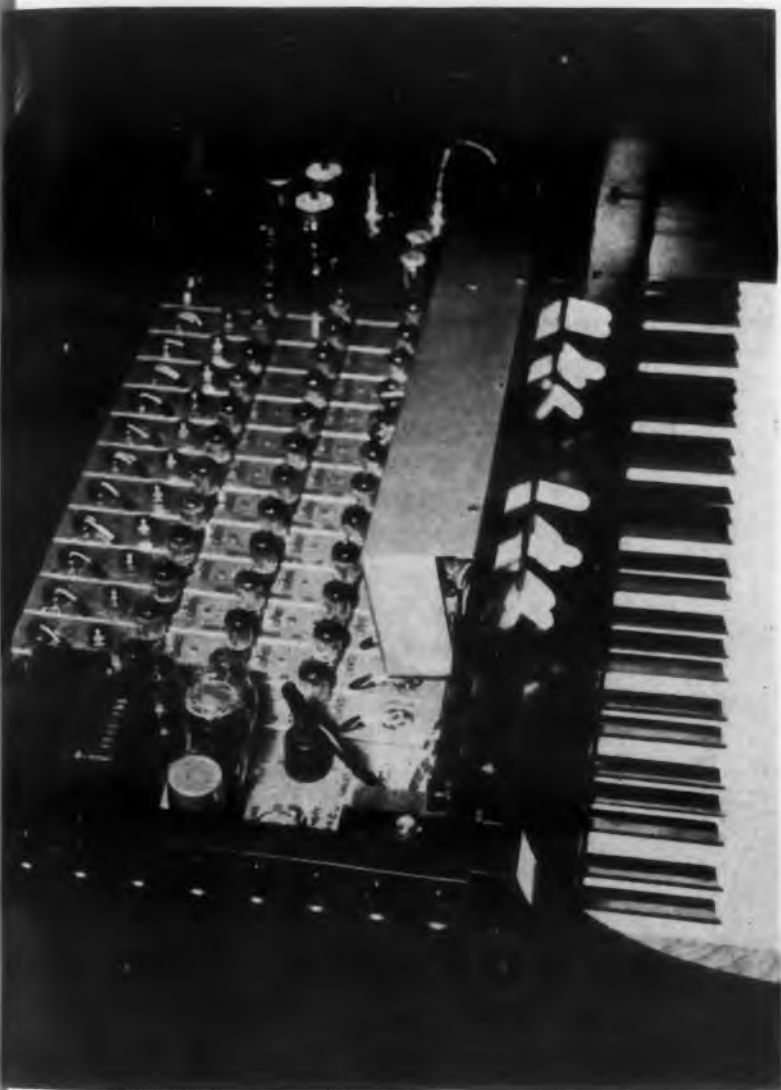
Tank accessories are explosionproof. Direct current flow in the transducers and coaxial cables has been eliminated, and alternating current energy levels are not high enough to ignite gasoline fumes under any possible open or short-circuit conditions.

Known as the Model SL-102, the indicator is made by Bogue Electric Mfg. Company, Paterson 3, N. J.

Silicon Transistors . . . Transistor application possibilities have been greatly extended with the successful development of experimental silicon transistors. Developed by Raytheon Manufacturing Co., Waltham 54, Mass., the transistors have been tested at temperatures up to 350°F.

These new units are expected to overcome most of the difficulties previously encountered in applications involving high wattage or high ambient temperatures. On a laboratory basis, the new devices have been proved capable of meeting stringent military temperature requirements where germanium transistors could not be used because of heat limitations.

Considerable work remains to be done before silicon transistors will be produced in quantities necessary for military applications and, according to the company, the transistors will not be commercially available for some time to come.



New Electronic Organ

This electronic organ, recently demonstrated in New York City, makes use of a special frequency divider circuit which saves up to 60% of the number of tubes ordinarily used in electronic organs. Manufactured by the Minshall Organ Co., Inc., Brattleboro, Vt., the instrument also employs etched circuits in its tone generators and channels.



WESTINGHOUSE THERMOSTATIC IGNITRON USES UP TO 90% LESS WATER

Westinghouse — pioneer in power tube development and original inventor of the Ignitron — now presents the decade's most important advance in Ignitron design — the Westinghouse Thermostatic Ignitron.

A thermostatic mount on the standard stainless steel Ignitron now indicates the temperature of the inner vacuum envelope. Standard available thermostats may be attached to the mount to control water flow and

provide complete protection for Ignitrons and welding equipment. Thermostats may be reused indefinitely.

Savings in cooling water of up to 90% or more can easily be achieved under conditions of light loading and low water temperature. With size D Ignitrons, for example, this can mean savings of 1,000,000 gallons per welder per year.

For complete details, specifications and samples of the new Westinghouse Thermostatic Ignitron, see your Westinghouse Electronic Tube Sales representative. Or write: Dept. P1034, at the address below.

ET-95054

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

RELIATRON® TUBES

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, N. Y.

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

"Intelligent" computer . . . The ability to sense and control its environment is an interesting feature of the compact high-speed JAINCOMP-C Digital Computer manufactured by the Jacobs Instrument Company, Bethesda, Md. Nine sensing devices feed information concerning the apparatus to be controlled into the computer. After computing the interrelationship of these quantities and 70 constants which it reads electronically from punch cards, the computer controls three independent external pieces of equipment. The computer performs this operation 10 times per second. By continuous examination of the past history of each of the nine signal inputs, the computer can decide if a sudden change represents just a short-term fluctuation or a long-term trend, and act accordingly. This represents rudimentary intelligence.

Handling 24-binary digit numbers, the 800-tube computer makes an automatic functioning check of itself every 3.2sec. It scans punched cards electronically in one millionth of a second and also incorporates various types of memory.

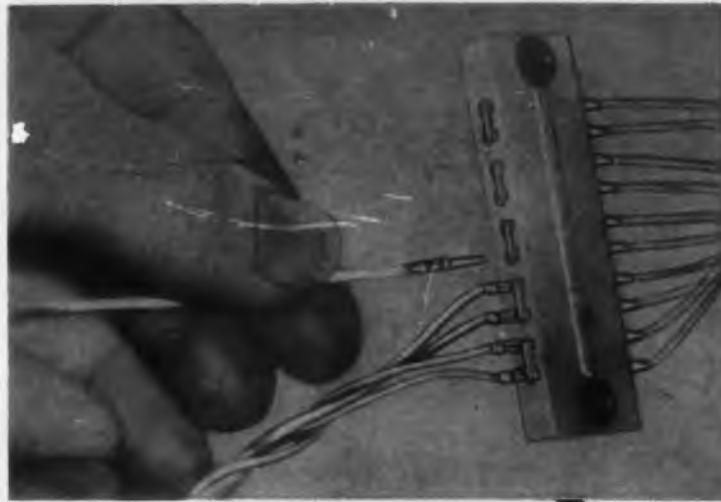
A larger companion model, the 1500-tube JAINCOMP-D, has a much larger memory and more flexibility. It can be programmed by either a magnetic tape, a punched card or its own memory. Its magnetic core storage capacity is 1024 36-digit words.

All of the circuits in both models are built in the form of tiny plug-in packages, and a faulty one can be removed and replaced in less than 30sec. The C model fits in a 22" x 24" x 28" cabinet, while the D model requires three such cabinets. Both types add in less than eight microseconds.

Alloys for Delay Lines . . . Isoelastic alloys may replace presently used materials for ultrasonic delay lines as a result of a study of thermally stable delay lines for computers and fire control devices. The National Bureau of Standards, Washington 25, D. C., investigated 14 materials at temperatures ranging from -50°C to $+200^{\circ}\text{C}$. Two isoelastic alloys, alloys which have a constant modulus of elasticity with respect to temperature changes, showed the proper thermal stability with respect to time delay. These isoelastic materials were alloys of iron, both containing approximately 36% nickel and 7% to 8% chromium plus other minor constituents.

The materials presently used in delay lines are quartz, mercury, water, and certain magnesium alloys. Quartz is expensive and hard to shape or machine while mercury is thermally unstable and is susceptible to shock, leakage, aging, and contamination.

The relationship between the transmission of ultrasound and such factors as chemical composition, cold deformation, annealing treatment, specimen length and sound path cross section were also studied. The investigation showed that there was little effect on the transmission of ultrasound attributable to specimen cross section so long as it was not less than the cross section of the transducer.



BASIC 10 CONNECTOR TAPER-BLOK WITH DUAL CONTACTS
Photo shows TAPER-BLOK with A-MP TAPER PINS in place. Strip measures only .610" x 2" Blocks, made of NYLON 10001, can also be stacked to accommodate hundreds of circuits.



TAPER PINS FOR MULTIPLE CONNECTORS, AN AND OTHER TYPES
Amphenol, Cannon, Continental and Winchester Connectors now are available with tapered receptacles for A-MP self-locking TAPER PINS. Saves over 80% of your wire assembly time and provides uniformly higher quality connections at lower cost.



TAPER TAB RECEPTACLE APPLICATIONS
More and more flat tabs on relays, switches and other components are being tapered to receive A-MP TAPER TAB RECEPTACLES. Fast easy assembly reduces costs and provides higher quality connections.

NEW **AMP** MINIATURE TAPER-BLOK For AMP Taper Pins

(Wire Ranges: #26 to #16)

NEW TAPER-BLOK FOR A-MP'S TAPER PINS HELPS YOU SAVE SPACE AND WEIGHT, SPEEDS UP WIRING ASSEMBLY, SIMPLIFIES DESIGN, AND REDUCES COST!

The TAPER-BLOK shown full size at the right has receptacles for 1000 connections, yet measures only 4" x 5" x $\frac{5}{8}$ "! Receptacles are designed to receive A-MP self-locking Taper Pins which can be easily pushed in place with A-MP's CERTI-LOK measured energy insertion tool.

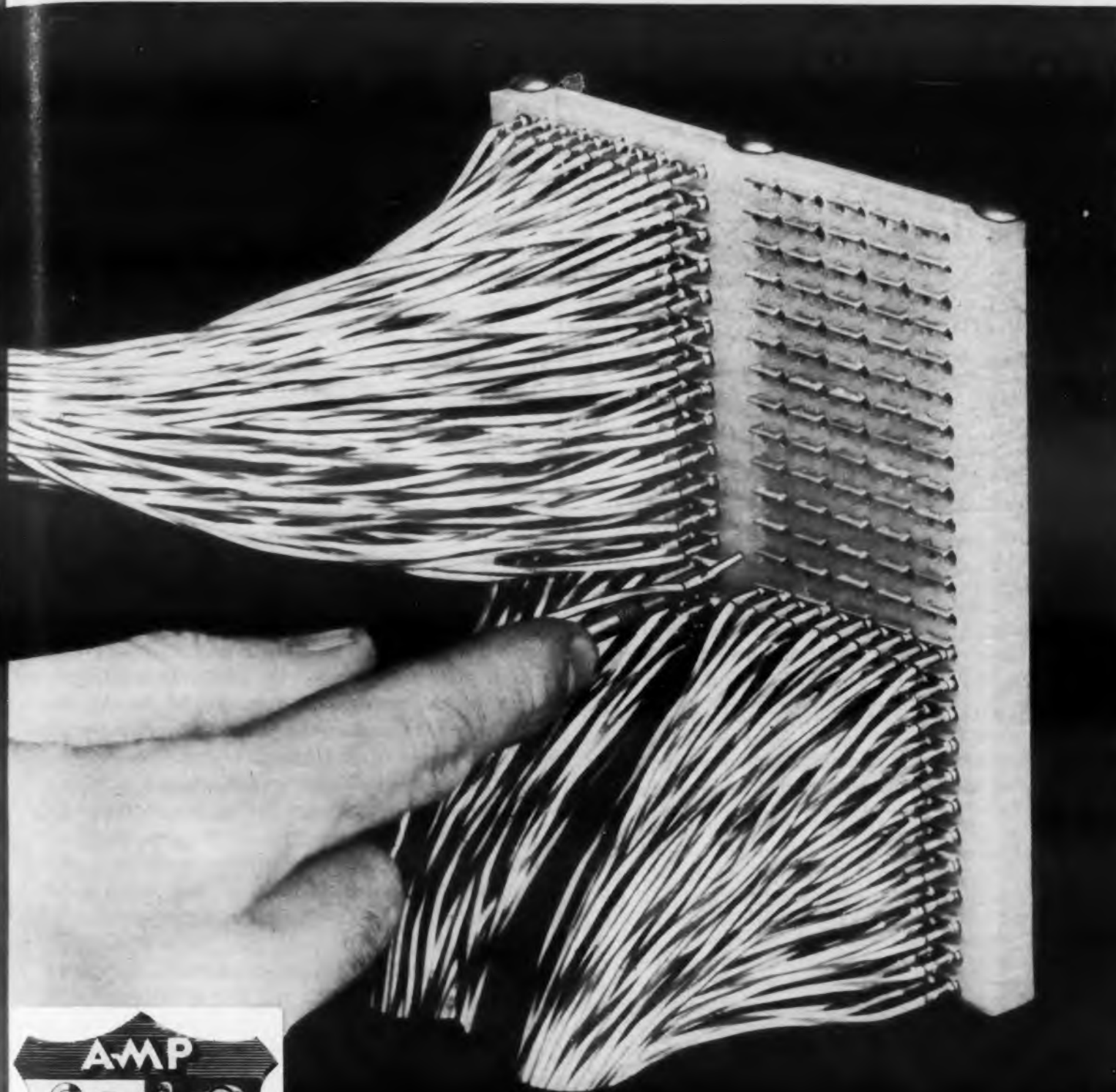
Extremely high contact pressure assures dependable, uniform, low resistance connections for electric and electronic circuits.

Assembled TAPER-BLOKS are available in 10 and 20 connector sizes with single or dual receptacles. TAPER-BLOK strips can be assembled by stacking to provide the number of connections required for your design. Write for specific information and latest prints.

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

ELECTRONIC DESIGN • March 1954



AIRCRAFT-MARINE PRODUCTS, INC.
2100 PAXTON STREET, Harrisburg, Pennsylvania
 In Canada — AIRCRAFT-MARINE PRODUCTS, INC.
1764 Avenue Road, Toronto 12, Ontario, Canada

AMP

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

Modular Design Training . . . Two training programs in modular electronic design have been organized by Sanders Associates, Inc., a major participant in Project "Tinkertoy". The first course, "Introduction to Modular Design Principles", is intended primarily for key engineering personnel and will consist of six lectures covering basic principles and reduction of circuits for modular electronics, design and manufacture, mechanical and circuit layout, plus demonstrations, tours, and discussion periods.

The second course is the "Advanced Course in Modular Design", prepared for engineering, production and technical personnel. It is three weeks long and covers basic principles and reduction of circuits to modular design, design and manufacture of components, circuit and mechanical layouts, test and assembly, and plant layout for modular production. Engineering personnel will "modular design" a specific circuit and supervise its construction and testing. Production personnel will schedule and supervise the operation of the semi-mechanized module facility of the school. Technicians will learn to use the special jigs and fixtures peculiar to modular assembly.

For more information, write to John W. Bettin, Dept. ED-3, Sanders Associates, Inc., Nashua, N. H.

Accurate Radar Altimeter . . . Military secrecy has been lifted from a new radar altimeter now being studied by the U. S. Air Force. Developed by Raytheon Manufacturing Co., Waltham 54, Mass. under contract to the U. S. Navy's Bureau of Aeronautics, the instrument keeps a pilot continually informed of his height above the earth.

The new altimeter sends off signals down to the surface of the earth which bounce back to the plane in millionths of a second. The time it takes them to return is measured electronically and converted automatically on an instrument panel where the altitude can be read in feet. The new altimeter functions reliably from a few inches off the ground to the limits of its operating range. It can also be set so that a warning light will indicate when the plane has gone below the desired altitude.

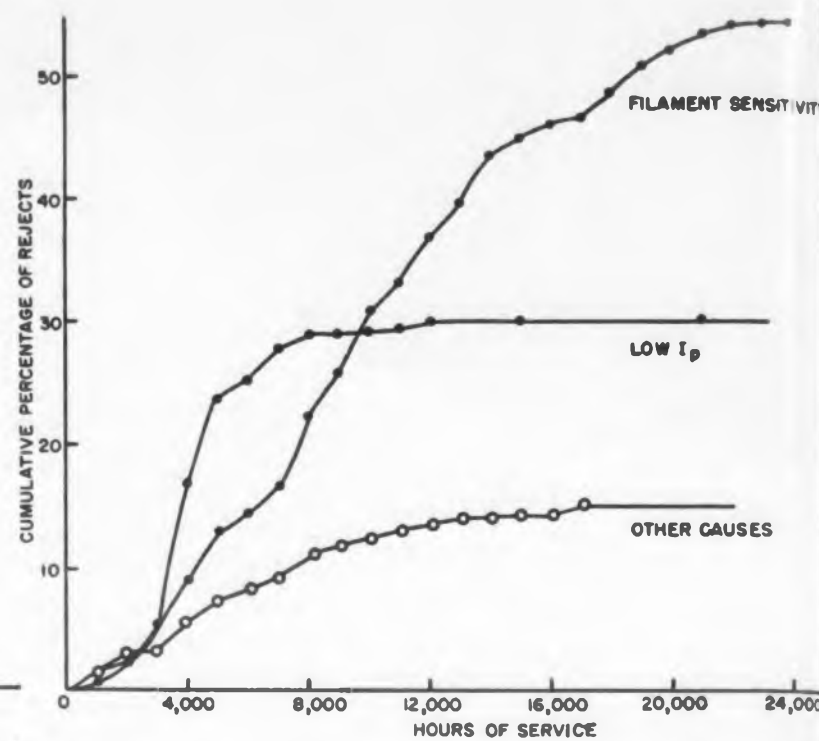
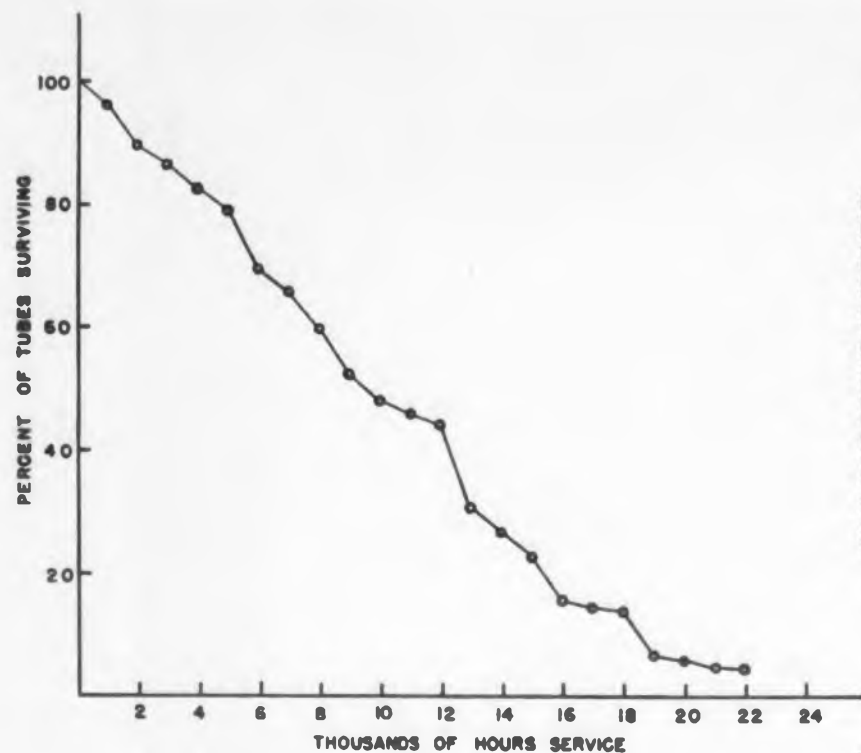
An important advantage of the new device is the instantaneous altitude indication it affords without "instrument lag"—or slow instrument reaction. This is a vital factor in view of the high speeds of jets.

Errors in the altimeter are practically negligible. If it picks up a false or misleading signal, the indicator needle is automatically masked out until the system has found a true reading again. This feature eliminates errors caused, for example, by a faulty tube, a weak transmitted signal, or interference.

Total weight of the new instrument is approximately 30 lb. Transmitting and receiving antennae are mounted flush beneath the wing for high-speed flight, and the entire system is designed for maximum convenience of maintenance and ease of calibration.

SEAC Tube Performance

These curves show the performance of Type 6AN5 tubes in the National Bureau of Standards' SEAC computer. At the left is a survival curve based on the service of 1775 tubes. The other graph shows cumulative rejection curves for about 800 tubes. After 8000hr of service, heater sensitivity is the main cause for rejection. Analysis of data obtained shows that median life is about 12,000hr for tubes used in the arithmetic and control units of the computer. Median life of 6AN5's in the entire machine is 8700hr.



Engineering Review . . .

Intercom System with a Memory . . . An intercommunication dial telephone system with a memory circuit and a device permitting key executives to cut in on a busy line was announced recently by the

Sound Equipment Division of the Stromberg-Carlson Co., Rochester 4, N. Y. The new system, called the "Dial-X", also provides direct connection with a paging or sound system, direct calling of telephone conferences, and unlimited simultaneous service of the entire system.

The "memory" circuit eliminates the need to repeat the dialing of a busy line by remembering the call

and completing it the instant the line is free. The "cut in" feature gives executives facilities for preempting any line in the system, busy or not. The executive dials the number he wants and, presses a button which sounds a warning signal on the busy circuit and then makes the connection. This permits urgent messages to go through at any time.

A "Conference Call" device enables any number of people to confer simply by dialing a conference call. Only those taking part in the conference are on the single line. Dial-X can also be connected with a regular paging or sound system, so that anyone can broadcast a message or make an announcement by dialing the paging line.

Dial-X switchboards provide complete protection against eavesdropping. When a line is in use, all other inside lines are locked out. The Conference Call or the executive right-of-way are the only exceptions.

Automatic Accounting Data Transmission . . .

Rapid transmission of punched-card accounting data between a company headquarters and its distant branches is offered by the new International Business Machines Corporation Transceiver, which utilizes normal telephone circuits. The units also check their coded sound transmissions for accuracy, thereby assuring high accuracy.

When the fully automatic duplicate machines are linked by telephone wires, 16 card columns of data can be transmitted and received every second and four separate transmittals can be sent simultaneously over the same wire. When linked by telegraph, over which one transmission at a time can take place, the transmitting speed is six columns per second. The receiving unit creates exact duplicates of the signal-actuating punched cards at the transmitting unit. These cards can then be processed as usual.



Automatic TV Picture Tube Metallizer

All phases of the operation of the new Stokes TV Picture Tube Vacuum Metallizer are controlled by this standard sequence-type electrical timer, adjustable to 10-second intervals. Here, the operator changes the settings of a micrometer adjustment on the timer, calibrated in seconds, which controls the duration of the flashing current.

Meetings

March 22-25: *Radio Engineering Show, Kingsbridge Armory, New York, N. Y.*

Information may be obtained through B. R. Lester, Technical Chairman, c/o IRE, 1 East 79 Street, New York, N. Y.

April 5-6: *The Society of The Plastics Industry, Inc., 12th Annual Conference.*

Mount Royal Hotel, Montreal, Ont., Canada. Contact William T. Cruse, Registrations Chairman, 67 West 44 Street, New York 36, N. Y.

April 8-9: *Operations Research in Business and Industry.*

Sponsored by the Midwest Research Institute, Kansas, City, Mo. Participating speakers will include over 400 authorities in industry and business contributing to a program which is to be one of the most comprehensive ever offered in the field. Advance registration may be obtained through Martin Goland, Midwest Research Institute, 4049 Pennsylvania, Kansas City, Mo.

April 12-14: *1954 International Symposium on Information Networks.*

Engineering Societies Building, 33 West 39 Street, New York, N. Y. The symposium will deal with network theory and synthesis, especially as it is influenced by newer concepts developed in information and general communication theory. American and European authorities who have made original contributions to the field will participate. For reservation information, address Polytechnic Institute of Brooklyn, Microwave Research Institute, 55 Johnson Street, Brooklyn 1, N. Y. Copies of the proceedings will be available in published form by October 1954.

April 19-20: *Symposium on the Automatic Production of Electronic Equipment.*

Sponsored by Stanford Research Institute and the U. S. Air Force. Fairmont Hotel, San Francisco, Calif. Contact L. K. Lee, head of Advanced Techniques Group, Stanford Research Institute, Palo Alto, Calif.

April 22-23: *AIEE Conference on Feedback Control.*

Claridge Hotel, Atlantic City, N. J. General Chairman, A. G. Kegel, Westinghouse Electric Corp., Friendship International Airport, Baltimore, Md.

April 24: *Eighth Annual Spring Technical Conference of the Cincinnati Section of the IRE.*

For information contact LaVern Winkle, Crosley Division, Avco Engineering, Inc., Cincinnati 25, Ohio.

April 27-29: *AIEE Electronic Components Conference.*

Department of Interior Auditorium, Washington, D. C. For information, contact AIEE, 33 West 39 Street, New York 18, N. Y.

If You Need a Modern Cathode-Ray Oscilloscope...

look to the *NEW* Du Mont Type 323

Thoroughly consistent in concept and design, the new Du Mont Type 323 embodies a number of unique, modern features engineered specifically for the exacting problems of today. The direct-coupled, wide-band vertical amplifier achieves stability and sensitivity required to display a wide range of signals, together with their d-c reference, if desired, by straight-forward, reliable and easy-to-service circuitry. Its sweep is a significant contribution to modern instrumentation. By developing the sweep signal at high level, sweep amplification — and resultant non-linearities — are avoided. Naturally, sweeps of the Type 323 are directly calibrated, with a precision fully consistent with the stringent requirements of modern technology. Only decade multiplying factors are employed. Recalibration, if ever needed, is readily accomplished by a single adjustment of a single control against an internally available timing standard. Calibrated sweep delay and expansion are provided by the modern Du Mont sweep "notch". The expanded two-inch notch may be moved along the four-inch trace, so that any portion of sweep may be examined in detail, while its relationship to the total signal is preserved. Completing the quantitative analysis of the input signal, accurate amplitude calibration is provided. A thoroughly modern cathode-ray tube, the new Du Mont Type 5AMP-, is employed in the Type 323. This cathode-ray tube, constructed to Du Mont's exclusive tight tolerances, and based upon the new Mono-accelerator principle, assures the high degree of accuracy required to exploit fully the precision inherent in the design of the Type 323. If your demands are beyond the capabilities of the ordinary oscilloscope, we invite your examination of this superb new instrument.



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

Cutting Costs of Chassis and Enclosures

Daniel S. Karp

Vice President in Charge of Engineering, Karp Metal Products Company,
Division of H & B American Machine Company, Brooklyn, N. Y.

ALL the savings that result from careful electronic circuit design can be lost by inadequate knowledge of sheet metalworking. Delivery also may be slowed and even functional effectiveness limited by improper specification of chassis and enclosures.

Five critical factors affect the cost of producing sheet metal cabinets, chassis, housings, racks and enclosures. There are other factors, of course, but these five are paramount: (1) The cost of new tooling; (2) tolerances; (3) complexity of piercing and forming operations; (4) provisions for strength and ruggedness in specifying types of welding; (5) the type and nature of finish required.

Avoiding New Tooling Costs

The greatest expense of any sheet metal fabrication is the cost of the tooling required. The fewer cabinets, chassis, housings, racks or enclosures required, the greater the per unit cost will be. For a small number of units, the cost is prohibitive. Yet this "new tooling" cost can be avoided by adapting designs to what sheet metal fabricators call "stock tooling". Stock tooling is fabricator-owned tooling which has been used previously and is now available for use on any job that comes into the plant. Fig. 1 shows typical shapes that can be stamped by stock dies.

Sheet metal fabricators who specialize in producing for the electronics industries have available stock dies



for tube sockets, transformers, dials, ground lugs, capacitors, gromet holes, etc. Some fabricators, in fact, have stock dies for all JAN and MIL components. By knowing what stock dies are available—and designing to them—the designer can minimize and often eliminate his new tooling costs. The designer may find it profitable to take the suggestions of the sheet metal fabricator in revising his design to take advantage of stock dies.

Tolerances

One of the biggest problems in sheet metal fabrica-

tion is that designers attempt to apply machine shop practices and tolerances to sheet metal work. Due to variations in commercial grade mill sheet in thickness ($\pm 0.003''$), in temper, and spring back, machine tolerances are very difficult to hold. Close tolerances can be held through the use of special dies and fixtures, but this is costly and should only be used when absolutely necessary. For economical production designers should specify the following tolerances when designing for sheet metal:

- 0.005" for close tolerances between hole centers, and 1/64" for average or commercial tolerances.
- $\pm 0.015''$ tolerances between hole centers to bend lines.
- $\pm 1/64''$ overall tolerances including two bend lines (without the use of special forming dies).
- Hole locations should not be placed too close to a bend line because bending tends to pull the hole out-of-round. The only way to overcome the problem is to drill rather than pierce the hole, and drilling adds to cost.
- Hole diameters less than the thickness of the material should be avoided where possible, since these holes must be drilled and are, therefore, more costly.

Locating Sockets

A simple example will demonstrate how costs are reduced by simple socket and hole locations. Consider, for example, a circuit layout calling for three tubes and four capacitor cans, and the physical location of these elements can be varied slightly without affecting operation of the circuit. In this case production costs of the chassis can be cut by (a) making hole locations symmetrical about the center line and on common centers, and (b) making the three tube sockets the same size and the four can sockets the same size. This gives the fabricator a "repetitive set-up" in his press. It means that only one, or at the most, two dies are used to stamp out the circuit. His press operation is simpler, faster, and cheaper.

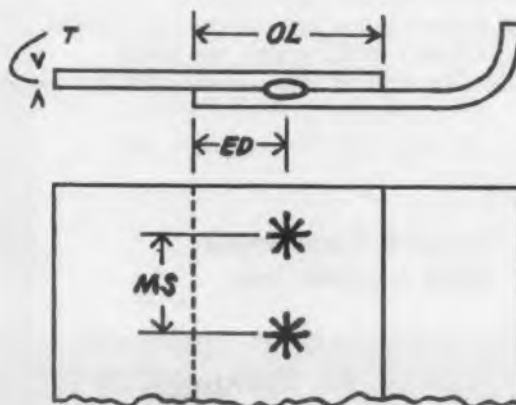
Standardize hole sizes whenever possible. Determine the most commonly used hole size, then examine the rest to see if they, too, cannot be of the same size.

Welding Specifications

In specifying for welding of sheet metal fabrications, electronic designers err on the side of over-specification. In designing a chassis, for example, engineers frequently call for welded and ground

Table 1. Specifications for spot welding (all dimensions in inches).

T thickness of stock	OL overlap	MS minimum space between spots	ED distance from center of spot to edge of flange
0.021	1/2	1/2	1/4
0.031	1/2	1/2	1/4
0.040	1/2	3/4	1/2
0.050	9/16	7/8	9/32
0.062	5/8	1	5/16
0.078	11/16	1-1/4	11/32
0.094	3/4	1-1/2	3/8
0.109	13/16	1-5/8	13/32
0.125	7/8	1-3/4	7/16



corners when simple lapped and spot-welded corners would suffice. Seam welding of a chassis is usually necessary only where shock and vibration are factors. Where these factors are not present, specifying welded seams only adds to cost unnecessarily. For sound design, it is wise to avoid choosing any welding process until the end use of the chassis has been carefully taken into account.

The same over-specification is found in designating separate ground lugs which are then welded to the chassis. Stock dies can be used to turn up a lug out of the chassis without need for welding. Another factor often encountered is a traditional resistance to spot welding aluminum. Early problems in this method have created an historical distrust of spot welding aluminum which lingers on even though the problems have since been worked out. The Air Force

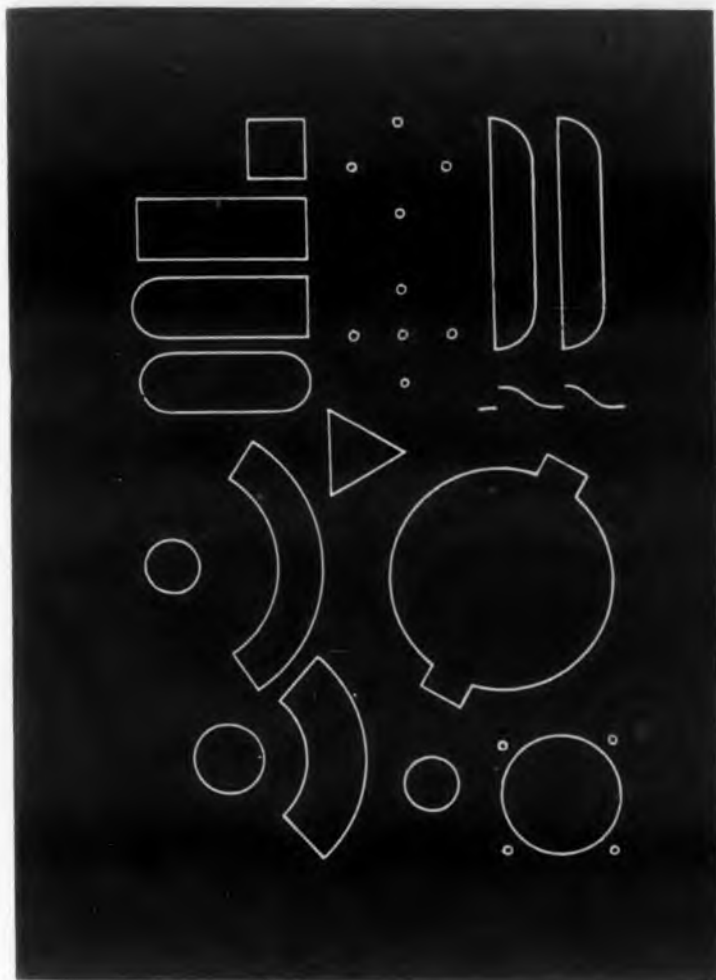


Fig. 1. These are a few of the many shapes, multiple holes and ground lugs that can be punched with stock dies.

and Navy accept spot welded aluminum fabrications because they know that a reliable fabricator working with the proper equipment can turn out spot welded aluminum fabrications that are satisfactory in every respect. Spot welding is a fast, clean, low-cost method of joining materials and is, in many cases, preferable to riveted construction or seam welding.

To specify for spot welding, however, the designer should know some of the fundamentals of spot welding. Maintaining proper space between spots is ex-

tremely important because of the shunted current effect between spots. If minimum distance is not maintained, costly special precautions have to be taken and inferior welds result. Care should also be taken with regard to flange joints. Table 1 gives the proper amount of overlap and distance from spot center to flange edge for the standard gages.

Finishing

The variety of problems encountered in finishing is infinite, and generalizations about finishing can be misleading if applied to specific problems. However, you can be sure that when you add several colors, insist on an exceptionally high gloss finish, or specify a finish that will be serviceable under the most adverse conditions, you add to the cost.

In approaching a specific problem in finishing, the first question a designer should ask himself is: do I need a finish? Many chassis do not. Most enclosures do. If you need a finish, determine the type of finish you need by examining the end use of your product and consulting with your fabricator. Describe the problem to him as completely as possible, and ask him what would best suit your needs.

The importance of this close counsel can best be illustrated by a brief example. Suppose you have designed an enclosure for non-military electronic gear. You feel that metal luster enamel would make an attractive and serviceable finish and specify it for the outside, and—to keep the cost down—you specify a lower cost finish for the inside. The finisher complies with your instructions. However, close consultation with him might have revealed that the production problems raised by specifying two finishes make the end cost higher than it would have been had you specified metal luster enamel inside and out.

Double Handling

Another factor which has a real though indirect influence on the cost of finishing is "double handling": where the enclosure is fabricated by one firm and finished by another. This procedure involves shipping the raw enclosure to you, whereupon you then send it out for finishing. At best the raw enclosure is shipped from fabricator to finisher and then to you. Either way, costs of "double handling" are added to the total cost of enclosure. The solution is to seek out a sheet metal fabricator who can give you "one-stop" service.

The surest way for a designer to save himself time, worry and money in the design of a sheet metal fabrication is to use the specialized talents of his sheet metal fabricator to the fullest extent. Most fabricators maintain engineering departments which are staffed with competent specialists. These men are continually facing problems which may seem alien to the designer. By bringing these sheet metal specialists in at "idea" stage, they can often show you how to cut costs throughout and also increase the functional effectiveness of your chassis or enclosure.

Bending Aluminum and Aluminum Alloy Sheets

When forming, always avoid narrow flanges. A wider flange gives a stronger, cleaner, better joint. A good rule of thumb for determining the minimum length of flange desirable is $F = 4 \times T$, (where $T =$ thickness of stock, and $F =$ flange.)

In forming aluminum, the bending radius is often a critical problem. Various aluminum alloys react differently to bending and, therefore, the chart below should be consulted whenever you specify.

Alloy and Temper	Bend Classification ¹	Alloy and Temper	Bend Classification ¹
2S-O	A	24S-T36 ² (24S-RT)*	K
2S-H12 (2S-1/4H)*	B	52S-O	B
2S-H14 (2S-1/2H)*	B	52S-H32 (52S-1/4)*	C
2S-H16 (2S-3/4H)*	D	52S-H34 (52S-1/2)*	D
2S-H18 (2S-H)*	F	52S-H36 (52S-3/4)*	F
3S-O	A	52S-H38 (52S-H)*	G
3S-H12 (3S-1/4H)*	B	61S-O	B
3S-H14 (3S-1/2H)*	C	61S-T4 (61S-W)*	E
3S-H16 (3S-3/4)*	E	61S-T6 (61S-T)*	F
3S-H18 (3S-H)*	G	75S-O	D
24S-O ³	B	75S-T6 ³ (75S-T)*	K
24S-T3 ³ (24S-T)*	J		

* Former temper designations are given in parentheses for information.

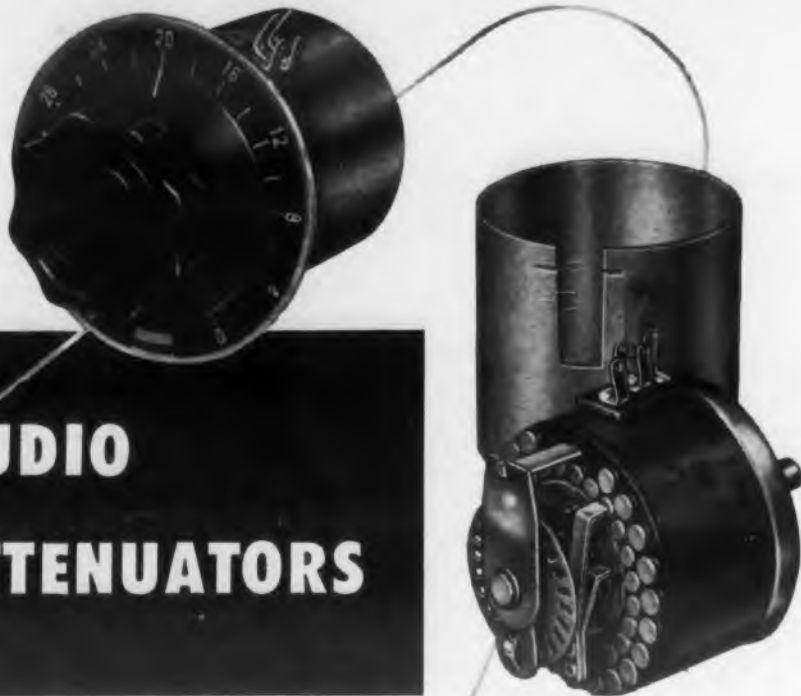
¹ For corresponding bend radii see table below.

² Alclad sheet can be bent over slightly smaller radii than the corresponding tempers of the uncoated alloy.

³ Immediately after quenching, this alloy can be formed over appreciably smaller radii.

Radii required for 90 degree bend in terms of thickness, t

Bend Classification	Approximate Thickness, in inches					
	0.016 1/64	0.032 1/32	0.064 1/16	0.128 1/8	0.182 3/16	0.250 1/4
A	0	0	0	0	0	0
B	0	0	0	0	0-1†	0-1†
C	0	0	0	0-1†	0-1†	0.5†-1.5†
D	0	0	0-1†	0.5†-1.5†	1†-2†	1.5†-3†
E	0-1†	0-1†	0.5†-1.5†	1†-2†	1.5-3†	2†-4†
F	0-1†	0.5†-1.5†	1†-2†	1.5†-3†	2†-4†	2†-4†
G	0.5†-1.5†	1†-2†	1.5-3†	2†-4†	3†-5†	4†-6†
H	1†-2†	1.5†-3†	2†-4†	3†-5†	4†-6†	4†-6†
J	1.5†-3†	2†-4†	3†-5†	4†-6†	4†-6†	5†-7†
K	2†-4†	3†-5†	3†-5†	4†-6†	5†-7†	6†-10†



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Do audio attenuator problems cost you money? Chances are Shallcross has a model to match your specifications exactly—and at moderate cost.

Shallcross attenuators are made in over 200 basic types. Each type can be supplied with a choice of attenuation characteristics . . . with a positive detent mechanism . . . and in numerous input and output impedances. Where calibration must be extremely accurate, Shallcross precision wire-wound resistors are used. For less critical applications, models with high grade composition resistors can be supplied—often at lower cost.

A complete description of all Shallcross attenuators — mountings, characteristics, and circuits is yours for the asking in Bulletin L-4A. SHALLCROSS MFG. CO., 526 Pusey Avenue, Collingdale, Penna.

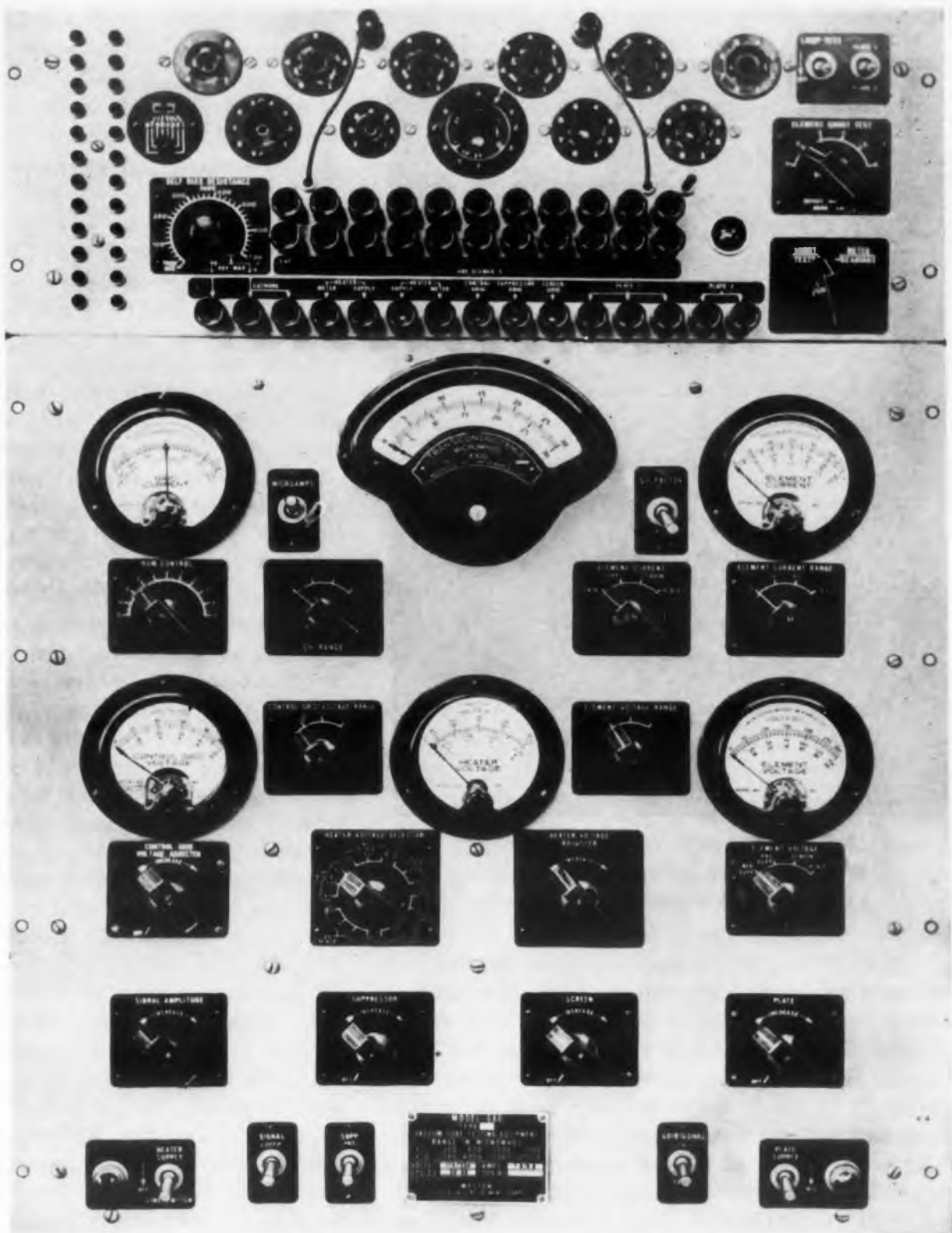
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CIRCLE ED-7 ON READER-SERVICE CARD FOR MORE INFORMATION

True G_m Analyzer

Fig. 1. Front panel of the Weston True G_m Analyzer. The unit weighs 29 lb and is 17-1/2" x 13-1/4" x 6" in size.



TRANSCONDUCTANCE measurements on all triodes, pentodes and beam power tubes under actual operating conditions can be made with the improved Model 686 Type 10A True Mutual Conductance Vacuum Tube Analyzer shown in Fig. 1. This instrument allows the circuit designer to determine the maximum and minimum values of G_m that give proper circuit performance. It also permits the designer to set up realistic preventative maintenance schedules for original equipment.

By means of a new circuit design, transconductance is measured independently of all other tube parameters, thus eliminating the need for an amplification factor corrector switch and a second scale on the G_m meter. The new G_m meter is therefore a single-arc type and more easily read. The use of correction factors or charts is eliminated entirely. The G_m meter and associated circuitry has an accuracy better than 3%. Residual errors in scale distribution are low.

Transconductance ranges have been extended, making available the following combinations of range and grid signal voltages:

Grid Signal (in Volts)	1.0	0.5	0.2	0.1
$G_m \times 1$ (in Micromhos)	300	600	1500	3000
$G_m \times 10$ (in Micromhos)	3000	6000	15000	30000

The $G_m \times 1$ range is especially useful in the measurement of subminiature tubes having low transconductance. Transconductance can be measured on tubes having a plate resistance as low as 250 ohms.

A well-filtered d-c power source is supplied, making it possible to test tubes with d-c potentials which can be accurately adjusted to correspond to actual circuit voltage operating conditions. Plate, screen and suppressor voltage are each separately adjustable and are measured by a 0-60/150/300v, three-range voltmeter with a selector switch. Suppressor voltages to -60v can also be selected by a toggle switch. This negative voltage may be used to bias one half of a dual tube beyond cutoff. Maximum ratings of plate supply are 100ma at 300v and 120ma at 250v. Plate, screen, suppressor and cathode currents are measured by a 0-3/12/60/120ma milliammeter.

The instrument is manufactured by the Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. A new ring shunt in the analyzer's element milliammeter eliminates the effects of switch contact resistance, and a special circuit selector switch limits the voltage drop to a maximum of 75mv. As a result, the accuracy of element voltage meter readings is affected by less than 0.13%. Accuracies for element voltage and current, and grid voltage are 2%.

Adjustable control grid bias is available from a separate regulated supply. Grid current, both plus and minus, can be measured by a 10-0-15, 1500-0-1500 μ amp microammeter. Heater voltages ranging from 0.6-117v can be set with 3% accuracy measured on a 0-2/4/8/20/50/150v voltmeter. **▲ This analyzer will be on display at Booths 533 and 535 at the Radio Engineering Show.**

ELECTRONIC DESIGN • March 1954



HERMETICALLY SEALED Germanium Diodes



JAN TYPES

- A. Ceramic Case
- B. Solder
- C. Germanium Pellet
- D. Weld
- E. Platinum-Rhuthenium Whisker
- F. Weld
- G. Solder
- H. Nickel Pin
- I. Weld
- J. Leaded Copper Clad Wire

COMPLETE METAL TO CERAMIC SEAL. Gas-tight ceramic cases with metalized ends permit solder seal to nickel pins.

MOISTURE PROOF. These new diodes exceed the requirements of JAN humidity specifications.

REQUIRED ELECTRICAL PROPERTIES. More than two years of development were necessary to perfect this combination of hermetic seal and superior performance.

MECHANICAL STABILITY. Platinum-rhuthenium whisker is welded to the germanium pellet.

LONG-LIFE. The elimination of moisture effects adds years to the life of your equipment!



Production quantities of hermetically sealed types 1N69, 1N70, and 1N81 are now available. Hermetically sealed commercial types are expected to be ready in a few months. Be sure to include them in your design planning now! For complete information write: *General Electric Company, Section X7434, Electronics Park, Syracuse, New York.*

DON'T MISS THE G-E EXHIBIT!
See Germanium Products In Action
I. R. E. Show . . . Booths 192-194

GENERAL ELECTRIC

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MAXIMUM RATINGS (At 25°C)

Hermetically Sealed DIODES	1N69	1N70	1N81*
Peak Inverse Voltage	75	125	50
Continuous Operating Inverse Voltage	60	100	40
Min. Forward Current (MA) at +1V	5.0	3.0	3.0
Max. Inv. Current (MA)			
At -50V	850	300	—
At -10V	50	25	10
AV Rectified Current (MA)	40	30	30
Peak Rectified Current (MA)	125	90	90
Surge Current (MA)	400	350	350

*JAN approval applied for

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● A four-terminal junction transistor has been developed having a region of negative output impedance. This switching device is unique in that two coincident trigger signals are required to turn it on. Thus two gating functions may be accomplished by a single transistor.

Compact Computer Design

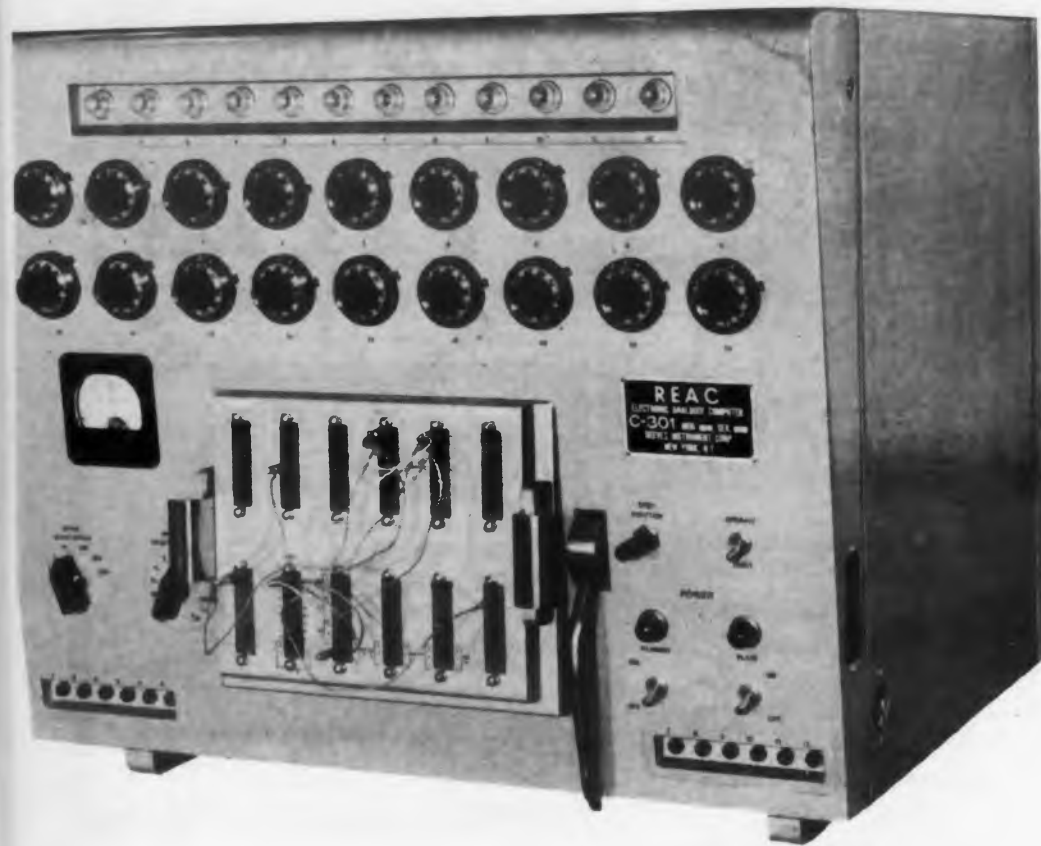
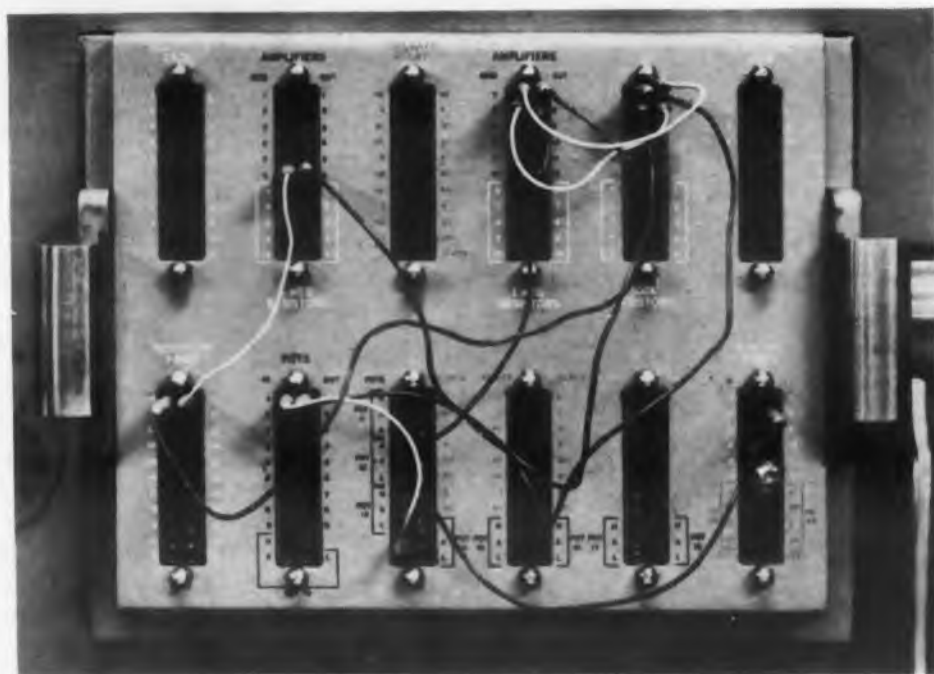


Fig. 1 (left). The Reeves Desk-top Computer. The front panel is tilted forward for ease of operation. All adjusting controls are at eye level. At the top of the panel are 12 overload indication lamps, one per amplifier, and 18 10-turn potentiometers. Below the potentiometers is the patchbay, where the removable problem board is held in place by the locking lever at the right. At the bottom are 12 connections for external equipment. Notice how the cabinet is raised for better cooling.

Fig. 2 (below). The computing amplifiers can be connected to the potentiometers, precision resistors and capacitors, and diodes through this patchboard.



FUNCTIONAL versatility, small size, attractive appearance and ease of maintenance were the design goals set when the new Reeves Desk-top Computer was planned. How well these goals have been achieved is evident from the illustrations shown on these pages. Norman Zatsky, Chief Mechanical Engineer of the manufacturer, Reeves Instrument Corporation, 215 East 91st St., New York 28, N. Y., is responsible for the neat mechanical design of the computer.

Only 20" x 25" x 20" in size, the 150 lb unit does the same job as conventional equipment that occupies



Fig. 3 (above and right). Two views of the front panel swung down showing how easily all components can be reached. All complex wiring is done on the rear of this panel and flexible cables are provided for the amplifiers and supply. The unit requires no internal cabinet wiring. Notice the open grid floor for cooling.

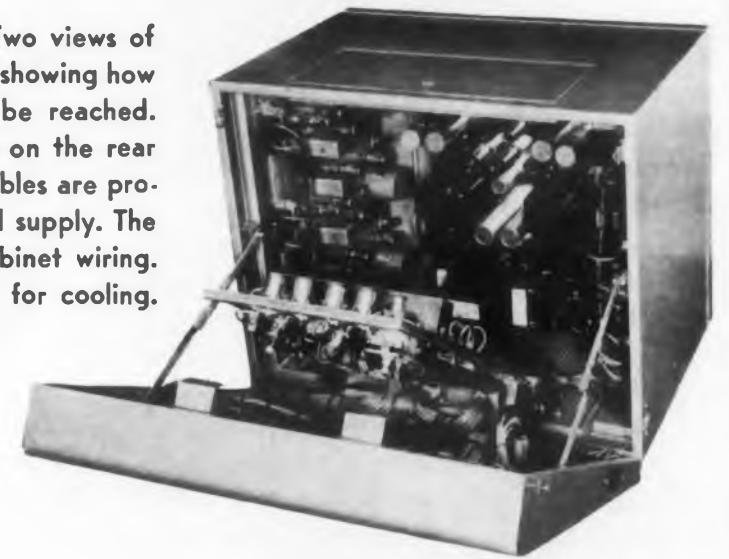


Fig. 4. With the rear panel open, the amplifier balance adjustment knobs are accessible. The power supply is swung down into servicing position by loosening only two screws.



a seven-foot cabinet two feet wide. Featuring exceptional stability, the computers can solve differential equations or simulate physical systems with a component accuracy of 0.1%.

For maximum use and flexibility, problems can be set up on one removable patchboard, shown in Fig. 2, while the computer is solving another problem, using a second board.

Made in two models, the computers are entirely self-contained. Auxiliary equipment can be wired into the problems and the device can be connected with other computers. With an auxiliary kit, repetitive solutions can be displayed on an oscilloscope.

Each model contains 12 individually chopper-stabilized computing amplifiers, which have extremely low noise, drift of less than 0.25mv per day, d-c gains of more than 15,000,000, flat frequency response and full load output over a range from $-100v$ to $+100v$. The 12 amplifiers are mounted on six chassis, each having two channels, which permits sharing of dual tubes and one vibrator between the two auxiliary balancing amplifiers. The circuit is insensitive to changes in chopper duty cycle, thereby reducing operation time and maintenance.

The amplifiers are made with printed-and-etched wiring on ethoxyline-impregnated glass fiber sheets mounted on metal frames. All resistors and capacitors are soldered for reliability and ease of maintenance. Thyrite varistors protect the choppers.

For greater amplifier output, the specified 12AV7 output tube in more than half the amplifiers can be replaced with a 5687 by using a tube adapter. If still greater power output is needed, an amplifier of different design using a 5687 tube in the output stage can be supplied. This modified amplifier is interchangeable with the original amplifiers.

Space-saving was accomplished in the regulated power supply by the use of junction germanium rectifiers. The circuit in Fig. 6 shows how voltages at six levels are obtained from two transformers. Regulator amplifiers for the power supply are constructed on sub-assembly printed circuits for compactness, as shown in Fig. 5. The power supply can also feed external equipment through a connector in the enclosure. **▲The REAC Series 300 Desk-top Computers will be demonstrated at Booths 341-347 at the Radio Engineering Show.**

Fig. 5. Rear panel open. The supply is in operating position showing its component board construction. One amplifier chassis is half removed with the detachable servicing handle. Its physical installation and electrical connection is performed simultaneously.

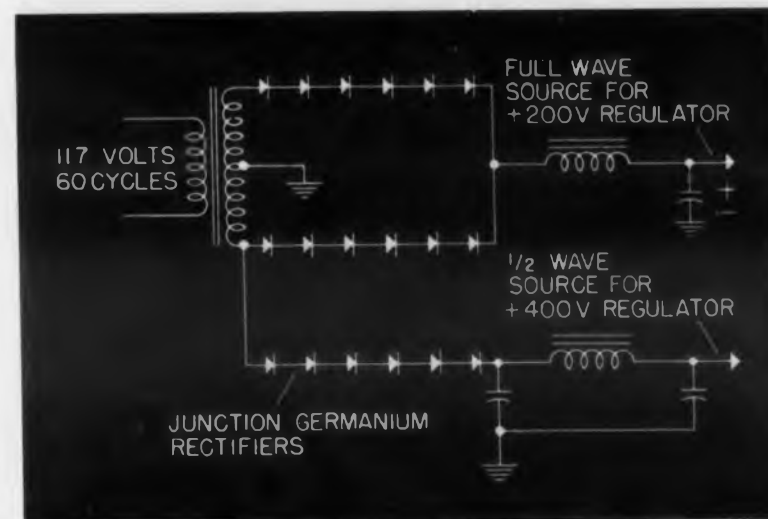
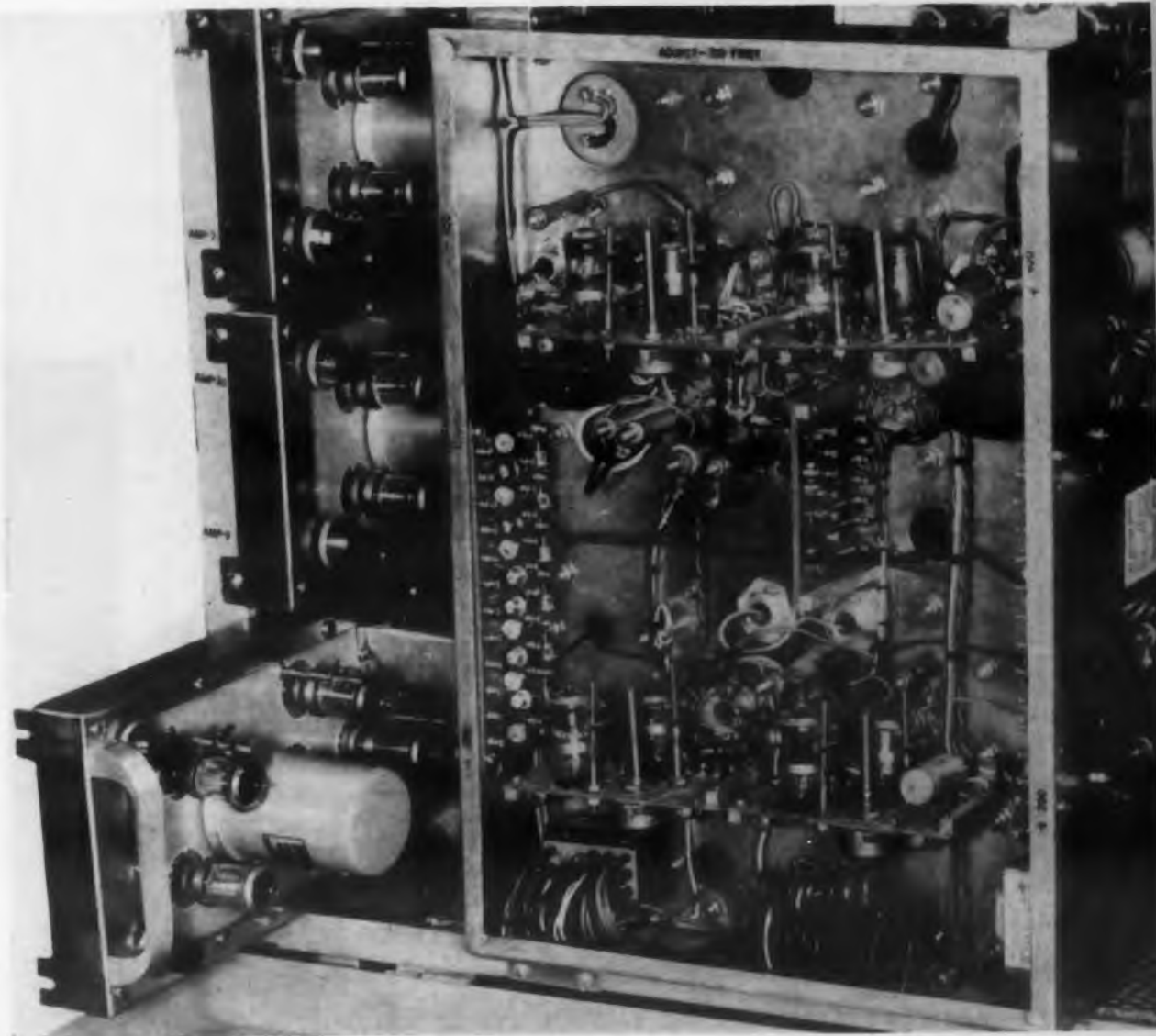


Fig. 6 (right). Power supply circuit for positive voltages. The required $+100v$ is obtained through dropping resistors. The negative circuit is similar. The six voltages are then fed to regulator circuits.

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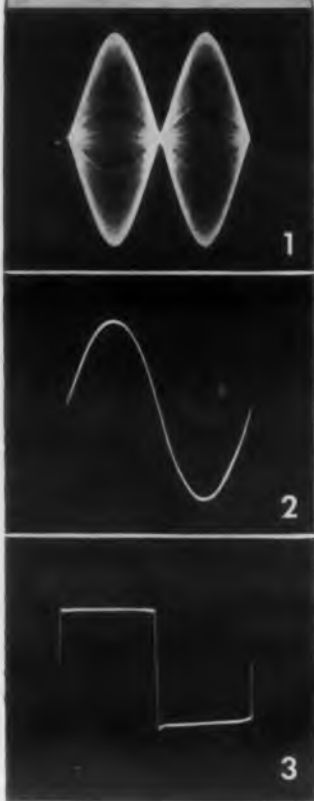
Only the **SERVOSCOPE** has all these features:

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- Dynamic frequency control range of 200 to 1.

Write Dept. ED-3

Booths 203 and 300 Production Road, IRE Show,
Kingsbridge Armory, Bronx,
March 22 through March 25.

SERVO
CORPORATION OF AMERICA
New Hyde Park, New York



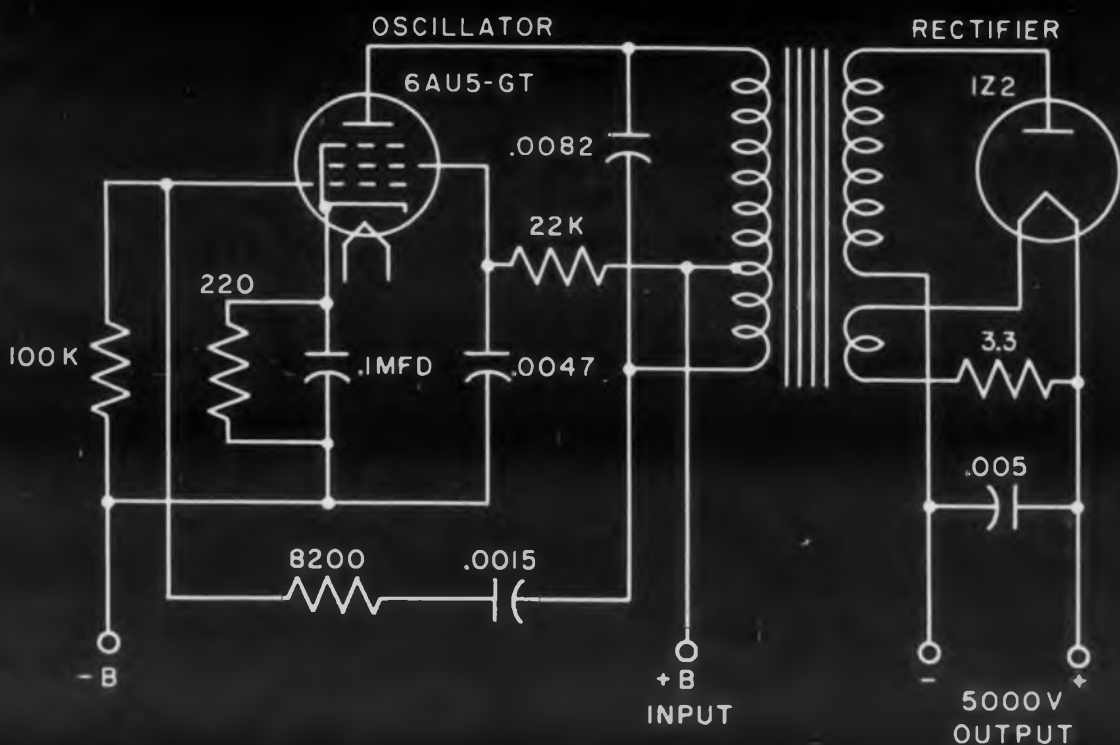
Output wave forms of Servoscope displayed against internal linear sweep generator, frequency $\frac{1}{2}$ cycle.

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

Compact High Voltage Power Supply



Fig. 1 (below). Circuit of the power supply shown above.



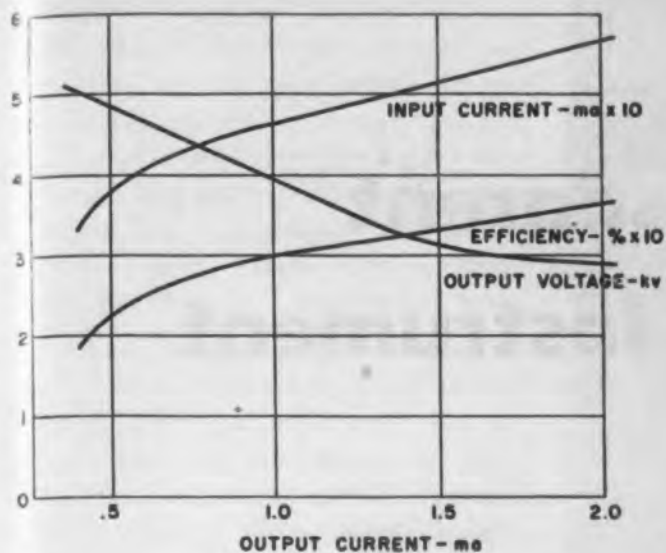


Fig. 2. Characteristics of the supply with a regulated input of +275v.

EXCELLENT regulation under adverse line conditions is a feature of the Model 503 high voltage power supply. Producing 5000v d-c, this compact unit weighs only 2 lb and measures 5-1/2" x 4" x 2-5/8".

Suitable for the anode potentials of cathode-ray tubes and other high voltage needs, the power supply is manufactured by the Servo Corporation of America, 20-20 Jericho Turnpike, New Hyde Park, N. Y.

Fig. 1 shows the circuit diagram of the supply. Steady output voltages for wide line fluctuations are obtained by feeding the oscillator from a regulated input potential. Such regulated potentials are available in the B+ supply in many types of electronic equipment, and the low input power requirements of this power supply afford improved overall performance at a small added cost. This input is 275v.

For 5000v d-c, the output current is 300 μ amp. Higher current at lower voltage can be obtained by varying the potential on the screen grid of the oscillator tube. Fig. 2 shows the characteristics of the unit. Both terminals of the output are free from internal d-c ground and, therefore, either terminal may be grounded or operated at some intermediate d-c potential with respect to ground.

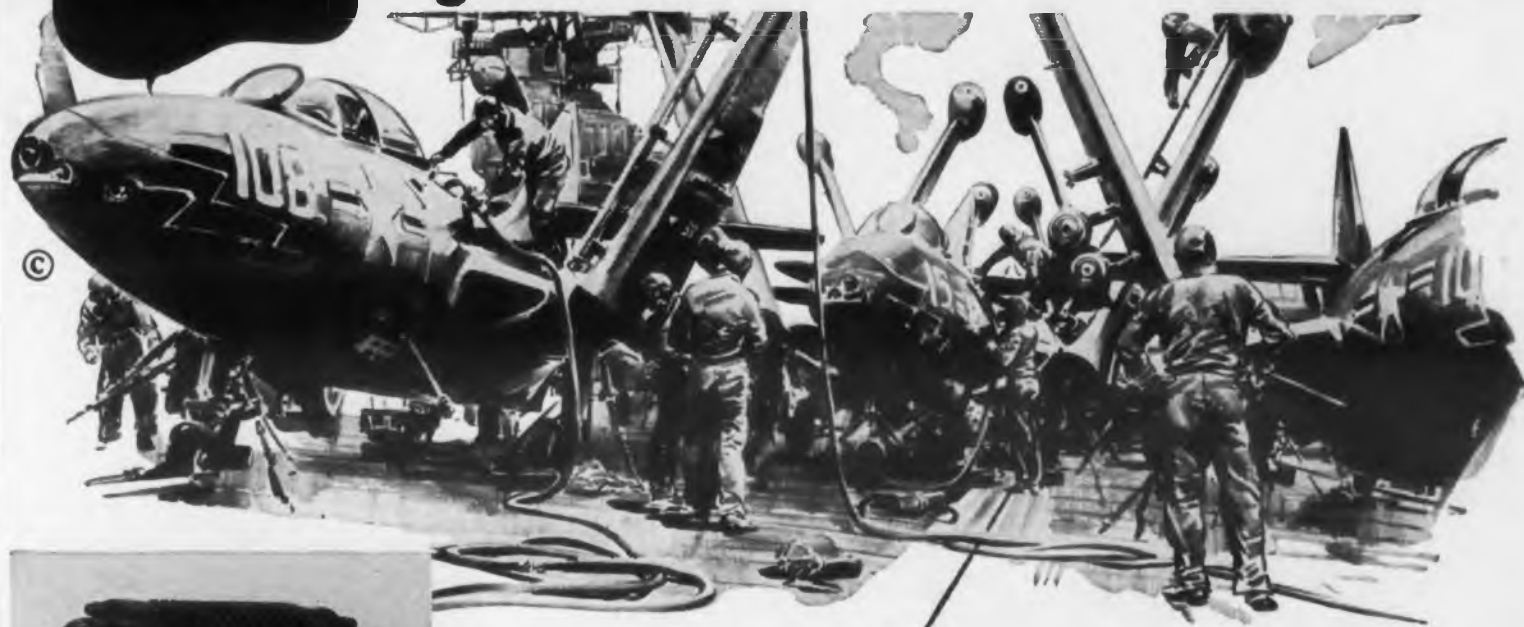
The oscillator operates at 30kc, which is well outside the audio frequency range, and is low in the r-f spectrum to avoid excessive radiation and interference with adjacent circuits. The transformer is hermetically sealed in an epoxy resin casting with excellent insulating qualities.

Additional holes are provided in the base plate for mounting suitable high-voltage and low-voltage pull-apart connectors for the input and output terminals. **▲ This unit will be on display at the Radio Engineering Show at Booths 203 and 300.**

ELECTRONIC DESIGN • March 1954

**DOW CORNING
SILICONES**

give motors more muscles



RELIANCE 20 hp (class H) Motor 330 Pounds Lighter than Conventional Design

For maximum safety, carrier planes are fueled and defueled immediately before take-off or after landing. Several fast reversible pumps are used, any of which can fill or empty a plane's tanks within minutes. The pumps and their motors are big and heavy, however. So much so that the Navy challenged manufacturers to produce new motors which would combine top dependability and absolute minimum weight.

The Reliance Electric & Engineering Company attacked the problem both inside and out. They made the entire TENV frame and the mounting brackets of aluminum, ribbed for maximum heat dissipation. On the inside, silicone (Class H) insulation raises the power-per-pound ratio by over 50%, and also provides extra resistance to

weathering and salt spray. As a result, the finished motors are among the smallest and lightest ever made in their class. The 20 hp unit, for example, weighs some 330 pounds less than the conventional 20 hp motor. Already they have been specified for the new super carriers Forrestal and Saratoga.

That's typical of the "design-ability" of Class H insulation made with Dow Corning silicones. Adaptable to any electrical equipment and costing only slightly more than the next best class of insulation, it can be used to increase the power-per-pound ratio or to extend the life of electrical machinery over ten times. For better performance, lower maintenance costs, and greater sales appeal, alert design and management men specify Class H insulation made with Dow Corning silicones



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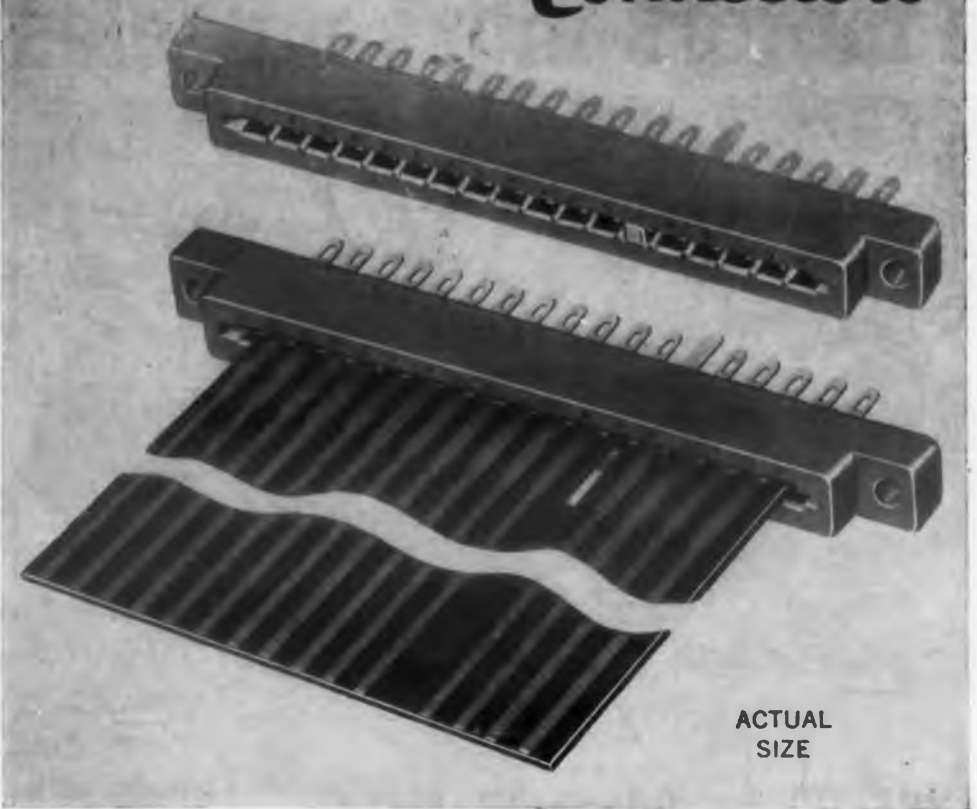
Dow Corning Corporation, Dept. DA-15, Midland, Michigan
Please send me

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 List of Class H Motor and Class H Transformer Manufacturers
 "Tall Tales and Fabulous Facts" about silicone products

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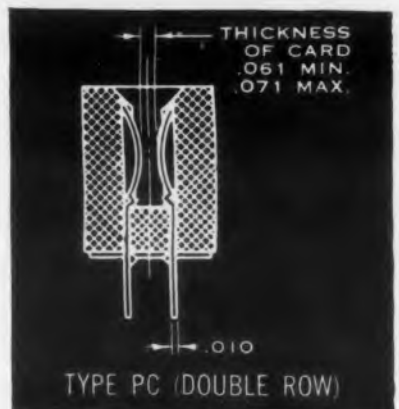
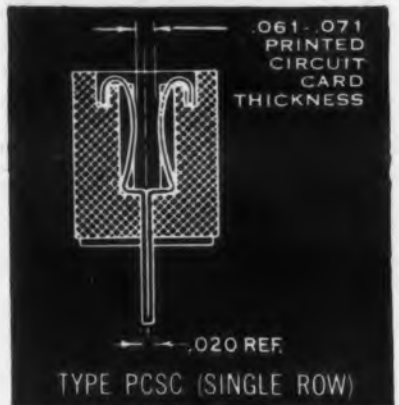
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Connectors**



PRINTED CIRCUIT CONNECTORS

Series P-C • 15, 18 and 22 contacts
in single or double rows

Answers the need for a positive, space-saving connection between printed circuitry and conventional wiring. Permits direct connection to a printed circuit "plug" mounted sub-assembly. (See line drawings) By specifying 22 contacts in a double row connector and using both sides of printed circuit card you have provision for up to 44 individual connections for #16 AWG wire. (Precision phosphor bronze pressure contacts assure a voltage drop of only 20 millivolts maximum at rated currents.) Can be custom-built to suit any card thickness. Available in three insulating materials; Mineral filled Melamine, Plaskon Reinforced (glass) Alkyd type 440-A, and Diallyl Phthalate (blue). For complete details write for Engineering bulletin, Series P-C



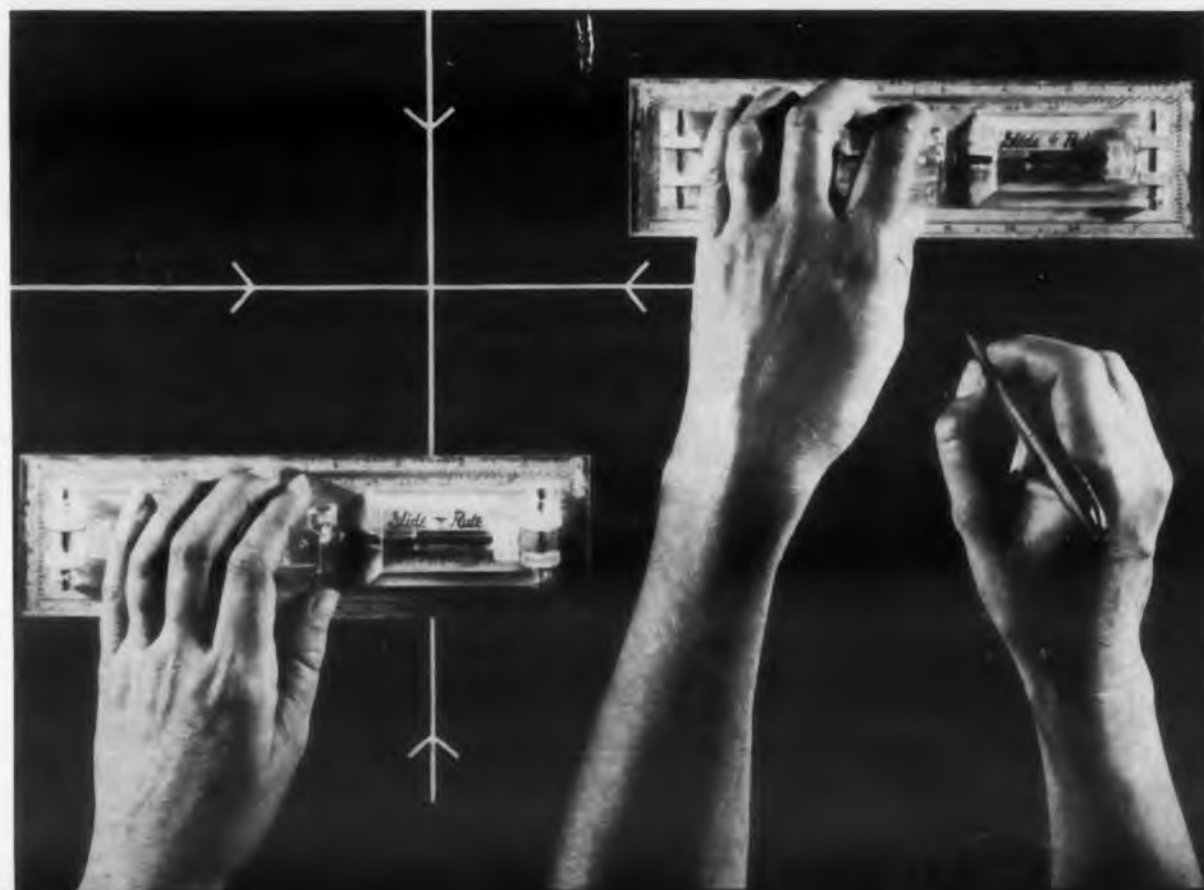
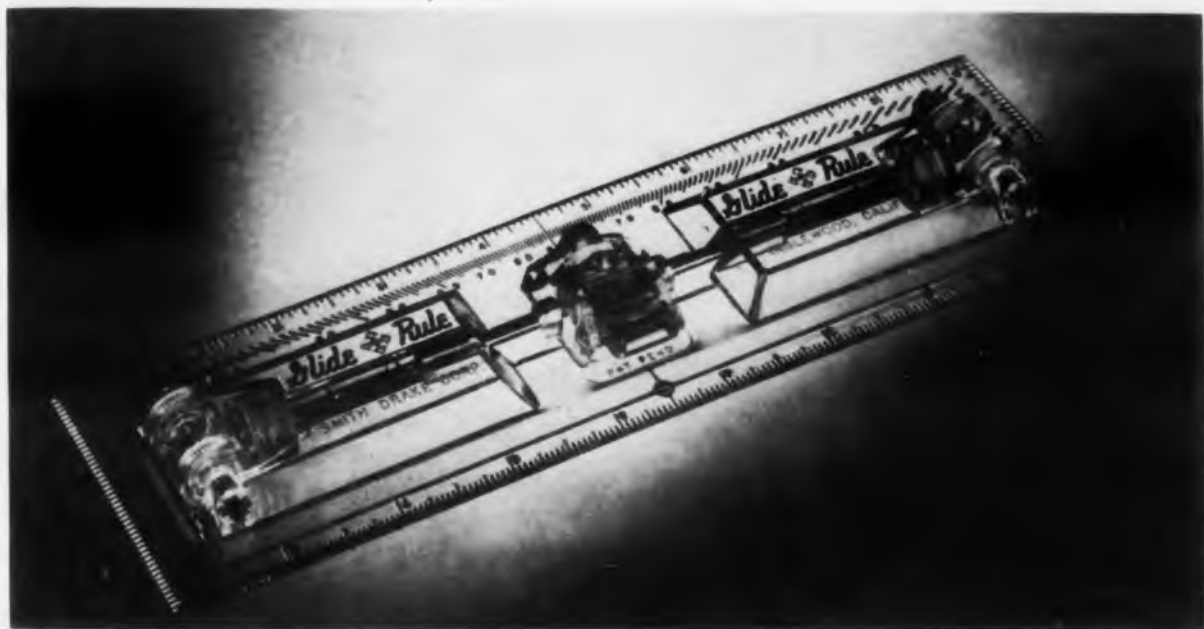
ELECTRONIC SALES DIVISION

DeJUR-AMSCO CORPORATION

Write Dept. EDPC-3, DeJUR-Amsco Corporation, 45-01 Northern Blvd., Long Island City 1, N. Y.
See the DeJUR line at Booth 200, "Production Road," Radio Engineering Show, Mar. 22-25
CIRCLE ED-11 ON READER-SERVICE CARD FOR MORE INFORMATION

Transparent Drawing Instrument

Fig. 1. This transparent drawing instrument can be used as a triangle, T-square, straight edge, scale, and a protractor. In use, it is free to move up and down or sideways as shown below.



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THE drawing functions of a triangle, T-square, straight edge, scale, and a protractor all can be performed by the transparent drawing instrument known as the "Glide-Rule" shown in Fig. 1. Designed for precision drawing in the field or at the desk, the "Glide-Rule" is a product of Smith Drake Corp., 1206 South La Brea Ave., Inglewood, Cal.

Unique feature of the device is that it is mounted on knurled wheels in such a manner that it is free to move either up and down or sideways. The direction of free movement is changed by pressing a small thumb button, permitting the Glide-Rule to be rolled quickly to the desired position. Because it is supported by its wheels above the drawing surface, the unit is smudgeproof, even on inked drawings.

Once orientated at any angle, the instrument can be moved parallel to itself sideways or up and down. In this manner it can be used to draw parallel lines or to transfer angles from one part of a drawing to another. The scales at the end edges permit drawing equally spaced parallel lines, and because the unit is transparent it can be quickly and accurately placed where needed on the drawing.

The instrument, made of stress relieved injection molded transparent polystyrene, has accurate hot stamped scales on its four drawing edges, two graduated in sixteenths and the other two in twentieths of an inch. On one of the long sides is a protractor scale providing a full 180° range with emphasized 30°, 45°, and 60° angles.

Completely self-contained, the instrument requires no attachments. It measures 2-1/2" x 9" overall and is small enough to be conveniently carried in the pocket in its protective carrying box.

The lower portion of Fig. 1 illustrates how the instrument is used. Because it is versatile and accurate, the Glide-Rule can be applied quickly to a wide variety of drawing applications for electronic designers, especially because its use can be mastered with a minimum of practice.

CIRCLE ED-12 ON READER-SERVICE CARD ►

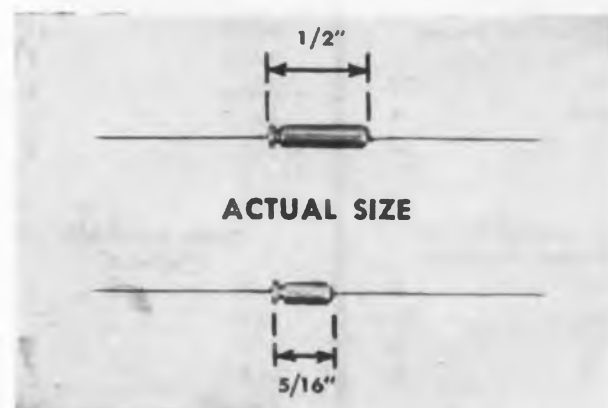


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THIS 8-MICROFARAD, 4-VOLT UNIT IS NOW AVAILABLE WITH -0% TO +100% CAPACITANCE TOLERANCE.

Announcing HIGHER RATINGS for Micro-miniature Tantalum Capacitors



LARGE CAPACITANCE and small size make Micro-miniature Tantalum capacitors valuable where space is at a premium. Diameters are .125 inches.

We can now supply up to 20 volts, or, up to 8 microfarads in the $\frac{3}{16}$ " case size, higher capacitance in the $\frac{1}{2}$ " case size . . . and with -0% to +100% capacitance tolerance!

**SEE THESE CAPACITORS
IN OUR BOOTH AT THE
NEW YORK IRE SHOW.**

Higher ratings are now available in General Electric's new *Micro-miniature* Tantalum capacitor line. Eight microfarads at four volts can now be obtained in the $\frac{3}{16}$ inch unit, higher capacitance in the $\frac{1}{2}$ inch unit. Designed for low-voltage d-c circuits, they are particularly adaptable to transistorized subminiature assemblies, where space is at a premium, such as hearing aids.

SUPERIOR PERFORMANCE. *Micro-miniature* Tantalum capacitors outperform aluminum electrolytics in electrical stability, operating and shelf life, because of the inert characteristics of tantalum metal and the stability of its oxide. They gain added reliability from the use of silver cases, a non-acid electrolyte, and complete sealing that prevents leaking and contamination of the interior.

WIDE TEMPERATURE RANGE. *Micro-miniature* Tantalum capacitors can operate over a -20 C to +50 C range—may be stored at -65 C. With some capacitance derating, they can operate well below -20 C. They also perform above +50 C with some life limitations.

AVAILABILITY. Designed especially for non-resonant, non-critical applications such as coupling, by-pass and filtering, *Micro-miniature* Tantalum capacitors can be obtained in sample lots in 2 to 3 weeks, production lots can be shipped in 6 to 8 weeks. For more information, see your G-E Apparatus Sales Representative or write for bulletin GEA-6065 to General Electric Company, Section 8 442-14, Schenectady 5, New York.

Progress is our most important product

GENERAL  ELECTRIC

Table 2. Comparison of tube use in "typical" 1954 and 1953 TV receivers.

	1954	1953
RF Amplifier (VHF)	6BZ7	6BK7
Oscillator Converter (VHF)	6J6	6J6
Video I-F Amplifier	6CB6 (3)	6CB6 (3)
Video Detector	Crystal	6AL5
Video Output Amplifier	12BY7	12AT7 (or 6CB6)
Sync Amplifier, Clipper, Separator	12AU7	12AU7
Vertical Sweep Oscillator	6SN7	6SN7
Vertical Sweep Output Amplifier	6S4	6S4
Horizontal AFC Discriminator or Phase Detector	6AL5	6AL5
Horizontal Sweep Oscillator	6SN7	6SN7
Horizontal Sweep Output Amplifier	6BQ6	6BQ6
Horizontal Sweep Damper	6AX4	6W4
High Voltage Rectifier	1B3	1B3
Low Voltage Rectifier	5U4	5U4
Audio I-F Amplifier Limiter	6AU6	6AU6
Audio Detector	6AL5	6AL5
Audio Amplifier (Voltage)	6AV6	6AV6
Audio Amplifier (Power)	6V6 (or 6W6)	6V6 (or 6W6)
Misc. (AGC, etc.)	Designer's Choice	Designer's Choice

different totals of small tubes appeared in sets surveyed. This does not include picture tubes, although rectifier tubes are included.

Number of Tubes	Number of Sets
17	1
18	1
19	5
20	3
21	8
22	2
24	1
25	3
26	1
28	1

The "typical" 1954 receiver would seem to have 21 tubes, not including the picture tube. A list of the tubes and their particular application in this "typical" 1954 receiver is shown in Table 2. A list of the tubes in a "typical" 1953 receiver is also included for comparison. It is interesting to note that changes in tube use appear in only four applications.

The manufacturers whose receivers were studied for this survey are listed below:

Admiral	Motorola
Arvin	Phileo
CBS-Columbia	RCA
Crosley	Raytheon
Du Mont	Sentinel
Emerson	Stewart Warner
Fada	Stromberg Carlson
General Electric	Sylvania
Hallierafter	True Tone
Hoffman	Westinghouse
Magnavox	Zenith

The receivers chosen for study are representative enough to give an accurate survey of tube use.



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These rugged, compact transformers have been designed in close cooperation with organizations directly concerned with the development of standards for aircraft communication, guided missile and related equipment. They are engineered to meet future, as well as current requirements for 400 cycle power supplies.

POWER TRANSFORMERS (All primaries 105/115/125 V., 380-1000 cycles)

HIGH VOLTAGE A.C. Volts	SECONDARY D.C. Ma.	RECTIFIER Volts	FILAMENT Amps.	OTHER FILAMENTS Volts	Amps.	CATALOG NUMBER
270-0-270	55	5.0	2	6.3 CT	2	4PHC-55
335-0-335	70	5.0	2	6.3 CT	3	4PHC-70
375-0-375	120	5.0	3	6.3 CT	4	4PHC-120
440-0-440	165	5.0	3	6.3	7.5	4PHC-165
				6.3	3	
				6.3	3	
				6.3	0.6	
450-0-450	200	5.0	2	6.3	4	4PHC-200A
				6.3	4	
				6.3	0.6	
550-370-75-0- 75-370-550	300	5.0	6	6.3 CT	5	4PHR-300
				6.3 CT	1	

FILTER REACTORS

INDUCTANCE (henries)	MAXIMUM D.C. Ma.	D.C. RESISTANCE (ohms)	INSULATION VOLTS RMS	CATALOG NUMBER
2.0	55	160	2,500	4RH-255
2.0	70	240	2,500	4RH-270
2.0	120	105	2,500	4RH-2120
2.0	165	80	2,500	4RH-2165
2.0	200	77	2,500	4RH-2200
2.0	300	49	2,500	4RH-2300

FILAMENT TRANSFORMERS (All primaries 105/115/125 V., 380-1000 cycles)

SEC. VOLTS	SEC. AMPS.	INSULATION VOLTS RMS	CATALOG NUMBER
6.3 CT	3	2,500	4FH-63
6.3 CT	5.5	2,500	4FH-65
6.3 CT	10	2,500	4FH-610
6.3 CT	20	2,500	4FH-620

Write for Chicago Bulletin #32 listing more complete specifications on these units, specially designed for 400 cycle, high-temperature operation.



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

Picture Tube for Color TV

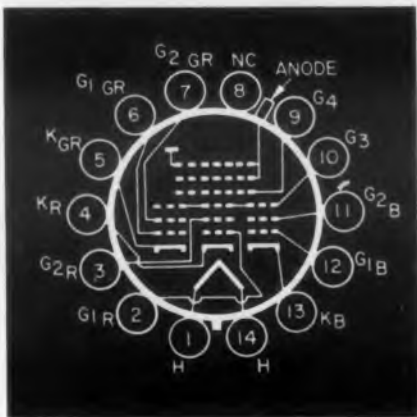
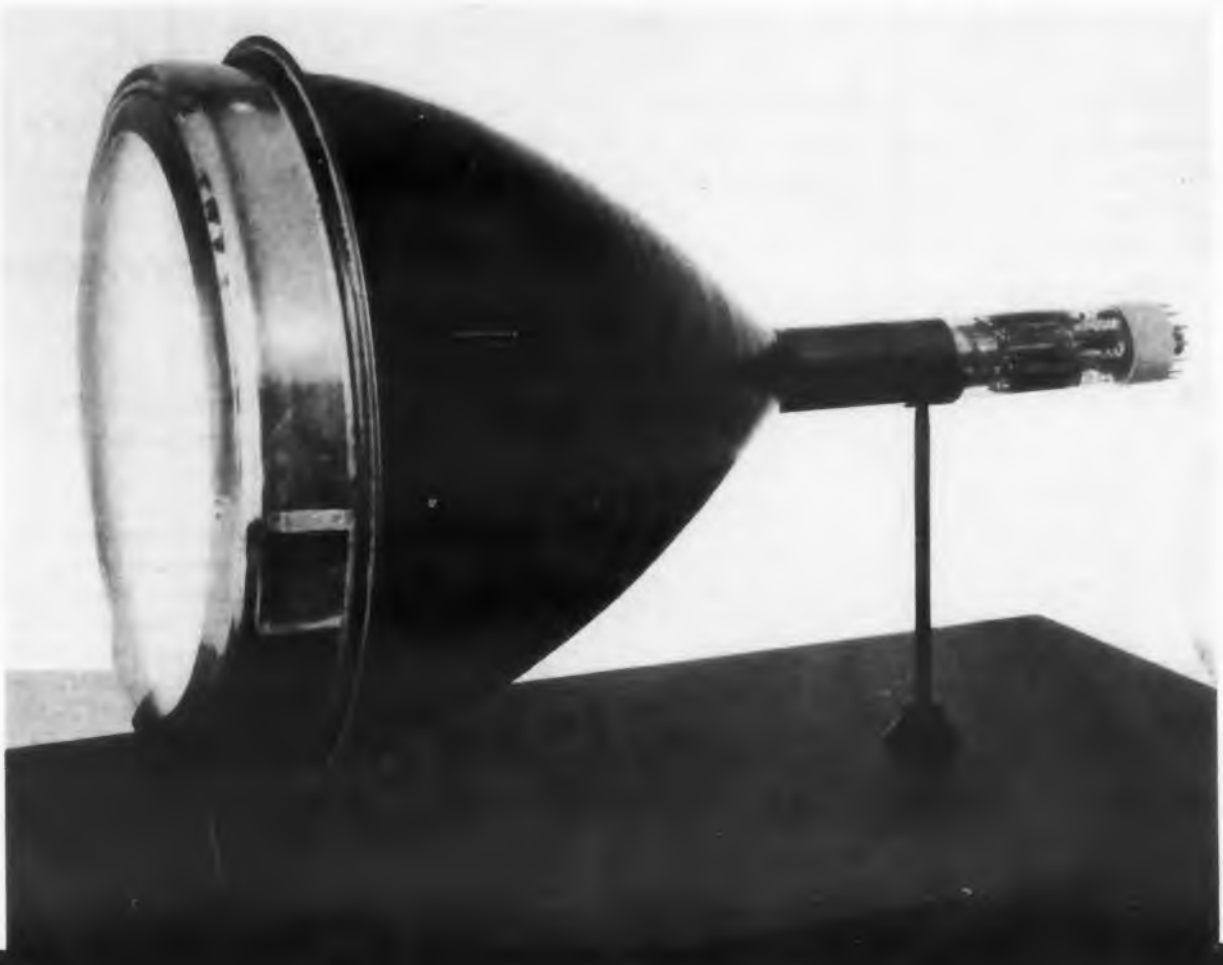


Fig. 1 (above). Basing diagram for the CBS-Colortron.

Fig. 2 (below). The CBS-Colortron. Weight: 18-1/2 lb. Length: 26-1/2". Maximum diameter: 15-3/4".

DESIGN information is now available for the recently announced CBS "Colortron," an aluminized, direct-view, tri-color TV picture tube. Electromagnetically deflected and electrostatically focused, the tube has a deflection angle of 45° , and provides either color or black-and-white images on a screen area of 104 square inches. The tube is designated as Type 11D-187. Its basing diagram appears in Fig. 1.

Typical operating conditions call for an anode voltage of 20,000v, a convergence voltage of 9300v, and a focusing voltage of 3100v. To maintain regulation of the anode and convergence voltages within the required 2% (to prevent misregistration) a shunt regulator or corona discharge tube should be employed. These regulated voltages may be derived from a flyback-type deflection system that employs a tapped autotransformer. Adjustment of the focus and convergence potentials can be achieved by using potentiometers in the high voltage divider network. Shield-



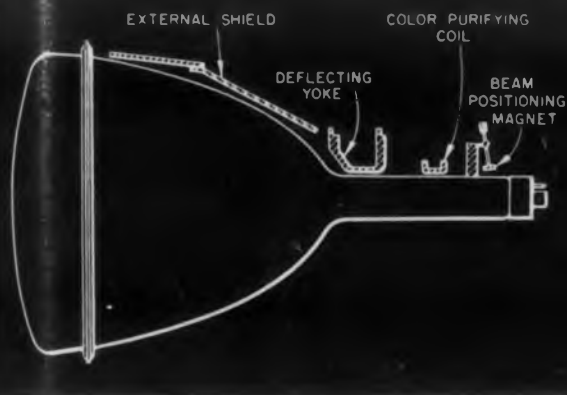


Fig. 3. Cross section diagram showing the positions of the external components.

ing of the tube for X-ray radiation may be necessary. Sufficient shielding is usually provided by the safety glass in front of the tube. The tube is a product of CBS-Hytron, 100 Endicott St., Danvers, Mass.

Fig. 3 shows the positions of the various external components which are employed with the tube. The deflection yoke must be free to move about 2" in an axial direction. Typical inductance values for this yoke are: 15mh for the horizontal winding and 79mh for the vertical one.

Provision for rotating the color-purifying coil, which moves the beams, must be made. The current in the coil determines the extent of this movement. A typical coil requires a source of 0-10ma.

Due to differences in phosphor luminescence efficiencies the cutoff voltage of each of the three guns must be adjusted to produce equal phosphor brightness. Individual grid-No. 2 voltage controls and grid-No. 1 drive controls should be provided. The grid-No. 2 controls should allow a 100-450v range.

Permanent damage may be done to the screen-and-mask assembly if scanning should cease during tube operation. For this reason, an electronic switch activated by the horizontal and vertical deflection voltages should be provided. The circuit should be arranged so that, in case of scanning failure, all beam current will be cut off.

A convenient method of achieving this protection is by obtaining the grid-No. 2 voltages from the boost voltage of the horizontal scanning circuit.

The three beam-positioning magnets provide for adjustment of the beams so that they will be properly acted upon by the convergence lens. They are mounted approximately 120° apart on the circumference of a non-ferrous ring located about 1-1/2" from the tube axis in the grid-No. 2 region.

Optimum performance of the tube necessitates proper shielding against the effects of the earth's magnetic field and stray fields around the picture tube. ▲ This tube will be on display at Booths 588, 589, 590 and 592 at the Radio Engineering Show.

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1. Low dark starting voltage — only 115 volts — no higher than for light starting.
2. Tightened Voltage Drop Range (83.5 to 85.5 volts at 2.5 mA).
3. Wider Ambient Temperature Range: -55°C to 150°C.
4. Reduced temperature coefficient: -5 mV/°C maximum, from 25°C to 150°C.
5. Reduced voltage jump*. Typical value: 5 mV.
6. Reduced drift (1 hour)**. Typical value: 50 mV.
7. Improved repeatability***. Typical value: 20 mV change.
8. Improved stability over 500 hour period (150°C ambient). Typically less than 1 volt change.
9. Improved stability over 5000 hour period (30°C ambient). Typically less than 1 volt change.
10. Ability to meet every requirement for military reliable tubes, including shock and vibration.

The development of this tube was sponsored by the Bureau of Ships, Navy Department, U.S.A.

Notes: *Voltage jump — Maximum sudden jump in operating voltage when operating current is varied slowly over specified range.

**Drift — Maximum operating voltage change during the period of operation.

***Repeatability — Maximum shift in operating voltage between successive firings of the tube.

RAYTHEON VOLTAGE REGULATOR AND REFERENCE TUBES

give you this complete range to choose from — each and every one a great performer

TYPE	MAX. DIMENSIONS INCHES		MIN. STARTING VOLTAGE SUPPLY	OPERATING VOLTAGE (Approx.)	MIN. OPERATING CURRENT MA.	MAX. OPERATING CURRENT MA.	MAX. REGULATION VOLTS
	HEIGHT	DIAM.					
OA2	2.63	.75	180	150	5.	30.	6
OB2	2.63	.75	127	108	5.	30.	3.5
CK1017	2.69	.75	750	700	0.005	0.055	15
CK1022	2.69	.75	1100	1000	0.005	0.055	20
CK1037	1.75	.40	730	700	0.005	0.100	15
CK1038	1.75	.40	930	900	0.005	0.055	15
CK1039	1.75	.40	1230	1200	0.005	0.100	25
CK5651*	2.13	.75	115	87	1.5	3.5	3
CK5651WA*	2.13	.75	115	84.5	1.5	3.5	2
CK5783*	1.63	.40	125	87	1.5	3.5	3
CK5783WA*	1.63	.40	125	86	1.5	3.5	3
CK5787	2.06	.40	135	100	5.	30.	6
CK5787WA	2.06	.40	135	100	5.	25.	4
CK5962	2.69	.75	730	700	0.002	0.055	15
CK6213	1.38	.40	200	130	1.0	2.5	2

RAYTHEON

*Voltage Reference Tube

RAYTHEON MANUFACTURING COMPANY

Raytheon Tube Division • Route 200 • 12 Chapel St., North Attle, Mass.

For Application Information Call Boston Office 4-7200 • Chicago, MA 3-1271 • New York, NY 4-4782 • Los Angeles, TR 4-1131

RAYTHEON MAKES ALL THESE:

RELIABLE TUBES • VOLTAGE REGULATORS • REFERENCE TUBES • THERMISTORS • DIODES • TRIODES • RECTIFIERS • RECTIFIER TUBES • RECTIFIER AND FILTER TUBES

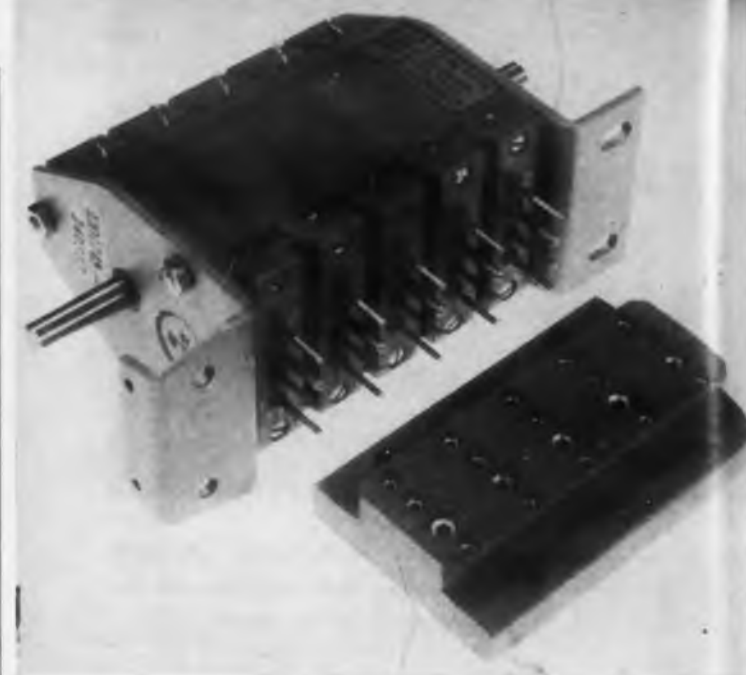


Fig. 1. A 5-potentiometer assembly showing the polarizing plug-in base.

Tandem Mounted Potentiometers

FROM one to 18 of these high precision tandem-mounted potentiometers can be compactly mounted on one shaft in a new plug-in assembly shown in Fig. 1. This assembly is mechanically secured, and the plug-in base assures correct polarization.

As shown in Figs. 2 and 3, one or more taps can be provided and located to within one winding convolution on these series 52 potentiometers made by Clarostat Manufacturing Company, Inc., 1 Washington Street, Dover, N. H. These units are available in resistance values from 10 to 100,000 ohms, with resistance tolerances of $\pm 5\%$. Potentiometers with tolerances of $\pm 0.5\%$ also are available.

Made linear or non-linear, the linearity accuracy of the potentiometers is ± 0.5 , or a voltage ratio accuracy of 0.005 where resolution permits. Power rating is 3w at 40°C, non-linear, with approximately 0.01w per degree of rotation. The insulation will stand 100v a-c in these low-loss, arch-shaped, phenolic casings. The control can be rotated 358°.

Each section needs a maximum torque of 1 oz-in. The assemblies exceed JAN-R-19 specifications, and can be used in servomechanisms, range finders, fire controls and computing devices. ▲ These products will be displayed at the Radio Engineering Show in Booths 725 and 727.

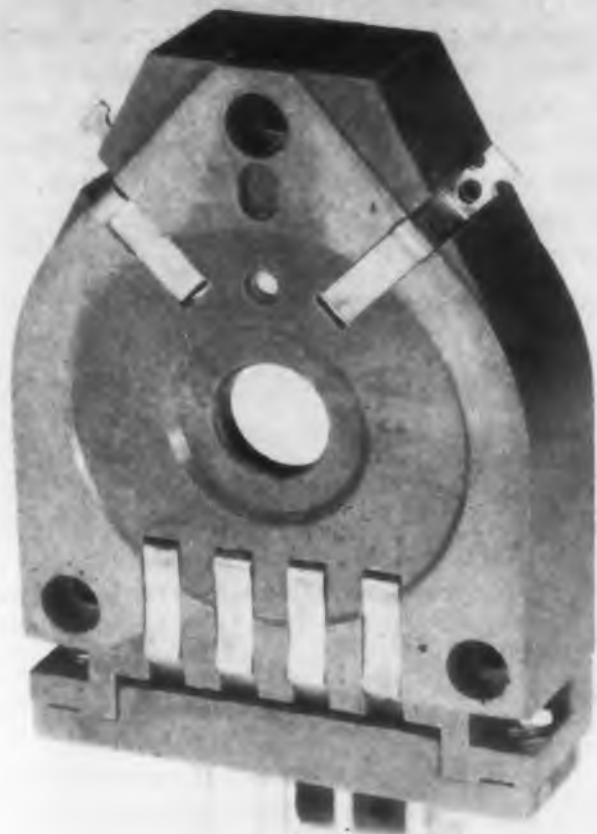


Fig. 2. Front and back views of one potentiometer showing the side terminal lugs (bottom) for checking section voltages.

New! A low-cost MARKER GENERATOR

for PRD's VHF-UHF Sweep Frequency Generator



↑ TYPE 909 CRYSTAL MARKER GENERATOR

GENERATOR: Crystal Oscillator, Harmonic Amplifiers
 OUTPUT: 2, 10 or 50 mc/s ($\pm 0.01\%$) markers up to 2000 mc/s
 OUTPUT CONTROL: Marker amplitude continuously adjustable
 OUTPUT IMPEDANCE: Both high and low
 RADIATION: Low

↔ TYPE 907 SWEEP FREQUENCY GENERATOR

WIDE RANGE: 40 to 900 mc/s
 WIDE SWEEP: At least 40 mc/s for UHF
 HIGH OUTPUT: At least 0.3 volts over entire range
 OUTPUT IMPEDANCE: 50 or 75 ohms
 LOW RADIATION: 10 μ v or less

The Type 909 Marker Generator—precision engineered by PRD—provides frequency markers of crystal accuracy, which are added electronically to the response pattern. This is accomplished by connecting the Marker Generator to a special marker injection circuit in PRD's Type 907 Sweep Frequency Oscillator.

UHF Frequency Meter Type 587 provides a method of accurate absolute frequency measurement in the UHF range.



↔ TYPE 587 FREQUENCY METER

CAVITY TYPE METER: May be connected as Reaction or Transmission Type
 FREQUENCY RANGE: 400-1000 mc/s
 ACCURACY: $\pm 0.2\%$
 Q FACTOR: Approx. 1000 (not less than 600)
 READING: Direct



Complete data and specifications will be forwarded promptly upon request to Department D-3.

See the Complete Line at the I.R.E. Show
 BOOTHS 293-295
 INSTRUMENTS AVE.

Polytechnic 

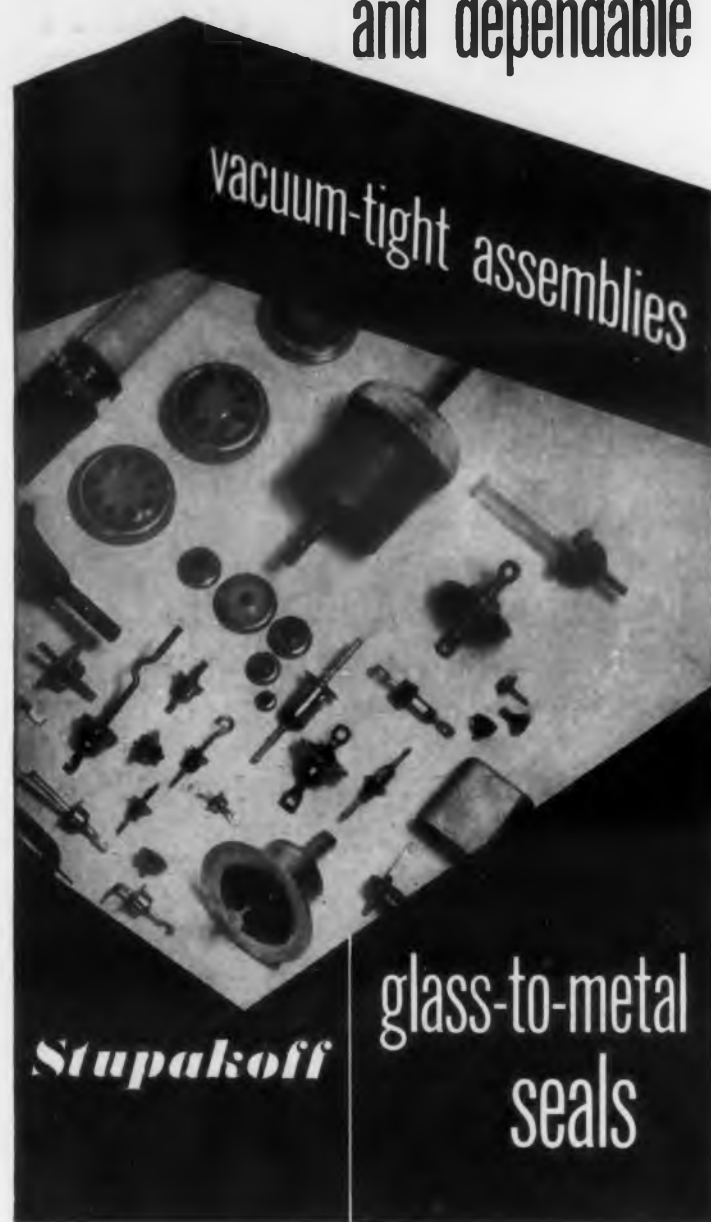
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CIRCLE ED-17 ON READER-SERVICE CARD FOR MORE INFORMATION

for durable
and dependable



A complete range of sizes and designs of terminals, lead-ins and stand-offs for hermetic sealing is offered by Stupakoff. Made with Kovar metal, the ideal alloy for sealing to hard glass, Stupakoff Seals are durable and dependable. These are not mechanical compression seals, but are permanently fused by chemical interaction. They may be installed by conventional assembly techniques.

Write for a copy of the new Stupakoff Catalog 453, giving details of over a thousand sizes and styles of Stupakoff Seals.



**STUPAKOFF CERAMIC
& MANUFACTURING COMPANY**

LATROBE, PENNSYLVANIA

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

28

New Products . . .

▲ U-H-F Beam Power Tube

Delivers 15kw at 500Mc, 12kw at 900Mc



Capable of delivering 12kw at 900Mc or 15kw at 500Mc, the type 6448 water-cooled Beam Power Tube shown here (and on the front cover) is designed to provide greater economy, efficiency, and simplicity in color and monochrome TV broadcasting and high frequency communications. It measures 7-3/8" in length by 11-3/8" diam, and has a centrally located plate surrounded by the other elements in a tetrode design. This construction permits unusually accurate alignment of elements and enables only one set of cavities to tune the entire u-h-f TV band.

Intended for operation as a grid-No. 1-driven power amplifier up to 1000Mc, the 6448 also can operate in CW service delivering 14kw at 400Mc.

Effective bypassing of grid-No. 2 to cathode is provided by a built-in capacitor. Ducts for water-cooling the plate, the grid-Nos. 1 and 2 blocks, and the cathode block are built-in and have simple hose connections. Other features include low-inductance, large-area, r-f electrode terminals insulated from each other by low-loss ceramic bushings; relatively low output capacitance; and low feedback capacitance.

These various features provide high gain in broadband TV service without the need for neutralization. Tube Department, Radio Corporation of America, Lancaster, Pa. ▲ This tube will be on display at Booth 151-153 at the Radio Engineering Show.

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

▲ Miniature Shielded Cables

High Temperature, Highly Flexible Design

The "super-flexible" miniature shielded cables made by this firm are now available with a tough outer jacket of Teflon. The jacket protects against mechanical



damage, and at the same time electrically insulates the metallic shield.

The cables are supplied in many standard constructions, including single and multi-conductor types, with conductor sizes ranging from No. 20 to 30 AWG. Both outer jacket and conductor dielectrics are Teflon, permitting continuous operation at temperatures from -90° to $+250^{\circ}\text{C}$, with maximum operating voltages to 1000v rms. The outer jackets are available in any one of 10 solid colors. Tensolite Insulated Wire Co., Inc., Dept. ED, Tarrytown, N. Y. ▲ This product will be on display in Booth 647 at the Radio Engineering Show.

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

▲ Point Contact Transistors

For Varied Applications



These two transistors should have many applications in computers, and telephone and communications systems. The Type No. OC50 is designed for amplifying purposes, and the Type No. OC51 is for switching operations.

The transistors are constructed for complete uniformity of characteristics and reliable performance by maintaining extremely tight manufacturing tolerances, both physically and electrically. Ampere Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N. Y. ▲ This product will be on display in Booth 273-75 at the Radio Engineering Show.

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

ELECTRONIC DESIGN • March 1954

▲ Printed Circuit I-F Strip For Monochrome TV Receivers



This 40Mc printed circuit i-f strip is for monochrome TV receivers using inter-carrier sound systems. The strip is an in-line design featuring high gain and full band pass response. It can be pre-aligned and tested to customer specifications.

The laminate used for the transformers and the base circuit has excellent electrical characteristics and mechanical rigidity. The windings are etched on both sides of the material. Tuning adjustments are above chassis through openings in the transformer cans.

Bandwidth is 3.75Mc (between 6db points). There are three i-f stages plus a crystal detector. Plate supply is 150v, filament supply 6.3v (parallel), and current drain is 28ma. Overall size is 8-3/8" x 1-29/32", and weight is 5.3 oz. The Allen D. Cardwell Manufacturing Corp., Dept. ED, Plainville, Conn. ▲ *This product will be on display in Booth 710 at the Radio Engineering Show.*

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

▲ Induction Potentiometer Withstands 750°F



The Model 293T Induction Potentiometer is designed to operate at temperatures up to 750°F. It has no brushes and thus is insensitive to vibrations and shock. A stainless steel case is provided for corrosion resistance. Output voltage is produced linearly proportional to the rotation of the shaft.

The potentiometer is continuously rotatable, but is useful only over an angular range of $\pm 30^\circ$. With a weight of 5 oz, it measures (approx) 1.4" diam x 2.3" overall length. Excitation is 26v at 400cy; input power is 0.5w; transfer characteristic 0.4v/degree $\pm 3\%$; phase shift (output/input) is less than 5° leading; output load is 10,000 ohms (min); and total null output voltage is 25mv rms (max). American Electronic Mfg., Inc., Dept. ED, 9503 W. Jefferson Blvd., Culver City, Calif. ▲ *This product will be on display in Booth 728 at the Radio Engineering Show.*

▲ *This product will be on display in Booth 728 at the Radio Engineering Show.*

CIRCLE ED-26 ON READER-SERVICE CARD FOR MORE INFORMATION
ELECTRONIC DESIGN • March 1954

▲ Germanium Diodes Single-Crystal-Stabilized Design

These diodes use the same high-quality single crystal germanium as in transistors. The casing is made from a non-porous ceramic, and each end is vacuum-sealed with a plastic which firmly bonds to both case and leads. In addition, the diode is



filled with a silicone impregnant. As a result, this design will withstand repeated temperature and humidity cycling with no adverse effects on electrical characteristics.

Size is less than 1/4" diam x 1/2" long. The flexible leads permit simple, easy mounting. Life is better than 10,000 hours. Shunt capacity is 1mmfd average. Seven different types of diodes are available, providing a variety of characteristics. Selenium-Intelin Dept., Federal Telephone and Radio Co., 100 Kingsland Rd., Clifton, N. J. ▲ *This product will be on display in Booth 887 at the Radio Engineering Show.*

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

▲ Miniature Relays Telephone Type



The Class 22 series of telephone type relays is furnished in hermetically sealed, dust-tight enclosed types, or in open types. The relays are especially adaptable to low

wattage sensitive applications, and for requirements where one relay must perform a large number of switching functions with minimum input power. They can be furnished with great resistance to shock and vibration and to withstand wide temperature variations. Coil and contact spring terminals at the mounting end facilitate concealed wiring of either individually or strip mounted relays.

Relays are available in any voltage up to 440v 60cy a-c, and up to 230v d-c. They are furnished with a great variety of contact combinations; single or twin contacts; snap action contacts; coil resistance from 0.12 ohms to 21,000 ohms; and time delay from slow release to 125millisec. Other variations are available to specifications. Magnecraft Electric Co., Dept. ED, 1442-A W. Van Buren St., Chicago 7, Ill. ▲ *This product will be on display in Booth 676 at the Radio Engineering Show.*

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

The LFE OSCILLOSCOPE Model 401 FEATURES:



PRICE \$895

- LINEARITY OF VERTICAL DEFLECTION
- HIGH SENSITIVITY AND WIDE FREQUENCY RESPONSE OF Y-AXIS AMPLIFIER
- ACCURATELY CALIBRATED SWEEP DELAY
- BUILT-IN TRIGGER GENERATOR

Linearity of Vertical Deflection. The vertical amplifier provides up to 2.5 inches positive or negative uni-polar deflection with negligible compression.

High Sensitivity and Wide Frequency Response of Y-Axis Amplifier. The vertical amplifier of the LFE Model 401 provides high sensitivity, 15 Mv./cm. at D-C and A-C, and wide band response to a 3 db. point at 10 Mc. Alignment of the amplifier is for best transient response, resulting in no overshoot for pulses of short duration and fast rise time.

Accurately Calibrated Sweep Delay. The accurately calibrated delay of the LFE 401 provides means for measuring pulse widths, time intervals between pulses, precisely calibrating sweeps and other useful applications of time measurement.

The absolute value of delay is accurate to within 1% of the full scale calibration. The incremental accuracy is good to within 0.1% of full scale calibration.

Built-In Trigger Generator. Provides triggers from 500 — 5,000 cps. for internally triggering sweeps. These triggers are simultaneously available, delayed or undelayed, for external use.



For complete information and specifications write:

LABORATORY for ELECTRONICS, INC.
75-5 Pitts Street • Boston 14, Mass.

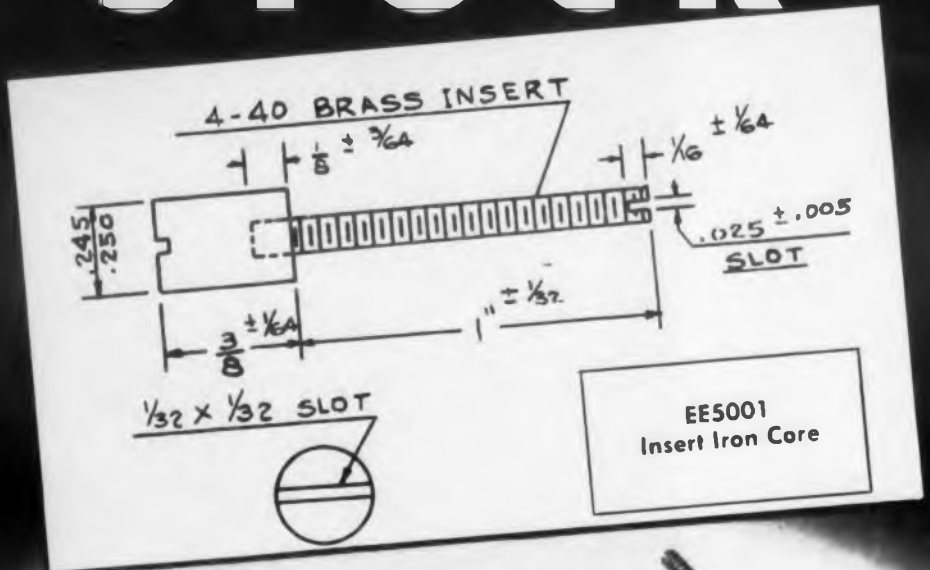
CIRCLE ED-29 ON READER-SERVICE CARD FOR MORE INFORMATION

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



New Products . . .

▲ Deposited Carbon Resistors

Ratings from 0.25w to 2w



This line of hermetically sealed deposited-carbon resistors is available in ratings from 0.25w to 2w. These units are completely sealed in steatite housings, assuring positive protection against moisture. Illustrated are the 0.25w and the 2w sizes, the smallest and largest units in the line.

Also available are resin coated types manufactured to MIL-R-10509A, glass enclosed and helium filled high stability types, and high frequency rod and disc units. Mepco, Inc., Dept. ED, Morristown, N. J.

▲ *These products will be on display in Booth 439-441 at the Radio Engineering Show.*

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

▲ Pulse Waveform Source

Has 0.2 μ sec to 60,000 μ sec Range



The Unit Pulser is a compact, versatile source of pulse waveforms for the laboratory. It has a self-contained oscillator, making it independent of external

synchronizing signals for most applications. It can be applied in transient studies on passive networks, square-wave testing of amplifier systems, and as a source of pulse-modulation voltage for r-f signal generators and oscillators. When synchronized by an external source of pulses or sine waves, it can also be used as a simple time-delay generator over its range of pulse durations.

Pulse duration is from 0.2 μ sec to 60,000 μ sec in four continuous ranges, with an accuracy of $\pm 10\%$ or 0.2 μ sec, whichever is greater. Pulse repetition rates are 30cy, 60cy, both synchronized to power line; and 100cy, 200cy, 500cy, 1000cy, 2000cy, 5000cy, 10ke, 20ke, 50ke, 100ke, all $\pm 10\%$ or 20cy, whichever is greater. Rise time is 0.5 μ sec. General Radio Company, Dept. ED, 275 Massachusetts Ave., Cambridge 39, Mass. ▲ *This product will be on display in Booth 251-255 at the Radio Engineering Show.*

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



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✓ CONNECTORS (AN Types)

- RECEPTACLES
 - PLUGS
 - CAPS
 - CABLE CLAMPS
- Pressurized — Waterproof
High Voltage — Capacitor



✓ CONNECTORS (RF Types)



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- BNC
- BN
- PULSE and TRIAX PULSE TYPES

✓ RACK & PANEL Types

- Special DT
- DTGS
- DTKS
- DT HIGH VOLTAGE
- DT MINIATURE

New 1954 Layout
Bulletin Available



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✓ MISC. COMPONENTS

- VIDEO JACKS—PLUGS
- SHORTING PLUGS
- SPECIAL JACKS—FEED THRU
- SWITCH BOOT
- SEALING-GASKETING DEVICES
- POLARIZED CONNECTORS
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CIRCLE ED-33 ON READER-SERVICE CARD

▲ Vacuum Variable Capacitor

Has 4-40mmfd Range



The Type VAC vacuum variable capacitor is recommended as a neutralizing capacitor in commercial applications, and for service in the amateur field. It has a capacity range of 4-40-mmfd with a non-linear variation that makes tuning easier at the low capacity end. It is rated at 42amp rms at 10kv peak (and 22Mc). The voltage rating of 10kv peak is determined at maximum capacity and increases rapidly as the plates are separated at lower capacities.

The unit is 5" long x 2-5/8" diam, with a 1/4" diam tuning shaft. Jennings Radio Manufacturing Corp., Dept. ED, P. O. Box 1278, San Jose 8, Calif. ▲ This product will be on display in Booth 436 at the Radio Engineering Show.

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

▲ Tube Tester

Proportional G_m Type



The Model 981 Type 2 Tubecheck-er provides for the accurate, rapid measurement of proportional mutual conductances, emission characteristics of rectifiers and diodes, and the firing potential

limits of voltage regulators and low power thyratrons. A feature is the provision for accurate meter measurement of leakage resistance, as high as 5 Meg, between the tube elements. In addition, the instrument measures transconductance up to 24,000 micromhos, in four ranges.

Multiple switching permits any combination of tube connections to be made. Three toggle switches make it possible to quickly check and compare the respective sections of twin-section tubes at only one setting of the selector switch. Sockets are provided for all conventional tube type bases as well as acorn, and 7 and 8 pin subminiatures. The instrument also includes a roll chart which places complete tube test data at the user's fingertips. Weston Electrical Instrument Corp., Dept. ED, 614 Frelinghuysen Ave., Newark 5, N. J. ▲ This product will be on display in Booth 533-535 at the Radio Engineering Show.

CIRCLE ED-35 ON READER-SERVICE CARD FOR MORE INFORMATION
ELECTRONIC DESIGN • March 1954

to follow the leader - precisely - specify

Doelcam

Synchros

PERFECTION of detail is the difference between a good performance and the very finest—like the coordinated attack and release of a brilliant string section. The precision with which DOELCAM Synchros transmit and receive electrical information is unsurpassed in a precision industry.

DOELCAM Synchros are tested and perfected standard military components for use in servomechanisms, computers, and automatic control systems. Many thousands have been delivered under Prime Government Contracts, which until recently absorbed our entire output. Now, the added facilities of our new plant enable us to make these outstandingly precise units available for general military and industrial usage. Your inquiry is invited.

Write for
Bulletin S 10



SIZES and Excitation	TYPES Control Transmitters	TYPES Control Transformers	TYPES Torque Transmitters	TYPES Torque Receivers
SIZE 11 1.062" O.D. 115v 400 Cycles	11CX4a	11CT4a		
SIZE 15 1.437" O.D. 115v 400 Cycles	15CX4a 15CDX4a	15CT4a	15TDX4a	15TR4a
SIZE 23* 2.25" O.D. 115v 60 & 400 Cycles	23CX4a 23CX6 23CDX4a	23CT4a 23CT6 23CT6a	23TX4a	23TR4a 23TR6 23TR6a
SIZE 31 3.10" O.D. 115v 60 Cycles			31TX6	

*All Type 23 Synchros are available with keyed or splined shafts.



SIZE 11
1.062" O.D.
Specification
MIL-S-16892 (BuOrd)

SIZE 15
1.437" O.D.
Specification
MIL-S-16892 (BuOrd)

SIZE 23
2.25" O.D.
MIL-S-12472 (ORD)
FXS-1066 (ORD)

SIZE 31
3.10" O.D.
Specification
MIL-S-12472 (ORD)

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



Doelcam-designed Torque Receiver Error Tester has established an entirely new quality level for Type "TR" Synchros

Doelcam CORPORATION
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West Coast Office: 304 Tejon Pl., Palos Verdes, Calif.
Instruments for Measurement and Control
Gyroscopic Instrumentation • Servomechanisms
Synchros • Microsyns • Servo Motors

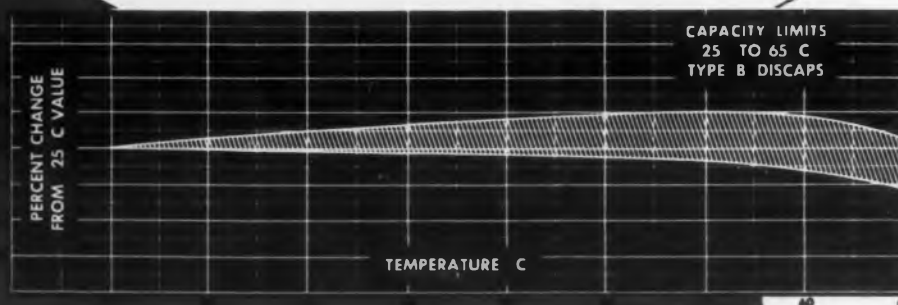
RMC DISCAPS

...the right way to say ceramic capacitors

SPECIFICATIONS GUARANTEED MINIMUM VALUE

POWER FACTOR: 1.5% Max. @ 1 KC (initial)
POWER FACTOR: 2.5% Max. @ 1 KC (after humidity)
WORKING VOLTAGE: 1000 V.D.C.
TEST VOLTAGE (FLASH): 2000 V.D.C.
LEADS: No. 22 tinned copper (.026 dia.)

INSULATION: Durez phenolic—vacuum waxed
INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms
AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms



I. R. E. Show

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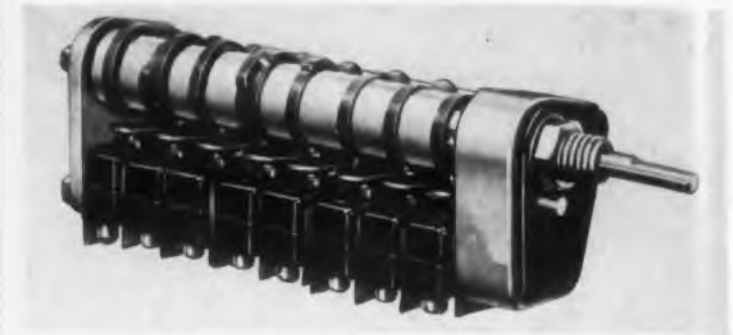
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CIRCLE ED-37 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

▲ Rotary Selector Switches Can Handle Eight Circuits



The "17AS" series of subminiature rotary selector switches offers a means of switching as many as eight different circuits with one compact assembly. Assemblies are available with from two to eight switching units and from two to eight detent positions, with a 45° angle between detents. Virtually any switching sequence is possible.

The switches are panel sealed. They are highly compact; the eight-switch assembly requires only a 1-17/64" diam mounting surface, and its overall length is less than 4".

The design uses spdt switching units. Terminals are drilled solder type (illustrated) or rap-around type turret terminals. The switches are rated for an inductive load of 3amp at 30v d-c, and 10amp at 125v or 250v a-c. Micro Switch, Dept. ED, Freeport, Ill. ▲ *This product will be on display in Booth 574-576 at the Radio Engineering Show.*

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

▲ "A" and "B" Batteries For Portable Radios



These two "Eveready" long life batteries are a low-cost complement for personal portable radios. At right in the illustration is the No. 964 1-1/2v "A" battery, which measures 1-3/8" diam x 4-11/64" high and weighs 5-9/10 oz. At left is the No. 437 75v "B" battery, which measures 1-15/16" x 1-15/32" x 6-15/32" high and weighs 14-3/4 oz. National Carbon Co., Div. of Union Carbide and Carbon Co., Dept. ED, 30 E. 42nd St., New York 17, N. Y. ▲ *These products will be on display in Booth 527-531 at the Radio Engineering Show.*

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

ELECTRONIC DESIGN • March 1954

▲ Direct Reading Meter

Checks Inductance, Capacitance

The Type 130 "L,C Meter" is a direct reading meter for small values of inductance and capacitance in components and circuits. It has five ranges covering 0-3, 0-10, 0-30, 0-100, and 0-300 microhenries or micromicrofarads, accurate within 5% of full scale.

The meter provides quick readings while circuit changes are being made.

It also is convenient for component testing, sorting, and color code checking. Weight is only 9 lbs. Tektronix, Inc., Dept. ED, P. O. Box 831, Portland 7, Ore. ▲ *This product will be on display in Booth 129, 131 at the Radio Engineering Show.*

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



▲ Transistor Amplifiers

Compact, Potted Units



The "Transamp" line of miniaturized transistor amplifiers is for low and medium power audio frequency applications, including intercommunication systems, pre-amplifiers, hearing aids, audio repeaters,

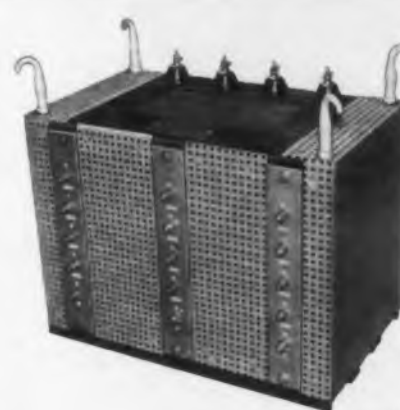
and many other applications where miniature size, light weight, and long life are valuable. Features include low noise, high efficiency low voltage operation, and high gain with uniform spectrum characteristics.

All units are in transformer type housings, specially potted to resist moisture, shock, and vibration. Standard models are available, as well as models designed to meet special commercial or military requirements.

The Type LL, illustrated, is a typical unit for use in a portable power megaphone. Characteristics include 30db gain; frequency response of 200-5000cy within ± 2 db; output impedance of 4-8 ohms; and output power of 0.1w. Input power may be supplied from a 3v flashlight cell. The Type LL contains the transistor amplifier and all circuit elements including the input and output matching transformers. Electronic Research Associates, Inc. Dept. ED, P. O. Box 29, Caldwell, N. J. ▲ *These products will be on display in Booth 216 at the Radio Engineering Show.*

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

ELECTRONIC DESIGN • March 1954

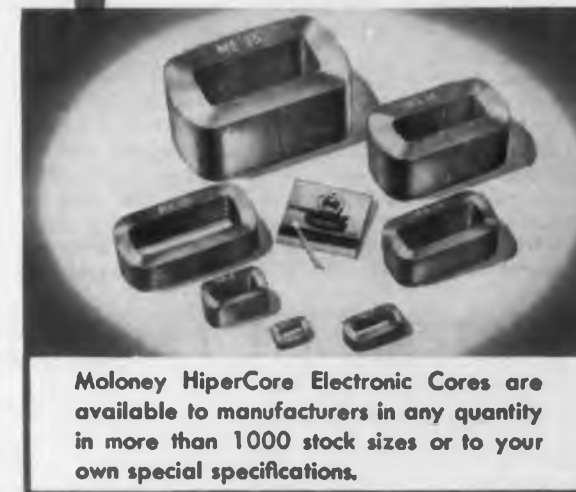


SPECIALTY TYPE transformers are now available to industry for applications which require the quality and superior performance characteristics of Moloney Transformers. Engineered to your specifications, tested to your specifications, *performance to your specifications.* Produced in any quantity . . . send your inquiry to us now for prompt attention.

Physical Characteristics: Per MIL-T-27 • Hermetically Sealed • Air Cooled; Class A, B and H • Solder-sealed Bushings • Askarel Filled • Oil Filled.

Write for Bulletin SR-205 describing HiperCore Electronic Cores and Bulletin ST-3505 describing Specialty Transformers.

ME54-8



Moloney HiperCore Electronic Cores are available to manufacturers in any quantity in more than 1000 stock sizes or to your own special specifications.

MOLONEY ELECTRIC COMPANY

Manufacturers of Power Transformers • Distribution Transformers • Load Ratio Control Transformers • Step Voltage Regulators • Unit Substations • Electronic Transformers

SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS 20, MISSOURI AND TORONTO, ONTARIO, CANADA
CIRCLE ED-42 ON READER-SERVICE CARD FOR MORE INFORMATION



SAR PULSESCOPE

by

Waterman

MODEL S-4-C

**DIRECT-READING
DELAYED SWEEP
ACCURATE TO
0.1%**



Size:
9 1/4" x 11 1/4" x 17 1/4"
31.5 Pounds



ANOTHER EXAMPLE OF **Waterman** PIONEERING...

The SAR PULSESCOPE, model S-4-C, is JANized (Gov't Model No. OS-4), the culmination of compactness, portability, and precision in a pulse measuring instrument for radar, TV and all electronic work. An optional delay of 0.55 microseconds assures entire observation of pulses. A pulse rise time of 0.035 microseconds is provided thru the video amplifier whose sensitivity is 0.5V p to p/inch. The response extends beyond 11 mc. A and S sweeps cover a continuous range from 1.2 to 12,000 microseconds. A directly calibrated dial permits R sweep delay readings of 3 to 10,000 microseconds in three ranges. In addition, R sweeps are continuously variable from 2.4 to 24 microseconds; further expanding the oscilloscope's usefulness. Built-in crystal markers of 10 or 50 microseconds make its time measuring capabilities complete. The SAR PULSESCOPE can be supplied directly calibrated in yards for radar type measurements. Operation from 50 to 400 cps at 115 volts widens the field application of the unit. Countless other outstanding features of the SAR PULSESCOPE round out its distinguished performance.

WATERMAN PRODUCTS CO., INC.

PHILADELPHIA 25, PA.
CABLE ADDRESS: POKETSCOPE

WATERMAN PRODUCTS INCLUDE

S-4-C SAR PULSESCOPE®
S-5-A LAB PULSESCOPE
S-6-A BROADBAND PULSESCOPE
S-11-A INDUSTRIAL POKETSCOPE®
S-12-B JANIZED RAKSCOPE®
S-14-A HIGH GAIN POKETSCOPE
S-14-B WIDE BAND POKETSCOPE
S-15-A TWIN TUBE POKETSCOPE
RAYONIC® Cathode Ray Tubes
and Other Associated Equipment



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

New Products ...

▲ Reflection Coefficient Meter

Compact, Wide Range Instrument



The Model 136A is designed for rapid measurement of reflection coefficient or vswr. It provides a simple method of matching loads to lines to minimize reflected power, and may also be used

as a wide range laboratory receiver. It may be readily used by non-technical personnel.

The instrument includes a local oscillator tunable from 92Mc to 355Mc, and an i-f amplifier centered at 60 ± 2 Mc. The oscillator produces a strong second harmonic in the range 184Mc to 710Mc, and a third harmonic at 276Mc to 1065Mc. Either the fundamental, second, or third harmonic may be used to mix with the incoming signal to produce the 60Mc i-f signal.

The meter is supplied with a Wideband Directional Coupler for insertion into the transmission line under test. Once the simple connections have been made, operation consists merely of selecting the desired local oscillator frequency on a direct reading dial, and reading reflection coefficient or vswr on the adjoining dial. For operation as a laboratory receiver, the instrument is used without the coupler. Sierra Electronic Corp., Dept. ED, 1050 Brittan Ave., San Carlos, Calif. ▲ *This product will be on display in Booth 711 at the Radio Engineering Show.*

CIRCLE ED-44 ON READER-SERVICE CARD FOR MORE INFORMATION

▲ Deposited Carbon Resistors

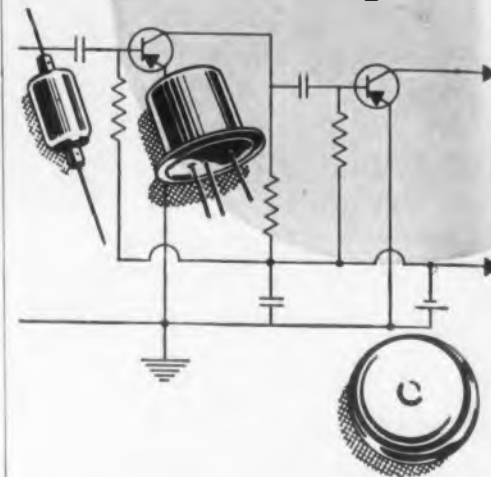
Stability Better Than 1% at 212°F

A black "Panclimatic" protective coating is now being applied to all "Welwyn" High Stability Deposited Carbon Resistors. The new coating provides complete reliability from -90° to $+300^{\circ}$ F; moisture protection; storage stability of better than 1%; and stability of better than 1% at 212°F ambient at 50% nominal rating.

It resists abrasion and impact, and is chemically inert to common solvents and plasticizers. Except for the "Panclimatic" coating, the resistors are identical with the older types. Rockbar Corp., Dept. ED, 215 E. 37th St., New York 16, N. Y. ▲ *This product will be on display in Booth 312 at the Radio Engineering Show.*

CIRCLE ED-45 ON READER-SERVICE CARD FOR MORE INFORMATION

IDEAL FOR TRANSISTOR CIRCUITS



MALLORY

**MERCURY BATTERIES and
SILVERLYTIC CAPACITORS**

Designed Specifically for
TRANSISTOR APPLICATIONS

Available Now in
PRODUCTION QUANTITIES



Mallory Mercury Batteries are ideally suited for the power supply requirements of transistor circuits.

Available as single cells or multi-cell packs in a wide range of voltages, they deliver the constant energy output needed for best results.



Also perfectly suited to transistor applications, these tiny, Mallory-developed Silverlytic Capacitors have been expressly designed for the requirements of low voltage circuits and miniaturization.

For complete data, write to
P. R. Mallory & Co. Inc.
Indianapolis 6, Indiana

P. R. MALLORY & CO. Inc.
MALLORY

CIRCLE ED-46 ON READER-SERVICE CARD

NOW CARTRIDGE TYPE GERMANIUM DIODES



AVAILABLE WITH OR WITHOUT LEADS

UHF TV MIXERS

Germanium Low Noise Types. Less than 10 db noise figure in newest codes. Available: equivalents to 1N72, 1N82, 1N110, 1N113, 1N114 and 1N147.

GENERAL PURPOSE DIODES

Hermetically sealed. No fragile glass. Moisture-proof silica-filled phenolic cases. Available: 1N34, 1N34A, 1N38, 1N38A, 1N39, 1N51, 1N52, 1N54, 1N54A, 1N55, 1N55A, 1N56, 1N56A, 1N58, 1N58A, 1N60, 1N63, 1N64, 1N69, 1N70, 1N75, 1N81.

HIGH FORWARD CURRENT TYPES

Up to 200 ma. @ 1 v. Only 1/5 volt drop max. at 1 ma. forward.

MICROTEMP UNITS

For high reverse resistance at elevated temperatures.

For data sheets and complete information on CLEVITE diodes, transistors and transistor test sets, write Dept. D3.



TRANSISTOR PRODUCTS, INC.

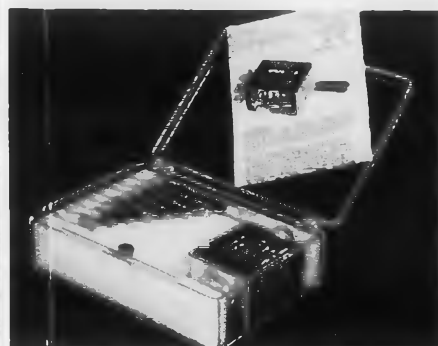
SNOW AND UNION STREETS, BOSTON 35, MASSACHUSETTS

AN OPERATING UNIT OF
CLEVITE CORPORATION

CIRCLE ED-47 ON READER-SERVICE CARD

Airflow Measuring Kit

Checks Air Velocity and Turbulence



This kit allows not only the determination of air velocity in an air duct at the point of insertion, but also makes possible a practical evaluation of conditions of turbulence.

Especially valuable for checking electronic equipment cooling setups, it consists of a Model 2A airflow interlock switch, together with a set of eight interchangeable snap-on vanes. The units are housed together in a convenient plastic box. Rotron Manufacturing Company, Dept. ED, Schoonmaker Lane, Woodstock, N. Y. **▲ This product will be on display in Booth 581-583 at the Radio Engineering Show.**

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

Integrating Gyros

Precision Control Devices



The main feature of the Hermetic Integrating Gyros is single gimbal flotation, in which a viscous fluid fills the gap between the gimbal drum and outer case. The fluid virtually eliminates static friction, provides viscous restraint, and absorbs shock and vibration disturbances. Gimbal bearing friction has been reduced to less than 1 dyne-cm. Though sensitive and accurate, the gyros withstand all conditions imposed by high speed flight.

There are three gyros in the group. The HIG-4 can be best utilized as a rate gyro for measuring very fast turn rates or for short time fire control platform stabilization; its angular momentum is 10^4 gm-cm²/sec. The HIG-5 satisfies essentially the same functions as the HIG-4; it cannot measure such high turning rates, but it is capable of lower drift rates in a platform stabilization application. Angular momentum of the HIG-5 is 10^3 gm-cm²/sec.

The third unit is the HIG-6. It is primarily intended for long-term platform stabilization in navigational systems. It has been designed with extremely low drift rates and drift uncertainties. Angular momentum is 0.725×10^6 gm-cm²/sec. Minneapolis-Honeywell Regulator Co., Dept. ED, 2753 4th Ave., S, Minneapolis 8, Minn. **▲ These products will be on display in Booth 741-743 at the Radio Engineering Show.**

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

Winchester Electronics

See them at the I.R.E. SHOW
388 Microwave Avenue

"L-LT" indicates
knob-actuated locking.
Knob (LT) may be on
either plug or receptacle.



QRE CONNECTORS

for HIGH CURRENT
HIGH ARC RESISTANCE
HIGH DIELECTRIC
RUGGEDNESS
COMPACTNESS
QUICK DISCONNECT

High acceptance is also a feature of Winchester Electronics' Connectors resulting from the exceptional service they give in critical applications. These patented* Connectors have the following **SPECIAL FEATURES:**

POLARIZING: Heavy guide pilot and socket insure self-alignment of contacts as well as polarization.

SELF-ALIGNING: Individually floating contacts assure self-alignment.

QUICK-DISCONNECTING: Individually spring loaded contacts enable ease of separation. Forcing, which results in damage, is eliminated and special levers are not required.

PRECISION MACHINED CONTACTS: Pins from brass bar (QQ-B611) and sockets from spring temper phosphor bronze bar (QQB-746a). They

are gold plated over silver for consistent low contact resistance, reduction of corrosion and ease of soldering.

MOLDED MELAMINE BODIES: (MIL-P-14) Mineral-filled and fungus-proof. Provide mechanical strength as well as high arc and dielectric resistance.

ONE-PIECE CONSTRUCTION: Eliminates unnecessary creepage paths, moisture and dust pockets, and provides stronger molded parts.

HOODS, CONNECTOR CLAMPS AND MOUNTING BRACKETS AVAILABLE.

WINCHESTER PRODUCTS AND WINCHESTER DESIGNS ARE AVAILABLE ONLY FROM WINCHESTER ELECTRONICS, INCORPORATED.

QRE Connectors are available with 6, 12, 18, 24, 34 and 208 contacts.
* Patent Number 2,466,370

Wire or write our Sales Department about your special requirements.

Winchester Electronics

INCORPORATED

West Coast Branch: 1729 WILSHIRE BOULEVARD
SANTA MONICA, CALIFORNIA

GLENBROOK, CONN., U.S.A.

CIRCLE ED-50 ON READER-SERVICE CARD FOR MORE INFORMATION



FUSITE TERMINALS

are light enough to fly!

From the very start when Fusite pioneered the first hermetic terminal that was an interfusion of glass and steel we aimed at a favorable weight-to-strength ratio.

Though there have been many improvements in both designs and materials our basic idea remains unchanged. Even a terminal which serves as a structural part (many of ours do) should not include unnecessary weight. Only where an actual interfusion of glass and metal exists can a light formed stamping be used.

We suggest that any hermetically sealed electrical component that may be called upon to fly should have rugged light weight Fusite Terminals.

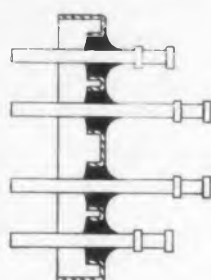
See us at the I.R.E. Show
Space 824 Audio Ave.

Send for your FREE copy of our catalog giving complete information of our extensive line to



Dep't. L1

THE FUSITE CORPORATION
6000 FERNVIEW AVENUE
CINCINNATI 13, OHIO

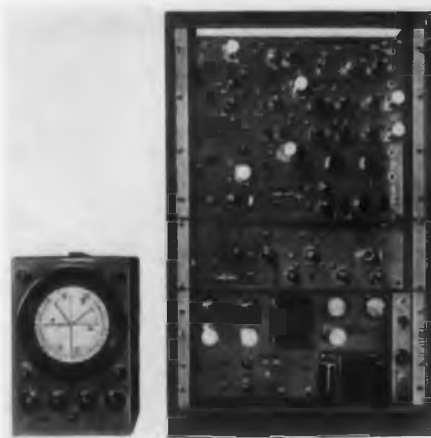


CIRCLE ED-51 ON READER-SERVICE CARD FOR MORE INFORMATION

36

New Products . . .

▲ Vector Display Equipment Indicates TV Color Signal Components



Model VDE-3 displays in vector form the chrominance components of standard color bar signals, or the prominent chrominance components of any composite TV signal. It also checks the accuracy of the color signal, the drift in "Color Coders" and other generating equipment, and the alignment of "Color Coders" using a standard color bar signal. Self-calibrating and checking circuits are incorporated.

The VDE-3 comprises a DK-1 Decoder and Keyer, a BCO-1 Burst-Controlled Oscillator, a PS-1 Regulated Power Supply, and a large oscilloscope having overlay accurately calibrated in degrees and amplitude. Also displayed are a calibration reference circle and a center dot representing a no-signal condition. Calibrated limits are provided for each of the six color vectors and the color burst. Wickes Engineering & Construction Co., Dept. ED, 12th St. and Ferry Ave., Camden 4, N. J. ▲ *This product will be on display in Booth 823 at the Radio Engineering Show.*

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

High Value Resistors

Up to 100 Million Megohm Units



Type H High Megohm Resistors can be used in electrometer circuits, radiation equipment, photo-cell circuits, and high resistance standards in measurement equipment. They are available with resistance values up to 100,000,000 megohms.

High stability is achieved with a special carbon coating on a steatite rod. The resistors can be used at high voltage with extremely low voltage coefficient of resistance. They can be soldered into a circuit or mounted on a panel or stand-off insulator.

Standard resistance tolerance is 10%, with closer tolerances available. Lengths are 1", 1-3/4", and 3". Resistance Products Co., Dept. ED, 714 Race St., Harrisburg, Pa.

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

Miniature ELASTIC STOP[®] nuts *



Here is the world's smallest self-locking nut, developed especially for your miniaturization program. Sizes as small as .109 across flats. The famous red nylon locking collar damps out severe shock and vibration—grips the bolt thread—holds adjustment indefinitely. One-piece fasteners—no extra parts can drop into delicate equipment and short out circuits. Weight, installation space and assembly time are cut to a bare minimum. Nylon collar makes miniature ELASTIC STOP nuts reusable many times. And the installed cost is considerably less than set screws or other double-operation fastening methods.



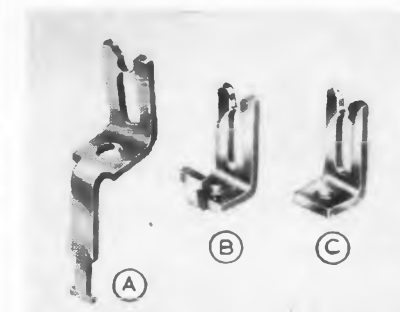
For information on all electronic fastener problems write ESNA—address Dept. N56-357.

ELASTIC STOP NUT CORPORATION OF AMERICA

2330 Vauxhall Road, Union, N. J.

DESIGN HEADQUARTERS FOR SELF-LOCKING FASTENERS
CIRCLE ED-54 ON READER-SERVICE CARD FOR MORE INFORMATION

New Diode Clips Available in three styles



Now you can benefit from a more reliable, specially developed gripping power featured in these new diode clips by C.T.C. — *guaranteed* for quality performance.

The special gripping power developed through heat treating to prevent fatiguing results in a vibration proof mounting with low contact resistance. The clips, mounted by means of a single rivet, are designed for diodes having nominal pin diameters of .079", but will accommodate .069" to .085" diameters. Three styles include: X2090-A with feed-thru solder lug; X2090-B with solder lug for top wiring; X-2090-C less solder lug, for printed circuit applications.

Clips are made of beryllium copper, alloy #25. Finishes are either .0002" brite alloy, or gold flash over .0002" silver. They have a maximum width of 3/16" and stand 13/32" when mounted.

For further data, write Cambridge Thermionic Corporation, 457 Concord Ave., Cambridge 38, Massachusetts.

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

ELECTRONIC DESIGN • March 1954

▲ Nylon Lacing Tapes

For Electrical Harnesses

These two fungus-resistant nylon flat-braided lacing tapes, "Gudelace", which has a wax finish, and "Gude-Nylace", which is wax-free, are used in all electrical harnesses. Either continuous or interrupted ties may be used. Both tapes are used in the manufacture of synchro motors or random wound coils.

The tapes will not cut through insulation. They tie securely, provide high lacing strength, and are easy to handle. The wax-finished tape is for most lacing problems, while the wax-free tape is for use where higher temperatures will be encountered. Gudebrod Bros. Silk Co., Inc., Dept. ED, 225 W. 34th St., New York 1, N. Y. ▲ *These products will be on display in Booth 737 at the Radio Engineering Show.*

CIRCLE ED-56 ON READER-SERVICE CARD

Glass Fiber Cloth

Coated With Mica

This mica-coated Fiberglas cloth is coated by a method that produces uniform mica particle distribution, with the particles lying flat instead of in the usual random position. The process uses a selected grade of ground mica and a high dielectric silicone binder for producing a Class II (100% inorganic) insulating material.

The cloth is suitable for transformers, capacitors, core windings, high speed motors, and numerous other applications where special qualities are required. It is available in 25yd, 50yd, and 100yd 36" rolls, or tape from 1/2" to 2" widths.

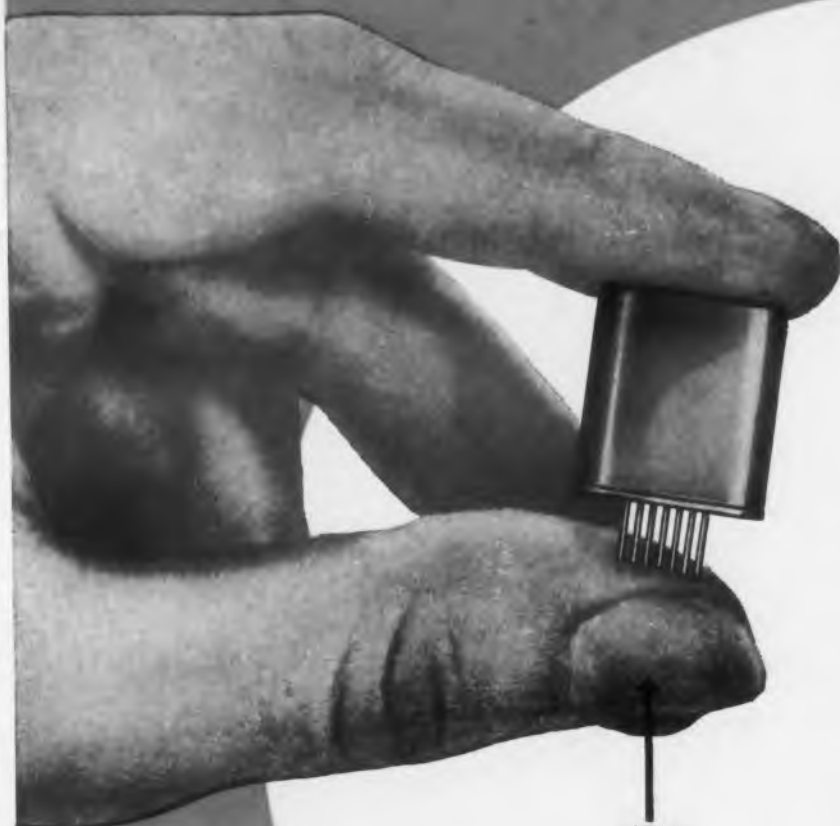
Advantages of the coated material include: high flexibility; greater resistance to abrasion, due to flat-lying particles; high dielectric breakdown (minimum resistance of 1500v/mil); heat resistance up to 250°C; high uniformity of potential gradient throughout; and long life. The same coating can be applied to other class B and A substances. Mica Coated Products Co., Inc., Dept. ED, 426-A Essex St., Salem, Mass.

CIRCLE ED-57 ON READER-SERVICE CARD

CIRCLE ED-58 ON READER-SERVICE CARD ➤

New Sub-Miniature Relay

APPLICABLE TO
PRINTED CIRCUITS



ACTUAL
SIZE



ALLIED TYPE KH RELAY
weighs .032 oz. —
has low capacity for
RF switching

ELECTRICAL SPECIFICATIONS

CONTACTS: Maximum of double pole rated at .25 amperes at 26.5 volts DC or 115 volts AC resistive

COIL: Sensitivity—nominal 1.0 watts, maximum 0.3 watts
Resistance—up to 1500 ohms
Voltage—up to 40 volts DC

TEMPERATURE: Minus 60° C to plus 125° C

VIBRATION: 10G up to 500 cycles

SHOCK: 50G plus (operating)

SPEED OF OPERATION: 1.5 millisecond at nominal voltage direct from battery supply volt and 1 millisecond with series resistance

ALTITUDE: 70,000 feet or 1.3 inches of mercury

TERMINAL TYPES: Printed circuit, solder terminals and plug-in

CAPACITY: No contact to case 0.85 mmf un-energized and 2.1 mmf energized

Write for catalog sheet giving complete information



ALLIED CONTROL

ALLIED CONTROL COMPANY, INC., 2 EAST END AVENUE, NEW YORK 21, N.Y.

New Products . . .

▲ Foil-Clad Laminates

For Printed Circuits

Accurate circuit reproduction on these copper and aluminum foil-clad laminates may be achieved through any commercial printing process, such as photo etching or silk screening. Unclad electrical grade laminate is used when patterns are to be reproduced by printing, plating, stamping, or the plater process.

The foil-clad laminates have a bond strength from 4 lb to 6 lb and are available in 36" x 36" sheets with foil thicknesses ranging from 0.00068" to 0.0094". Depending upon the needs of the circuit designer, foils may be bonded to one or both sides. The principal laminate used is "Synthane Grade XXXP". Even in thin sheets, this paper-based grade combines excellent electrical properties with good machinability. Synthane Corp., Dept. ED, Oaks, Pa. ▲ *This product will be on display in Booth 532-534 at the Radio Engineering Show.*

CIRCLE ED-59 ON READER-SERVICE CARD

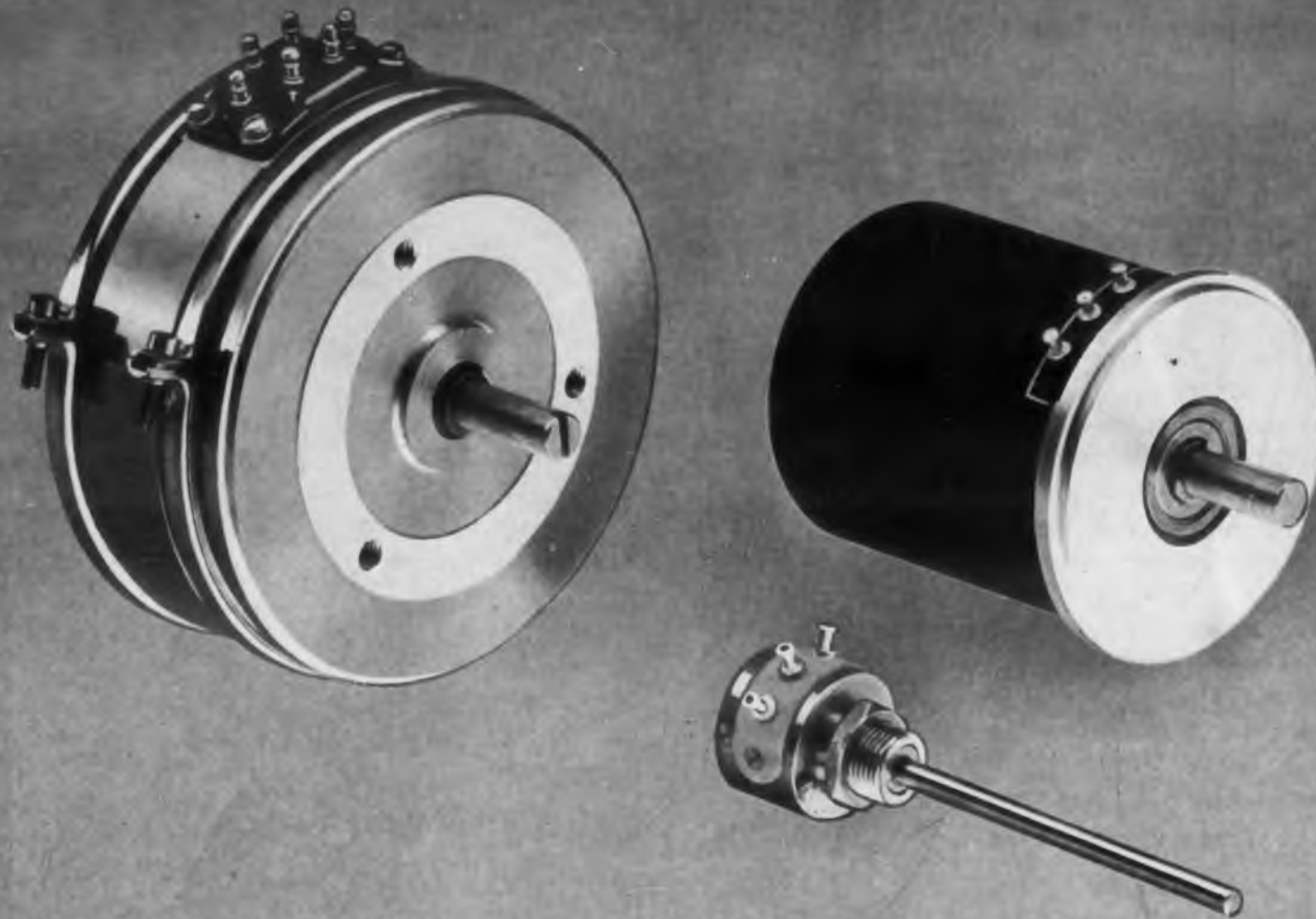
Vacuum-Tube Characteristics

Provided on Large Graphs

Circuit design is simplified and made more reliable by use of these large-size easily-read vacuum-tube characteristic curves. Bound into 8-1/2" x 11" pads, the curves show plate characteristics, positive-grid characteristics, μ , g_m , and r_p . Limits of maximum current, voltage, and dissipation are clearly marked. The reverse side of the sheet gives tabulated electrical and mechanical data and ratings for the tube, and for electrically equivalent types, showing similarities, differences, and special features.

Pads are immediately available for tube types 12AU7, 12AT7, 12AX7, 6SN7, 6SL7, 6L6 pentode, 6L6 triode, 5965, and their single-unit, industrial, aircraft, rugged, and computer equivalents. Data for other tube types and transistors are in preparation. Technical Publishing House, Dept. 17, 15B Everett St., Cambridge 38, Mass.

CIRCLE ED-60 ON READER-SERVICE CARD



5 NEW

5 More reasons why FAIRCHILD can meet



TYPE 753 — Sine-cosine potentiometer — Full sine-cosine function without mechanical cams and linkages — can be ganged up to 6 cups. 20,000 ohms per quadrant; linearity, $\pm 0.5\%$ peak-to-peak; 3" diameter, 1 1/4" long from front of servo flange to rear of cup. Also available as straight sine function.

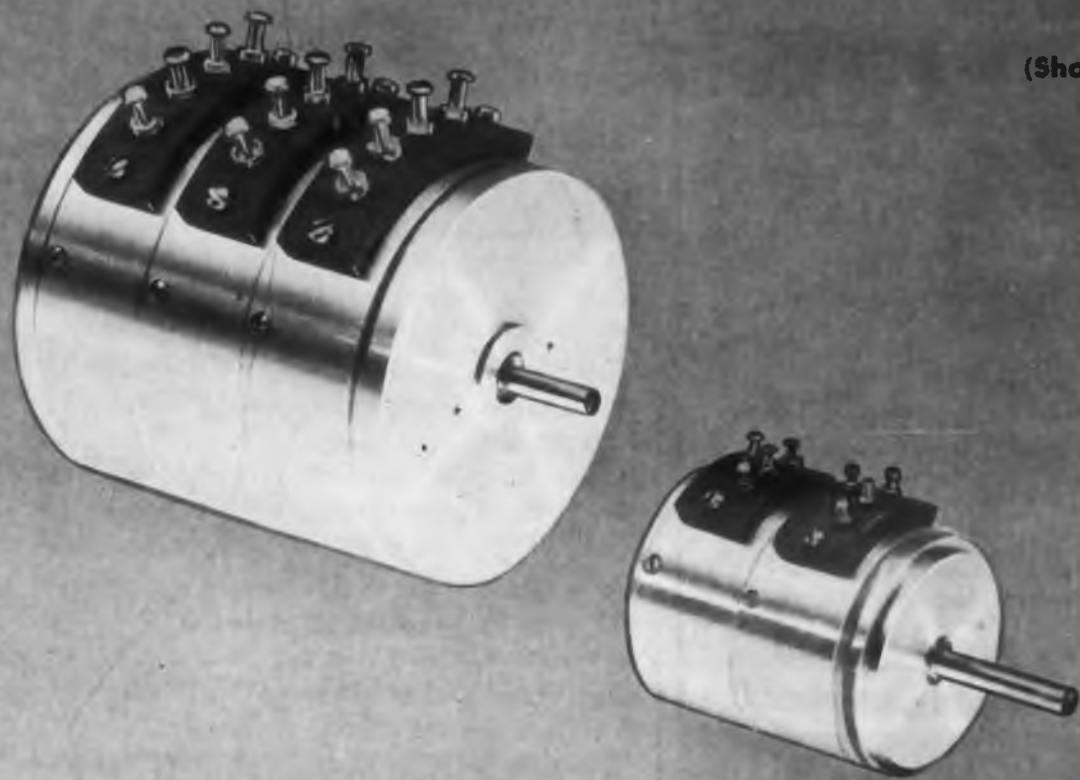


TYPE 745 — 10-turn helical potentiometer — Meets rigid government requirements for humidity, salt spray, altitude, temperature, vibration, shock, sand, dust and fungus resistance. High electrical accuracy (linearity $\pm 0.025\%$); resistance range 100 to 300,000 ohms. 2" diameter, 2 1/2" long from front of servo flange to end of case. Mechanical and electrical rotation, 3600° (+2° -0°).



TYPE 771 — The FilmPot, metallic film potentiometer — Infinite resolution, high temperature operation (225°C). High wattage dissipation and exceedingly wide resistance range (100 to 200,000 ohms). Only 3/4" in diameter and 1/2" long. Resistance element is precious metal deposited on an inorganic base. Available with servo flange or threaded bushing mounting.

See the complete Fairchild line of pots at the IRE Show, Booth 648, Radio Road and Circuits Avenue.



(Shown actual size)

POTENTIOMETERS

all your precision potentiometer needs



TYPE 754—2" linear potentiometer—Resistance range from 800 ohms to 100,000 ohms. High linearity ($\pm 0.15\%$ standard). Internal clamp rings permit ganging up to 8 cups on single shaft without increasing over-all diameter. AIA standard 2" servo mount. Depth is 1" with .594" added for each cup section ganged. Gold-plated terminals are easier to solder and have better resistance to corrosion.



TYPE 741—1½" linear potentiometer—Internal clamp rings permit ganging up to 5 cups on a single shaft without increasing the over-all diameter. Resistance range 500 to 25,000 ohms; linearity $\pm 0.5\%$ standard. Electrical angle 350°. Only 1½" in diameter and 1½" long; starting torque is 0.25 oz.-in. The simplified slip ring construction and a one-piece paliney wiper give longer life and lower noise.

● Available immediately in sample quantities. Look to Fairchild for assistance in solving all your precision potentiometer problems. Fairchild has, or can make, a potentiometer to fit any requirement. For information write: Fairchild Camera & Instrument Corp., Potentiometer Division, 225 Park Avenue, Hicksville, L. I., N. Y., Dept. 140-45N.

FAIRCHILD
PRECISION POTENTIOMETERS

Dry-Process Paper

Usable in Bright Light

Office photocopying in four to five times brighter light is made possible by "Dri-Stat" No. 1 (negative) paper, which is coated with a slow-speed emulsion. Photocopies can be made under fluorescent or incandescent light of fairly high intensity or in subdued daylight. Results are as sharp and clear as those obtained with standard speed "Dri-Stat" paper and similar papers of other make. Pre-exposure is no longer a serious problem.

"Dri-Stat" No. 2 (positive) paper is now available in three different types: Standard 95-gram paper for general office use; a duplex paper, the same weight as the Standard, but coated on both sides; and in a light-weight Thin paper.

"Dri-Stat" papers can be used with almost every type of transfer-process photocopying equipment now on the market. Dri-Stat Division, Peerless Photo Products, Inc., Dept. ED, Shoreham, L. I., N. Y.

CIRCLE ED-62 ON READER-SERVICE CARD

Specialized Litz Cables

For High Voltage Applications

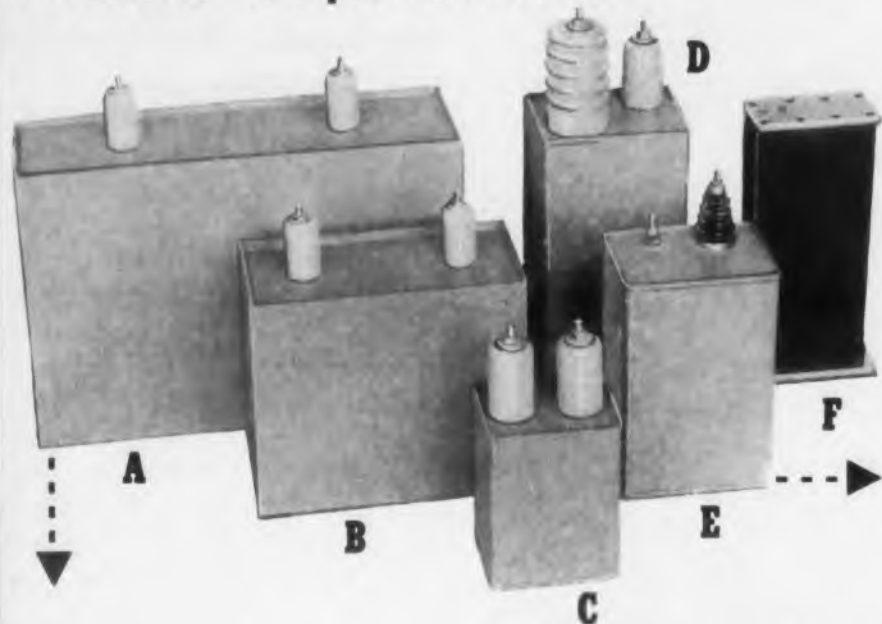
These Litz cables, for applications of high voltage in the 20-400kc region are being wound on dielectric cores of rope-like construction formed from a variety of plastic films. Diameters range from 1/8" to 2" core.

Typical cables produced have included copper conductors of 33 and 38 gauge laid on the core with a spiral of three turns per foot, although these specifications can be varied fairly widely. A maximum of 125 multi-conductor strands can be applied.

Conductors of nylon-enamel insulated wire can be made individually continuous to extremely rigid specification requirements. Polyethelene, Mylar, or other plastic core materials are utilized, depending upon requirements of cost, operating temperature, fungus resistance, and other characteristics. U. S. Plastic Rope Co., Dept. ED, 2581 Spring St., Redwood City 10, Calif.

CIRCLE ED-63 ON READER-SERVICE CARD

Plastic Capacitors'...



- (A) 10 mfd, 7500 V
- (B) 10 mfd, 6000 V
- (C) 0.1 mfd, 20 KV
- (D) 0.1 mfd, 30 KV
- (E) 0.5 mfd, 15 KV
- (F) 0.08 mfd, 60 KV

- Plastic Film Capacitors
- High Voltage Power Packs
- Pulse Forming Networks

HIGH VOLTAGE CAPACITORS

for DC filter applications

- Small size
- Extremely wide temperature range
- Economical
- Durable

Our specially designed facilities guarantee faster delivery.

We invite inquiries on High Voltage Capacitor Design
Ask for our complete catalog on your company letterhead



Plastic Capacitors, Inc.
2511 W. MOFFAT STREET, CHICAGO 47, ILLINOIS

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

New Products . . .

▲ Flexible R-F Cable With High Transmission Efficiency



"Heliac", a 7/8" diam r-f coaxial cable, combines the high transmission efficiency of air di-

electric cables with a flexibility approaching that of solid dielectric cables. In addition, it offers high resistance to crushing, and is available in long, splice-free lengths.

Flexibility is derived from the corrugated construction of the sheath, which is made of a steel strip, copper clad on the inside and seam welded. The outer surface of the sheath is protected against corrosion by a layer of bituminous material, over which is extruded a vinyl jacket. The copper tube inner conductor is supported within the sheath by a spirally wrapped polyethylene strip.

Easy to bend by hand, the cable has a characteristic impedance of 50 ohms and a velocity of 91.6%. Minimum bending radius is 10", and weight is 0.49 lbs per ft. The cable is also available in 1-5/8" size. Andrew Corp., Dept. ED, 363 E. 75th St., Chicago 19, Ill. ▲ *This product will be on display in Booth 352 at the Radio Engineering Show.*

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

▲ Precision Resistors Metal-Film Type

This line of 1/2w, 1w, and 2w precision resistors is being offered in values from 10 ohms to 100,000 ohms (higher values on special order) and tolerances of 1%, 1/2%, and 1/4%. They are noble metal resistors capable of meeting and surpassing the requirements of MIL-R-10509A.

The resistors consists of a pure metallic film



coated on the *inside* of a rugged glass tube. Tinned end caps are bonded to the tube with a true glass-to-metal seal forming a hermetic barrier protective to over 60psi. Resistors can be mounted by means of axial leads or held by fuse-type clips. After 1000 hours at full dissipation rating in a 40°C ambient, the average percentage change in resistance is only 0.23%. Inductance of the units is negligible. The 1w size measures 1" long x 5/16" overall diameter. Balco Research Laboratories, Dept. ED, 49-53 Edison Place, Newark 2, N. J. ▲ *This product will be on display in Booth 818 at the Radio Engineering Show.*

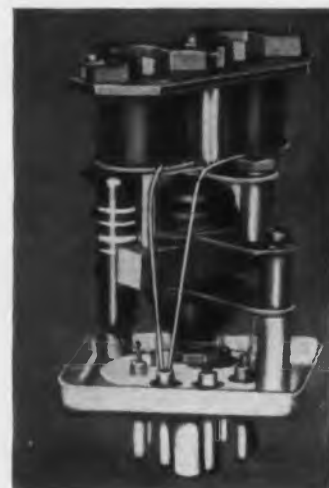
CIRCLE ED-67 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1954

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

FRAHM® REED RELAYS →

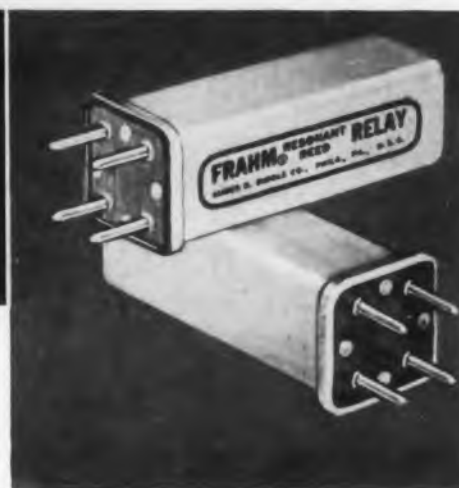
← FRAHM® OSCILLATORS



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 signal 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.

James G. Biddle Co. 8-407
1316 Arch St., Phila. 7, Pa.
Gentlemen:
Please send me Bulletin 33-ED—
Frahm Relays
 Bulletins 34-10-ED—Frahm
Oscillators

NAME _____
JOB FUNCTION _____
COMPANY _____
ADDRESS _____

JAMES G. BIDDLE CO.

- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET
PHILADELPHIA 7, PA.

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

AIR-DAMPED BARRYMOUNTS for shock and vibration isolation in Aircraft



- Vertical resonance 7 to 9 cps.
- Approximate amplification at resonance 3.5 (sea level) to 4.3 (50,000 feet).
- No snubbing at resonance for Government-specified vibration amplitudes.
- Isolation efficiency exceeds military requirements.
- Special resilient materials available for operation over wide temperature range.
- Loads from 1/10 pound to 35 pounds per unit isolator.
- Available separately, or with standard mounting base.
- Available in ruggedized form to meet military shock-strength requirements.
- Low cost.

AND they are backed by years of successful experience in the most exacting fields of shock and vibration control.

For further information, address The Barry Corporation, 775 Pleasant Street, Watertown 72, Massachusetts. Or get in touch with your nearby Barry representative.

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

NYLON CABLE HANGER . . . high-strength clip resists temperature extremes, chemicals



Eleven standard diameter sizes accommodate single cables or bundles from 3/16" to 2". Several sizes have two or three-hole tongues, to permit diameter adjustment in installation.

Combining the best features of metal clips with the advantages of nylon, Burndy molded nylon cable hangers weigh 70% less than metal cable clips of comparable size, yet have sustained loads of more than 300 lbs., in the larger sizes. Extremely flexible, these nylon cable hangers are preformed, for ease of installation, requiring no shaping or forming on the job and retaining their shape permanently. Resistant to sustained temperatures from -60°F to 250°F, these cable hangers are also unaffected by oils, gasoline, alcohol, or hydraulic fluid. An insulator itself, this type of cable hanger cannot cause grounds or short circuits and is free from hysteresis losses. Smooth, rounded-edge, non-abrasive surfaces facilitate installation and prevent injury to insulation.

For information on Burndy nylon cable hangers, write Department D, BURNDY, Norwalk, Connecticut.

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

Power Resistor

15w, 1-10,000 Ohm Units

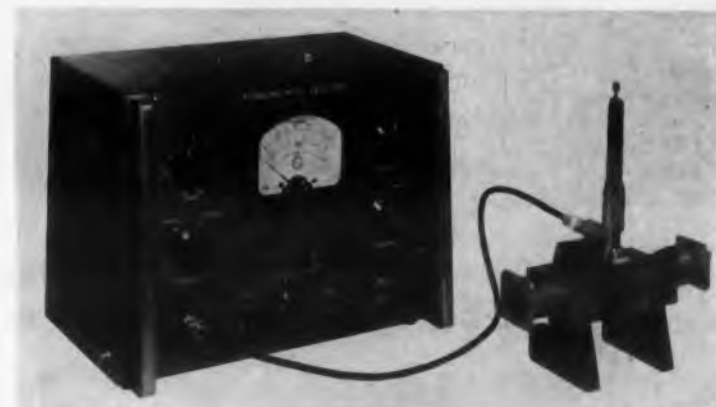


A 15w Series C8JJ resistor has been added to the "Greenohm Jr." line of power resistors, which are distinguished by sealed ceramic casings containing the wire-wound element.

The resistor is 2" long x 1/2" diam. and is available in a resistance range from 1 ohm to 10,000 ohms. Clarostat Mfg. Co., Inc., Dept. ED, Dover, N. H.

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

▲ Standing Wave Amplifier For Microwave Measurements



These three units permit accurate and convenient measurement of impedance and standing waves.

The FXR Type B810A Standing Wave Amplifier is designed to fully utilize latest precision slotted sections and probes when measuring impedance or vswr in a coaxial or waveguide transmission line. Its features include: vswr range to 100; noise level less than 0.03mv; variable, metered bolometer bias, 3.5ma to 9ma constant current; narrow and wide band operation; and an bolometer protective circuit.

The FXR Type B200A Broadband Probe provides high sensitivity and broadband tuning. The dual tuning control provides optimum matching from the probe pick-up to the easily replaceable crystal or bolometer detector.

The FXR Type 100A Series of Slotted Sections features: a tapered slot for low residual vswr; stable carriage movement for true readings; easy fingertip control; and all bearing action for low wear. Sections are available in all waveguide sizes from 2600-40,000-me/sec. Electronics & X-Ray Div., F-R Machine Works, Inc., 44-14 Astoria Blvd., Long Island City 3, N. Y. ▲ These products will be on display in Booth 387 at the Radio Engineering Show.

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

"SPECIAL transformers?"



Oh, they're no problem with us. We let
Electronic Transformer Co.
worry about 'em."

That's right. When we tackle those tricky special transformer jobs we relieve our customers of the complete headache. We're prepared to do *your* worrying, too, because custom-designing, custom-building transformers is our sole business. Government and industrial companies throughout the country have depended upon us since 1938.

Behind ETC transformer quality are a thoroughly trained engineering staff and the resources of our fully equipped laboratory and production department. We carry the ball from the circuitry stage right down the line to pilot and production runs.

What have you on the board or in your mind? Please telephone or write us without obligation.

TRANSFORMERS

REACTORS

AND FILTERS

ENGINEERED

TO YOUR NEEDS



Since
1938

ELECTRONIC TRANSFORMER COMPANY
209 WEST 25th STREET • NEW YORK 1, N. Y.
Telephone: WAtkins 4-0880

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



1 Time delay relay with

430
variations!

Here is the Edison Time Delay Relay, Model 501. There are now 430 different variations of this standard model—half of which are in stock and available for immediate delivery!

The reason there are so many variations of the Edison Time Delay Relay is because of Edison's policy to give customers the exact kind of relay to meet each application.

The experience and know-how of eight years in the design and manufacture of time delay relays makes this Edison policy possible.

Investigate Edison's ability to meet your requirements. Select to your certain satisfaction the exact time delay relay from the widest range presently available. Profit



**YOU CAN ALWAYS
RELY ON EDISON**

from the resulting reduction of engineering time.

CHECK THESE ADVANTAGES:

- Time Delays from 2 seconds to 300 seconds.
- Ambient compensated from -60 to $+85^{\circ}$ C.
- Heater Voltages from 2.5 to 130 V. AC or DC.
- Meets aircraft vibration and shock requirements.
- Timing is calibrated after sealing for greatest accuracy and production uniformity.

Free Bulletin on Request!

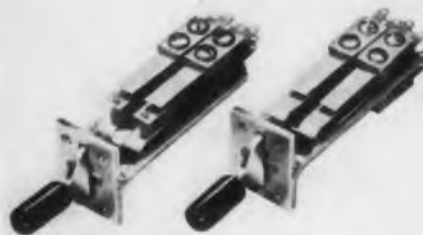
Thomas A Edison
INCORPORATED
Instrument Division
55 Lakeside Ave., West Orange, N. J., U.S.A.

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

New Products . . .

Telephone Type Switch

In Many Contact Types



This switch, the "Telever", features a T-beam, rugged frame construction. It is available in many contact arrangements in 2- and 3-position types (shown at left and right, respectively). Size is $4\frac{1}{2}$ " long overall by approximately $1\frac{7}{32}$ " x $15/16$ ". It is usually mounted with four No. 348 machine screws.

This switch is for applications requiring light weight plus sturdy construction. Three heavy steel stampings are press welded, utilizing the natural forming radius in the steel frame to locate the stainless steel pivot pin of the lever.

Nylon rollers on the lever actuate the nickel silver springs to provide smooth action. The welded cross bar palladium contact is rated at 3amp, 120v a-c, non-inductive load. Switchcraft, Inc., Dept. ED, 1328 N. Halsted St., Chicago 22, Ill.

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

▲ Square Wave Generator

Covers 5cy to 5Mc Range



The Model HF-101 Square Wave Generator is a wide-range, general purpose source of square waves, which covers a frequency range from 5cy to 5Mc. Frequencies still lower or higher can be obtained by the use of an external capacitor. Waveform symmetry is adjustable.

The generator is provided with output impedances of 75 ohms and 500 ohms. The rise time is approximately 0.02μ sec. Power supply is regulated, and a standby switch and indicator are incorporated for convenience in operation. Linear Equipment Laboratories, Brightwater Pl., Massapequa, L. I., N. Y.
▲ This product will be on display in Booth 786 at the Radio Engineering Show.

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

**YOU CAN'T
SHAKE 'EM LOOSE!
BUT YOU CAN COOL 'EM OFF . . .**



With BIRTCHER

KOOL KLAMPS

BIRTCHER KOOL KLAMPS will help keep your subminiature tubes COOL . . . and hold them firm and secure, regardless of how they are shaken, or vibrated.

KOOL KLAMPS are made of a specially developed heat treatable alloy 99 $\frac{1}{2}$ % pure silver of high thermal conductivity.

KOOL KLAMPS under certain conditions are able to reduce bulb temperatures as much as 40° C. KOOL KLAMPS have proved of particular value in miniaturized electronic equipment.

Where heat conditions are less critical, beryllium copper KOOL KLAMPS are available.

The BIRTCHER CORPORATION

4371 Valley Blvd.
Los Angeles 32, California

Dept. ED3-4

Please send Bulletin which describes and illustrates Kool Klamps in detail.

Company
Attention of
City State

CIRCLE ED-76 ON READER-SERVICE CARD

Impedance Comparator

Has Four Ranges



The Model 60 Impedance Comparator is designed for testing of resistors, capacitors, and inductors. The percentage deviation of the component under test from a standard

component is read on a large meter. Four ranges are provided: 1%, 5%, 10%, and 20% full scale. One simple linear scale serves for all ranges.

No zero adjustment is required and range calibration is readily performed by means of a built-in standard. The design of the instrument eliminates the necessity for operating pushbuttons or relays.

Component impedances from 1 ohm to 5 megohms at 60cy may be compared. A built-in regulator permits line voltage variations from 105-125v, 60cy. Dimensions are 9" x 15" x 8". Industrial Test Equipment Co. Dept, 55 E 11th St., New York 3, N. Y.

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

▲ Polar Relay

Readily Adjustable



The Series PTW Polar Relay, complete with cover, measures only 2-11/16" high (plus 5/8" projection of

the banana-type plug connections). The base, plug housing, and easily removed cover are single black phenolic moldings that will not affect the magnetic circuits they enclose.

The relay can be quickly and easily adjusted to meet specified performances. Coils are wound in four sections, and sensitivity as low as 2ma can be obtained by placing all coil windings in series-adding. Travel time (break to make) varies with the degree of energization of the operating windings. With the standardized 0.006" contact gap and, for example, energization of 98 ampere-turns (35ma) through either of the main line windings, travel time is approximately 0.9 millise.

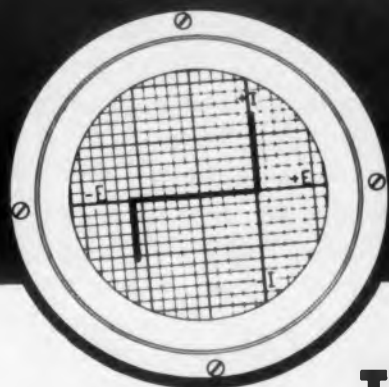
Tests indicate that the relay will perform nearly a billion operations before readjustment of the contact spacing (a simple setscrew adjustment) is necessary. A base with 11 banana-type plug connections has been standardized for the relay. Automatic Electric Co., Dept. ED, 1033 W. Van Buren St., Chicago, Ill. ▲ *This product will be on display in Booth 463 at the Radio Engineering Show.*

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

ELECTRONIC DESIGN • March 1954

Introducing

SILICON JUNCTION DIODES



TYPE

IN137A IN138A IN180 IN183

SALIENT CHARACTERISTICS

Ambient Temperature Range -75°C to $+100^{\circ}\text{C}$

Back Resistance 1,000 Times Greater Than Equivalent Germanium Diode

Steep Forward Characteristic

Forward Conduction Moderate to Heavy
Low Dynamic Resistance in Reverse Breakdown Region

Excellent Voltage Regulation over Large Ranges of Current in Breakdown Region

Back Voltage Ranges from 5 Volts to 70 Volts



APPLICATIONS

HIGH TEMPERATURE OPERATION

MATCHED "QUADS"

MATCHED PAIRS

FUNCTION GENERATORS

DIODE-CAPACITOR "MEMORY" UNITS

MAGNETIC AMPLIFIERS

CONSTANT VOLTAGE SOURCES

SURGE PROTECTION

CLIPPING AND LIMITING

SILICON JUNCTION DIODES ARE AVAILABLE IN PRODUCTION QUANTITIES NOW. SPECIFIC DATA TO FIT YOUR APPLICATION OF SILICON JUNCTION DIODES WILL BE SUBMITTED PROMPTLY ON REQUEST. (Licensed by Western Electric Co., Inc.)

NATIONAL SEMICONDUCTOR PRODUCTS

DIVISION OF NATIONAL FABRICATED PRODUCTS, INC.

930 PITNER AVENUE

• DAVIS 8-0800

• EVANSTON, ILLINOIS

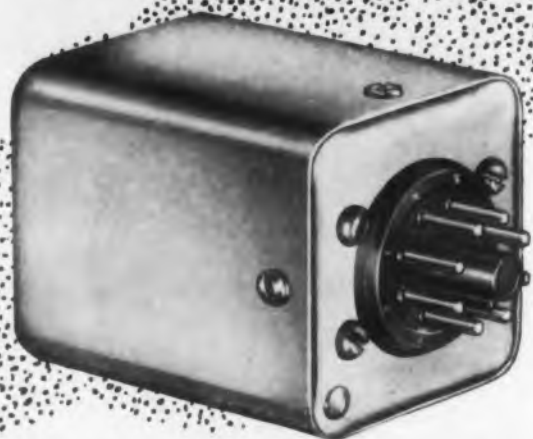
CIRCLE ED-79 ON READER-SERVICE CARD FOR MORE INFORMATION

Now...



AMRECON®

DOS RELAY
with New **LOW COST**
DUST COVER



Here is a new unit that meets the current demand for a general-purpose relay that is compact but can handle relatively large power loads and is protected against dust. It is ideal for many industrial applications where dirt and dust can cause controls to fail. The inexpensive aluminum enclosure needs no finishing and, of course, will not rust. Plug-in mounting permits quick installation and removal. The relay itself is the popular, high-quality Model DOS made by AMRECON.

SPECIFICATIONS

Coil Rating	2.5 watts DC or 3 watts, 60 cycle AC, up to 230 VDC or 440 VAC
Contact Rating	15 amps—at 115 VAC or 32 VDC, non-inductive
Weight	7 oz approx.
Size	2" x 2" x 3 1/2" high over-all (2 1/2" high, excluding plug)



WRITE FOR
CATALOG R-10



American Relay & Controls, Inc.

3643 Howard Street, Skokie, Ill.

Suburb of Chicago

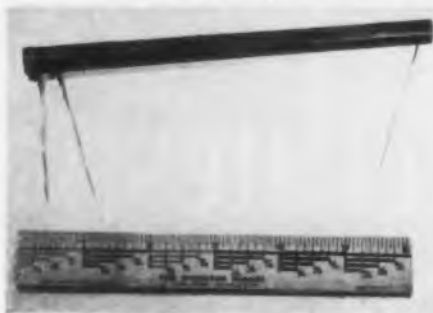
(Subsidiary of Ohmite Manufacturing Co.)

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

New Products . . .

▲ Delay Lines

With 0.01 μ sec to 1.6 μ sec Delays



These delay lines can be obtained in a tubular shape or a package, with a wide choice of mountings. Delay can be varied from 0.01 μ sec to 1.6 μ sec. Characteristic impedance can be had

from 400 ohms to 2500 ohms. Frequency response is wide; for example, a line with 0.5 μ sec delay at 1200 ohms impedance has frequency response of 3db down at 5Mc, 6db down at 8Mc, and 10db down at 10Mc.

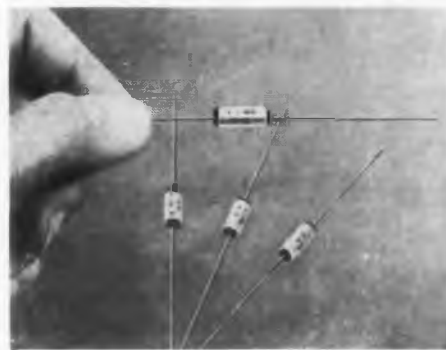
Continuously wound, the delay lines provide minimum pulse distortion and are extremely stable with temperature variations. All lines are covered and impregnated to protect against moisture and mechanical damage.

Illustrated is a line for color TV applications. It is 6-3/8" long, weighs 3/4 oz, has a 1 μ sec nominal delay, an impedance of 1000 ohms \pm 10%, and a voltage rating of 500v. Phase is linear within 1% to over 6Mc. Technitrol Engineering Company, Dept. ED, 2751 N. 4th St., Philadelphia 33, Pa. ▲ *These products will be on display in Booth 330 at the Radio Engineering Show.*

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

Tantalum Capacitors

Sub-Miniature, High Temperature Units



Size of this Type Tan Tantalum Foil Electrolytic Capacitor is only 9/16" long x 3/16" diam. Thirty-five units are available, ranging in capacity from 0.01mfd to 8.0mfd, and from

3v to 150v (d-c working voltage ranges), in both polarized and non-polarized types. The capacitors are well suited for application in transistor circuits and for other uses demanding compactness.

The units cover an operating temperature range from -55° to + 85°C. Other features include low leakage current, and excellent power factor and frequency characteristics. Cornell-Dubilier Electric Corp., Dept. ED, South Plainfield, N. J.

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

▲ Ballistic Meter

Uses Large Movement



The D-C and A-C (Rectifier) Milliamperes - Milliampere Second Meters can be furnished in any types and ranges except highly sensitive meters. They are 5" meters, but have the same size moving coils as

regular large switchboard meters. The large movement is required to achieve the extremely sluggish action desired for these meters, valuable where extreme ruggedness, extra high damping, ballistic characteristics, and similar features are required. Dials are drawn for each order.

The meter illustrated (furnished to H. G. Fisher & Co.), the Model S43X, is illuminated by means of two lucite rods which carry light from incandescent bulbs. The meters can be furnished without illumination. The Hickok Electrical Instrument Co., Dept. ED, 10525 Dupont Ave., Cleveland 8, Ohio. ▲ *This product will be on display in Booth 458-460 at the Radio Engineering Show.*

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

▲ Controls

Easily Snapped into Panels or Chassis



No tools are needed for installation of Model 2 "Snap-Tite" Controls. Six pressure springs grip the panel; there are no mounting nuts, lockwashers, or twisting of mounting tabs to cope with. The controls

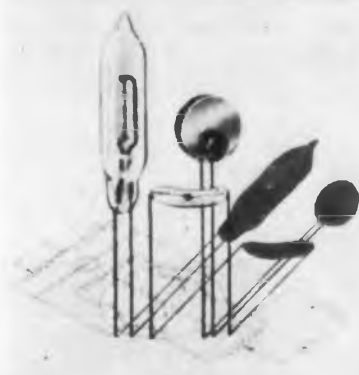
fit any chassis punching for: twist-tab mounting type controls, and any standard bushing-mounted and single or double locating-tug type controls.

They are available in all CRL Model 2 standard resistance values and tapers. Diameter is only 15/16". Shafts are molded of a special high-impact polystyrene, knurled for fingertip adjustments, and slotted for screwdriver adjustments. Centralab, Division of Globe-Union, Inc., Dept. ED, 900 E. Keefe Ave., Milwaukee 1, Wis. ▲ *This product will be on display in Booth 920 at the Radio Engineering Show.*

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

ELECTRONIC DESIGN • March 1954

Thermistor-Varistor Kit For Circuit Experimentation



The Model 168 Experimental Thermistor-Varistor Package contains two plain Thermistor washers, two Thermistor discs, two Thermistor beads, and one Varistor washer. The inexpensive kit is of

value in experimental circuits and in designing for compactness and sensitivity. It includes a technical information sheet of simple circuitry and electrical characteristics of these units.

The illustration shows two bead-type Thermistors sealed in glass tubes, and a disc-type Thermistor. Victory Engineering Corp., Dept. ED, Springfield Rd., Union, N. J.

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

Deflection Yoke

For Rotating Coil Applications



The Rotating Coil Deflection Yoke is designed for radar P.P.I. (plan position indicator) and similar rotating coil applications. It is available in two types, identical except in deflection angle. Type Y15-1 has a deflection angle up to 52°, Type Y17-1 up to 70°. Each unit is com-

plete in an aluminum housing containing the deflection coil, slip ring and brush assembly, drive gear, and bearing. A wide range of impedances is available.

Dimensions of the yoke are only 3-3/4" long x 3-3/8" O.D. High resolution, low distortion, and maximum efficiency are obtained with a series field wound core distributed coil design. There are no magnetic fields outside the deflection region, and there is no bearing magnetization. Adequate tube clearance and easy alignment of 1-1/2" neck diameter tubes are assured by a 1-5/8" yoke diameter. A protective smooth inner nylon bobbin eliminates any shorting that might occur from rubbing of coil wire on the tube shell due to inadvertent misalignment between tube neck and coil axis. Syntronic Instruments, Inc., Dept. ED, 100 Industrial Rd., Addison, Ill.

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

ELECTRONIC DESIGN • March 1954



Here's why G.E. can supply the aircraft motor you require



DESIGNED TO POWER sensitive equipment in tight applications where torque requirements are low, this tiny 10 frame motor, only 1 3/8" in diameter, is among the smallest of many specially designed motors, amplidyne and tachometer generators made by G.E. for rigorous aircraft operation. Weighing from 9 to 15 oz. these units deliver from 0.65 oz. in. to 120 oz. in. torque at 2 to 10,000 RPM in continuous operation. Spur gearing permits many speed combinations. Flange-mounted, these motors are ideal for such applications as computers, radar equipment, controls for sensitive equipments of all types, switch and cam combinations and blowers.

PICTURED ABOVE is a small sample of the wide variety of specialty motors designed and built by General Electric for aircraft and armament applications. A half-century of engineering experience backs up every motor, and provides a significant reason why the G-E Specialty Component Motor Department is able to design any specialty motor to meet your most exacting requirements.

IN ADDITION, some of the most complete testing facilities in the world are used at G.E. to insure that your aircraft motor completely meets environmental specifications, including altitude, temperature, humidity, vibration, shock, and centrifugal force.

WHATEVER your aircraft or armament specialty motor problem, G-E engineers at the Specialty Component Motor Department are ready to assist you.

For further information, see your local G-E Apparatus Sales Office, or write to Section 704-22, General Electric Company, Schenectady 5, New York.

Progress is our most important product

GENERAL ELECTRIC

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

Miniature and sub-miniature



multiple contact

**CANNON
PLUGS**

DPM-14

for diminutive
applications

Turn to Cannon when you want midget connectors!

Type DPM-14 illustrated has 2 (10 amp.) No. 16 and 12 (5 amp.) No. 20 brass contacts. Entire assembly only $\frac{1}{4}$ " x 2". Similar unit, Type DPM-A20 has 2 No. 16 and 18 No. 20 contacts. Ideal for rack, panel, and instrument applications.

You get positive contact, rugged, rectangular mounting assembly, Cannon high quality performance, with or without shell support. Types D, U, and miniature K's... all in extremely small space.

Write TODAY for Bulletins covering all the lines of Cannon Miniature and Sub-Miniature Connectors. **CANNON ELECTRIC COMPANY, 3209 Humboldt Street, Los Angeles, California.** • Factories in Los Angeles; New Haven; Toronto, Canada; London, England. Representatives and distributors in all principal cities.

Refer to Dept. 143

CANNON ELECTRIC Since 1915

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



Get the right resistor!

• You'll be most likely to find it among Ward Leonard's dependable Vitrohm resistors—the most complete line ever offered by any manufacturer. Write for 64-page free catalog to Ward Leonard Electric Company, 77 South St., Mount Vernon, New York.

WARD LEONARD ELECTRIC CO.

Result-Engineered Controls Since 1892

PRESTATS • RELAYS • MOTOR CONTROLS • CHROMASTER



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

46

New Products . . .

▲ Sliding Drawer

Fits Standard 19" Cabinets



This sliding drawer is designed to fit standard 19" enclosed relay rack cabinets (22" wide x 18" deep). The panel is constructed of 12ga steel, and the chassis is made of 16ga steel, with a 1" flange on top and bottom to accommodate plywood for such equipment as a record changer. The chassis is mounted in ball-bearing suspension slides which can sustain 40 lb.

The entire unit mounts on angle brackets which can be bolted into the cabinet. The drawer extends 11" in front of the cabinet. Two sizes are available: chassis size 17" x 16-1/2" x 3", and 17" x 16-1/2" x 4". The drawer is supplied knocked down, with all necessary bolts for easy assembly. It is finished in black or gray wrinkle. Premier Metal Products Co., Dept. ED, 3160 Webster Ave., Bronx 67, New York, N. Y. ▲ This product will be on display in Booth 671 at the Radio Engineering Show.

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

▲ Transistor Analyzer

Traces Negative Resistance Curves



The Model TA-2 Transistor Analyzer, a negative resistance and characteristic curve tracer, is designed for use with laboratory type oscilloscopes. It will

trace all negative resistance curves of both N-type and P-type point contact transistors.

Because all circuit parameters controlling the negative resistance curves are available as metered variables on the front panel, the TA-2 enables the user to visually design any negative resistance circuit in a matter of minutes. It will also determine the applicability of any transistor in a given negative resistance circuit. In addition, the unit will trace the collector characteristic, R_{22} , for both grounded emitter and grounded base connections, and transfer characteristic, R_{12} , of N-type and P-type point contact transistors and N-P-N and P-N-P junction transistors. Polyphase Instrument Co., Dept. ED, Bryn Mawr, Pa. ▲ This product will be on display in Booth 767 at the Radio Engineering Show.

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

Have you a similar use for this 1-piece fastener?



It's a Cabinet Door Strike... Simple to install; eliminates welding and cuts assembly cost. Any head can be designed without affecting fastening principle.



It's a Shelf Support... For ranges or refrigerators—in plastic and metal. Leading appliance makers have achieved substantial installation savings through it.



It's a Blind Rivet... Or a removable fastener. It locks and unlocks with a 90° clockwise rotation. No mating parts such as nuts or receptacles.



It's a Lifter Knob or Dashboard Plug... Plastic Spring-Lock heads are molded around steel inserts, giving strength at point of load or impact. Any shape head can be molded in any color.

What's Your Application?

...Tell us how you can use Spring-Lock Fasteners in your products. We'll be glad to work out the details with you.

Send for more data and Free Samples today.

Simmons Fasteners

QUICK-LOCK • SPRING-LOCK
ROTO-LOCK

SIMMONS FASTENER CORP., 1763 North Broadway, Albany 1, N. Y.
CIRCLE ED-92 ON READER-SERVICE CARD FOR MORE INFORMATION



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

ELECTRONIC DESIGN • March 1954

Slide Rule

Pocket-Size Plastic Unit

A handy pocket-size slide rule made of heavy-gage plastic with a transparent runner is available without charge. Lightweight and measuring 6-1/2" long, it carries the most useful A, B, C, D, and C1 scales.

The slider is also useful as a ruler; one edge is calibrated in sixteenths, and the other in millimeters. The reverse of the slider bears Ohm's Law formulae and a Fahrenheit-Centigrade Conversion scale. Helipot Corp., Dept. ED, 916 Meridian Avenue, South Pasadena, Calif.

CIRCLE ED-94 ON READER-SERVICE CARD

Recording Tape

Available in Colors

Plastic recording tape is now available from this firm in green and blue, as well as the standard clear plastic base. Plastic reels in a choice of five colors can also be supplied. The colored tape permits much quicker selection and playback of specific sections of recordings.

It also protects against accidental erasure of sections and against labeling errors, and the same time simplify packing and shipping problems. It can be spliced like any other tape. Audio Devices, Inc., Dept. ED, 444 Madison Ave., New York 17, N. Y.

CIRCLE ED-95 ON READER-SERVICE CARD

Plating Solution

"Rubs On" Silver Coat

"Nu-Silver", an industrial silver-plating solution, is easily applied in a few seconds with a soft cloth or swab, or by immersing. It is already being used by manufacturers for silver-plating connections, terminals, joints, etc., to increase conductivity and reduce resistance.

No plating equipment is needed, providing a savings in materials and time. Two formulas are now available: No. 66, for non-ferrous metals, silver, copper, brass, bronze, etc.; and No. 67, for all-purpose uses. Specialty Manufacturers and Distributors, Dept. ED, 508 New York St., Aurora, Ill.

CIRCLE ED-96 ON READER-SERVICE CARD

CIRCLE ED-97 FOR MORE INFORMATION ➤

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— for every hermetically sealed termination

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Development, production and design engineers will find the complete E-I Data File a helpful addition to company files. The new brochure includes standardized terminations that economically solve all but the most unusual terminal problems. If custom types are required, E-I can supply these quickly, to exact specifications at quantity production prices.

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On hermetically sealed terminals. Discusses cushioned glass construction, thermal shock resistance, preferred types and special terminals. Explains code systems and methods of installation.

2. BULLETIN 950-A

On hermetically sealed multiple headers. Explains vacuum tight feature, cushioned glass construction, strain-free qualities. Tin dipped for easy soldering and silicone treated for highest electrical resistance.

3. BULLETIN 951

With complete information on octal type plug-in and multiple headers. Feature a new principle of hermetic sealing. Solid metal blanks insure maximum mechanical strength and rigidity.

4. BULLETIN 952

Complete information on E-I end seals for hermetic sealing condensers, resistors and other tubular electronic and electrical components. Provide a permanent hermetic seal. Completely strain-free.

5. BULLETIN 953

Individual, color-coded hermetically sealed terminals. Available with glass inserts colored in standard, easily identified RMA color codes. Coloring is in the glass —no lacquers or enamels are used.

6. BULLETIN 960

Compression type multiple headers. Super rugged, absolutely rigid and practically indestructible. An exclusive E-I achievement offers vastly greater resistance to shock and vibration. Guaranteed vacuum-tight.

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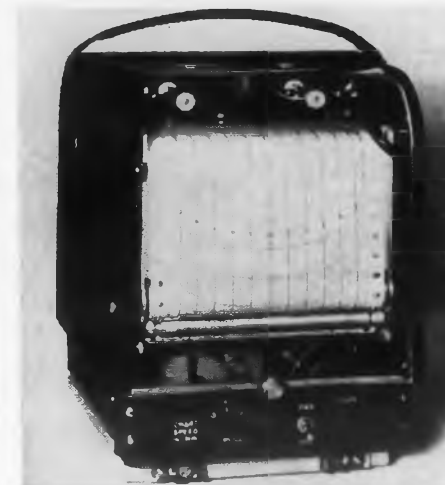
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New Products . . .

▲ Dual Recording Milliammeter
Compact, Sensitive Unit



The Dual Recording Milliammeter uses standard 6" curvilinear chart paper and features two independent channels and four selective chart speeds, from 12"/hr to 12"/min. Non-corrosive alloy metal pens are used for both recording and marker timing.

The unit can continuously record up to 100 hours without reloading.

The complete recorder occupies less than 1/2 cu ft and weighs only 15-1/2 lbs. It meets rigid military aircraft requirements for shock, vibration, explosion, and humidity resistance. Frequency response ranges through 15cy with an accuracy of +5% from dc through 6cy. Sensitivity is 0.45 inch per 100μamp, with a linear recording range to 500μamp. Unidirectional recording is possible to 1ma. Texas Instruments, Inc., Dept. ED, 6000 Lemmon Ave., Dallas 9, Tex. ▲ *This product will be on display in Booth 776 at the Radio Engineering Show.*

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

Antenna Coils
High Q, Compact, Rugged Units



Hy "Q" antenna coils are available for 20m, 40m, and 75m operation. Engineered to deliver highest possible Q consistent with good design, they are compact, rugged, light-

weight units with a specially coated air-spaced coil winding to insure transmission and reception quality.

The coils require little or no tuning and are instantly interchangeable. Dimensions and weights are as follows: 20 Meter Size: 3-1/2" x 2-3/8" diam, 7-1/2 oz; 40 Meter Size: 6-1/2" x 2-3/8" diam, 11 oz; 75 Meter Size: 7-1/2" x 2-3/8" diam, 12 oz. Master Mobile Mounts, Inc., Dept. ED, 1306 Bond St., Los Angeles 36, Calif.

CIRCLE ED-99 ON READER-SERVICE CARD FOR MORE INFORMATION
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 5/16"
 3/8"
 7/16"
 1/2"
 9/16"
 5/8"
 11/16"
 3/4"
 7/8"
 1"
 1 1/8"

TUBES
 1/16" wall
 1/4" O.D.
 3/8" "
 1/2" "
 5/8" "
 3/4" "
 7/8" "
 1" "



ACE PLASTIC COMPANY
 Precision Extruders and Fabricators

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

ELECTRONIC DESIGN • March 1954

▲ Gold-Bonded Germanium Diodes

Have High Forward Conductance



This line of gold-bonded germanium diodes is designed to provide forward conductance five times greater than that of the conventional whisker diode. In addition, both static and dynamic inverse resistance are higher. The design makes possible

grades featuring megohms at 100v inverse.

Other features include high mechanical stability, with the bond often exceeding whisker tensile strength; ease of soldering of the heavily tinned leads; staked leads; high humidity resistance; and resistance to temperature cycling. The line includes 12 types of diodes, including three JAN types. Transatron Electronic Corporation, Dept. ED, Melrose 76, Mass. ▲ *This product will be on display in Booth 681 at the Radio Engineering Show.*

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

▲ Wide Band Oscilloscope

Incorporates Magnifier Positioner



The Model 308 Wide Band Oscilloscope is a commercial unit with many features of more expensive equipment. Its large cathode-ray tube gives the equivalent of a tube 8-1/2" high, by over 7 ft wide when in the "Magnifier" position. The magnifier positioner allows any part of the waveform to be observed.

Picture sharpness, definition, and writing speed are greatly increased by the inclusion of a separate third anode intensifier ring on the cathode-ray tube plus a separate high voltage supply.

The vertical section includes such features as: push-pull inputs for internally mixing two signals or observing push-pull waveforms; a frequency compensated stepping attenuator for input attenuation without distortion; and a bandwidth from d-c through 5Mc within $\pm 1-1/2$ db. The unit is available in kit form or factory wired. Precise Development Corp., Dept. ED, Oceanside, N. Y. ▲ *This product will be on display in Booth 282-284 at the Radio Engineering Show.*

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

Koiled Kords* permit EASY SERVICING of In-a-Door or Sliding Units . . .



A six inch section of KOILED KORDS retractile cord will extend to more than two feet when pulled and when released will retract immediately to its original neat, compact, spring-like shape. KOILED KORDS solve the problem of carrying current to movable units without having a long trailing cord to foul in the mechanism. They make it possible to retain electrical contact between units when they are pulled out for servicing, facilitating trouble location and correction.

KOILED KORDS extend as needed without looping, dangling or tangling.

KOILED KORDS are compact, neat, attractive, built to withstand continued flexing.

KOILED KORDS are available on special order to your specifications in multi-conductor types up to 37 conductors. Stocked types include 2, 3, 4 and 5 conductor #23 AWG communications cords and 2, 3 and 4 conductor Underwriters' Laboratories approved SO, SJO and SV-neoprene jacketed power cords. KOILED KORDS can be supplied in 48 inch mandrel lengths or prepared into cord sets for attachment to equipment.

WRITE FOR KOILED KORDS APPLICATION BULLETIN
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Koiled Kords

Incorporated



Box K, New Haven 14, Conn.

*KOILED KORDS is the trademark of Koiled Kords, Inc.

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

RESINITE

Brings you the
HIGHEST RESISTIVITY of any
RESINATED PRODUCT

Resinite Coil Forms are laboratory tested and field proven. Their operating characteristics—volume resistivity . . . power factor . . . thermal properties . . . low moisture absorption . . . and resistance to voltage breakdown—represent a new achievement in basic components for electronic application.

Resinite Coil Forms are available with inside or outside threads, slotted, punched or embossed. Axial pressure in excess of 25 lbs. is accomplished through a special three row threaded design. Torque can be controlled to + or - 1 in. oz.

RESINITE 8104: for coil forms requiring very high dielectric properties under extreme humidity.

RESINITE "AC": for applications requiring very high dielectric strength. Electrolytic corrosion is impossible.

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CIRCLE ED-106 ON READER-SERVICE CARD FOR MORE INFORMATION

Need a complete complement* of High Voltage Capacitors for developmental color TV?

Leaders for over two years in experimentation with component parts for color TV, Jeffers Electronics has developed this first complete complement of high-voltage capacitors.

Drawings and additional technical information furnished on request. Complete kits of high-voltage capacitors listed below available at nominal cost.

Each kit includes the following units:

No. per kit	Capacity	Voltage Rating
1	10,000 MMFD	6KV
1	2,000 MMFD	30KV
1	500 MMFD	30KV
2	1,000 MMFD	10KV
3	1,200 MMFD	15KV

* Typical quantities proposed

Other Divisions: Speer Resistor
International Graphite & Electrode



CIRCLE ED-107 ON READER-SERVICE CARD FOR MORE INFORMATION

50

New Products . . .

VSWR Measuring System Provides Automatic Checks



The Model 620 is a compact, commercial version of this firm's AN/UPM-12 Automatic VSWR Instrumentation System, which has been proven in military use. The Model 620 is suited for portable use or permanent installation where frequent VSWR measurements of radars or other amplitude-modulated microwave transmission systems are required.

The computer-display unit provides automatic VSWR determinations over two ranges covering ratios of 1.02 to 1.2, and 1.2 to infinity, at any preset power level from 5w to 1 megawatt, and repetition rates from 400pps to 4000pps.

A companion instrument designed for laboratory bench use, the Model 621 is also available for analysis of microwave systems at carrier power levels supplied by signal generators. Cubic Corp., Dept. ED, 2841 Canon St., San Diego 6, Calif.

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

Twin Triode

Improved Version of Type 6J6

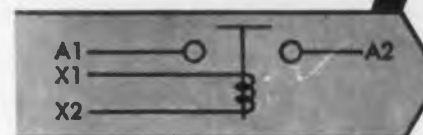


The 6101 is a "premium" medium-mu Twin Triode of the 7-pin miniature type. It is especially designed for use as a Class A amplifier and control tube in mobile and aircraft equipment where dependable performance under shock and vibration is a fundamental consideration. Constructed and processed to meet military requirements, the tube is an improved version of the Type 6J6. Maximum Class A1 ratings include 330v plate voltage, 0.85w plate dissipation, and 180v peak heater-cathode voltage. It has an amplification factor of 38, a plate resistance of 6300 ohms, and a transconductance of 6000 μ mhos. Radio Corporation of America, Dept. ED, Harrison, N. J.

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

Better Performance . . .

WITH THIS NEW HERMETICALLY SEALED RELAY



No. A-53-110

Developed to meet exacting specifications for a current aircraft equipment application, this hermetically sealed, solenoid-type relay combines high contact rating and large contact area in a lightweight, compact envelope.

CHARACTERISTICS

DESCRIPTION: SPST, NO., bracket mounted.
COIL DATA: Nominal voltage 24-28 VDC; maximum operating voltage 29 VDC; maximum pick-up voltage 18 VDC; drop-out voltage 7 VDC, plus 0, minus 5.5 VDC; standard coil 160 ohms, maximum coil current .180 amps.
CONTACT RATING: 25 amp. resistive; 20 amp. inductive; 15 amp. motor.
RATED DUTY: Continuous.
WEIGHT: 6.25 ounces.
MAXIMUM DIMENSIONS: Width 1 $\frac{1}{32}$ " length 1 $\frac{1}{16}$ " height 2 $\frac{3}{4}$ "

RELAY
DIVISION

Brochure and specifications
available upon request.

Electrical Products Corp.

1100 North Main Street, Los Angeles 12, California

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

is this your
timing
problem?



Sorry . . .
A. W. HAYDON CO.
can't help you.

Only instruction, practice, and patience can improve your score!

But . . . if your problem is
PRECISION TIMING

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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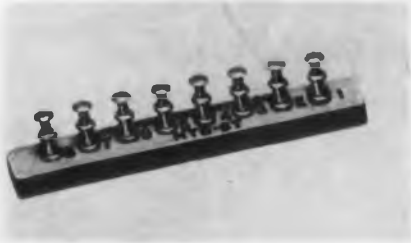
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Design and Manufacture of Electrical Timing Devices

CIRCLE ED-111 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1954

Miniature Terminal Board

Only 1-9/16" Long



Shown full size, the Series "MT" terminal board has eight turret-type terminals, tinned for easy soldering and molded directly

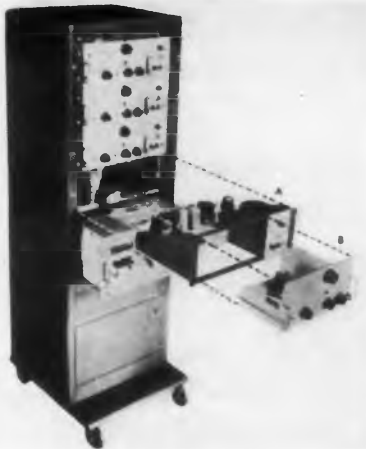
into the body of the compact terminal board.

The terminal board can be molded in any of three compounds: mineral-filled Melamine for high dielectric and mechanical strength; Plaskon reinforced alkyd type for unusually high impact strength and arc resistance; and Diallyl Pthalate for high dimensional stability, excellent dielectric properties, and maximum moisture resistance. DeJur-Amsco Corp., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N. Y.

CIRCLE ED-112 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscillographic Recording System

Can Record Four Phenomena Simultaneously



The Model 150 system consists of a vertical amplifier cabinet containing a four-channel recorder assembly, and a built-in driver amplifier and power supply unit (A in illustration) for each of the channels. The system is applicable to the graphic registration of almost any phenomenon (individually or up to four simultaneously) within the frequency range of 0 to 100cps.

The preamplifier (B in illustration) required for the specific application is plugged into the appropriate channel. Standard plug-in preamplifiers now available include ac-dc, carrier, d-c coupling, servo monitor, log-audio, and low level types. Blank assemblies are also available to permit the user to make his own special circuits.

Other features of the system include: improved control of input signals by use of 1, 2, 5 ratios on the attenuator; and a selection of nine paper speeds provided on one control (0.25-100mm/sec). The system can record such phenomena as stress, strain, pressure, displacement, thickness, velocity, voltage, temperature, torque, light, flow, position, radiation, and tension. Sanborn Co., Industrial Division, Dept. ED, 195 Massachusetts Ave., Cambridge 39, Mass.

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

ELECTRONIC DESIGN • March 1954

I.R.E. NATIONAL CONVENTION and RADIO ENGINEERING SHOW

New York City
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See latest developments in Fusion Sealed semiconductor devices at the

Hughes Exhibit

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Kingsbridge Armory

Inspect the new Hughes Silicon Junction Diode shown for the first time. Standard Hughes point-contact germanium diodes in RETMA and special types will also be on display.

HUGHES DIODES

A New Standard of Reliability

Reliability in semiconductor devices is determined principally by permanent freedom from the two major causes of failure—moisture penetration of the envelope, and electrical instability under extreme operating conditions.

HUGHES SEMICONDUCTOR DEVICES are designed to prevent such failures through two exclusive features:

1. **Fusion Sealing**—The glass-to-metal seal, proved in billions of vacuum tubes, is incorporated to full advantage in semiconductor devices by the Hughes-developed process of fusion sealing at high temperature. The result is a rigid one-piece glass envelope impervious to moisture.

2. **100% Testing**—Hughes 100% testing procedures invite instabilities to occur prior to shipment, assuring rejection of defective units. Each standard HUGHES DIODE is temperature-cycled in saturated water vapor, JAN shock-tested, and electrically tested under vibration. This testing procedure insures operation of HUGHES DIODES under adverse conditions of moisture, temperature, vibration and severe shock.

Reliability of HUGHES DIODES has been proved in advanced airborne military radar and fire control systems, and for guided missiles. All Hughes semiconductor devices are designed to the same high standards of reliability.

Dimensions of
actual diode
envelope:
0.130" X .265"



FUSION SEALED IN GLASS

for electrical
stability

Hughes

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

ONLY ONE — out of many — IS FIRST

They all started equal... but
ONLY ONE WON!

A spanking breeze across the bay . . . the echoing boom of the race steward's deck cannon . . . ropes and sails straining for advantage of position. Each boat, sleek and ship-shape, is out to win — but only one will come in first.

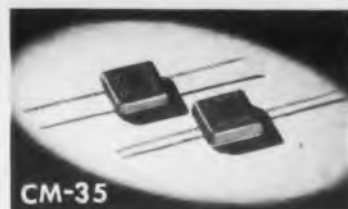
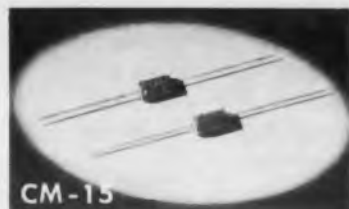
most capacitors start even, too

. . . but EL MENCOCAPACITORS always win first place in specification requirements because their superiority and dependability have been proven. They're factory-tested at more than double their working voltage . . . they're guaranteed stable under the most adverse conditions of application.

No matter what your requirements — from the mighty high-capacity CM-35 (5-10,000 mmf) to the midget low-capacity CM-15 (2-525 mmf) — EL MENCOCAPACITORS gives you superior job-rated, job-tested performance. They're built to win!

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THE ELECTRO MOTIVE MFG. CO., INC. WILLIMANTIC, CONNECTICUT

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

New Products . . .

Fluted Set Screws Easily Tightened or Loosened

Fluted Socket set screws can be tightened or loosened repeatedly without risk of damage or distortion. Strength is dependent on the special design rather than the screw material. The extra strength makes it possible to supply small sizes particularly suitable for small, precision products.



Both "Zip-Grip" Self-Locking and conventional set screws are available with the fluted sockets. A special key or wrench is required, making the set screws tamper-proof. The screw stays positively on the key or wrench while inserting or starting in a tapped hole, an advantage on the production line. Set Screw & Mfg. Co., Dept. ED, 265 Main St., Bartlett, Ill.

CIRCLE ED-117 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Potentiometer With 360° Electrical Rotation



ACTUAL SIZE

The "D-100" Miniature Precision Potentiometer is available with up to 360° electrical as well as mechanical rotation, in resistance ranges up to 50,000 ohms, $\pm 1\%$. The resistance element and its mounting, like a watch movement, is pre-assembled and then placed into the housing. The complete unit weighs only 1/2 oz. It has an anodized 7/8" diam aluminum case. Windings are available with linearity guaranteed to within $+1\%$ of total resistance. The units are rated at 1w at 25°C, and the resistance alloy has a temperature coefficient of 0.00002 parts per degree C for values of 500 ohms or more. Ambient temperature rating is from -67° to $+250^\circ$ F. The terminal board material withstands 250°F. Terminals are available in silver or gold plating. Jet Electronics, Inc., Dept. ED, 93 Mass. Ave., Boston, Mass.

CIRCLE ED-118 ON READER-SERVICE CARD FOR MORE INFORMATION

• speed production

• eliminate hardware with



Carry-Through Printed Circuits

proved enormously successful as shown by this sub-assembly

I.C.I. carries the pattern of the printed circuit through the holes to the other side to maintain efficient continuity.

NO hardware . . . with resulting excellent economies plus speeded-up production and more useable space. In a one square foot area of a printed circuit board .125" thick, 150 holes .020" in diameter can be successfully plated through.

I.C.I.'s unparalleled experience and engineering staff are at your disposal. WRITE, detailing your requirements for specific help and a copy of our thorough, new technical brochure which explains our research, design and conversion services.

I.C.I. also handles complete sub-assemblies as shown.

117 Roosevelt Avenue, Belleville, New Jersey

CIRCLE ED-116 ON READER-SERVICE CARD FOR MORE INFORMATION

When Contact Reliability
is most important...

**the NEW
8QA
MULTI-CONTACT D.C.
Phil-trol
RELAY**

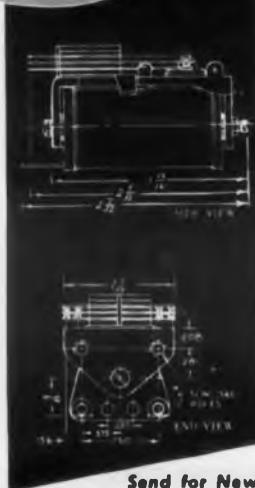


Dependability plus high sensitivity have made this new Phil-trol relay an immediate favorite with engineers and designers. Compactness and adaptability provide new answers to problems confronting electronic and control engineers.

Features include immediate response; fast closing and opening; contact springs with twin contacts; heavy duty, long-life bronze bearings; light weight.

Like all standard Phil-trol relays, the 8QA is available in a wide range of modifications. Coils may be single or double wound, and equipped with copper slugs or sleeves for slow release or for slow operation.

Phil-trol engineering experience and design facilities are available to help you solve any new application problem.



Send for New
Phil-trol Catalog

Phil-trol

IS THE REGISTERED TRADE MARK OF
PHILLIPS CONTROL CORP. • JOLIET, ILLINOIS
A THOR CORPORATION SUBSIDIARY • OFFICES IN ALL PRINCIPAL CITIES

CIRCLE ED-119 ON READER-SERVICE CARD FOR MORE INFORMATION

Laboratory Electromagnet And Matching Power Supply



The 6" Model V-4007 multi-purpose laboratory electromagnet is designed to provide a wide range of field values and configurations. It features changeable pole caps for uniform or high field work, an adjustable gap to provide a gap

range from 1/4" to 6", and a dolly mount that gives complete mobility without loss of rigidity in operating positions. The yoke angle can be easily changed to provide a variety of positions for working access.

Also available is a matching Model V-2200 regulated magnet power supply which provides highly stable d-c for operation of the electromagnet. The supply has provisions for field modulating and n-m-r (nuclear magnetic resonance) field controlling signals, and offers maximum current regulation against load and line changes. Slow drift of magnetic current is essentially unaffected by room temperature changes. Varian Associates, Dept. ED, Palo Alto, Calif.

CIRCLE ED-121 ON READER-SERVICE CARD FOR MORE INFORMATION

▲ U-H-F Sweep Generator Has 0-40Mc Sweep Width



The Model 130 U-H-F TV Sweep Frequency Generator operates in the 450-900Mc range. It is constructed with single range tuning, a minimum of controls, and a simple attenuator. The design makes it valuable for production and servicing applications, as well as for use in the laboratory.

Output is unmodulated or swept. Sweep width is continuously variable from 0 to at least 40Mc. The instrument blanks the return sweep, thus providing a zero level reference base line. Output voltages are: (1) high r-f output 0.1-1.0v into a 75 ohm load, and (2) low r-f output approximately 20db below high r-f output. The attenuator is continuously variable. New London Instrument Co., Dept. ED, P. O. Box 189, New London, Conn. ▲ *This product will be on display in Booth 166 at the Radio Engineering Show.*

CIRCLE ED-122 ON READER-SERVICE CARD FOR MORE INFORMATION



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CIRCLE ED-123 ON READER-SERVICE CARD FOR MORE INFORMATION

Announcing... POWERSTAT

VARIABLE
TRANSFORMERS

TYPE 136
and 236



Type 136

Higher Ratings — to meet the demand for POWERSTATS with 20 ampere capacity. **Small Size** — "pancake" coil design provides compact assembly • **Easy, Versatile Installation** — 3 sets of mounting holes — simple to change from bench to panel — terminals provide for any method of connection • **Smoother Operation** — self-lubricating nylon bearing shaft support • **Easy Service** — simply remove plate block for easy access to brush assembly • **Rhodium Plated Commutator** — assures smoother performance — contact surface forever free of oxides — uniform contact drop maintained — allows greater overload characteristics • Single and three phase assemblies are offered for manually-operated and motor-driven duty in 120, 240 and 480 volt ratings. Write for Bulletin P354.

• SEE the complete line at the 1954 Radio Engineering Show, March 22nd to 25th at Kingsbridge Armory in New York. Visit our exhibit in Booths 100-104.

The **SUPERIOR ELECTRIC** Company
1703 Clarke Avenue, Bristol, Conn.

CIRCLE ED-120 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1954



Actual Size

DIAMETER:
From 1/8" to 13/32"
LENGTH: From 1/4" to 1/2"
RMS applied voltage:
From 26 volts to 208 volts
DC output voltage:
From 20 volts to 160 volts
DC output current:
avg. from 200 microamperes
to 11 milliamperes

Reverse Leakage at 10 volts RMS:
0.6 microamperes to
2.4 microamperes
Potted in thermosetting
compound
Temperature Range:
From -60° C to 100° C
Available in 1, 2, 3, 4, 5, 6, 7
and 8 cell Diodes.

WRITE FOR BULLETIN SD-1

**INTERNATIONAL RECTIFIER
CORPORATION**

1521 E. Grand Ave., El Segundo, Calif. Phone: ORegon 8-3778
CHICAGO 205 W. Wacker Drive. Phone: FranklIn 2-3889
NEW YORK 501 Madison Avenue. Phone: Plaza 5-8665

CIRCLE ED-124 ON READER-SERVICE CARD FOR MORE INFORMATION

**FREE SAMPLE KIT
PROVES BIG
TIME SAVINGS!**

SEMS-by-SHAKEPROOF



Tedious separate lock washer handling is completely eliminated. Specially designed SHAKEPROOF® Lock Washers are pre-assembled to screws — two parts are handled as one! Held on by the rolled thread, the washer can't drop off!

SEND FOR FREE TEST KIT NOW!

*T. M. REG. U. S. PAT. OFF.

SHAKEPROOF

"Fastening Headquarters"

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

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

Illustrated
Actual
Size

SEE

the advantages in performance and economy you get with

SMALL NYLON COIL BOBBINS

These plastic moldings are more uniform, more accurate, less expensive . . .

—THE SUPERIOR RESULT OF

an exclusive single cavity molding method which assures low mold and maintenance costs. Only from GRC can you get the many advantages of

GRC'S PATENTED MOLDING METHOD

Write for samples of GRC coil bobbins and similar small parts in nylon and other thermoplastics.

Max. Wt. .025 oz.
Max. Lgh. 1"
SMALLNESS
UNLIMITED



Send Specifications for Prompt Quotation



GRIES REPRODUCER CORP.

40 Second Street, New Rochelle, N. Y., Tel.: New Rochelle 3-8500

CIRCLE ED-126 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Test Equipment Stand Saves Bench Space



The "Tek-Stand" is an accessory complementing the standard line of Shasta test instruments. It employs specially constructed arms clamped to the upright member which are firmly

attached to the backs of instrument cabinets, permitting adjustment to any position or angle. Up to three "A" size cabinets may be mounted on a single stand (see illustration).

The stand minimizes bench space required for instruments and makes them easy to attach, read, and adjust. Multiple a-c outlets are provided in the base for power cords of the instruments. Shasta Division, Beckman Instruments, Inc., Dept. ED, P. O. Box 296, Sta. A, Richmond, Calif.

CIRCLE ED-127 ON READER-SERVICE CARD FOR MORE INFORMATION

Thyratron Pulse Modulator Operates at 400-4000pps



The Model 12 Laboratory Thyratron Pulse Modulator is designed especially for research in the field of pulse power generation. Designed to be externally triggered at various repetition rates, it is primarily intended for pulsing magnetrons, but also may be used with the proper external load for other purposes.

The unit is supplied complete with tubes and pulse cable, but without the linear changing network. Provisions are made for insertion of various networks and pulse transformers. It will operate at repetition rates from 400pps to 4000pps and with pulse forming networks from 1μsec to 6μsec or more. Rated output power is 250,000w peak into a 50 ohm load. Duty cycle is 0.01%. Voltage is provided up to 20v to operate a magnetron. Meters are included to read operating voltage and current of the modulator, as well as current of the magnetron oscillator if used. Dormitzer Electric & Manufacturing Co., Inc., Dept ED, 5 Hadley St., Cambridge, Mass.

CIRCLE ED-128 ON READER-SERVICE CARD FOR MORE INFORMATION

with this NEW Variac Twice the Power for the Same Price!

The new Type V-2 VARIAC has twice the power rating of its predecessor, the popular Type 200-B. In addition it is equipped with the exclusive DURATRAC brush-track coating which insures long life, ability to withstand initial surges up to ten times rated value, and minimum maintenance.

- ★ Load rating of 0.345 kva (instead of 0.17Q)
- ★ Terminal board showing circuit and connections
- ★ Much less panel space
- ★ Standard mounting holes, interchangeable with Type 200-B
- ★ Metal base for improved cooling and added strength
- ★ Improved stops
- ★ No-load loss less than 3.5 watts
- ★ Meets MIL-T-27 requirements
- ★ Same price: \$12.50



Write for the
VARIAC BULLETIN

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Massachusetts, U. S. A.
NEW YORK 6 · CHICAGO 5 · LOS ANGELES 38

CIRCLE ED-129 ON READER-SERVICE CARD FOR MORE INFORMATION

TUBE SHIELDS

FOR
HIGH
TEMPERATURE
WINDINGS
TO 250° C

Our fibreboard shields with
aluminum liner or wrapper will
SAVE 50 %

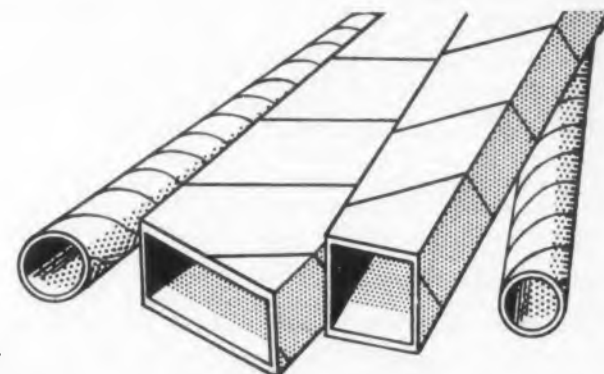
decrease microphonic
disturbances

(QUINTERRA)
TUBES

effectively shield
yoke leads

available in more than
2000 sizes, round, square
and rectangular.

made to fit 7&o9p
pin bases or to
your exact
specifications



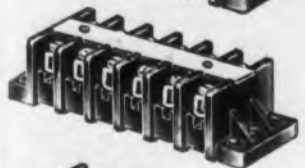
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FOR
CATALOG

ACCURATE PAPER TUBE CO.

809 N. PEORIA STREET
CHICAGO 22, ILLINOIS

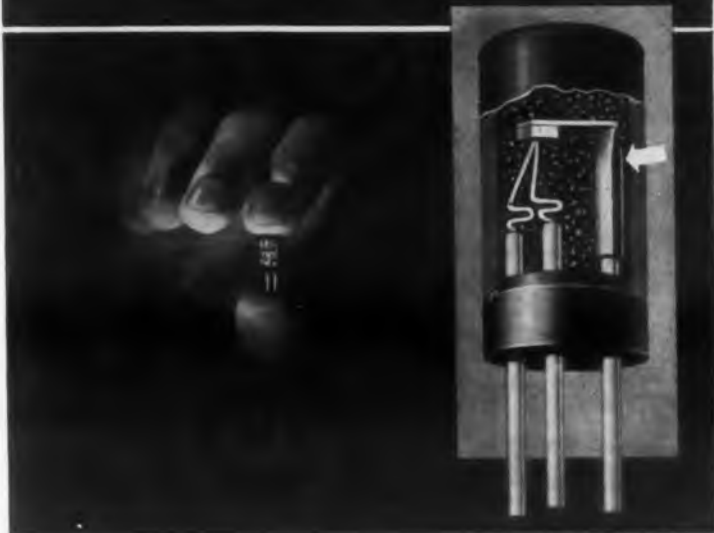
CIRCLE ED-130 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1954

NEW**CURTIS**
"R"—"RH" and "RHR"
TERMINAL
BLOCKSBuilt-Up Assembly
of 1 to 20 TerminalsSee them in
BOOTH No. 644Radio Engineering Show
Kingsbridge Armory
Bronx, New York
March 22 - 25**If you do not attend**Write for literature on this new
development for high-current applica-
tions and information of the
complete line of Curtis Terminal
Blocks including designs and sizes
for every purpose.**Remember -**Curtis Terminal Blocks
make better connections
economically — quickly.**CURTIS DEVELOPMENT & MFG. CO.**

3236 North 33rd Street, Milwaukee 16, Wisconsin

CIRCLE ED-132 ON READER-SERVICE CARD FOR MORE INFORMATION

SMALL TUBING—BIG NEWS
...THAT'S THE TRANSISTORTop 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 TUBINGAll analyses .010" to 3/8" O.D.
Certain analyses in Light Walls up to 2 1/2"

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

ELECTRONIC DESIGN • March 1954

Rotary Limit Switch
Works As Automatic ControlThis rotary limit
switch, equipped
with a cam and
gear mechanism, is
designed for use
where movement
can be expressed
as shaft revolu-
tions. Its primary
application is in-
tended for revers-
ing movement be-
tween two limits,such as the opening and closing of valves and ma-
chinery. A large selection of gear ratios, plus easily
adjusted, positive locking cams, provides unlimited
control of the movement between any two limits.The enclosure is of "Gemco Fibraloy" and is re-
sistant to heat, shock, acids, alcohols, and hydro-
carbons. NEMA Type 4 and 7 enclosures are also
available. The electrical circuit has two cam-operated
switches supplying one open and one closed circuit
for each travel position. A standard 1/2" pipe thread
is supplied for conduit connections. Gemco Electric,
Dept. ED, 25685 W. Eight Mile Rd., Detroit 19, Mich.

CIRCLE ED-133 ON READER-SERVICE CARD FOR MORE INFORMATION

Portable Insulation Tester
Light Weight, Low Cost UnitBuilt for non-
destructive testing,
this low-cost port-
able insulation
tester checks for
dielectric break-
down, leakage, and
short circuits on
high voltage equip-
ment and compo-
nents.It is equipped with a test voltage control,
test voltage indicator, current trip circuit, sensitivity
range switch, fault indicator signal lamp, oral fault
indicator, plus the other features generally found on
insulation testing units.Input voltage is 115v, 50/60cy; output voltage is
continuously variable from 0-5000v a-c; and capacity
is 100va max. The current trip circuit has two sensi-
tivity ranges: 1ma high sensitivity range, and a low
range adjustable to any set value between 5ma and
20ma to accommodate equipment or components hav-
ing higher capacity to ground. Milwaukee Electronics
Corp., Dept. ED, 5231 North Hopkins St., Milwaukee
9, Wisconsin.

CIRCLE ED-134 ON READER-SERVICE CARD FOR MORE INFORMATION

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 operat-
ing 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**

CIRCLE ED-135 ON READER-SERVICE CARD FOR MORE INFORMATION

**MINIATURE**
10 AMPS**2 PDT**
RELAY**QUALITY**
DEPENDABILITY... and
VIBRATION IMMUNITY
EXCEEDS MILITARY SPECIFICATIONS**ADAPTABLE**

COIL RESISTANCE TO 80,000 OHMS

Mounting plate is drawn and formed of 1/16" steel
Other enclosures available to your specifications.Dimensions: 1.625" Diameter, 2.187" Height,
1.856" Mounting Dimension Between Holes.**PROMPT DELIVERY**

For further information on this model 2021, write to:

ELECTRO-MECHANICAL SPECIALTIES CO., INC.
6819 MELROSE AVE. • LOS ANGELES 38, CALIFORNIA

See our display at the annual IRE Show, Booth No. 609

CIRCLE ED-136 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-137 ON READER-SERVICE CARD FOR MORE INFORMATION

"Helineers"

Electrical Noise in Wire-Wound Potentiometers

by Irving J. Hogan

Reprints of a talk presented at the 1952 West Coast I. R. E. Convention are now available. A copy is yours for the asking.



ASK FOR
DATA FILE No. 324

Helipot corporation

a division of BECKMAN INSTRUMENTS, INC.
SOUTH PASADENA, CALIFORNIA

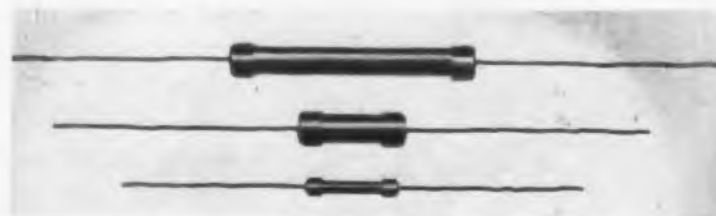
...first in precision potentiometers

235

CIRCLE ED-138 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

▲ Deposited Carbon Resistors Silicone Coated Units



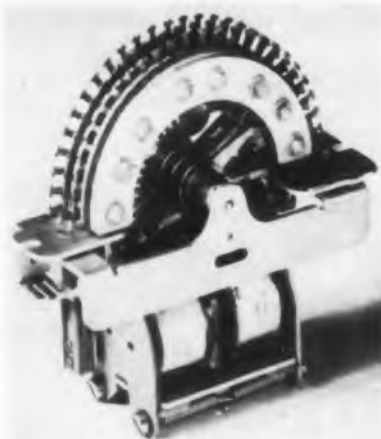
These commercial grade deposited carbon stable resistors are offered in tolerances of 1%, 2%, 5%, and 10%. Standard resistance ranges in the 1/2w size are from 1 ohm through 5meg; in the 1w size from 1 ohm through 10meg; and in the 2w size from 5 ohms through 100meg.

A tough silicone coating seals the stable precision element and protects it from physical abrasion without the addition of a protective sleeve. Dale Products, Inc., Dept. ED, Columbus, Nebr. ▲ *This product will be on display in Booth 769-771 at the Radio Engineering Show.*

CIRCLE ED-139 ON READER-SERVICE CARD FOR MORE INFORMATION

Stepping Selector

Operates in Either Direction



The G.E.C. (General Electric Company, Ltd., of England) Two-Way Stepping Selector operates in either direction at a speed of approximately 65 steps per second on self-interruption, and at speeds up to 20 per second from external impulses. The unit can replace multiple standard one-way stepping switches in many applications.

The unit is designed for use with standard 25-contact banks of up to six levels, or 50-contact banks of up to three levels. All selectors can be furnished with bridging or non-bridging wipers, or any desired combination of both. Armature coils are available for operation at 12v, 24v, 50v, 110v, or 220v d-c. IMTRA Corp., Dept. ED, 58 Charles St., Cambridge, Mass.

CIRCLE ED-140 ON READER-SERVICE CARD FOR MORE INFORMATION

Correction

The Expanded Scale Voltmeter described in the February issue (*ED-92, page 50*) carried an incorrect accuracy rating. Manufactured by the Arga Div., of Beckman Instruments, Inc., 220 Pasadena Ave., South Pasadena, Calif., the instrument has an accuracy of $\pm 0.1\%$ of input voltage instead of $\pm 1\%$ as originally stated.

Another outstanding DESIGN ACHIEVEMENT by Federal GERMANIUM DIODES

S.C.S.
"SINGLE-CRYSTAL-STABILIZED"

by Federal
GERMANIUM
DIODES

"SINGLE-CRYSTAL-STABILIZED"

... precision-made and vacuum-sealed to provide a new high in performance for germanium diode applications!

SINGLE-CRYSTAL GERMANIUM—the finest for reliable performance

MOISTURE-PROOF—vacuum-sealed, all-ceramic construction to provide stable characteristics

EVERY DIODE TESTED for all characteristics

COMPLETELY INSULATED CASE POLARITY clearly identified

HEAT SINKS protect during soldering

SMALL SIZE ($\frac{1}{4}$ " diameter, $\frac{1}{2}$ " long)

FLEXIBLE LEADS for easy mounting

NO FILAMENT—no heater power drain or hum

LOW SHUNT CAPACITY (average 1 mmf.)

SELF-HEALING for temporary overloads

NO CONTACT POTENTIAL

WITHSTANDS adverse temperature and humidity cycling

INSURES tens of thousands of hours of dependable performance

Available in 14 types. For full information, write Dept. R-135.



Federal Telephone and Radio Company

SELENIUM-INTELIN DEPARTMENT

100 Kingsland Road

Clifton, N. J.

CIRCLE ED-141 ON READER-SERVICE CARD FOR MORE INFORMATION

KULKA

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



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

TERMINAL BLOCKS

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



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

CIRCLE ED-142 ON READER-SERVICE CARD FOR MORE INFORMATION

HOW JOYAL INFLUENCES DESIGN

Joyal WELDING AND SOLDERING MACHINE 5000 W— MODEL D

Eliminates 5 Production
Handling Operations



Design with production-wise Joyal equipment in mind to achieve easier production and increased efficiency. **BEFORE:** In making the contact arm shown, it was necessary to thread the wire into the hole, bend the wire, cut the wire, flux, bring part to soldering

iron, solder and then clean. **NOW:** Just bring the 2 parts together; weld. Find out about Joyal's line of standard equipment and how Joyal can engineer special and automatic soldering and welding machines. Write for data detailing your problems.

JOYAL PRODUCTS, INC., 115 Edison Place, Newark 5, N. J.

CIRCLE ED-143 ON READER-SERVICE CARD FOR MORE INFORMATION

BERKSHIRE LABTRANS PULSE TRANSFORMERS



COMPACT • CONVENIENT • VERSATILE

These miniature pulse transformers are designed for use in the microsecond and fractional-microsecond range, in equipment where space must be saved at no sacrifice in quality. They are provided with standard octal bases, stand 1.1 inch above chassis, and have a diameter of 1.37 inch.

Type	Imp.	Rise Time	Percent droop at:				Price
			1 μ s	2 μ s	5 μ s	10 μ s	
PT-1	100 ohms	.04 s	20	50	60	80	\$8.95
PT-2	100 ohms	.04 s	20	30	50	70	8.95
PT-3	120 ohms	.03 s	20	40	55	75	9.50

These transformers are available at considerable savings in a sample package containing one of each type, at only \$21.50 f.o.b. Lincoln, Mass.—or postage prepaid if remittance accompanies order. Additional details and specifications are free on request.

Berkshire Laboratories, 708 Beaver Pond Road, Lincoln, Mass.

CIRCLE ED-144 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1954

▲ Time Interval Meter With Selectable Polarity



The Model D-705 Time Interval Meter measures intervals from 40 microsec to 1sec with an accuracy of ± 10 microsec. It also records the data in 10's of microseconds in a unique in-line presentation based on a newly developed drum-type indicator. The instrument combines a counting chain with a precision frequency source and appropriate starting and stopping circuits. Trigger pulses start and stop the counting. Electronic counters accurately count the high-speed internal pulse frequency which is 100kc. The counters store this information and, at the same time, indicate the progress of the count on a series of neon lamps located behind numbered panels.

Flexibility in operation is provided by adjustable triggering levels and by selectable polarities for each channel. Where two pulses occur on a single channel, a combined start-stop channel is provided.

A recording attachment, Model RC-135, is also available. Digital Instrument Co., Inc., 4221 Ponce de Leon Blvd., Coral Gables, Fla. ▲ *These instruments will be on display at the Radio Engineering Show at Booth 340.*

CIRCLE ED-145 ON READER-SERVICE CARD FOR MORE INFORMATION

▲ Piston Capacitors With Extruded Lead-In



Dust-proof metal caps are available with extruded lead-ins fused to this firm's Piston Type Variable Trimmer Capacitors. Also, silver plating throughout is offered at slight extra cost for better performance at u-h-f and microwave frequencies.

Some piston capacitor models are less than 1" in overall length at maximum capacitance and have ranges from 0.7mmfd to 18.0mmfd. Electronics Div., JFD Mfg. Co., Dept. ED, 1462 62nd St., Brooklyn 19, N. Y. ▲ *This product will be on display in Booth 123 at the Radio Engineering Show.*

CIRCLE ED-146 ON READER-SERVICE CARD FOR MORE INFORMATION

FORMULA 602 VS. CARBON TETRACHLORIDE

(report by independent test laboratory)

CARBON TETRACHLORIDE



FORMULA 602

Ten healthy adult albino rats inhaled 125 parts FORMULA 602 per million parts air in an inhalation box for 30 minutes. This was repeated daily for 14 days. At the end of this time **ABSOLUTELY NO ILL EFFECTS OR DEATHS OCCURRED!**



After 30 minutes exposure to 125 parts carbon tet per million parts air in an inhalation box, seven out of ten rats died. The following day, the remaining 3 rats died after another 30 minutes exposure. **CARBON TET KILLED ALL THE RATS!**

FORMULA 602 CLEANS MOTORS AND ALL ELECTRONIC EQUIPMENT

FORMULA 602 cleans without leaving a residue, corroding metals or damaging electric insulation. Use it wherever carbon tet is used for cleaning!

SEND FOR FULL INFORMATION TODAY

the PENETONE co.

BOX ED-354, TENAFLY, NEW JERSEY

CIRCLE ED-147 ON READER-SERVICE CARD FOR MORE INFORMATION

INTRODUCING THE NEW

MODEL "U"

- Choice of 12 alternative blower performance curves.
- All-angle, resilient, sleeve-bearing, NEMA rated, G.E. motor, nylon insulated.
- Integral electrical, airflow interlock switch, air velocity type.
- Ready fitted with inlet and outlet clamps and adaptors.

The new MODEL "U" line of UTILITY blowers are specially designed for electronic, instrument and light industrial application. They are compact and move large volumes of air in relation to their size and weight. Handy mounting arrangements as well as integral ducting connectors are a designers delight. Motors are 1-phase, dual voltage, capacitor start.

Complete line on display at IRE SHOW, Booth 581-583.



ROTRON MFG. CO., INC.
7 Schoonmaker Lane, Woodstock, N. Y.

CIRCLE ED-148 ON READER-SERVICE CARD FOR MORE INFORMATION

Design Simplified...



with the
Metron
VARIABLE
SPEED DRIVE

- Permanently lubricated
- Your choice of 6 controls
- Speeds up to 10,000 RPM
- Nominal output .025 HP

• For further information about how Metron units can simplify your costly speed changing problems, write for Bulletin 99.



Model 3 B lever type control

Design engineers at Century Geophysical Corporation make use of the Metron Variable Speed Changer to give them continuously adjustable chart speeds in their miniature oscillograph. Century engineers find that it is simpler and more economical to use Metron Miniature units as components than to design and build their own. Metron Variable Speed Changers are designed into countless products that call for changes in speed. The units are small—only 4 3/16" long—to fit minimum space. They are smooth and accurate in operation and cover infinitely variable output speeds from 5:1 step down thru 1:1 to 1:5 step up.

Metron INSTRUMENT COMPANY
480 LINCOLN ST., DENVER 9, COLO.

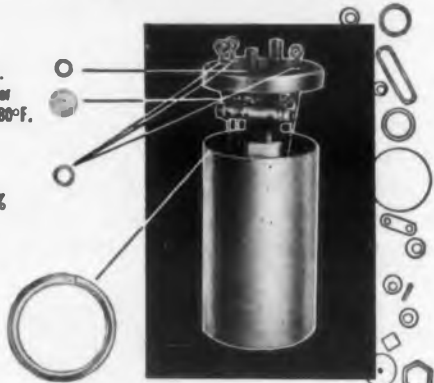
CIRCLE ED-149 ON READER-SERVICE CARD FOR MORE INFORMATION

3 Soldering Operations in 1 Easy as ABC with KESTER "SOLDERFORMS"

A Solder screws and stud to can cover.
"Solderform" Disc & Rings 9% Silver
—95% Lead Alloy. Melting Point 680°F.

B Solder glass terminals to cover.
"Solderform" Rings 63% Tin—37%
Lead Alloy. Melting Point 361°F.

C Hermetically seal cover on can.
"Solderform" Ring 28.5%
Bismuth—28.5% Tin—43%
Lead Alloy. Softening Point 250°F.



Here's a typical example of a tough resistance soldering job involving progressively lower melting temperatures. Kester "Solderforms" made sure this high precision oscillator coil came through every test successfully.

WRITE TODAY for free "Solderform" samples and literature.

KESTER
SOLDER COMPANY

4266 Wrightwood Avenue • Chicago 39, Illinois
Newark 5, New Jersey • Brantford, Canada

CIRCLE ED-150 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products...

Plug-In Power Supply

Delivers 12.6v, 0.9amp, D-C



The Model 119 "Unitized" D-C Filament Supply is a self-contained plug-in unit for operation from 115v, 60cy line. It delivers well-filtered d-c for the operation of electron tube filaments, and it will operate a maximum of six 1.9w filaments. Output

voltage is 12.6v, d-c (6.3v filaments must be wired in series pairs). Output current is 0.9amp max. Momentary overloads ten times this current will not cause damage.

The transformer primary winding has five taps to allow close adjustment of the output voltage; it also permits operation at other than 115v (approximately 95-135v at 50% load). Ripple content is less than 2.0% at maximum load. Compact and sturdy, the unit has an octal pin base, measures 3" x 3-1/4" x 3-3/4" seated, and weighs 2 lb. C. J. Applegate and Co., Dept. ED, 1816 Grove St., Boulder, Colo.

CIRCLE ED-151 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Relays

Withstand High Shock, Temperatures



"Hi-G" Power Relays operate reliably under the high temperature, high shock, and high frequency vibration found in aircraft, rocket,

and missile applications. They are securely braced to their hermetically sealed containers and constructed throughout of non-volatile materials that cannot generate gases at high temperatures.

The relays are available in four basic series: High-G types that withstand 20G's vibration at over 500cps; Standard types for 10G's vibration at 55cps; special High Temperature types; and Industrial types for less severe applications. Each series is available with 2, 3, and 4-pole double or single-throw, or 6-pole single-throw contacts, and can be furnished in hermetically sealed metal containers with either solder lugs, screw terminals, or standard AN connectors. Contact ratings of 3amp, 5amp, or 10amp are standard. Coils are available for practically any d-c voltage. Hetherington, Inc., Dept. ED, Sharon Hills, Pa.

CIRCLE ED-152 ON READER-SERVICE CARD FOR MORE INFORMATION

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TYPICAL MODEL
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6000v. @ 100μamps.
115v., 400cps., 1 phase input
Built to MIL specs.
Potted with specially
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Units up to 50kv. can be built to your specs.

MAGNETIC AMPLIFIER REGULATED POWER SUPPLIES

1% REGULATION AND RIPPLE

Model	Volts	Amps	Model	Volts	Amps
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MR1040-30	10-40	30	MR2432-200	24-32	200

Write or phone factory for literature or quotations. Samples of M1139D can be loaned for your testing purposes!

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CIRCLE ED-153 ON READER-SERVICE CARD FOR MORE INFORMATION

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CIRCLE ED-154 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1954

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COAXIAL SWITCHES

BY

TRANSCO



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Same RF head construction and performance as famous TRANSCO remote control switches.

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CIRCLE ED-155 ON READER-SERVICE CARD FOR MORE INFORMATION

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- Any pulse width from 0.1 to 40 microseconds
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- Any voltage rating from 1000 to 25000 volts

Tobe pulse forming networks have an excellent record of performance, both in radar sets and in seasoning equipment for magnetrons and hydrogen thyratrons. Our design experience and production facilities assure deliveries to your schedule requirements. Widely used networks are tabulated below. Many others are available—write for data sheet.

TOBE DEUTSCHMANN
CORPORATION
NORWOOD, MASSACHUSETTS

CIRCLE ED-156 ON READER-SERVICE CARD FOR MORE INFORMATION

▲ Impedance Comparator

Tests Resistors, Capacitors, Inductors



Impedance Comparator Model 60 reads, on a large meter, the percentage deviation of the component under test from a standard component. Designed for testing of resistors,

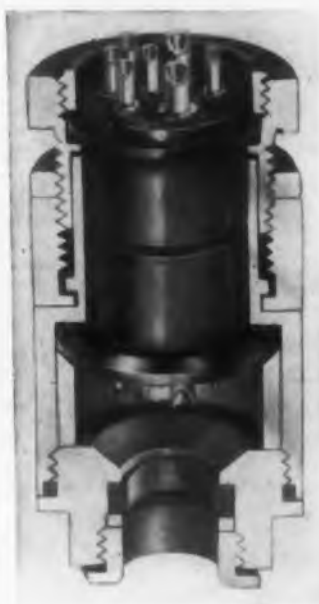
capacitors, and inductors, it has four ranges: 1%, 5%, 10%, and 20% full scale. One simple linear scale serves for all ranges.

No zero adjustment is required, and the range calibration is readily performed by means of a built-in standard. There is no need to operate push-buttons or relays. Component impedances from 1 ohm to 5 megohms at 60cy may be compared. Industrial Test Equipment Co., Dept. ED, 55 E. 11th St., New York 3, N. Y. ▲ This product will be on display in Booth 309 at the Radio Engineering Show.

CIRCLE ED-157 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Connectors

Pressure-Tight Design



This lightweight, miniature connector design features molded melamine inserts in an aluminum shell for high dielectric properties and maximum mechanical strength. Contacts are gold plated over silver to assure easy soldering and prevent corrosion. Male contacts are of brass; female socket contacts are of spring temper phosphor bronze.

Pressure-tight features are obtained by neoprene rings between the molded inserts and shell, and by a neoprene cylinder ring around the cable insulation which is compressed by means of a gland nut. Leakage is rated at less than 1 cu in per hr at 30psi.

A threaded coupling ring on the cable shell permits easy engagement and rapid uncoupling. Mating keyways in the shells provide positive polarization. Weight of the panel mounted receptacle is 0.5 oz; of the cable mounted plug is 1.5 oz. Gorn Electronics, Dept. ED, 883 Main St., Stamford, Conn.

Pressure-tight features are obtained by neoprene rings between the molded inserts and shell, and by a neoprene cylinder ring around the cable insulation which is compressed by means of a gland nut. Leakage is rated at less than 1 cu in per hr at 30psi.

CIRCLE ED-158 ON READER-SERVICE CARD FOR MORE INFORMATION

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THEORY AND DESIGN OF ELECTRON BEAMS

By JOHN R. PIERCE

Bell Telephone Laboratories, Inc.



Here is a truly basic presentation of the theory of electron flow. It is particularly useful in the analysis and design of microwave amplifier and oscillator tubes, cathode ray tubes, and other devices in which a high beam current is important. It also includes much fundamental material on general electron optical problems, with emphasis on such important topics as space charge, thermal velocities and periodic focusing. New material that has not yet been published has been integrated with fundamental relations from many sources to provide in one systematic treatment the minimum amount of theoretical material necessary for a thorough understanding of electron flow and focusing in these various present-day devices. From the first page to the last this book is organized most effectively to give a thorough understanding of the basic principles governing electron beams in their application to many important design problems.

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Properties of Electric and Magnetic Fields • Forces and Equations of Motion • Simple Electron Motions • Some General Relations • Some Typical Special Problems • The Paraxial Ray Equation • Magnetic and Electric Lenses: Analytical and Numerical Solutions • The Effect of Thermal Velocities • Space Charge in Electron Beams • Electron Guns • Periodic Focusing Fields • About Designing Electron Beam Devices. 240 pages, illustrated \$4.50

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



SIGMA SENSITIVE RELAY FACTS

MECHANICAL CONSTRUCTION
 OPERATING CHARACTERISTICS
 FORCE CURVES
 OPERATING TIME CHARACTERISTICS
 HOLD TIME CHARACTERISTICS
 SENSITIVITY • ADJUSTMENTS
 MOUNTINGS • ENCLOSURES
 DIMENSIONS • WIRING DIAGRAMS
 STANDARDS : OPERATING LIFE
 SALT SPRAY • TEMPERATURE CYCLING
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The Sigma Relay Manual is frankly patterned after the RCA Tube Hand Book which in our view is one of the best things in the industry. It will be a long time before the Manual, even in its much more limited field of usefulness, achieves anything like the near perfection of its model.

Howsoever, there are here assembled all known facts about each Sigma relay, type, series, and adjustment. Each available combination is tabulated so that it can be selected with foreknowledge of all important attributes, notably including ratings under all test conditions selected for regular proof testing.

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

New Literature . . .

Cathode Follower Probe 162

A 2-page 2-color bulletin (F-400) covers the Model F-400 Cathode Follower Probe, which features small size, high input impedance, low power consumption, and low microphonics. Specifications, performance curves, and other relevant data are included. Gulton Mfg. Corp., Metuchen, N. J.

Volt-Ohm-Microammeters 163

A 4-page bulletin (A-4 RCS) describes, illustrates, and gives specifications and data on ranges of five volt-ohm-milliammeters and volt-ohm-microammeters. Also included is a section giving complete information on the new Model 269 100,000 ohms/volt sensitivity volt-ohm-microammeter. Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.

Radio-TV Products 164

A 16-page catalog (No. 56) covers a wide range of instrument, radio, and TV knobs; knob and plate combinations; a variety of switches; cord sets; fuse holders and connectors; phono and antenna jacks and plugs; wafer sockets; tube pin straighteners; fuse clips; and many other items. Gee-Lar Mfg. Co., Rockford, Ill.

Flexible Coaxial Cable 165

This 2-page bulletin (70-A) covers type "HX-O" r-f flexible coaxial cable, giving detailed data on characteristics, corrosion protection, lengths, and fittings. The cable has a 7/8" diam and has a high stability sheath. Andrew Corp., 363 E. 75th St., Chicago 19, Ill.

Data Sheets and Books 166

Two booklets cover the "Lefax" forms, binders, filing equipment, data books, and data sheets. One booklet (48 pages) gives prices and lists hundreds of data sheets on many subjects, including mathematics, metallurgy, communications, electrical engineering, physics, and other fields. The other booklet (32 pages) gives prices and describes forms for practically every purpose, illustrates and describes binders and filing equipment of numerous types, and describes a variety of handbooks. Lefax, Philadelphia 7, Pa.

Selenium Rectifiers 167

This 4-page 2-color bulletin illustrates and describes a line of 3-phase selenium rectifiers developed for applications requiring kilowatts of power. The rectifiers operate from nominal a-c line voltages and deliver 115v or 230v d-c. Convection and fan cooled units are shown, with ratings for 10kw, 20kw, 25kw, and 75kw. Ther Electric and Machine Works, 17 S. Jefferson St., Chicago 6, Ill.

Decade Scaler 168

A 4-page bulletin describes and illustrates the Type 12100 30ke Decade Scaler and the Type 52214 E1T Counter Tube decade stage. The first unit is for counting applications requiring a unit with high resolving power, small dimensions, and reduced consumption. The second unit is designed principally for the counting and indicating of electrical pulses. Both units can count at rates up to 30,000/sec. Electronics Division, North American Phillips Co., Inc., Mount Vernon, N. Y.

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Glass-to-Metal Sealing 169

A 24-page, 2-color brochure describes the facilities of this firm for producing glass-to-metal seals for the insulating and protection of electronic and electric products. A wide variety of typical standard products are described and illustrated, including: four types of electrodes for a wide range of applications, tubular button seals, glass seal tubes, multiple electrode sealed headers, octal plugs, and grommets. Much technical data is provided on these items. Also included are illustrations and descriptions of 22 different special products. The Hermaseal Co., Inc., Elkhart, Ind.

Batteries for Transistors 170

This 4-page 2-color bulletin describes a line of small batteries that meets specifications required in transistor operation. It presents curves of voltage vs time, and discharge curves of various batteries, and illustrates and describes batteries now being used in transistor service. Burgess Battery Co., Freeport, Ill.

Metal Preservation 171

A 12-page folder serves as a check list of metal protective and paint bonding chemicals and processes. It includes protective coatings for steel, zinc, and aluminum; phosphate coating chemicals for paint bonding, rust-proofing, and protecting friction surfaces; copper coating chemicals; soldering fluxes; heat-resisting paints; and copper stripping and brightening solutions. American Chemical Paint Co., Ambler, Pa.

Magnetic Amplifiers 172

An 8-page technical data bulletin (TD-601) describes transducer magnetic amplifiers developed for instrumentation, metering, and control of d-c currents and voltages requiring isolation. A section is devoted to definitions of magnetic amplifier terms; this is followed by a section on theory of operation. Other sections cover application specifications and operating characteristics. Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

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Size 15 Resolver shown full size

- Extremely accurate computing unit
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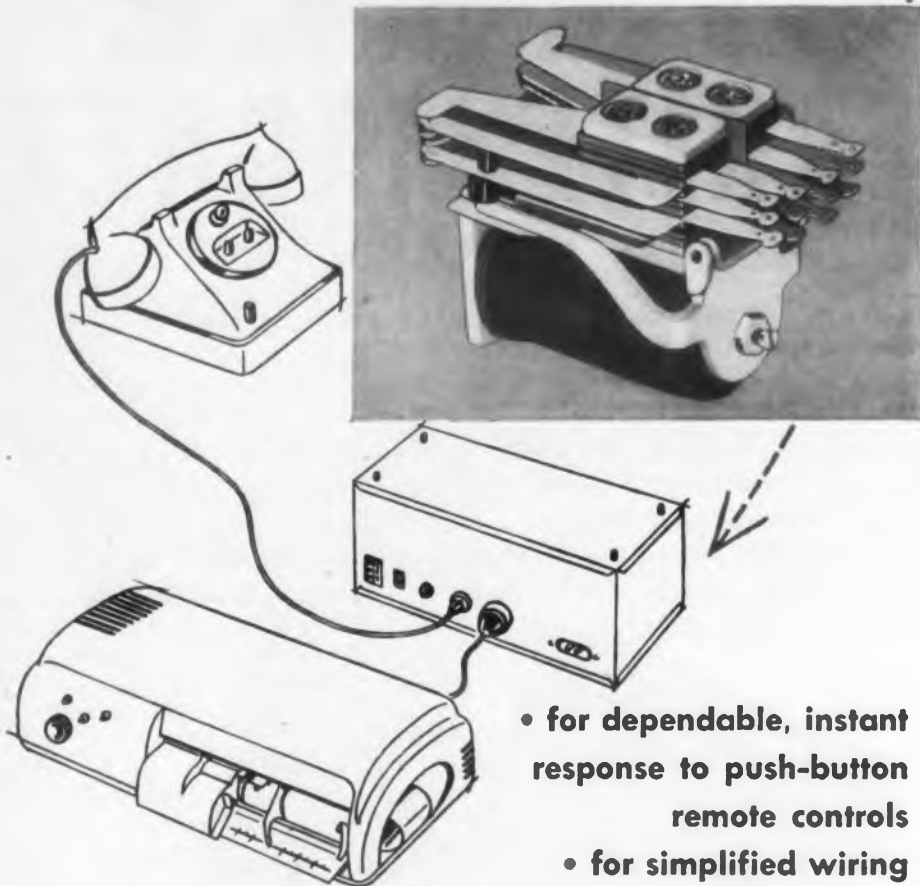
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CIRCLE ED-174 ON READER-SERVICE CARD FOR MORE INFORMATION

Dictaphone Telecord central dictation system uses **STERLING RELAYS**



- for dependable, instant response to push-button remote controls
- for simplified wiring

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Whatever *your* product's requirements for relays, standard or special, it will pay you to submit your specs to Sterling!

General Specifications Sterling Type GS Relays

COIL—Single or double wound up to 220 volts D. C. • **SPRING ASSEMBLY**—Up to 10 springs per pile-up, in any arrangement • **CONTACTS**—All types up to 3/16" diameter • **RESIDUAL**—Adjustable screw • **OPERATE TIME**—.005 to .050 sec. • **RELEASE TIME**—.010 to .100 sec. • **MOUNTING**—2 or 4 "8-32 or "6-32 tapped holes • **DIMENSIONS**—2½"x 1½"x 1-1/16" maximum • **WEIGHT**—6 to 10 oz.



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CIRCLE ED-175 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature ...

Time Delay Relay 176

A 4-page 2-color bulletin (SR4) describes the Model NET pneumatically controlled, time delay relay, which is designed to introduce either a sequence of time delay periods, or a momentary impulse, into an electrical circuit. The bulletin describes operating sequences, typical applications, and includes wiring diagrams and mounting dimensions. A'G'A Division, Elastic Stop Nut Corp. of America, Elizabeth, N. J.

Engineering Facilities 177

This 18-page brochure describes the research and development, field engineering, systems design, electronics interference reduction, and installation planning and supervisory engineering services available from this firm. International Electronics Engineering, Inc., 1612 K St., N.W., Washington 6, D. C.

Wire Thread Inserts 178

New military standard sheets covering helical coil wire thread inserts (National Coarse and National Fine Series) for aircraft applications are provided in this 20-page bulletin (689). Separate sheets list nominal lengths of 1, 1-1/2, 2, 2-1/2, and 3 diameters. Thread diameters range from .164-32 to 1.000-8. Also provided are two interchangeability lists: Military vs. "Heli-Coil" part numbers, and "Heli-Coil" vs. Military part numbers. Heli-Coil Corp., 1435 Shelter Rock Lane, Danbury, Conn.

Vinyl Chloride Materials 179

This 16-page 2-color brochure emphasizes the flexibility of product design attainable with "Opalon" vinyl chloride injection molding materials. Ten illustrated pages suggest dozens of uses for the materials in a variety of fields. In addition to physical flexibility, the compounds feature heat resistance, good electrical insulation, durability, and good color and finish. Monsanto Chemical Co., Springfield, Mass.

CHATHAM ELECTRONICS ULTRA-STABLE REGULATED POWER SUPPLIES

**.002% REGULATION FOR
10% CHANGE IN LINE VOLTAGE**

For those laboratories requiring the utmost in stability and regulation from D.C. power supplies, Chatham Electronics offers a group of ultra-stable regulated power supplies. The use of a driftless regulating circuit and mercury cell batteries as a voltage reference provides the extreme stability attained. These units can be supplied to meet your power requirements. Some typical supplies are listed below:

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400 to 1500	180	2	.002%	20
0 to 400	20	0.5	.005%	10
1500 to 3500	100	3	.005%	30
290 to 310	500	0.5	.002%	5
6.3 to 7.3	3 amps	10	.03%	1

*Max. drift in millivolts over 10 min. period

STANDARD REGULATED POWER SUPPLIES

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

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

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Executive and General Offices: LIVINGSTON, NEW JERSEY
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CIRCLE ED-194 ON READER-SERVICE CARD FOR MORE INFORMATION

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Conn.

Deep Drawn Boxes 180

A 16-page catalog lists more than 750 seamless deep drawn boxes of aluminum, brass, and steel, available from standard tooling. This catalog should be of value to buyers in the electronic, aircraft, and electrical fields. Also illustrated are some precision metal cabinets. All boxes have a smooth satin finish, unusual on drawings of this type. Zero Mfg. Co., 1121 Chestnut St., Burbank, Calif.

Pressure Potentiometer 181

A 4-page, 2-color bulletin (3553) describes a new miniature gage pressure potentiometer in standard ranges from 0-100psi to 0-5000psi. Photos illustrate the method of transmitting the movement of the bourdon tube to the sliding contact of the wire-wound potentiometer. Diagrams, charts, curves, and outline drawings provide additional technical information. Detailed specifications are included. Bourns Laboratories, Dept. NL, 6135 Magnolia Ave., Riverside, Calif.

Oscillator Controls; Relays 182

A 4-page bulletin (34-99) on "Frahm" oscillator controls is available with a companion 8-page bulletin (33-99) on "Frahm" reed, frequency sensitive relays. The oscillator controls are miniature tuning forks for use in electronic oscillators to provide stable output frequencies in the 50-1000cps range. The relays permit the transmission of a number of control signals over a single circuit; they can be used on all types of communication circuits, including wire, and radio and carrier systems. Full technical data are provided in the bulletins. James G. Biddle Co., 1316 Arch St., Philadelphia 7, Pa.

Boron-Carbon Resistors 183

Comprehensive data on 1/2w Molded Boron-Carbon "Precistors" are given in a 2-page bulletin (B-8). It includes characteristics, applications, tolerances, windings, terminations, dimensions, charts and graphs, and other valuable information. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

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CIRCLE ED-184 ON READER-SERVICE CARD FOR MORE INFORMATION



Centralab rotary switches solve a wide variety of electronic applications

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- Available in standard (1 7/8" diameter) or miniature size (1 1/2" diameter).
- Standard or special switching combinations — up to 12 positions or up to 6 poles per section.
- Single or multiple sections.
- Indexing: 30° or 60° (standard or miniature); 90° (standard only).
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- Steatite insulation — JAN Grade L-5 for low loss characteristics.
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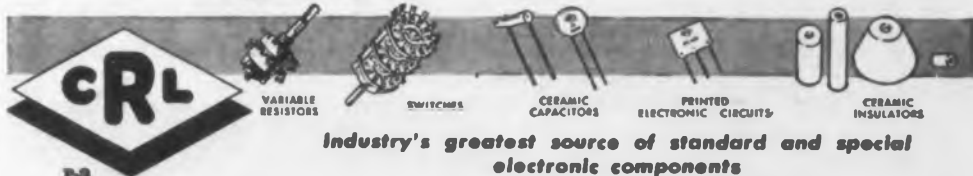
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More and more engineers are finding other uses for these precise and rugged units—jobs which thermal relays of the usual bi-metal design often cannot do... such as:

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East Orange, New Jersey

U. S. and Foreign Patents Pending

CIRCLE ED-186 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature . . .

Frequency Meters 187

A 2-page bulletin describes a group of four frequency meters designed for both field and laboratory use. They are each supplied complete with a microammeter, sensitivity control, and calibration charts, all mounted in a hardwood carrying case. The four units range from 900-1200Mc to 1700-2550Mc. Frequency Standards, Asbury Park, N. J.

Identification Markers 188

A 4-page bulletin describes the new "Speedy-Marx" identification markers which are available in solid cards (where all markers are the same), sequence cards, "odds and ends", colors of solid or mixed symbols, and special cards for individual needs. Application data on the stripping and simple installation of the markers is provided. North Shore Nameplate Co., Glenwood Landing, L. I., N. Y.

Measuring Instruments 189

This 36-page 2-color catalog, "Instruments for Modern Measurements", provides detailed illustrative and descriptive information on equipment for electrical, physical, surface, resistance welding, ultrasonic energy, electro-acoustical, and other measurements. It includes such instruments as magnetic oscillographs, a variety of amplifiers, vibration pick-ups, surface comparators, "Hypersonic" generators, deviation test bridges, frequency analyzers, integration networks, and numerous other equipments. Also available is a complete price list. Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

Power Resistors 190

This 2-page bulletin (P-2) provides comprehensive data on characteristics, applications, construction, ranges, ratings, and tolerances of Types PW-7 and PW-10 power resistors with axial leads. It includes valuable charts and graphs. International Resistance Co., Philadelphia 8, Pa.

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ELECTRONIC DESIGN • March 1954

Antenna Systems

192

This 24-page, 2-color catalog illustrates, describes, and provides essential data on a wide range of antenna types, including: bow tie antennas; "Corner" reflectors; "Colinear" multi-channel antennas; two-way, multi-channel "Colinear" antennas; a variety of yagis; antenna rotators; "Mighty Match" isolation filters for combining separate u-h-f and v-h-f antennas into a single transmission line; lightning arrestors; and boosters and accessories. Lapointe Electronics, Inc., Rockville, Conn.

Capacitors

193

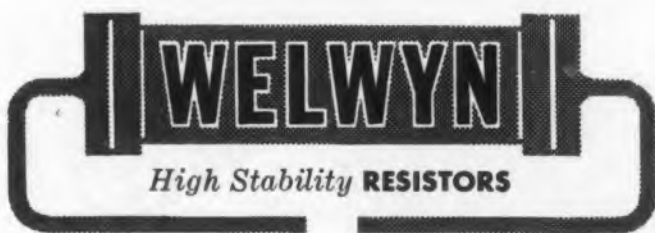
Two 4-page, 2-color bulletins (NB-149 and NB-153) illustrate and describe "Fixfil" metal-can cased capacitors and "Fixfil Demicon" metal-cased capacitors. Both types use "Fixfil" impregnant which permits capacitors to be operated at full rated voltage over the range of -55° to $+130^{\circ}\text{C}$. Ratings and dimensions, test data, and graphs of temperature characteristics are included. Cornell-Dubilier Electric Corp., 333 Hamilton Blvd., South Plainfield, N. J.

Linear Equations

This 126-page publication, "Simultaneous Linear Equations and the Determination of Eigenvalues", contains a majority of the papers presented at the National Bureau of Standards Institute for Numerical Analysis at Los Angeles on Aug. 23-25, 1951. The papers should be of value to workers in many branches of pure and applied mathematics, as well as to workers in fields such as physics, chemistry, and aerodynamics. Price is \$1.50. Write direct to Government Printing Office, Washington 25, D. C.

Small Synchros and Servos 195

A complete line of synchros, two phase servo motors, synchro transformers, synchro resolvers and induction motors for aircraft and other applications is listed in this 4-page, 2-color bulletin. Specifications for over 100 items are given. Examples of rigorous testing methods are also illustrated. Ketay Manufacturing Corporation, 555 Broadway, New York 12, N. Y.



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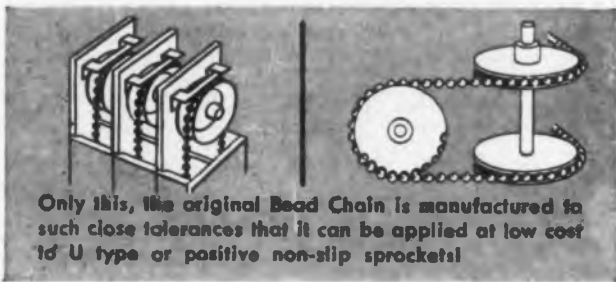
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New Literature . . .

Silicon Carbide 199

A 52-page brochure, "Facts About Silicon Carbide", includes sections on: discovery and occurrence, formation, properties, grain preparation, products—loose grain and grinding compounds, bonded and coated abrasives, refractories, resistors, metallurgical uses of silicon carbide, miscellaneous products, and other related subjects. The Carborundum Co., Niagara Falls, N. Y.

Thermometer Bulbs 200

Catalog 5701 describes, in 16 pages, a line of resistance thermometer bulbs of high speed, marine, room temperature, and sanitary types for temperature spans as narrow as 20°F. Also included are wet-and-dry-bulb resistance thermometer assemblies for measurement of relative humidity. Industrial Division, Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa.

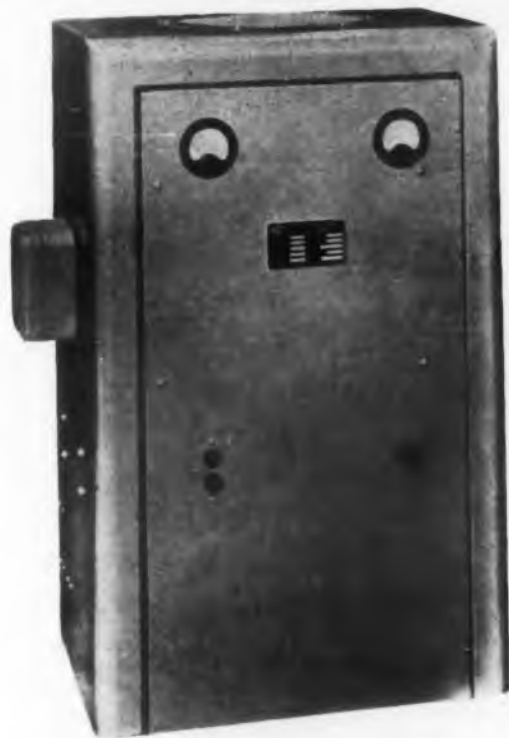
Photoelectric Relays 201

Two 4-page, 2-color bulletins (GEA-5920 and GEA-5921) illustrate and fully describe two new photoelectric relays, one rated at 450 operations per minute, and the other, a high-sensitivity, high-speed model, rated at 600 operations per minute. The bulletins explain how the relays work, cover their features, provide application data, and also describe the accessories available. Specialty Control Dept., General Electric Co., Schenectady 5, N. Y.

Twin Tetrode Tube 202

A 26-page data and application booklet on the type 5894/AX-9903 twin tetrode tube contains complete engineering information. The tube is designed to allow high power gain as an r-f power amplifier, modulator, and frequency multiplier. Data, application notes, typical performance curves, special features, and a description of construction are provided. Ampere Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N. Y.

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ELECTRONIC DESIGN • March 1954

Transmission Lines, Fittings 204

This 28-page, 2-color catalog (Form B 767) describes low-loss coaxial transmission lines and fittings for u-h-f TV broadcast applications. Much data is provided on 3-1/8" and 6-1/8" lines, fittings, and accessories, with complete tables of efficiencies for channels 2 to 83 for distances from 100' to 1600'. In addition to complete technical specifications, the brochure provides important data on layouts and installations. Broadcast Equipment Sales, RCA Victor Division, Camden 2, N. J.

Laplace Transforms

A 36-page publication, "Tables of Coefficients for the Numerical Calculation of Laplace Transforms", facilitates the evaluation of infinite integrals expressible in the form of Laplace transforms, such as arise in the theory of heat conduction and in various branches of electrical engineering. Price is 25¢. Write direct to Government Printing Office, Washington 25, D. C.

Varnishes and Resins 206

This 4-page bulletin reviews five coating and impregnating varnishes, an adhesive, and six bonding and laminating resins. Each product is described individually, along with its recommended applications. Tables compare each resin with all the others through nine properties. Also included are curves showing the thermal life of leading silicone dipping varnishes and cloth coating resins, plus that of Class B materials. Dow Corning Corp., Midland, Mich.

Circular Chart Recorders 207

Bulletin F-452M covers, in four pages, "Multi-Point Circular Chart Recorders". These instruments employ the "Turret" pen assembly, which makes possible 6 individual records on a single chart. Through a "Segmental" chart drive unit, the design becomes a 24, 48, or 96 point multi-record system. Construction features, specifications, and other data are included. Fielden Instrument Division, 2920 N. 4th St., Philadelphia 33, Pa.

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- Two watts continuous at 80° C.
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- Diameter 1/2 inch, depth 1/2 inch.
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- Occupies no more space than absolutely necessary.
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- Will not require YOU to do production-control checking for the manufacturer.



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- Precision wire-wound construction.
- Three watts continuous, to 80 degrees C.
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- Diameter 7/8", depth 3/8".
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quickly — simply — accurately



The new Type 1002-A Incremental Inductance Bridge combines outstanding features of compactness, ease of operation, accuracy, and wide range of measurement. A visual balance indicator allows measurements to be made in a few seconds, even in noisy locations. Maximum sensitivity at the balance point greatly increases the accuracy of balance. Only a single balance control is used, with cathode ray tube indication.

Inductance can be measured from one to 200 henries. Direct current through the reactor under test is accurately controllable from one to 500 ma, depending on the resistance of the coil windings. The effect of a change of dc on the inductance value is immediately measurable, by simple re-balancing. The inductance is measured at a constant frequency of 120 cps.

For design and test work on iron-core inductors, filter chokes, transformers, and plate reactors, this compact and self-contained instrument is unsurpassed.



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for the ultimate in reliability where the 6L6 is called for . . .

Absolute reliability!

There, in two words, is the net result of all the engineering which TUNG-SOL has put into the 5881. This completely new tube is designed to operate in circuits for which the 6L6 is specified and is completely interchangeable wherever the 6L6 is now in use. Full utilization of the design and production techniques which have proved themselves over the past 15 years, has created this exceptionally reliable tube.

The 5881 is manufactured under laboratory conditions accompanied by the most severe tests. It is rugged both mechanically and electrically, with tremendous overload capacity. The 5881 maintains high efficiency throughout its life and provides low cost operation through reduced maintenance.

Where reliable service is essential in audio circuits, the TUNG-SOL 5881 is a "must." Order it from your regular TUNG-SOL supplier.

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TUNG-SOL ELECTRON TUBES

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Patents . . . By John Montstream

Synchronization Circuit . . . Patent No. 2,645,717. A. W. Massman, Wheaton, Ill. (Assigned to Motorola, Inc.).

This patent describes the synchronization circuit shown on the opposite page, which provides a simple and effective automatic frequency control of the horizontal sweep circuit.

The synchronization circuit is connected with the synchronizing signal separator (25) of a conventional television receiver. The horizontal sync signal is applied to the control grid of the triode section (32) which acts as a phase splitter with negative going pulses *a* developed across cathode resistor 38 appearing on cathode 33 and equal positive going pulses *f* on anode 34. A phase detector section (40) has the negative going sync pulses applied to its cathode resistor (41). The

positive going sync pulses are applied to the grid of the section. Series connected resistors 45 and 46 develop a control voltage which is transmitted through a filter formed by resistor 48 and capacitors 49 and 50 to a multivibrator (52). Its output is fed to the horizontal deflection system 29.

From the deflection system at point 60, positive going pulses *b* are integrated by circuit elements 61, 62, 63, and 64 to form a sawtooth wave *c* which is applied to the plate (65) of the phase detector. The negative going pulses from wave *a* tend to cause grid current to flow so that the grid will become negative. When the sawtooth applied to the plate (65) is more positive, plate current will flow causing the cathode (42) to become more positive. Resistors 45 and 46, which connect the negative grid with the positive cathode, will then have



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ELECTRONIC DESIGN • March 1954

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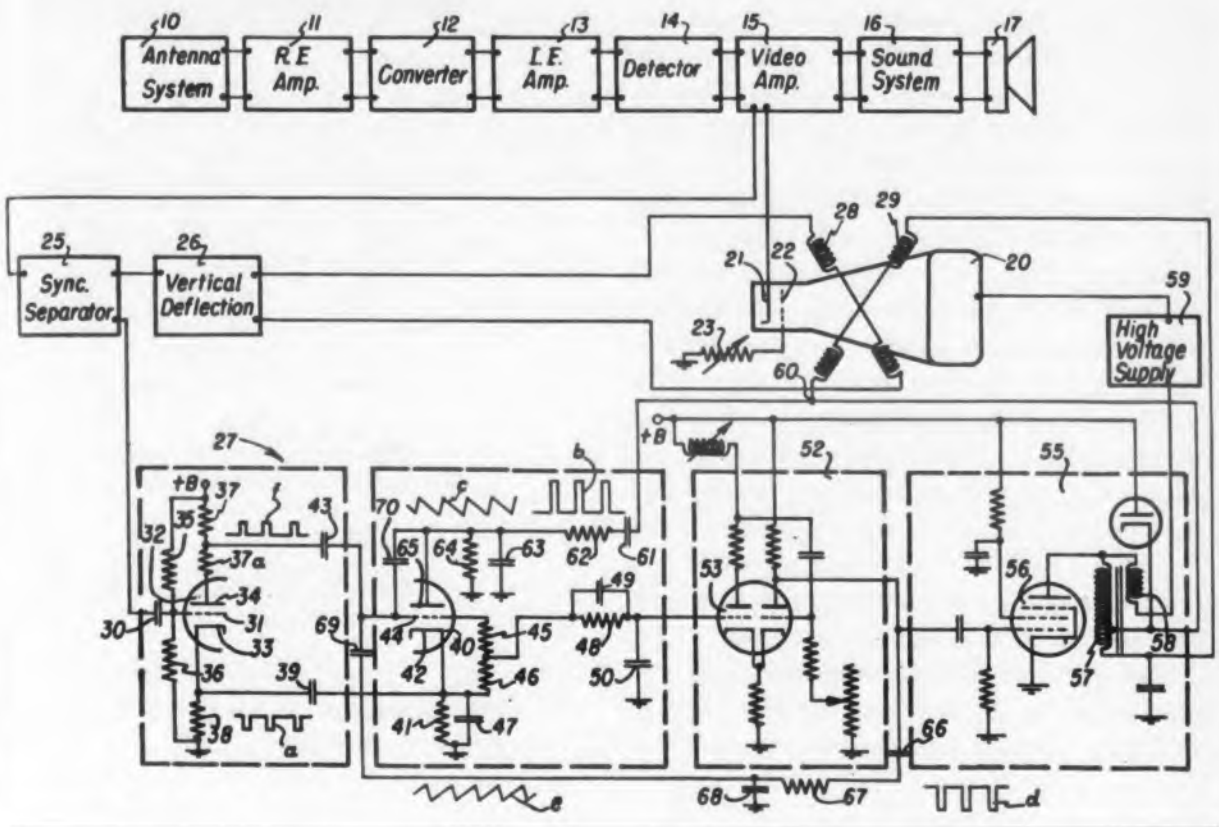
25
Sync.
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an intermediate point which is at zero potential when the sawtooth wave is in synchronism with the pulse wave, and will vary when not in synchronism..

The circuit affords satisfactory control

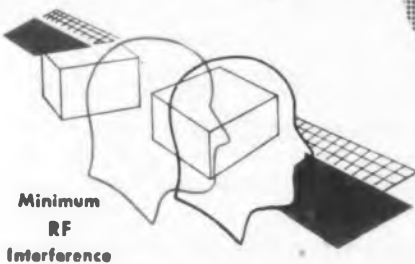
by applying a sawtooth wave to the grid (44) of the phase detector triode. This wave is produced by integration through 67 and 68 of the negative going pulse d from the output of the multivibrator.



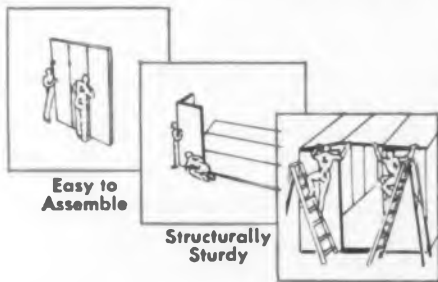
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for continuous . . .
automatic . . .
measurement of VSWR

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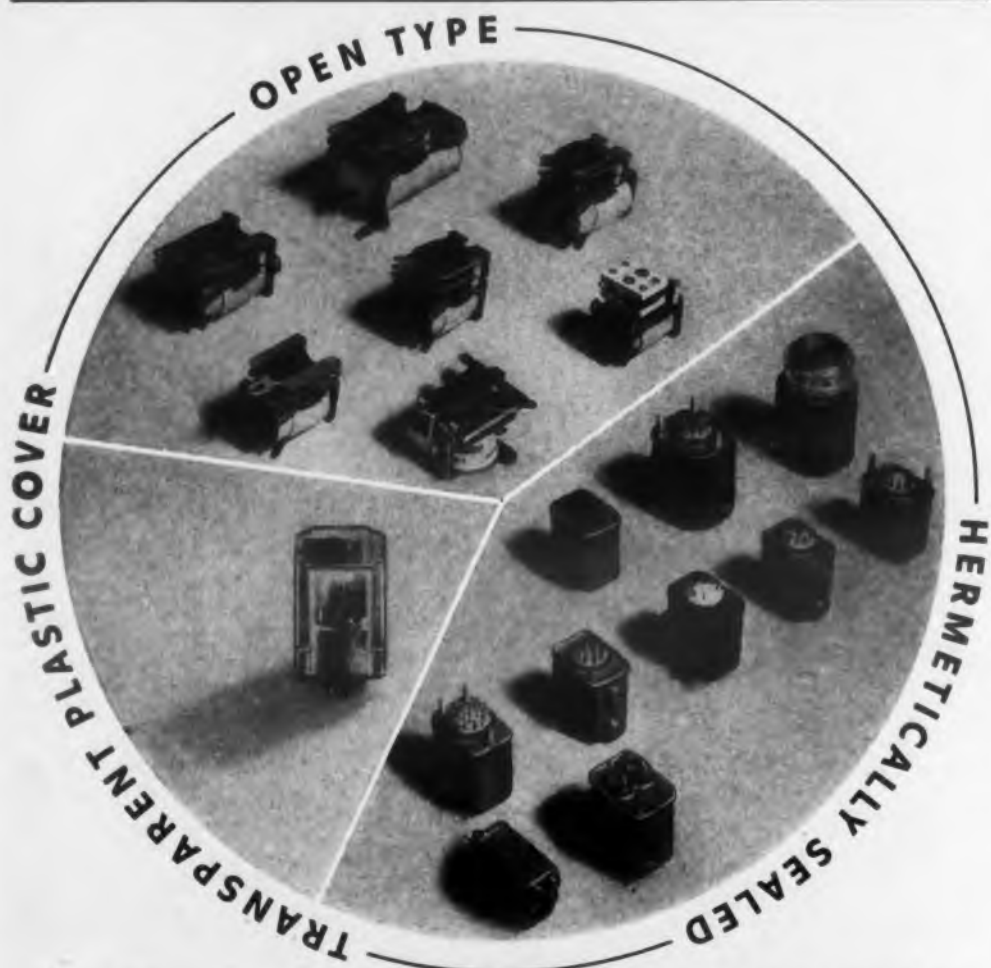
New designs make new demands. CUBIC engineers are constantly conducting research to develop new products to enable those new Electronic designs—still on the drafting boards, to become reality. In this connection, our Engineering and service departments are always at your disposal on any Electronic problem.

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*Controls for Electronic,
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Patents . . .

Self-compensating Inductor . . . Patent No. 2,654,861. A. S. Khouri, Milwaukee, Wis. (Assigned to Globe-Union Inc.).

This inductor, which is self-compensating as temperature changes, will have substantially fixed resonant frequency and accurate retrace characteristics. The inductance coil is bonded to a ceramic form that has a negative coefficient of dielectric constant close in value but of opposite sign to the ceramic's temperature coefficient of expansion. As the temperature rises, the coil's rising inductance is compensated for by its decreasing interturn capacitance.

In the bottom form shown in Fig. 1 the inductance material is applied into grooves in the form so that nearly all of the inductor's interturn capacitance is through the ceramic dielectric. In the upper three forms, the inductor is applied to ungrooved forms for partial compensation through the dielectric, which is usually sufficient.

The coil is either electroplated to or applied by a Shoop's gun to the core so that they expand and contract together.

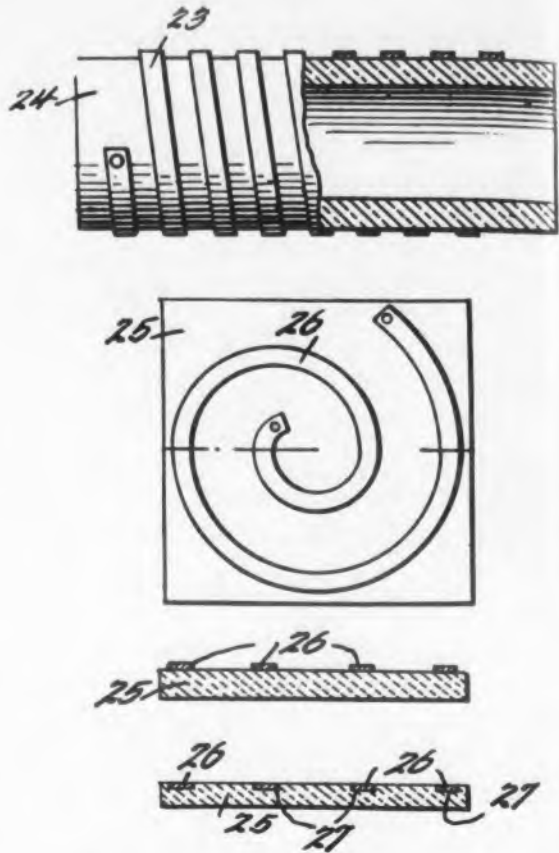


Fig. 1. One cylindrical and two helical ceramic forms on which the inductor (23, 26) is wound.

LESS LEAKERS with NICORO BRAZING ALLOY



A Wesgo developed nickel bearing gold-copper alloy that possesses—

- ★ Improved wetting and flow characteristics
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ELECTRONIC DESIGN • March 1954

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Noninductive Resistor . . . Patent No. 2,655,582. Leonard Kirby, Jr. and Gustave A. Erickson, Mendham, N. J. (Assigned to Mepco, Inc.)

Inexpensive, noninductive resistors, which can be compactly folded or rolled, are described in this patent. The resistance element is a line of resistive alloy (2, 6, 9, see Fig. 2) formed on one surface of a nonconductive paper (1, 5, 8).

The paper base can be folded accordion fashion, examples A and B, with the inductive fields of sections of the alloy on parallel faces of the folds cancelling each other out. For the first accordion form, a strip of insulating paper (4) must be folded in the accordion to prevent shorts. If the alloy (6) is applied in zigzag fashion, its sections do not short in the folded form and this insulation is not required.

In the cylindrical form, example C, the alloy (9) is applied in either parallel or sinuous lines and bridged at (10). In the roll, the inductive fields of the lines, cancel each other. The rolled or folded resistors are finally encased in protective coating of varnish, lacquer or the like.

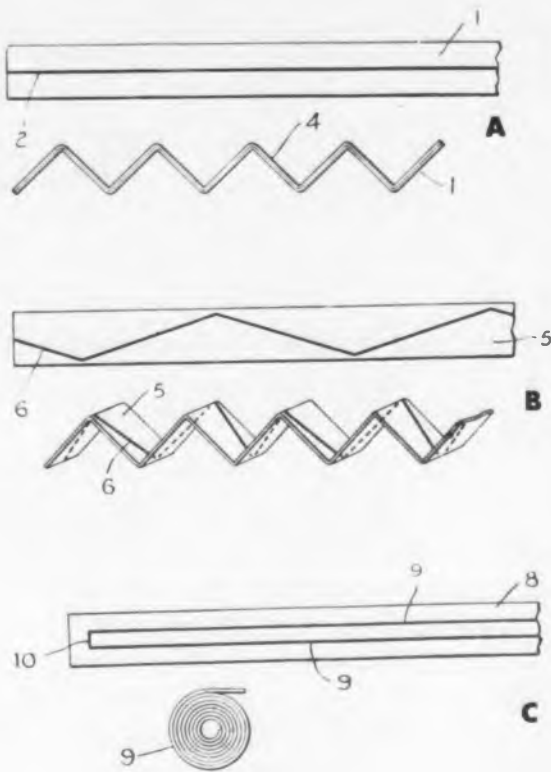


Fig. 2. The noninductive resistor can be folded like an accordion (A and B) or rolled (C).

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● Be first to make high-reliability tubes standard in your new receivers! G.E.'s 5-Star GL-6265 is your key to more business from communications users who want the utmost in dependability. Write for Bulletin ETD-892 to Sec. B, Tube Dept., General Electric Co., Schenectady 5, N. Y.

HIGH-RELIABILITY GL-6265



Sharp-cut-off pentode, for
r-f or i-f amplification
REPLACES 6BH6

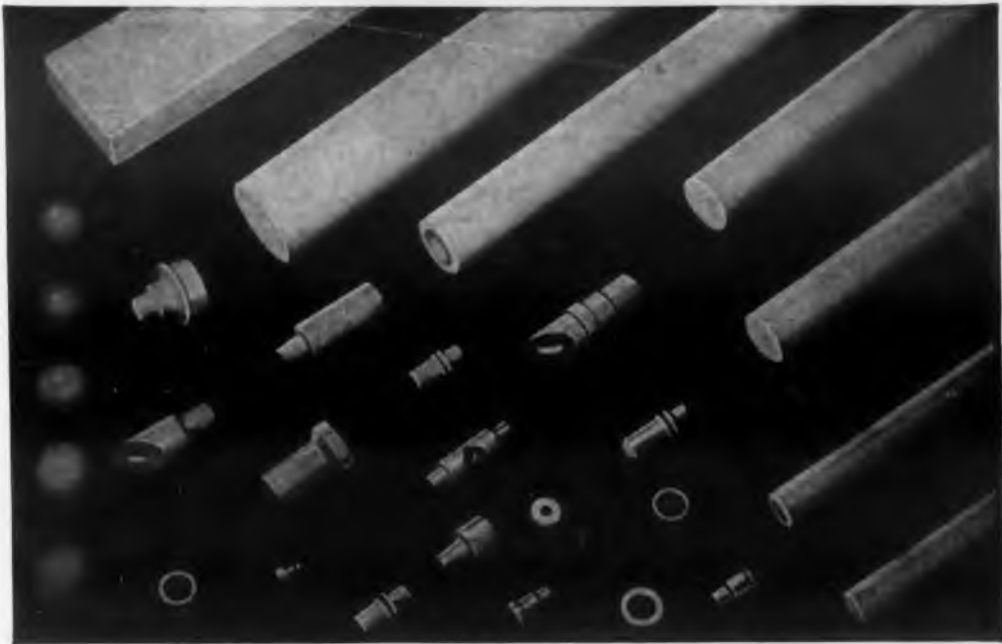
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*DuPont trade-mark for tetrafluoroethylene resin



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- Please send us your TEFLON Bulletin including stock list.

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Books . . .

Theory and Design of Electron Beams

. . . *By J. R. Pierce, second edition, 222 pages. D. Van Nostrand Company, Inc., 250 Fourth Ave., New York 3, N. Y. \$4.50.*

The second edition of this excellent work on electron beams includes added material on focusing in the presence of space charge as well as a whole new chapter on focusing by means of periodic fields. A few sections have been altered and a number of errors appearing in the previous edition have been corrected.

For the benefit of those not acquainted with the original work, the book presents the minimum amount of theoretical material necessary for a good understanding of electron flow and electron focusing in

devices other than electron microscopes and image tubes. The first seven chapters cover basic material on electron flow in terms of fundamental laws and principles. The remaining five chapters deal with topics of great importance in beam devices. These include: the effect of thermal velocities, space charge in electron beams, electron guns, periodic focusing fields, and a brief chapter which cites a few cautions that should be observed when designing electron beam devices.

This book definitely deserves a place on every tube designer's reference shelf, and circuit designers will find much material of interest from the point of view of gaining clearer insight into the inner working of electron beam devices.

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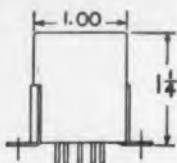
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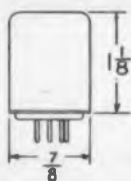
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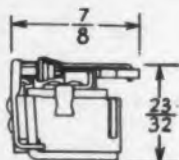
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High Fidelity Techniques . . . By John H. Newitt, 494 pages. Rinehart Books, Inc., 232 Madison Avenue, New York 16, N. Y. \$7.50.

The widespread interest in high fidelity has encouraged the publication of several books on the subject. The present work is intended for practicing engineers not engaged in audio work, the prospective home constructor, the radio serviceman, recording studio and sound system operators concerned with installation, and professional audio technicians, engineers, and home receiver designers.

In order to satisfy the needs of these people the author covers a wide range of topics. These include a discussion on high fidelity in general; sound, hearing, listener tests, and acoustics; loudspeakers and reproducer enclosures; electrical crossover networks; distortion; special high fidelity circuits; high fidelity amplifiers and amplifier characteristics; high fidelity receivers; records and record players; magnetic recording; and custom installation of high fidelity equipment.

Within these chapter headings are quite a few sub topics and four appendix sections are included at the end of the book. Many commercial audio system components such as tuners, preamplifiers, amplifiers, speakers, and speaker enclosures are illustrated, and basic as well as commercial circuits also are shown. The practicing engineer will find the book a relatively easy introduction to this interesting and rewarding (to the music lover) field.

Probability and Information Theory, with Applications to Radar . . . By P. M. Woodward, 128 pages. McGraw-Hill Book Co., Inc., 330 West 42nd Street, New York 36, N. Y. \$4.50.

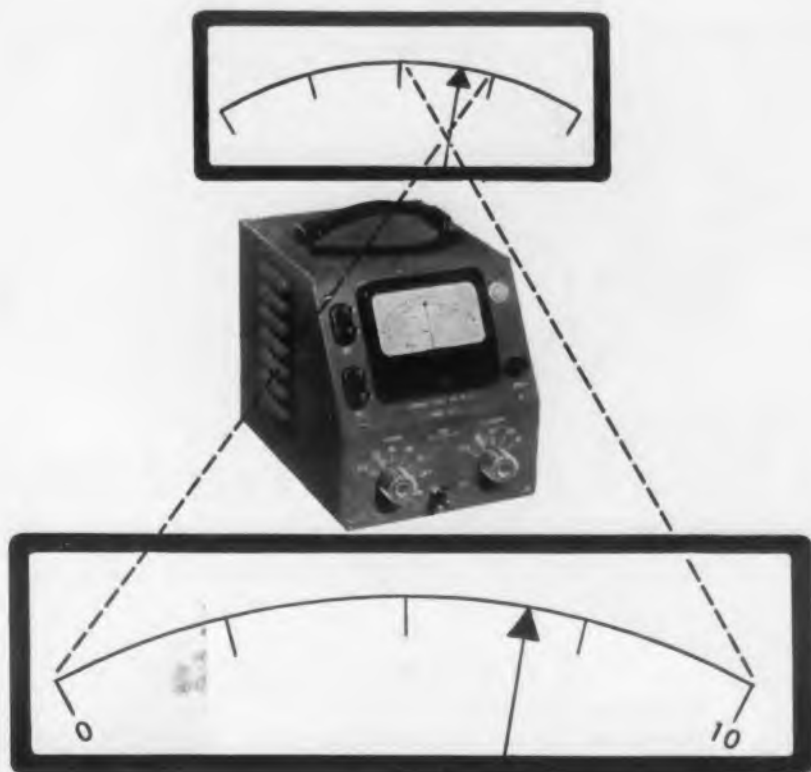
This book is one in a series of monographs reporting upon research carried on in electronics and applied physics. The series is under the general editorship of D. W. Fry, of the Atomic Energy Research Establishment at Harwell, England, and Mr. Woodward is the principal Scientific Officer, Telecommunications Research Establishment, Ministry of Supply at Malvern, England.

The first two chapters of the monograph cover an introduction to probability theory and waveform analysis and noise. The third chapter deals with information theory and summarizes much of Shannon's original work. In chapters 4 and 5, the author discusses the problem of detecting signals in noise and employs an approach based on inverse probability.

The remaining chapters are devoted to radar and cover such topics as the simple theory of radar reception, mathematical analysis of radar information, and the transmitted radar signal.

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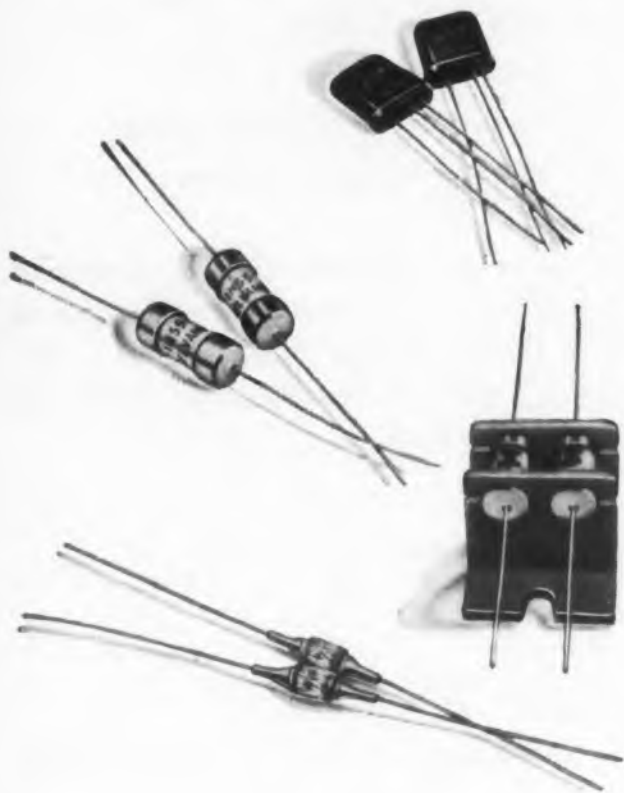
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Advertising Index

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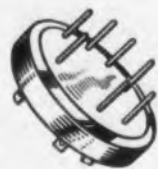
Inquiry No.	Advertiser	Page
130	Accurate Paper Tube Co.	54
102	Ace Plastic Co.	49
208	Aerohm Corp.	67
5	Aircraft-Marine Products, Inc.	8
58	Allied Control Co., Inc.	37
80	American Relay & Controls, Inc.	44
1	Amperex Electronic Corp.	2
221	Arga Division, Beckman Instruments, Inc.	73
15	Astron Corp.	25
68	Barry Corp., The	41
198	Bead Chain Mfg. Co., The	66
144	Berkshire Laboratories, Inc.	57
65	Biddle, James G., Co.	40
76	Birtcher Corp., The	42
33	Buggie, H. H., Inc.	30
69	Burndy Engineering Co.	41
55	Cambridge Thermionic Corp.	36
88	Cannon Electric Co.	46
184	Carter Motor Co.	63
194	Chatham Electronics Corp.	62
14	Chicago Standard Transformer Corp.	24
214	Cubic Corp.	69
132	Curtis Development & Mfg. Co.	55
3	Daven Co., The	4
11	DeJur-Amsco Corp.	20
36	Doelcam Corp.	31
10	Dow Corning Corp., The	19
6	Du Mont, Allen B., Laboratories, Inc.	11
73	Edison, Thomas A., Inc.	42
54	Elastic Stop Nut Corp. of America	36
97	Electrical Industries	47
110	Electrical Products Corp.	50
135	Electric Regulator Corp.	55
136	Electro-Mechanical Specialties Co., Inc.	55
115	Electro Motive Mfg. Co., Inc.	52
72	Electronic Transformer Co.	41
215	Essex Wire Corp., R-B-M Div.	70
137	Faber-Castell, A. W., Pencil Co., Inc.	56
61	Fairchild Camera & Instrument Corp.	38
141	Federal Telephone & Radio Co.	56
218	Flexrock Co.	71
173	Ford Instrument Co.	61
51	Fusite Corp., The	36
220	Gee-Lar Mfg. Co.	72
12	General Electric Co., Apparatus Sales	21
87	General Electric Co., Apparatus Sales	45
8	General Electric Co., Electronics Div.	15
217	General Electric Co., Tube Dept.	71
129	General Radio Co.	54
185	Globe-Union, Inc., Centralab Div.	63
93	Green Instrument Co., Inc.	46
126	Gries Reproducer Corp.	54
186	G-V Controls, Inc.	64
111	Haydon, The A. W., Co.	50
138	Helipot Corp.	56
174	Heppner Mfg. Co.	61
223	Hermetic Seal Products Co.	75

LIGHTING • RADIO • ELECTRONICS • TELEVISION

Inquiry No.	Advertiser	Page
114	Hughes Aircraft Co.	51
	Hughes Research & Development Laboratories	72
203	Inet, Division of Leach Corp.	66
116	Insulated Circuits, Inc.	52
124	International Rectifier Corp.	53
143	Joyal Products, Inc.	57
150	Kester Solder Co.	58
105	Koiled Kords, Inc.	49
142	Kulka Electric Mfg. Co., Inc.	56
29	Laboratory for Electronics, Inc.	29
213	Lindgren, Erik A., & Associates	69
46	Mallory, P. R. & Co., Inc.	34
149	Metron Instrument Co.	58
42	Moloney Electric Co.	33
79	National Semi-Conductor Products	43
322	Neomatic, Inc.	73
191	NRK Mfg. & Engineering Co.	64
147	Penetone Co., The	57
153	Perkin Engineering Corp.	58
119	Phillips Control Corp.	53
154	Pike, E. W., & Co., Inc.	58
64	Plastic Capacitors, Inc.	40
17	Polytechnic Research & Development Co., Inc.	27
2	Potter Instrument Co., Inc.	3
30	Radio Cores, Inc.	30
13	Radio Corp. of America	23
320	Radio Corp. of America, Tube Dept.	76
37	Radio Materials Corp.	32
16	Raytheon Mfg. Co.	26
106	Resinite Corp., Div. of Precision Paper Tube	50
196	Rockbar Corp.	65
148	Rotron Mfg. Co., Inc.	57
197	Sangamo Electric Co.	65
9	Servo Corp. of America	18
125	Shakeproof, Div. of Illinois Tool Works	54
7	Shallcross Mfg. Co.	14
161	Sigma Instruments, Inc.	60
92	Simmons Fastener Corp.	46
212	Society of Plastics Industry, The	68
107	Speer Carbon Co., Jeffers Electronics Div.	50
101	Star Stainless Screw Co.	49
175	Sterling Engineering Co.	62
20	Stupakoff Ceramic & Mfg. Co.	28
120	Superior Electric Co., The	53
321	Superior Tube Co.	55
222	Sylvania Electric Products, Inc., Tungsten & Chem. Div.	74
160	Taylor Tubes, Inc.	59
156	Tobe Deutschmann Corp.	59
155	Transco Products, Inc.	59
47	Transistor Products, Inc.	35
211	Tung-Sol Electric, Inc.	68
123	United Catalog Publishers, Inc.	53
159	Van Nostrand, D., Co., Inc.	59
89	Ward Leonard Electric Co.	46
43	Waterman Products Co., Inc.	34
209	Waters Mfg. Co.	67
210	Waters Mfg. Co.	67
215	Western Gold & Platinum Works	70
	Westinghouse Electric Corp., Electronic Tube Div.	7
	Winchester Electronics, Inc.	35

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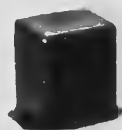


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April 1954