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ELECTRONIC DESIGN

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This new series of electrical thermostats is specially designed to meet the difficult operating conditions of electronic and aircraft applications. Operating points, regardless of setting, are not changed by exposure to temperatures from -100°F. to +300°F. Shocks up to 150 G for 3 milliseconds, vibration of 25 G up to 1000 cps, and vibration of 10 G up to 2000 cps do not damage these thermostats or change their setting.

Hermetically Sealed But Rapid in Response

Sealed in a metal shell which is also its sensing element, the G-V Series C8 Thermostat responds as rapidly as a laboratory thermometer. Temperature settings may be made at the factory or by the user. Contacts are rated at 5 amps. 115 volts AC, or 3 amps. 28 volts DC, non-inductive load. Differential is about 1°F. Insulation test is 1250 v. between circuit and shell, and insulation resistance is over 100 megohms. These thermostats are suitable for direct control of heaters and for over-temperature and under-temperature indication, alarm, or cut-off.

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complete technical and
application data.



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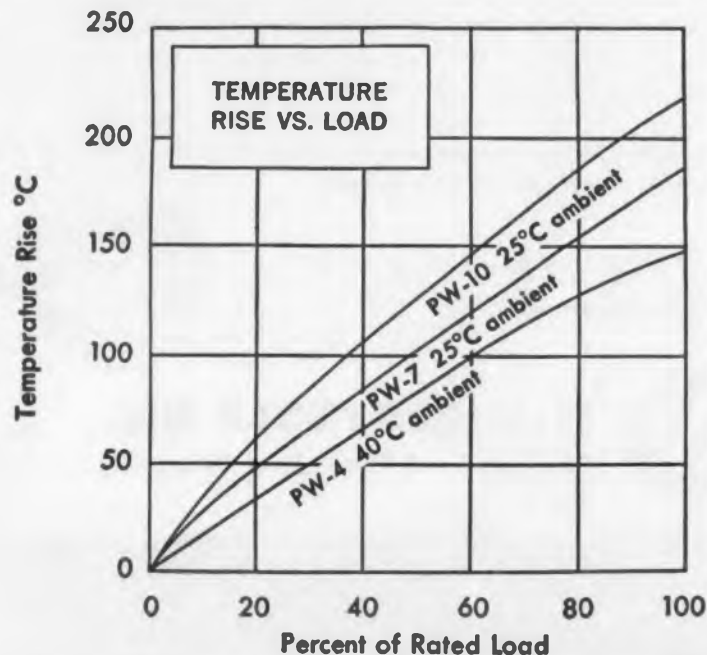


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3 new wire wound resistors

IRC's new power wire wounds are lower cost per watt than any other power type. At 4, 7 and 10 watts, they offer savings of several cents each in any application requiring compact, low cost, efficient power resistors. Types PW-4, PW-7 and PW-10 resistors assure safe operation in circuits where stability and low wattage dissipation are needed.



Voltmeter Multipliers • Boron & Deposited Carbon Precistors • Insulated Composition Resistors • Power Resistors • Volume Controls • Low Wattage Wire Wounds •

Wherever the Circuit Says

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4 WATT

Type PW-4 allows safe operation with hot-spot temperatures up to 165°C. Fully insulated housing will not burn or support combustion.



7 WATT

Types PW-7 and PW-10 allow safe operation with hot-spot temperatures up to 275°C.



10 WATT

UNUSUAL DESIGN AND ASSEMBLY TECHNIQUE PROVIDES LOWER COST PER WATT.

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Please send Bulletin P-1 on PW-4 Resistors
 Bulletin P-2 on PW-7 and PW-10 Resistors.

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Editorial

Reward Creative Talent

"We don't know too much about what can be done to attract more people into the engineering profession. We do think that something ought to be done about keeping engineers from leaving strictly technical jobs for more lucrative administrative positions. Creativity should be rewarded by incentives for greater creativity and not by greater administrative responsibilities".

This is the gist of several remarks we recently heard while discussing the engineering manpower shortage with several prominent engineers. Their comments are significant because they echo the sentiments of many technical people. They reflect a general business philosophy in many companies favoring incentives that tend to deplete our technical manpower ranks.

Today's picture of the "successful engineer" is a man who is an administrator. He spends half his time shuffling paper work and a good part of the rest of his time negotiating with contractors, expediting projects, ironing out personnel problems, etc. Very little time is left for really creative technical work.

How did he get that way? Well some time ago he had an excellent record of technical performance and so he was in line for a promotion. The only way he could get "promoted" (which really meant a substantial raise in pay) was to give him a job that entailed administrative responsibility, justifying the increased salary. And so he winds up being a "successful engineer" with few engineering duties and lots of administrative responsibilities. This promotion can, and often does, result in making a mediocre administrator out of a good engineer.

Surely something could be done about this situation. There are hundreds of jobs available which could be filled by really creative technical men. And yet all throughout the profession we find young engineers preparing themselves for "advancement" by taking courses in administrative skills. The rule is: "if you want to really advance, you have to get out of strictly technical work".

If we are not to lose our best technical brains, management must make technical jobs attractive in terms of prestige and money. Some companies are already doing this by setting up special engineering groups outside of normal administrative channels. They make possible greater financial rewards for creative personnel. This practice should be more and more widespread among the electronic industries. Let us not make top-flight engineers into second-rate administrators. On a national, industry, and company level we can't afford this wasteful practice.

Engineering Review . . .

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

Cameraless TV Broadcasting . . . A newly developed color television pickup system reverses the usual arrangement of picture pickup in which a scene is scanned from many light sources is scanned from a single point. In the new system the scene is scanned by a flying spot of light and the reflected light is picked up by banks of photomultiplier tubes mounted about the studio. Since the scene must be dark while the spot is being thrown over it line by line, a stroboscopic lighting system is employed to light the scene for the actors. The strob light goes on 60 times a second only while the flying spot is retracing. The phototubes are mounted behind light filters that different groups of phototubes pick up each primary color, respectively. The new system feeds a standard TV color signal to the station's transmitter. Known as the "Vitascan" system, it was developed by Allen B. Du Mont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J.

The Vitascan system is not intended as a replacement for standard TV color cameras. It is comparatively inexpensive pick-up that can be used for interviews, commercials, and other subjects with little movement. It can supplement the standard color camera and provide a means of originating local material and commercials for a small station equipped to broadcast color TV but lacking expensive color cameras. It can also be used as a pick up for monochrome transmission.

The flying-light-spot pick-up does not have any registration difficulties and only requires one operator with a minimum of training. In addition, the system requires only a few seconds to warm-up compared to the hours of warm-up time often required by present color cameras.

The phototubes have four-inch-diameter faces. They were specially developed for this application by

Du Mont. The light source in the Vitascan is a flying-spot cathode-ray tube. This tube develops an extremely bright raster. Light from this tube is directed by means of a mirror and lens system into the studio to scan the scene being televised.

If purchased by a number of stations, the Vitascan system could stimulate the sale of color TV receivers by providing more color programs at low cost to the local station.

One of the banks of phototubes employed in the Du Mont Vitascan color TV pick-up systems for studio use. The face of the mount contains color filters. Two of the tubes pick-up reflected red light, while the other two receive blue and green light, respectively.



Electronics Being Taken Over by Aircraft Makers?

. . . Fears that the responsibility for designing electronic equipment for military aircraft will be taken over by the airframe manufacturers were voiced at the recent National Conference on Aeronautical Electronics. The electronic industries were reassured by various representatives of the aircraft industry that electronic engineers employed by the aircraft makers are mainly for testing and liaison and not design.

The fears were raised by the Air Force's procedure of considering an airplane and its electronic gear as a "weapons system" and, therefore, assigning the contract for the complete system to the aircraft manufacturer. The airframe maker then subcontracts for the radar, fire-control, communications, and other electronic gear. In the latest planes, the electronic equipment sometimes represents more than half the cost. The above was considered at a forum on "Weapons System Concept and its Effect Upon Electronics" held at Dayton on May 10, 1955. It was sponsored by the IRE professional group on aeronautical and navigational electronic equipment.

INCREASE CIRCUIT RELIABILITY WITH TI-RADELL deposited carbon RESISTORS

newest line of precision components
from Texas Instruments

For precise resistance values under extreme operating conditions, design with RADELL deposited carbon resistors — now manufactured by Texas Instruments. With resistance tolerance held to $\pm 1\%$, Texas Instruments RADELL resistors provide exceptional stability plus a wide range of resistance values. Like all TI components, they are manufactured to exacting instrument standards.

Texas Instruments RADELL resistors are mass-produced in three lines and in $\frac{1}{2}$, 1, and 2 watt sizes. Resistance values range from 25 ohms to 30 megohms.

WRITE for Bulletin No. DL-C 539 giving detailed specifications of all three lines of Texas Instruments RADELL resistors. Your best source for precision components, TI also manufactures a complete line of subminiature transformers as well as custom capacitors, delay lines, special transformers and other reliable electronic components.



TEXAS INSTRUMENTS INCORPORATED

6000 LEMMON AVENUE DALLAS 9, TEXAS

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



Hermetically sealed line — designed for extreme conditions of moisture and temperature. Specially treated ceramic shell effectively seals out moisture and air, resists abusive handling, and assures complete insulation.

MIL-Line — designed for the broad field of military applications. Exclusive multi-layer coating provides environmental protection substantially equal to hermetic sealing throughout low and middle ranges of resistance. MIL-Line resistors more than meet MIL-R-10509A specifications.

Industrial-Line — differs from MIL-Line series only in type of coating. Industrial line resistors provide close tolerances for military, instrument and industrial applications where less extreme humidity conditions are encountered. Typical applications include computers, test equipment, communication and control systems.

Compact Direction Finder . . . A compact new automatic direction finder priced within the budgets of small airports has been developed. The receiving instrument only weighs 39 lb. It indicates the direction of an incoming plane within $\pm 1^\circ$.

The only complementary equipment required for the plane is a standard v-h-f transmitter. The device requires a special antenna consisting of four vertically polarized dipoles symmetrically mounted around a central housing. Inside the housing a transformer coupled to the dipoles is rotated at 1800rpm. For a signal arriving from any particular direction the rotation produces 30cy amplitude modulation of the incoming signal. The phase of this modulation depends upon the direction of arrival of the signal.

Developed by Olympic Radio & Television, Inc., 34-01 38th Ave., Long Island City 1, N. Y., the device can operate on incoming signals that are too weak for intelligible transmission. Unskilled technicians can operate the device. The principle on which this equipment is based has been utilized in other devices, notably for the military, but the earlier equipment is generally much larger and more bulky.

Coliseum Leased by IRE for '56 . . . The Radio Engineering Show will be held at the New York Coliseum from March 19 to 22, 1956. The Institute of Radio Engineers has leased all four exhibit floors of the Coliseum from the Triborough Bridge and Tunnel Authority. The building, now under construction at Columbus Circle and 59th Street, should be opened on March 1, 1955, despite the recent disaster in which one floor collapsed and dozens of workmen were injured.

Use of the building means that attending engineers can move between the exhibits and the technical sessions at the Waldorf-Astoria with greater ease and speed. At the 1955 Show, there were so many exhibitors that some exhibits were held at an indoor skating rink about 10 minutes walk from the Kingsbridge Armory. The Coliseum will be able to hold the more than 800 exhibits expected. The IRE will be the first organization to use the entire capacity of the building.

Rocket Models Supplement Wind Tunnels . . . Because of difficulties involved in producing supersonic winds in wind tunnels, plane models driven by rockets are being studied as an alternative. According to a speech by Hugh L. Dryden, Director, National Advisory Committee for Aeronautics, presented at the National Telemetry Conference, Chicago, Ill., on May 19, the behavior of the rocket-driven models is then relayed back by electronic telemetry methods. One of the problems with wind tunnels is that the great expansion necessary to drive the air in the tunnel cool it so much that some of the air liquefies.

PERKIN TUBELESS!!

MAGNETIC AMPLIFIER REGULATED DC POWER SUPPLY

MODEL MR 532-15
5 TO 32 VOLTS @ 15 AMPERES

Immediate Delivery

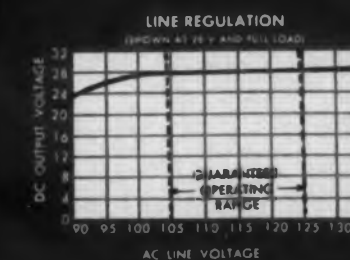
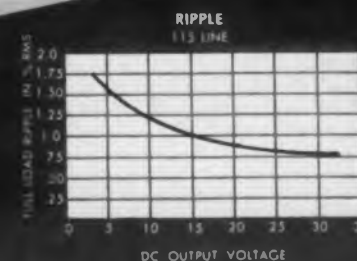
YOU can test 6, 12, 24 and 28 volt systems . . . with this **ONE UNIT!**

- WIDE VOLTAGE RANGE
- ELIMINATES NEED FOR BATTERY
- FILTERED DC • LONGER LIFE
- NO TUBES TO REPLACE
- LOWER MAINTENANCE COST



MODEL MR 532-15

5 to 32 volts @ 15 amperes (continuous)



Specifications . . .

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

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

A.C. INPUT: 105-125 Volts, Single Phase, 60 cps.

RESPONSE TIME: 0.2 Seconds Max.

AMBIENT TEMPERATURE RANGE: Up to 45°C

METERS: 4½" Rectangular AM and VM — 2% Accuracy

TYPE COOLING: Convection cooled

AC INPUT AMPS: 12 amps

DIMENSIONS: 22" Wide x 17" Deep x 14½" High

MOUNTING: Cabinet with handle or (19" rack panel — 19" wide x 17" deep x 12¼" high)

FINISH: Baked Grey Wrinkle

WEIGHT: 150 lbs.

Wire the factory collect TODAY for price quotations on above and other standard models!

PERKIN ENGINEERING CORP.

345 KANSAS STREET, EL SEGUNDO, CALIFORNIA • OREGON 8-7215 • EASTGATE 2-1375

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



Decorative Steel

Strips of steel up to 18" wide can be made with almost any design. Uncoated or plated with other metals, the "Pattern Designed" strip is made by Thomas Strip Div., Pittsburgh Steel Co., Warren, Ohio. It is about 1/100" thick.

Higher-Frequency Transistors . . . A new method of transistor manufacture in which wire-shaped crystals rather than sliced semiconductor ingots are employed results in small-signal transistors that can be used at very-high frequencies. Known as the "meltback" process, it results in closer control of the proper impurities because the wire-shaped crystals cool much faster than the large cigar-shaped crystals.

Developed by Dr. Robert N. Hall, General Electric Research Laboratory, Schenectady, N. Y., the meltback process produces transistors that also have greatly improved power-amplification characteristics at the higher frequencies. In order to be utilized at higher frequencies, the layer of impurities in the semiconductor surface must be very thin. Since the crystals in the meltback process cool in less than one second compared with some 20 minutes by older methods, the layer of impurities can be made as thin as 1/5000". There is also less inter-mixing or contamination between layers.

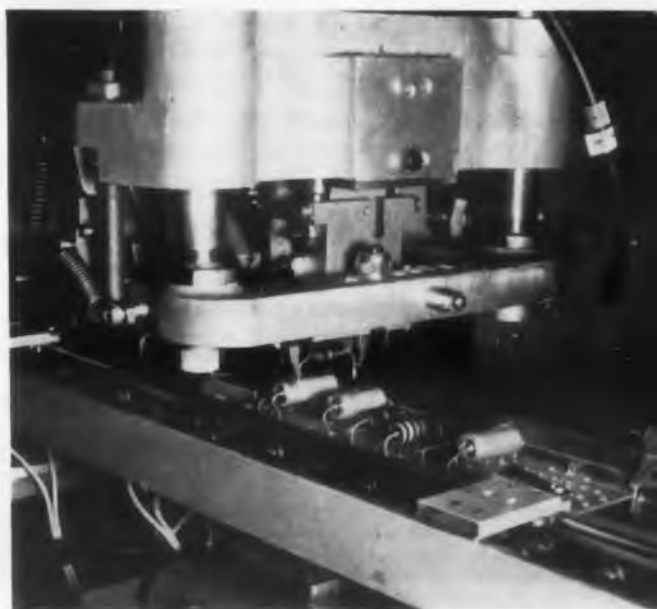
The new process can be applied to both germanium and silicon crystals. Transistors produced by this process should be capable of operation in TV receivers, short-wave communications, and radar equipment. They are not commercially available at present.

Starting at the right, printed-circuit boards pass under 24 turrets, receiving a component from each.



The turret (right) containing the printed-circuit boards can be refilled while "Autofab" is in operation.

An attaching head is poised to insert a resistor in the motionless board.



Automatic Production of Printed Circuits

Another machine that automatically inserts certain components into a printed-circuit board has been developed. As many as 24 different resistors, capacitors, pulse transformers, diodes and other components of conventional manufacture can be inserted in a board at the rate of 20 boards per minute. The firm that developed this machine is also working on a machine that automatically prepares components for insertion and another machine that dip-solders a printed-circuit board automatically.

Known as "Autofab", the machine was produced by Mechanical Div., General Mills, Inc., 1620 Central Ave., Minneapolis 13, Minn., in cooperation with International Business Machines Corp., 590 Madison Ave., New York 21, N. Y. As illustrated, the printed circuit boards are fed from a turret to the attaching head by a conveyor. The board is stopped under each attaching head, which then inserts a component from the loading magazines. The first turret can hold printed circuit boards varying in length dimension from 2 to 20".

A companion machine to prepare and load components into the magazines that are hung on turrets is under construction. This machine will straighten and trim leads. Throughout the entire operation the various machines only handle the components by their leads, thus preventing damage to the body of the component. (A manually operated machine for bending leads for insertion in a printed circuit board has already been developed—*ED*, November, '54, pp. 36-37.)

Only three people are required to operate "Autofab". Printed-circuit boards and magazines of components can be loaded on the turrets without stopping the machine. If any station runs out of components the machine stops and a warning light indicates which turret is empty. The attaching heads are interchangeable. They weigh only 25 lb, which means they can be removed easily by one man. The attaching heads insert components in various ways—on the board, standing off the board, or mounted in holes spaced closer together than the unit's length.

The development of automatic methods of producing electronic equipment was enormously stimulated by the development of printed circuitry. Once a completely automatic method of producing electronic devices constructed around the printed circuit is developed, it will be of interest to see whether this system or the "Tinkertoy" system (*ED*, Oct., p. 5) becomes the most widely used automatic system or whether they co-exist for different purposes. Other machines or methods for automatically producing printed-circuit boards in addition to "Autofab" are also being developed (*ED*, Sept. '54, pp. 12, 13, 32, 33). All of these machines handle components of conventional design, but components are being specially designed for use with automatic machines for making printed-circuit assemblies (*ED*, Nov., pp. 36-39).



RHEEM ELECTRONIC EQUIPMENT FOR OUTSTANDING QUALITY

RHEEM SUBMINIATURE INSTRUMENTATION AMPLIFIER Model REL-12



Specifications

Size 7/8" x 2-5/16" x 4-3/8"
 Weight7 ounces
 Frequency Response ... 5 to 20,000 cps with less than $\pm 1\%$ deviation
 Voltage Gain Adjustable 5 to 500
 Linearity Within $\pm 1\%$
 Output 5 v rms maximum
 Input Impedance Over 100 megohms—shunted by 6 uuf
 Output Impedance Less than 100 ohms
 Load 33,000 ohms minimum
 Will maintain a constant output with B+ and filament variations of $\pm 15\%$.
 Different models available with variations of frequency response and recovery time. Recovery time as low as 30 milliseconds.

RHEEM SUBMINIATURE VOLTAGE REGULATOR Model REL-11



Specifications

Size 1-3/4" x 2-5/16" x 4-3/8"
 Weight14 ounces
 Output Voltage Any nominal voltage from 135 to 230 volts, adjustable range $\pm 10\%$ of the nominal voltage
 Current Up to 200 milliamperes
 Ripple Reduction Factor 5×10^{-4}
 Output Impedance Will not exceed 2 ohms from 1 cps to 200,000 cps
 Regulation Within .05% for load variations of $\pm 25\%$ and input variations of $\pm 20\%$
 Minimum DC Input Voltage Equal to 100 volts greater than the regulated output voltage

RHEEM SUBMINIATURE DC AMPLIFIER Model REL-15

By the time you read this advertisement, the REL-15 Subminiature D. C. Amplifier will be ready for production. Specifications, prices, and delivery information will be supplied promptly. The REL-15 will feature double ended input, chopper stabilization and ruggedized compact design. Please contact us for detailed specifications.

AIRBORNE POWER SUPPLY REL-14 (-1, -2, -3)

Special Features

*Size 7" x 7" x 5"
 Weight 14 lbs.

*REL-14-2 and REL-14-3 have slightly larger dimensions.

ELECTRICAL CHARACTERISTICS

	-1	-2	-3
Regulated output			
Voltage	150 V DC	150 V DC	150 V DC
Current	150 ma	250 ma	300 ma
Ripple	5 MV rms	5 MV rms	5 MV rms
Impedance	2 ohms	2 ohms	2 ohms
Regulation	0.5%	0.5%	0.5%
Unregulated output			
Voltage	250 V DC	250 V DC	250 V DC
Current	100 ma	100 ma	200 ma
Power requirement			
Input voltage	27 V DC	27 V DC	27 V DC
	$\pm 10\%$	$\pm 10\%$	$\pm 10\%$
Input current	6 amps	10 amps	14 amps

RHEEM MINIATURE R. F. POWER AMPLIFIER Model REL-09



Specifications

Size 4.90" x 3.37" x 2"
 Weight16 ounces
 Controls Plate tuning
 Grid tuning
 Filter 85-db attenuation filter on all power leads
 Tuning Range 215 to 235 megacycles
 Power Output 12 watts nominal
 Required Drive 1 to 2 watts minimum
 Plate 300 VDC @ 100m
 Filaments 12.6 V @ 0.41 amp
 or 6.3 V @ 0.82 amp
 Bias None Required

RHEEM AIRBORNE POWER SUPPLY Model REL-16

Specifications

Input 115 V, 400 cycle, single phase
 Regulated Output 150 V, dc at 200 ma
 Regulation Within 0.05% for Load Variations of $\pm 25\%$ and input variations of $\pm 20\%$
 Ripple Reduction Factor MV rms
 Output Impedance Will not exceed 2 ohms from 1 cps to 200,000 cps
 Size 8-3/4" x 2-5/16" x 3-1/8"
 Weight 2 lbs., 13 ounces
 Environmental Operation Meets existing aircraft and missile environmental specifications of vibration, temperature, acceleration, shock and altitude.

RHEEM R. F. AMPLIFIER Model REL-06



Specifications

Size 4-5/8" x 5" x 4"
 Weight2 lb 6 oz
 Controls Plate tuning
 Grid tuning
 Filter Rheem encapsulated 85-db attenuation filter on all power leads
 Tube Amperex 9910
 Tuning Range 215 to 235 megacycles
 Power Output20 watts
 Required Drive1.4 watts minimum
 Plate 400 volts dc at 100 ma
 Filament 6.3 V @ 1.8 amps
 12.6 V @ 0.9 amps
 Bias None Required
 This unit is completely reliable while under environments of:
 Shock50 g's along any axis for 10 ± 1 milliseconds
 Vibration 10-500-10 cps at 10 g's
 Temperature -65°F to +185°F

RHEEM Instrumentation Units are:

... Designed to operate under the most rigorous environmental conditions and to meet the most exacting specifications required by modern systems.

... Designed to fulfill the demands of industries for increased performance from existing instrumentation units.

... Designed for compactness, simplicity, and versatility, and for integration into existing systems.

... Designed and built with components of the highest quality for lasting accuracy and dependability.

for complete information on these and other units or on specialized electronic design problems, contact:

RHEEM Manufacturing Company

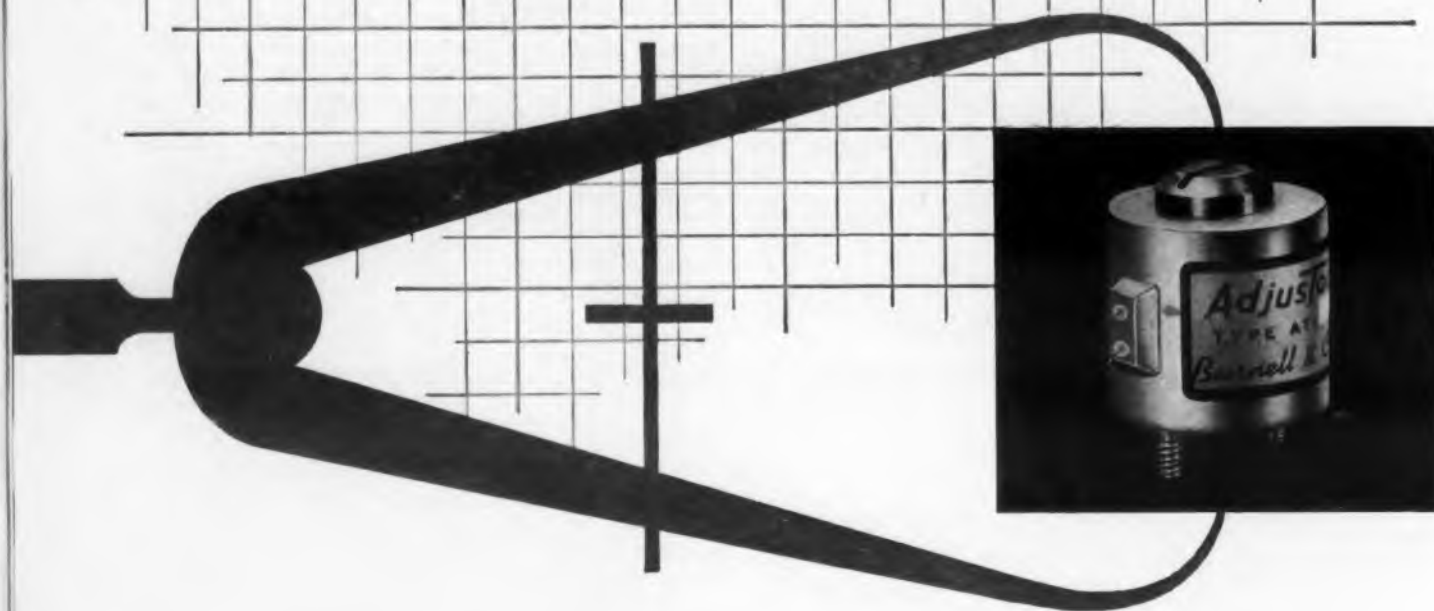
Government Products Division
 9236 East Hall Road, Downey, California

YOU CAN RELY ON...



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Adjustoroid®



Introducing **A LOW-COST ADJUSTABLE TOROID**

- precise, instant adjustment
- inductance variation of 10%
- eliminates critical close tolerance capacitors
- high Q
- no external power supply
- truly hermetic sealing
- temperature coefficients same as fixed toroids
- no increase in case diameter
- developed by Burnell, creators of the Rotoroid®

Write for Adjustoroid
Technical Brochure A 55



Teletype: Yonkers, N. Y. 3633

BURNELL & CO., INC.

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Yonkers 2, New York

Pacific Division: 720 Mission St., S. Pasadena, Calif.

LET BURNELL ENGINEERS SHOW HOW USE OF ADJUSTOROIDS REDUCES EQUIPMENT COSTS

Copyright patent applied for

Egleston Award . . . Rear Admiral Hyman G. Rickover is this year's recipient of the Egleston Award for outstanding engineering achievement. The award is presented annually to a graduate of the School of Engineering of Columbia University. Admiral Rickover, director of the Navy Atomic Propulsion Program and leader of the group that built the Nautilus, holds a master's degree in E.E. from Columbia.

In his acceptance speech, the Admiral called for more aid to education, stating that our human resources are more important than our nuclear resources.

TV in Perambulator . . . A reader has proposed that television receivers could be installed in baby carriages. By mounting a small set in the front of the carriage, both mother and child could watch programs as they stroll along. Parents wouldn't have to miss their favorite programs on Sunday just because baby needs some attention.

The unit would be battery operated, of course. However, a recharging generator could be connected to the perambulator's wheels. Mothers could watch TV while their children are sleeping in the carriages in the sun. There is little chance of the children being kept awake by the afternoon TV programs.

Swords into Plowshares . . . Many war-time electronic devices such as radar and sonar have found civilian employment; now the mine detector has been adapted for peaceful purposes. Known as the "Beachcomber," this detector can be used by construction crews and public utilities to locate hidden metal objects that might impede an evacuation.

The battery operated device is manufactured by the Radiac Co., 400 Fifth Ave., New York 17, N. Y. It can also be used by amateur treasure hunters and beachcombers. Indications of buried metal are given by a meter and an earphone.

◀ CIRCLE ED-6 ON READER-SERVICE CARD



PROPERTY AND APPLICATION DATA ON THESE
VERSATILE ENGINEERING MATERIALS: "ZYTEL,"
"ALATHON," "TEFLON," "LUCITE."

NEWS

No 2.

1955

Smaller capacitors for RF equipment with TEFLON® as dielectric

A new line of capacitors, using Du Pont "Teflon" tetrafluoroethylene resin as the dielectric, has achieved an 80% reduction in size under comparable mica capacitors. Designed for RF tank circuits, airborne radio and radar equipment, these capacitors of "Teflon" operate to 100°C. and meet all electrical specifications of JAN C-5, types E, F, and G.



Capacitors of "Teflon" ranging in size from .0004 microfarads with 6,000 effective working volts to a .001-microfarads unit with 24,000 effective working volts. (Manufactured by Condenser Products Company, Division of New Haven Clock and Watch Company, New Haven, Connecticut.)

Installation of these units is easy. End terminals serve as mounts, and the capacitors can be installed in parallel groupings. The glass cases require no insulation between them.

Are you acquainted with the exceptional dielectric and mechanical properties of Du Pont "Teflon"? Use the coupon below for complete information.

Superior properties of Du Pont Zytel® nylon resin utilized in tip jacks

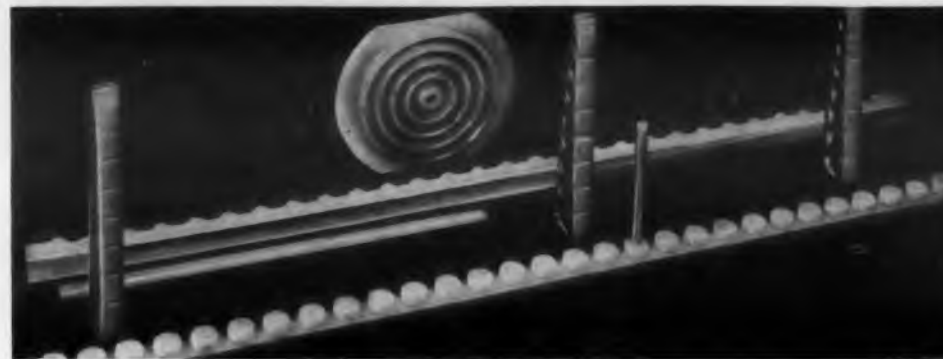
Tip jacks molded of Du Pont "Zytel" nylon resin are used on aircraft radar equipment because of the many useful properties of "Zytel" nylon.



The 105-600 miniature tip jack shown uses Du Pont "Zytel" nylon for the dielectric. "Zytel" is mechanically strong. It is molded inexpensively in a variety of colors. (Manufactured by E. F. Johnson Company, Waseca, Minnesota.)

"Zytel" proved itself the best engineering material for the tip-jack application because of such dielectric characteristics as low-loss, high-voltage breakdown, and excellent insulating properties. Mechanical strength is excellent. For this application, coloring is important, and "Zytel" can be molded in color, or dyed easily, with inexpensive dyes.

Parts molded of ZYTEL® nylon resin solve air-filter design problem



Sixty parts of Du Pont "Zytel" are used in the electrostatic air-filtering unit manufactured by American Air Filter Company, Inc., Louisville,

Kentucky. "Zytel" is lightweight and strong. Plastics Department, General Electric Company, Pittsfield, Massachusetts, molds the parts.

Molded "Zytel" nylon resin has been successfully applied by design engineers in an electrostatic air-filtering unit functioning at a 12,000-volt potential. While the actual current flow is on the order of only 20 milliamps, materials previously tested were charred by occasional arcing. The resulting carbon deposit formed a path for short circuits, making replacement necessary. The resistance of "Zytel" nylon resin to corona dis-

charge completely eliminated this short-circuit problem.

The filter parts molded of "Zytel" are much lighter in weight and much more resistant to breakage than filter parts (of comparable capacity) which use conventional materials.

Sixty parts in six different designs are molded of Du Pont "Zytel" nylon resin for each unit of the filter. Parts are complex in shape, but injection molding makes production easy.

New black "ZYTEL" has increased weather resistance

Black "Zytel" 105 nylon resin is a tough material with excellent weatherability. Results of accelerated weathering tests and exposure, in Florida, indicate that excellent outdoor life can

be expected. Toughness, abrasion resistance, and form stability at high temperatures are combined with lightness of weight to make "Zytel" ideal for many outdoor applications.

NEED MORE INFORMATION?

CLIP THE COUPON

for additional data on the properties and applications of these Du Pont engineering materials.

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department
Room 416, Du Pont Building, Wilmington 98, Delaware
in Canada: Du Pont Company of Canada Limited, P. O. Box 660, Montreal, Quebec.

Please send me more information on the Du Pont engineering materials checked: "Teflon"® tetrafluoroethylene resin; "Alathon"® polyethylene resin; "Zytel"® nylon resin; "Lucite"® acrylic resin. I am interested in evaluating these

materials for _____

NAME _____

POSITION _____

COMPANY _____

STREET _____

CITY _____ STATE _____

TYPE OF BUSINESS _____

*"Teflon," "Alathon," "Zytel" and "Lucite" are registered trademarks of E. I. du Pont de Nemours & Co. (Inc.)

3,000,000 Radar Order . . .
United Air Lines, 5959 S. Cicero Ave., Chicago 38, Ill., has signed a contract with the Radio Corp. of America, Harrison, N. J., for delivery of 200 C-band airborne radar units at a total cost of \$2,500,000. Modification of the planes and installation will require another \$1,500,000.

Portable TV . . . A portable TV receiver that weighs only 32 lb is being marketed. The 14" set utilizes vertical-chassis construction with most of the circuitry on printed-circuit boards. Manufactured by General Electric Co., Syracuse, N. Y., the set is for use in primary reception areas. It is 16 1/2" high x 13-3/8" x 17" deep. The tube complement exclusive of picture tube is 15.

Maids Demand TV . . . The continuing shortage of house maids is leading many housewives to offer prospective servants a TV set for their rooms, according to reports from employment agencies. This trend could lead to a growing "third-TV-set" market.

Tinkertoy Factory Changes Hands . . . The pilot plant for mechanized production of electronic equipment (formerly known as "Project Tinkertoy"), will be operated by a new organization. Aerovox Corp., New Bedford, Mass., will succeed Kaiser Electronics Div., Willys Motors, Inc., in operation of the production line at Arlington, Va.

If you need a special circuit, component, material, send us your request on company letterhead. We will publish it along with your name and address in the earliest issue possible. Interested readers can answer you directly.

Address brief requests to Bulletin Board, ELECTRONIC DESIGN, 19 E. 42nd St., New York 21, N. Y.

CIRCLE ED-7 ON READER-SERVICE CARD >

Packaged Nuclear Power Plants

. . . Prefabricated nuclear-energized power stations that can be shipped anywhere are now being marketed. The Ford Instrument Co., Div. of Sperry Corp., 31-10 Thomson Ave., Long Island City 1, N. Y., is cooperating in this venture with the Catalytic Construction Co., Philadelphia, Pa. All controls up to the heat exchanger and instruments are manufactured by Ford. This expanding field has created a demand for magnetic amplifiers and other ruggedized control devices.

Subminiature British Components

. . . A British firm has developed a number of subminiature components including a transformer 1/4" thick; a magnetic amplifier smaller than a matchbox; a torque motor about the size of a sleeve button; and volume controls and switches one-half inch in diameter. These components are produced by Fortiphone Ltd., Component Div., 247 Regent St., London W. 1., England, a leading British manufacturer of transistor hearing aids.

International TV . . . Residents of Jamaica, B.W.I., are regular observers of Cuban TV programs broadcast from Santiago de Cuba. In fact the Santiago station schedules a few hours of English programs each day specially for Jamaica. As a result, British electronic manufacturers are making TV receivers to American standards for sale in Jamaica, which does not have its own TV station yet.

Electronic Fire Detector . . . A photoconductive cell sensitive to infrared light is the key element in an electronic detection system that can spot a fire up to 100' away. Mounted in the ceiling of a factory or hangar, the cell actuates a fire alarm through an amplifier. The system was designed by Electronics Corp. of America, Cambridge, Mass.

CIRCLE ED-8 ON READER-SERVICE CARD ➤

ALLIE



**Sensitive
Versatile
Stable**

NEW



This new polarized relay designed and manufactured by Siemens & Halske Company of Germany, is now available from Allied Control and in the near future will be produced by Allied with the technical assistance of Siemens & Halske.

Types Trls 63 to 69 are recommended for use in industrial applications where the special features of a polarized relay are required, or where its inherent high sensitivity, long life and precision operation are desired. They are available with transparent or metal dust covers and are produced with solder terminals or 16 point plug-in bases (sockets are available from Allied Control). Bulletin TR gives complete details.

For military applications, these relays will be available hermetically sealed with either solder terminals or 16 point plug-in base.

POLARIZED RELAY

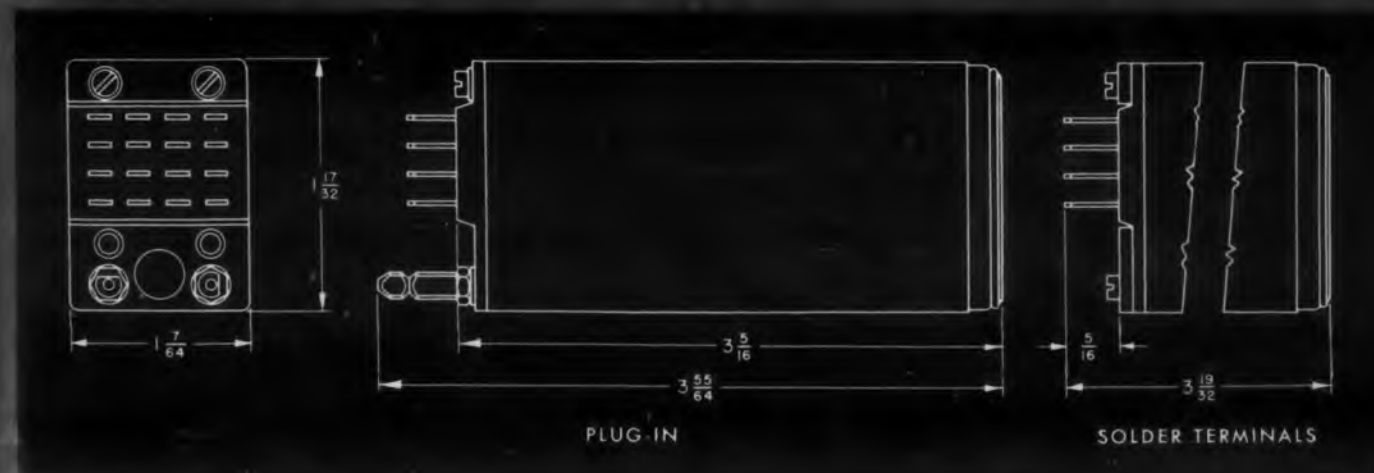
Specifications For Allied's Types Trls 63-69

Type Number		Trls 63	Trls 64	Trls 65	Trls 66	Trls 67	Trls 68	Trls 69
Description	Positions	2		3	2	2	3	2
	Operation	Magnetic Latch		Null-Center	Magnetic Latch	Spring Biased	Null-Center	Spring Biased
High Contact Pressure		High Sensitivity						
Contact Arrangement		SPDT		SPDT	DPDT	SPDT	DPDT	DPDT
Circuit Symbols	for telegraphy							
	other purposes							
"Operate" Excitation	Amp. Turns	7	2	2.2	5.5	5	4	15
"Operate" Power	μ Watts	500	40	50	300	250	160	2250
Working Excitation	Amp. Turns	15	4	6	10	10	10	25
Working Power	μ Watts	2250	160	360	1000	1000	1000	6250
"Release" Excitation	Amp. Turns			2.2		2.4	4	5
Max. Rate of Operation	Oper./Sec.	200	200	200	200	100	200	100

Contacts:	Silver, General Purpose
	2 amp., 28v d-c resistive load
	Platinum Alloy A. Low-Level
	Applications up to 1 amp.
	Platinum Alloy B. Heavy Duty
	Applications above 1 amp.
	Max. Continuous Current 5 amps.

Dielectric Test Voltage	Coil to Frame	500v rms.
	Contact to Contact	350v rms.
	Contact to Frame	500v rms.
	Coil to Coil	150-500v rms.
Standard Coils	Resistances from 1.1 to 18,000 ohms	
	Max. number of windings	8
	Max. Continuous Loading	1 watt
Temperature	Max. Ambient	85°C

DIMENSIONS



ALLIED CONTROL

ALLIED CONTROL COMPANY, INC., 5 EAST 89th AVENUE, NEW YORK 31, N. Y.

Nuclear-Powered Helicopter . . . In a recent lecture, Dr. Igor Sikorsky discussed a hypothetical nuclear-powered helicopter with the passengers suspended a few hundred feet below the helicopter in a cabin. The pilot in the cabin would direct the helicopter by remote control. Dr. Sikorsky, the helicopter pioneer delivered the Clayton Lecture at the General Meeting of the Institute of Mechanical Engineers in London, England, on April 29. He received that society's James Watt International Medal.

Cathode Coating Control . . . A device that provides a continuous, non-contacting control of coating thickness on cathode heater wire has been developed. Accurate coating control within $\pm 3/10,000''$, such as this equipment affords, is necessary for the cathode wire used in series string tubes.

Developed by Industrial Gauges, Englewood, N. J., the unit measures the wire from its shadow instead of by contact, as a micrometer would. As a result, the coating process need not be interrupted.

Rotating Ferrite Antenna . . . Many of the European table-model radios being imported into the United States feature directional ferrite-core antennas and electrostatic tweeter speakers. The rotatable antennas are mounted inside the cabinets and they are tuned by a wheel on the front panel.

This type of antenna is needed in Europe where the broadcast frequency spectrum is very crowded. When these sets also include an f-m tuner, it has a separate antenna.

Many Tube Types in TV Sets . . . A survey of 150 different 1955 and 1954 TV receivers of various manufacturers has revealed that 119 different receiving tube types are in use. The study was made by the receiving-tube department, General Electric Co., Owensboro, Ky.











◀ CIRCLE ED-8 ON READER-SERVICE CARD

THE SELENIUM RECTIFIER WITH THE GREATEST

Manufacturer
Acceptance

More design and component engineers in the radio-TV industry have placed their approval on Federal Selenium Rectifiers than any other make—

And **HERE'S** why— point by point:

-  **LONGER LIFE** ... 5,000 hours life expectancy in approved applications.
-  **HIGHER OUTPUT VOLTAGE** ... 3 to 6½ higher B+ output volts than competitive selenium rectifiers in conventional doubler circuits.
-  **LOWER TEMPERATURE RISE** ... 2° C to 10° C lower average operating temperature than competitive selenium rectifiers.
-  **SUPERIOR HUMIDITY RESISTANCE** ... passes 1,000-hour life test in 95% relative humidity at 40° C.
-  **PROVEN MECHANICAL CONSTRUCTION** ... brass eyelet or aluminum stud construction used exclusively. Patented "dead-center" construction allows stack to be tightened until rigid, without affecting the pressure-sensitive selenium characteristic.
-  **UNDERWRITERS LABORATORY ACCEPTANCE FOR 85° C OPERATION** ... Federal's popular radio-TV types have been tested and accepted by UL for operation at cell temperatures of 85° C.
-  **CONSERVATIVE RATINGS** ... rectifiers offered to the industry are rated only after exhaustive temperature rise and aging tests on minimal grade units to insure full value and satisfaction.
-  **MORE UNIFORM QUALITY** ... Federal rectifiers are automatically 100% tested and inspected to meet standard forward and reverse current specifications, as well as for dielectric strength.
-  **LARGEST PLANT CAPACITY** ... production facilities to satisfy any quantity requirement.
-  **MORE ENGINEERING KNOW-HOW** ... the research and design facilities of the world-wide, American-owned International Telephone and Telegraph Corporation assure continued product leadership.

For full information, write Dept. F-635.



Federal Telephone and Radio Company
A Division of INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION
COMPONENTS DIVISION • 100 KINGSLAND ROAD • CLIFTON, N. J.

In Canada: Standard Telephones and Cables Mfg. Co. (Canada) Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., New York

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



Automatic Electronic Sextant . . . Joining long radar, sonar, and direction-finders, another electronic navigation aid has been developed. An experimental automatic sextant utilizes a telescope focusing on a photoelectric cell to locate and track a desired celestial body. The sextant can be mounted at any point on an airplane for remote operation.

The equipment has been developed by Kollsman Instrument Corp., 80-08 45th Ave., Elmhurst 73, N. Y. It consists of a tracking device, which can be remotely located, and an indicator which is mounted in the navigator's compartment. In use, the navigator selects the estimated position of the selected celestial body on the control panel. The tracking device then begins to automatically search for the body. The telescope sweeps from right to left with several steps of elevation, searching a patch of sky 7° by 5° until it automatically recognizes the star to be tracked.

As soon as the star is recognized, the system starts its tracking operation. An automatic averaging period can be started at any time by throwing a toggle switch. When the averaging period is over, the navigator can read the average star altitude. Tests show that under normal conditions accuracy within ten miles can be obtained with a running fix from a succession of several star shots.

Because the sextant will retain a star when the aircraft changes course, repeat observations can be made with the same star—a valuable means of determining true heading accurately.

This new sextant will solve one problem encountered in the operation of long-range military aircraft.

ELECTRONIC DESIGN • June 1954

At present the navigator must move up into a plexiglass canopy to take star shots. The pressure suits worn by plane crews make it difficult to move about. The new sextant means that the navigator does not even have to stand up to take a reading. The canopy is also eliminated, making the plane's hull smoother and stronger.

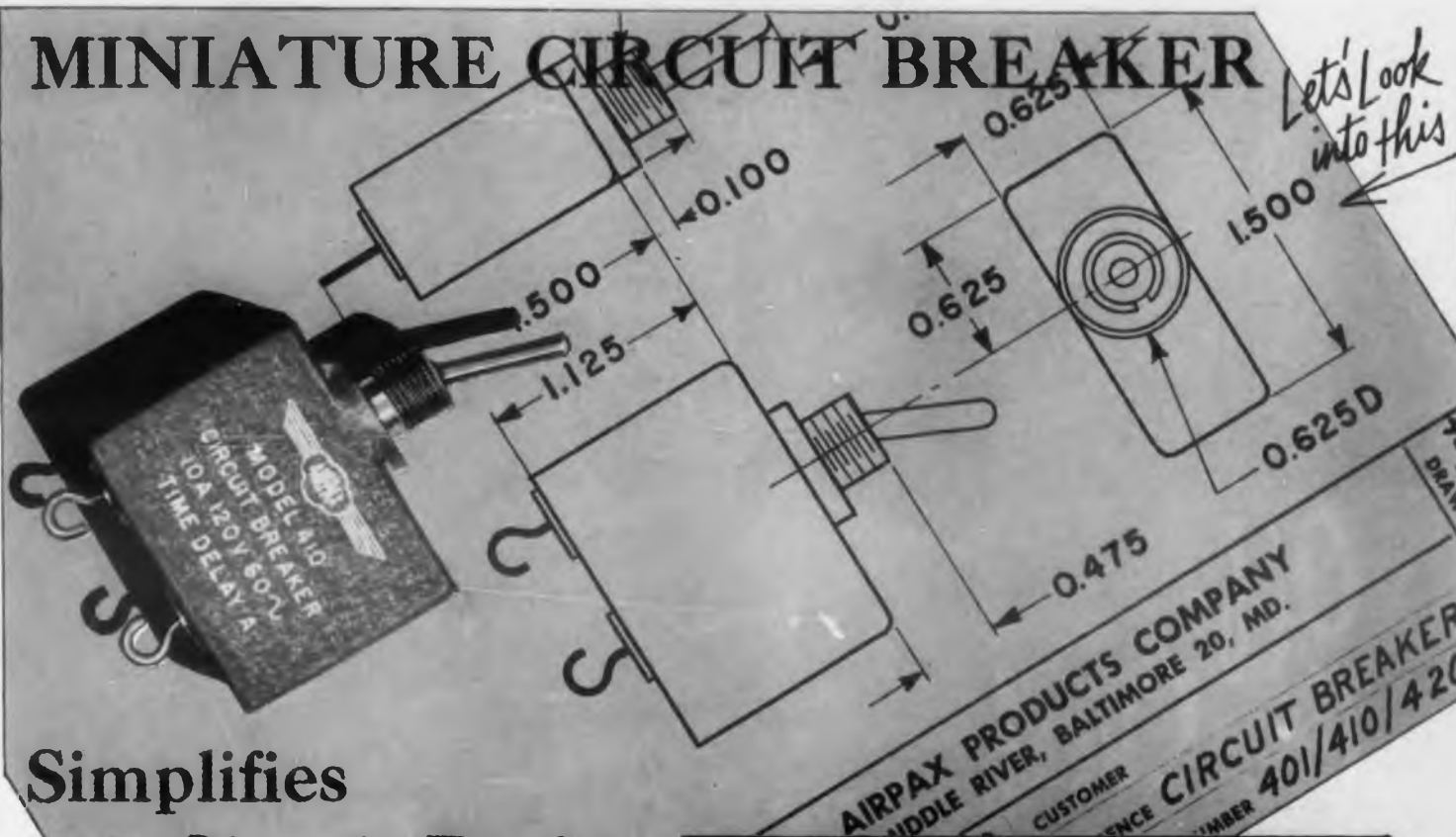
Computer Aids Human Engineering . . .By determining the ability of most soldiers in tracking targets, a new electronic device will aid designers of weapons systems. The device consists of a computer operating a 21" oscilloscope. The computer generates various target patterns on the screen, and the ability of the soldier under test to follow the pattern is recorded. The special-purpose computer is being constructed by the Battelle Institute, 505 King Ave., Columbus 1, Ohio, for the Army Medical Research Laboratory, Fort Knox, Ky. Test results recorded by the apparatus will assist psychologists in determining the basic capabilities and limitations of the human in performing complex, continuous tasks. Army developmental agencies will be able to use this basic human engineering information in designing weapons systems that can be operated by a larger number of men. The equipment could also be used to study civilian jobs that draw heavily on motor skills and perception.

Pliable Plastic

This piece of "Super Dylan" polyethylene has been stretched 575% without breaking. Regular polyethylene elongates about 200% before breaking. The new plastic was developed by Koppers Co., Inc., Pittsburgh, Pa. It retains its shape at high temperatures.



MINIATURE CIRCUIT BREAKER



Simplifies Circuit Design

You can now perform the *two* functions of power ON-OFF control and circuit protection with *one* miniature fully magnetic time-delay trip-free circuit breaker. Save space (see diagram above); save weight (weighs less than 2 oz). The characteristics (tabulated at right) of this new Airpax component show it to be a significant advance in power control; just what you need.

Handle has ON and OFF positions; it moves to OFF position when breaker trips, yet breaker cannot be prevented from tripping by holding handle in ON position. Stable tripping mechanism assures reliable operation even under adverse temperature and vibration. Give your equipment the protection it deserves.

To restore service after fault has been removed, simply reset the breaker. A breaker having a 30-sec time delay recovers full delay in about 20 sec.

To receive complete engineering data, simply write to

CHARACTERISTICS

RATINGS: 0.05 amp to 10 amp at 50 V DC or 1.0 to 10 amp at 120 V AC

MINIMUM TRIP: 125% of rated load

INSTANTANEOUS TRIP: 1,000% of rated load

INTERRUPTING CAPACITY: a typical value is 500 amp at 30 V DC

POWER CONSUMPTION: 0.6 watt in lower current ratings, rising to about 2 watts at 10 amp rating

SHOCK: resists 50 g in all directions

VIBRATION: 10 to 55 CPS at 0.06 in. total excursion in all directions

TEMPERATURE: -40 C to +100 C

LIFE: 10,000 operations at rated current into resistive load

ENCLOSURE: hermetically sealed

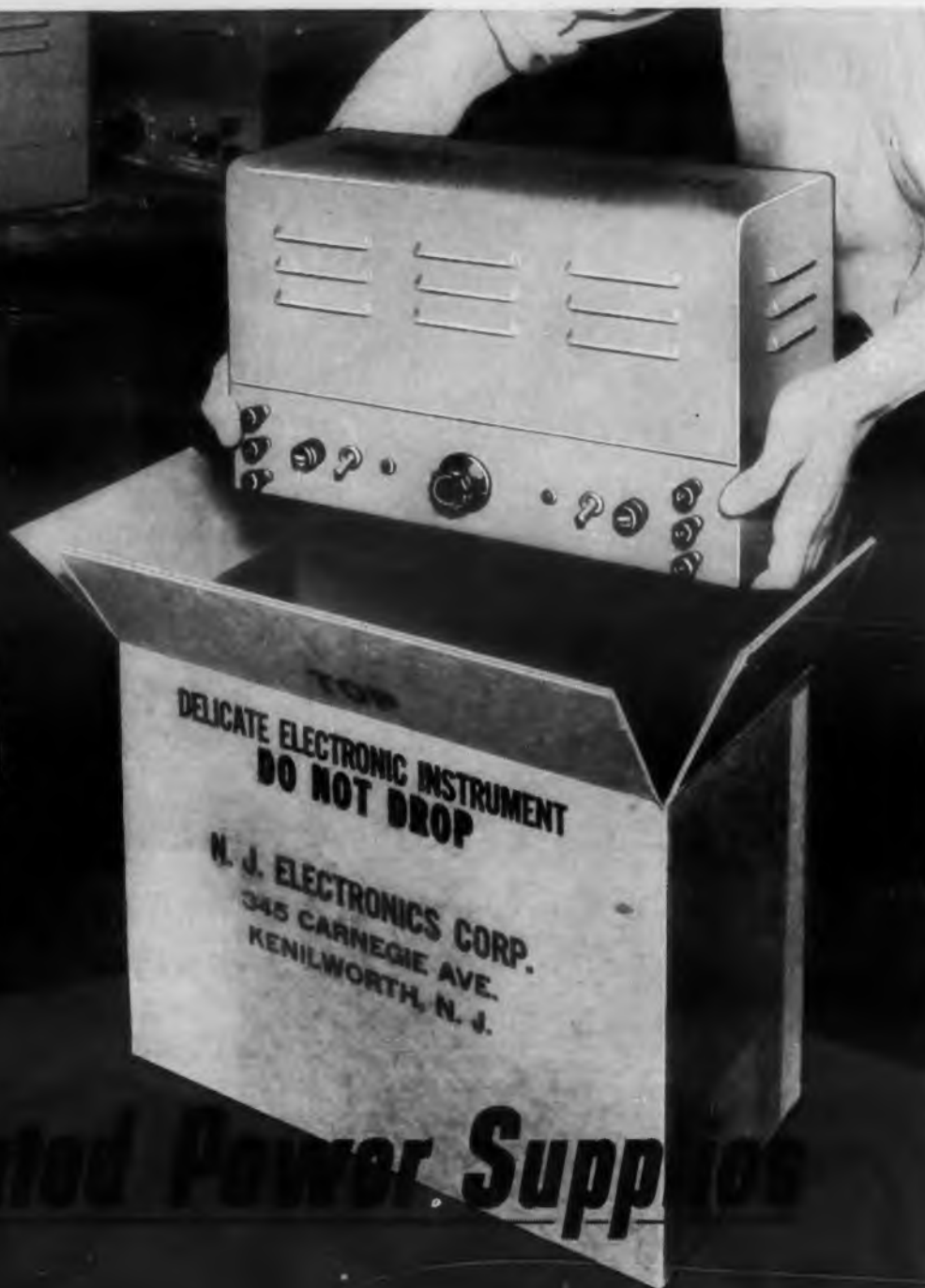


MIDDLE RIVER

BALTIMORE 20, MD.

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

Off-
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Delivery



of Regulated Power Supplies

64 models
available
from stock!

Send for your copy of "A Sensible Approach to Regulated Power Supply Design". Full price and performance data on the industry's most complete line of regulated plate supplies.



NEW JERSEY ELECTRONICS CORP.

345 Carnegie Avenue, Kenilworth, New Jersey

Corporate Headquarters

Send complete company information card (ED-17) to:
New Jersey Electronics Corp., Dept. ED-17, Kenilworth, N. J.

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

Titanium Its Own Crucible . . . In a variation of the zone-melting process (*ED, March, 1954, p. 5*), titanium is being purified in a crucible formed by the outer walls of the metal ingot itself. Since titanium is very active at its high melting point of over 3000°F, it might react with a crucible of another metal. The purification apparatus is illustrated.

The apparatus is mounted inside a glass container filled with an inert gas at low pressure. A square cross-section bar of impure titanium standing upright on a platform is lifted through an induction heating coil. The coil carries energy at 10kc. While the inside of the bar is melting, the four corners of the bar rapidly lose what heat they hold to the surrounding atmosphere. Thus the corners remain rigid and act as a crucible.

This "cage zone refining" was developed by P. H. Brace, Dr. A. W. Cohardt, and Dr. George Comenit of the Westinghouse Research Laboratories. It can also be used to purify other scarce metals, including semiconductors. In one variation of the new process a round bar is machined so that several ridges or fins run lengthwise along it. These ridges form the crucible in the process. They permit bars of larger diameter to be purified. Perhaps bars as much as three inches in diameter will be purified eventually by this process.

Small Plane Homing System . . . A walkie-talkie can provide the homing signal for a homing system developed for small aircraft. The system requires only the addition of a device weighing five pounds to the plane. It can be used to assist liaison planes and helicopters in the finding of lost army units, the dropping of supplies, or finding their home base.

The system operates with any standard 24-52Mc army transmitter on the ground that emits vertically polarized signals. It is limited to line-of-sight operation, and its range, therefore, is determined by the altitude of the plane. The system was developed by the Radio Systems Laboratory, Stanford Research Institute, Stanford, Calif., under the sponsorship of the U. S. Air Force and the Army Signal Corps.

The plane's f-m radio has to be modified so that it will operate as an a-m receiver when it is utilized in the homing operation. A circuit added to the receiver generates a 400cy tone. Two vertical antennas are mounted on the tail of the plane in such a manner as to set-up a heart-shaped radiation pattern on either side of the plane.

These patterns are switched on one at a time back and forth to indicate which direction the signal is coming from. One pattern is keyed to a "D" signal and the other to a "U". The operation of the system depends on a comparison of the signals received during the existence of each of the two patterns. The 400cy tone is controlled by the strength of the radio signal received.



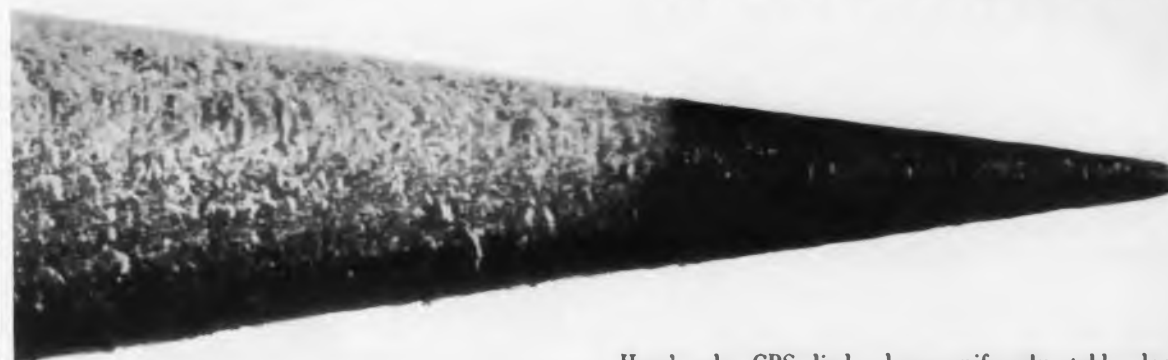
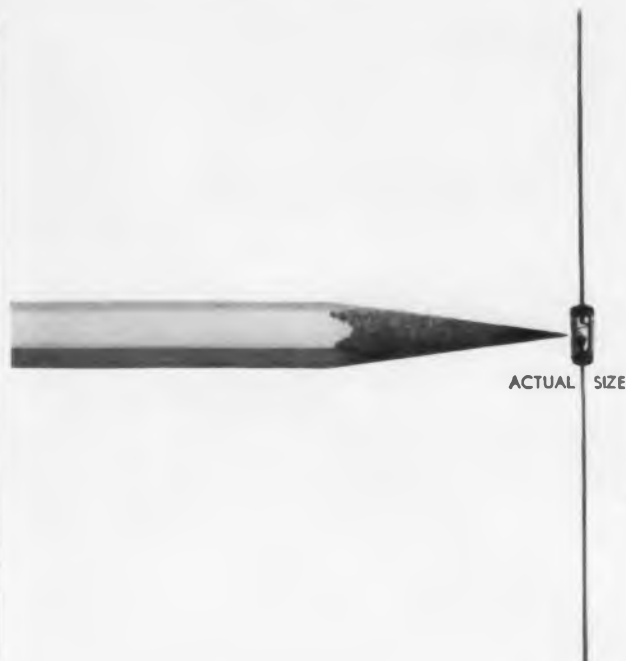
Titanium is being purified by the "cage zone refining" process in which it forms its own crucible.

The homing system produces a steady hum in the pilot's earphones when he is on course. If he is to the right of the proper course, the letter "D" sounds. If he is to the left, he hears a "U" signal. The system has also been adapted to a visual dial to indicate whether the pilot should turn right or left to be on course.

The size of this system contrasts with the extensive direction finding equipment required at most airports for homing in large commercial and military planes.

Electronic Test Pilot

The performance of this experimental vertical-rising plane is being checked with the aid of a 650 Magnetic Drum Data Processing Machine, made by International Business Machines Corp., New York, N.Y. The jet-propelled craft is being developed by Bell Aircraft Co., Buffalo, N.Y.



Here's why CBS diodes have uniformly stable electrical characteristics.

1. During manufacture, mechanical pressure of each catwhisker on its crystal is the same.
2. This pressure is locked in permanently by rigid glass-to-metal seals.
3. Humidity and contamination are sealed out . . . stability is sealed in.
4. CBS glass diodes are rugged. Repeated bending of leads will not break glass.

CBS-Hytron's Commercial Engineering Department will recommend the best in diodes, or tubes, for your applications upon request.

Ask for data on CBS Glass Diodes

Gold bonded computer . . . silicon uhf . . . video detector and harmonic generator . . . and general purpose diodes . . . all available in the new CBS subminiature line.

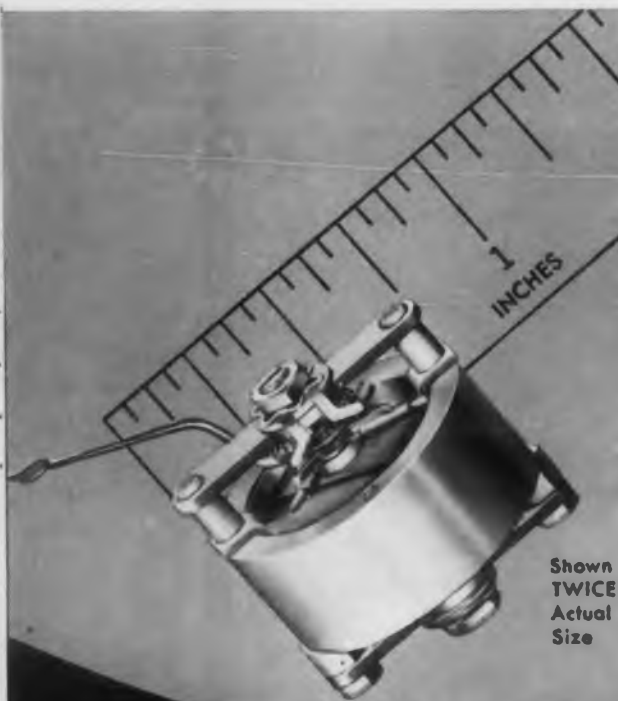
Quality products through *ADVANCED-ENGINEERING*



CBS-HYTRON, Danvers, Massachusetts . . . A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

CIRCLE ED-11 ON READER-SERVICE CARD FOR MORE INFORMATION

New Simpson Core Meter Movement



Shown
TWICE
Actual
Size

fine

Here's the new Simpson **Core-Type Meter Movement**. It's a more compact, more sensitive, **self-shielding** movement that gives electrical measurements with laboratory accuracy, yet has the ruggedness to withstand severe shocks. Its accuracy specifications are so rigid that Simpson engineers had to devise unusual production techniques.

Let Simpson engineers design panel meters using the new core movement to your special instrument requirements. Simpson continues to maintain its large stock of standard panel meters in over 700 sizes and ranges, available through distributors.

RUGGEDIZED METERS

Simpson's 2 1/2" and 3 1/2" Panel Meters are available in **sealed, ruggedized** models to meet specifications MIL-M-10304-(Sig. C). Movements are sealed against moisture and other adverse atmospheres, and are spring-mounted to absorb excessive vibration.

SEND FOR NEW CATALOG 17



INSTRUMENTS THAT STAY ACCURATE

ELECTRIC COMPANY

5217 W. Kinzie St., Chicago 44, Illinois, Phone: ESTebrook 9-1121
in Canada: Bach-Simpson, Ltd., London, Ontario

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



Tiny Hearing Aid

This 3-transistor hearing aid can be concealed in a woman's hair. The microphone is at the right end and amplifier at the left. The speaker is plugged into the amplifier. Made by Acousticon, Jamaica, N. Y., the unit operates 175 hr on a RM-450 mercury battery.

Electronics in Cold War . . . World-wide distribution of cheap radios and hand-operated phonographs has been advocated as a means of defeating Russia in the propaganda cold war. In a memorandum to President Eisenhower, Brig. General David Sarnoff, Chairman of the Board, Radio Corp. of America, urged that the radios and phonographs be sold at cost or given away in underprivileged or backward areas subject to Communist propaganda. Cheap cardboard records could be sent out regularly to be played on the phonographs.

The receivers would be tuned to American stations. The phonographs would be distributed in areas without electric power. The inexpensive radios could be made by either the printed-circuit or "Tinkertoy" method.

Electronic Travel Aid . . . An electronic device that tells New York City subway travelers how to arrive at their destinations has been developed. When a button is pressed a series of colored bulbs light up.



ELECTRONIC DESIGN • June 1954

on a subway map showing the route to be travelled and at the same time specific instructions in illuminated print appear adjacent to the transit map.

Every subway station on the transit system is listed alphabetically according to the boroughs. In addition to the stations, there is a separate listing of the points of interest in the city.

Known as the "Electronic Destination Locator", the device was developed by Femeo, Inc., Irwin, Pa., for the New York City Transit Authority, 370 Jay St., Brooklyn, N. Y.

Semiconductor Research . . . Solid state physics research will be stressed at a new laboratory being constructed at Parma, Ohio, for the National Carbon Co., a division of Union Carbide & Carbon Corp., 10 East 42nd St., New York 17, N. Y. The metallic and non-metallic compounds of carbon and the inter-metallics and semiconductors will be studied. New semiconductor materials for transistors will be a major objective of the laboratory.

Bulletin Board

Is the lack of a certain circuit, component, instrument, or material delaying your design project? Do you believe that some design laboratory is capable of producing a special component? Is your list of suppliers of certain components incomplete? Prepare your specifications or needs in less than 150 words, typewritten on company letterhead stationery, and send them to Bulletin Board, ELECTRONIC DESIGN, 19 East 62nd St., New York 21, N. Y. Include a name and address where our readers can communicate with you. If a sketch is necessary, please draw in black ink on white paper (no ozalids). The following requests were recently received. If you can supply any of these requests, please write to the address given.

Tube: A rectifier tube equivalent to the 5U4 but with an indirectly heated cathode. Such a tube would prevent the power-supply from applying voltage to the plates of heavy drain tubes before they heat up.
Write to: Byron St. Clair, Waveforms, Inc., 333 Sixth Ave., New York, N. Y.

Connector: Bayonet-type two-prong connector with male or female mounting.

Write to: Joseph Schulman, Davies Laboratories, Inc., 4705 Queensbury Rd., Riverdale, Md.

Resistor: A resistor of 1 to 10 megohm, not exceeding 1/4" in length and 1/8" diam. It must not contain any organic materials or soft solder, and be suitable for use inside a sealed vacuum system. The temperature characteristics and tolerance are of secondary importance. Radial leads suitable for spot welding are preferred. The unit should be able to withstand 400°C during vacuum exhausting. Approximately 200v will be placed across the resistor in operation.

Write to: L. G. Sloan, National Co., Inc., Engineering Annex, 34 Essex St., Melrose, Mass.

CAPACITY	DIELECTRIC	SIZE	AVAILABLE CAPACITY TOLERANCES	
2-KV				
5-15	N-750	1/4"	5-10-20%	GMV
16-47	N-750	3/8"	5-10-20%	GMV
48-72	N-750	1/2"	5-10-20%	GMV
73-200	N-750	3/4"	5-10-20%	GMV
201-250	N-750	1"	5-10-20%	GMV
251-330	N-750	1 1/8"	5-10-20%	GMV
3-KV				
5-15	N-750	3/8"	5-10-20%	GMV
16-28	N-750	1/2"	5-10-20%	GMV
29-56	N-750	3/4"	5-10-20%	GMV
57-68	N-750	1"	5-10-20%	GMV
69-180	N-750	1 1/8"	5-10-20%	GMV
181-240	N-750	1 1/4"	5-10-20%	GMV
4-KV				
5-56	N-1500	3/8"	5-10-20%	GMV
57-180	N-1500	1/2"	5-10-20%	GMV
5-KV				
5-30	N-1500	3/8"	5-10-20%	GMV
31-60	N-1500	1/2"	5-10-20%	GMV
61-130	N-1500	3/4"	5-10-20%	GMV
6-KV				
5-20	N-1500	3/8"	-10-20%	GMV
21-100	N-1500	1/2"	-10-20%	GMV

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

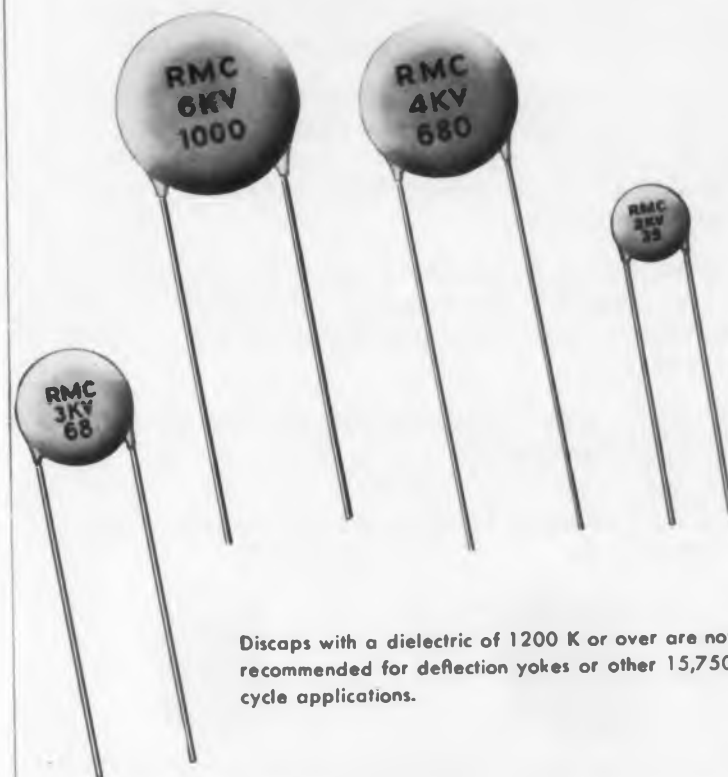
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331-470	1200-K	3/8"	± 20%	GMV
471-1000	1200-K	1/2"	± 20%	GMV
1001-2700	HI K	3/4"		GMV
2701-5000	HI K	1"		GMV
5001-10000	HI K	1 1/8"		GMV
3-KV				
241-500	1200-K	3/8"	± 20%	GMV
501-1000	1200-K	1/2"	± 20%	GMV
1001-5000	HI K	3/4"		GMV
4-KV				
181-680	1200-K	3/8"	± 20%	GMV
681-1000	HI K	1/2"		GMV
5-KV				
131-330	1200-K	3/8"	± 20%	GMV
331-1000	HI K	1/2"		GMV
6-KV				
101-220	1200-K	3/8"	± 20%	GMV
221-470	1200-K	1/2"	± 20%	GMV
471-1000	HI K	3/4"		GMV
1001-2000	HI K	1"		GMV

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

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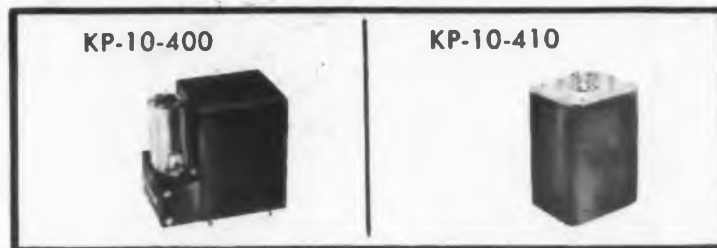
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Meetings

June 16-18: *National Applied Mechanics Conference*, Rensselaer Polytechnic Institute, Troy, N. Y. Sponsored by the American Society of Mechanical Engineers. For information, write to T. A. Marshall, Jr., American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

June 20-25: *International Symposium on Electromagnetic Wave Theory*, Univ. of Michigan, Ann Arbor, Mich. Sponsored by Commission VI of URSI. For information, write to J. W. Crispin, Jr., Univ. of Michigan, Ann Arbor, Mich.

June 27-29: *First Annual Nuclear Society Meeting*, Pennsylvania State University, State College, Pa. Sponsored by the American Nuclear Society. For information, write to Prof. W. W. Miller, Pennsylvania State University, State College, Pa.

June 27-July 1: *AIEE Summer General Meeting*, New Ocean House, Swampscott, Mass. For information, write to AIEE, 33 West 39th St., New York 19, N. Y.

June 28-July 9: *International Electrotechnical Commission*, London, England. For information, write to the U. S. National Committee, c/o American Standards Association, 70 E. 45th St., New York 17, N. Y.

August 22-23: *Symposium on Electronics and Automatic Production*, San Francisco, Calif. Jointly sponsored by Stanford Research Institute and the National Industrial Conference Board. For information, write to Stanford Research Institute, Palo Alto, Calif., or the National Industrial Conference Board, 247 Park Ave., New York, N. Y.

August 24-26: *Western Electronics Show and Convention*, Civic Auditorium, San Francisco, Calif. Sponsored by the West Coast Electronic Manufacturers' Association and the Seventh Region of the IRE. For information on exhibits, write Mal Mobley, Jr., 344 N. LaBrea Ave., Los Angeles, Calif. Technical papers should be submitted to Dr. W. A. Edson, Applied Electronics Laboratory, Stanford, Calif.

September 12-16: *Tenth Annual Instrumentation Automation Conference and Exhibit*, Shrine Exposition Hall and Shrine Auditorium, Los Angeles, Calif. Sponsored by the Instrumentation Society of America. Analytical Instrumentation, Computer, and Maintenance Clinics will be held during the conference. For information, write to Dr. Arnold O. Beckman, 3443 S. Hill St., Los Angeles, Calif.

September 14-16: Annual Meeting of the Association for Computing Machinery, Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, Pa.

Sept. 26-27: Symposium on Electronics for Automation and Automation for Electronics, Irvine Auditorium, University of Pennsylvania, Philadelphia, Pa. Sponsored by the Radio-Electronics-Television Manufacturers Association. For information, write to RETMA, 777 14th St., N. W., Washington 5, D. C.

Sept. 26-30: Meeting on Marketing the Products of Atomic Energy and Trade Fair, Sheraton-Park Hotel, Washington, D. C. Sponsored by the Atomic Industrial Forum. For information, write to Atomic Industrial Forum, Inc., 60 Madison Ave., New York 16, N. Y.

October 3-5: Eleventh Annual National Electronics Conference, Hotel Sherman, Chicago, Ill. For information, write to J. Kocik, c/o Illinois Bell Telephone Co., 208 W. Washington St., Chicago 6, Ill.

Oct. 12-15: 1955 Convention and Audio Fair, Hotel New Yorker, New York, N. Y. Sponsored by the Audio Engineering Society. For information, write to G. K. Dahl, 230 W. 41st St., New York 36, N. Y.

October 24-25: First Annual Technical Meeting of the Professional Group on Electron Devices of the IRE, Shoreham Hotel, Washington, D. C. For information, write to IRE, 1 E. 79th St., New York, N. Y.

October 24-26: Sixth National Conference on Standards, Sheraton Park Hotel, Washington, D. C. Sponsored jointly by the American Standards Association and the National Bureau of Standards. For information, write to the American Standards Association, 70 E. 45th St., New York 17, N. Y.

Oct. 31-Nov. 1: 1955 East Coast Conference on Aeronautical and Navigational Electronics, Lord Baltimore Hotel, Baltimore, Md. Sponsored by the Baltimore Section of the IRE and the IRE Professional Group on Aeronautical and Navigational Electronics. Interested persons should submit 150 word abstracts of papers before July 1, 1955, to Norman Caplan, Bendix Radio Div., Bendix Aviation Corp., Towson 4, Md. Organizations interested in sponsoring exhibits should contact C. E. McClellan, Air Arm Div., Westinghouse Electric Corp., Friendship Airport, Baltimore, Md.

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Power Transistor Temperature Rating

LeRoy A. Griffith
Director, Transistor Engineering
Minneapolis-Honeywell Regulator Company



Fig. 1.
mounted
contact
base for

UNTIL recently, components designed for electronic equipment involving low power were rated on their ability to dissipate heat in still air. Tubes, potentiometers, and transformers are typical examples. If excessive heat was present a heat dissipating device was generally designed as a part of the component.

The building of more complex assemblies using smaller components has involved the combining of many functions into a single assembly in a small space. The use of transistors makes possible further major reductions in the space required to obtain the desired functions. In such designs the heating problem is a combined function of all the components of the assembly. The heat dissipation takes place from the outside of the assembly while the internal components conduct heat to the surface and exchange heat among themselves.

Heat removal from power transistors where watts are involved is such an important aspect of transistor applications that we need a clear and meaningful language for use in writing specifications. The expression "heat sink" is being used in relation to heat removal from transistors in such a manner that a serious examination of the adequacy of the term appears proper.

"Heat sink" is a mathematical term meaning a location where one can place or obtain unlimited quantities of heat. It connotes infinite quantities and does not appear practical for use in describing actual

thermal circuits which would be used by the designer.

The term "dissipator" is used in engineering in such forms as "heat dissipator", "plate dissipation", etc. A dissipator is defined as a device which allows heat to flow from a point of high temperature to a point of low temperature. This is the type of heat flow that takes place in a design using transistors.

Heating has always been the one big limiting factor in electrical design. The size, performance, etc., of a final assembly is generally determined by heating. The distribution, conduction, and dissipation of heat must be treated as a thermal problem involving the whole assembly. As an example of this, Fig. 1 shows a power transistor mounted on a copper disk which has a flange to transmit the heat directly to the outside metal case of the instrument.

If the final assembly is arranged so that proper heat conduction is established to the surface of this assembly, the internal heat problem has been handled. If the final assembly cannot dissipate the heat, the dissipator should be designed on this assembly. In the case of airplanes, this problem is reaching the place where the airframe can be considered as the heat dissipator and the internal structures arranged to properly conduct heat to the airplane structure.

The old concept that each component should be tested individually in still air without additional heat dissipators results in large, oversize assemblies. A design that provides means of conducting the heat of each component to the surface of the assembly

where it can be dissipated, allows major reductions in the size of the assembly without an increase in temperature rise. This is a sound procedure, because one can only exchange heat from unit to unit inside a closed assembly. Heat dissipators on each individual component within the assembly would only increase the over-all size and impede the heat flow to the surface of the assembly where it must ultimately be dissipated.

The development of very small components such as resistors and capacitors has contributed materially to the design of efficient electronic equipment. To maintain this size and performance efficiency there are several fundamentals that must be remembered: internal heat generation must equal the total dissipation to obtain stable temperatures; metal is a better heat conductor than air; crowding of individual components into a final assembly makes heat dissipators which are designed for free air convection ineffective.

The transistor heat is primarily produced at the collector junction, but it is necessary to consider the total heat in estimating the temperature rise and the required heat dissipator. Power transistors should be designed with adequate conduction facilities to transmit its heat to the surface of the final transistor assembly and make proper thermal connections to associated structures. When such a transistor is tested individually without a heat dissipator, the transistor will obviously overheat. To aid in understanding this

Fig. 1. Power transistor mounted on copper disk in contact with outside metal base for good heat removal.

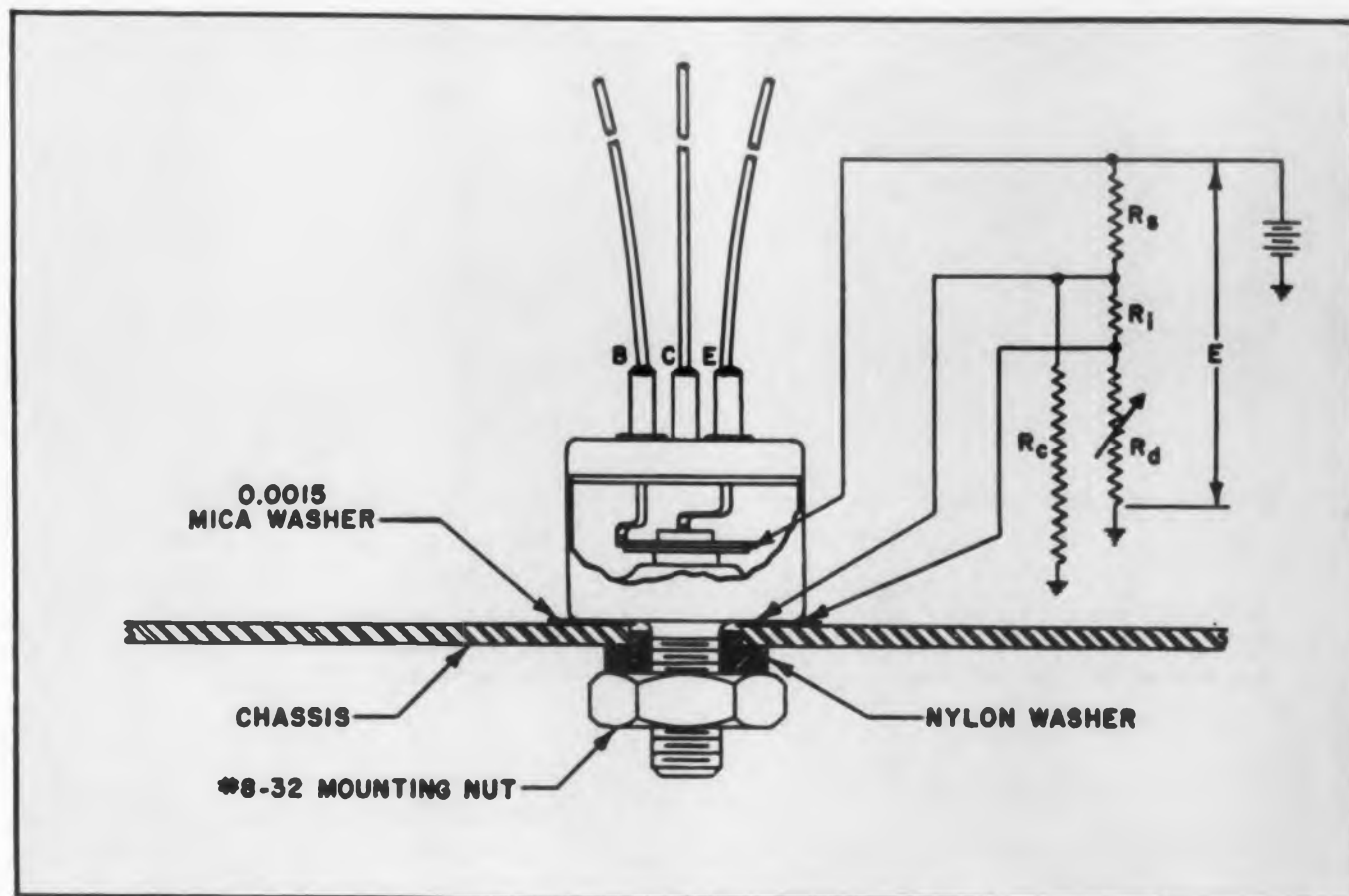


Fig. 2. Power transistor mounted on a heat dissipator. Resistances to heat flow are shown.

Unit	Circuit	Power Output	Total Power Dissip.	% Efficiency	% Distortion	DB Gain
6L6*	Triode Cathode Bias	1.3w	16.2w	7.8	6	28
2N57	Common Emitter	1.3w	2.7w	48.0	5	30
2N57	Common Emitter	5.5w	10.9w	50.0	10	15

*Tube filament power of 5.67w was included in the total dissipation. (Data from RCA Tube Manual)

Table 1. Power transistor produces only a small fraction of the heat produced by a vacuum tube.

problem, consider Fig. 2, which shows a power transistor mounted on a heat dissipator.

The heat dissipator serves to conduct the heat from the transistor to other structural parts where heat is dissipated. The mica washer and the insulator bushing serve to insulate the transistor from the metal mounting structure when the circuit requires electrical isolation. When the transistor frame can be directly connected to the heat dissipator, the insulators are omitted. The mica washer is in series with the heat path and directly offers a resistance to heat flow. The insulator bushing is outside of the heat path to such an extent that it can be neglected in considering the heat problem.

The heat flow from the collector and emitter junctions passes through the top portions of the stud into the mica washer and on into the heat dissipator. This thermal circuit is the equivalent of an electrical circuit. R_s represents the resistance to heat flow imposed by the top portions of the stud. This resistance is effectively constant. R_i represents the resistance to heat flow of the mica insulator. This resistance is constant for a given thickness of washer and area of transistor contact. R_d represents the resistance to heat flow of the heat dissipator. This resistance is quite variable, depending upon the effectiveness of the heat dissipator.

For R_s , R_i , and R_d , all surface resistances to heat flow are considered as a part of the material. The heat losses from the transistor case are small, and act

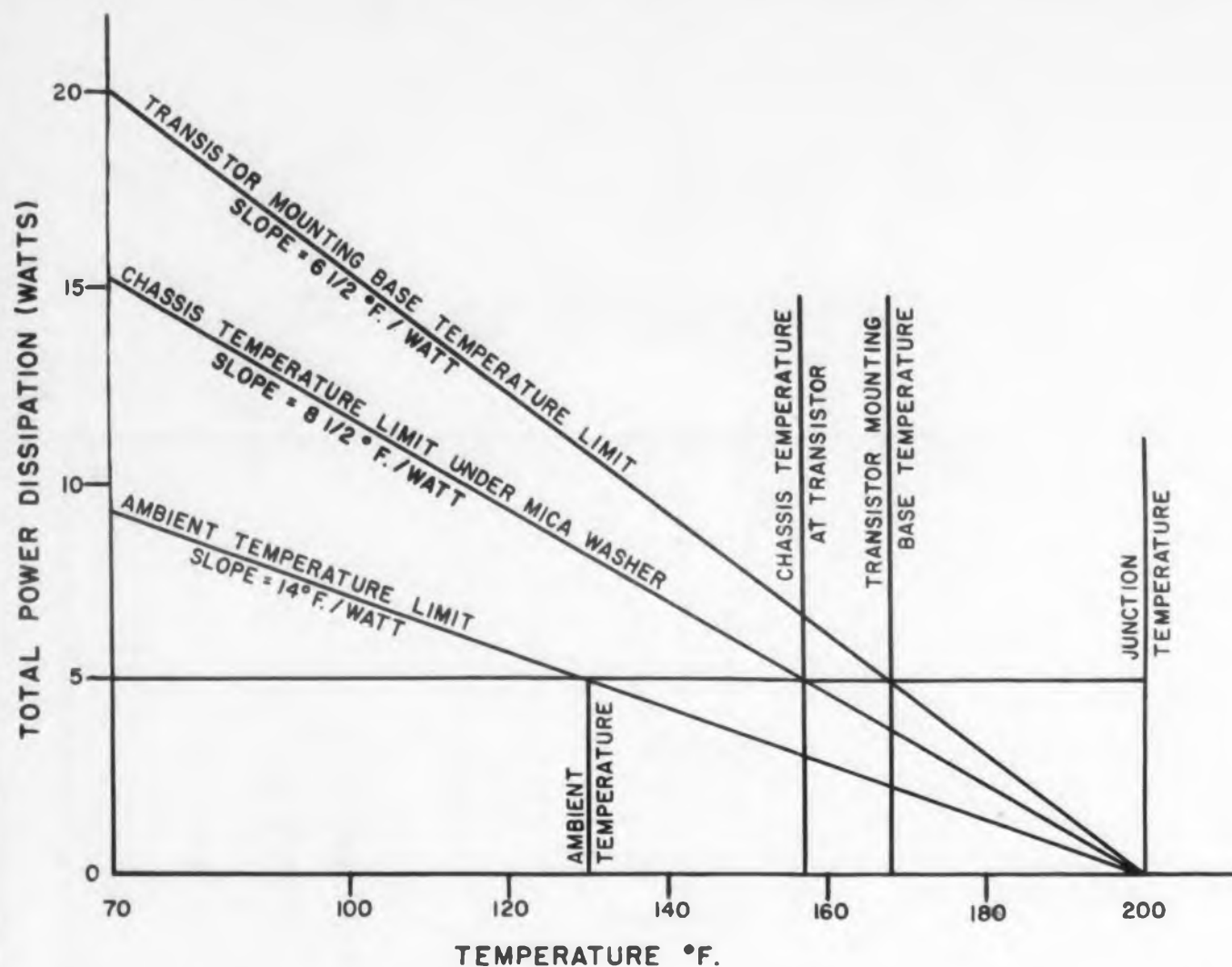


Fig. 3. Power dissipation possible without exceeding maximum junction temperature of 200°F. Thermal resistance of case, washer, etc. per watt means junction is hotter than exterior surface.

as a parallel heat loss as represented electrically by R_c .

The power transistor produces only a small fraction of the heat produced by a vacuum tube of a corresponding power rating as shown in the accompanying table. If the designer takes advantage of the major reductions in size which the transistor makes possible, the resulting temperature is about the same as was experienced in designs using vacuum tubes.

If the operating temperature of the transistor is limited by the junction temperature and the junction is unavailable for measurement, some indirect means must be found to determine the junction temperature from measurements which are available. The materials and geometry of the transistor assembly determine the temperature difference that must exist to conduct heat at any given rate. At the temperature levels encountered in transistors, the thermal conductivity of materials is essentially constant so the temperature difference per unit power can be easily expressed in terms of thermal resistance or temperature difference per watt dissipation. For the 2N57 transistor, the thermal resistance is 6-1/2°F/watt. Thus at any given mounting base temperature, the junction will be 6-1/2°F hotter for every watt dissipated in the unit. With a junction temperature of

200°F, no dissipation is allowed. If the mounting base of the transistor can be kept at 70°F the rise in the temperature of the junction can be 130°F to give a junction temperature of 200°F. Under these conditions the power dissipation can be 20 watts! ($20 \times 6-1/2 = 130^\circ\text{F}$ temperature rise.)

This information may be shown graphically by plotting the allowable power dissipation against the transistor mounting base temperature such as shown in Fig. 3. The slope of this line is the thermal resistance of the unit and the zero power intercept is the maximum junction temperature.

Similar curves for other junction temperatures may be drawn parallel to this and passing through zero dissipation at the junction temperature desired. However, this curve is for maximum limits so it will pass through the axis at the junction temperature limit, in this case at 200°F. The thermal resistance of a .002" mica washer for this size transistor is about 2°F/watt. This thermal resistance is directly additive to the transistor thermal resistance and a line with a slope of $6-1/2 + 2$ or 8-1/2°F/watt will indicate the limiting temperature of the chassis under the transistor for each power dissipation. As the heat flows out of the chassis material and eventually dissipates to the surrounding air, the temperature rise

of the chassis mounting point over the ambient air establishes the thermal resistance of the chassis for this dissipation. This also is additive to the other thermal resistances. However, this resistance is one that the designer has control over.

Suppose it is necessary to operate at an average dissipation level of 5 watts in an ambient of 130°F. A line is drawn across the chart at 5 watts dissipation and a vertical line is drawn at 130°F. Through the intersection of these two lines and the 200°F point, a line is drawn representing the maximum total thermal resistance. This line will have a slope of 14°F/watt. Of this, 6-1/2°F/watt are used in the transistor, and 2°F/watt are used by the mica washer. This leaves only 5-1/2°F/watt as the maximum allowable thermal resistance of the chassis.

At a lower ambient temperature, say 116°F, the dissipation can be increased to 6 watts without exceeding the junction temperature limit. At an ambient temperature of 144°F the dissipation must be reduced to 4 watts. Conversely, if the ambient temperature dropped to 116°F and the power remained at 5 watts, the whole set of curves would move to the left until the ambient temperature curve again passed through the operating condition, and thus all temperatures would be reduced 14°F. Similarly, an increase in ambient temperature would increase the junction temperature the same amount.

If the power dissipation and/or the ambient temperature is reduced the curves will shift to the left, giving a new mounting base temperature and junction temperature. Under these conditions the transistor can stand a peak power dissipation in excess of the steady state dissipation. Suppose that the transistor mounting base temperature has been reduced to 150°F; an instantaneous power of 7.9 watts may be dissipated without exceeding the junction temperature limit. This excess dissipation is allowable for a short duration only as the mounting base temperature will immediately begin to climb.

The above statements would be exact if the thermal resistance of the chassis dissipator were constant. Unfortunately, this is not quite true. The thermal resistance goes down as the temperature difference increases. Let us see what dissipator area is needed for dissipating 5 watts at a thermal resistance of 5-1/2°F/watt. This calls for a temperature rise above ambient of $5 \times 5-1/2$, or 27-1/2°F. If the entire outside enclosure of the device were 27-1/2°F above ambient, the area necessary to dissipate 5 watts, as shown in Fig. 4, is about 100 square inches.

Since there is some temperature drop from the

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transistor location to the outside case, larger dissipation area is required. Perhaps the design can be made so that only $7\frac{1}{2}^{\circ}\text{F}$ is lost from the chassis at the transistor to the average skin temperature of the device. Then there remains a 20°F difference to ambient. This will require 160 square inches to handle 5 watts dissipation.

Fig. 4 is general and can be used with any transistor or other heat producing device. It is based on the conduction from both sides of a disk whose entire surface is at the same temperature. Except for second order effects, it is a useful approximation for any standard shape of enclosure for a device which is cooled by convected air on all faces.

The charts discussed can be applied to any transistor. In order to construct a chart, it is only necessary to know the junction temperature limit, and the thermal resistance of the unit or its power dissipation limit at any temperature.

In addition to aiding in the thermal design of power transistor devices, the charts indicate the transistor case temperatures which provide a means for checking the adequacy of the dissipator system used.

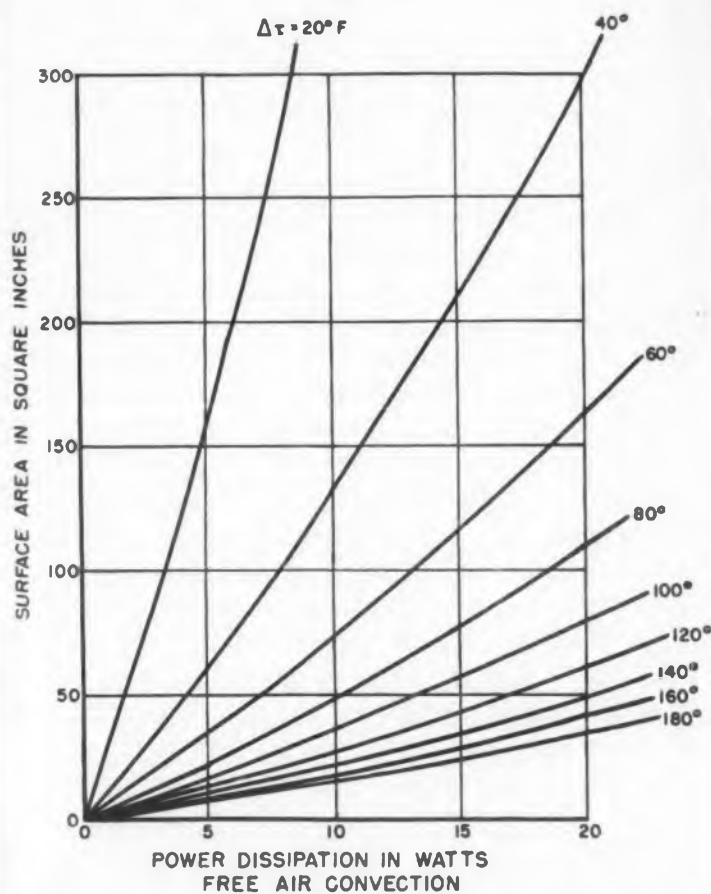


Fig. 4. Graph showing surface area required to dissipate power for temperature differential above ambient.

In case after case



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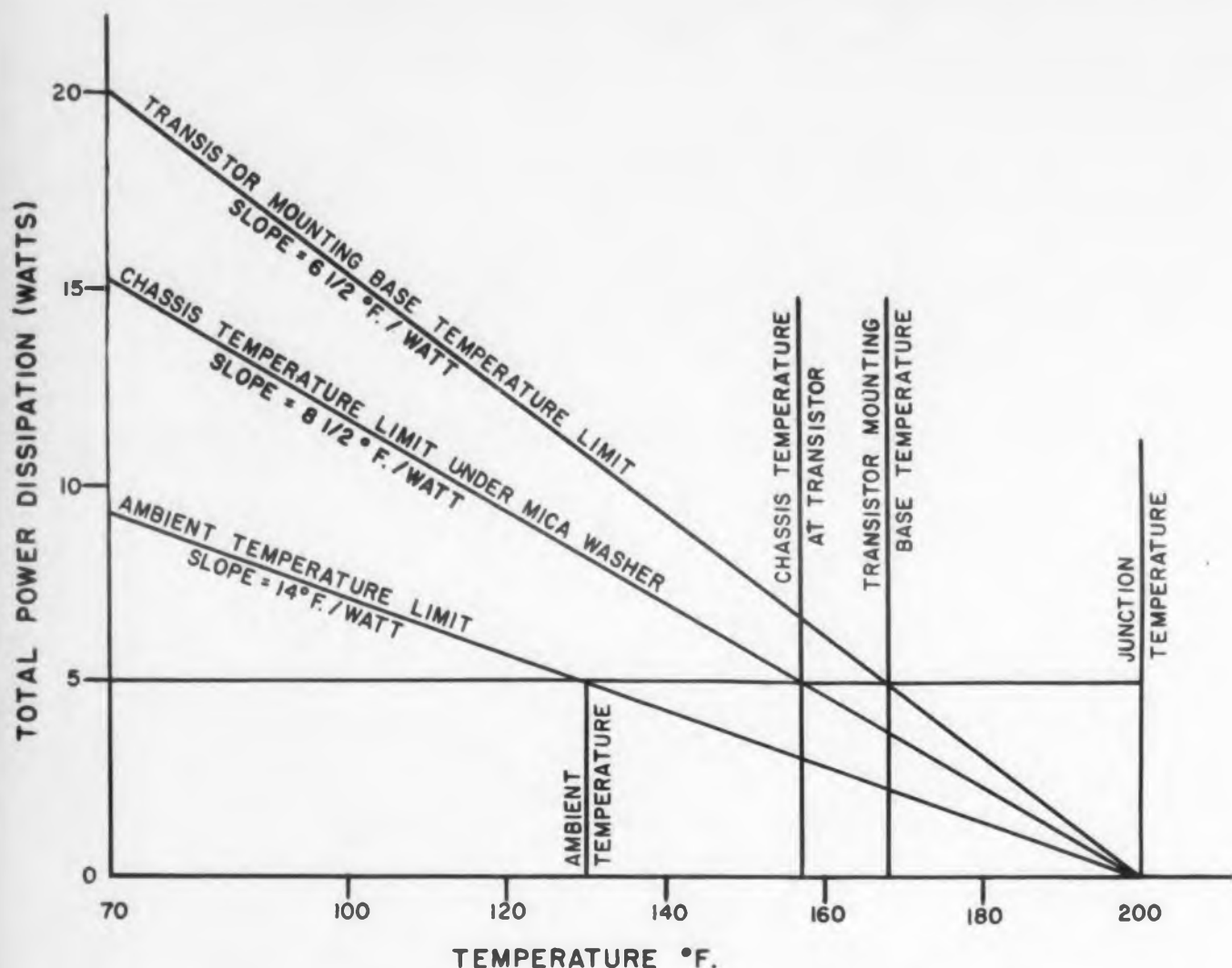


Fig. 3. Power dissipation possible without exceeding maximum junction temperature of 200°F. Thermal resistance of case, washer, etc. per watt means junction is hotter than exterior surface.

as a parallel heat loss as represented electrically by R_c .

The power transistor produces only a small fraction of the heat produced by a vacuum tube of a corresponding power rating as shown in the accompanying table. If the designer takes advantage of the major reductions in size which the transistor makes possible, the resulting temperature is about the same as was experienced in designs using vacuum tubes.

If the operating temperature of the transistor is limited by the junction temperature and the junction is unavailable for measurement, some indirect means must be found to determine the junction temperature from measurements which are available. The materials and geometry of the transistor assembly determine the temperature difference that must exist to conduct heat at any given rate. At the temperature levels encountered in transistors, the thermal conductivity of materials is essentially constant so the temperature difference per unit power can be easily expressed in terms of thermal resistance or temperature difference per watt dissipation. For the 2N57 transistor, the thermal resistance is 6-1/2°F/watt. Thus at any given mounting base temperature, the junction will be 6-1/2°F hotter for every watt dissipated in the unit. With a junction temperature of

200°F, no dissipation is allowed. If the mounting base of the transistor can be kept at 70°F the rise in the temperature of the junction can be 130°F to give a junction temperature of 200°F. Under these conditions the power dissipation can be 20 watts! ($20 \times 6-1/2 = 130^\circ\text{F}$ temperature rise.)

This information may be shown graphically by plotting the allowable power dissipation against the transistor mounting base temperature such as shown in Fig. 3. The slope of this line is the thermal resistance of the unit and the zero power intercept is the maximum junction temperature.

Similar curves for other junction temperatures may be drawn parallel to this and passing through zero dissipation at the junction temperature desired. However, this curve is for maximum limits so it will pass through the axis at the junction temperature limit, in this case at 200°F. The thermal resistance of a .002" mica washer for this size transistor is about 2°F/watt. This thermal resistance is directly additive to the transistor thermal resistance and a line with a slope of $6-1/2 + 2$ or $8-1/2^\circ\text{F/watt}$ will indicate the limiting temperature of the chassis under the transistor for each power dissipation. As the heat flows out of the chassis material and eventually dissipates to the surrounding air, the temperature rise

of the chassis mounting point over the ambient air establishes the thermal resistance of the chassis for this dissipation. This also is additive to the other thermal resistances. However, this resistance is one that the designer has control over.

Suppose it is necessary to operate at an average dissipation level of 5 watts in an ambient of 130°F. A line is drawn across the chart at 5 watts dissipation and a vertical line is drawn at 130°F. Through the intersection of these two lines and the 200°F point, a line is drawn representing the maximum total thermal resistance. This line will have a slope of 14°F/watt. Of this, 6-1/2°F/watt are used in the transistor, and 2°F/watt are used by the mica washer. This leaves only 5-1/2°F/watt as the maximum allowable thermal resistance of the chassis.

At a lower ambient temperature, say 116°F, the dissipation can be increased to 6 watts without exceeding the junction temperature limit. At an ambient temperature of 144°F the dissipation must be reduced to 4 watts. Conversely, if the ambient temperature dropped to 116°F and the power remained at 5 watts, the whole set of curves would move to the left until the ambient temperature curve again passed through the operating condition, and thus all temperatures would be reduced 14°F. Similarly, an increase in ambient temperature would increase the junction temperature the same amount.

If the power dissipation and/or the ambient temperature is reduced the curves will shift to the left, giving a new mounting base temperature and junction temperature. Under these conditions the transistor can stand a peak power dissipation in excess of the steady state dissipation. Suppose that the transistor mounting base temperature has been reduced to 150°F; an instantaneous power of 7.9 watts may be dissipated without exceeding the junction temperature limit. This excess dissipation is allowable for a short duration only as the mounting base temperature will immediately begin to climb.

The above statements would be exact if the thermal resistance of the chassis dissipator were constant. Unfortunately, this is not quite true. The thermal resistance goes down as the temperature difference increases. Let us see what dissipator area is needed for dissipating 5 watts at a thermal resistance of 5-1/2°F/watt. This calls for a temperature rise above ambient of $5 \times 5-1/2$, or $27-1/2^\circ\text{F}$. If the entire outside enclosure of the device were $27-1/2^\circ\text{F}$ above ambient, the area necessary to dissipate 5 watts, as shown in Fig. 4, is about 100 square inches.

Since there is some temperature drop from the

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transistor location to the outside case, larger dissipation area is required. Perhaps the design can be made so that only $7\frac{1}{2}^{\circ}\text{F}$ is lost from the chassis at the transistor to the average skin temperature of the device. Then there remains a 20°F difference to ambient. This will require 160 square inches to handle 5 watts dissipation.

Fig. 4 is general and can be used with any transistor or other heat producing device. It is based on the conduction from both sides of a disk whose entire surface is at the same temperature. Except for second order effects, it is a useful approximation for any standard shape of enclosure for a device which is cooled by convected air on all faces.

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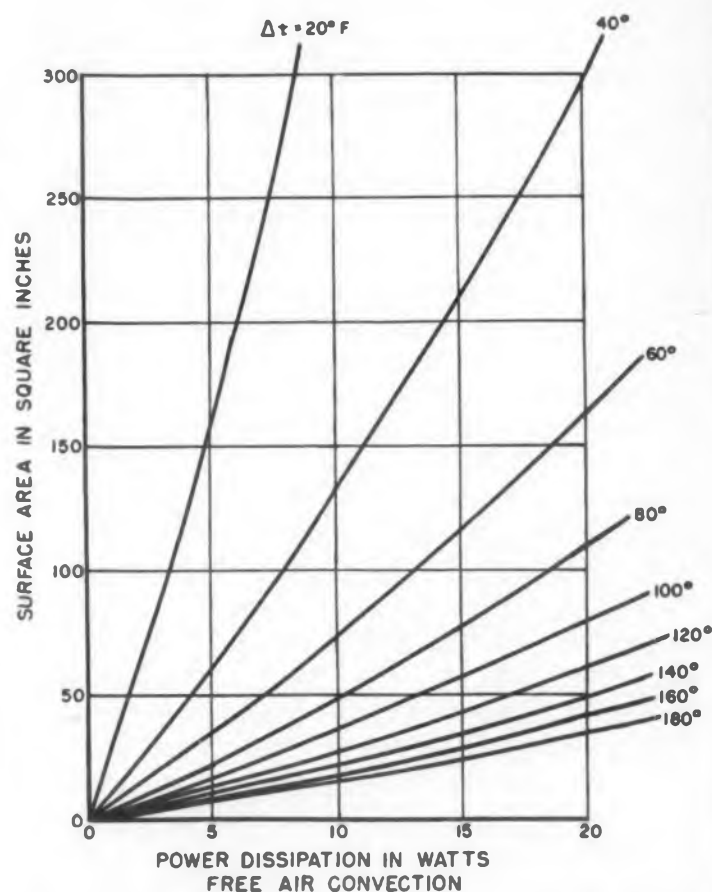


Fig. 4. Graph showing surface area required to dissipate power for temperature differential above ambient.

In case after case



New tube cap connector made of KEL-F Plastic insures high insulation resistance, and excellent dimensional stability over a wide temperature range (-320° to 390°F .) for critical installations.

KEL-F® PLASTIC IS UNIQUE. A polymer of trifluorochloroethylene, its molecular construction produces a combination of outstanding properties headed by excellent electrical characteristics, resistance to chemical attack and negligible deformation under load.

KEL-F Plastic is dense, tough, and readily moldable. It has an operational temperature range of approximately 710°F . (-320°F . to 390°F .) KEL-F Plastic is non-wettable, and moisture absorption is zero! In electrical applications it can be used structurally as well as dielectrically—particularly in the

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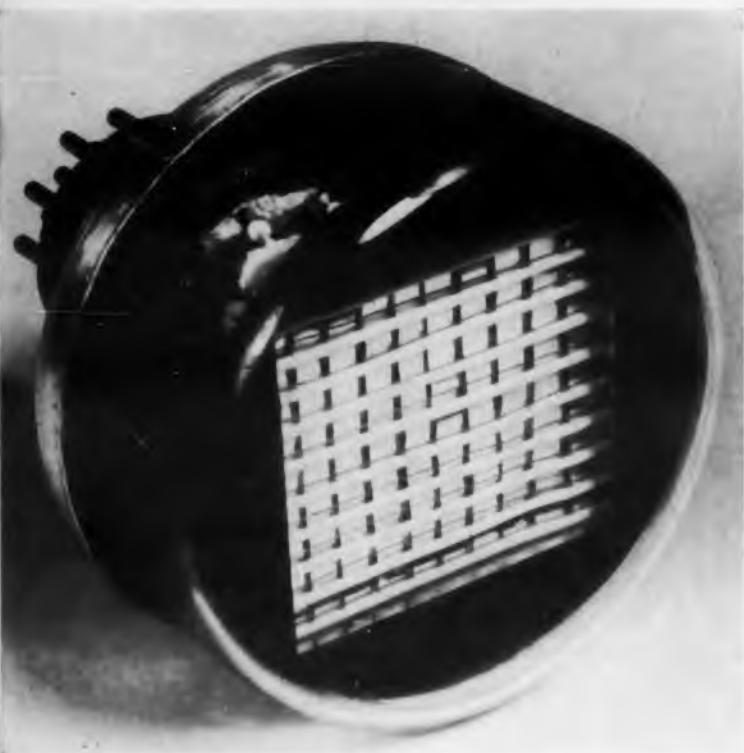
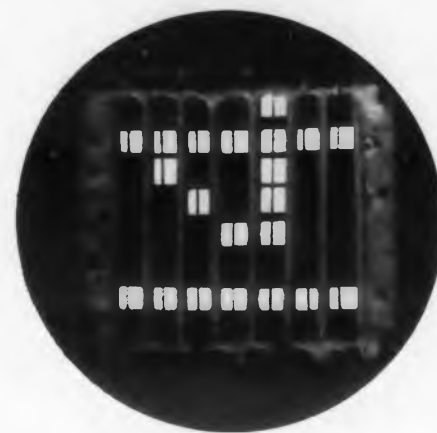
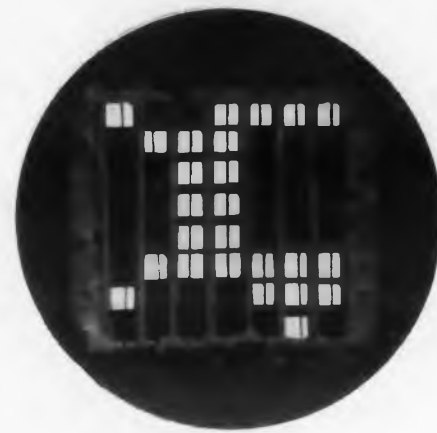
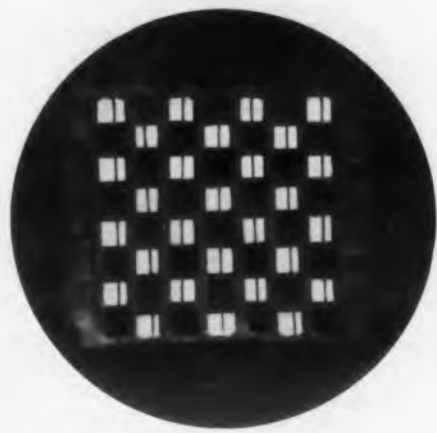
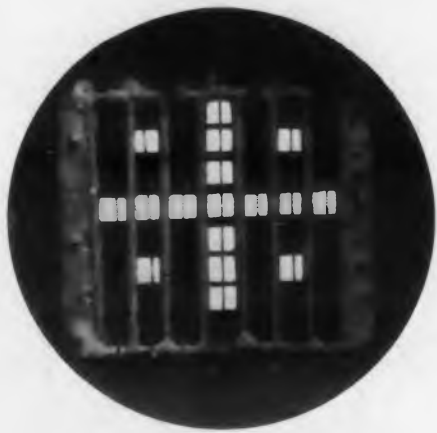
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CIRCLE ED-18 ON READER-SERVICE CARD FOR MORE INFORMATION



"Flat" Display Tube

The diameter of the face is 3", and the display area is 1-3/4" x 1-3/4". The tube is 3-1/2" deep including base-pins.

Connections to the array are brought out at the sealed edges in this proposed "sandwich" construction of the Videotron.

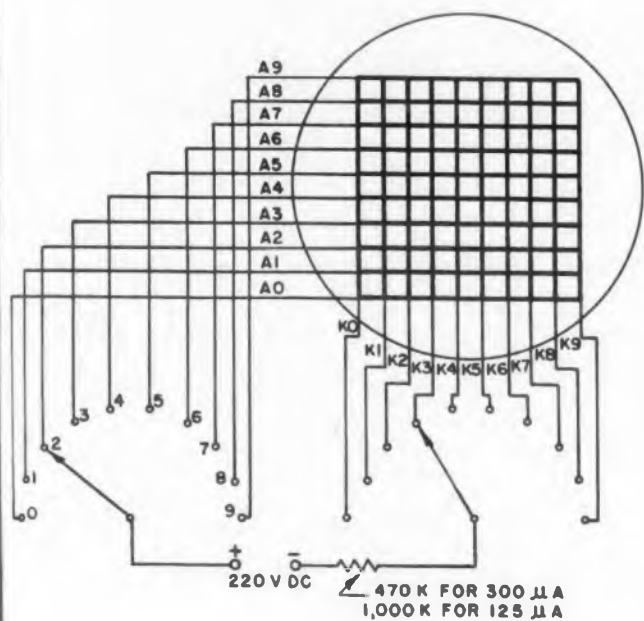
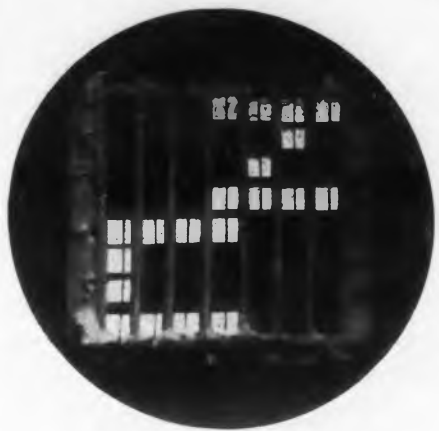


VARIOUS letters, patterns, or numbers, as illustrated above can be displayed on the 100-V Lattice Videotron. A bank of these comparatively "flat" tubes could be used as a radar plot board, as an information display for computers or instruments, or in curve tracing. It can also be used as a form of matrix or function switching device for computers.

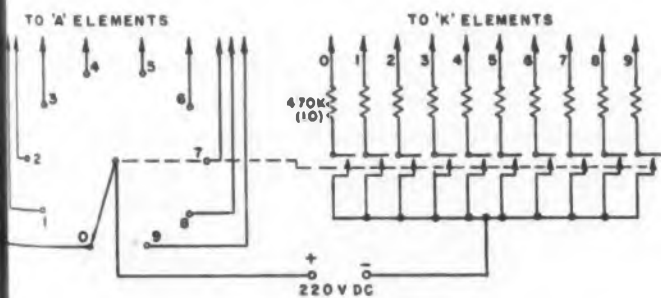
The tube consists of a lattice of 10 vertical flat anode strips crossed by 10 horizontal fine wires. The tube can be filled with various inert gases. Applying a potential of about 180v between any anode strip and a wire results in a glow spot at their intersection. One hundred glow spots are available. In its present form the connection wires to the array are brought out to a standard 20-pin Amphenol No. 77-MIP-20 socket behind the lattice. Another proposed version of the tube would consist of a really flat sandwich of glass plates with the lattice in between. The connection wires would be brought out through the glass seal at the edges of the enclosing plates, as illustrated. The lattice can be made much larger with a 100 by 100 wire array, for example, producing 10,000 spots.

In its ultimate development, this tube could become the much heralded "picture-on-the-wall" TV picture tube (*ED*, Sept. 1954, p. 5). However, such a sandwich tube with a 500 by 600 wire array for 300,000 glow spots would require extremely complex switching circuitry. This large number of wires would be required to produce resolution comparable to that of the standard TV picture tube.

The 100-V tube is made by National Union Electric Corp., 350 Scotland Rd., Orange, N. J. Two simple circuit arrangements employing the tube are illustrated. The rate at which spots can be triggered is limited by the speed of the associated switching circuitry and not by the tube itself. A variation of the tube is available in which the glow remains at any spot until it is wiped out. For more information, turn to the Reader's Service Card and circle **ED-19**.



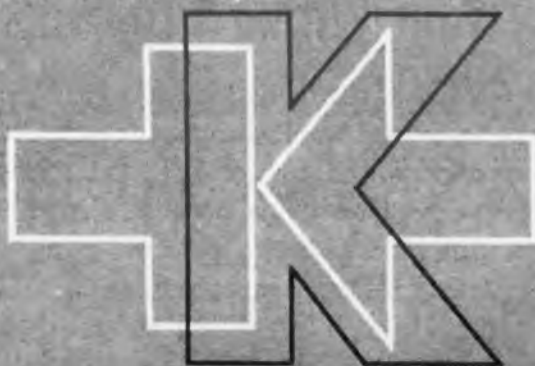
By proper switching of the two 10-point input switches, the 100 glow spots can be illuminated one at a time in any order.



Each cathode element has a separate switch. If the anode switch is driven as a continuous-commutation type sweep, and the cathodes are switched in and out in synchronization, patterns like those above can be generated.

ELECTRONIC DESIGN • June 1955

THE NAME EVERYBODY SHOULD KNOW



KEMTRON

• SEMICONDUCTORS

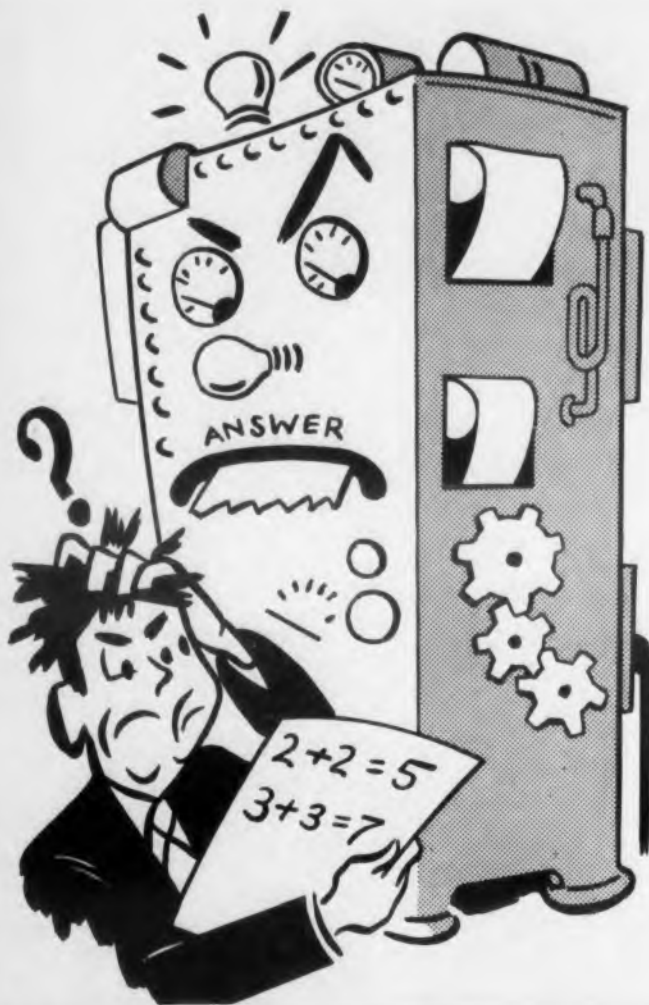
- *Research, manufacture and application of silicon diodes, transistors, germanium diodes.*
- **FIRST** to guarantee set-tested crystal diode performance.

Can Kemtron help you be first?



KEMTRON ELECTRON PRODUCTS, INC.
NEWBURYPORT, MASSACHUSETTS

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



Not Getting The Right Answers?

Install Hubbell *Interlock* Plugs To Solve Your Wiring Problems

Computers are just one of the many modern electronic units that depend upon small component parts for accuracy of operation. The wiring of connections to sources of power, as well as between elements within the unit, must be dependable and must be designed for fast, easy rearrangement and maintenance. Hubbell *Interlock* Plugs meet all these requirements and actually provide an extra margin of dependability.



You Can Be Sure Of A Positive Connection



Unlike other terminals, *Interlock* Plugs are designed with a locking mechanism that permits contact on *two surfaces* and provides a constant low contact resistance. *Interlock* plugs lock automatically in their eyelets or jacks, can be quickly disconnected when intended, yet cannot disconnect accidentally — — and they're designed to withstand unusual strain and vibration!



Tests Prove It!

By actual laboratory test, the Hubbell *Interlock* Type "A" Plug, capacity 10 amperes, withstands a 47 pound pull without disconnecting; the Type "B" Plug, capacity 5 amperes, a 16 pound pull; Type "C", capacity 1 ampere, 4.7 pounds; and the heavy duty Type "S" Plugs, capacity 15 amperes, up to 222 pounds.



HARVEY HUBBELL, Inc.

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

DESIGNERS of military electronic equipment will find that the accompanying table speeds the choosing of the proper size case for power transformers. The table is based on the case sizes determined by Specification MIL-T-27. The transformer case size must be determined before laminations are specified.

In order to determine the case size, the primary volt-ampere load must be determined. Primary load is calculated by finding the secondary load and adding 5 to 10% for losses. The maximum load figure for a given transformer must be reduced by such factors as multiple taps, added windings, high dielectric breakdown requirements, and non-sinusoidal waveforms, such as for rectified loads.

Sample Problem

Determine the proper case size for a typical filament transformer with 115v at 50/60cy on the primary. Both secondary windings carry a load of 10amp at 6.3v.

$$\text{Secondary VA} = 10 \times 6.3 + 10 \times 6.3 = 126 \text{ (rms).}$$

$$\text{Primary VA} = \text{Secondary VA} \times 1.1 = 138.$$

Columns 2 and 3 apply to 50/60 operation. Case sizes *LA* or *KB* can be specified. Case size *KB* is smaller, but requires grain oriented laminations at a higher cost and usually a non-centered terminal stud layout.

The following four types of laminations are considered in the table:

Lamination A is "C" Lamination 0.019" thick.

Lamination B is "Silectron" Lamination 0.014" thick.

Lamination C is Audio Transformer Lamination 0.014" thick.

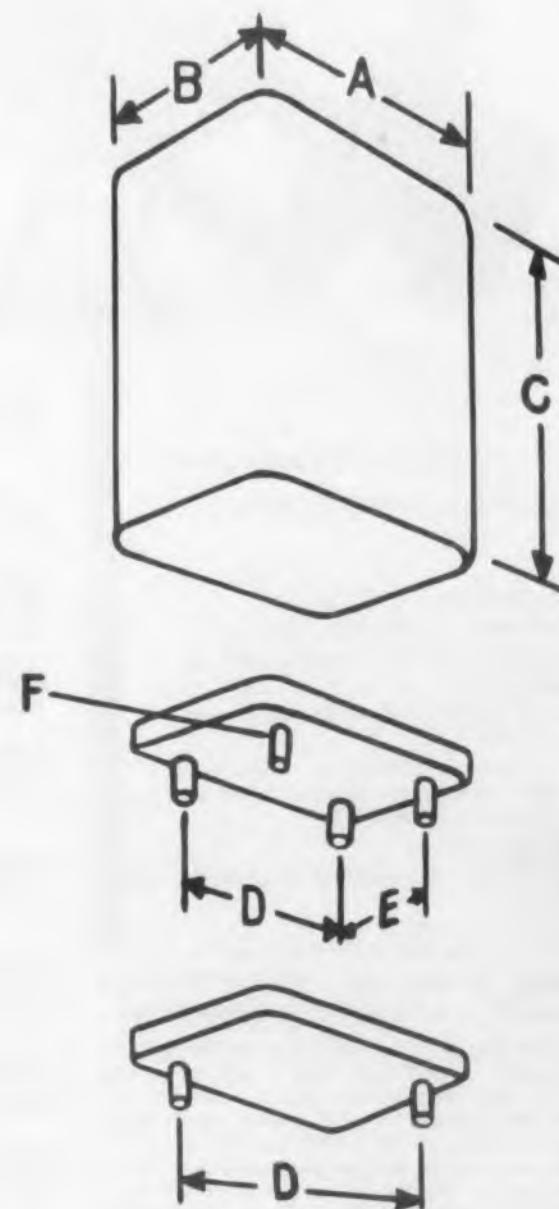
Lamination D is "Silectron" "C" 0.004" thick.

The first three laminations are made by Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa. The last type is made by Arnold Engineering Co., 350 Fifth Ave. New York, N. Y.

In addition to specifying laminations and case size Specification MIL-T-27 details a grey finish and potting with an asphalt compound. Tolerances for dimensions *A*, *B*, and *C* are $+0 -0.062$ " for case sizes *AF*, *AG*, *AH*, and *AJ*. For all the other sizes, the tolerances are $+0 -0.125$ ". Tolerances on dimension *D* and *E*, the mounting centers, are ± 0.015 ", referred to cover center lines. Mounting stud length tolerance is $\pm 1/16$ ". Mounting dimensions for case sizes *AF*, *AG*, *AH*, and *AJ* are not specifically established under the specification. This table was compiled by Audio Development Co., 2833 13th Ave. South Minneapolis 7, Minn. For additional copies turn to the Reader's Service Card and circle **ED-22**

Transformer Case Size Table

Volt-Ampere Classification					Case-Size Designation	Maximum Outside Dimensions					Mounting Dimensions	Weight (lb)	
1	2	3	4	5		A	B	C	D	E			F
25cy Lam. A	50-60cy Lam. A	50-60cy Lam. B	400-2600cy Lam. C	400-2600cy Lam. D									
—	1	1	1-2	2-3	AF	0.750	0.750	1.125	0.563	Diagonal	4-40 x 3/8	0.05	
—	1-2	2-3	3-5	6-10	AG	1.000	1.000	1.375	0.687	0.687	4-40 x 3/8	0.1	
1-3	3-5	4-6	5-10	10-20	AH	1.312	1.312	1.750	0.875	0.875	6-32 x 3/8	0.3	
2-4	4-8	5-9	7-15	14-30	AJ	1.625	1.625	2.375	1.187	1.187	6-32 x 3/8	0.6	
6-8	10-13	12-15	20-40	40-80	EA	1.937	1.812	2.750	1.375	1.250	6-32 x 3/8	1.0	
3-5	6-10	7-12	15-25	30-50	EB	1.937	1.812	2.437	1.375	1.250	6-32 x 3/8	0.9	
10-15	20-30	24-34	35-60	70-120	FA	2.312	2.062	3.125	1.687	1.437	6-32 x 3/8	2.0	
—	14-20	17-24	30-50	60-100	FB	2.312	2.062	2.500	1.687	1.437	6-32 x 3/8	1.5	
17-25	35-50	40-60	60-100	120-200	GA	2.750	2.375	3.812	2.125	1.750	6-32 x 3/8	3.0	
—	20-40	24-43	50-75	100-150	GB	2.750	2.375	2.812	2.125	1.750	6-32 x 3/8	2.4	
20-35	40-75	48-90	70-120	140-240	HA	3.062	2.625	4.250	2.296	1.859	8-32 x 3/8	3.5	
—	35-55	42-65	65-100	130-200	HB	3.062	2.625	3.187	2.296	1.859	8-32 x 3/8	3.0	
25-50	60-100	70-120	150-190	300-380	JA	3.562	3.062	4.875	2.625	2.125	8-32 x 3/8	5.5	
—	75-100	90-120	130-175	260-350	JB	3.562	3.062	3.875	2.625	2.125	8-32 x 3/8	5.7	
60-80	80-130	95-150	175-225	350-450	KA	3.937	3.375	5.250	3.000	2.437	10-32 x 1/2	8.0	
50	75-125	90-140	160-210	320-420	KB	3.937	3.375	4.312	3.000	2.437	10-32 x 1/2	7.5	
60-90	100-160	120-180	225-325	450-650	LA	4.312	3.687	5.562	3.312	2.687	10-32 x 1/2	9.5	
100	95-100	100-170	200-300	400-600	LB	4.312	3.687	4.500	3.312	2.687	10-32 x 1/2	9.0	
150-175	175-350	190-370	400-1000	800-2000	MA	4.687	4.000	6.000	3.687	3.000	1/4-20 x 5/8	16.0	
150	175-300	190-350	300-500	600-1000	MB	4.687	4.000	4.937	3.687	3.000	1/4-20 x 5/8	13.0	
200	225-400	250-450	500-1500	1000-3000	NA	5.062	4.312	6.812	4.062	3.312	1/4-20 x 5/8	17.0	
200	225-400	250-450	500-1500	1000-3000	NB	5.062	4.312	5.500	4.062	3.312	1/4-20 x 5/8	16.0	



**PRECISION
ATTENUATION
TO 3000 mc!**



Protected under Stoddart Patents

six-position
TURRET ATTENUATOR
featuring **PULL-TURN-PUSH** action

FREQUENCY RANGE: dc to 3000 mc.
CHARACTERISTIC IMPEDANCE: 50 ohms.
CONNECTORS: Type "N" Coaxial female fittings each end.
AVAILABLE ATTENUATION: Any value from 1 db to 60 db.
VSWR: 1.2 max., dc to 3000 mc/s, values from 10 to 60 db. As value decreases below 10 db, VSWR increases to not over 1.5.
ACCURACY: ± 0.5 db.
POWER RATING: One watt sine wave power dissipation.

**SINGLE "IN-THE-LINE" ATTENUATOR PADS
and 50 ohm COAXIAL TERMINATIONS**

This new group of pads and terminations features the popular Type C and Type N connectors, and permits any conceivable combination of the two styles. For example, the two connector types, either male or female, can be mounted on the same attenuator pad, with or without flanges, so that it may serve as an adapter as well as an attenuator. Frequency range, impedance, attenuation, VSWR, accuracy and power rating are as designated above. Send for free bulletin entitled "Measurement of RF Attenuation."

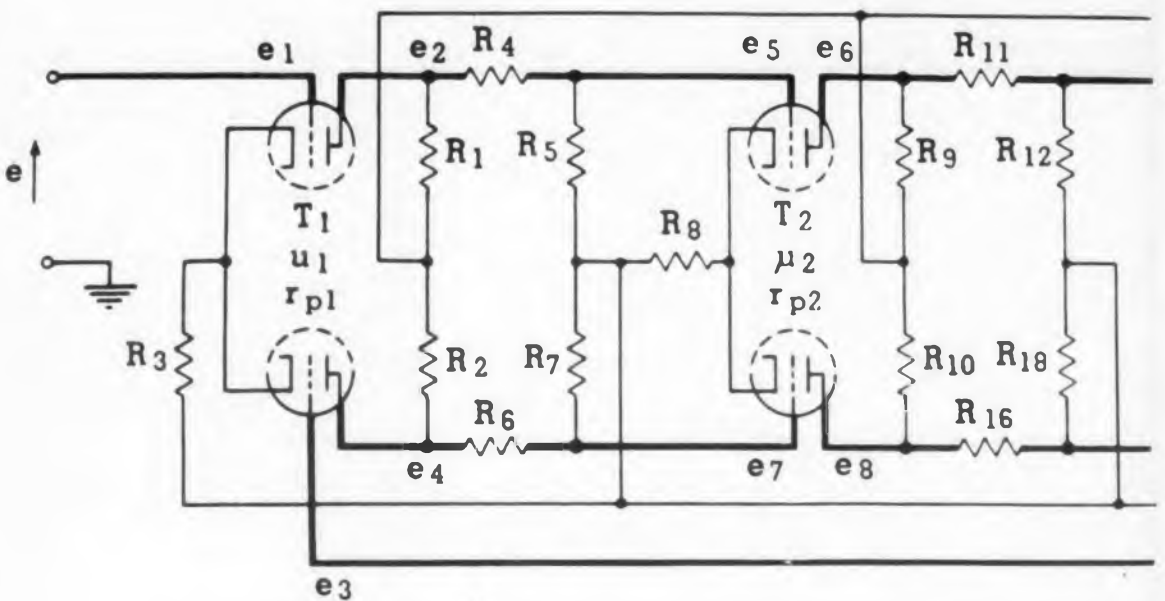


STODDART AIRCRAFT RADIO Co., Inc.

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

Extended-Range VTVM



LOWER full-scale ranges are achieved in this unique VTVM which develops feedback across only the meter multiplier resistor. A low value multiplier resistance permits low ranges. Because of high feedback, the amplifier simply transfers the unknown voltage at a high impedance level to the terminals of the meter at a low level with negligible error. The current taken from the source is a fraction of a microampere (about 10^{-11} amp).

Calibration depends only on the current in the meter and the precision multiplier resistor. Meter resistance changes have no effect. The multiplier resistance has a value smaller than that of the meter resistance thereby increasing the instrument sensitivity one decade. The full-scale ranges for d-c, a-c, current, and resistance are

broad, for example, d-c measurements of 0.1 to 1000v can be made.

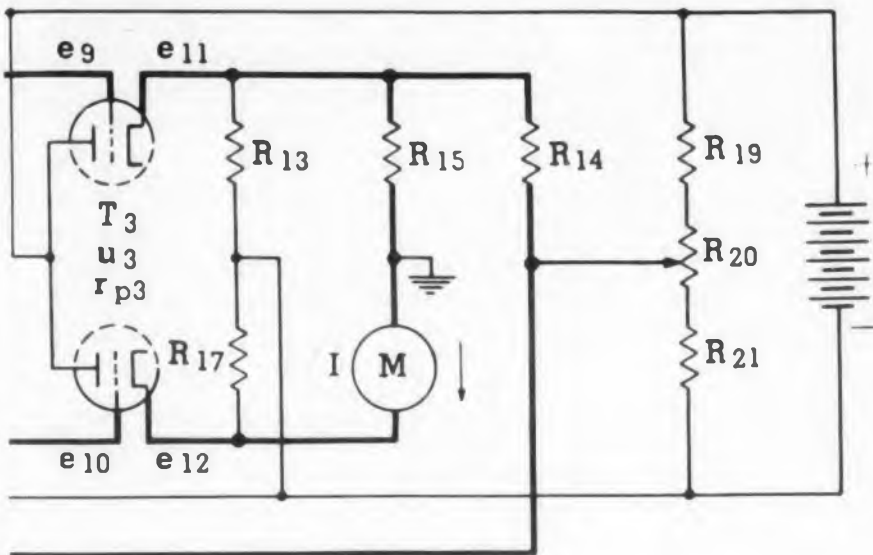
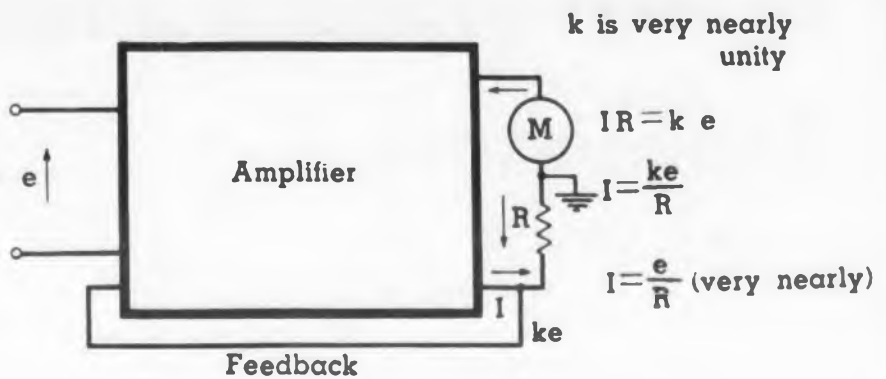
Change of voltage range on this type 800-A VTVM, manufactured by Technology Instrument Corp., Acton, Mass., is made by changing the multiplier resistor R_{15} within the voltage handling capability of the circuit. In practice, range is set by both the input voltage divider and the multiplier resistor. The a-c heater source and the d-c plate circuit supply are stabilized. The power supply is isolated from ground allowing it to assume a potential with respect to ground as determined by the feedback loop. The meter current can be made zero when the input is zero by the potentiometer R_{20} .

A high value of isolation resistance is included in the probe tip for d-c measure-

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Calibration is simplified because feedback is across R only. R is made very low.



Basic measuring circuit. Ratio of IR_{15}/e is essentially unity with proper choice of R_{14} . Forward gain is extremely high.

ments. This minimizes shunt capacitance to a-c components. Input impedance for d-c is 100 megohms; impedance of the a-c probe is 10 megohms at lower frequencies with 5mmfd capacitance. The a-c probe contains a diode acting as a linear peak device. To balance out thermionic emission potential, a similar diode is inserted in the feedback loop. To overcome diode non-linear effects at low voltages, multiplier resistance is chosen to yield full-scale current for the lower input voltage settings compensating for the non-linear regions.

For resistance measurements, a fixed voltage is furnished by the stabilized d-c power source. For current measurements the multiplier is fixed and the input resistances are selected so that the input voltage drop is 0.1v for full scale on all ranges.

The inherent stability of the degenerative measuring circuit permits such low voltages to be used. The low input current drain makes it possible to measure as small as $0.001\mu\text{amp}$ full scale.

The full-scale voltage ranges for d-c voltages are 0.1 to 1000v in 9 steps; a-c, 0.1 to 300v in 8 steps. The full-scale direct current range is from $0.001\mu\text{amp}$ to 100ma in 9 steps. A single resistance scale is calibrated from 0.2 to 500 ohms with multipliers of $\times 0.1$ to $\times 10\text{Meg}$ in 9 steps. Accuracy for all d-c measurements is between $\pm 2\%$ and $\pm 3\%$ depending on ranges. A c volt accuracy is $\pm 3\%$ for 1v and higher ranges, $\pm 5\%$ for lower ranges. Frequency response is 15cy to 100Mc. For more information about this wide range VTVM, turn to the Reader's Service Card and circle **ED-24**.

Amerac's 192B Series

ROCKET TUBE CAVITY OSCILLATOR



The #192B Rocket Tube Cavity Oscillator is a coaxial line cavity, employing the Sylvania UHF Planar Triode, which supplies a stable R.F. CW signal source. This cavity enjoys a stability possible only with a triode.

— FEATURES —

- Single knob tuning control
- Fixed feedback—requiring no adjustments
- Rugged anti-backlash tuning mechanism
- Accurate Root counter for frequency calibration
- Adjustable type "N" 50 ohm inductive loop coupling
- Convenient tube receptacle for quick replacement
- Only three electrical connections
- Long duration R.F. output stability
- Can operate on inexpensive power supply (plate input 6 watts, filament 5.7 to 6.3 VAC at 400 MA, anode 100 VDC at 50 MA)
- Power output 1 watt maximum (minimum of 0.5 watt over tuning range).

— TUNING RANGES —

Cavity Model	Range in MC.
192 B1	750 to 1050
192 B2	850 to 1250
192 B3	1000 to 1450
192 B4	1250 to 1750
192 B5	1400 to 2000



Amerac, Incorporated

116 TOPSFIELD ROAD
WENHAM, MASSACHUSETTS

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

Reliability of Hermetically Sealed Transistors

C. H. Zierdt, Jr.

General Electric Co., Syracuse, N. Y.

LIFE test results on 5500 junction transistors are presented in this article. These tests indicate that transistors are rapidly approaching the theoretical properties of extremely long life, ruggedness, and stability of characteristics. Design of transistorized equipment whose life span will not be limited by the active component is today a realistic undertaking.

Sober study has convinced us that the full potential life of transistors cannot be realized without the most careful preparation of the internal elements, and their protection by housings that do not merely retard but absolutely prohibit changes of atmosphere at the junctions. Our study of well-made, well-housed transistors has been gratifying; we have observed large numbers of units made in small-scale production, which have remained unchanged throughout the most rigorous testing.

Any reliability study made prior to actual service is limited to certain assumed conditions of storage, use, and abuse; the legitimacy of such tests as predictions of actual service life is recognized as open to debate. We have chosen arbitrarily the following service conditions for our evaluations:

1. Cycled maximum—rating life tests
2. Shelf life
3. Mechanical and environment tests required by Tentative Specification for Semiconductor Devices MIL-T-12679A

The data given were taken on various lots of General Electric 2N43, 2N44, and 2N45 p-n-p alloy junction transistors manufactured on pre-production pilot lines. A transistor is considered to have failed when the collector saturation current (I_{co}) exceeds

$30\mu\text{a}$ at 45v, when current gain ($-h_{21}$) has drifted outside the specification limits for the grade, or when mechanically open or shorted. Line test acceptance limits for the same characteristics were $I_{co} = 25\mu\text{a}$ at 45v, and grade specification for $-h_{21}$.

Cycled life tests are made with 50 minutes of "power on" and 10 minutes of "power off" per hour, automatically cycled continuously. Life hours stated, except where noted, are actual "on" hours (5/6 of the elapsed time). 150mv tests are made at $V_c = -26.5\text{v}$, $I_o = 5.75\text{ma}$. Full voltages are switched on and off by the timer without surge limiting or delay. All units are submitted to 15psig steam pressure at about -30°C for 4 hr prior to final grading, to eliminate seal leaks.

Mechanical and environment testing as reported was performed by General Electric personnel, the test conditions and limits being those of Specification MIL-T-12679A. A transistor is scored as failing these tests if permanent change in any electrical characteristic or any mechanical fault is detected.

Environmental and mechanical tests to which these transistors were subjected.

Type of Test	Range	No. Tested	Cycles	Results
Temperature Cycling	-70° to -100°C abrupt change	30	25	no change in any characteristic
Humidity Cycling	MIL-STD-202 Method 106	42	100	no change in any characteristic
Vibration Fatigue	45cy: (32hr each plane)	30	3 (96hr total)	no change in any characteristic
Vibration-High Acceleration	100-1000cy 10g peak	30	10	noise across 100k load less than 1mv
Shock	500g peak (each plane)	50	3	no change in characteristic noise not measured
Centrifuge	20,000g (each plane)	50	3	no change in characteristic noise not measured
(Design Tests)				
Lead Bend		20		no failures
Salt Spray		20		no failures
Pressure		20		no failures
Altitude		20		no failures

Test Data

The survival curves of Fig. 1 illustrate several points that were significant in transistor improvement. The early drop in the Lot No. 1 curve was charged to leaks and mechanical failures. The continued downward slope was, to say the least, discouraging. In fact, the causes had not been isolated and corrected four months later, as witnessed by the Lot No. 7 curve. In this lot, many causes of early failure had been removed, but the overall slope remained the same. The objective then became "forcing" failures to occur earlier so that analysis and correction could be made.

The results of a combination of new processing techniques (obviously unsuccessful), when tested at different dissipation levels on the life racks is shown by Fig. 2. Early failures had been markedly increased, and the curves were showing some hopeful

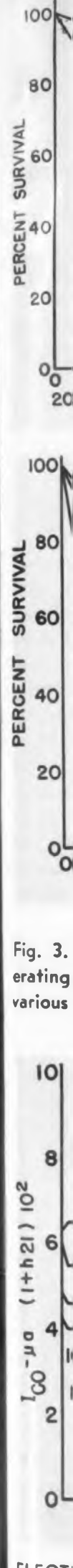


Fig. 3. Rating curves for various test conditions.

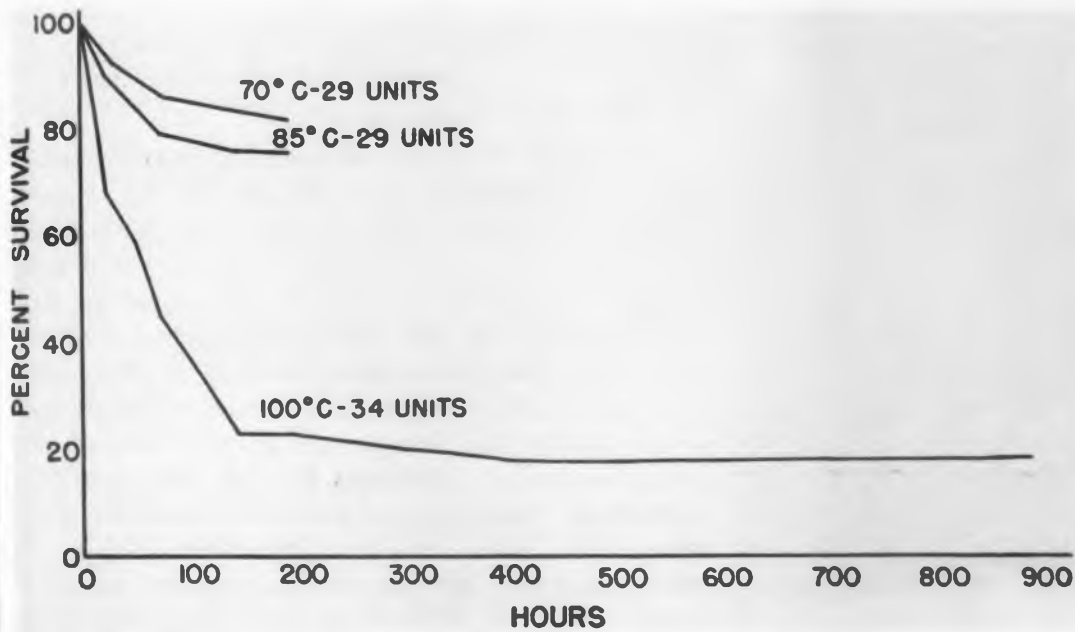
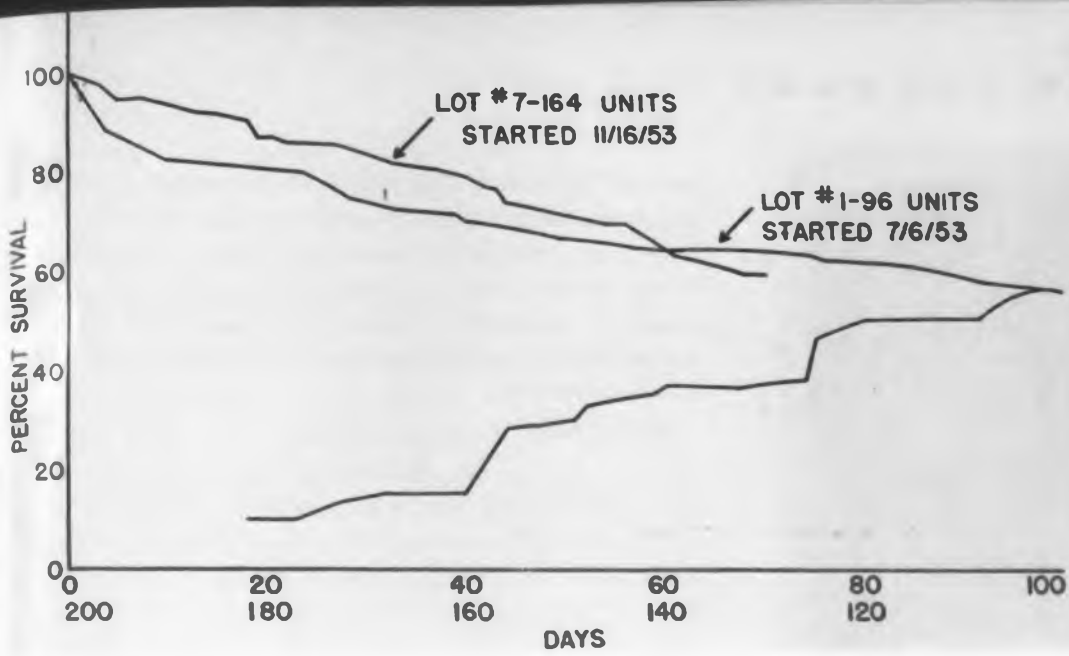


Fig. 3. The transistors were not operating in these tests of survival at various temperature levels.

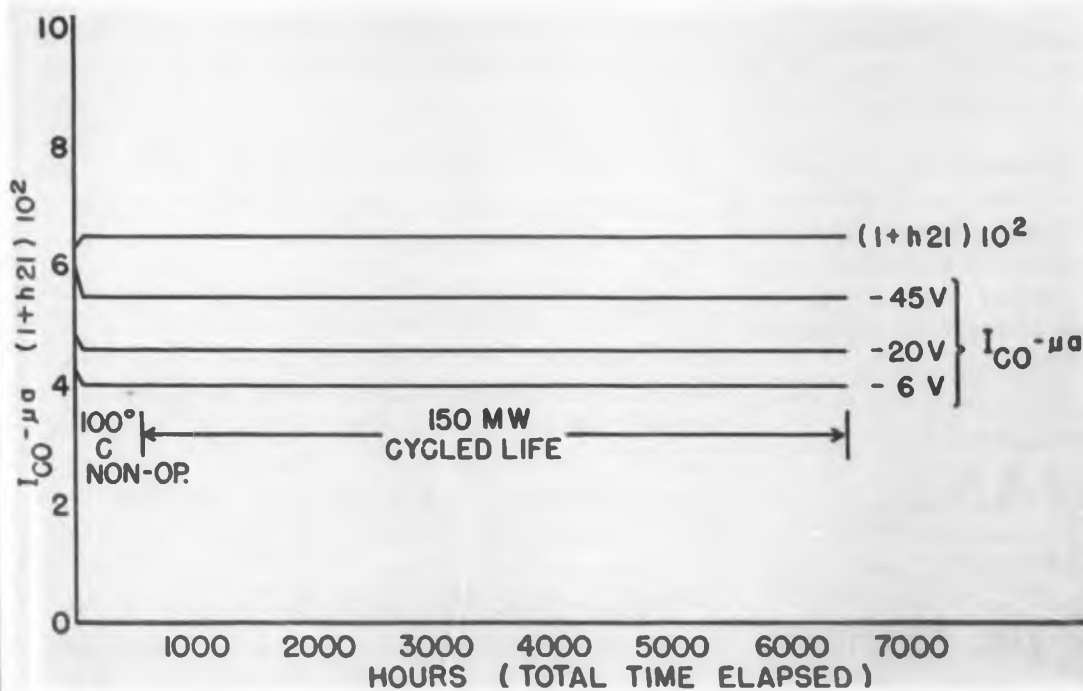


Fig. 1. Results of life tests on two lots of transistors cycled at 150mw.

Fig. 2. Survival results on hermetically sealed transistors cycled at three different dissipation levels, respectively.

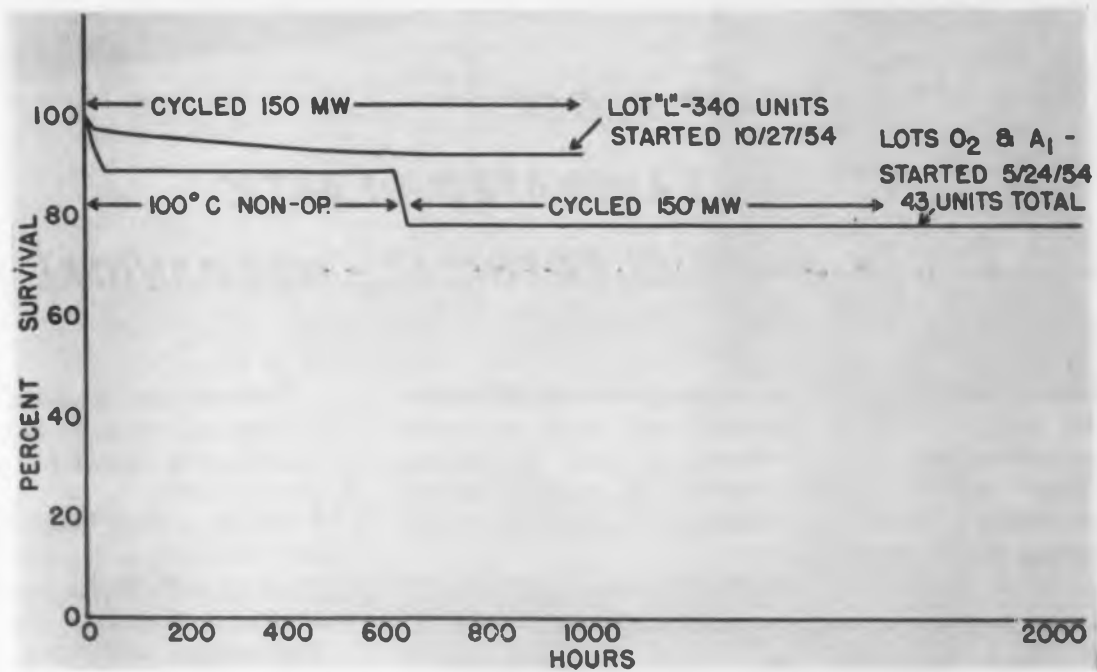
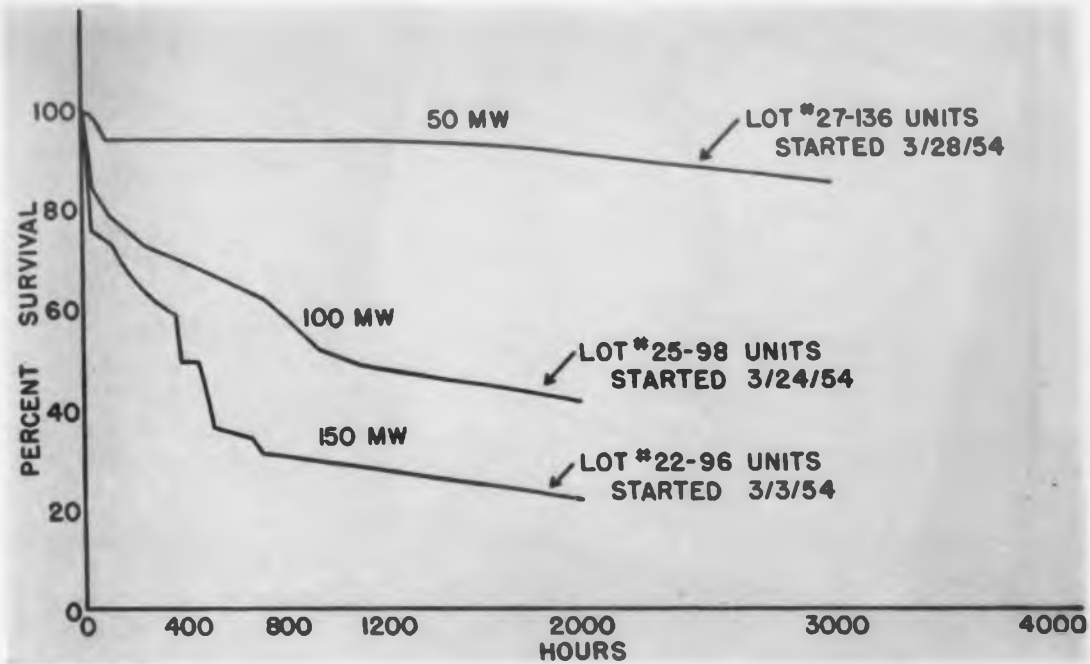
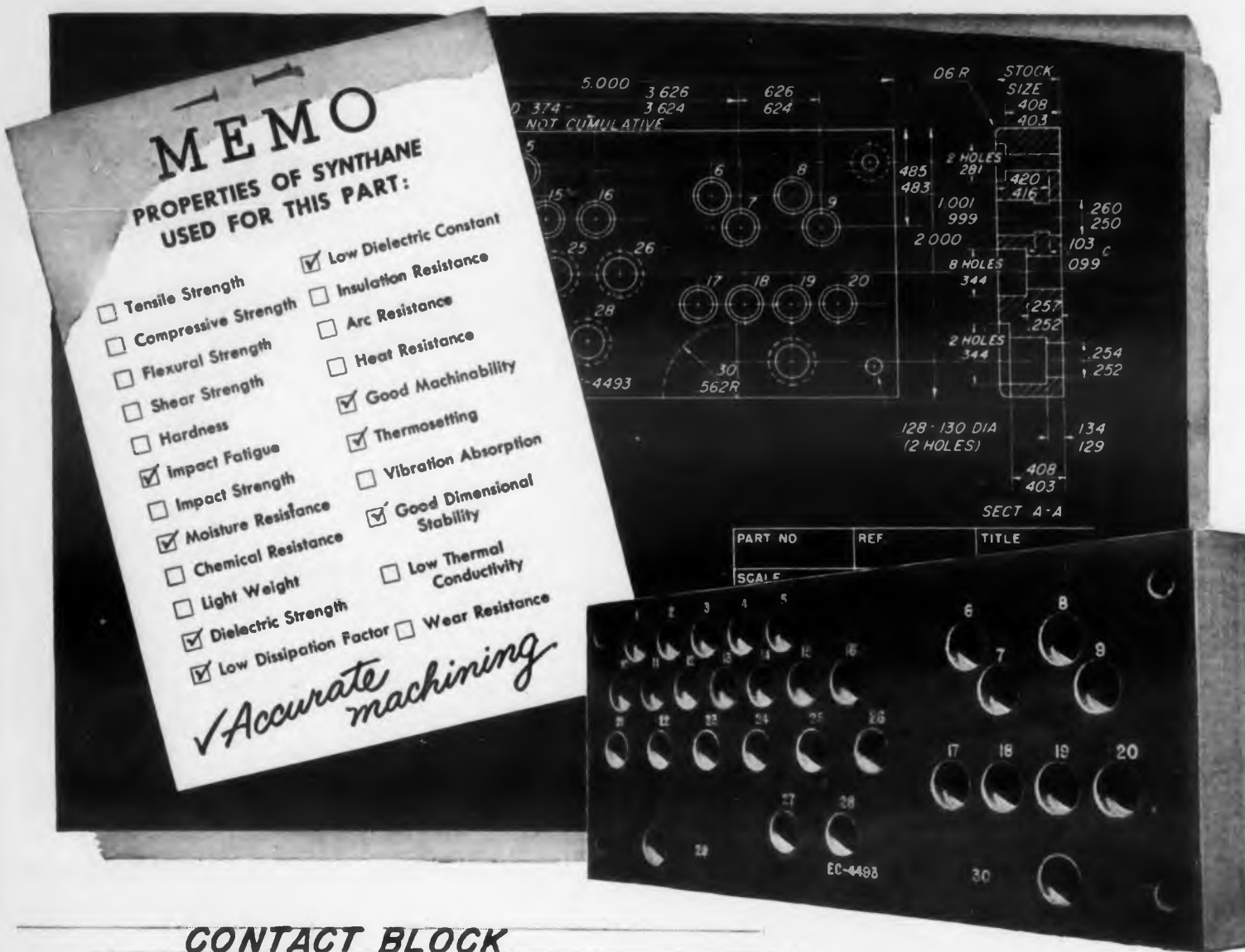


Fig. 5. These life tests were performed on a representative transistor selected from among the 33 survivors of Lots O2 and A1 charted in Fig. 4.

Fig. 4. The transistors were subjected to an initial non-operating heat soaking at a high ambient temperature followed by cycled tests at 150mw output.

YOU FURNISH THE PRINT, WE'LL FURNISH THE PART



CONTACT BLOCK

OF SYNTHANE LAMINATED PLASTIC

MEETS MANY ELECTRICAL, MECHANICAL REQUIREMENTS

This contact block—for an electronic device—illustrates the rising demand for materials with many properties in combination. High dielectric strength, mechanical strength and dimensional stability are essential for the application; accurate machining is a must for proper mating of components.

The customer supplied the blueprint; Synthane Corporation did the rest—first producing the proper grade of material and then fabricating—accurately and without waste or delay.

The more than 33 grades of *Synthane* laminated plastics offer you a very wide range of properties in combination—physical, mechanical, electrical, and chemical. And good service and quality characterize *Synthane* fabrication. The coupon will bring you further information and technical data covering *Synthane* sheets, rods, tubes, and molded parts, and *Synthane* service.

SYNTHANE CORPORATION, 42 River Road, Oaks, Pa.

Please send me more information about Synthane laminated plastics and the Synthane fabrication service.

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SYNTHANE
LAMINATED **S** PLASTICS

SYNTHANE CORPORATION • OAKS, PENNSYLVANIA

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signs of flattening after 1000 hr. The effect of increasing dissipation levels was anticipated and was believed to be associated with increased junction temperatures. It was known that, at 150mv dissipation, the average junction operated at about 75°C at 25°C ambient, while total junction temperature spread was 65°C to about 100°C.

The curves of Fig. 3 verified the effect of junction temperature on the life. Possible electrolytic or galvanic effects had been eliminated by merely soaking the units at high ambient temperatures, without dissipation. Combining these curves with those of Fig. 2 led to the conclusion that high junction temperature was a major factor tending toward short life. It could be assumed that, on cycled life test, units whose characteristics were such as to raise the junction temperature died first with others following at a more leisurely pace.

The first attempts at correction of these troubles were quite successful as evidenced in Fig 4, Lots 02 and A1. These combined lots were soaked for 624 hr at 100°C non-operating. No failures and no changes in characteristics were noted after the first 48 hr. At 624 hr the units were moved to 150mw cycled life test, producing a substantial loss in the first 24 hr. No further failure and no change in characteristics has been noted to this date in the remaining units, which are still on life test. It is interesting (although unexplained) that all units which failed when changed from soak to life test were retained on life and returned within test limits within the next 2000 hr of test. The immediate failure of some units when placed on life test after prolonged heat soaking was taken to indicate that the presence of voltage produced or excited failure of a different nature from that caused by heat alone. This failure has not yet been isolated.

As a result of this experience, a 48-hr bake at 100°C (later raised to 120°C then 140°C) was incorporated in the manufacturing process before final grading, to weed out "weak sisters" before delivery. Fig. 4, Lot "L" illustrates the effect of this "aging" in reducing early failures on life. When these units were made, 10 to 12% of units aged were lost in the aging process.

The variation of I_{co} and $-h_{21}$ of a representative unit from the survivors of Lots 02 and A1 (Fig. 4) from the start of the test to Jan. 3, 1955 is shown in Fig. 5. Minor reading-error "wiggles" in the curves are not reproduced. In the 33 units represented, no change of any electrical characteristic has been observed in the 6500 hr (total elapsed time) since the start of the test. The small improvement of characteristics during the first 24 hr of life test is typical of all units made in the past 8 months.

Current production line aging procedure combines electrical and heat treatment by applying 160% of

ELECTRONIC DESIGN • June 1955

rated dissipation (240mw or $V_c = 30v$, $I_c = 8ma$) for 80 hr, before final grading. The most recent transistor lots show failure rates of 0-2% after 1000hr at 150mw (cycled), after 3-4% aging loss.

Some comment on shelf life is in order to complete the life story. Small lot shelf life samples (10 units or so) have been observed concurrently with active life tests for several years. Their failure rate has always been much lower than that of active tests, and has recently been negligible.

An interesting "fringe benefit" of the general improvement in characteristics and life survival is an appreciable reduction in average noise figure of the transistors. During the period covered by this data, the average noise figure of production transistors has changed from 22db to 9.5db and the maximum from about 50db to 19db. This appears to correlate roughly in magnitude with an improvement in the average saturation collector current, I_{co} .

Mechanical and Environment Tests

The conditions and results of vibration, shock, and centrifuge tests are stated in the table. Measurement of microphonic or strain noise generation during centrifuging has not been attempted; measurements made during the 500g shock test have been inconclusive because of equipment (particularly contact) troubles. The basic noise level of the equipment used for checking during vibration test is about 1mv; no noise peaks in excess of this value have been measured over the vibration frequency range from 100 to 1000cy. Humidity and temperature cycling tests have induced no leaks or other damaging effects in the units tested.

Transistors of almost ideal stability and ruggedness under simulated service conditions are being produced. Their development has been completed logically without resort to witchcraft or unexplained recipes. Consistent yields of good transistors from established processes, over a 5-month period, give reasonable assurance that the test results are repeatable and may be relied upon. Application of the same production processes to other germanium devices (both rectifiers and transistors) has yielded equivalent results in quality and reliability, lending credence to the evidence that the techniques are sound and generally applicable to germanium products. Current application work using the transistors described will yield valuable data on their reliability in actual circuits under use conditions. We sincerely hope that it contains no unpleasant surprises.

Many challenges in cost reduction and production tooling still remain; a prime engineering objective is elimination of the need for aging to assure that transistors delivered to customers will live. It is being prosecuted vigorously.

Both the development work and the testing described were performed under Tri-Service Contract AF33(600)17793.

Flexibility in Application Versatility in design... packaged analog-digital converters

Shaft Position to Digital Converters features reliability, long life, non-ambiguity and speed makes these converters ideal for computers or data handling systems where serial read-out is preferred. Librascope converters transmit information at almost any rate desired up to 1 mc and in some cases above, and may be multiple time-shared, holding extra circuitry to a minimum. All units quickly adjustable, synchro-mounted. Available in Binary, Gray code or Binary decimal code as shown in chart below. Special units may be designed to your order.

Write for catalog information.



FEATURES:

- Unique, staggered double brush pick-off system.
- Reads out serially into relays or single or multiple scan matrices.
- Analog digital or digital-analog operation
- May be time-shared.
- Synchro mounted
- Associated circuitry can be designed to fit your data handling problems

CODE	MODEL*	RESOLUTION PER INPUT SHAFT REV.	RESOLUTION OVER FULL RANGE	DIMENSIONS DIAMETER X LENGTH
BINARY	7 digit	128	1 part in 128	2" x 2 ³ / ₄ "
	13 digit	128	1 part in 8192	2" x 3 ¹ / ₂ "
	17 digit	128	1 part in 131,072	2" x 4 ¹ / ₆ "
	19 digit	128	1 part in 524,288	2" x 4 ¹ / ₆ "
BINARY CODED DECIMAL	0-2000	200	1 part in 2000	3 ¹ / ₁₆ " x 4 ⁷ / ₃₂ "
	0-3600	200	1 part in 3600	3 ¹ / ₁₆ " x 4 ⁷ / ₃₂ "
	0-20,000	200	1 part in 20,000	3 ¹ / ₁₆ " x 4 ⁷ / ₃₂ "
	0-36,000	200	1 part in 36,000	3 ¹ / ₁₆ " x 6 ³ / ₁₆ "
GRAY	8	256	1 part in 256	3 ¹ / ₁₆ " x 1 ¹ / ₁₆ "
*SPECIAL UNITS AVAILABLE	Precision gearing Shaft Speed: 120 rpm continuous Operating temp: -55° C to +75° C Shock and Vibration: up to 15 G, 5 to 500 cps.		Life Expectancy: Function of load current. For 13 digit unit @ 2 ma. per brush, life approx. 5x10 ⁸ breaks or makes at approx. 120 rpm.	

Engineers, physicists and mathematicians interested in challenging California careers, contact Mac McKeague, Personnel Director.

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TRANSISTOR TEST SET

Type 210



- ACCURATE
- CONVENIENT
- SELF-CONTAINED

DESIGNED for those using transistors, this test set is particularly adapted to the needs of the circuit development laboratory and the incoming inspection department. Operation is simple and straightforward, and no auxiliary equipment is required. The Type 210 is completely a-c powered, and contains no batteries or other short-life components.

The "h" parameters, as standardized upon by transistor manufacturers, are quickly measured over a wide range of d-c conditions. Base-input current amplification and collector saturation current are also directly indicated.

A transistor socket adaptor and a test adaptor for making a variety of other measurements using accessory instruments are furnished with the test set. Write for complete data, or call the nearest representative listed below for a demonstration.

CONDENSED SPECIFICATIONS

- **Transistor types:** PNP or NPN junction or point contact.
- **D-C operating conditions:** constant emitter current, zero to 7.5 ma; constant collector voltage, zero to 75 volts.
- **A-C operating conditions:** measurements made at 1.5 kc. Parameter meter (a-c voltmeter) sensitivity is one millivolt rms full-scale.
- **Parameters measured:**
 - h_{11} , input impedance.
 - h_{12} , voltage feedback ratio.
 - h_{22} , output impedance.
 - h_{21} , current gain with emitter input (α).
 - β , current gain with base input.
 - I_{c0} , collector saturation current.

and with external variable-frequency oscillator and voltmeter:

- Alpha cut-off frequency.
- Beta cut-off frequency.
- Collector capacitance.

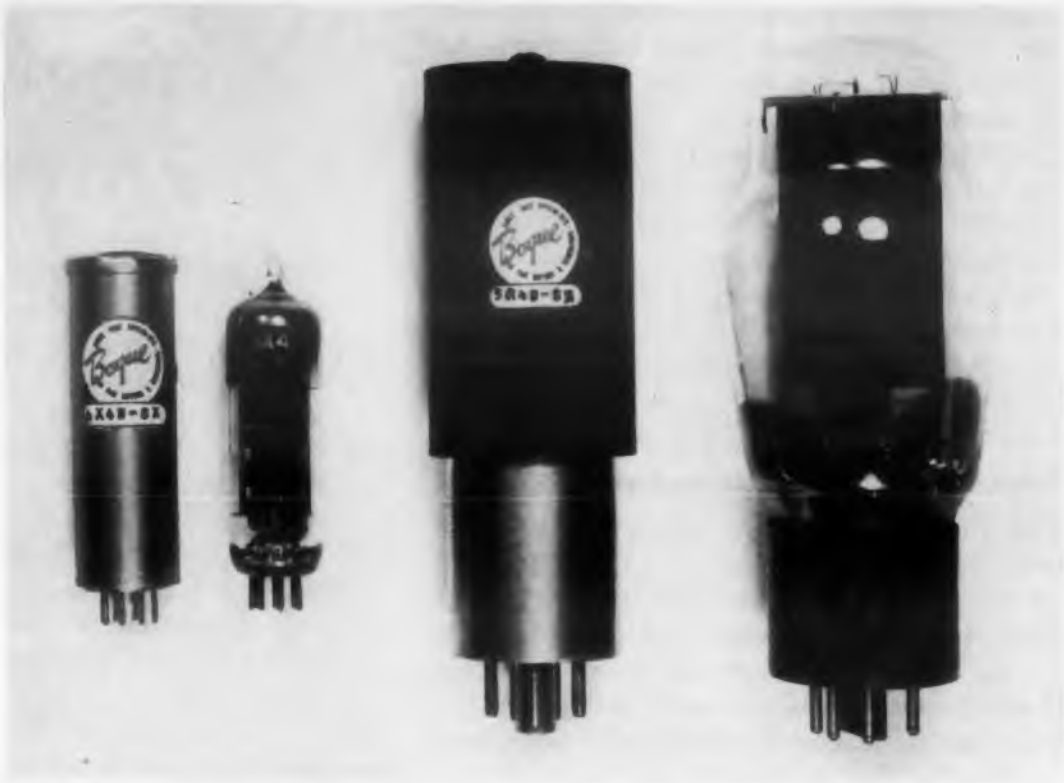
- **Size:** 15 x 13 x 4 inches. Weight approximately 18 lbs.
- **Price:** \$475, f.o.b. Pasadena.

- **Chicago:** JKM Inc., Whitehall 4-6345
- **Cleveland:** S. Sterling Co., Evergreen 2-4114
- **Detroit:** S. Sterling Co., Broadway 3-2900
- **Los Angeles:** Luscombe Engineering Co., Madison 6-0211
- **New York-Newark:** Gawler-Knoop Co., Digby 4-8417, Caldwell 6-4545
- **Philadelphia:** Gawler-Knoop Co., Livingston 8-5480, Orontz 8805
- **Pittsburgh:** H. E. Ransford Co., Grant 1-1880
- **Washington:** Gawler-Knoop Co., Juniper 5-7550

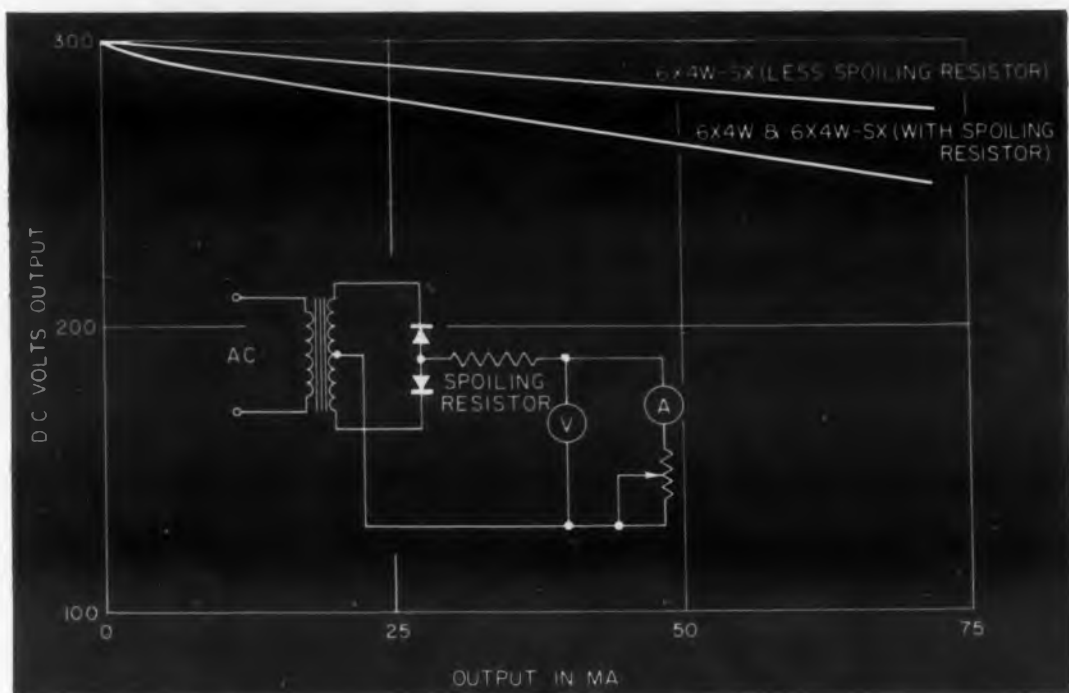
Owen
LABORATORIES

412 Woodward Boulevard
Pasadena 10, California
SYcamore 6-5167

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Two of the silicon rectifiers and the vacuum-tube types they replace.



The regulation of the silicon rectifier is improved when the spoiling resistor is removed.

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Standard-Base Silicon Rectifiers

SILICON rectifiers that are exact replacements for vacuum-tube rectifiers offer the design engineer a rugged, theoretically infinite-life component as well as a means of eliminating rectifier filament power needs. Power savings of from 3.8 to 10w per tube replaced, depending on type, are possible. Silicon replacements with the same bases are already available for the 5R4, 6X4, and 421A, respectively, and replacements for other conventional types are under development. These devices are also illustrated on the cover.

To insure uniformity between the vacuum-tube rectifier and its silicon replacement, a spoiling resistance is internally incorporated in the latter to increase its forward drop to match that of the vacuum-tube type. Thus the replacements can be specified in equipment already in prototype form, actual production, or even in use. For new designs, however, these plug-in units can be obtained without the spoiling resistance. These "unspoiled" types offer additional savings in power load and heat dissipation as well as improved regulation. These units are made by Bogue Electric Manufacturing Co., 52 Iowa Ave., Paterson 3, N. J.

These rectifiers are hermetically sealed. They can be inserted in the same socket as the tube they replace without modifying the socket. The pins that mate with the filament power connections in the socket are dead pins. The rectifiers exceed ruggedized versions of standard vacuum-tube rectifiers in ability to withstand shock and vibration. For identification, the silicon types carry an —SX suffix added to the standard tube designation. The rectifiers can be operated at ambient temperatures ranging from —60°C to 150°C.

These rectifiers have the additional advantage of no warm-up time. In certain applications, however, this characteristic may call for a delay in the rectifier circuit to prevent the application of plate voltages to the other tubes in the equipment before their heaters warm-up. For more information, turn to the Reader's Service Card and circle **ED-29**.

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designed for specific applications

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The 1N55B with a 150 volt rating, and the T5G with a 100 volt rating are particularly suitable for circuits where high voltages are encountered.

HIGH TEMPERATURE TYPES

The T18G and 1N198 diodes are rated, specified, and 100% tested for operation at 75°C. They are specifically intended for use where high inverse resistance and reliable performance is required at elevated ambient temperatures.

HIGH CONDUCTANCE TYPES

For applications requiring high forward conductance, types such as the T7G and T25G with over 200 ma at + 1 volt provide improved circuit performance.

HIGH RESISTANCE TYPES

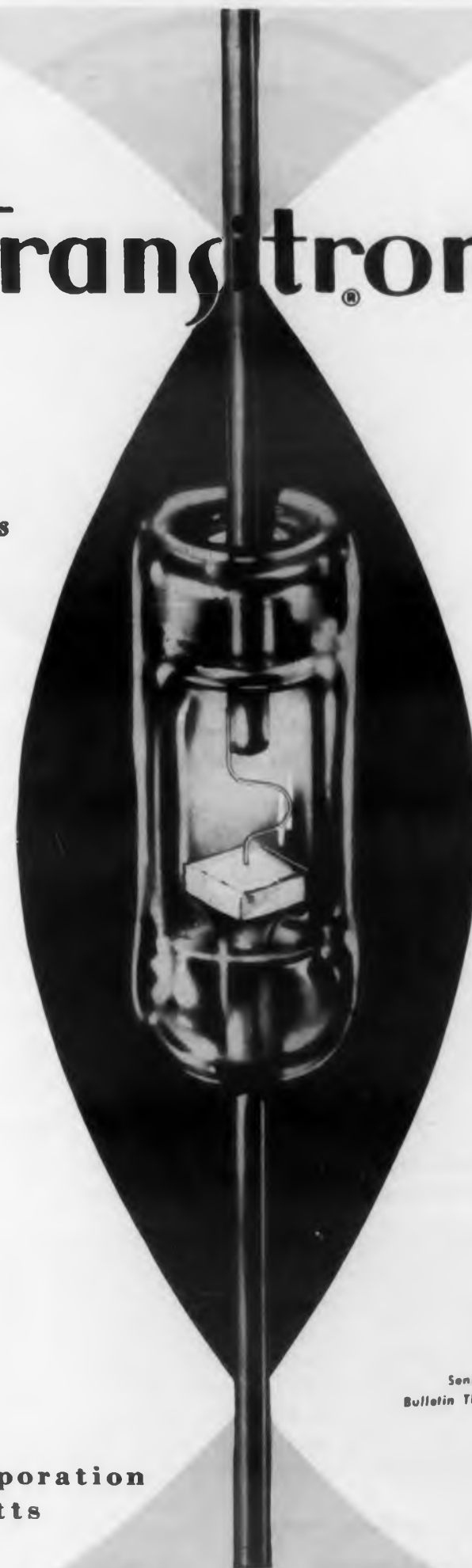
The T8G and T9G offer several megohms inverse resistance and are ideal for critical circuits requiring a minimum of diode loading.

COMPUTER TYPES

Specified for recovery time, the T16G, T17G, 1N191, and 1N192 are suited for critical pulse circuitry. Types T7G, T6G, and T25G have been designed especially for fast core switching.

JAN TYPES

The 1N126, 1N127, 1N128, and 1N198 are designed and tested to meet all requirements of MIL-E-1B.



*actual
size*

See 1 for
Bulletin TE1319

Transitron electronic corporation
melrose 76, massachusetts



Power Transistors



Transistors



Germanium Diodes

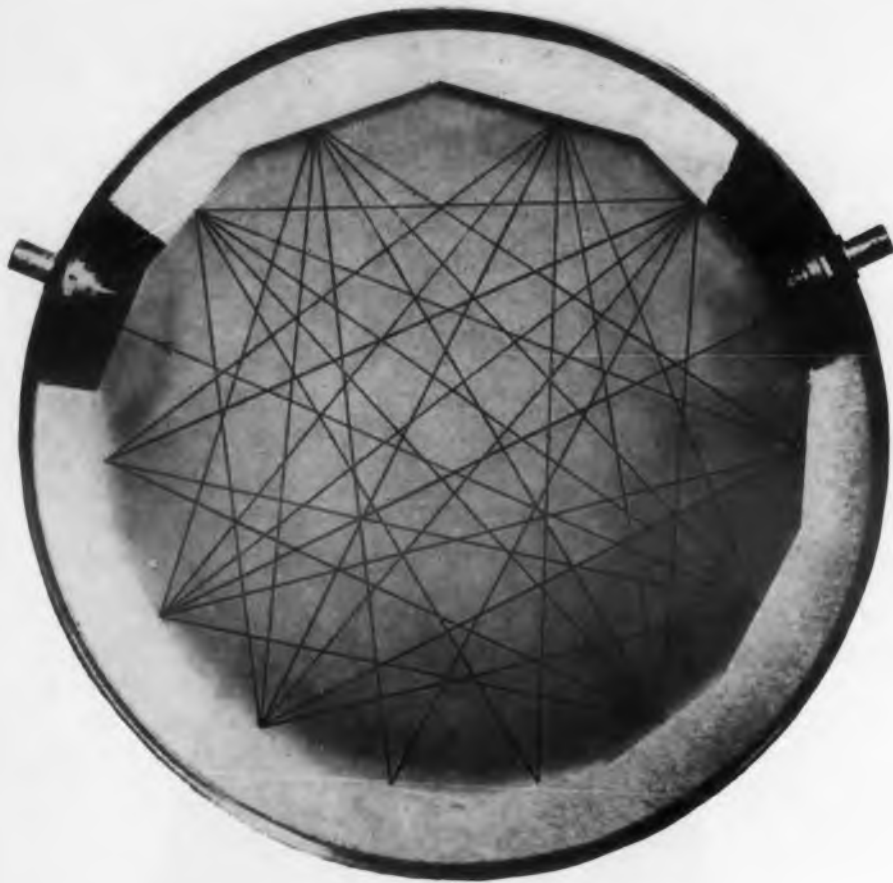


Silicon Diodes



Quads

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The reflected path of an ultrasonic signal in this fused silica delay line.

Using Glass in Electronic Designs

II—The Forms of Glass

William H. McKnight

Corning Glass Works, Corning, N. Y.

GLASS has always been one of the prime raw materials for the electronic designer. The properties of glass were detailed in the first part of this article (*Electronic Design*, May 1955, pp. 28-29). The many forms of glass, their applications in electronic equipment and components, and the procedures for specifying most forms of glass are considered in this concluding article.

Enclosures

More glass is used for enclosures than for any other purpose in electronic equipment, and there is little reason to believe that enclosures will not remain the major use of glass in the electronic industry. Enclosures must be carefully specified to the glass fabricator. The physical size of the piece to be covered and the space allotted to the finished unit are the major factors in designing an enclosure. In addition, the size and type of base (if there is a base), and the test requirements such as thermal shock, drop and vibration standards, and optical needs (clear or opaque), must be furnished to the fabricator.

The Multiform Process

Similar to powder metallurgy, a new cold glass-working process that is expanding the use of glass in electronic devices is known as "dry press multiform". In this process, glass is ground into a fine powder, mixed with a suitable binder, and then

pressed into a mold. After ejection from the mold, it is sintered at temperatures near the softening point of the base glass. The resulting product is opaque, and has nearly all the characteristics of the original material. The chief advantage of this process is the ease with which small shapes, some of which are shown opposite, may be produced with tooling that is not subjected to the high temperatures needed to work hot glass. Parts may be produced with finer tolerances, usually in the range of ± 0.005 " in diameter and ± 0.010 " in length. Even more precise parts can be made by grinding, selection, or proper design.

One of the major uses of multiformed glass is for hermetic seals. By this process the beads for glass-to-metal seals are economically made to the required tolerances. The glass beads can be made of any composition desired to match the expansion coefficient of the metal composition desired to match the expansion coefficient of the metal to be joined. Glass to metal seals are available today using kovar, Dumet, Sylvania 4, 17% chrome iron, 1010 steel, platinum, molybdenum, tungsten, aluminum, and other metals in combination with a suitable glass. The choice of the combination used depends strictly on the requirements of the seal, such as electrical characteristics, temperature cycle, environment, etc.

Other products being made today by this method include relay headers with the pins sealed to the unit, relay spacers made to close tolerances, and transistor

and diode enclosures. Undergoing tests at the present time are miniature tube sockets made of multiformed glass. These sockets can be dicsoldered.

Multiform parts are specified in much the same manner as other mechanical parts. The pertinent differences are the tolerances required and the increased cost if side holes or reentrant angles must be used. Long, thin sections and radical changes in thickness should be avoided.

Another cold process is the slip-cast multiform method in which a glass slurry is made and cast in porous molds. This process is limited to high-silica glasses at the present time, but parts can be produced by this method that cannot be manufactured by any other commercial process.

Conductive Glass

Although glass is generally classed as an insulator, by proper treatment it can now be made to conduct electricity. This electrically conductive or "E-C" glass is proving useful in a number of electronic applications. It consists of a good insulating glass as a base with a transparent fired-on electrically conducting coating on the surface.

For use in the electronics field, a series of resistors are available using glass rods for a base and E-C coating as the conductor. The coating is spiralled according to the resistance range required. Terminals

Multiform parts are a tul mount, tr

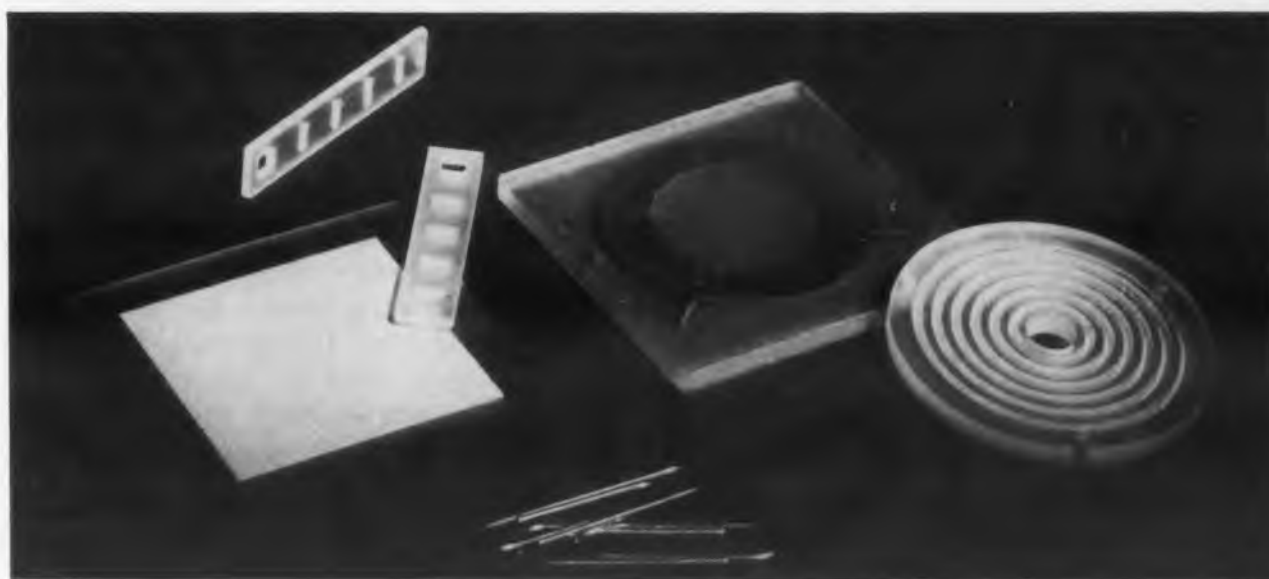
Table I. Applications for glass in electronic components.

Application	Glass	Advantages
Enclosures	Lime	Transparent, excellent dielectric, stands high heat, can be formed into unusual shapes; low cost.
	Metallized	Forms excellent solder seal to base; transparent; excellent dielectric; stands high heat.
Resistors	Metallized	Forms excellent seal.
	Electrically Conductive	Stability of coating; high temperature characteristics; good temperature coefficient.
Space heater	Electrically Conductive	(same as above)
Dummy antenna	Electrically Conductive	
Capacitors	Ribbon	Excellent dielectric free of holes, cracks, or foreign imperfections.
Trimmer capacitors	Metallized	Low temperature coefficient.
High-frequency inductances	Metallized	Drift stability; low temperature coefficient.
Tuning Units	Metallized	(same as above)
Balanced split-stator capacitor	Metallized	(same as above)
Delay lines	Fused silica	Low ultrasonic attenuation; low loss; high temperature operating range.
Crystal growing crucibles	Fused silica	Extreme chemical purity.
Ultra-violet transmission	Fused silica	
Precise parts	Photosensitive	Parts with unusual configurations can be produced cheaply and accurately.
Decorative effects	Photosensitive	Produced accurately.
Grids	Photosensitive	(same as above)
Hermetic seals	Multiform	Can match temperature coefficient of any metal; high tolerances.
Small parts	Multiform	Can be made in variety of shapes.



Multiform parts made from powdered glass. Included are a tube socket, tube header, TV picture tube gun mount, transistor and diode cases, and various spacers.

Photosensitive glass was used to make these precision parts. The square on the left is a screen with over 200,000 holes. The bars are relay spacers, while the other two parts are bases for flush contact circuits.



The electrical properties of ribbon glass are equal to that of high-grade mica. It is about 1/1000" thick.





Electrically conductive metallic oxides bonded to glass tubing or rods make excellent resistors.

Table 2. Ribbon glass data.

Physical Properties	
Strain point	357°C
Annealing point	384°C
Softening point	527°C
Electrical Properties (at 1 Mc and 20° C)	
Power Factor	0.045
Dielectric constant	8.45
Loss factor	0.40
Available Sizes	
Width	Thickness
0.093"	0.0015"
0.093"	0.0019"
0.193"	0.0015"
0.193"	0.0019"
0.406"	0.0015"
0.406"	0.0019"
1.000"	0.0013"

are made using fired-on silver bands over which silver plated brass caps are fitted for axial leads. For mechanical protection the resistors are generally supplied with a varnish coating for low operating temperature units, and a silicone coating for all others. The thinness of the E-C film, the bonded film construction, and the small lead size produce inherently good high frequency properties for these resistors. Preliminary data indicate that the high frequency performance is at least equivalent to characteristic S for v-h-f resistors as proposed by ASES. This conductive glass is available with a dissipation of 15w per square inch. It can also be used as a space heater.

Ribbon Glass

The superior electrical insulating properties of ribbon glass are more like those of mica than any other commonly used dielectric. Ribbon glass, glass in the form of a uniform ribbon about one-thousandth of an inch thick, is entirely free of holes, cracks, foreign inclusions, and other imperfections, and it is flexible. It has several unique properties that make it especially desirable as a dielectric material in capacitors. Its properties and the forms in which it is available are given in Table 2. At the present time ribbon glass is available in spools of 100' for experimental purposes, and in production rolls of 1600'.

Capacitors now being manufactured with ribbon glass are assembled using many layers of the dielectric combined with metal conductors. The unit is sealed together at a high temperature and pressure to form an integral, rugged, monolithic structure. The seal of the electrodes to the dielectric sheets cannot be broken or shifted without destroying the capacitor. Where necessary, they may be assembled with wire leads and an enclosing cover made of glass. The performance is therefore a function only of the dielectric and not of any enclosing, potting, or impregnant material.

Metallized Glass

Metallized glass is currently employed in making enclosures, high-frequency inductances, composite tuning units, balanced split-stator capacitors, trimmer capacitors, and resistors. The most common use for metallized glass is in making transparent enclosures, an example of which is shown opposite. This type of enclosure is very similar to the well-known light bulb, except that the open end is metallized around the edge. The unit to be protected is built up in the usual manner. The final step is to place the glass enclosure over the assembly and close the joint with solder.

Obvious advantages of headers made in the above manner are transparency and resistance to moisture, oil, most chemical fumes, temperature and other environmental conditions. One advantage frequently overlooked is that the glass enclosure provides electrical protection through its insulating properties, making available for other use the space usually unoccupied just around metal enclosures.

Using this metallizing process, a conductor can be added to glass by firing silver onto the surface in any desired configuration. To this base coat of silver can be added an electro-copper plate and a final protective surface of other metals. Terminals or auxiliary metal parts can also be conveniently soldered to the fired-on silver. Because the conductor is in intimate contact with the form at all points, its electrical characteristics are largely dictated by the quality of the form. Many products have been and are being developed around this process.

One use of the above process has been in manufacture of high-frequency inductances. These offer characteristics such as drift stability, ruggedness, design versatility, and low temperature coefficient ($7 \times 10^{-6}/^{\circ}\text{C}$). Values of Q in the vicinity of 150 are reasonable, with 180 attainable with some designs.

Composite tuning units consisting of LC combinations can also be fabricated by this method within practical limits. The maximum length of coil for such applications is six inches with a minimum length of band used on the capacitive section of $5/32''$.

Other metallized designs are possible on glass tubes. One unit now in production is a balanced split-stator capacitor design frequently used in television oscillator circuits. The glass core is formed by the Multi-form process then metallized and cemented to the shaft. This construction conveniently insulates the core from the ground. Generally a glass with a relatively high dielectric constant and low temperature coefficient is used for the base in designs of this type. However, the cores can be made of metal in which case the split stator capacitor becomes balanced to ground.

Glass trimmer capacitors are made up essentially of glass tube with a metallized band on the outside and a metal slug in the bore. Customer preference in most cases dictates the type of terminal supplied on the glass trimmer capacitor. Among the types generally used are the standard pan terminal, the saddle clip terminal, and the wire wrap-around terminal. Similarly, several types of mounting are available among which are the threaded bushing and the push-on type bushing.

Standard trimmer glass units made up with an

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invar core will have a temperature coefficient below one hundred ppm/°C in the range of 25 to 85°C. The standard voltage breakdown rating is 500v, d-c, but special units have been made to withstand 1500v.

Another new use of metallized glass is in resistors with a resistive metal deposited on the inside of the glass. (*ELECTRONIC DESIGN, November, 1954, pp. 30-31*). This process could also be used to make inductors and the spiral element in travelling-wave tubes.

Fused Silica

Fused silica, a new basic material, offers certain valuable characteristics such as high transmission in the ultraviolet spectrum, good optical quality, homogeneous structure, extreme chemical purity, non-darkening under X or gamma radiation, low ultrasonic attenuation, low-dielectric loss, high (1585°C) softening point, and a very low thermal expansion coefficient.

This material may be obtained in discs up to 20" in diameter and 2-1/4" thick, and may be finished to precise tolerances if desired. Tubes, rods, and other shapes are under development and should soon become available. Fused silica can be slip cast and sintered to a porous, rigid, and opaque body with fairly good dimensional reproducibility. Plates, cylinders, or more

complex shapes compatible with slip casting practice can be produced.

The principal use for fused silica is in solid ultrasonic delay lines, as shown on p. 38. Delays ranging from 25microsec to over 3000microsec are available with bandwidths greater than 50% of the carrier frequency. In the shorter delays, any one of several glasses may be used, depending on the particular requirements involved, while for longer delays, fused silica is used to provide the extremely low ultrasonic losses required. The use of a solid delay medium provides several inherent advantages over its mercury predecessor, particularly with regard to shock resistance, environmental stability, operating temperature range and bandwidths.

Photosensitive Glass

Photosensitive glass is a means of producing parts of unusual configuration, detail, or size, some examples of which are illustrated. This type of glass is compounded with a chemical that reacts when exposed to ultraviolet light. After exposure with ultraviolet-transparent negative, the glass is heat treated, then placed in a chemical etching bath. The glass is etched away where it was exposed. It may be etched to any

depth or clear through, as shown on p. 39.

Among the parts that can be produced by the process are: fine mesh screens for vacuum and cathode-ray tubes; flush contact printed circuits where no back connections are required; reticles with a resolution up to 500 lines per inch; in the photoceram state for high-strength attenuator plates; insulators with small holes (for example: 0.010" diam hole through a 0.050" plate with a tolerance of 0.0005").

Flush contact patterns can be produced in any glass, but photosensitive glasses are proving quite useful for this application. The method of manufacture is to place a relief pattern in the glass by the process, then fill the pattern with metal, and finally grind the unit flush to a single plane surface. Intended for use with wiping contacts, these patterns can be used as contactor boards, commutators, or simply as switches. Not only can this process, in effect chemical machining of glass, be utilized to produce special component parts, but it can also produce sheets of glass with unusual decorative effects. Such effects could enhance the appearance of cabinets or dials on radios.

To specify photosensitive glass parts, the glass specialist must be furnished with accurate engineering drawings to determine the appearance and depth of the chemical etch in the glass.

Table 3. Specification sheet for enclosures made with metallized glass.

1. Physical Size

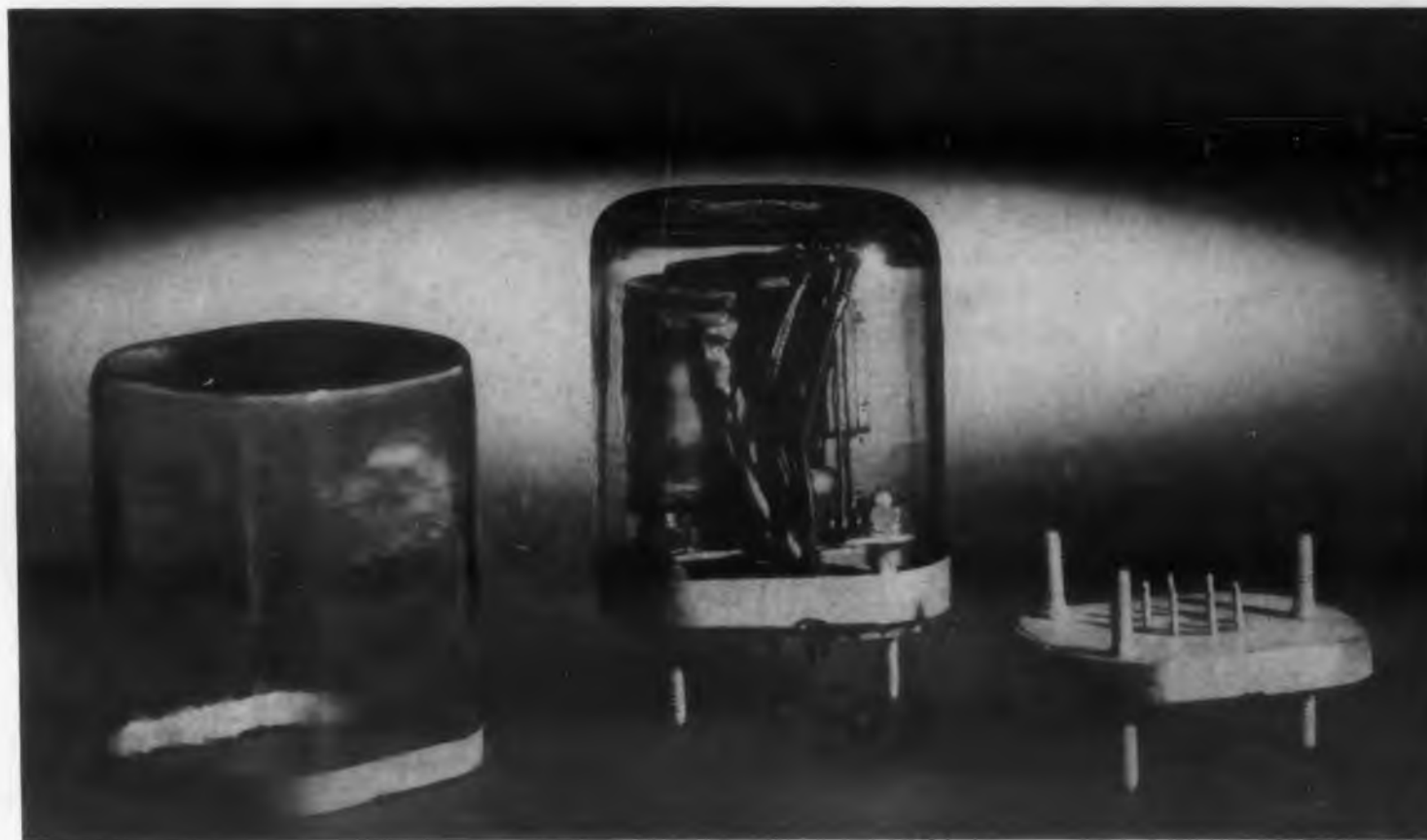
- (a) outside diameter: max.....min.....
 (b) inside diameter prior to metallizing:
 max.....min.....
 (c) inside diameter after metallizing: max.....
 min.....
 (d) length: max.....min.....
 (e) ends out of square—tolerance.....

2. Metallizing Data

- (a) band width—max.....min.....
 (b) electro-tinned.....or hot solder dipped.....(check which)

3. Operating Temperature°C Range.....

The metallized edge of this glass relay enclosure is soldered to the metallized edge of the header, which is made by the Multiform process.



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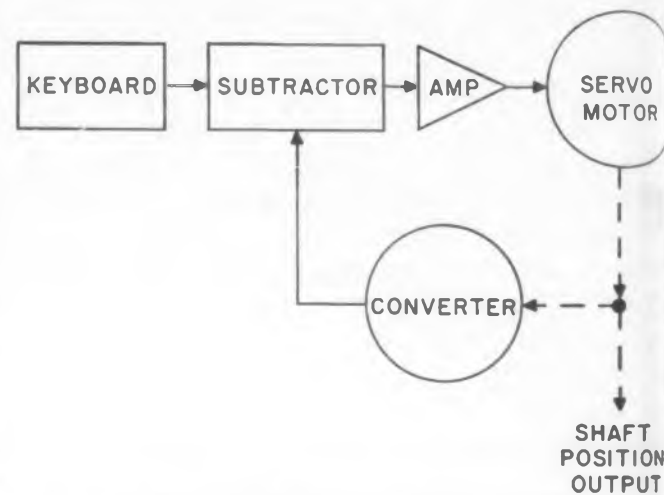
CIRCLE ED-31 ON READER-SERVICE CARD FOR MORE INFORMATION



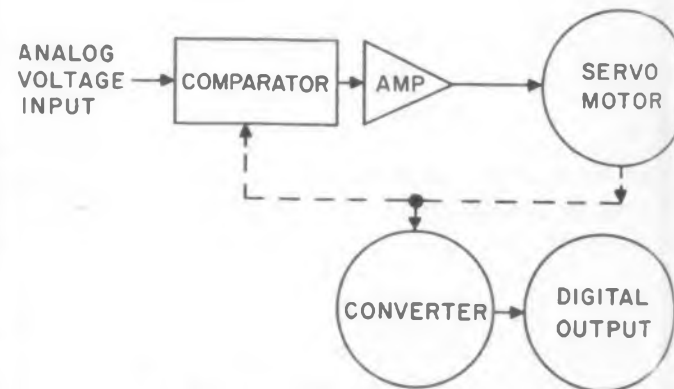
Weighing 7 oz, the
converter is 2-3/4"
long x 1-3/4" diam.



Data Converter



A digital output converted to a shaft position.



An analog-to-digital application of the unit.

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REPLACING a synchro in an accurate positioning system for radar-controlled firing is one of the uses for the ADC-1A Digital Converter. This 13-bit device can also be used as a high-speed counter and totalizer, in the conversion of shaft position to analog voltage or digital output, in a digital clock, telemetering, or combined with a self-balancing potentiometer system to record the values of a variety of transducers into many types of outputs.

When used in analog-to-digital conversions, the output of the compact converter is in unambiguous conventional binary numbers. No coding or decoding or external translation equipment is needed. Only a simple driving circuit such as a resistor network or a flip-flop is required. It will operate on direct current or pulses, and it affords parallel output for all 13 bits. The unit is made by Norden-Ketay Corp., 99 Park Ave., New York 16, N. Y.

The converter has a count of 8192 and a resolution of one part in 16,384. The torque required to drive it is 0.2 oz-in. The input shaft can be driven at 200rpm or higher, but the unit lasts longer at the lower shaft speeds. The output load may be 5ma average at -35v or 15ma peak. The direction of rotation for increasing numbers can be selected. It has a standard synchro mounting. The read-out rate is up to 10^6 per second. For more information, turn to Reader's Service Card and circle **ED-32**.

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SILICON SOLAR BATTERY*
Type S1 Single Cell

Write for
Prices
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Here rectifiers are automatically tested and inspected in mass quantities.

Rectifiers in mass-production lots are placed in Life-Test Equipment and are tested to 10,000-hour life standards.



How G.E. assures 85°C operating reliability of the new 1N315 Germanium Rectifier

This array of testing equipment mass-checks individual germanium rectifiers to 10,000-hour standards under *maximum voltage and current* conditions and at 85°C. Each rectifier is electrically connected to a testing circuit and any unit which falls below guaranteed limits is automatically rejected.

This life test is only one of the many severe quality checks imposed on General Electric Semiconductor products. Precision mass production coupled with precision mass testing assures uniform, reliable quality at low, mass-quantity prices.

G.E.'s new 1N315 rectifier operates efficiently and with long life at 85°C because of new germanium crystal growing techniques developed by the General Electric Research Laboratory and improved junction forming methods. Controlled characteristics are assured by accurate machines which reproduce assemblies to extremely close tolerances. The high reverse resistance and low forward resistance characteristics make it specially adaptable for use in magnetic amplifiers or other circuits where high temperature and extremely low leakage current are required.

Full details are available on request. Write or wire today to: General Electric Company, Section X7465, Semiconductor Products, Electronics Park, Syracuse, New York.

Progress Is Our Most Important Product

GENERAL ELECTRIC

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



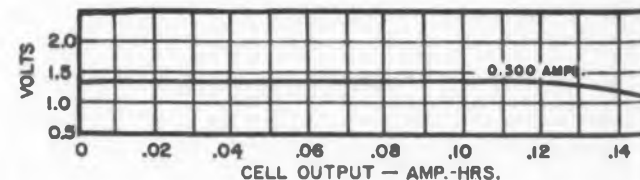
SPECIFICATIONS 1N315 and 1N315A (Resistive or Inductive Load)

	55°C	71°C	85°C	
Maximum allowable peak inverse voltage	200	200	100	V
Maximum allowable D-C output current	100	100	100	ma
Maximum full load forward voltage drop48	.46	.44	V
Continuous reverse working voltage	150	100	50	V
1N315 minimum forward to reverse current ratio (average forward/average reverse at full load)	700	300	200	
1N315A minimum forward to reverse current ratio (average forward/average reverse at full load)	1600	750	400	
Maximum operating frequency (70% rectification efficiency)	50	50	50	KC
Storage temperature	95	95	95	°C

Postage-Stamp Storage Battery



Powered by five rechargeable HR 01 Silvercells, this self-recording accelerometer manufactured by Gul-ton Mfg. Corp., Metuchen, N. J., provides instantaneous tape recording of vibration and shock acceleration. The entire unit is 4½" in diameter and 3" high. White circle shows batteries.





RECHARGEABLE, these miniature cells provide new concepts for powering portable telemetering, communication, and flash photography equipment. Flat output voltage makes the silver-zinc battery illustrated above useful for instrumentation and voltage reference applications. Continuous drain of 500ma and peak current of 3amp from this 0.14oz cell are characteristics which made the HR 01 useful for a constant-speed tape drive unit in the self-recording accelerometer designed for guided missiles, parachutes, underwater devices, ordnance, and mobile equipment.

This tiny 1/10th ampere-hour battery, manufactured by Yardney Electric Corp., 40 Leonard St., New York 13, N. Y., conceivably could operate an electronic wristwatch for more than a year before recharging. The cell is 3/16" by 5/8" by 1-1/8" in size and has an extremely long shelf life. The watt-hours/pound rating is very high. Individual units can be easily assembled into higher-voltage packs. The units, called Silvercels, provide dependable power at temperatures as low as -50°F and loads up to 1000g.

This new ultra small battery is best suited for instrumentation and telemetering applications. Designs of subminiature transmitters, underground Geiger counters, and underwater depth and sound recorders using the HR 01 are in process. For higher power applications such as servo control and propulsion, larger capacity Silvercels are available. For more data on this battery, turn to the Reader's Service Card and circle **ED-35**.

*Quick
Cure*

**FOR ELECTRONIC and
ELECTRICAL TROUBLES**

Model 785
Supersensitive
INDUSTRIAL ANALYZER



Model 633
A-C CLAMP VOLT-AMMETER



With these two versatile instruments, the maintenance department is equipped for 'most any trouble that comes along, even on new electronic control equipment.

MODEL 785, for example, has *seven* d-c voltage ranges, 1 to 1000 volts (20,000 ohms per volt)—*six* a-c voltage ranges, 5 to 750 volts (1000 ohms per volt)—*six* d-c current ranges, 50 microamperes to 10 amps.—*four* a-c current ranges, .5 to 10 amperes—*five* resistance ranges, 3000 ohms to 30 megs. All ranges full scale, and current ranges can be extended with external shunts. A complete electrical-electronic maintenance kit.

MODEL 633 is the real time-saver for motorized equipment. Measures a-c voltage and current without breaking the circuit. Has five full-scale a-c current ranges of 1000/250/100/25/10 amperes with range overlap for readability—three self-contained a-c voltage ranges of 700/350/175 volts; with all ranges available through convenient thumb switch, and provision for measuring motor starting current.

Both instruments are available through leading distributors. For literature, write Weston Electrical Instrument Corporation, 614 Frelinghuysen Ave., Newark 5, N. J.

**Model 639 self-contained
POWER ANALYZER**

—combines Voltmeter, Wattmeter,
Power Factor Meter, Ammeter,
with all interconnections made.



WESTON
Instruments

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Nothing Less than this **ALL-ANGL Mount** gives sure protection in **JETS and MISSILES**

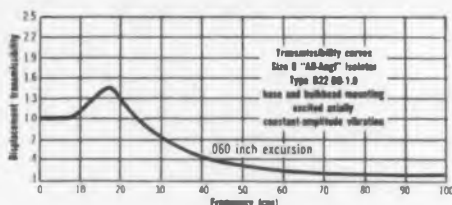
WHY? Because this Barry mount is independent of operating or mounting position. Through every operational maneuver of jets, VTO's, and missiles, the ALL-ANGL gives the same effective shock and vibration protection as in level flight.

These are the vital performance characteristics of the ALL-ANGL Mount:

- Equal stiffness in all directions
- Equal damping in all directions
- Low transmissibility at resonance — less than 3
- Isolation under superimposed steady state accelerations up to 5 g

Maximum load ratings of Size 0 ALL-ANGL mounts now available are 0.5 to 3.0 pounds per mount, in four ranges.

Write today for Data Sheet W5. For specific recommendations, call your nearest Barry Sales Representative.



Typical transmissibility curve for ALL-ANGL mount, both base and bulkhead mounting, excited axially at constant amplitude.

BARRY CONTROLS

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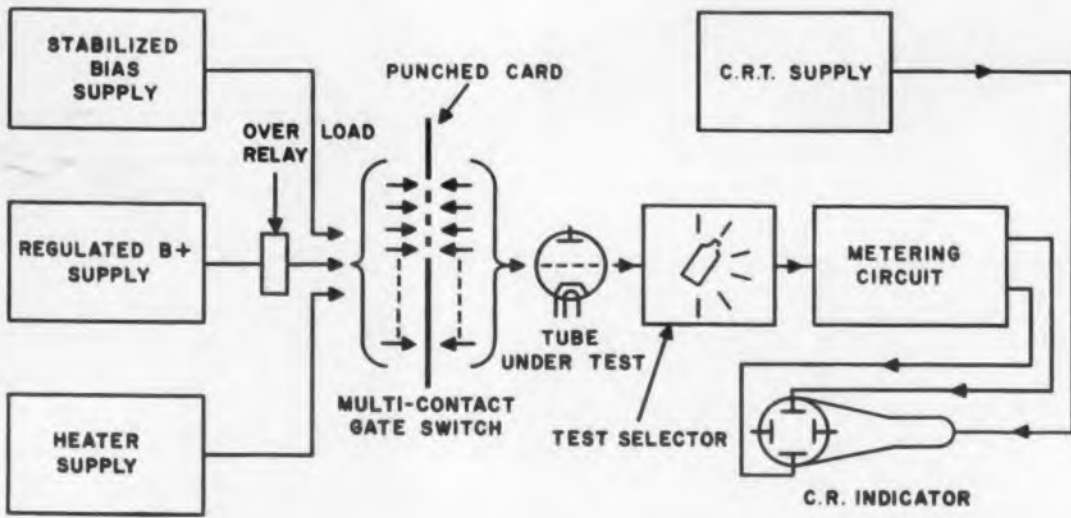
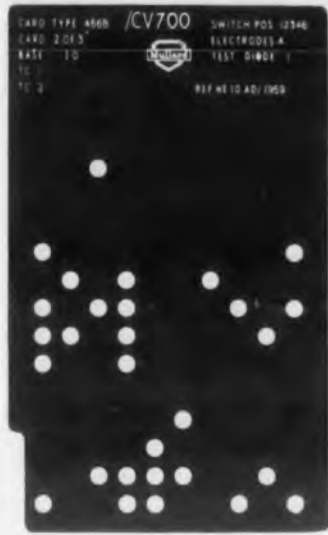
Formerly The Barry Corporation

775 PLEASANT STREET WATERTOWN 72, MASS.

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Punched-Card Tube Tester



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ELECTRO

INSERTING a punched-card into this tube tester appropriate for the tube type to be tested automatically makes all required circuit connections. A single rotary switch selects various tests in sequence; results are indicated by the position of a spot on a cathode-ray tube. A colored scale reveals whether the tube under test is within prescribed limits or considered unserviceable.

This high-speed instrument is manufactured by Mullard, Ltd., Shaftesbury Ave., London, W.C.2. Punched cards are available for many American tubes; sales are made through International Electronics Corp., 81 Spring St., New York 12, N. Y. Although the tester does not give a quantitative measure of tube characteristics, it does give a general assessment of tube quality. It does detect particular defects as open filaments or heaters, short circuits, and disconnected electrodes; faulty insulation and intermittent shorts or opens; excessive grid current due to gas or insulation leaks; and emission.

Contacts of a gate switch, which operate through holes in the punched card, select the test circuit and the correct voltages for the tube electrodes. The gate switch has 130 pairs of these silver contacts. The lever to the right of the control panel closes the switch and makes connections according to the punching on the card. In addition to the selector switch, four spring-loaded toggle switches are operated to apply continuity and insulation test voltages to electrodes. A line voltage calibrating switch is also located on the control panel.

Seventeen types of tube sockets are provided. The cathode-ray tube which has a 2-3/4" screen diameter is, of course, able to withstand high overloads (it is superior to meters in tropical environments). Punched cards are made of synthetic resin board. Tube identification and typical tests to be made are marked on each card. For more data, turn to the Reader's Service Card and circle **ED-38**.

Punched card, top, permits proper voltages to be made to tube under test as shown in the functional diagram. Cathode-ray tube window is in center of control panel, left.



meet **AMPLI-mite**

Trade-Mark

Especially designed for use with miniaturized components and blocks in Guided Missiles and Electronic Equipment, these small (AWG 26-22) Pre-Insulated Diamond Grip Terminals and Connectors have all the features that made A-MP's larger size Pre-Insulated Diamond Grip terminations famous.

A-MP's Miniature **AMPLI-MITE** terminals and connectors will help you • save valuable space • improve reliability • reduce cost

A-MP's precision confined wire crimp assures maximum area, high pressure contact for stable, low resistance connections for your most critical electronic and electrical circuits.

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AMP

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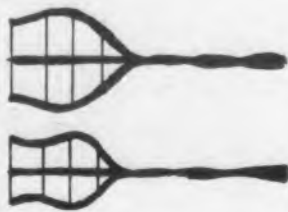
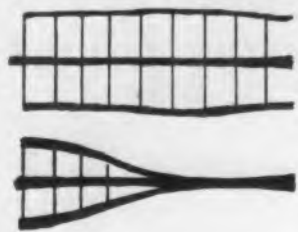


Fig. 2. Examples of low-pass filter synthesis.

Network Synthesizer

Fig. 4. Effects of over-adjusting terms when synthesizing a response.

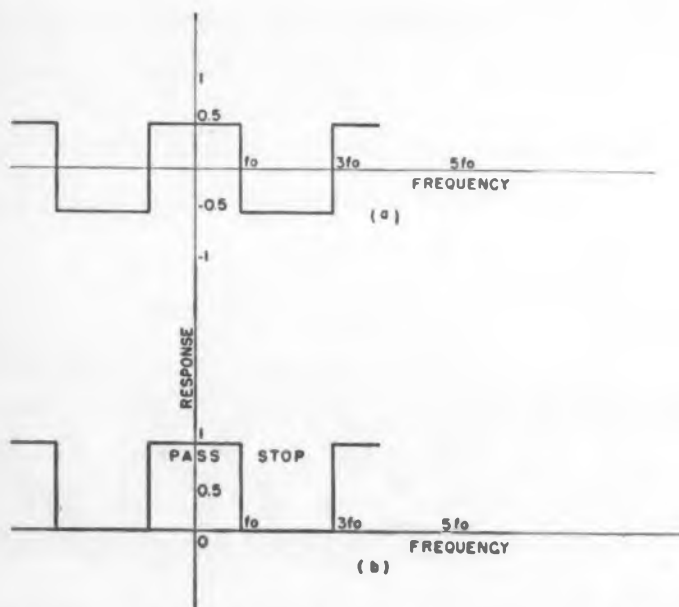


Fig. 1. Square wave curves made to correspond to filter.

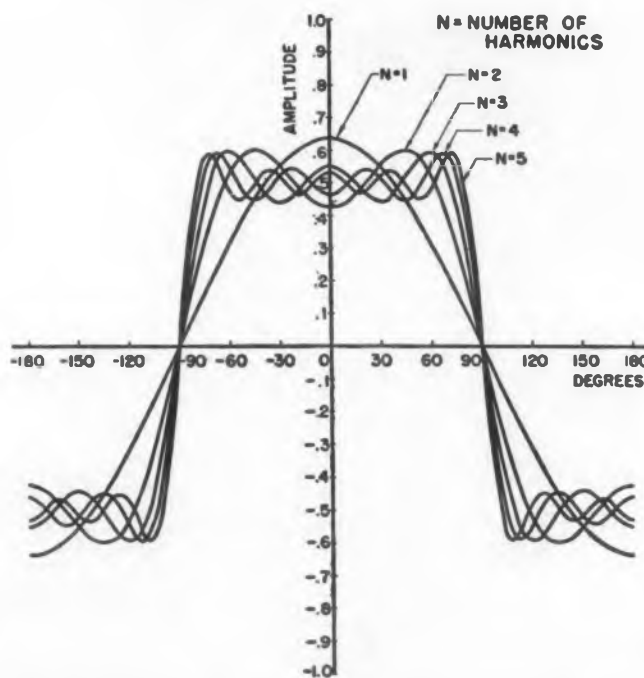
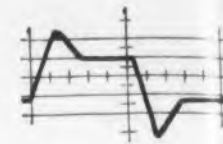


Fig. 3. Harmonics in a square wave response filter.



SELECTIVITY curves expressible by Fourier cosine series, or any transient response function, can be synthesized with this device. The unit eliminates time-consuming design calculations. It is used somewhat like a decade box; after the desired response is obtained by setting attenuators and selector switches, the necessary lumped constants for an equivalent circuit are determined by simple measurements. The network synthesizer featured here is useful in the video frequency range.

A 50-section delay line of special design in the Model NS-1, manufactured by Wickes Engineering and Construction Co., 12th St. and Ferry Ave., Camden 4, N. J., permits rapid synthesis of any filter characteristic over the entire video range. Ten cathode followers, each having an individual attenuator and polarity (algebraic sign) selector switch, permit picking off voltages without loading the line.

Any 10 voltages can be selected and combined, so that either 10 terms of a Fourier Series can be obtained, or any 10-step approximation to a transient response function can be made. Voltages can be added up in accordance with the harmonic analysis schedule of any selectivity curve. The receiving end of the line can be terminated or open, to allow synthesis in either the frequency or time domain.

The voltage of a point of x units from the receiving end of a lossless unterminated delay driven from its characteristic impedance can be shown to be

$$E_x = E_g \cos x\theta/n (e^{-j\theta})$$

where E_g is the generator voltage

θ is the length of the line in radians

$$= (\text{delay time}) \times (\text{radian frequency})$$

$$= t_d(2\pi f)$$

n = total number of sections in the line

The voltages at any point on the line are in phase lagging the generator voltage by an angle θ which is proportional to frequency. Hence the voltages can be combined algebraically to obtain the sum of the component voltages.

Adding voltages at various sections of a line, the sum of the component voltages is

$$E = E_g (1 + \cos \theta/n + \cos 3\theta/n + \cos 5\theta/n \dots)$$

letting $y = \theta/n$,

$$E = E_g (1 + \cos y + \cos 3y + \cos 5y \dots)$$

This equation is recognized as a Fourier type. The terms can be obtained from the Network Synthesizer. For a more complete discussion of principles, refer to the *RCA Review*, June 1954, p. 163.

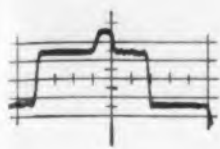


Fig. 5. Typical transients that can be synthesized.

A typical selectivity curve synthesis procedure is illustrated by Figs. 1 and 2. It is assumed that a low pass filter is desired having a cut-off frequency of 1.835Mc. The characteristic of a symmetrical square wave about the frequency axis altered by the addition of a d-c reference (0.5) alternately bypasses and stops bands corresponding to a low-pass filter. In Fig. 1b the response between 0 and f_0 is unity, between f_0 and $3f_0$, zero, and so on. This low-pass filter, neglecting frequencies beyond $3f_0$, is described by the series

$$E = E_g (1 + \cos y - 1/3 \cos 3y + 1/5 \cos 5y \dots)$$

From previous definitions we know $y = t_d 2\pi f$, therefore $t_d/n = y/2\pi f$. From Fig. 1, when $f = f_0$, $y = 90^\circ$ or $\pi/2$ radians, and t_d/n (delay per section) = $1/4f_0$.

For a cut-off frequency of 1.835Mc, the delay per section equals $0.136\mu\text{sec}$. Since the delay per section is $0.034\mu\text{sec}$, the section, or tap, to be used for the first section of the filter is No. 4 ($4 \times 0.034 = 0.136$). Number of sections for the third, fifth, and so on harmonics are then determined and switched in. Attenuators associated with each term are adjusted to obtain the proper amplitude (coefficient of $\cos y$). When the desired curve has been completely synthesized, the NS-1 can be placed in the system to determine whether the original response actually performs as desired. Adjustments can be easily made if it is found that any changes in the cut-off frequency and/or rate of cut-off are desirable. The final filter can then be constructed using sections of delay lines or combinations of R, L, and C as desired. The way in which the selectivity curve develops is shown in Fig. 2. The calculated square wave response is shown in Fig. 3 for comparison. The network synthesizer can also be used for time domain synthesis of transient response. This study is helpful in eliminating undesirable transients or changing them into useful waveforms.

If a unit step function is applied to the line, it will be propagated down the line without distortion or reflection. In a similar manner as for the selectivity curve synthesis, the voltages supplied through taps can be added together. Any response within the limits imposed by the total number of taps available, and the delay between taps, may be synthesized.

The equipment is extremely stable in operation. The controls can be reset to repeat a desirable network. For more information about this synthesizer turn to the Reader's Service Card and circle ED-40.



revolutionary ALUMINUM CORE BOX[†] construction

withstands HIGH TEMPERATURE • VACUUM IMPREGNATION
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This is a development which calls for immediate changes in purchasing specifications for Tape Wound Cores, because introduction of the Aluminum Core Box means designing your toroids around four important new advantages:

1. Use of an aluminum core box means the new Magnetics, Inc. tape wound cores will withstand temperatures of at least 450°F .
2. Because of the unusual seal provided by forming the aluminum over the silicone glass seal, true vacuum impregnation of your coils is now possible. Varnish cannot penetrate the core box and affect magnetic properties of the tape.
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Because of the many advantages of these new Magnetics, Inc. Tape Wound Cores, it will pay you many times over to specify "Aluminum Core Boxes" on your next order.

[†]PATENT PENDING

Immediately available in 109 standard sizes, using all commercially available magnetic materials.

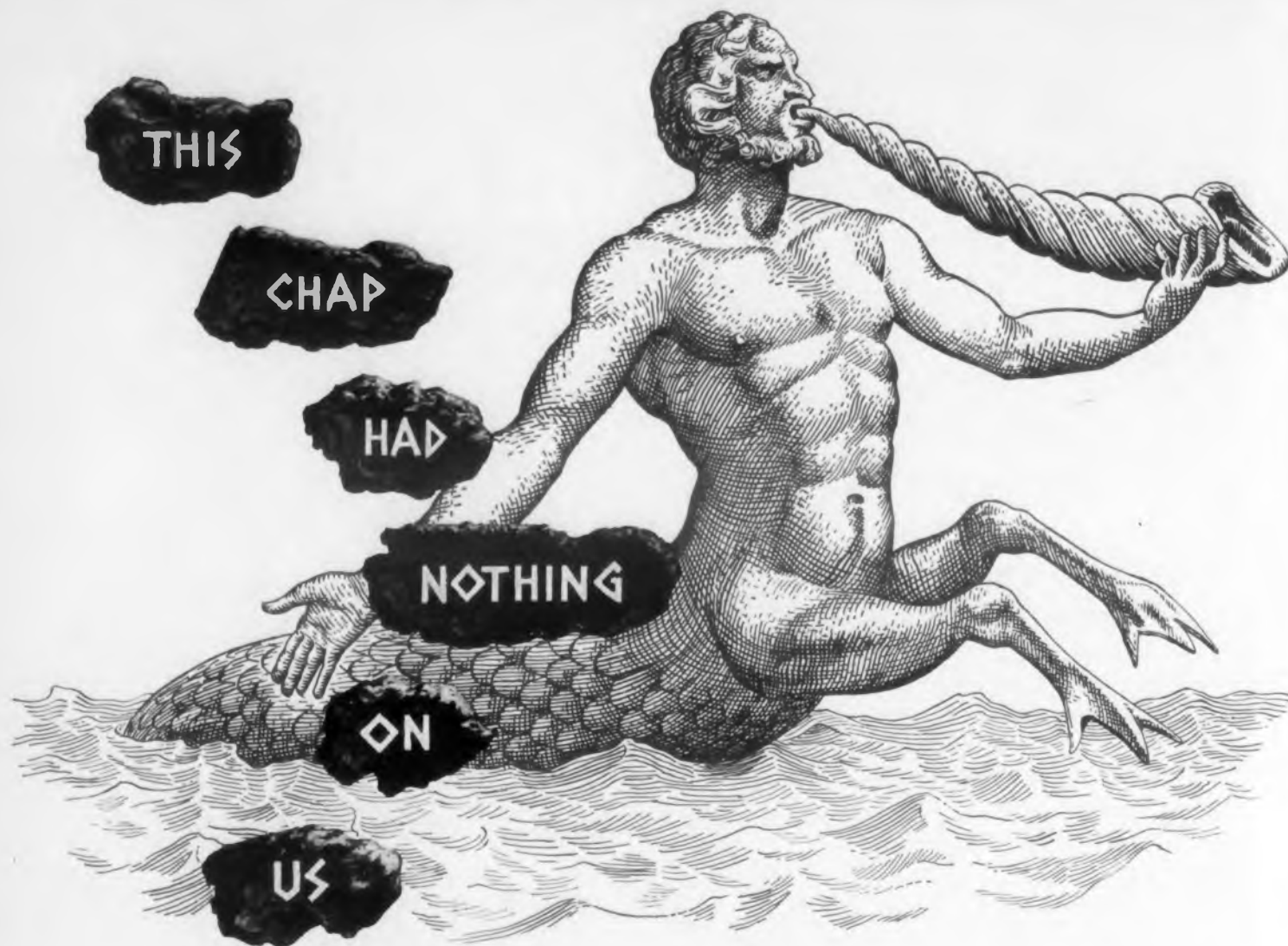
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He's Proteus, Neptune's son, a highly versatile character—hence the adjective *protean*. You never knew whether next you'd see him as a lion, a raging fire, a reptile, or an angry bull.

Here at Driver-Harris, we do protean marvels too . . . with *metals*. For instance, Nichrome®, the unique heat-resistant, corrosion-resistant, electrical-resistance alloy known the world over, has long been the engineer's yardstick of comparison not in one, but *in at least 3 widely different applications*.

TO GENERATE HEAT: In all applications of producing heat by electricity, particularly to temperatures above 1700°F., Nichrome and Nichrome V set the quality standard. From simple electrical appliances such as ranges, broilers, toasters, etc. to giant industrial furnaces, no other alloys enjoy such widespread recognition and use.

TO RESIST HEAT: Because of its unsurpassed resistance to heat and corrosion, Nichrome is used for making massive furnace muffles and

retorts often weighing tons, and work-loading fixtures of all shapes. The outstanding property of Nichrome here is its extremely long life, which results in low heat-hour costs.

TO RESIST ELECTRICITY: The greatest contribution to outstanding stability and miniaturization of resistors is made by Nichrome wire. Drawn to sizes as small as .0005 and finished in a variety of insulations, Nichrome is a boon to electronics in the manufacture of high tolerance resistance units of all types.

Added to the nickel and chrome of Nichrome and Nichrome V is always one exclusive ingredient—the supreme mastery of the Driver-Harris specialists, gained in their 57 years of melting and drawing experience.

In recognition of its unique properties, the United States Patent Office in August, 1908, granted solely and exclusively to us the trademark NICHROME. There is *only one* Nichrome, and it is made only by Driver-Harris.

*T. M. Reg. U. S. Pat. Off.



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Lighted Push-Button Switch



These switches can be mounted on one-inch centers.

CROWDED panel space on computers, complex test instruments, or control consoles can be saved by means of these Type 31PB1 push-button switches. A hole for an accompanying indicator light is not required, because the button itself lights up. Groups of these buttons can be mounted on one-inch centers. These spdt switches can switch up to 5amp, a-c.

They are designed for low-voltage applications. The push-buttons are either red or white frosted for use with 6v or 28v incandescent bulbs, or in clear plastic for use with No. 51 neon bulbs. The neon bulb can be used with a resistor across 115v lines. The mounting panel must be at least 3/32" thick. These units are made by Micro Switch Div., Minneapolis-Honeywell Regulator Co., Freeport.

ELECTRONIC DESIGN • June 1955



Switch-life is about 1,000,000 operations.



RELIABILITY—
BUILT IN
...A DISTINGUISHED
FEATURE IN ALL E-I
DIGITAL VOLTMETERS



ELECTRO INSTRUMENTS' digital voltmeters have established a new standard of reliability, recognized by test laboratories throughout the United States and Canada. This distinguished quality of *built-in reliability* is your assurance of trouble-free operation in day-to-day instrument applications.

E-I reliability is the product of advanced engineering know-how... exemplified by proper electromechanical design utilizing stepping switches and a minimum of quality, aged components operated at conservative design levels. In E-I voltmeters, dust-protected stepping switches assure positive electrical contacts, plus positive mechanical interlocking... all critical adjustments are eliminated. Gold-plated contacts for bridge levels provide low, constant contact resistance.

Built-in reliability is one of many laboratory-proven features of E-I digital voltmeters. In addition, every E-I voltmeter offers:

- Stability of 0.01% under regulated laboratory conditions... short-term drifts minimized due to matched coefficients of secondary reference and standard cells... long-term drifts virtually eliminated by specially encapsulated, wire-wound precision Cal-Ohm resistors—doubly aged by temperature and power dissipation cycles.

- Accuracies to 0.01%.
- Completely automatic operation.
- Readability... made possible by error-proof in-line read-outs.
- Ease of calibration with front-panel adjustment.

Outstanding construction... a rugged, all-metal frame... a vertical chassis for natural convection cooling... utmost ease of maintenance and replacement... switch housing assures dust protection, reduces temperature gradients in standard

cells and bridge elements, and minimizes audible noise. Every E-I voltmeter combines quality components with highest craftsmanship.

Machine-recording output for automatic operation of printers, electric typewriters, IBM punch equipment.



Precision Instrumentation

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For complete information and specifications concerning Electro Instruments' versatile line of 17 standard digital voltmeters, plus optional design features, write Dept. 400 for the new Bulletin 300.

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Electro Instruments' family of direct-reading, in-line instruments include 17 standard digital voltmeters for precision laboratory and production measurements, automatic binary-decimal con-

verters, and digital read-outs providing unambiguous numerical indication for many instrument applications. Complete literature is available upon request.

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

Ill. The bulbs are replaced by unscrewing the button. Operating force is from 4 to 8 oz.

The switches have a large amount of travel before the contacts make. They extend 3-3/32" back from the panel and 3/4" out. They are rated 125v or 250v, a-c, 5amp; 30v, d-c inductive: 3amp at sea level and 2.5amp at 50,000'; and 30v, d-c resistive, 4amp at both sea level and 50,000'. Maximum inrush current is 15amp. A choice of soldering or turret-type solder terminals is available. A terminal block is provided and power to turn on the light when the switch is operated must be picked up from the circuit being switched by means of a direct connection or by relay. For more information on these widely-applicable switches, turn to the Reader's Service Card and circle **ED-43**.

Ideas for
Design

ACCURATE measurements of audio-frequency current and voltage can be made easily and rapidly with the two instruments described on these pages. Their development was based on the principle of electrothermic transfer, in which standards are

calibrated on direct current. The first, known as a "volt-ampere converter", provides 0.05% accuracy for laboratory use in conjunction with a d-c potentiometer. The second, called a thermocouple volt-ammeter, is a portable direct-reading instrument of 0.05% accuracy. Both devices were developed at the National Bureau of Standards, Washington 25, D. C., by F. L. Hermach and E. S. Williams of the electrical instruments laboratory.

These electrothermic transfer instruments make use of thermal converters. Each converter consists essentially of a conductor, heated by the alternating current to be measured, and a thermocouple, one junction of which is thermally connected to the heater at its midpoint. The value of the direct voltage produced in the thermocouple thus depends on the value of the alternating current measured.

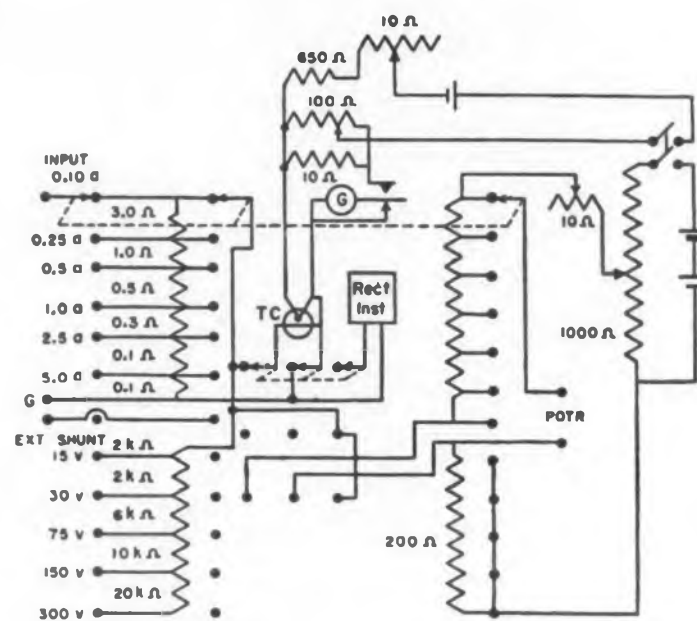
Volt-Ampere Converter

In the volt-ampere converter, the heater of a single thermal converter is connected in series with appropriate resistors for voltage measurements and in parallel with appropriate shunts for current measurements. The resulting output electromotive force of the thermocouple is balanced against the voltage from an internal d-c "bucking circuit." Balance is indicated by the null reading of a built-in galvanometer. The heater is then switched to an internal d-c circuit, which is adjusted to give the same output emf and therefore equivalent heater current and voltage drop. The voltage across a portion of this circuit is measured with an external potentiometer and is multiplied by a simple factor to obtain the unknown alternating voltage or current. This instrument is self-contained, and requires no external direct-current source or controls.

The circuit of the volt-ampere converter is designed so that the measured alternating quantities are not dependent upon the conversion characteristics of the thermal converter nor on the resistance of the heater. They are dependent only on the potentiometer reading and the internal resistors, which can be made highly stable and whose values can be determined with great accuracy. The modification for voltage measurements consists in adding to the internal d-c circuit a resistor equal to the resistor connected in series with the thermal converter in the a-c position of the selector. For current measurements, a resistor equal

to the shunt resistance is added to the d-c circuit. These compensating circuits have been found to be practical, and the added resistors need be of only moderate accuracy.

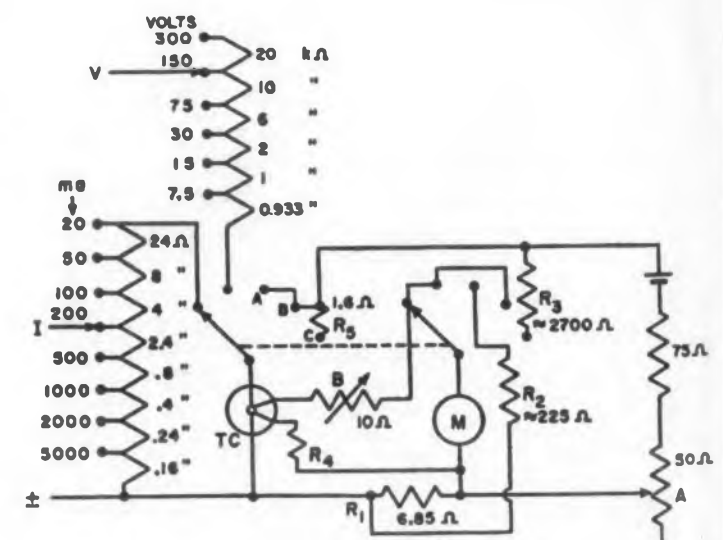
A 7.5ma, 10mv thermal converter of the insulating-bead type (in which one thermocouple junction is attached to the heater by an electrically insulating bead) is used in the volt-ampere converter. This thermocouple has an a-c—d-c difference of not more than 0.01% at the audio frequencies. The a-c resistors for the voltage ranges and the two lowest current ranges are high-grade 0.05% audio frequency resistance cards. The four-terminal bifilar (parallel-strip) a-c shunts for the 5- and 2.5amp ranges were constructed of 8-mil manganin strip 0.5cm wide, with



Schematic for the volt-ampere converter, an a-c standard.

4-mil woven-glass tape as insulation. Bifilar shunts of No. 20 manganin wire were constructed for the 1- and 0.5amp ranges. Considerable care was taken in connecting all of the a-c shunts to minimize inductive coupling between the current and potential circuits of the shunts. These arrangements were adequate to keep the a-c impedance within 0.05% of the d-c resistance, even at 20kc. The wire and strip were initially annealed at 500°C, and the completed shunts were aged at 150°C for 24 hours before final adjustment.

Newly developed commercially available rotary switches with enclosed solid-silver contacts and a unique internal circuit are important components in the instrument. Mercury cells of 3amp-hr capacity



Circuit diagram of the direct-reading thermocouple volt-ammeter.

are used as the internal d-c sources because of their flat discharge-voltage characteristic and very long shelf life. The combined drifts in the balancing circuit and the thermal converter are less than 0.001%/min.

A useful feature of the volt-ampere converter is a 7.5ma, 0.5v rectifier instrument, which is switched in place of the heater when the thermal converter is connected to the internal d-c source. This instrument tells at a glance what effect circuit changes have on the measured current or voltage. It also indicates within 5% what voltage to set on the potentiometer. In addition, it can serve as an overload indicator.

Thermocouple Volt-Ammeter

The thermocouple volt-ammeter consists essentially of a d-c milli-voltmeter connected to the output of the thermal converter. The sustained accuracy in service of the usual instrument of this type is limited by the relatively high temperature coefficient of the combination (0.1 to 0.3%/degC), and by changes in the converter, probably due to stress relaxation in the heater, to moderate overloads, or to leakage of air into the evacuated bulb. It is often desirable, although seldom convenient, to test an instrument by comparison with a d-c instrument at one scale point before important measurements are made with it. However, in this instrument the d-c millivoltmeter itself, together with appropriate resistors, is arranged as a milliammeter to provide for the important single-point check of the thermal converter, and adjustable resistors are incorporated to compensate for any changes. Wiring is designed so that voltage and current can be measured successively in the same circuit without changing leads. Over-all temperature coefficient of the unit is less than 0.02%/degC.

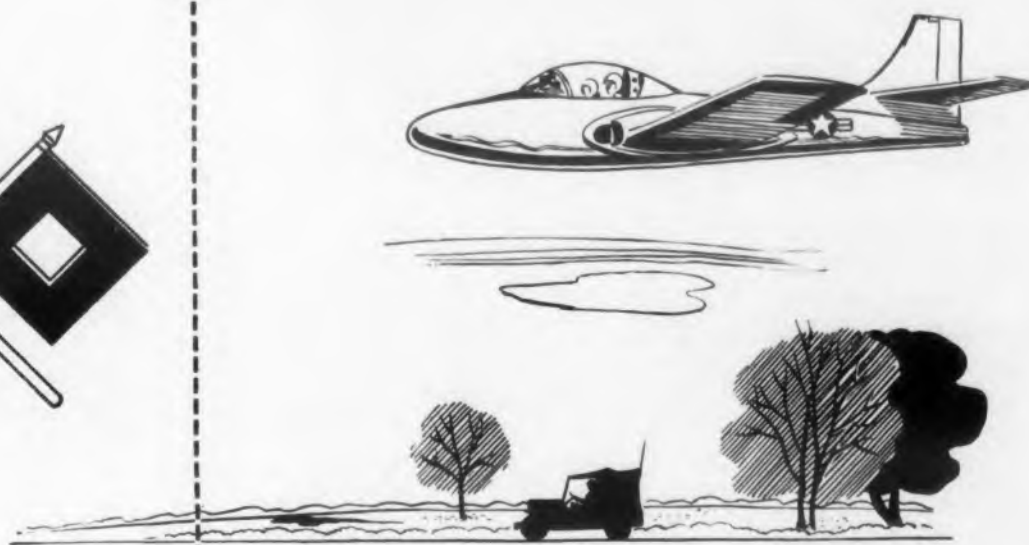
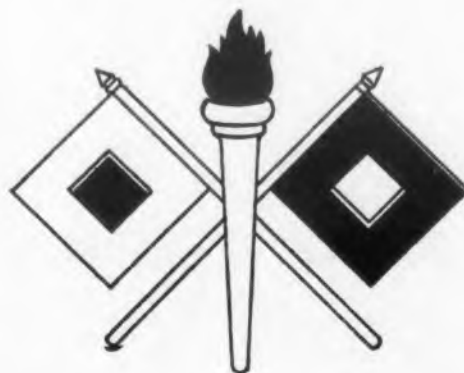
The thermal converter is of the same type as that used in the first instrument. This is also true of the a-c resistance cards for the voltage ranges. Likewise, a bifilar manganin resistor is connected in series with the heater of the converter to adjust it to the proper value. A ring shunt was constructed for the current ranges, with commercial a-c resistance cards for the four lower ranges and bifilar manganin wire and strip for the higher ranges.

No overload protection has been built into this instrument, but matching thermal converters are used for replacement. It has been found possible to select converters in this current range from larger lots, which match within 0.3% of full scale when adjusted for equality of millivoltmeter deflection at rated current. Thus the expense of recalibration should not be necessary in case of burnout.

Tests of a-c—d-c difference and temperature coefficient tests indicate that this volt-ammeter has an accuracy within 0.5% over an extended range of temperatures. The construction of an instrument of this type accurate to 0.25% might prove feasible, but would depend largely on the inherent stability and readability of the millivoltmeter.

Winco dynamotors qualify

for Signal Corps Reduced Inspection Plan



The Wincharger Corporation's long history of producing dynamotors "equal to or better than the Acceptability Quality Level established by the government" has resulted in the Signal Corps' selection of Winco dynamotors for its Reduced Inspection Quality Assurance Plan.

As of this writing, Wincharger is the only manufacturer of dynamotors qualified under RIQAP. Only those suppliers who have consistently furnished material of the highest quality level and who maintain quality control and inspection methods and procedures acceptable to the Signal Corps are considered for this honor.

This new Signal Corps plan places more responsibility for maintenance of quality on the manufacturer by reducing the amount of government inspection. It is an honor inspection program.

What does Wincharger qualification for RIQAP mean to you — further evidence that you can depend on Winco Products.

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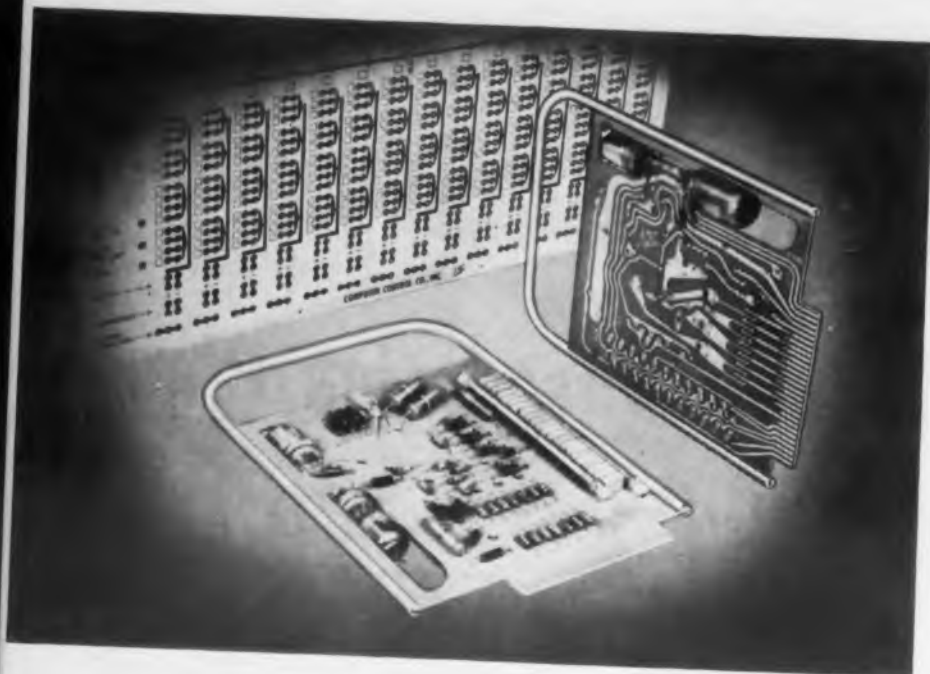
Power for the nation's mobile communications

WINCHARGER CORPORATION

Sioux City 2, Iowa

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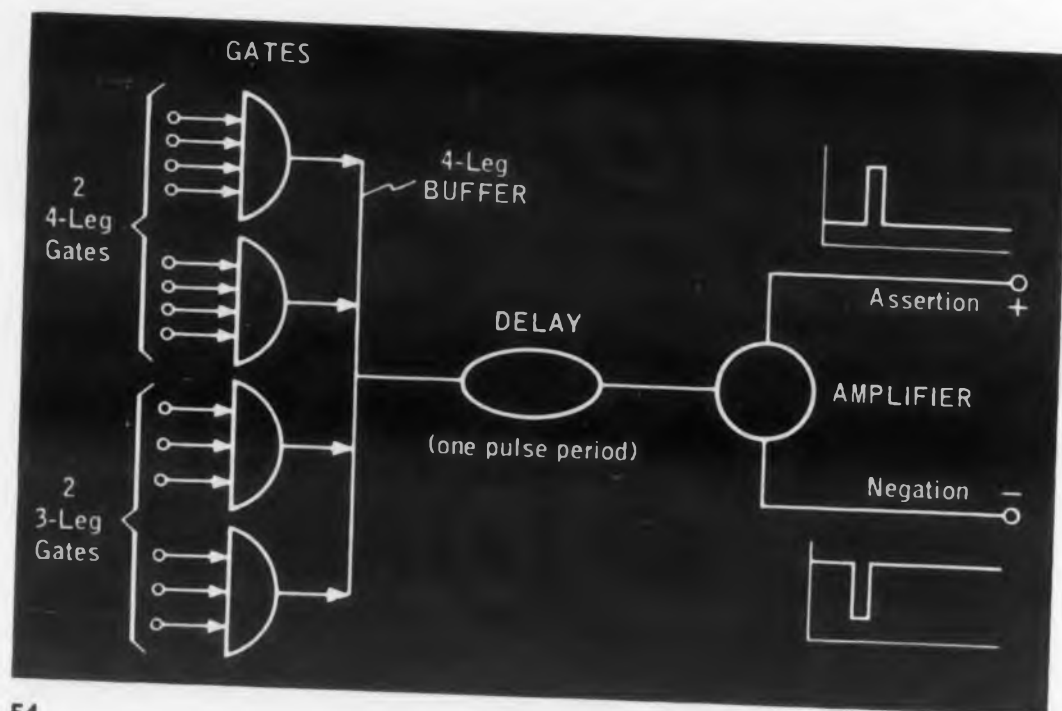
CIRCLE ED-45 ON READER-SERVICE CARD FOR MORE INFORMATION



Logical statements for the Gating Package, foreground, are implemented on the plug-board of 3C-BLOC equipment, rear.

Typical logical and computing applications for 3C-BLOC equipment made up of Gating Packages.

APPLICATION	TYPE OF DIGITAL ELEMENTS REQUIRED	APPROXIMATE NUMBER OF 3C-BLOCS REQUIRED
CLASSROOM DEMONSTRATION	BI-STABLE COMPUTING ELEMENT, SHIFT REGISTER, COMPARATOR, CODE CONVERTER, ADDER, SUBTRACTOR	1/5
OPERATIONS RESEARCH LOGICAL ANALYZER	"AND" CIRCUITS, "OR" CIRCUITS, STORAGE	1
TEST EQUIPMENT—such as DIGITAL FUNCTION GENERATORS, SIMULATION EQUIPMENT, TIME-MARKER GENERATORS, RADAR VIDEO SIGNAL GENERATORS	LOGICAL COMBINATION CIRCUITRY	1 - 2
AUTOMATIC MACHINE OR PROCESS CONTROL	ADDERS, SUBTRACTORS, CODE CONVERTERS, MULTIPLIERS, SHIFT REGISTERS, STORAGE	35
LARGE-SCALE 1-mc COMPUTING INSTALLATION	ARITHMETIC, CALCULUS, CODE CONVERSION, PROGRAMMING and STORAGE FUNCTIONS	300



The simple Gating Package includes 4 gates for "and", a buffer for "or" and an amplifier for "not" connectives.

Plug-In Logic Unit

LOGICAL operations, digital computations, and control functions of many varieties can be performed with this universal plug-in digital gating package. By cascading these computing packages, installations can be modest, to perform simple logical analyses, or extensive, to perform large-scale industrial research and control.

The 3C-PAC Gating Package, manufactured by Computer Control Company, Inc., Wellesley, Mass., can serve as a logical gating element or as a storage flip-flop. A flip-flop with input gating provisions and output driving capacity can be implemented with this one-tube package. A complete serial binary adder can be formed with only two Gating Packages. Only this one basic component need be stocked to meet nearly all digital system needs. They operate at a 1Mc repetition rate.

The Gating Package, as the symbolic illustration shows, consists of two 4-leg gates and two 3-leg gates which represent the "and" connective. The gates are joined by a 4-leg buffer which represents the "or" connective. The "not" connective is supplied by polarity reversal in the amplifier-inverter. Any logical function of three variables (using the connectives "not", "and", and "or") can be handled with this package. Up to 51,358 functions of four variables, and many functions of five or more variables can be implemented.

Components of this package are mounted on an etched circuit panel to form a rugged unit measuring

DOW CORNING
CORPORATION

Silicone News

FOR DESIGN ENGINEERS

Founder Celebrates 25 Years' Service To Silicone Industry

In 1930, Dr. J. F. Hyde first started his investigations into the field of organo-silicon chemistry. His work, which preceded that of any other chemist in this country, led to the first commercial production of silicones.

Frank Hyde received a master's degree in chemistry from Syracuse University in 1924. He then enrolled in the graduate school of the University of Illinois and



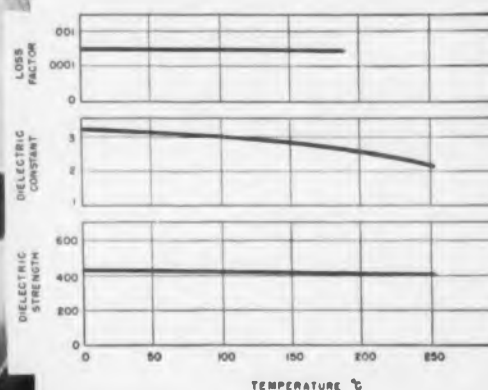
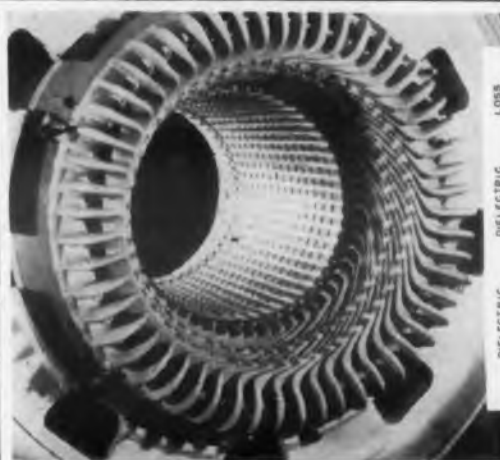
DR. J. F. HYDE

received his Ph.D. in organic chemistry in 1928. To pursue still further his interest in basic organic chemistry, he spent two years as a post Doctorate Fellow at Harvard University under Dr. J. B. Conant.

Hyde's work in the field of silicone chemistry began the day he was hired by Dr. E. C. Sullivan of Corning Glass Works in 1930. His first project was to explore the possibility of incorporating organic chemical groups into glass compositions to increase their shock resistance and flexibility. His investigations led deep into the work done by Prof. F. S. Kipping of Nottingham University (England) in the field of organosilicon chemistry. Applying his creative imagination to Kipping's findings, Hyde produced silicone polymers with the very properties that so rapidly propelled the silicones into almost every phase of American industry.

Frank Hyde carried on basic exploratory work in the silicone field at Corning until 1951. He then transferred his laboratory to Midland, Michigan, to be closer to actual silicone operations at Dow Corning Corporation where he continues to apply his research ability to producing more and better silicone products.

At this time, many people join us in saying, CONGRATULATIONS TO THE MAN WHO WAS FIRST IN THE WORLD TO PRODUCE A USEFUL SILICONE AND ON WHOSE WORK AN INDUSTRY WAS FOUNDED
DR E C SULLIVAN



ALLIS-CHALMERS ANNOUNCES ALL-SILICONE-RUBBER INSULATION FOR LARGE MOTORS AND GENERATORS

Allis-Chalmers Manufacturing Co. has announced development of the first all-silicone-rubber electrical insulating system for large motors and generators. Known as Silco-Flex, this new Class H insulation increases the life and efficiency of rotating electric machines by providing greater overload protection and maximum resistance to abrasion, moisture, shock, and vibration.

Made with Silastic*, the Dow Corning silicone rubber, Silco-Flex is dielectrically superior to all types of resinous insulations. As shown in the figure, dielectric strength of 1/16 inch slabs cured 24 hours at 250 C remains practically constant over a temperature span ranging from 0 to 250 C. Dielectric constant decreases gradually from 3.2 to zero to 2.2 at 250 C.

In manufacturing Silco-Flex insulated stator coils, Silastic is applied to the conductors and vulcanized into a homogeneous mass by the application of heat and pressure. This produces a continuous and impervious dielectric barrier which provides a flexible, moisture and heat resistant wall over the entire coil structure including leads.

Silco-Flex insulation is expected to change many of the motor application practices in the utility and industrial fields. In power plant induced draft fan motors, for example, the abrasive effect of atmosphere-borne cinder and fly ash will have little effect on the resilient all-silicone-rubber

system. Motors in cement, ore crushing and similar installations will retain high overload capacities despite reduced ventilation resulting from dust accumulation in ventilating passages. In the chemical, paper, food and similar industries, applications that formerly required totally enclosed motor frames may now be supplied more efficiently and economically with Silco-Flex insulated semi-protected or open type frames.

Allis-Chalmers is already building large Silco-Flex insulated machines in the 2300 and 4000 volt class. These will be priced on the same basis as previous units constructed with resinous Class H insulation. A-C engineers also expect to extend the advantages of the all-silicone-rubber system to a wide range of high and low voltage rotating equipment. No. 41

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

Design Edition 10

DOW CORNING CORPORATION - Dept. 4706
Midland, Michigan

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ATLANTA • CHICAGO • CLEVELAND • DALLAS • DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D. C. (Silver Spring, Md.)

Canada: Dow Corning Silicones Ltd., Toronto; Great Britain: Midland Silicones Ltd., London; France: St. Gobain, Paris

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

ing 7" square and less than 1" thick. The panel is designed for plugging into a receptacle of a panel plugboard on which logical operations are determined by means of jumper connections. The circuit contains one tube for amplification, and a transformer for impedance matching and double-ended (assertion and negation) outputs. Germanium-diode pulse gating is used, and a one-pulse-period lumped-constant delay is provided between circuit input and output.

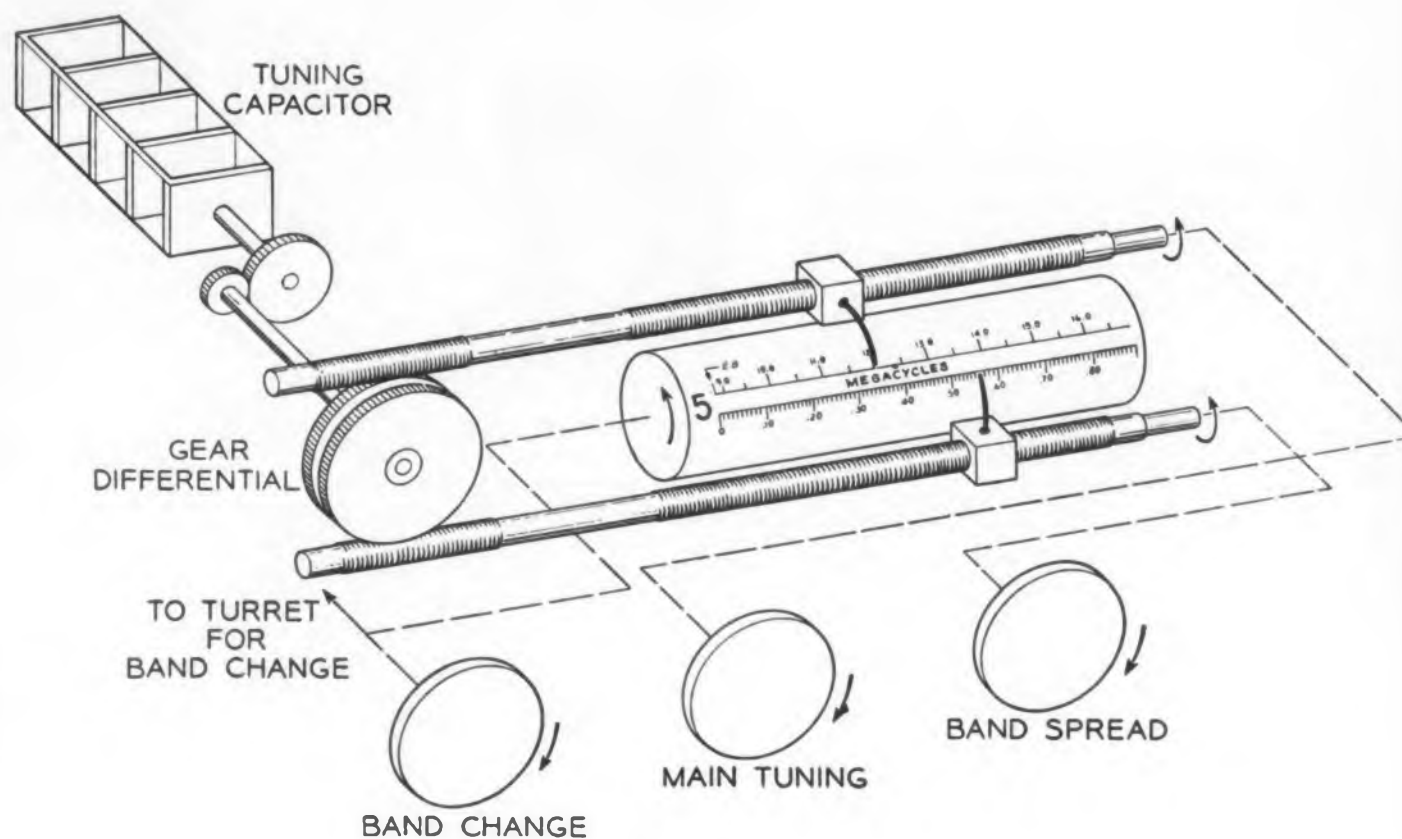
Designed for input signals including up to fourteen trains of logical information pulses and a uniform train of 1Mc synchronizing pulses, the output produces assertion and negation pulse trains which can drive up to ten gate legs directly. The low output impedance of 93 ohms matches into coaxial cable.

Fifteen gating packages and one timing package can be plugged into the company's mounting chassis (3C-BLOC) having a convenient plugboard for making input and output connections. This mounting chassis and such accessories as electrical and acoustical delay equipment can be mounted on a standard 19" relay rack. The accompanying table shows typical applications and the approximate number of such assemblies required. Instead of the 1,100 vacuum tubes in the arithmetic unit of some medium-sized computers, this system requires only 450 tubes. For more data, turn to the Reader's Service Card and circle ED-46.

Stable Communications Receiver



The bandspread knob turns the tuning gang only 1/10 as fast as the main tuning knob by means of this differential gear system.



THE IMPORTANCE of a sure knowledge of mechanical design by electronic designers is demonstrated by the amateur communications receiver discussed on these pages. The differential gear system for tuning, the measures taken to insure rigidity of the tuning section, and the method of mechanically isolating the oscillator tuning capacitor are design features worthy of a mechanical engineer. In addition, this receiver, known as the "Pro-310" features some printed circuitry, and a sectional construction to implement production and cut costs. The circuitry also affords some advances. This unit is made by the

Hammarlund Manufacturing Co., 460 W. 34th St., New York 1, N. Y.

The tuning method of the Pro-310 utilizes an unusual method of gaining bandspread. Only one group of capacitors ganged on the same shaft are used for tuning. By means of a differential gear, the capacitors are turned to a major frequency division by one knob and then turned slowly over smaller frequency ranges by a second knob, as illustrated. The actual frequency to which the receiver is tuned is the sum of the main and the bandspread dial readings. In operation, the bandspread dial is set to zero, and the

main dial is set to the nearest identifiable marking. Then using the bandspread dial, an interpolation is made between the markings on the main dial. The unit can be tuned to within 1kc. The tuning turret and dial are switched simultaneously from one band to another by means of a bead-chain drive. The receiver covers 0.55 to 3.5Mc, over which it is continuously calibrated. Narrow, medium, and broad i-f bandwidths can be selected.

The oscillator section of the tuning gang is isolated from the rest of the gang by the illustrated split-shaft arrangement. A precision glass ball bear-

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ing supports each end of the separate oscillator capacitor shaft. The entire tuning capacitor assembly is mounted rigidly to the frame at three points to prevent any pressure on the cabinet from distorting the capacitor plates.

The antenna input circuit is a two-mesh tuned circuit instead of the more common single-tuned circuit. The extra selectivity not only contributes to improved image attenuation, but increases the attenuation of strong undesired signals before they get to the vacuum tubes where cross modulation may occur. The improvement in selectivity is actually more than twice the conventional antenna stage selectivity because the effective Q of the second mesh is not reduced by the antenna radiation resistance.

Printed Circuits

Designing the r-f amplification section with only one vacuum tube is an uncommon feature in this class of receiver. The single tube provides sufficient gain and meets that most important design criterion—simplicity. Printed circuitry is employed in the r-f section to provide short leads and reduce stray capacitance. It also assures uniformity of circuitry with at-

The shaft of the oscillator's tuning capacitor is mechanically isolated by means of a coupling so that any expansion due to heat of the shaft or any shaft vibration will not distort the first capacitor or introduce microphonics. Notice the two steel pins sticking out of the assembly. They mate with holes in the frame to hold it rigid.



The three subchassis are attached to the rigid frame that fits inside the cabinet. For relay rack mounting, the cabinet is eliminated. The differential gear and bead chain drives are at the top.

tendent control of unwanted stray capacitance for all units produced. Cost cutting was a lesser consideration in choosing printed circuits because this is not a mass-produced item. The printed circuit board has copper foil on both sides, which tends to prevent the laminate from warping. The loops that contact the tuning turret are hand soldered to the printed circuit. The careful design of the r-f section means that CW signals of much less than $1\mu\text{v}$ can be received with an output signal-to-noise ratio of 10db.

Double Superheterodyne

Because the high-frequency oscillator is well protected from drafts and power supply heat, the warm-up drift is entirely over in about one hour, and drift is hardly noticeably after the first half-hour. For example, at 30Mc, the total drift of the receiver from cold start to steady state was observed to be about 6kc. Most of this drift occurred in the first few minutes of operation, and was caused by the heating up of the oscillator tube.

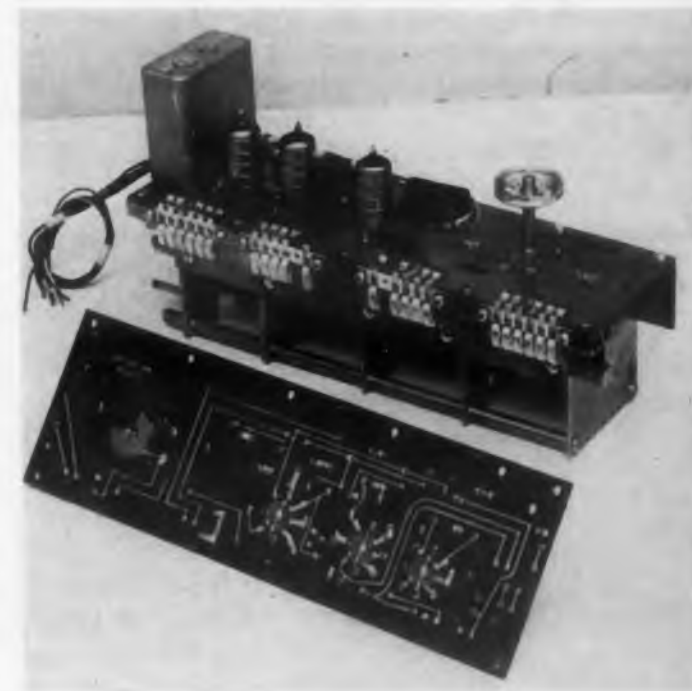
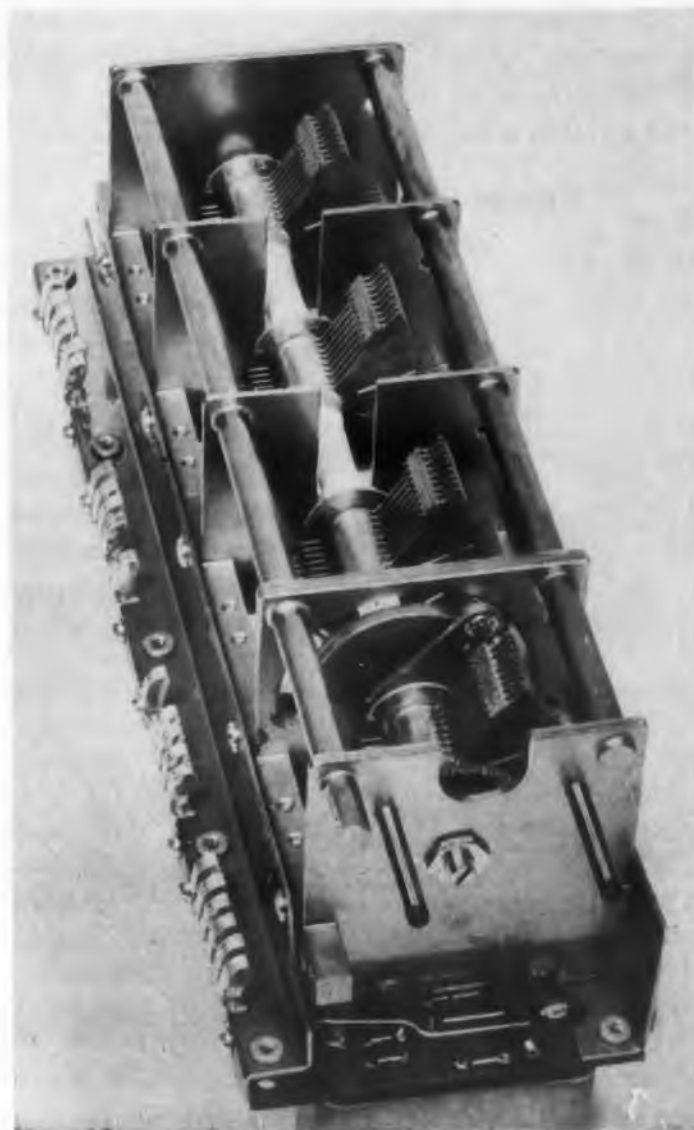
To further achieve oscillator stability, the plate voltage is regulated and the oscillator tube connections are picked off from a low impedance link and a tap on the resonant circuit. Tube aging effects are

reduced. The connections are so proportioned that a $1\mu\text{mfd}$ change of grid-to-cathode capacitance corresponds to about $1/4\mu\text{mfd}$ change across the entire resonant circuit. A 10% change in line voltage shifts the oscillator frequency less than 0.003% anywhere within the receiver range.

This receiver incorporates a double superheterodyne design. The selectivity of the three-mesh h-f i-f filter eliminates its own images well below the noise level of the receiver. The second conversion oscillator is crystal controlled and its frequency is accurate within 0.005% of the required 1.75Mc. This oscillator is carefully shielded and its leads filtered so that normally none of its harmonics can be picked up by the receiver's r-f stages.

The S-meter does not have an internal light. The light was not included so that the meter assembly could be sealed against dust and not to economize.

The techniques for producing communications receivers of astounding sensitivity and selectivity have been known for years. If price were no consideration, such receivers could be produced. Within the limitations of a reasonable price, the designers of the Pro-310 have created an outstanding receiver that should give many years of pleasure to its operators.



Both sides of the printed circuit board used in the r-f stage. The small antenna trimming capacitor is mounted on the board without the usual supporting framework. Notice how the top foiled area is broken up to prevent warping of the laminate during dip soldering. The loops along the edge of the assembly make contact with the tuning turret.

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**NEW G-E AIRCRAFT MOTOR MET THESE
AIRCRAFT RADIO CORP. SPECS:**

- 1 oz-in. output at 120 rpm: 28 volts input
- Minimum brake life: 150 hr at 40,000 ft, 50 hr at sea level
- Brake must stop motor within 45 degree rotation of output gear
- Weight, not over 0.94 lb
- Continuous duty cycle

A. W. Parkes, Jr., Vice President, Aircraft Radio Corporation says —

“New G-E aircraft motor designed for us stands terrific shock, extreme temperatures”

“We recently went to General Electric for a top-grade aircraft motor for remote tuning of an aircraft radio receiver we were designing,” Mr. Parkes goes on to say. “G.E. came up with a motor that operates dependably and smoothly at temperatures ranging from -50C to +70C. At the same time, of course, the motor stands up under humidity, vibration, and the shock accompanying aircraft operation under both normal and combat conditions.

“In dealing with G.E., we especially like the teamwork possible between G-E sales and application engineers and our engineers. G-E sales and application engineers worked right in our plant and Aircraft Radio

Corporation engineers went to the G-E plant to take advantage of extensive environmental testing equipment there. We're sold on the value of such application help.”

TO SERVE YOU, General Electric offers application engineering experience like that provided the Aircraft Radio Corporation—experience gained through years of helping solve difficult aircraft and armament problems. Contact your local G-E Apparatus Sales Office early in your planning. For more information, write today to Section 704-53, General Electric Company, Schenectady 5, N. Y.

Progress Is Our Most Important Product

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Pressure Sensitive Tapes For Masking Purposes

Die-cut pressure sensitive tapes have been developed to precisely mask out unusual shapes or to protect holes and apertures during manufacturing operations. These handy masks assure sharpline masking during painting, plating, buffing, polishing, stenciling, and sand-blasting. Die-cut masks are supplied in rolls and are mounted on a quick-release paper backing for fast application. Printed Cellophane Tape Co., Dept. ED, 521 N. LaBrea Ave., Los Angeles 36, Calif.

CIRCLE ED-60 ON READER-SERVICE CARD

Paste Solder Powder Mixed in Flux

Redi-Mix is a mixture of fine powdered solder in exactly the right proportions with an active flux. The product is a creamy paste that spreads on easily to any area to be bonded. It is in a plastic “squeeze” bottle.

Cleaning action and wetting ability of the highly active flux prepares the entire metal surface for fusion, resulting in a strong, clean, and permanent bond when heat is applied. This bond is equal in strength to a solder joint made with conventional solder and flux. Anchor Metal Co., Dept. ED, 244 Boerum St., Brooklyn 6, N. Y.

CIRCLE ED-61 ON READER-SERVICE CARD

Expoxide Impregnant For Use at 200°C

A new class II impregnant for transformers, coils, and electronic components is a solvent-free epoxide base material designated Ecco W 28 G. It is suitable for continuous use at 200°C. It is extremely simple to use; no catalyst is required. A filler designated A-21 is also supplied so that Ecco W 28 G can be used simultaneously as an impregnant and embedment compound. Volume resistivity at 25°C is 2.3×10^{16} ohm-cm³; dielectric strength at 25°C is 412v/mil. Emerson & Cuming, Inc., Dept. ED, 869 Washington St., Canton, Mass.

CIRCLE ED-62 ON READER-SERVICE CARD

◀ CIRCLE ED-63 ON READER-SERVICE CARD

P-N-P Junction Transistor For High-Temperature Applications

The type 2N82 is a p-n-p junction germanium transistor designed for high-temperature amplifier applications.

It is hermetically-sealed in a small-size, metal case to provide protection against surface contamination, light excitation, and humidity. Collector dissipation at 71°C is 35mv. At V_c of -6v and I_c of -1ma, current gain may be 20 to 60. CBS-Hytron, Div. of Columbia Broadcasting System, Inc., Dept. ED, Danvers, Mass.

CIRCLE ED-64 ON READER-SERVICE CARD

Vinyl Glass Sleeving Organic and Silicone Resins

BH Vinyl-Sil 8000 is an improved vinyl glass insulation having increased electrical insulating properties. It has a minimum individual dielectric breakdown of 8000v exceeding NEMA Grade B-A-1.

By adding the high heat and moisture-resisting properties of silicone to vinyl-glass sleeving the product has much stronger dielectric and physical properties. Bentley, Harris Mfg. Co., Dept. ED, Conshohocken, Pa.

CIRCLE ED-65 ON READER-SERVICE CARD

Tape Resistors For Experimental Layouts

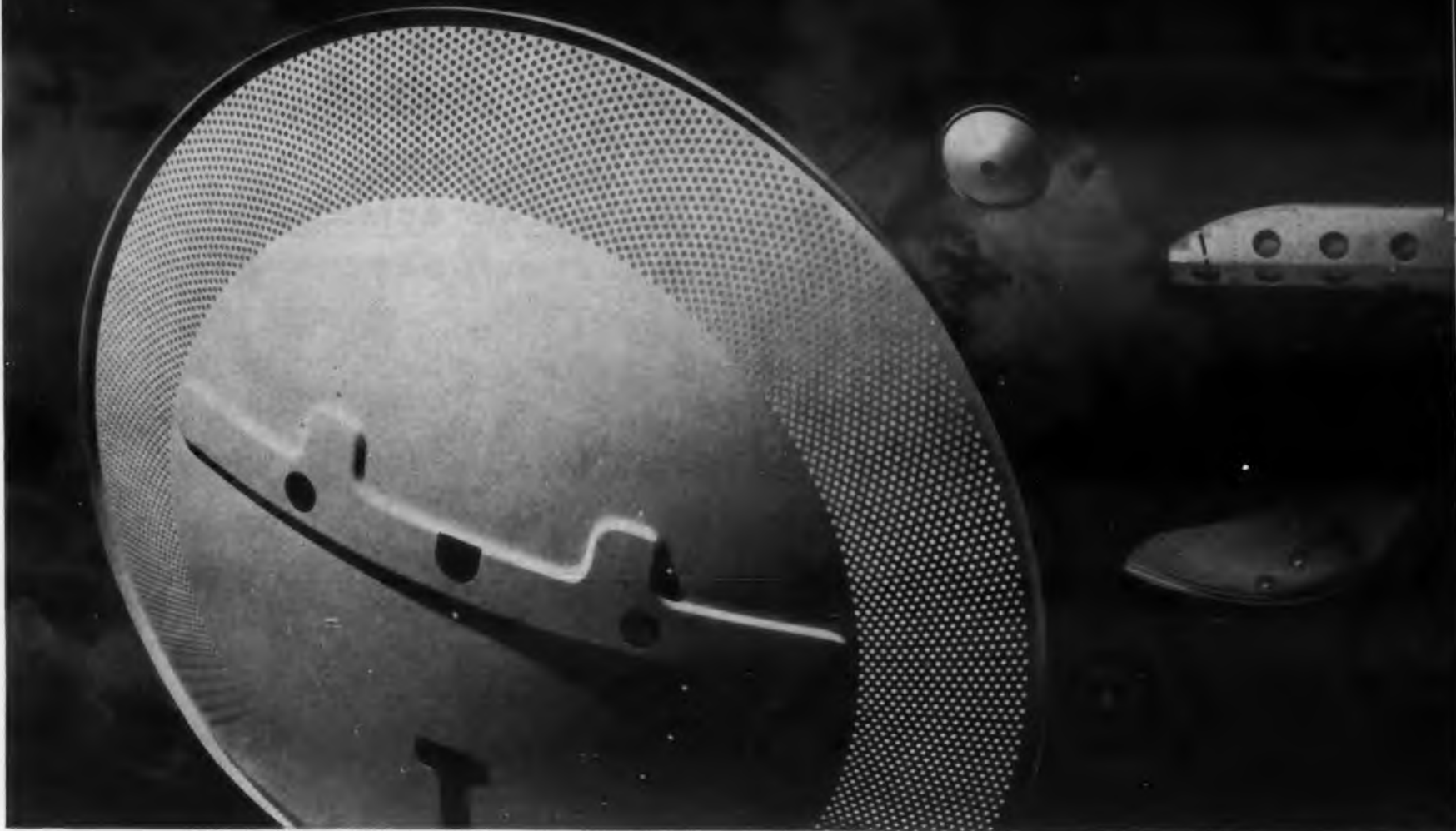
Type RTW Tape Resistors are designed for experimental work in building prototype assemblies of modular design. The tape can be applied directly on the wafer.

The type RTW Resistor is 1/2" long by 0.110" to 0.150" maximum width and is available in resistances from 39 ohms to 4.7 megohms. Temperature coefficient is within characteristic F of Specification MIL-R-11A. Type RNP precured tape resistors for other than ceramic baseplates have an overall length of 1.3", with 0.4" leads and are available in resistances from 100 ohms to 1 megohm, with a tolerance of $\pm 5\%$ and $\pm 10\%$. Hansen Electronics Co., Dept. ED, 7117 Santa Monica Blvd., Los Angeles 46, Calif.

CIRCLE ED-66 ON READER-SERVICE CARD

CIRCLE ED-67 ON READER-SERVICE CARD >

magnesium



ELECTRONIC EYES ON THE MOVE

...made of magnesium



Now is the time to get complete details about Dow magnesium—

- ★ It's *light in weight*, actually the lightest of all structural metals.
- ★ It has *high strength and rigidity* which permits simplifying your design for even further weight reduction.
- ★ *Excellent weldability and formability* are just two of the many plus values in fabricating magnesium.

From design to production is a long trip—take the first step with the *right metal!* Investigate magnesium. Complete engineering and fabricating facilities are available at Dow's Bay City Division as well as from other fabricators located throughout the country. THE DOW CHEMICAL COMPANY, Magnesium Sales Department MA 307E, Midland, Michigan.

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DOW

Soldering Gun

Heavy-Duty Electronic Unit



This heavy-duty electronic soldering gun, the "Quick Hot" Model 250, is hot and ready to do a soldering or plastic cutting job three seconds after pressing the trigger. Because the tip is actually part of the electronic ele-

ment, it produces heat instantly and in large volume.

The gun can solder relatively heavy materials and handle production jobs, as well as intermittent soldering. The tip is so designed that with normal action it will remain tinned indefinitely, and burning and corrosion is materially retarded. The tip can be replaced with only a one-quarter turn of the compression nut.

The case is molded plastic, available in red, black, and green. The unit operates on 120v 60cy. Wen Products, Inc., Dept. ED, 5806 Northwest Highway, Chicago, Ill.

CIRCLE ED-68 ON READER'S SERVICE CARD FOR MORE DATA

Binding Post

With OD of Only 1/2"



This Multi-Purpose Binding Post has an OD of only 1/2", permitting ease in mounting

on 3/4" centers, or less if desired. The post can be mounted on panels up to 3/16" thick. It is designed for attractive appearance and small size without sacrifice in utility. It is offered in red and black models.

Metal parts are brass, cadmium plated 0.0003" to 0.0005" thick to withstand 50hr minimum salt-spray exposure. Insulation of the binding post is molded thermosetting phenolic in accordance with MIL-P-14, type CFG; this will withstand 295°F without distortion.

Hex studs are recessed into a hex nest in the phenolic insulator to prevent turning. The 3/32" crosshole of the stud is flush with the base to minimize crimping or cutting of the inserted wire lead. The back-of-panel stud is equipped with two hex nuts and a solder terminal to permit either a connection with a wire lead between the two nuts or a soldered connection. Grayhill, Dept. ED, 561 Hillgrove Ave., LaGrange, Ill.

CIRCLE ED-69 ON READER'S SERVICE CARD FOR MORE DATA

Doelcam
Master-precision
Servo Motors

SIZE 11,
1.062" O.D.

SIZE 15,
1.437" O.D.

SIZE 15, 1.437" O.D.

SIZE 18, 1.75" O.D.

SIZE 18, 1.75" O.D.

Labels on motors include: SERVO MOTOR MARK 7 MOD 0, SERVO MOTOR MARK 7 MOD 1, SERVO MOTOR MARK 7 MOD 2, SERVO MOTOR MARK 8 MOD 0, SERVO MOTOR MARK 8 MOD 1, SERVO MOTOR MARK 8 MOD 2, SERVO MOTOR MARK 16 MOD 0, SERVO MOTOR MARK 16 MOD 1, SERVO MOTOR MARK 16 MOD 2, MOTOR TACHOMETER MARK 12 MOD 0, MOTOR TACHOMETER MARK 12 MOD 1, MOTOR TACHOMETER MARK 12 MOD 2, MOTOR TACHOMETER TYPE 3170A, MOTOR TACHOMETER TYPE 3170B.

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

DOORS OF TOMORROW...

Doelcam Master-precision Synchros

SIZE 11,
1.062" O.D.

SIZE 15,
1.437" O.D.

SIZE 23, 2.25" O.D.

SIZE 31, 3.10" O.D.

DOELCAM Master-precision Synchros and Servo Motors are *proven* components. Many thousands have been delivered on Prime Government Contracts for use in computers, automatic pilots, airborne radar and missile guidance systems. Whether your application involves servomechanisms for industrial control or military weapons systems, DOELCAM Synchros and Servo Motors are among those vital components that are . . . helping to open the doors of tomorrow.

DOELCAM SYNCHROS are precision-built electromagnetic devices for electrically transmitting angular position information to remote locations. Available in:

Size 11-115v, 400 cps-11CX4a, 11CT4a
Size 15-115v, 400 cps-15CX4a, 15CDX4a, 15CT4a, 15TDX4a & 15TR4a
Size 16-115v, 400 cps-16CXB4a & 16CTB4a
Size 18-115v, 60 cps-18CT6 & 18CT6a
Size 19-115v, 400 cps-19CXB4a & 19CTB4a
Size 23-115v, 400 cps-23CX4a, 23CDX4a, 23CT4a, 23TX4a, 23TDX4a, 23TR4a, 23TDR4 & 23TDR4a
115v, 60 cps-23CX6, 23CDX6, 23CT6, 23-TX6, 23TDX6, 23TR6, 23TDR6 & 23TDR6a
Size 31-115v, 60 cps-31TX6 & 31TX6a

Write for Bulletin S10

DOELCAM SERVO MOTORS are miniature motors which feature an optimum combination of high torque and low rotor inertia for use in high performance servo systems where fast response is of prime importance. Available in:

Size 11-MK 14-115v, 400 cps-SM142 & SM143
Size 15-MK 7-115v, 400 cps-SM070, SM071, SM072
Size 18-MK 8-115v, 400 cps-SM080, SM081, SM082

Write for Bulletin SM10

DOELCAM MOTOR TACHOMETERS are miniature motor generator combinations which produce mechanical power as well as an electrical output signal in direct proportion to their speed . . . ideal for use in position or velocity servos where the tachometer provides a signal for damping or integration. Available in:

Size 15-MK 12-115v, 400 cps-SM120 & SM121
Size 18-MK 16-115v, 400 cps-SM160 & SM161

Write for Bulletin SMT 10

Doelcam

A DIVISION OF MINNEAPOLIS-HONEYWELL



SOLDIERS FIELD ROAD
BOSTON 35, MASS.

Instruments for Measurement and Control

Synchros • Gyros • Amplifiers • Microsyns • Servo Motors

Rack Cabinet With Controlled Cross Ventilation



"Ventrak" controlled cross-ventilated rack cabinets permit accurate control of quantity, direction, and velocity of air flow over components anywhere in the cabinet. Controlled flow is made possible by "knock-out" construction of the interior walls. Vertical and horizontal rows of square

openings in these walls can be treated in three ways to accomplish the desired cooling objective: they can be closed by flat sheet metal plates to stop flow, allowed to remain open for maximum flow, or equipped with sheet metal scoops to direct the flow. The sheet metal inserts are easily snapped into place, and can be interchanged simply. Quantities of scoops and plugs are supplied with each rack cabinet.

The lower section of the cabinet may be fitted with a filter intake and equipped to receive a blower. Either pressure or suction systems are possible. Air volume is controlled by a damper on each cabinet, and cabinet doors are strip-sealed to prevent leakage. Cabinets intended for group installations are available, upper and lower plenum chambers may be combined with cabinet blowers or with a separate remote exhaust system. "Ventraks" are available in several types to meet requirements. Ventrak Corp., Dept. ED, 11 West 42nd St., New York, N. Y.

CIRCLE ED-71 ON READER'S SERVICE CARD FOR MORE DATA

Line Voltage Stabilizer 3% Accurate, Automatic Unit



The Model LVS-153 Line Voltage Stabilizer automatically maintains output line voltage at 115v \pm 3% over an input voltage range of 95v to 125v. One model, which automatically turns on and off with the television set or appliance, covers a wattage range from 100w to 300w. Output voltage

is free from wave shape distortion and dependency of variations of output with frequency. Crest Laboratories, Inc., Dept. ED, 84-11 Rockaway Beach Blvd., Rockaway Beach 93, N. Y.

CIRCLE ED-72 ON READER'S SERVICE CARD FOR MORE DATA

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

Field Strength Meter

For 100-400Mc Energy



Field Strength Meter II-W509 provides an indication of the relative field strength and approximate frequency (within 5%) of r-f energy emitted by a transmitter within the band of 100 to 400Mc. It is a portable, self-contained unit, with a waterproof, removable cover providing access to a control panel when open.

A six-section telescoping antenna, carried in the cover, plugs into a receptacle on the control panel for use. A 90° joint at the base of the antenna permits it to be extended horizontally or vertically with the case placed either with the control panel in a horizontal or vertical position. The control panel consists essentially of a tuning knob and dial, sensitivity control, meter, and antenna receptacle. Harvey-Wells Electronics, Inc., Dept. ED, Southbridge, Mass.

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

R-F Attenuator

For Remote-Control Uses



A new remote-control adaptation of its standard r-f attenuator has been made available by this firm. The unit, Series 544, is cam operated and solenoid driven. Its salient feature is a special arm which permits remote selection of any of the following cam operated positions on the r-f attenuator:

first position and second position, entirely out of circuit; first attenuation position in the circuit, and second attenuation position out of the circuit; both attenuation positions in the circuit. This cycle can be repeated indefinitely.

The unit features all of the characteristics of the standard attenuator. It is flat from d-c to 225Mc and maintains a resistance accuracy to $\pm 2\%$. Power rating is 0.25w. It operates on 115v d-c and measures 5-3/8" x 5-1/2" x 2-3/8" wide. Although shown with 3 steps, variations can be provided with up to 5 steps plus zero attenuation. A maximum of 20db per step can be supplied. Daven Co., Dept. RH, 191 Central Ave., Newark, N. J.

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



DATA FOR I



NEW TRIODE-PENTODE FOR VARIETY OF TV RECEIVER APPLICATIONS

RCA-6AZ8 . . . general-purpose, 9-pin miniature type containing a medium- μ triode and semiremote-cutoff pentode in one envelope. Triode section is useful in low-frequency oscillator, sync-separator, sync-clipper, and phase splitter circuits. Pentode section which features high trans-conductance, and semiremote-cutoff characteristics to minimize cross-modulation effects and overload distortion in picture-if stages, may be used as an if, video, or agc amplifier, and as a reactance tube.

For technical information on all products shown here call your RCA Representative:

EAST.....HUmboldt 5-3900
744 Broad St.
Newark 1, N. J.

MIDWEST...WHitehall 4-2900
Suite 1181,
Merchandise Mart Plaza
Chicago 54, Ill.

WEST.....MAdison 9-3671
420 S. San Pedro St.
Los Angeles 13, Calif.

Or write RCA, Commercial Engineering,
Section F-18-R, Harrison, N. J. using this
coupon. Circle types you are interested in.

2N77 2N109 5604-A 6521 6655
2N104 3B2 6AZ8 6570 6694
2N105 5AYP4

Name _____

Position _____

Company _____

Address _____



NEW POWER TRIODE FOR INDUSTRIAL HEATING AND GENERAL COMMUNICATION SERVICES

RCA-5604-A . . . a forced-air-cooled power triode with improved heat-radiation design that reduces forced-air requirements. Well suited to "on-off" industrial operations. Features include: single-phase, multi-strand tungsten filament; sturdy Kovar anode, grid, and filament seals; heavy-wall copper anode. RCA-5604-A has a plate dissipation rating of 10 kw—can be operated with full ratings at frequencies as high as 25 Mc. When operated in unmodulated class C service at a plate voltage of 12 kv, a single 5604-A can deliver 22.5 kw approx.

VACUUM PHOTOTUBE FOR INDUSTRIAL SERVICE EQUIPMENT

RCA-6570 . . . especially useful in industrial applications critical as to microphonics and sensitivity gradient. Features high sensitivity to red and near-infrared radiant energy and is, therefore, suitable for use with an incandescent light source. Has maximum anode-supply voltage rating of 500 volts; maximum average cathode-current rating of 5 μ amperes; and average luminous sensitivity-30 μ amperes per lumen.



NEW VIEW-FINDER KINESCOPE FOR PORTABLE TV CAMERAS

RCA-5AYP4 . . . electrostatically focused and magnetically deflected, this 5-inch cathode-ray tube offers high resolution and good uniformity over the entire picture area. It has a high-efficiency, aluminumized white fluorescent screen which eliminates need for an ion-trap magnet and improves contrast and brightness.

ELECTRON TUBES — SEMICONDUCTOR DEVICES — BATTERIES —
TEST EQUIPMENT — ELECTRONIC COMPONENTS

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

ELECTRONIC DESIGN • June 1955

R DESIGNERS



NEW MULTIPLIER PHOTOTUBE FOR GAMMA-RAY SPECTROSCOPY AND SCINTILLATION COUNTERS

RCA-6655 . . . a 10-stage, flat-face, head-on type with 1-11/16" diameter cathode; focusing electrode for optimizing magnitude, uniformity, or speed of response; 3000 to 6500 angstroms spectral-response range (max. at approx. 4400); cathode luminous sensitivity of 50 μ amp/lumen; short pulse resolving time at relatively low supply voltage of 1000 volts; and sturdy structure to withstand the rigors of field use.



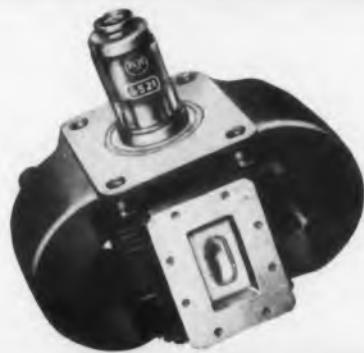
NEW PHOTOCONDUCTIVE CELL FOR LIGHT-CONTROLLED RELAYS, COMPUTERS, AND LIGHT METERS

RCA-6694 . . . very tiny, cadmium-sulfide, head-on type featuring high luminous sensitivity, very low dark current, extremely low background noise, and signal output directly proportional to incident light intensity. Characteristics not substantially affected by wide temperature changes. Spectral response covers range from 3500 to 5500 angstroms with peak at about 5000. Luminous intensity sensitivity is 3 μ amp/ft-c at 90 volts.



NEW HALF-WAVE VACUUM RECTIFIER FOR PULSED-RECTIFIER SERVICE

RCA-3B2 . . . a glass-octal, high-voltage rectifier of the heater-cathode type for use in the scanning systems of modern black-and-white and color-TV receivers. Rated at a maximum peak inverse plate voltage of 35,000 volts (absolute), maximum peak plate current of 80 ma., and maximum average plate current of 1.1 ma.

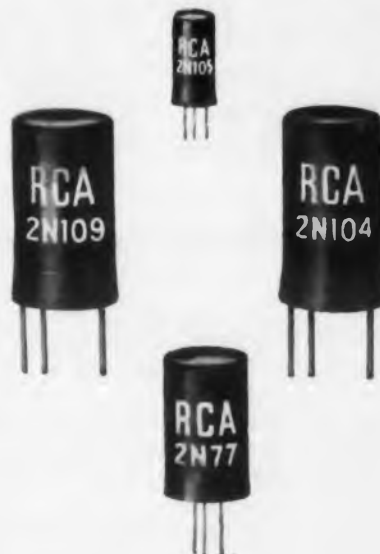


NEW "C" BAND MAGNETRON FOR AIRCRAFT WEATHER RADAR

RCA-6521 . . . for service as pulsed oscillator at fixed frequency of 5400 \pm 20 megacycles. It is designed and conservatively rated to insure long, reliable performance. Operates with high efficiency at pulse durations up to 2.2. microseconds. Has peak input power rating of 25.6 kw, peak anode voltage rating of 16 kv, and peak anode current rating of 10 to 16 μ amperes. Peak power outputs up to about 100 kw may be obtained.

FOUR NEW ALLOY-JUNCTION TRANSISTORS

Hermetically sealed, germanium, p-n-p types offering extreme stability and uniformity of characteristics—initially and during life. RCA-2N104 for low-power, audio-frequency applications; RCA-2N109 for large-signal applications, such as class B audio service; RCA-2N77 and -2N105 for hearing-aids.



New RCA Transistors shown twice actual size



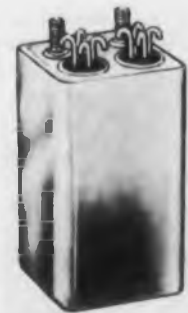
RCA RADIO CORPORATION of AMERICA
TUBE DIVISION

HARRISON, N. J.

Relays

Sensitive Miniature Types

These miniature sensitive relays, Series 100, 105, and 106, are suited to both commercial and military applications where single-pole or double-pole sensitive relays must meet the rigid requirements of space, shock, temperature, and vibration. They are hermetically sealed, with terminals for solder connections.



Standard operating power for dpdt is 75mw for Series 100 and 45mw for Series 105 and 106. Other contact arrangement and conditions may permit lower operating power. Units have 10g vibration immunity in accordance with MIL-R-5757B. Silver contacts are rated 2amp, 28v d-c resistive. Life is over 100,000 operations at rated resistive load.

The double-coil magnetic circuit is a high efficiency type with windings up to 8000 ohms and 1w maximum dissipation. Size is (approx) 2" overall length x 1" square. Signal Engineering & Mfg. Co., Dept. ED, Long Branch, N. J.

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

Power Supply

Serves as Computer Reference

The "Computer Reference Power Supply", for use with analog computers, provides two output voltages of ± 100 v and a current of 2amp on each output. The significant advantage of this power supply is that both outputs are maintained within $\pm 0.02\%$ of their absolute voltage value, and both outputs are inter-referenced to $\pm 0.01\%$.

The long-time stability of the unit is in excess of 100 parts per million, and the short time stability in excess of 50 parts per million. Output ripple and noise are less than 1mv; output impedance for d-c is less than 0.01 ohm

and for a-c to 200ke it is less than 0.5 ohm. The line regulation factor for $\pm 10\%$ change is $\pm 0.01\%$. Kay Lab, Dept. ED, 5725 Kearny Villa Rd., San Diego, Calif.

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

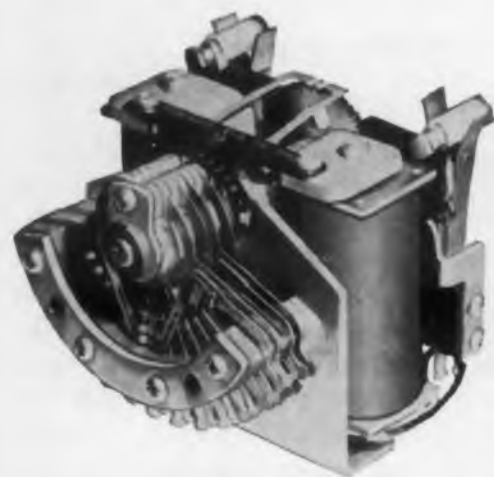
CIRCLE ED-75 ON READER-SERVICE CARD FOR MORE INFORMATION

SIMPLE OR COMPLEX DESIGN



Series PS—Heavy Duty Power—Low Cost—High Quality AC or DC Relay.

Sterling
has the answer



Series SS—Bi-Directional Stepping Switch—Direct Current Actuated.

Sterling Engineering is daily designing and producing products from *Simple Single Spring* relays to *Complex Multi-Spring Bi-Directional Stepping Switches*.

The PS Series of relays—one of the many built to the high quality standards of all Sterling products is priced lower than competitive relays and are in stock for immediate shipment.

The Series PS heavy duty power relay, is small in overall dimensions, only 1 5/8" x 1 3/8" x 1 1/2" high, yet has a contact capacity up to 20 amperes. Available in any operating voltage to 230 AC or 220 DC.

Type SS Bi-Directional Stepping Switch is a new conception in magnetically actuated devices. The output shaft may be operated in either direction to drive the wipers or as a Stepping motor to drive potentiometers, servo mechanisms or other control devices. In computer applications it is a converter from digital to analog or vice versa.

The contact banks can easily be removed from the driving unit without disturbing the switch adjustments, thus making easy bench wiring or field service.

Type SS can be equipped with up to 4 switch banks, each with up to 12 positions and each set of contacts will carry up to 3 amps.

Write:
Sterling Engineering Co., or
Potter & Brumfield Mfg. Co.,
Princeton, Indiana



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

Dielectric Potentiometers

Introduce No Phase Shift



The Type PD-2 Dielectric Potentiometer is a variable voltage divider free of phase and frequency distortion over the wide range of 20cy

to 10Mc. The output voltage thus has the identical waveform of the input voltage. Consequently, this device should be valuable as a calibrated attenuator in wideband oscilloscopes, transmission measuring sets, amplifiers, signal generators, network analysis systems, and waveform comparison or balancing schemes.

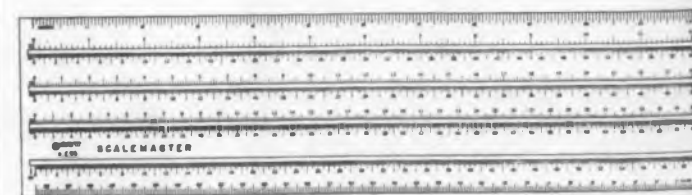
In effect, the unit is a three-terminal network. The effective resistance-capacitance shunt and series elements of this network result from the inherent resistivity and dielectric constant of a lossy liquid dielectric immersing the terminal electrode structures. The output electrode is mechanically mobile with respect to the input electrode. Since the resistance and capacitance components vary in exactly inverse manner with movement of the output electrode, a precisely constant RC product is maintained in each of the ratio arms.

The stepless movement through the liquid dielectric provides a smoothly continuous voltage division. The constant RC product of the two ratio arms assures the same voltage division for all frequencies within the band range of the device. Similarly, there is no shift of phase. Attenuation range is approximately 25db. Input impedances over a wide range can be provided. Technology Instrument Corp., Dept. ED, Acton, Mass.

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

Plastic Scale

Embodies Nine Scales



This drawing aid is a transparent plastic "Engineering Scalemaster". It permits use of a flat scale (instead of a triangular rule) embodying many multiple scales, yet exposing all of them at one time.

Convenient slotted apertures enable the user to scale a drawing with a minimum of trouble. There are nine full divided scales on the one instrument. The C-Thru Ruler Co., Dept. ED, 827 Windsor St., Hartford, Conn.

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

ELECTRONIC DESIGN • June 1955

Decade Capacitor

Gives Straight-Line Readout



The "Capacitance Dekabox", Model DC-40, is a compact, highly stable, multi-state capacitance decade instrument designed for convenient laboratory use.

Four decade step switches provide coverage of the range between 0 to 1mfd in 10,000 incremental steps of 0.0001mfd each. Accuracy of the capacitors is maintained to within $\pm 1\%$. All capacitance readouts are made in a straight line on the dual deck of dials. Tenths, hundredths, thousandths, and ten-thousandths of microfarads are each selected with separate dials.

Accurate capacitance selection is assured through the use of precision components, "Dry-Filmed" ceramic switches having solid silver alloy contacts, and firm positioning switch detents. The unit is assembled in a unique adjustable base mount which provides for setting the dial face at any angle for maximum readability. All components are enclosed in a metal case which affords complete shielding for the instrument. Electro-Measurements, Inc., Dept. ED, 4312 E. Stark St., Portland 15, Ore.

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

Polystyrene Capacitor

With Extreme Insulation Resistance



This polystyrene capacitor of extremely high insulation resistance is designed for use as a charge storage capacitor and as a capacitance divider.

A high-insulation resistance plastic tube is used for the case. The capacitor, except for its studs and aluminum foil winding, is completely plastic. The case itself has much higher insulation resistance than either glass or metal, the usual capacitor case materials. Thus, surface leakage is kept to a minimum.

Insulation resistance at room temperature is 30,000,000 megohms x mfd at 400v d-c. At 75°C, the insulation resistance is 1,000,000 megohms x mfd at 400v d-c. These resistance values are measured by the time-decay-of-voltage method. The plastic case has the added advantage of being only slightly affected by humidity conditions. Condenser Products Co., Div. of New Haven Clock and Watch Co., Dept. ED, 140 Hamilton St., New Haven, Conn.

CIRCLE ED-82 ON READER-SERVICE CARD FOR MORE INFORMATION
ELECTRONIC DESIGN • June 1955



NEW TEST KIT of GLOBAR® Type BNR VARISTORS for design and application work

Quantity	Cat. No.	R @ Calibration Voltage	Load Watts
6	432	100000 @ 10 volts	0.25
6	479	100000 @ 100 volts	0.3
6	328	10000 @ 40 volts	0.5
6	463	24000 @ 40 volts	1.0
6	524	24000 @ 100 volts	1.5
6	430	17500 @ 175 volts	2.7

KIT No. 3 Type BNR VARISTORS PRICE \$20.00 to evaluate use of GLOBAR® Type BNR Varistors for

- Reduction of surge voltage peaks from 50% to 90%.
- Reduction of contact arcing time up to 95%.
- Reduction of R. F. radiation.
- Stabilizing amplifier gain.
- Stabilizing speed and voltage.
- Stabilizing of rectifier circuits by limiting peak voltages.

**ORDER
YOUR KITS
NOW...**

use this Handy Coupon

GLOBAR Division
THE CARBORUNDUM COMPANY
Dept. ED 87-56, Niagara Falls, New York

Please ship kits as follows:

_____ **No. 1** _____ **No. 2**
(Quantity) (Quantity)

_____ **No. 3** _____ **No. 4**
(Quantity) (Quantity)

Check enclosed (to which we have added applicable local tax)

Please invoice us.

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

Please send FREE engineering bulletin on Kit No. _____

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

OTHER TEST KITS

of GLOBAR® Ceramic Varistors and Thermistors now available to help you solve your circuitry problems include:

KIT No. 1 PRICE \$29.25 Type F THERMISTORS

- To evaluate series filament circuit application in radio and television receivers.

Quantity	Cat. No.	R @ 25°C	R @ Rated Current	B Constant	Load Watts
6	763	15		1500	0.5
6	441	880	100 ohms @ 150 ma	1900	2.7
6	341	375	40 ohms @ 300 ma	1950	3.6
6	525	250	20 ohms @ 600 ma	1900	7.2
6	327	460	35 ohms @ 600 ma	1900	12.6
6	421	125	43 ohms @ 600 ma	1100	16.5

KIT No. 2 PRICE \$24.50 Type H THERMISTORS

- To evaluate time delays in relay and solenoid circuits; temperature compensation in field coils and meters.

Quantity	Cat. No.	R @ 25°C	B Constant	Load Watts
6	416	1200	3200	0.7
6	479	1000	3800	1.85
6	373	10	2700	3.0
6	343	20	2700	3.0
6	549	5000	3200	1.5
6	588	11000	3200	2.0

KIT No. 4 PRICE \$18.25 Type F, Type BNR VARISTORS and THERMISTORS

- To evaluate stabilizing rectifier circuits by limiting peak voltages.

Quantity	Type BNR Cat. No.	R @ Calibration Voltage	Load Watts	
6	432	25000 @ 10 volts	0.25	
6	432	100000 @ 10 volts	0.25	
6	432	200000 @ 10 volts	0.25	
Type F Cat. No.		R @ 25°C	B Constant	Load Watts
6	763	15	1500	0.50
6	763	120	1750	0.50
6	763	330000	2150	0.50

EACH KIT CONTAINS 36 resistors — 6 of each specified type, packaged in attractive transparent plastic boxes, plus an engineering bulletin. Kits will be shipped postpaid to any point in the United States and Canada. All resistance values specified carry standard production tolerance.

87-56

Hydro-Carbon Lubricant Cleans and Lubricates

Specially formulated for the electronic and electro-mechanical industries, "Contact" is a new colloidal solution with a hydro-carbon carrier base. The super-capillary action of this product forces it into inaccessible places where it instantly cleans and deposits a coating of "duralube"—a hard-bonded dry lubricant which resists corrosives, heat and cold.

The lubricant leaves no gummy deposit and does not effect resistance, capacitance, or inductance. It has been tested and approved for use in the most critical u-h-f and r-f circuits. It does not build up dirt are layers. Beaver Laboratories, Inc., Dept. ED, 86-51 Palo Alto Ave., Hollis 23, N. Y.

CIRCLE ED-84 ON READER-SERVICE CARD

Resistance Elements Precise from -200°C to 550°C

Improved platinum-wound resistance spirals are available for precise temperature measurements over the range -200°C to 550°C . These standard spirals have a guaranteed accuracy of $\pm 1^{\circ}\text{C}$.

A special high temperature resistance element encased in an appropriate ceramic envelope is available for measuring temperatures up to 750°C . Charles Engelhard, Inc., Dept. ED 850 Passaic Ave., E. Newark, N. J.

CIRCLE ED-85 ON READER-SERVICE CARD

Resin Kit For Casting and Potting

Kits of casting and potting resins are available for experimental work including: clear potting resin, black general purpose casting and potting resin, flexible mold material for making molds suitable for casting plastics, dip insulating and coating plastic for forming a tough resilient rubbery film, putty-like plastic which upon the application of heat cures to form a tough rubbery material, necessary promoter and catalyst. Plastronics, Dept. ED, P. O. Box 96, Winter Hill 45, Mass.

CIRCLE ED-86 ON READER-SERVICE CARD

CIRCLE ED-87 ON READER-SERVICE CARD >

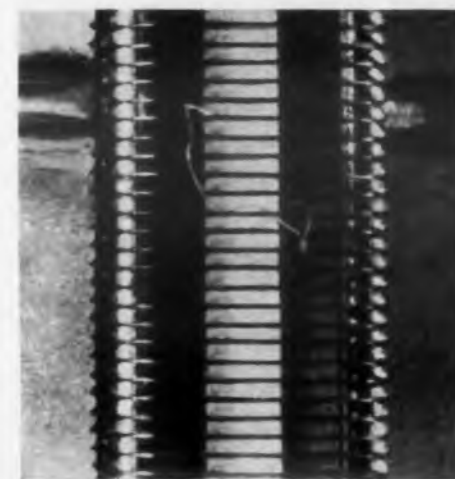


SEPARATE LARGE G-E FACTORY BUILDING at Owensboro, Ky., is devoted to the production of 5-Star miniature and subminiature tubes for military, communications, and industrial uses. Dust control and air-conditioning during assembly and inspection help to assure G-E 5-Star Tube reliability.



AIR-LOCKS AT ALL DOORS. Employees and other persons entering, pass through air-locks, with a grating underfoot through which powerful suction removes any loose dirt from their shoes. All outer garments, lunches, and personal articles are left outside, in a separate cloak-room. Traffic is closely controlled, and those permitted to enter must wear lint-free clothing. Incoming mail is left in the air-locks, for pick-up and delivery later on by employees who work inside the "Snow White" area.

AT G.E., FURTHER



LINT CAUSES GRID SHORT. This untouched photograph of a tube grid magnified some 40 times, shows a stray particle of lint which can easily cause an inter-electrode short-circuit. Dust often causes a similar conductive path to form between closely-spaced tube elements.

LINT, DUST ARE SEALED OFF FROM 5-STAR PARTS. G-E tube grids are given a special cleaning, and then are rinsed, dried, inspected, and sorted. Afterwards G-E employees enclose them in treated paper bags, and fold and staple the ends of the bags so no lint or dust can enter.



"OPERATION SNOW WHITE" INCREASES TUBE RELIABILITY

5-Star Tube inoperatives are greatly reduced by ridding assembly and inspection areas of lint and dust!

Optimum cleanliness during manufacture has resulted in a two-thirds drop in G-E 5-Star Tube inoperatives—mainly caused by intermittent short-circuits from lint. 100% factory tests prove this gain in dependability.

G-E "Operation Snow White" shields the work of 750 skilled employees from lint, dust, and dirt; involves the operations of a whole tube factory; helps assure the reliability of 5-Star types—both miniatures and subminia-

tures—in many million critical military, communications, and industrial tube sockets.

The extensive and important story is told briefly in the pictures and text on these pages. Ask for additional 5-Star Tubes information!

Learn why G-E 5-Star Tubes—specially designed, built, and performance-tested—are the most dependable tubes you can specify and install! *Tube Department, General Electric Company, Schenectady 5, New York.*



WHITE LINT-FREE UNIFORMS of Nylon and Dacron are worn by the 750 selected, trained employees who assemble and inspect G-E 5-Star Tubes. The entire working area, a part of which is shown above, is pressurized to keep out dust, with air that first has been thoroughly filtered, then dehumidified, and cooled.



ASSEMBLY, INSPECTION UNDER GLASS. G-E 5-Star Tube assembly and microscope inspection are carried out under special protective hoods that are glass-paneled for work observation. Employees wear rubber finger cots—changed every hour—to avoid contaminating the tube parts with any dirt or moisture.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

162-183

High-Purity Graphite In Larger Sizes

A new process permits the purification of graphite in diameters up to 2-3/4", and up to 43" in length, to almost the levels of purity previously achieved only in small-diameter, high-purity, spectrographic rods.

The four new high-purity grades, which have improved machining characteristics, all have a total ash content of 0.003% or less. Purification is carried out as a separate process on completely finished items to eliminate all possible contamination from machining or excessive handling. Several grades have found use in purifying germanium. They may also be used as anodes. Stackpole Carbon Co., Dept. ED, St. Marys, Pa.

CIRCLE ED-88 ON READER-SERVICE CARD

Illumination Kit For Inspection Purposes

Powered by flashlight batteries, the Syte-Ayde provides 4 light transmitting rods to illuminate out-of-the-way places. Two are straight, 3-1/2" and 6" long and two, of the same lengths are bent 90°.

Three 1-1/2 power mirrors, 1/2", 3/4", and 1-1/4" in diameter are supplied with clips which fit rod ends. All parts are contained in separate compartments of a plastic kit. General Scientific Equipment Co., Dept. ED, 2700 W. Huntingdon St., Philadelphia 32, Pa.

CIRCLE ED-89 ON READER-SERVICE CARD

Ground Seal Tungsten Rod Completely Inspected

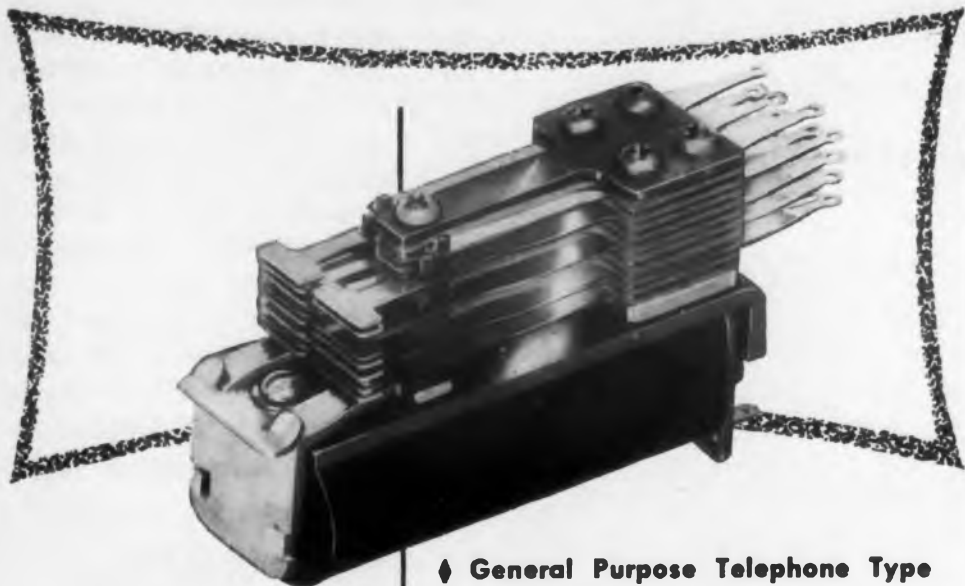
Ground Seal Tungsten Rod is 100% microscopically inspected for defects to insure that when the rod is used in production, there will be no splits, cracks, or other flaws to cause costly rejects.

This ground seal tungsten, used for precision leads in electronic tubes, has many other applications. Electronic Parts Manufacturing Co., Inc., Dept. ED, 508-10 25th St., Union City, N. J.

CIRCLE ED-90 ON READER-SERVICE CARD

← CIRCLE ED-87 ON READER-SERVICE CARD

Kellogg provides custom assembled relays for industry



SPECIFICATIONS

- COIL**—Single or double wound.
ARMATURE—Frictionless armature travel. Both knife edge and hinged pivots.
OPERATING VOLTAGE—Up to 115 volts, D.C.
OPERATING TIME—From 2 to 30 milliseconds.
RELEASE TIME—From 5 to 50 milliseconds.
RESIDUAL—Fixed (clip) or adjustable (lock screw).
CONTACTS—Twin bar-dome type palladium contacts.
CONTACT ASSEMBLY—Forms A to D. Maximum of 16 A's, 14 B's, 10 C's, 10 D's or any equivalent combination of these contacts.
MOUNTING—Two No. 8-32 tapped holes in heelpiece allow versatile mounting.



A famous name in communications
now solving problems
in the control industry

- ◆ General Purpose Telephone Type
- ◆ At Stock Prices
- ◆ Life Expectancy—
Over 100 Million Operations
- ◆ 1710 Contact Spring Combinations
- ◆ 100 Stock Coils Available
- ◆ Precious Metal Contacts—
Palladium or Gold Alloy
- ◆ Delivery 20 to 45 Days

Variations of Relays available
at Kellogg:

TIME DELAY RELAYS

TWIN RELAY—2 relays in space of one

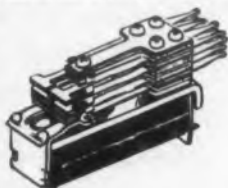
SNAP ACTION RELAY

MULTI-CONTACT RELAY

PLUG-IN RELAY

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KELLOGG SWITCHBOARD AND SUPPLY CO.

A Division of International Telephone and Telegraph Corporation
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CHICAGO 3, ILLINOIS



KELLOGG SWITCHBOARD AND SUPPLY COMPANY
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CIRCLE ED-91 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Clutches For Multitude of Uses



These miniature clutches or clutch brakes are precision components designed for use in the electro-mechanical control systems, servomechanisms, and other devices,

and for such functions as rapid starting and stopping, rapid positioning, tuning and cycling, speed controlling, and synchronizing of shafts. The units operate on the principle of an electromagnetic actuation of a friction plate to provide virtually instantaneous starts and stops. Response speed is measured in milliseconds and is dependent upon application.

When coil is de-energized, the clutch is disengaged and breaking action occurs, if desired. Energizing or de-energizing can be remotely controlled by vacuum tubes, limit switches, relays or other devices. Standard coil voltage is 28v d-c; however, coil voltage and current can be provided to customer requirements. Units have through output shafts, thus allowing input and output on the same end, which facilitates use in combination with gear speed-reducer components. Design is such that on brake units, the output shaft will not angularly display while the clutch is energized or de-energized when the input shaft is held stationary. Globe Industries, Inc., Dept. ED, 1784 Stanley Ave., Dayton 4, Ohio.

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

Electronic Chopper Has No Moving Parts

This chopper, the Model 307, is able to modulate d-c to frequencies up to 400cy for a minimum life period of 3000hr. Modulation is accomplished by illumination of a photoconductive element in a typical voltage divider.



The unit has no moving parts and incorporates such other features as: temperature insensitive operation over a range of -50° to $+100^{\circ}\text{C}$; d-c to a-c conversion ratio over 0.5; noise pick-up of less than $200\mu\text{v}$ rms; 115v 3ma a-c excitation.

The chopper measures only $7/8$ " high x $7/8$ " wide x 2" long and weighs 1.6 oz. Avion Instrument Corp., Dept. ED, 299 State Highway No. 17, Paramus, N. J.

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



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CIRCLE ED-94 ON READER-SERVICE CARD

ELECTRONIC DESIGN • June 1955

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Laminates

Easily Punched Cold

Four new N.E.M.A. grade phenolic laminates have exceptional punching characteristics and high mechanical strength. "Textolite" grade 11561 can be punched cold to 1/8" and sheared cold to 3/32". "Textolite", grade 11562 (N.E.M.A. grade P) can be punched cold to 1/16" and sheared cold to 3/32". It has a uniform appearance and possesses high flexibility and dielectric strength. Grade 11563 (N.E.M.A. grade XXP) features high electrical and chemical strength. Grade 11564 (N.E.M.A. grade XXXP) is designed for high-frequency applications under severe humidity. Laminated & Insulating Products Dept., General Electric Co., Dept. ED, Coshocton, Ohio.

CIRCLE ED-95 ON READER-SERVICE CARD

Insulating Wire Enamel Good Heat Resistance

The new high-temperature coating "Alkanex" is capable of withstanding 155°C heat for 3000hr without loss of dielectric strength. Life test data indicates this heat-resistance will permit design of electrical equipment with increased ratings and greater compactness.

It may be applied to bare copper wire or aluminum. Chemical Materials Dept., General Electric Co., Dept. ED, Bldg. 77, River Road, Schenectady, N. Y.

CIRCLE ED-96 ON READER-SERVICE CARD

Metallizing Materials High Speed Process for Films

These film materials for metallizing have high dielectric strength, are durable, acid-resistant, water-proof, and will take rough handling. They may be metallized with a new high speed process. Materials in 38" widths are available. The most popular metallic deposition is aluminum, but other metals such as copper and pure gold are used. National Metallizing Corp., Dept. ED, 930 Washington Bldg., Washington 5, D. C.

CIRCLE ED-97 ON READER-SERVICE CARD

CIRCLE ED-98 ON READER-SERVICE CARD

PYRAMID SOLID DIELECTRIC GLASSEAL CAPACITORS FOR 6 POINT PREFERENCE

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1. Hermetically sealed in metallic cases.

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3. Subminiature in size.

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Especially sturdy capacitors capable of withstanding vibrational stresses of high acceleration and frequency, and severe shock conditions encountered in guided missiles and airborne equipment.

Utilize new, rugged compression-seal type, glass-to-metal solder-seal terminals. Terminals will not work loose or rotate under any operating conditions.

Functional operating range from -55°C to +125°C.

Operates normally under severe humidity conditions.

Production tests for voltage breakdown, capacitance, power factor, insulation resistance and seal are performed on a 100% basis.

Capacitance range: .001 mfd. to 1.0 mfd.; voltage range: 100 to 600 V.D.C. operating; can be provided to standard tolerance of ±20% or to closer tolerances, if desired.

+ FACTORS



SEVEN NEW INSTRUMENTS!

Seven more reasons for specifying



Type 219 STANDING WAVE DETECTOR. Supersedes 100 to 1000 mc/s slotted sections. VSWR and reflection coefficient angle may be read directly. Small size. Low in cost.

Type 858 "C" BAND SPECTRUM ANALYZER. New r-f head combined with standard PRD indicator unit for the 5100 to 5900 mc/s range. Direct reading frequency meter. Cutoff attenuator with very low backlash enables high precision.

Type 809 KLYSTRON POWER SUPPLY. Complete, well-regulated source of power for wide assortment of low voltage klystrons. Includes square wave and saw tooth modulation and provision for external modulation. Clamping tube makes it unnecessary to readjust reflector voltage when switching modulation. Low in cost.

Type 643 WAVEGUIDE THERMISTOR MOUNT. Provides broadband match over entire 8.2 to 12.4 kmc/s range for faster power measurements. No tuning required. Rugged, efficient, accurate. Ideal for pulsed power measurements. Other waveguide sizes.

Type 277 STANDING WAVE INDICATOR. Three scales, one expanded for low VSWR plus easy-to-read db scale. Three bandwidths. Thus faster, more accurate VSWR measurements. High sensitivity, low noise, and wide range of input levels. Inexpensive.

Type 504 HETERODYNE FREQUENCY METER. Measures frequency over the broad band of 100 to over 10,000 mc/s. Direct reading, hand calibrated dial for the heterodyne frequency oscillator eliminates calibration booklet. High sensitivity. Simple to use. Temperature-controlled crystal accuracy. Inexpensive.

Type 408 DIRECTIONAL COUPLER. High directivity, frequency insensitive, 10 db coupler for precision measurements in the 8.2 to 12.4 kmc/s band. Guaranteed directivity of over 40 db. Ideal for reflection measurements. Other waveguide sizes.



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

Oscilloscopes

With Wide Bands, Low Price



The Models 701 and 701-D (with delay line) Oscilloscopes cover the range of 5cy to 10Mc and are useful to 20Mc. Both models have a conservatively rated sensitivity of 16mv peak-to-peak/cm and a rise time of 0.035μsec.

Large signal displays are possible through 4" of useful deflection. Easy-to-operate sweep circuits provide triggered or recurrent sweeps from 0.1μsec/cm to 10,000μsec/cm, and a high input impedance of 2 megohms paralleled by 25mmfd permits more accurate measurements through low loading of the tested circuit.

An internal 1kc square wave is available for calibration and adjustment of attenuators and probes. Cathode follower outputs for external gate and sweep connections provide synchronization for auxiliary equipment. On the Model 701-D, leading edges of pulses can be effectively displayed by delaying vertical signal through a 0.25μsec delay line until sweep starts. A universal power supply permits operation at any frequency between 50cy and 500cy and at voltages of either 115v or 230v. Weight is only 43 lb. Browning Laboratories, Inc., Dept. ED, 750 Main St., Winchester, Mass.

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

Torque Meter

Reads Directly



This unit is offered in two models for quick and accurate measurement of starting and moving torque on servo-mechanisms, potentiometers, variable capacitors, and rotating machinery having torque loads of 0.01 to 20 in-oz. Known as the "Torque-Watch", it weighs only 7oz and measures 1-1/8" diam x 3-7/16" long, including the small Jacobs chuck which accepts shafts up to 1/4" diam.

The two models available are: Model 6000-1 for 0.010 to 1.2 in-oz, and Model 6000-2 for 1.0 to 20 in-oz. Repeatable accuracy is ±5% on the 300° watch-face; a mechanical stop prevents overstressing the mechanism. Waters Manufacturing, Inc., Dept. ED, 4 Gordon St., Waltham 54, Mass.

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

ELECTRONIC DESIGN • June 1955

Miniature Connectors Are Moisture Proof



Moisture-proof construction and ease of field assembly are features of these light weight subminiature connectors for aircraft and other applications where

weight, size, and performance are critical. The units are approximately one-third the size and one-quarter the weight of comparable BNC types, and provide direct replacement of these larger types in a wide variety of instrument and control circuits. They are impervious to moisture and will maintain a minimum shell-to-conductor resistance of 100 megohms even after prolonged immersion in salt water.

In addition to plugs and jacks, types available include crosses, tees, right angles, and pressurized bulkhead feed-throughs. Specialized units, such as hermetically sealed types and friction disconnects, are also available.

Intended for use with lightweight wire, units will accommodate shielded wire OD sizes from 0.070" to 0.150", and unshielded wire from 0.060" to 0.130". Avien, Inc., Dept. ED, Woodside, N. Y.

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

Contact Terminals Simplify Wiring Problems



Two new styles of contact terminals that facilitate assembly wiring or increase the operating current of electrical connectors are offered in the miniature, quick-disconnect, and small-power connector class.

Ideal for higher currents, the turret terminals (Fig. A) enable wrap-around wiring of two or more wires per contact, or, if preferred, allow the use of larger AWG wire than formerly permitted by conventional solder cup terminals. Internally-tapered terminals (Fig. B) are designed for use with No. 53 AMP taper pins to speed individual wire attachment and permit selective engagement or disengagement of wires.

One or both types can be provided on several of this manufacturer's connector series. Winchester Electronics, Inc., Dept. F, Norwalk, Conn.

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

"WE LIKE THE CONSISTENT QUALITY OF RICHARDSON PLASTICS"

SAYS....



Exploded view shows a CTS control—a concentric shaft tandem variable resistor with switch. Arrows indicate laminated parts made with Richardson plastics.

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Chicago Telephone Supply Corporation is the world's largest producer of variable resistors. To achieve this position, they have stressed *quality*—both in their manufacturing operations and in their sources of supply. For many years, The Richardson Company has supplied the Chicago Telephone Supply Corporation with laminated and molded plastic products which meet their high standards for insulating and electrical properties—a testimonial to Richardson's own quality-mindedness.

If you are looking for a plastic supplier who can give you what you need, contact Richardson. Their complete laminating and molding facilities permit volume production with consistent high quality and accuracy. Write or phone today for complete information.

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

Systems Development and The Ramo-Wooldridge Corporation

The Ramo-Wooldridge Corporation (except for the specialized activities of our subsidiary, Pacific Semiconductors, Incorporated) is engaged primarily in developing—and will soon start to manufacture—systems rather than components. For military customers our weapons systems responsibilities are in the fields of guided missiles, fire control, communications, and computers. Our non-military systems activities are in the general area of automation and data-processing.

Emphasis on systems development has consequences that profoundly affect all aspects of an organization. First, it demands an unusual variety of scientific and engineering talent. A single systems development project often requires concurrent solutions of challenging problems in the fields of electronics, aerodynamics, propulsion, random phenomena, structures, and analytic mechanics. In addition, the purely technical aspects of a systems problem are often associated with equally important non-technical problems of operational, tactical, or human relations character.

Therefore, competent systems development requires that a company contain an unusually large proportion of mature, experienced scientists and engineers who have

a wide range of technical understanding and an unusual breadth of judgment. Further, all aspects of company operations must be designed so as to maximize the effectiveness of these key men, not only in the conduct of development work but in the choice of projects as well.

At Ramo-Wooldridge we are engaged in building such a company. Today our staff of professional scientists and engineers comprises 40% of the entire organization. Of these men, 40% possess Ph.D. degrees and another 30% possess M.S. degrees. The average experience of this group, past the B.S. degree, is more than eleven years.

We believe the continuing rapid growth of our professional staff is due, in part, to the desire of scientists and engineers to associate with a large group of their contemporaries possessing a wide variety of specialties and backgrounds. It is also an indication that such professional men feel that the Ramo-Wooldridge approach to systems development is an appropriate one.

We plan to continue to maintain the environmental and organizational conditions that scientists and engineers find conducive to effective systems development. It is on these factors that we base our expectation of considerable further company growth.

POSITIONS ARE AVAILABLE FOR
SCIENTISTS AND ENGINEERS IN
THESE FIELDS OF CURRENT
ACTIVITY:

Guided Missile Research and Development
Digital Computer Research and Development
Business Data Systems Development
Radar and Control Systems Development
Communication Systems Development

The Ramo-Wooldridge Corporation

DEPT. ED, 8820 BELLANCA AVENUE; LOS ANGELES 45, CALIFORNIA

Reflectometer System

Fast and Easy to Operate



This fast, accurate reflectometer system is capable of wide-range microwave impedance measurements. It includes a new ratio meter, a 7-10kMc swept-frequency oscillator, a power supply, and related crystal detectors and directional couplers.

All have been developed specifically for use in the reflectometer system, although, individually, components have many additional uses.

Besides permitting instantaneous measurement of reflection coefficient or SWR over a wide frequency range, the system makes possible direct and continuous swept-frequency oscilloscope presentation. It eliminates point-by-point checking, and the system is unaffected by amplitude variation. It is particularly applicable to fast checking of reflection coefficient or SWR, as well as useful in waveguide system alignment, checking of waveguide components, determining antenna and rotary joint performance, and similar laboratory or production measurements.

Reflection coefficient readings are direct. Single frequency measurements can be made with accuracies greater than possible with slotted lines. At present available for X-band operation only, the system will soon include components for operation at other microwave frequencies. Hewlett-Packard Co., Dept. ED, 395 Page Mill Rd., Palo Alto, Calif.

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

Multiple Meter

With up to Five Scales



The Multiple-Scale Series HD-647 Meters provide up to five scales in all sensitivities a-c or d-c. The units are in durable, space-saving JAN-1-6 2-1/2" sealed housings of sturdy

drawn metal with die-cast aluminum mounting flanges. Screw-lock terminal connectors provide quick installation and disconnect for replacement or service. The "Multi-Meter" is also available in 3-1/2" diam on special order. DeJur-Amsco Corp., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N. Y.

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

ELECTRONIC DESIGN • June 1955

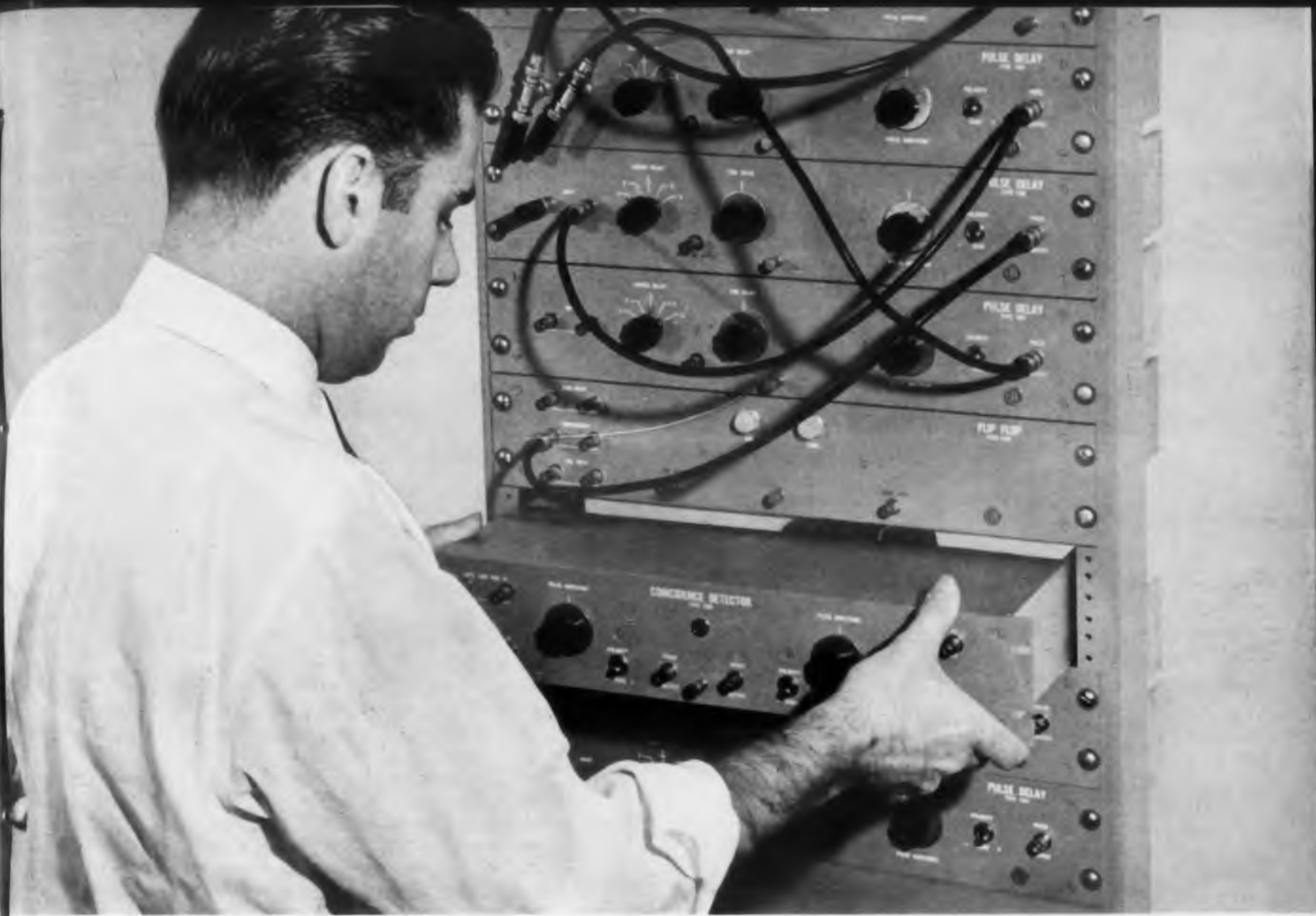
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A simple pulse system. Engineer sets up and connects Burroughs Pulse Units to produce a pattern of pulses used in testing magnetic cores.

Every engineer who works with pulses should read this news from **BURROUGHS**

New packaged pulse handling units performing basic functions connect together to form a virtually unlimited variety of pulse systems

Now you can assemble any kind of pulse system you need from the simplest to the most complex—usually in a matter of minutes. All you do is connect together Burroughs Pulse Units, using standard plug-in cables.

Speed of set-up is one of the chief advantages of this equipment. There's no soldering required. Systems can be set up or radically changed with no tools except possibly a screw driver.

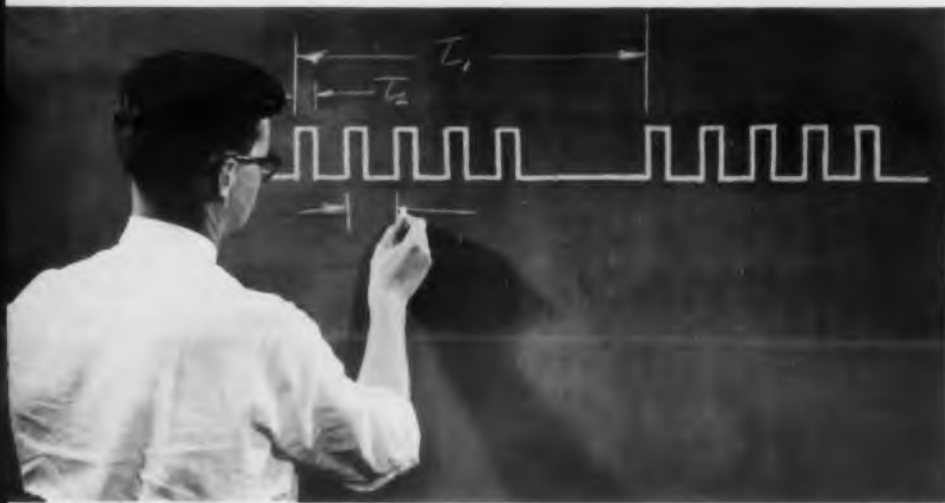
Since Burroughs Pulse Units are complete within themselves and matched to each other, you're relieved of the problem of detailed circuit design. You work with simple block diagrams and basic ideas only . . . concentrate your efforts entirely on the logic of the system.



UDEC II, a complex pulse system. The giant Burroughs Unitized Digital Electronic Computer is built entirely from Burroughs Pulse Units connected together with standard cables.

READ MORE →

Burroughs Pulse Test Units Help

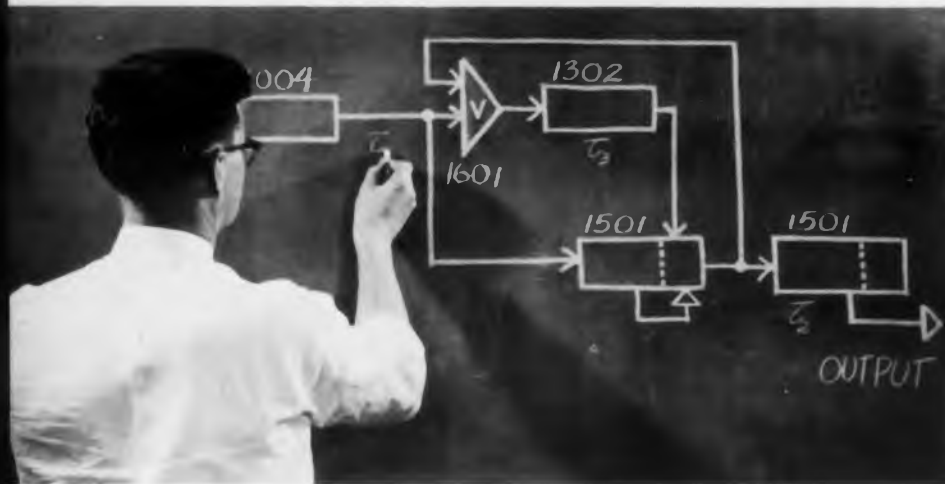


No time lost building test equipment

Simple 3-step set-up builds a complete pulse system

1. Study the pulse sequence

This is the time chart of the desired pulse output from the pulse system. It shows pulse height, pulse width, pulse frequency, and pulse separation. Usually, the pulse sequence is worked out as part of your preliminary planning prior to beginning actual engineering with the equipment.



2. Draw the block diagram

This is the first step in planning the actual pulse system. Using standard block diagram symbols, you can plan your complete system within a matter of minutes. And you needn't worry about circuit details within the units themselves, because all units are complete and matched to each other.



3. Connect the units together

From the block diagram you can determine which Burroughs units you need in your rack. Connect them together with standard cables, and there's your pulse system. Convenient front-panel controls add further flexibility—enable you to make frequency changes over a wide range as easily as turning knobs.

INDIVIDUAL UNITS PERFORMING BASIC FUNCTIONS CONNECT TOGETHER



Pulse generators



Flip-flops



Mixers



Coincidence detectors



Pulse delays

Engineers Save Time to Do More



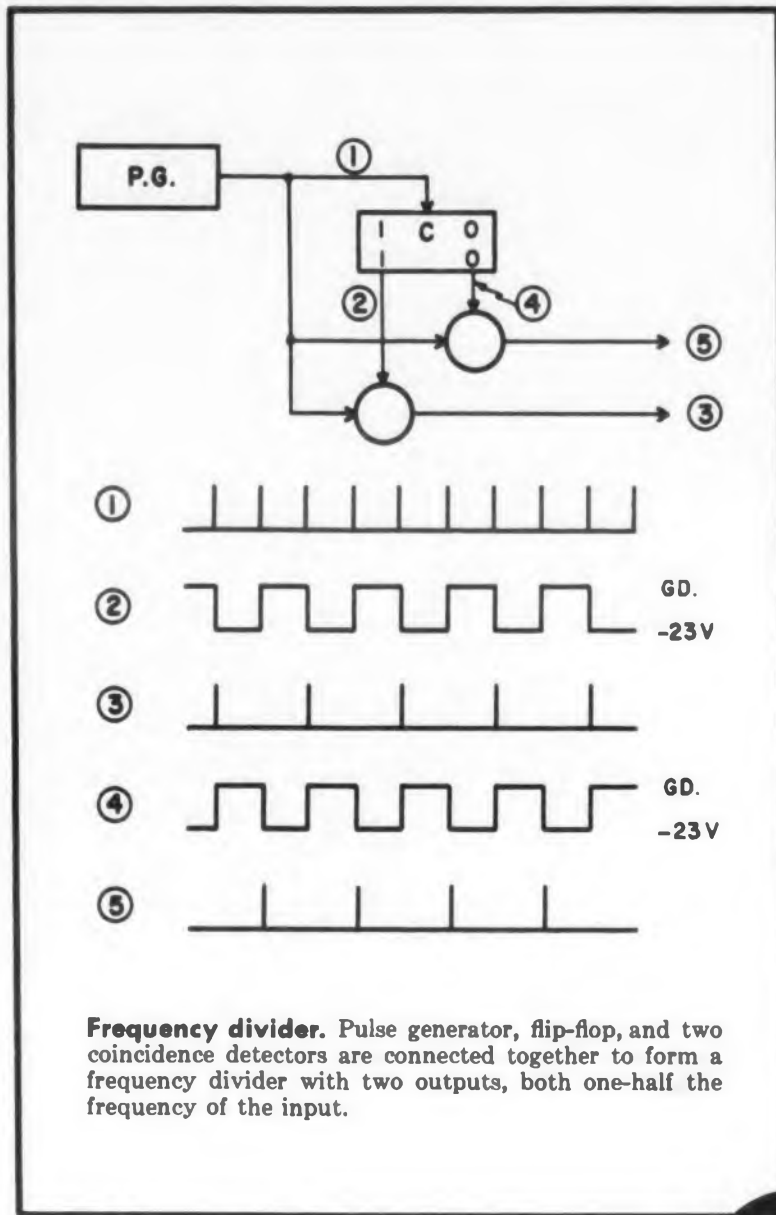
Try new ideas—Burroughs Pulse Units are so easy to use they make it possible for you to try many new ideas that you might otherwise never find time for. Think of it. No breadboard engineering. No designing special test equipment before you begin on a new project. Consider how many more new ideas you can try when you have this convenient, flexible equipment at your finger tips. If you work with pulses, you need these new engineering tools.

Correct errors fast—Before Burroughs Pulse Units were developed, errors in pulse system planning meant a serious economic loss—in equipment as well as time. Not so now. When you discover an error in planning your system, simply reconnect the cables and correct the error. It only takes minutes. Often you can't be sure how a system should be connected. With Burroughs units, you can try different ways—at no loss. You can experiment without losing engineering time.



Speed completion of engineering—Every day lost in the engineering phase of product development postpones product delivery. So you're the loser when you take time to build your own test equipment. How much easier it is to make deadlines when you can simply connect Burroughs pre-engineered units together. Leading laboratories engaged in all phases of electronics research are now benefiting from the time-saving advantages of Burroughs Pulse Units.

Use equipment over and over again—This is where the real economy comes in. But first let us say a word about original cost. Burroughs Pulse Units usually cost less than you would otherwise have to spend in engineering time and equipment to design and build your own pulse system. Beyond that, they can be used over and over again on different future jobs—saving additional cost in every application. The total savings can be incalculable.



Typical Applications for Burroughs Pulse Units

Pulses are being used so widely today in information handling and control systems that it would be impossible to list fully the many fields of application for Burroughs Pulse Units. Generally, however, they are being used in research engineering, development engineering, and even product test applications in connection with such products as:

- | | |
|------------|--------------------|
| Radar | Telemetry |
| Computers | Electronic control |
| Television | Test equipment |

Can Burroughs Help You?

If you have an engineering problem involving pulses, write Burroughs. Without charge, we'll engineer a system for you showing which Burroughs Pulse Units you need and how much they cost. Prove to your management just how much you can save in engineering time and equipment cost. Deliveries can be made immediately from stock. For detailed brochure, just send the coupon.

ELECTRONIC INSTRUMENTS DIVISION
Burroughs
 FIRST IN PULSE HANDLING EQUIPMENT

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Yes, I want the detailed brochure on Burroughs Pulse Units.

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ELECTRIC

Power Rectifier 35kw Liquid-Cooled Unit



This 35kw liquid-cooled germanium power rectifier, Type 53-0075-0, is a 3-phase bridge unit, rated for a maximum of 450-amp d-c continuous output. It can be supplied for in-

put voltages of 26v, 36v, 52v, and 66v rms maximum.

The unit has a volume of approximately 220 cu in as compared to 1650 cu in for a comparable selenium unit (fan-cooled) and 14,000 cu in for a copper-oxide unit (fan cooled). This unit requires liquid coolant (water, oil, etc.) at a maximum inlet temperature of 25°C and a volume of 1/2 gallon per minute.

Efficiencies up to 97% are attainable, and the power factor is essentially 100%. Aging is negligible or zero. Rectifier regulation as low as 2% is possible from no-load to full-load. The rectifier is applicable for all types of d-c load requirements except those requiring heavy surge currents and those subject to heavy intermittent overloads or occasional short circuits. Sizes may vary with ratings. International Rectifier Corp., Dept. ED., El Segundo, Calif.

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

Instrument Bearings Made With Thin Sections



The design of these Thin Section Instrument Bearings provides a complete ball complement and also offers advantages of high load capacity and longer life, without a loading notch. In addition, the

manufacturing method allows construction of integral shields as a part of the bearing.

The new series has the same boundary dimensions as the AFBMA (Anti-friction Bearing Manufacturers Association) B-500 Series torque tube bearings. Bore sizes offered range from 0.6250" to 3.1245".

Construction variations are offered: one-piece synthetic retainers, full ball complement, alternate undersize ball complement, or either of the latter two with integral shielding. The alternate ball series is specially interesting: alternate balls are slightly undersize, acting as spacers, and the resulting bearing has very low and constant torque values at low and moderate speeds. Split Ballbearing Corp., Dept. ED, Lebanon, H. H.

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

CIRCLE ED-108 ON READER'S SERVICE CARD >

COPPER-CLAD PHENOLITE

When it proves itself in products like these...



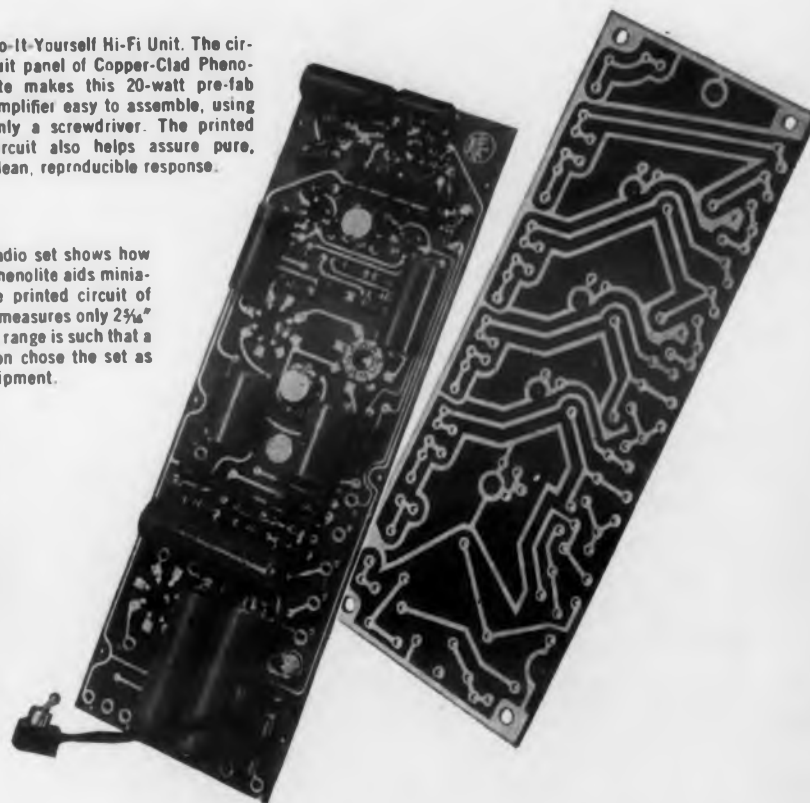
Do-It-Yourself Hi-Fi Unit. The circuit panel of Copper-Clad Phenolite makes this 20-watt pre-fab amplifier easy to assemble, using only a screwdriver. The printed circuit also helps assure pure, clean, reproducible response.

Tom Thumb radio set shows how Copper-Clad Phenolite aids miniaturization. The printed circuit of this tiny radio measures only 2 3/4" x 1 1/4". Yet the range is such that a polar expedition chose the set as part of its equipment.

Printed circuit—18" x 21" —for a modern computer. The panel contains more than 1,000 through-holes for connection soldering, all of which are pierced in one operation! This shows the fine workability of Copper-Clad Phenolite and its ability to eliminate complex wiring, costly operations, expensive components.



Switch plates, commutator discs, and drum commutators with printed circuits have proved themselves in many diversified applications. Low-cost printed circuit switches are ideal for simple switching, and show up to best economical advantage in complex switching functions.



You know it's best for any printed circuit

The most widely used foundation material for printed circuits is Copper-Clad Phenolite by National.

Reason? Copper-Clad Phenolite—in its many grades—possesses all the properties and characteristics demanded for the job. This scientifically compounded laminate has high dielectric and mechanical strength, resistance to heat, moisture, solvents, oils, acids, alkalies. Also, it's light in weight—easy to machine, punch, saw, drill and solder.

You can't buy a more dependable, versatile, cost-cutting material than Copper-Clad Phenolite. Write us today.

YOUR GUIDE TO PRINTED CIRCUIT SIMPLIFICATION. You'll find this booklet a most helpful tool in achieving miniaturization or automation. Complete coverage of basic technical facts and design data related to applied printed circuitry. Methods of producing printed circuits and economies in design are fully treated. For your free, personal copy of "Mechanize Your Wiring," write Dept. AG-6.



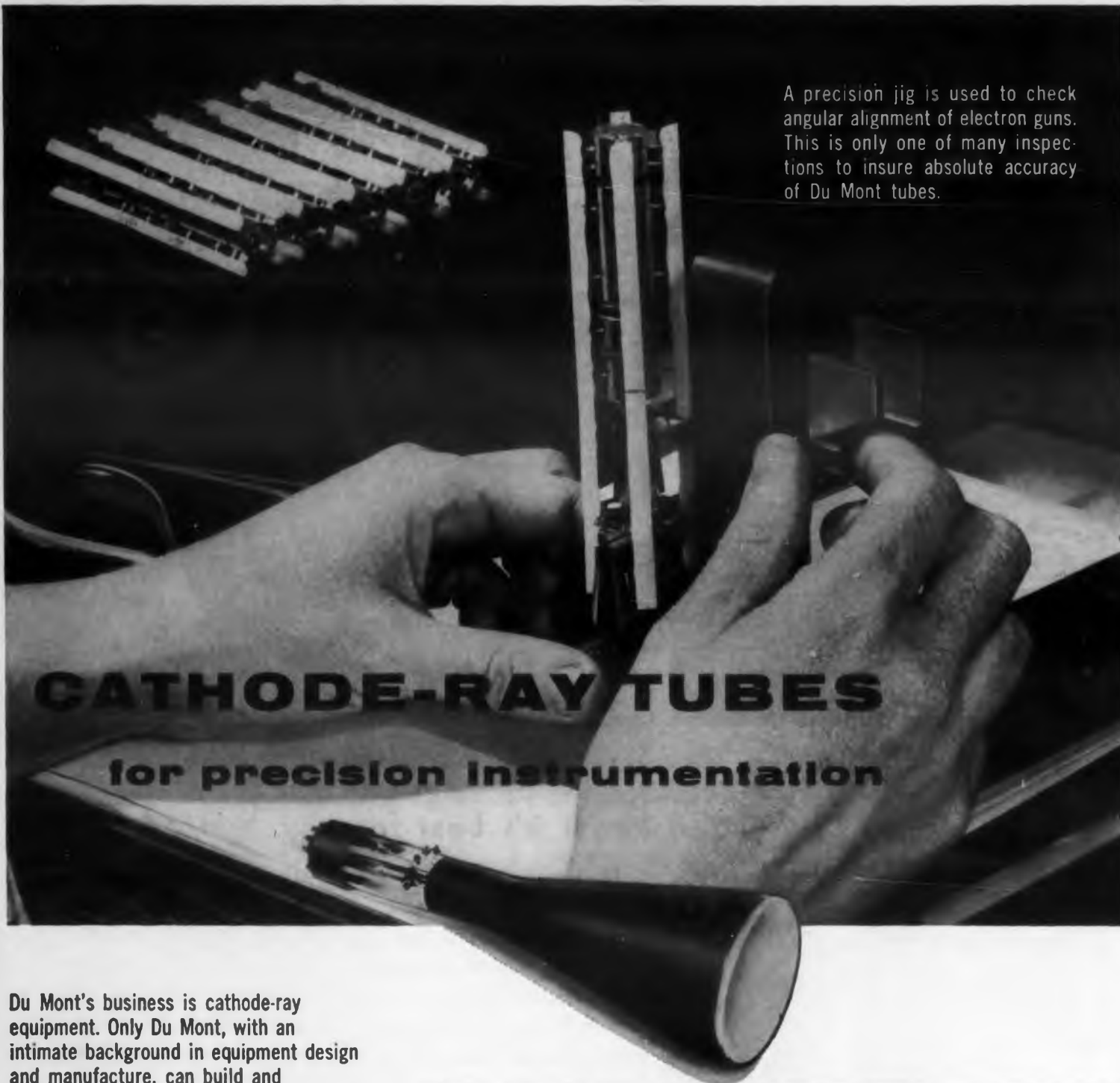
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Also Manufacturers of Peerless Insulation, Materials Handling Receptacles, Vul-Cot Wastebaskets and Textile Bobbins

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



A precision jig is used to check angular alignment of electron guns. This is only one of many inspections to insure absolute accuracy of Du Mont tubes.

CATHODE-RAY TUBES for precision instrumentation

Du Mont's business is cathode-ray equipment. Only Du Mont, with an intimate background in equipment design and manufacture, can build and recommend the right cathode-ray tube to the equipment designer. Through years of consultation on all kinds of tube problems, Du Mont, working with the equipment designer, has been able to lead the way with such developments as the flat face-plate, tight-tolerance glass-rod construction, mono-accelerator design, and many others. Development which leads the way toward the ultimate use of cathode-ray tubes as sensitive, precision measuring devices is our aim. Consult Du Mont for precision tubes to meet your exacting requirements. The best costs no more than the ordinary.

IMPORTANT SPECIFICATIONS OF PRECISION Cathode-ray Tubes						
TYPE	DEFLECTION FACTOR*		DEFLECTION UNIFORMITY	LINE WIDTH*	ANGULAR ALIGNMENT BETWEEN PLATES	P1 LIGHT OUTPUT*
	D1 D2	D3 D4				
3JP-A	150 dcv/in	111 dcv/in	3%	.03" max.	90° ± 1°	25 ft. L. Min.
3WP-	69 dcv/in	47.5 dcv/in	2%	.026" max.	90° ± 1°	7 ft. L. Min.
5ADP-	45 dcv/in	35 dcv/in	2%	.03" max.	90° ± 1°	15 ft. L. Min.
5AMP-	45 dcv/in	22.5 dcv/in	1%	.032" max.	90° ± 1°	15 ft. L. Min.
5AQP-	45 dcv/in	35 dcv/in	1%	.030" max.	90° ± 1°	15 ft. L. Min.
5ARP-	dual beam mono-accelerator — each gun equivalent to Type 5AQP — (see above)					
5ATP-	104 dcv/in	38 dcv/in	1%	.035" max.	90° ± 1°	170 ft. L. Min.

*Under typical operating conditions (7-inch versions of the five inch tubes will be considered on request.)

DU MONT

For further information write to: TECHNICAL SALES DEPT.
ALLEN B. DU MONT LABS., INC., 760 BLOOMFIELD AVENUE, CLIFTON, NEW JERSEY
CIRCLE ED-112 ON READER-SERVICE CARD FOR MORE INFORMATION

Relay 2-Pole Subminiature



The HG-2SM sub-miniature, 2-pole unit is designed to provide maximum space conservation in a relay of high-performance characteristics. Less than 1-1/2" high,

it is enclosed in a cylindrical can equipped with a conventional 2-hole mounting flange of 1-3/32" x 3/4" over-all dimension. It retains the balanced rotating armature and efficient magnetic circuit of standard units in this firm's line. Weight is 1 oz.

Exceeding specifications such as MIL-R-5757B, the relay withstands shock accelerations in excess of 20g at frequencies up to 2000cy, with no contact break. It is capable of operating at temperatures up to 200°C. Insulation resistance is greater than 100 megohms.

Contact current is rated at 3amp, 28v d-c, and 3amp, 115v a-c, with contact life in excess of 100,000 operations. Higher contact currents can be handled where shorter contact life is permissible. Contact resistance, held as low as 0.01 ohm, is ideal for signal circuits. Coil resistance for the 2-pole unit is rated 325 ohms at 28v d-c.

The new unit is also available in a single-pole model with coil resistance of 520 ohms. Relays may be hermetically sealed and filled with either dry air or nitrogen. Hi-G, Inc., Dept. ED, Bradley Field, Windsor Locks, Conn.

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

Differential Capacitor For Circuit Balancing



The CST-50-D miniaturized differential capacitor is for circuits where balancing is required. This capacitor features a single tuning element of unusual design to minimize air dielectric loss.

Mounted, the capacitor stands 19/32" high. It is under 1/4" in diameter and has an 8/32thd mounting stud. Range of top half of this unit is 1.5mmfd to 10mmfd; of bottom half, 5mmfd to 10mmfd. Terminals have two soldering spaces. A locking nut affords stability with no capacity change. Cambridge Thermionic Corp., Dept. ED, Cambridge, Mass.

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

Field Intensity Receiver Covers 950-11,260Mc Range



The Model R Field Intensity Receiver covers the microwave range 950Mc to 11,260-Mc, with four interchangeable plug-in r-f tuning units. It is designed for communications work, laboratory measurements, field intensity measurements, production testing,

and automatic monitoring. It features single-dial frequency control with a direct-reading "Uni-Dial", along with double-tuned r-f preselection, and automatic frequency control.

The Model R will receive AM, FM, and pulse signals. It reads directly in decibels and provides separate audio and video outputs. Also, provision is made for external metering and recording, as well as connectors for external i-f attenuators.

An external-type cavity klystron is provided with non-contacting chokes. Klystron voltages are regulated and automatically tracked with the oscillator. The unit is completely self-contained in a sturdy carrying case with its own power supply. Polarad Electronics Corp., Dept. ED, 43-20 34th St., Long Island City 1, N. Y.

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

Digital Voltmeter

A High-Speed Converter



This high-speed Analog - Digital Converter uses radar type measuring circuits. The equipment is packaged as a convenient general purpose voltmeter providing for both manual reset and periodic measurements at adjustable rates. Readings as frequent as 20 three-digit numbers per second can be made.

Voltage measurements from 100mv to 999v of either polarity can be made with an accuracy of one digit. Applications include process instrumentation and data reduction when combined with time division multiplex equipment for scanning and with a peak detector for transient studies. Chopper stabilized d-c amplifiers are also available for applications requiring high measuring sensitivity. Franklin Electronics, Inc., Dept. ED, 415 W. Pike St., Philadelphia, Pa.

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

ELECTRONIC DESIGN • June 1955

JUST LOOK at the watt-hour rating of

Centralab's New, Exceptionally Small, Military-Quality Model 3 Radiohm®



The model 3 has many other desirable characteristics:

Designed for high operating temperatures.

Closed case construction readily lends itself to sealing and potting, (even though we believe that a control should "breathe").

Available in 1/8" diameter shaft, standard or locking-type.

Order a quantity of Model 3's for pilot testing. Call in your Centralab representative or write directly to the office.

DON'T look further for a high-quality variable resistor that you can use at exceptional wattage for short periods of time with minimum resistance change. Centralab's new Model 3 Radiohm is your answer. Tests prove it.

Take the 10,000 Ohm value for example. It stacks up this way:

ONLY 10% MAXIMUM CHANGE

when used at . . .	1 watt for 1 1/2 hours
. . .	3/4 watt for 35 hours
. . .	1/2 watt for 80 hours
. . .	1/3 watt for 300 hours
. . .	1/4 watt continuous rating

This is just one of a complete selection of values for all miniature applications, guided missiles, geophysical equipment, etc., etc.

Technical bulletin EP-63 gives you complete engineering data. Write for it.

**More proof that
if it's a job
for electronic components,
it's a job for Centralab**

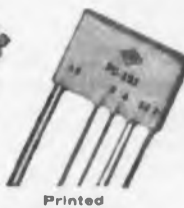
Centralab's
advanced engineering
continues to create
the prototypes
of the components
industry



Capacitors



Switches



Printed
Electronic
Circuits



Volume
Controls



Ceramics

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of high-fidelity records
of your own choosing?
Enter this month's

Electroni-Kwiz†

Answer this question in 50
words more or less:
What qualifications do you
consider most important
when specifying
electronic components?
A leading editor will
pick the winner of this
month's major prize.
Mail your entry to us
before June 30.

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Centralab

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How to make a Magnetic Core that's really small? Use PERMENDUR!

Write for
your copy

"MAGNETIC MATERIALS"

This 32-page book contains valuable data on all Allegheny Ludlum magnetic materials, silicon steels and special electrical alloys. Illustrated in full color, includes essential information on properties, characteristics, applications, etc. Your copy gladly sent free on request.

ADDRESS DEPT. ED-66

When the conditions of service make it imperative for you to hold the size and weight of magnetic cores at an absolute minimum, that's the place to use Permendur. With it you can push the flux density up to 20 kilogausses, and practically eliminate weight as a consideration.

Along with its suitability for cores wherever the premium is laid on compactness, Permendur is just the thing for sonar magnetostriction applications, too. We maintain proper annealing facilities for this

alloy. Write for technical data on it, and let our engineers help you to cash in on its possibilities.

In addition to Permendur, we offer a range of high-permeability alloys, oriented silicon steels and other electrical alloys that is unmatched in its completeness. Our services also include the most modern facilities for lamination fabrication and heat treatment.

Let us supply your requirements. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

STEELMAKERS to the Electrical Industry
Allegheny Ludlum

WAD 8443



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

"Mylar" Capacitors In Commercial Models



"Mylar" dielectric capacitors are now available in commercial construction at competitive prices from this firm. These models (620S and 621S) closely approximate the performance of expensive hermetically sealed capacitors, but are reasonably priced.

The capacitors are miniature in size and are available in extended foil or inserted tab construction. "Miracle X" liquid impregnate is used, and the capacitors are housed in ceramic tubular enclosures using a new thermosetting plastic end seal. Operating temperature is -55 to $+125^{\circ}\text{C}$. They easily exceed RETMA specifications REC 118-A. Both models are available for standard printed circuit or specialty applications. Good-All Electric Manufacturing Co., Dept. ED, Good-All Bldg., Ogallala, Nebr.

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

Ohmmeter

A Low-Resistance Unit



The Model LRD Low-Resistance Ohmmeter, featuring extremely low test current, is especially adaptable to measurement of relay contact resistance, fuse resistance, bonding and ground wire

resistance, and any other application requiring low resistance measurements with minimum test current. It has an accuracy of $\pm 1\%$ of full-scale reading.

Ranges include full-scale readings of 0.1 ohm, and 10 ohms. The scale is divided into 100 divisions. Current passing through the test piece never exceeds 110ma on any range.

Protection for the meter is incorporated in the event resistance being measured is outside the range of the instrument, or open. Connection to resistance to be measured is made by a special test lead which provides four terminal measurement for increased accuracy in the low-resistance ranges. The instrument is entirely self-contained. Power is supplied by standard flashlight battery of 1-1/2v. Industrial Instruments, Inc., Dept. ED, Cedar Grove, N. J.

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

Punched Tape Converter

Operates X-Y Plotters



A convertor, which operates from a punched tape reader, has been added to this firm's line of converters for operating X-Y plotters from digital inputs. If a printed

listing is desired in addition to the plot, the new unit can be operated from a tape-actuated typewriter, such as the "Flexowriter."

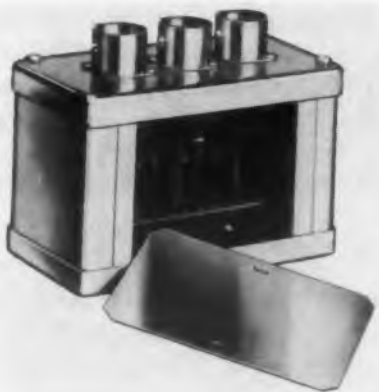
For the standard converter, the tape is punched in the five-hole communications code (other codings can be accommodated on special order). Nine symbols are required on the tape for each point plotted; a sign and three digits for each coordinate, and a tab or carriage return which initiates the plotting of the point. The tape reader normally operates at 10 symbols/sec, and the plotter requires 1sec to travel full diagonal, so the plotting proceeds at a rate of from 1sec to 2sec per point, depending on the point spacing.

Maximum power drain from the 115v supply is 75va—a result of all but one of the 42 tubes in the converter being cold-cathode gas tubes. Specially designed to operate with Librascope X-Y plotters, the punched tape converter can be adapted to other plotters. It measures 10-1/2" x 19" x 12" in case or rack mount, and weighs 42 lb. Librascope, Inc., Dept. ED, Glendale, Calif.

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

Cases

For Plug-In Packages



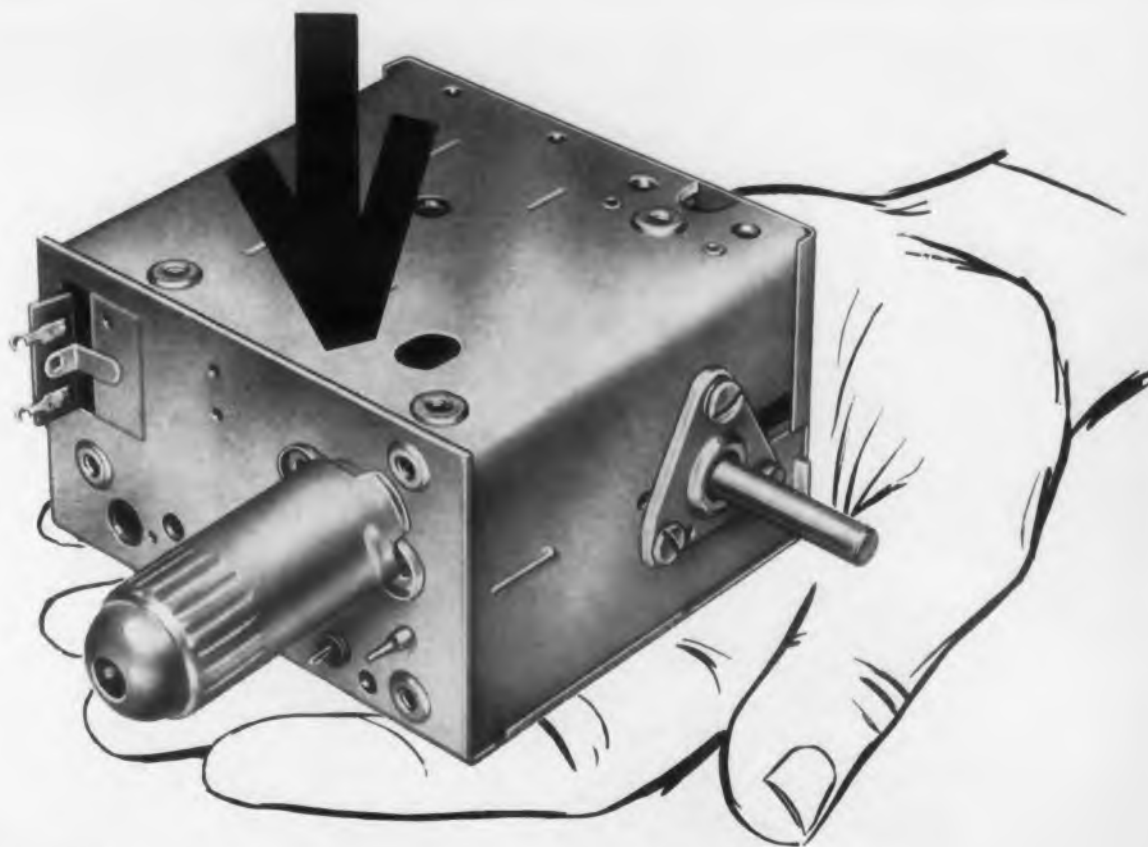
Designed especially for electronic plug-in packages, "Lip-Loc" cases feature "Snap-Open" side panels for quick accessibility and attractive appearance. Removal of two screws allows the entire case to come apart. Cen-

ter sections may be perforated for ventilation or omitted entirely.

Components, such as sockets, plugs, or transformers, may be mounted on any four of the six sides with excellent accessibility. Component mounting structures are also available for the inside of the case. Vector Electronic Co., Dept. ED, 3352 San Fernando Rd., Los Angeles 65, Calif.

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

ELECTRONIC DESIGN • June 1955



NEW

low cost UHF tuner

FEATURES OSCILLATOR RADIATION FIXES

Here's famous R/C quality at the lowest price ever! The new T-90 Series uhf t-v tuner meets all RETMA spurious radiation requirements. Yet it costs less than any previous Radio Condenser uhf tuner.

The double-circuit tuned T-90 Series has excellent i-f and image rejection, giving remarkably high selectivity. As indicated by R/C statistical quality control, the noise figure of the new tuner exceeds most requirements, and the drift characteristics are equally good. Field results to date have been uniformly excellent.

If you want information fast on the T-90 Series, we'll be happy to have one of our engineers call at your convenience.

Get Complete Engineering and Performance Data.

Write Radio Condenser for your free copy of Bulletin T-90.



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



Dial Skirted Round;
175 Series
(actual size)

Why spend \$1.04 for this knob?

Sure, you could pay less for an ordinary knob, but the premium price of the Raytheon Standard Control Knob is well worth the difference! Here's why:

Raytheon knobs conform to government specifications for material, high and extreme temperature, humidity, salt spray, vibration, impact and torque. They are handsomely designed and molded of "Tenite II." They have anodized aluminum inserts with dual Allen head set screws. Most important, Raytheon knobs offer the smartly turned professional look that adds so

much to the fine appearance of your product. You put time, skill, money *inside* your equipment. You incorporate the finest circuitry; you select each component with care—your goal is quality *outside*, too. The right knobs, the finest knobs give the important finishing touch. They help convince your customers that yours is thoughtful, thorough craftsmanship.

Let us send you complete information on the finest control knobs available today. Write Dept. 6120, or see your electronic supplier.

OTHER FINE RAYTHEON STANDARD CONTROL KNOBS

Prices range from
69¢ to \$3.10



Round



Skirted
Round



Pointer



Skirted
Pointer



Crank Knob



RAYTHEON MANUFACTURING COMPANY

Equipment Marketing Division
Waltham 54, Mass.

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

Digital Controller Can Control Tool Operations



This compact automatic digital controller can be used to control machine tool operations, conveyor belts, batch mixing operations, to hold aircraft or refinery valves within pre-

set limits, and similar applications. Heart of the controller is a unit only 7" high x 10" wide x 8" deep with a count capacity of 2500 counts, which adds and subtracts automatically at rates up to 20 decimal digits per second with an accuracy of 0.04%. The count at any instant is shown on four illuminated windows by a new type of indicator tube, known as an "Inditron."

In a typical machine tool operation, this controller is used on a line of "Stretch Forming" machines. A sheet of aluminum is placed in the stretcher, and a small transmitter establishes a digital count as the machine is operated manually from the start to the completion of the metal-forming operation. The transmitter, consisting of a mechanical switch and capacitor, sends pulses to a thyatron in the controller, and the count is noted at the start and stop of the operation. Then, for all succeeding operations, the stretcher is controlled by these two counts preset by two sets of switches on the controller. The operator of the machine thereafter merely places a piece of aluminum in the stretcher, and at the correct count the controller starts a motor switch for the forming operation. This operation proceeds automatically until the transmitter sends the final count corresponding to the end count preset in the controller. At the conclusion of the count, the controller automatically stops the motor operating the stretcher. American Electronic Mfg., Inc., Dept. ED, Culver City, Calif.

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

Ceramic Capacitors Miniature Mylar Units



This firm is now producing miniature Mylar dielectric capacitors housed in ceramic jackets with thermosetting plastic end fill. The capacitors are specially impregnated to minimize the temperature coefficient. The insulation resistance is maintained under the most severe conditions of temperature and humidity. Film Capacitors, Inc., Dept. ED, 3400 Park Ave., New York, N. Y.

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

ELECTRONIC DESIGN • June 1955

Bridge

For Low Ohms Measurement



The "Low Ohm Bridge", K.S.-2119, for checking the lower resistance values, is a self-contained, portable Wheatstone Bridge with a null indicator, precision potentiometer, calibrating resistors, balanced control, and battery box mounted on a panel enclosed in a rugged box.

The potentiometer has 10 turns of 100 divisions each, giving a total of 1000 divisions to cover the various ohm ranges, reading to 0.0001 ohm on the low range. The dial indicates resistance values directly without requiring conversion charts. Switching ranges is easily accomplished by a selector switch.

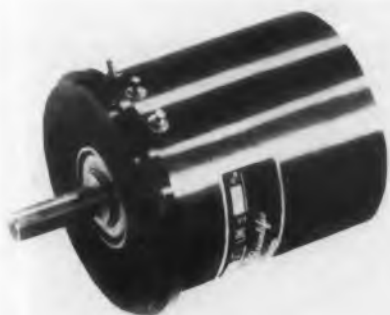
Built-in calibration standards with 0.1% accuracy are used for calibrating the bridge. Overall bridge accuracy is 0.25% at normal requirements. Power is supplied by four "D" size flashlight batteries which are easily replaced by removing a cover located on the front panel.

The instrument has a wide variety of applications to measure resistances in electrical bus bar joints, rail joints, pipe and conduit joints, switch and circuit breaker joints, contractor resistances, and motor, transformer, and reactor windings. Size is 8-1/2" x 7-1/2" x 4-1/2". Weight is 5 lb net. The Kell-Strom Tool Co., Inc., Dept. ED, Weathersfield, Conn.

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

Potentiometer

Accurate, 10-Turn Unit

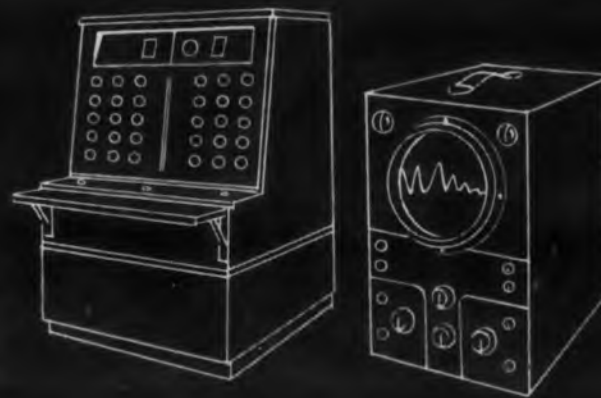


The "M10-3000 HT", a 10-turn, high-resolution potentiometer, is recommended for application where extreme accuracy is required, such as fire control equipment and analog computers.

It is provided with servo mountings and will function in ambient temperatures up to 200°C. It is designed to be highly compact and rugged. General Scientific Corp., Dept. ED, North Hollywood, Calif.

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

for equipment
which demands the
finest paper tubulars
available...



Leading manufacturers specify
the industry's finest paper tubular capacitor

... the Sangamo *Telechief*

For critical applications such as hi-fi equipment, computers and other electronic gear... applications which require exceptionally high insulation resistance and unusual stability at high

temperatures, your best bet is a Sangamo Telechief.

It is the molded paper tubular which, tests by leading manufacturers show, outperforms all other paper tubulars in...

MOISTURE RESISTANCE

Sangamo paper tubulars are molded in Humiditite, the remarkable plastic molding compound which gives them moisture resistance properties far superior (10 to 15 times greater) than any other molded tubular capacitor.

HIGH TEMPERATURE OPERATION

The resistance qualities of Humiditite also make Telechief the winner over other paper tubulars in this department. (Tests show top performance in temperatures up to 125° C.)

HOLDING RATED CAPACITY

The exclusive Sangamo solid dielectric impregnant enables the Telechief to hold its rated capacity under all conditions... makes it a really rugged paper tubular.

Because the Telechief outperforms other paper tubulars in all of these areas, you can be sure that here is a paper tubular which will deliver long, trouble-free capacitor life.



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

SC95-11



IMPORTANT
facts

about
**COIL
BOBBINS**

SALES REPRESENTATIVES

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Framingham, Mass., Trinity 3-7091

New York, New Jersey:
Jersey City, New Jersey,
Journal Square 4-3574

Upstate New York:
Syracuse, N.Y., Syracuse 4-2141

Maryland:
Baltimore, Maryland, Plaza 2-3211

Philadelphia:
Philadelphia, Pa., Chestnut Hill 8-0282

Northern Ohio, Western Pennsylvania:
Cleveland, Ohio, Atlantic 1-1060

Indiana, Southern Ohio:
Logansport, Indiana, Logansport 2555

Missouri, Southern Illinois, Iowa:
St. Louis, Missouri, Sterling 2318

California:
Pasadena, California, Sycamore 8-3919

Canada: Montreal, Quebec, Canada,
Walnut 0337

SPECIFICATIONS

—any size, shape, length,
with flat, recessed or em-
bossed flanges.

MATERIALS

—dielectric kraft, fish paper,
acetate, phenol impregnated
material or combinations.

INFORMATION

—Bulletin contains impor-
tant data on bobbin construc-
tion, heat factor and cost.

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

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



**PUSH BUTTON
INSULATION
RESISTANCE
TESTING**

with

VIBROTEST

- RANGES TO 50,000 MEGOHMS
- NO CRANKING • NO LEVELING
- ALL-ELECTRIC • RUGGED
- FULLY PORTABLE • ACCURATE

VIBROTEST is built throughout to make insulation
resistance testing FAST, EASY and ACCURATE
for you. No laborious cranking...No mechanical parts to
get out of order...Only two binding posts for ALL tests.
Several Models have A. C. and D. C. volt ranges, as well
as low resistance ohmmeter.

This is an instrument that makes insulation resistance
testing a "push-button" affair! Ask for more information.

WRITE FOR BULLETIN 2-A

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CIRCLE ED-131 ON READER-SERVICE CARD FOR MORE INFORMATION

**Digital Computer
For Smaller Companies**



Developed pri-
marily for use by
small commercial
and technical or-
ganizations with
large computa-
tional require-
ments, the "Alwac
III" is a versatile,
reliable and easy-
to-operate digital
computer. Fast ac-

cess storage is 128 words, and provisions are available
for additional supplementary input-output equip-
ment.

Like earlier models, the computer utilizes magnetic
drum storage having a memory capacity of 4096
words; 8192 word storage drums are available. Word
length is 32 binary digits plus sign, and two instruc-
tions may be stored in the space occupied by one
word. Seventy-eight single address instructions are
available.

Final results of computations are printed out with
form control, signs, decimal points, and alphabetical
headings completely under control of a sequence of
instructions, permanently stored on the magnetic
drum. The unit utilizes a "Flexowriter" with punched
tape input-output. Auxiliary equipment consisting
of IBM conversion units enable input-output rates
of 100 cards/min.

Housed in three cabinets (shown in background of
illustration) weighing a total of 2200 lb, the "Alwac"
requires only 125" x 28" of floor space. Power is
5kw at 110/220v a-c. Logistics Research, Inc., Dept.
ED, 141 S. Pacific Ave., Redondo Beach Calif.

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

**Pulse Transformer
Sealed 75μsec Unit**



The H75-11, two-
winding, epoxy-
resin impregnated
and hermetically
sealed 75μsec pulse
transformer has a
rise time of only
2μsec. The unit
meets MIL-T-27,
grade 1, class A

test specifications. Operating temperature range is
from -70 to 135°C. Size is 7/8" x 7/8" x 1-1/8",
exclusive of terminals and mounting flange. The
Gudeman Co. of California, Inc., Dept. ED. 9200
Exposition Blvd., Los Angeles 34, Calif.

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

**New RF Choke Kit
Contains 14 pie-wound chokes**

Chokes are on
LPB-3 forms,
which have axial
leads and are only
5/32" in diameter
by 1/2" long. Wind-
ings are 1/8" wide,
varying up to 1/2"
approximately in
diameter. All units
varnish-impreg-
nated for moisture and fungus-proofing. Induct-
ances are RMA preferred values from 6.8 micro-
henries to 1.0 millihenry, with color-coding enabling
easy recognition of values.



Modern packaging adds to the advantages of the
kit for laboratory or experimental use. Supported in
a foam plastic block, the chokes are protected from
damage in transit and can easily be removed and
reinserted. Block stands on any flat surface. Chart
on inside cover of kit gives necessary electrical
data, plus C.T.C. part numbers for ordering
separately or in bulk. Kit price is \$4.25 F.O.B.,
Cambridge, net 30. Cambridge Thermionic Cor-
poration, 457 Concord Ave., Cambridge 38, Mass.

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



**AUDIO POWER
PULSE
TRANSFORMERS**

From low level matching and blocking
oscillator to high power Magnetron
types. Computer Transformers . . .
Zero phase shift, 0.1% accuracy.

QUALIFICATION APPROVAL
NEED NOT DELAY DELIVERY
FROM ITC SINCE WE HAVE
APPROVED QA IN PLANT
TESTING FACILITIES.

INDUSTRIAL TRANSFORMER
Corporation
GOULDSBORO PENNSYLVANIA

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

Three-Element Governor Can Control Three Circuits



This governor can be arranged to open or close three separate circuits at three different speeds anywhere between 1200rpm and 10,000-rpm. On special order, units can be furnished for operation at lower or higher speeds. Although all trip speeds are preset at the factory to customer specifications, any of the three trip points can be easily adjusted after installation.

The operating mechanism consists of rotating governor flyweights acting upon snap switches. This combination eliminates the need for collector rings. Contact "chatter" has been reduced to minimum, and repeatable accuracy is extremely high. The contacts are rated 10amp at 115v a-c.

When this three-element unit is used in conjunction with engine or turbine control systems, the three functions of starter disconnect, under-speed, and over-speed protection are combined in one small compact package. Shown is the Model GA-3, which has been arranged for mounting on a standard aircraft AND20005 engine tachometer drive pad. It is also available in all of the older style drives including flexible shaft, SAE distributor take-off, and belt or chain drive. Standard units are completely splash-proof, and all parts are either plated or made from non-corrosive metals. Special waterproof and/or fungus proof units can be furnished. Synchro-Start Products, Inc., Dept. ED, Skokie, Ill.

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

Load Control Relay Eliminates Damaging Overloads



The MEK-2128 Load Control Relay can detect the slightest change in input current to the machine or process drive motor, and can be used to correct the difficulty, stop the machine or process, adjust the feed, sound an alarm, etc. It is designed to detect increases in current above a desired

preset load. Other machinery load controls available from this firm detect load decreases, or changes both above and below desired limits. Machinery Electrification, Inc., Dept. ED, Northboro, Mass.

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

Broadband RF Power Meters

THE CHOICE OF ALL ARMED SERVICES
FOR MICROWAVE POWER MEASUREMENTS

POWER: PULSE and CW—5 μ W to 5W average

FREQUENCY: 20MC — 10,000MC

ACCURACY: \pm 5% Absolute at all ranges,
frequencies, temperatures

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

TYPICAL APPLICATIONS

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

Write for descriptive literature to Department ED 6-M

Bruno - New York Industries Corporation

DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT

460 WEST 34TH STREET

NEW YORK 1, N. Y.



HIGH RESOLUTION LABORATORY STANDARD DC VOLTMETERS

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

Model LVM-5

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

Model PVM-4

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

The Model LVM-5 may also be used as a deflection potentiometer, a sensitive null indicator and a precision millimicroammeter. Write for catalog PL which describes these instruments completely. Address Dept. ED 6-D.



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

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

Computer Company of America
DIVISION OF BRUNO-NEW YORK INDUSTRIES CORP.
460 WEST 34TH STREET

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



NEW!

Silic-O-Netic TIME DELAY RELAY

- Silicone-controlled response
- Accelerated core reset

At low cost, this new Heinemann Silic-O-Netic Relay offers . . . long-life stability . . . fast reset time . . . long time delays.

Heinemann has applied its industry-proven hydraulic-magnetic principle to a newly designed time delay relay.

The Type A Silic-O-Netic Relay is a masterpiece of simplicity. It's positive in action, fully dependable, trouble-free. Its time element has only one moving part . . . no mechanical linkages . . . no friction or wear . . . no sticking or binding ever . . . no adjustments to be made.

Now in the Type A design, this well-accepted time delay principle has been successfully integrated into a highly practical relay for industrial service. It's well worth your immediate investigation.

Write for Bulletin T-5002.

IN BRIEF

Hermetically sealed . . . definite operating characteristics are sealed in . . . do not change with age.

Time delays . . . from $\frac{1}{4}$ to 120 seconds.

Small size . . . Overall dimensions: $2\frac{1}{16}$ " x 2" x $1\frac{1}{16}$ ". . . Weight: 3 ozs.

High speed actuation . . . positive contact operation, good contact pressure.

HEINEMANN

ELECTRIC COMPANY

156 Plum St., Trenton 2, N. J.



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

High-Frequency Heating Unit For Induction and Dielectric Heating



This high frequency unit, for both induction and dielectric heating, can be used initially in the laboratory to determine the most effective applications, then transferred directly to full or part-time duty on the production line. Uses cover the full range of heat-treating operations.

Applications of the induction unit include, for example: sealing polyethylene; bonding Teflon; pin-point heating of metals isolated in insulation or in a vacuum; and rapid glueing, brazing, soldering, hardening, annealing, and melting of metals. Unusual other uses include melting a non-conductor in a matrix of the same material; and inducing controlled, variable voltages into isolated circuits. Dielectric applications include rapid vulcanizing, polymerizing, and sealing of plastics; heating, drying, or sterilizing liquids and solids (regardless of thickness); and gas ionization (as in spectographic work).

With a single power supply and timer, permitting low cost, the 5kw dielectric unit can be run continuously at a frequency of 85Mc. The induction unit has a 10kw output tube. Both outputs are variable from 0 to 5kw. By simple switching in the wiring, a wide range of voltages can be made available. Radio Frequency Co., Dept. ED, Medfield, Mass.

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

Rectifier Stack 12' Corrosion-Resistant Unit



The "Mastodon" Rectifier Stack has been added to this firm's standard line of rectifiers, transformers, and battery charges (a line of 128 models ranging in output yields from 18w to 150,000w). The new unit derives its name from its physical size and skeletal appearance, measuring 12' long and 3' x 3' square.

The assembly as a whole is made up of 48 selenium stacks, conveniently and strongly mounted in an angle-iron frame. It is protected with fungus resistant paint and varnish, permitting use in damp places or in laboratories where chemical fumes may be encountered. Electronic Rectifier Co., Dept. ED, Rochester, N. Y.

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

there's a

BETTER WAY...



use BIRTCHER KOOL KLAMPS!



KOOL KLAMPS will help keep your miniature and subminiature tubes COOL — and will hold them firm and secure, no matter how they are shaken or vibrated.

KOOL KLAMPS are made of a specially developed heat-treatable alloy 99½% pure silver. They combine high thermal conductivity with great strength — in a one-piece unit. No need for special "inserts" which slow up installation and make maintenance difficult.

KOOL KLAMPS are available with new "independent finger" construction or standard solid construction.

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

SEND FOR KOOL
KLAMP CATALOG ED-6

The BIRTCHER CORPORATION
4371 Valley Blvd. Los Angeles 32, California

CIRCLE ED-142 ON READER-SERVICE CARD

ELECTRONIC DESIGN • June 1955

transistor & digital computer techniques

APPLIED TO THE DESIGN, DEVELOPMENT AND APPLICATION OF

AUTOMATIC RADAR DATA PROCESSING, TRANSMISSION AND CORRELATION IN LARGE GROUND NETWORKS

Engineers & Physicists

Digital computers similar to the successful Hughes airborne fire control computers are being applied by the Ground Systems Department to the information processing and computing functions of large ground radar weapons control systems.

The application of digital and transistor techniques to the problems of large ground radar networks has created new positions at all levels in the Ground Systems Department. Engineers and physicists with experience in fields listed, or with exceptional ability, are invited to consider joining us.

FIELDS INCLUDE

- TRANSISTOR CIRCUITS
- DIGITAL COMPUTING NETS
- MAGNETIC DRUM AND CORE MEMORY
- LOGICAL DESIGN PROGRAMMING
- VERY HIGH POWER MODULATORS AND TRANSMITTERS
- INPUT AND OUTPUT DEVICES
- SPECIAL DISPLAYS
- MICROWAVE CIRCUITS

Scientific and Engineering Staff



Culver City, Los Angeles County, California

CIRCLE ED-143 ON READER-SERVICE CARD

Dial Saw

Cuts Holes from 1-1/8" to 3-1/2"



This universal hole-cutting tool is now available with increased cutting range in the Model 400. It will cut any size hole from 1-1/8" to 3-1/2" diam in metals, wood, plastics, etc. It uses the same principle of operation as the two

earlier models: three high-speed-steel cutting blades adjust simultaneously to the size desired by rotating the dial. It can be used with hand drills, drill press, lathe, and milling machines.

The high-alloy shaft, 3/8" round with three flats milled for chuck mounting, has a strength of 175,000-psi. The saw comes complete with three sets of cutter blades (each set consisting of three individual cutters); one set for non-ferrous metals and plastic, one set for iron and steel, one set for wood. The cutting depth of the metal cutting blades is 3/8", the wood blades 1"; material twice as thick as the length of the cutter blades can be cut by reversing the work. Robertson & Ruth, Dept. ED, Box 534, Elmhurst, Ill.

CIRCLE ED-144 ON READER-SERVICE CARD FOR MORE INFORMATION

Wire-Wound Resistors

Made for Easy Adjustment



This adjustable wire-wound resistor, the "Smoothie", features an adjustable slider band, which can be loosened and tightened by a

convenient knurled plastic nut or a hexagon nut, as desired, for smooth, quick adjustment. The adjustable slider band is moved to a new position without danger of damage to fine wire windings: the contact point is automatically lifted out of contact during adjustment. No screwdriver is needed. Adjustment is accomplished with one hand and without danger of burns, regardless of resistor temperatures.

Available sizes include nominal core diameters of 5/16", 9/16", 3/4", and 1-1/8", ranging in nominal wattages from 10w to 200w. Contacts are made in the embossed dimple type or of silver. Resistors, Inc., Dept. ED, 5226 W. 26th St., Chicago 50, Ill.

CIRCLE ED-145 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • June 1955

Condense and Save!



*plastic condenser block capacitors
save you Space, Labor, Money!*

Multiple capacitors in **one** block! Now you can install one capacitor case and use 125% less space as before — at a saving in labor costs of up to 300%.

Available with polystyrene or MYLAR* dielectric to tolerances as close as 1%.

NOW!



Precision Decade Capacitors

with attached rotary switch or completely board.

CAPACITANCE
... FROM .001
TO 10 MFD

CHECK THESE OUTSTANDING FEATURES:

- STANDARD VOLTAGE RATING... 200 V. D. C.
- VERY HIGH INSULATION RESISTANCE
- LOW DISSIPATION FACTOR
- LOW DIELECTRIC ABSORPTION
- SMALL SIZES

Available with polystyrene or MYLAR* dielectric to tolerances as low as 1%.

*DuPont T.M.

Join America's leading electronic equipment manufacturers in specifying Southern Electronics' precision polystyrene capacitors for your most exacting requirements. Write for complete catalog today!

SOUTHERN ELECTRONICS



Corporation

239 West Orange Grove Ave., Burbank, Calif.

CIRCLE ED-146 ON READER-SERVICE CARD FOR MORE INFORMATION

New Information OF INTEREST TO Computer Engineers and Designers

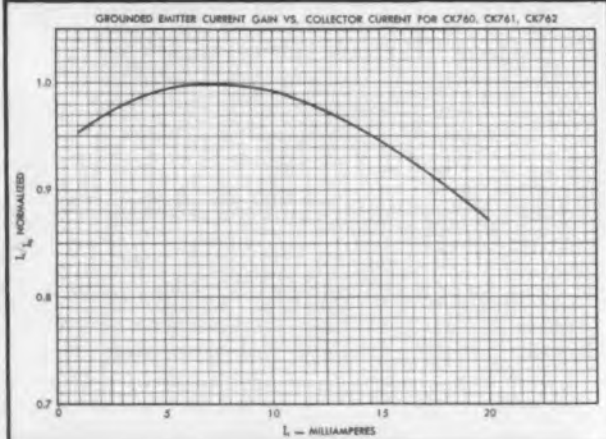
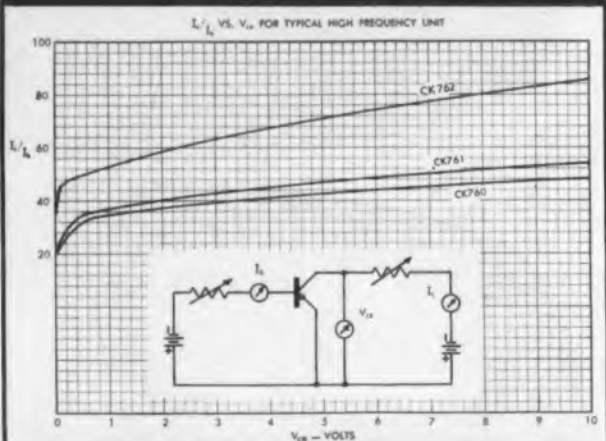
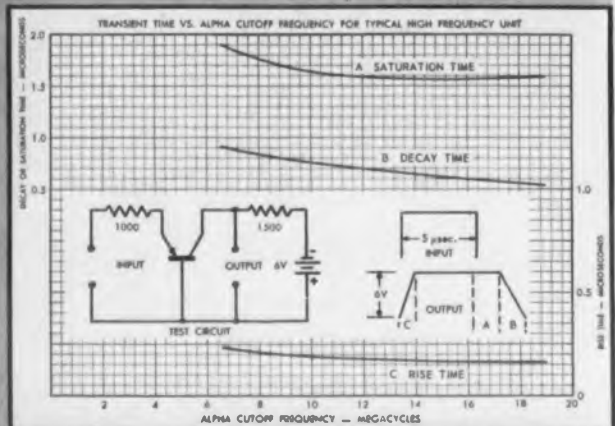
on the
NEW



RF Transistors

RAYTHEON RF TRANSISTORS ARE

- completely interchangeable without selection of components
- successfully field tested for an entire year. In mass production for several months.
- made by the Raytheon perfected fusion process that has already produced nearly two million transistors



HIGH FREQUENCY TRANSISTORS — HERMETICALLY SEALED CASE										
Type	Collector		Emitter		Extrin. Base Resis. ohms	Base Current Ampl. Factor	Alpha Freq. Cutoff mc.	Max. Junc. Temp. °C	Temp. Rise °C/mW	Coll. Capac. μμf
	Volts	Cutoff μA	mA	Cutoff* μA						
2N112/CK760	-6	1	-1.0	0.5	75	40	5	85	0.62	14
2N113/CK761	-6	1	-1.0	0.5	75	45	10	85	0.62	14
2N114/CK762	-6	1	-1.0	0.5	75	65	20	85	0.62	14

*Cutoff current measured at Vc = -12 volts Note: above characteristics are average except where noted



Excellence in Electronics.

RAYTHEON MANUFACTURING CO.

RELIABLE SUBMINIATURE AND MINIATURE TUBES
SEMICONDUCTOR DIODES AND TRANSISTORS
NUCLEONIC TUBES - MICROWAVE TUBES
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380 Fifth Avenue, New York 17, New York, Plaza 9-3900 • 622 South La Brea Ave., Los Angeles 36, California, WEbeter 6-2851

CIRCLE ED-147 ON READER-SERVICE CARD FOR MORE INFORMATION

Data Translator For Analog-Digital Uses



This "Datrac" Data Translator is for use with analog computers or as a general laboratory instrument. It converts the voltage of a single input to digital output at the rate of 100,000 sam-

ples/sec. In addition, it will continuously furnish a parallel digital code at its output from a varying voltage input every $10\mu\text{sec}$. It also provides immediate follow-up of each new signal input with a digital code at the output.

This servo type voltage-to-digital converter consists of a reversible counter, a digital-to-voltage converter, and input comparator and appropriate control circuits. The code in the reversible counter is continuously applied to the converter so that a voltage proportional to the digital code is generated. At $10\mu\text{sec}$ intervals, this voltage is compared to the input voltage and the control circuits servo the reversible counter so that the difference between the input voltage and the reconverted signal is zero.

Accuracy is $\pm 0.05\%$ with a full scale range as small as 20mv or as large as 10,000v bipolar. Output codes may be visual display of binary digits or in electrical form that will drive magnetic tapes, electrical printers, etc. Both binary and decimal models are available. It is furnished with standard cell reference and is completely self-calibrating. Epsco, Inc., Dept. ED, 588 Commonwealth Ave., Boston 15, Mass.

CIRCLE ED-148 ON READER-SERVICE CARD FOR MORE INFORMATION

Small Socket Screws Offered as Standard Items



A complete line of socket head cap and set screws in sizes from No. 4 (0.112") down to No. 0 (0.060") is being offered as standard items. This company offers a full range of small size socket

screws in both 18-8 stainless steel and heat-treated alloy steel, in a variety of lengths and threads. The socket screws are available in either the "hex" socket or the multiple spline socket. The Bristol Co., Socket Screw Div., Dept. ED, Waterbury 20, Conn.

CIRCLE ED-149 ON READER-SERVICE CARD FOR MORE INFORMATION

Sure it's still writing!



unique clutch actuated dual recording milliammeter

... keeps writing accurately - regardless of jolts, tilts or vibration! Designed and built by Texas Instruments, this ink-writing instrument features TI-developed high-torque magnetic fluid clutch meter movements and exclusive enclosed ink system that make it ideal for use in moving vehicles ... aircraft, jeep, truck or boat. Thousands of these portable recorders in operation throughout the world provide field proof of their writing superiority and trouble-free operation.



durable . . . portable . . . dependable

lightweight - only 15½ lb.

sensitive - one milliamperere for full scale (4½ inch) deflection.

fast response - 60 milliseconds full scale rise time; will respond to 10 cps.

eliminates galvanometer - unique TI-developed instrument-sized magnetic fluid clutches replace delicate galvanometer.

dual channel - two independent writing systems and four selective chart speeds within one recorder.

write today for
bulletin DL-C 400



TEXAS INSTRUMENTS
INCORPORATED

6000 LEMMON AVE. DALLAS 9, TEXAS

CIRCLE ED-150 ON READER-SERVICE CARD
ELECTRONIC DESIGN • June 1955

64 pages!

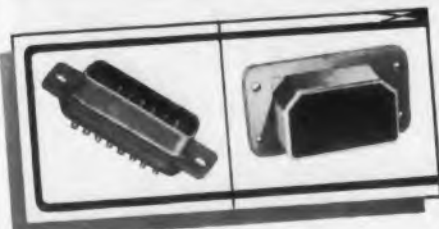
New Material on

CANNON

Rack-Panel-Chassis

CONNECTORS

THE MOST COMPLETE LINE AVAILABLE



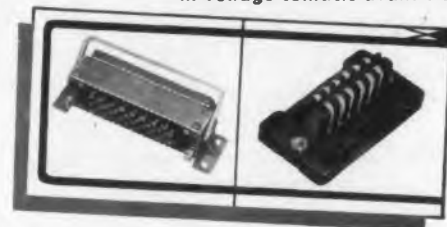
Steel-shell sub-miniatures in 4 sizes, 15 to 50 five-amp. contacts. Hermetic seal pin side also available. Aluminum-shell miniatures in two sizes, 9 inserts.



Instrument panel disconnects.



Twinax, coaxial, thermocouple, hi-voltage contacts available.



For use in close or cramped quarters. Radio terminal connectors, right, have no shell, designed for quick-disconnect on radio chassis.

Cannon DP-RTC rectangular connectors range all the way from sub-miniature to standard size units... meet every need where space is a problem.

Insulators are designed for strength, lightness and high dielectric qualities. Contacts are copper alloy, precision machined from solid bar stock for perfect fit. Socket contacts, wherever size permits (except RTC leaf type), use closed-entry construction to prevent spreading that might be caused by over-sized contacts or test probes.

Write for New DP9 Bulletin—a new kind of engineering bulletin. Please refer to Dept. 143.



CANNON PLUGS

CANNON ELECTRIC CO., 3209 Humboldt St., Los Angeles 31, Cal.

CIRCLE ED-151 ON READER-SERVICE CARD
ELECTRONIC DESIGN • June 1955

Camera
Has Many Lab Uses



The Model C-4 "Kymograph" Camera features precision for both intermittent and continuously moving film advance. It is suitable for cathode-ray oscilloscope, photoflash sequence, and time lapse photography.

Accuracy registration permits play-back on conventional 35mm projectors. The major new feature of this camera, other than its accuracy, is a control system which allows it to drive synchronously, or to be driven by associated equipment or subject material.

There are 12 continuously moving film speeds ranging from 0.25mm/sec to 1000mm/sec, accurate to 0.5%. Full recording speed and full stop are reached in only 20millisec. Total running time may be preset. Control may be by remote signal or by an internal switch. Commutator contacts "make" at standard frame length for flash cinematography.

Intermittent frame advance may be single or repetitive, with single or double frame size. The range of repetitive frame advances is from 1/min to 4/sec. Both exposure time and time between exposures are independently adjustable. Exposure range is 1/100-sec to 1sec. Synchronous outputs include a voltage pulse at full shutter opening with a make-or-break contact 4millisec later. Several cameras at remote points may be synchronously controlled. Grass Instrument Co., Dept. ED, 101 Old Colony Ave., Quincy, Mass.

CIRCLE ED-152 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Resistors
In Space-Saving Construction



These encapsulated precision wire-wound resistors, shown full size, have a "flat" shape offering a

space-saving up to 50% over conventional round units with the same wattage and comparable resistance value characteristics. Non-inductively wound, the high precision units will remain stable under all adverse climatic conditions within an ambient temperature range of -65° to $+125^{\circ}\text{C}$, and will meet all "A" characteristics of salt water and humidity tests. They are available in 1/3w, 1/2w, 3/4w, and 1w sizes. Standard performance tolerances are available down to 1/20 of 1%. RHO Engineering Co., Dept. ED, 4205 Sepulveda Blvd., Culver City, Calif.

CIRCLE ED-153 ON READER-SERVICE CARD FOR MORE INFORMATION

Kearfott
RDF Loops
Exceed
41,000 Hours
Operation

Test Made with Equipment Exposed to Full Range of Weather Conditions.



The Kearfott AS-313 Radio Direction Finder Loop and the ID-90 Indicators withstood continuous operation for 41,977 hours. This is over 40 times the 1,000 hours required by Air Force specifications for Sealed Aircraft instruments.

The ability of Kearfott equipment to operate long beyond requirements is significant. The same hermetic seal principle employed in the construction of Kearfott Loops is also used to impart dependability and long life to Kearfott Gyros, Computers and Packaged Servo Systems.

The Kearfott organization is available to you to aid in meeting instrumentation requirements of modern airborne equipment.

—Send for Technical Data Sheets

KEARFOTT COMPONENTS
INCLUDE:

Gyros, Servo Motors, Synchros, Servo and Magnetic Amplifiers, Tachometer Generators, Hermetic Rotary Seals, Aircraft Navigational Systems, and other high accuracy mechanical, electrical and electronic components. Send for bulletin giving data of components of interest to you.

ENGINEERS:

Many opportunities in the above fields are open. Please write for details today.

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION



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

Sales and Engineering Offices: 1378 Main Avenue, Clifton, N. J.
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West Coast Office: 253 N. Vinado Avenue, Pasadena, Calif.

CIRCLE ED-154 ON READER-SERVICE CARD FOR MORE INFORMATION

I tol 'em and I tol 'em!



Yes, I did

"Being chief engineer on one of these red hot projects ain't hay and the big gripe is that no matter what goes wrong I can't fix it. That's why at the start when the confusion is still gently confined to the breadboard you should call in Sigma. Confusion is an old story to those boys." — actual unsolicited testimonial by I. M. A. Ape, Sc. D., chief engineer, Simian Products Company, Kivu Heights, Africa.

OK, now that you've had the hard-sell, we do have a relay that we'd like to talk about. It does some difficult jobs very well. Here are the basic specifications:

SIGMA SERIES 22

Miniature (not sub-miniature) sensitive double pole sensitive relay. Excellent combination of small size and high performance.

22KN

Sensitivity . . . SPDT: 20 milliwatts (e.g., with 8000 ohm coil, operate 1.6 ma.)
DPDT: 40 milliwatts (e.g., with 8000 ohm coil, operate 2.3 ma.)

Contact Rating . . . 2 amp., 115 V AC or 28 V DC, 100,000 operations

Vibration . . . 10 g from 10-2000 cps

Shock and Acceleration . . . 100 g non-operating

50 g operating with additional margin

Size . . . 22RJ: 1" square x 1 1/2" high
22RJ2, 22KN: 1" square x 2" high

Weight . . . 3 ounces max.

If you are interested, we'll be glad to send you a bulletin sheet on the Series 22, or a complete catalog if you prefer.



SIGMA

SIGMA INSTRUMENTS, INC.

91 Pearl St., S. Braintree, Boston 85, Mass.

CIRCLE ED-155 ON READER-SERVICE CARD FOR MORE INFORMATION

Registration Control

Uses Phototube



Control Type 23LF3, Model 1006, is a registration control which operates continuously over both high and low speed ranges without special attachments. De-

signed for maintaining precise accuracy in automatic machine operations on paper, textiles, plastics, tin, steel, or other sheet material, it responds instantly to the appearance of a mark printed on material moving past at a speed from 15fpm to more than 500fpm. The abrupt change in light intensity caused by the passage of this mark actuates the control relay which will trigger speed correction devices, keeping the material in perfect synchronization with the machine operation.

The circuit will respond to impulses as short as 0.0005sec. The circuit design ensures great stability over wide variations of line voltage. The scanner supplied with the control consists of a light source, lens system, phototube, and amplifier tube, all mounted in a single rugged housing. The precision lens system is used for both incident and reflected light. Several scanner models are available to accommodate the reflectance characteristics of most materials.

Supply required is 115v 60cy. Consumption is 35w. Net weight is only 20 lb. Photoswitch Div., Electronics Corp. of America, Dept. ED, 77 Broadway, Cambridge 42, Mass.

CIRCLE ED-156 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Connector

Miniature AN-Type



The compact, lightweight, Series 1300 "Continental" Connectors meet military requirements for precision AN-type connectors of rugged electrical and mechanical construction. Applications are extremely varied, with special emphasis on missiles, aircraft electronics, and miniature portable electronic gear.

A feature of this series is one-piece molded inserts to prevent moisture traps and electrical breakdown. Two shell sizes accommodate 3, 4, 5 contacts, or 15, 19, 27, 31 contacts for No. 20 AWG wire. DeJur-Amseo Corp., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N. Y.

CIRCLE ED-157 ON READER-SERVICE CARD FOR MORE INFORMATION

for
• Less space
• Longer life
in Transistor
Circuits

... use MALLORY
MERCURY
BATTERIES



Pioneered by Mallory, mercury dry batteries and Power-Paks deliver constant voltage and constant energy for optimum transistor performance... give long life on the shelf and in service. High energy in miniature size.

... use
MALLORY
SILVERLYTIC*
CAPACITORS



Capacitances up to 30 mfd. at 6 volts are compressed into sub-miniature case only 7/32" in diameter by 3/8" long, with temperature range from -55° C. to +85° C. Ultra-miniature Type TAW, rated 4 and 6 mfd. at 4 volts is only 0.145" in diameter by 3/8" long.

For complete technical data, write to P. R. MALLORY & CO. INC., Indianapolis 6, Indiana.

*Trade Mark

MALLORY

CIRCLE ED-158 ON READER-SERVICE CARD
ELECTRONIC DESIGN • June 1955

where
QUALITY
is a
MUST

and
COST
a
PROBLEM

IT'S TIC'S NEW P-SERIES PRECISION POTENTIOMETERS



Typical production line application of TIC's "P" series potentiometers is shown at the plant of Massa Laboratories, Hingham, Mass. These units have enabled Massa Laboratories to economically achieve and hold the critically accurate gain control calibration and wide band frequency response required in their Model M-185 60db Laboratory Amplifier widely used in high intensity sound and vibration research. Production savings arise from the low first cost and from economy of assembly brought about by the precision linearity of these potentiometers which permits use of pre-engraved attenuator dials without elaborate circuit padding or adjustment.



New, low-cost P-series precision potentiometers meet growing demand for economical precision potentiometers in commercial instrumentation.

Precision features developed for stringent military applications have been retained in the new, low-cost P-Series.

Unique, dual, precious metal wiper provides low-noise operation . . . long life . . . and low torque. Precision-bored, phosphor-bronze sleeve bearing further reduces torque. Moulded bakelite housing minimizes distributed capacitance providing wide frequency response. Patented resistance — element design permits greater variety of nonlinear functions. Low temperature coefficient of resistance wire produces stability in extremes of temperature . . . minimized distributed capacitance provides stability in extremes of humidity.

The P-Series potentiometers are available in three sizes: 3-inch (P-3) . . . 1 3/4-inch (P1 3/4) . . . and 1 1/4 (P1 1/4). Resistance ranges are from 100 ohms to 200,000 ohms Threaded bushing . . . tapped hole . . . or precision pilot mounts are available. Single or ganged assemblies as required.

For complete specifications write for FREE brochure No. P-103.

* U.S. Patent No. 2511807

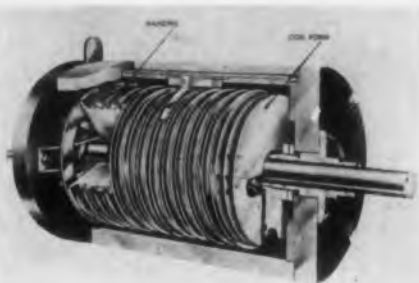
TECHNOLOGY INSTRUMENT CORP.

555 Main Street, Acton, Mass. COlonial 3-7711
P. O. Box 3941, No. Hollywood, Calif. POplar 5-8620

CIRCLE ED-159 ON READER-SERVICE CARD

Delay Lines

Employ Special Coil Forms



High dielectric qualities and form stability in the coil form are largely responsible for the measuring accuracy and sensitivity of these continuously variable dis-

tributed constant, electromagnetic delay lines. Current losses are held to a minimum by use of a rigid ultra-high-frequency insulating material known as "Polypenco Q-200.5" for the coil form. The material, supplied by the Polymer Corp. of Pennsylvania, is a rigid, clear, and transparent heat-hardening polymer with a low dielectric constant of 2.4 to 2.5.

These helical lines give time delay of 0 to 0.2 μ sec in 10-turn models, and 0 to 0.3 μ sec in 15-turn models, in increments of only 0.02milli μ sec. They feature extremely sharp rise-time of 0.0175 μ sec max, and are accurate to within 5% of full scale.

The delay lines, produced in both variable-delay and fixed-delay models, are used for laboratories, research and development work, radar scanning, speed trap monitors, color TV broadcasting, high-frequency oscilloscopes, and short-time memory systems. Though intended as trigger type variable delay lines, they provide a band width of 20Mc with negligible phase distortion. For signal applications, the fixed delay model provides a band width of 25Mc with only 3db down. Helipot Corp., Dept. ED, S. Pasadena, Calif.

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

Correction

Not *not* but *now* describes the availability of **HIG-3 Integrating Gyros**, ED, April 1955, p. 63, ED-70.

Relay

Low-Cost 1 oz Unit



This small spdt relay is designed to sell in quantity at very low cost for use in such devices as automatic headlight dimmers, radiosondes, radio-controlled toys, and similar items. Tentative specifications include 50mw to operate

(24ma in 9000 ohm coil); 1amp max contact load; up to 9000 ohm coil resistance; 1-5/32" x 1-5/16" x 1" high max size; and weight of 1oz. Sigma Instruments, Inc., Dept. ED, 81 Pearl St., So. Braintree, Boston 85, Mass.

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

● For production or laboratory use, units with performance characteristics similar to those shown below can be furnished to your configurations and frequency requirements.

KEARFOTT MAGIC TEE #W 122-1A

A broad band impedance-matched hybrid junction, engineered and produced to exacting tolerances in RG 52/u, or RG 67/u. This Magic Tee provides a maximum VSWR of 1.20 over a 10% band width...has isolation of better than -35db from any arm with output balance of 0.1% or better.

Available in aluminum or brass.



TYPICAL CURVE

Write for brochures on Microwave Components Test equipment

KEARFOTT SPECIALIZED MICROWAVE COMPONENTS

IMPEDANCE-MATCHED
MINIMUM VSWR

KEARFOTT SHORT TWIST #W 128-1A

Where space is important...an X band 90° rotation in only 1 3/8" of guide length.



CURVE 1—For minimum VSWR at midband.
CURVE 2—For optimum broadband characteristics.

Good power handling capacity and low VSWR. Other units of this matched series include a "Twist and Turn Elbow," a 90° E to H Plane Tee, Mitred Elbows and a block type Magic Tee. These and standard components can be supplied for specific frequency ranges from 2.5 to 17.5 KMC., upon request. *PATENTS PENDING

Kearfott Stock X-Band units are frequency matched at 9.0 KMC. Other units tuned to different design frequencies can be made on special order. Available in aluminum or brass.

Kearfott COMPANY, INC.

LITTLE FALLS, NEW JERSEY
WESTERN MANUFACTURING DIVISION
14844 OXNARD ST. • VAN NUYS, CALIF.

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

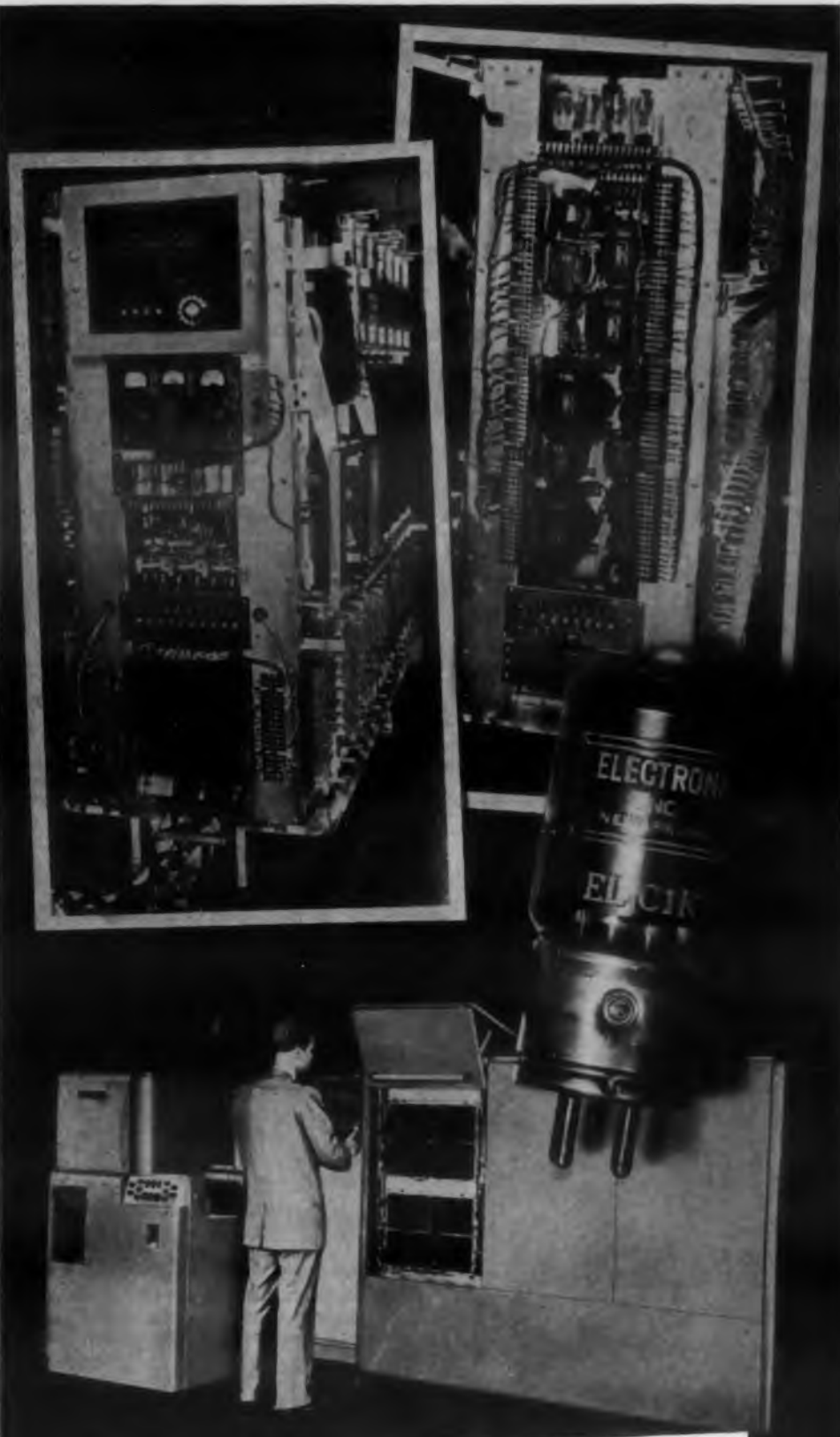
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ELECTRONS, INCORPORATED

127 SUSSEX AVENUE

NEWARK 3, N. J.

*Remington Rand's Univac 120 uses Electronics' xenon,
high current, temperature-free thyratron and
rectifier tubes for reliable power supply.*

CIRCLE ED-164 ON READER-SERVICE CARD FOR MORE INFORMATION

Wheatstone Bridges

Portable and Completely Gasketed



Type RN Portable Wheatstone Bridges are now offered as completely gasketed units. This feature eliminates infiltration of wire or other metal particles to switch assemblies.

The bridges are available with or without Murray and Varley loops.

All models are complete with batteries and ready to operate. Ratio dial settings of bridges are: 0.001; 0.01; 0.1; 10; 100; 1000; M10; M100; M1000; 1/4; 1/9. Decade knobs have steps of 1, 10, 100, 1000 ohms. Ratios are guaranteed to $\pm 0.05\%$ tolerance and resistance dial resistors to $\pm 0.1\%$ of nominal value.

Coils are bifilar wound on ceramic cores, oven aged and varnish-impregnated. All switches are self-cleaning. The indicating galvanometer is of the moving-coil type with a dial having 15 millimeter divisions each side of zero. Sensitivity of the galvanometer is $1\mu\text{amp}/\text{mm}$. The instrument is in a hardwood cabinet with removable cover and carrying handle. Industrial Instruments, Inc., Dept. ED, Cedar Grove, N. J.

CIRCLE ED-165 ON READER-SERVICE CARD FOR MORE INFORMATION

Tapped Delay Line

With Extreme Accuracy



The Model F-110 Tapped Delay Line provides a delay of $112\mu\text{sec}$ tapped at every $2\mu\text{sec}$. An unusual feature is the ac-

curacy of delay, which is up to 0.1% at full delay. Each $2\mu\text{sec}$ tap is calibrated from the beginning of the delay line, thereby preventing the accumulation of error.

The total delay is made up of four units of $28\mu\text{sec}$ each, housed in four separate boxes. If desired, the $28\mu\text{sec}$ units will be supplied separately. The rise time is less than $1.5\mu\text{sec}$ for the total delay of $112\mu\text{sec}$. The impedance is 240 ohms.

These lines are suitable as laboratory standards or for inclusion in laboratory equipment. Control Engineering Co., Inc., Dept. ED, 1925 New York Ave., Huntington Station, N. Y.

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



FOR
ELECTROMECHANICAL
DESIGNERS...
IN THE DEVELOPMENT
OF RADAR AND
COMPUTING EQUIPMENT.

The most advanced developments in electronics are being made in the sphere of airborne radar and related ground control systems because of military emphasis. Further applications of electromechanical techniques in these fields are creating new openings in the Systems Division of Hughes Research and Development Laboratories.

Engineers who have demonstrated ingenuity and inventive ability will find interest in areas of work that call for devising reliable, maintainable, manufacturable designs for precision equipment developed at Hughes Research and Development Laboratories.

The design of this equipment, manufactured at Hughes, involves mechanical, electromechanical, electronic, microwave and computing problems. Design also requires the use of such advanced techniques as subminiaturization, unitized "plug-in" construction, with emphasis on design for volume production. Knowledge of electronic components, materials, finishes and military specifications is useful.

ENGINEERS
experienced in the field of electromechanical design at the research and development level, or those interested in entering this area, will find outlets for their abilities and imagination.

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CIRCLE ED-167 ON READER-SERVICE CARD

ELECTRONIC DESIGN • June 1955

CRYSTAL OVEN for Electronic Industry NOW INVESTMENT CAST BY



Cells cast to depth of 15/16". Oven cast in Aluminum 356T6

INVESTMENT CASTINGS IN ANY CASTABLE ALLOY EXCEPT MAGNESIUM

Crystal oven for electronic industry was formerly machined from solid stock. Now it is an EPCO Investment Casting produced to size, ready for use except for base facing operation and drilling and tapping for mounting screws.

Something you are now machining may be EPCO Investment Cast at considerable saving in time and money.

Get an EPCO quotation before machining or assembling your intricate parts.

Ask about our Vacuum Casting Process for increased quality control



**ENGINEERED
PRECISION CASTING CO.**

MATAWAN-FREEHOLD RD.
MORGANVILLE, N. J.

CIRCLE ED-168 ON READER-SERVICE CARD

Frequency Standard

Delivers up to 5v at 60/120cy



Frequency Standard Model 620 can deliver up to 5v at a precise frequency of 60cy or 120cy (factory set to within $\pm 0.01\%$). Other frequencies can be supplied upon request. Frequency stability is

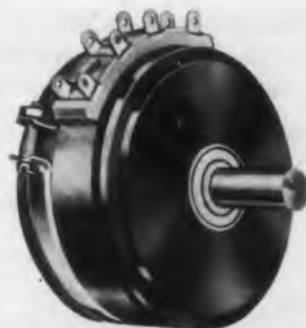
such that temperature variations from -40° to $+85^{\circ}\text{C}$ or line voltage variations from 105-125v will affect frequency of oscillation by less than $\pm 0.01\%$. Output distortion is less than 1%.

The output amplifier is transformer-coupled, which presents the option of either isolated output or grounding. Dimensions are 9" x 15" x 8". Weight is 17 lb. This instrument should be highly useful in accurate low-frequency timing applications. Industrial Test Equipment Co., Dept. ED, 55 E. 11th St., New York 3, N. Y.

CIRCLE ED-169 ON READER-SERVICE CARD FOR MORE INFORMATION

Potentiometers

Fill Non-Linear Requirements



New "Series V Helipot" Precision Potentiometers are engineered especially to meet non-linear requirements. As many as 25 may be ganged on a common shaft during manufacture, while 13 tap connections can be added to

each pot. Every tap is spot-welded to a single turn of resistance wire, assuring a strong, trouble-free connection without shorting out adjacent turns.

Size is 1-3/4" diam x 0.8" long with a 1/4" shaft. The "Helipot" have external clamps for rapid phasing even after installation. Operating range is -55° to $+90^{\circ}\text{C}$. Power rating is above 5w at 25°C ; above 4w at 40°C , and 2.5w as high as 60°C . Standard conformity in models having non-linear output is $\pm 1\%$. Linear models have standard linearity of $\pm 0.5\%$. Finer conformity or linearity is possible on special order.

The "V" series also offers resistances up to 130,000 ohms. Mechanical rotation is 360° continuous; maximum electrical contact angle, 345° ; effective electrical rotation, 325° . Helipot Corp., Dept. ED, 919 Meridian Ave., South Pasadena, Calif.

CIRCLE ED-170 ON READER-SERVICE CARD FOR MORE INFORMATION



GENERAL ELECTRIC ANNOUNCES . . .

NEW, faster, smaller micro-miniature relay

LIGHT WEIGHT, SMALL SIZE: Weighs only .35 ounces and measures .34" x .781" x .81". This tiny relay utilizes balanced armature and simple design, giving you quality and more reliable operation at a consistently high level.

HIGH CONTACT RATING: For low contact resistance and long life, fine silver is used . . . contact rating is 2 amps resistive load at 30 V d-c or 115 V a-c.

FAST OPERATION: With rated voltage on coil, operating time is 1.5 milliseconds. By adding series resistance in coil circuit or by applying high voltage pulse to coil . . . pickup time will be less than 1 millisecond!

LOW OPERATING POWER: 250 milliwatts for standard model . . . 100 milliwatts for current sensitive model.

HIGH SHOCK; VIBRATION RESISTANT: G.E.'s balanced armature and high tip forces withstand shock of over 50 g's and vibration of 10-55 cp's at .12" maximum excursion and 55-500 cp's at 20 g's acceleration.

HIGH TEMP OPERATION: This new micro-miniature relay gives you continuous and efficient operation at ambient temperatures of 125° C.

G.E.'s line of aircraft-type relays will help solve your space-weight problems. Contact your G-E Apparatus Sales office for more application information. General Electric Company, Schenectady 5, New York.

MAIL THIS COUPON FOR G-E RELAY DATA . . .

- A:** Micro-miniature Relay—Bulletin GEA-6346
- B:** High Speed Relay—Bulletin GEA-6212
- C:** Miniature Relay—Bulletin GEA-6213
- D:** Subminiature Relay—Bulletin GEA-6211
- E:** Have Sales Engineer contact me.

Section B792-2, General Electric Company,
Schenectady 5, New York

NAME..... TITLE.....

COMPANY.....

ADDRESS.....

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

GENERAL  ELECTRIC



FIRST REPORT



MYCALEX[®]

TELEMETERING TESTS

1660 hours

of high quality switching at **600 rpm**

March 29, 1955:

After 1660 hours of operation, the new Mycalex Model TM 55 Series Commutator Switch continues to function with a perfect and unchanging signal. This initial continuous test run was halted only to permit a simple brush cleaning and the life test resumed. Test goal **10,000 hours!**



170 hours

of uniform operation at **1,800 rpm**

A second test running concurrently and using the new Mycalex Model TM 55 Series brush construction provided a clean signal for 170 hours at 1,800 rpm! Once again, operation was halted only to permit brush cleaning and the test resumed.

Mycalex 410 provides:

- absolute dimensional and age stability
- imperviousness to moisture
- precision dimensional tolerance control
- temperature endurance to 650°F.

Write today:

Mycalex Electronics Corporation
Dept. 123
P. O. Box 311
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MYCALEX ELECTRONICS CORPORATION



Under exclusive license
of the Mycalex Corporation
of America

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

CIRCLE ED-172 ON READER-SERVICE CARD FOR MORE INFORMATION

Phase Display Equipment

Covers 100kc to 10Mc



The PDE-1 Phase Display Equipment displays the transfer function of any network, amplifier, or system as a simultaneous vector plot of amplitude response and phase shift.

The equipment

measures phase and amplitude distortion over the range of 100kc to 10Mc.

The network under test can have either lumped or distributed constants. Because the phase and amplitude components are displayed simultaneously, the PDE-1 is highly precise and rapid. This feature is of particular value when comparing two supposedly identical networks, or when it is necessary to align, simultaneously, phase and amplitude. The equipment is also of value in the design and evaluation of feedback amplifiers and servo systems. In transistor studies and testing, various parameters can be displayed, and the effects of varying currents through the transistor can be observed instantly.

A built-in marker generator provides markers at 500kc intervals, for Z-axis modulation of the display oscilloscope. Switching circuits permit display of "P" (in-phase) component, the "Q" (quadrature) component, or simultaneous display of "P" and "Q" (polar plot). Wickes Engineering and Construction Co., Dept. ED, Camden 4, N. J.

CIRCLE ED-173 ON READER-SERVICE CARD FOR MORE INFORMATION

15-amp Relay

Weights Only 2 1/2 oz



Special heavy-duty contacts are now available on the Series 595 d-e Telephone Type Relay. The unit is capable of withstanding an inrush current of 50amp at 28v d-c, and is rated for continuous operation at 15amp 28v. Standard 3amp auxiliary contacts can also be supplied.

Designed for high power for its size and weight, it is approximately 1-1/4" long and weighs only 2-1/2 oz. Rugged construction assures long life. It is available as an open-type unit, or hermetically sealed to specification. Guardian Electric Manufacturing Co., Dept. ED, 1621 W. Walnut St., Chicago 12, Ill.

CIRCLE ED-174 ON READER-SERVICE CARD FOR MORE INFORMATION

Thomas A. Edison

A GREAT NAME CONTINUES GREAT NEW ACHIEVEMENTS

When you need
more
than a relay—
consider the
Edison 219



So sensitive — so sure in action is the new EDISON 219 Sensitive Control Relay that it actually eliminates the need for a vacuum tube amplifier. Because of low operating power level, the Model 219 can operate *directly* from a thermocouple or photocell output. And this extreme sensitivity is matched with compact design and relative lightness in weight.

Designed and developed in the world-famous EDISON Laboratory, the new Sensitive Control Relay has proven reliability in military and commercial applications.

Important features of the EDISON Model 219 include:

extreme versatility — interchangeable coils can be supplied with resistances from 0.5 to 23,000 ohms. Normal closing power may be increased 10,000 times without adverse effects.

absolute stability — repeatability averages about $\pm 1.5\%$.

platinum-iridium contacts — either SPST or SPDT, with capacity of 1/2 ampere at 28 volts DC, non-inductive.

maximum vibration resistance — withstands shock of 50 g's in all planes without damage.

Simplify your design problems by writing for complete data on the new EDISON Model 219 — today!

Thomas A. Edison
INCORPORATED

INSTRUMENT DIVISION
55 LAKESIDE AVENUE
WEST ORANGE, NEW JERSEY

CIRCLE ED-175 ON READER-SERVICE CARD

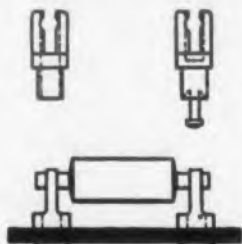
ELECTRONIC DESIGN • June 1955

CIRCLE
ELECT

LERCO

a name to remember
in electronic hardware

new DIODE CLIPS



An efficient, new way of holding crystal diodes. Three types available. Model #9010 for front panel mounting. Model #X9010 for front panel mounting with a blind hole for dip solder application. Model #9015 for rear-of-panel connections. All models available for standard terminal board thicknesses, or to your specifications. Silver plate on half hard brass assures good contact resistance. Retains excellent grip after multiple insertions.

always call **LERCO** for

Complete hardware
Terminal boards
Terminal lugs
Miniature terminals
Taper pin terminals
Insulated terminals
Printed circuit hardware
Connectors

Write for free catalog



LERCO division of
LYNN-DEATRICK, INC.
501 South Varney Street
Post Office Box 69
BURBANK VICTORIA 9-3558

CIRCLE ED-176 ON READER-SERVICE CARD

Dual Shaker System For Aircraft Structural Studies



A system for vibration excitation of aircraft and missiles to help predict flight characteristics from ground tests has been announced by this firm. Two Model S6 Vibration Exciters built for 2" total table travel form the heart of the system, which enables structural resonance and vibrational modes to be determined. One Model S6 is illustrated.

In a typical test of a large airplane, possibly 200 vibration pickups would be mounted at various points in and on the structure. The vibration exciters, attached to convenient points such as wing tips, engine nacelles, stabilizers, flaps, etc., would convert electrical power into vibratory mechanical force. At the various natural frequencies of aircraft, large amplitude vibrations result from quite low mechanical forces. At each such resonance, a revealing study would be made of the mode shape.

The S6 Exciters develop up to 150 lb force from an electronic power supply with an 0.35cy to 500cy frequency range. For light control surfaces, two Model S31-1X Exciters can be provided, each developing up to 25 lb force, and up to 1" total table travel. The pairs of exciters may be operated in phase or 180° apart. MB Manufacturing Co., Inc., Dept. ED, New Haven, Conn.

CIRCLE ED-177 ON READER-SERVICE CARD FOR MORE INFORMATION

Folding Handle Has Numerous Applications



This three-position folding handle, Type X2062, is a nickel-plated unit for applications where compactness is desired, as on portable electronic equipment, drawers, flat cases, and rack-mounted units. Spring-loaded detents allow the grip to lie flat against the object to which it is attached or to open out for pulling or carrying.

Outside dimensions are 4-5/8" wide x 3/8" diam. Hand clearance is 1-13/16". The grip and mounting studs are brass, finished in polished nickel plate. Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.

CIRCLE ED-178 ON READER-SERVICE CARD FOR MORE INFORMATION



FOR THE UTMOST
DEPENDABILITY
AND LONG LIFE
E. F. JOHNSON CO.
USES . . .

CHICAGO

the World's Toughest
TRANSFORMERS

in the *Viking* KILOWATT

This superbly designed and engineered "Transmitter of Tomorrow" will meet the most rigid electrical, mechanical and performance specifications.

E. F. Johnson engineers chose CHICAGO "Sealed-in-Steel" transformers for the Viking Kilowatt . . . modulation, filaments, screen voltage, bias filament, plate and matching choke and filter chokes . . . eleven in all, including many stock units.

Here is further proof of the rugged, trouble-free construction of CHICAGO transformers. Learn about the full line of the world's toughest transformers by writing for the latest CHICAGO Catalog. It is available from your local electronic parts distributor or from Chicago Standard Transformer Corporation.



Export Sales:
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431 Greenwich St.,
New York 13, N. Y.

CHICAGO STANDARD
TRANSFORMER CORPORATION
ADDISON & ELSTON • CHICAGO 18, ILL.

CIRCLE ED-179 ON READER-SERVICE CARD FOR MORE INFORMATION

TO THE FINE ENGINEERING MIND
SEEKING THE CHALLENGING PROJECTS IN



MISSILE TEST

Fine career opportunities in Southern California and Florida exist now within our expanding Convair Engineering Department for engineers experienced in these areas of missile field test operations:

ELECTRONICS ENGINEERS experienced in the installation, check-out and operation of missile guidance systems; installation, check-out, operation and maintenance of ground line and airborne telemetering equipment.

PROPULSION ENGINEERS with experience in liquid rocket engine installation, check-out, operation and maintenance.

HYDRAULICS AND PNEUMATICS ENGINEERS with experience in hydraulic and pneumatic missile control systems (experience in handling liquefied gases advantageous).

CONVAIR offers you an imaginative, explorative, energetic engineering department... truly the "engineer's" engineering department to challenge your mind, your skills, your abilities in solving the complex problems of vital, new, long-range programs. You will find salaries, facilities, engineering policies, educational opportunities and personal advantages excellent.

Generous travel allowances to engineers who are accepted. Write at once enclosing full resume to:

H. T. Brooks, Engineering Personnel, Dept. 1006

CONVAIR

A Division of General Dynamics Corporation

3302 PACIFIC HIGHWAY

SAN DIEGO, CALIFORNIA

Selector Switch Has Diameter of Only 3/4"



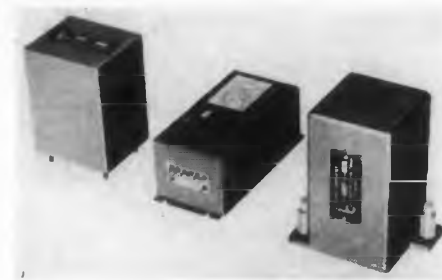
The Series BH Miniaturized Rotary Selector Switch is slightly larger than a penny in diameter, yet provides for a wide range of multi-switching operations.

This switch is available in single-pole (up to 12 positions), two-pole (6 positions), 3-pole (4 positions), and four-pole (3 positions), shorting or non-shorting, as required. It has enclosed construction, constructed to military or commercial usages.

Mounting is the same as that for the usual volume control, with standard 3/8" bushing and 1/4" shaft. The switch measures only 3/4" diam x 13/16" overall for body and terminals. Current ratings are 50ma at 300v a-c or d-c; 500ma at 30v. Clarostat Mfg. Co., Inc., Dept. ED, Dover, N. H.

CIRCLE ED-182 ON READER-SERVICE CARD FOR MORE INFORMATION

Servo Amplifiers With Highly Stable Null



The 434-B, 463-B, and 472-B (shown in that order) are complete 400cy servo amplifiers, requiring no auxiliary components such as demodu-

lators, preamplifier, power supply, and damping generators. They are designed to drive the BuOrd MK 14 and MK 7 servo motors, directly from the 117v, 400cy line. Input may be synchro or potentiometer data.

The significant feature of these units is a null point stable from -55° to $+75^{\circ}$ C, over power line variations of 100v to 130v and 360cy to 440cy. In addition, size and weight have been drastically reduced. They require only six connections: two for input, two for output, and two for 117v power. They are available in the three different packages and mounting styles shown.

These amplifiers are designed for airborne automatic controls, where small size and weight, absolute reliability, and freedom from environmental effects are essential. Industrial Control Co., Dept. ED, Wyandanch, L. I., N. Y.

CIRCLE ED-183 ON READER-SERVICE CARD FOR MORE INFORMATION

FOR TRUE MAGNETIC SHIELDING

SPECIFY

JAN'S
MU-METAL
SHIELDS

- DE-IONIZED and TOTALLY ANNEALED under HYDROGEN
- EFFICIENT PRODUCTION to provide LOWEST COST
- FUNCTIONAL DESIGN

"The most advanced
know-how in
Magnetic
Shielding"



AVAILABLE FROM STOCK — Over 150 combinations of engineered Bezel and Shield assemblies including heavy rubber cushions and calibrated filters FOR ALL POPULAR C. R. T. AND PHOTOMULTIPLIER TUBES.

QUICK DELIVERY OF SPECIAL PROTOTYPES.



HARDWARE MANUFACTURING
CO., INC.

75 NORTH 11th STREET, BROOKLYN 11, N. Y.

CIRCLE ED-184 ON READER-SERVICE CARD
ELECTRONIC DESIGN • June 1955

**Got a
production or
design problem?**

with

- GASKETS • PACKINGS
- WASHERS • SEALS • SHIMS
- BUSHINGS • "O" RINGS



**85 YEARS OF
AUBURN "KNOW-HOW"
HAS THE ANSWERS!**

Yes . . . over 85 years experience in engineering, designing, fabricating and production qualifies Auburn to help you find the ideal answer to your problem. Where gaskets, washers, and other sealing devices are concerned, Auburn engineers are tops in the field. Their know-how is yours—for the asking. We are tooled to fabricate in virtually any material:

- Leather • Asbestos • Teflon • Silicone Rubber
- Neoprene • Rubber • Cork • Fibre • Compositions
- Phenolics • Cloth • Felt • Paper • Cardboard
- Plastics • Brass • Steel • Copper • Aluminum
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Send us your specifications or blueprints.

You'll receive

quotations, recommendations without obligation.



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Representatives: Atlanta, Ga.; Detroit, Mich.; St. Louis, Mo.; Los Angeles, Cal.; Minneapolis, Minn.; Washington, D. C.; Cincinnati, O.; Rochester, N. Y.

CIRCLE ED-185 ON READER-SERVICE CARD

ELECTRONIC DESIGN • June 1955

Terminals and Contacts

For Printed Circuits



These miniature tubular pins and female contacts are designed to cut wiring time, speed production, and save assembly costs on printed circuit applications. They are self retaining types especially designed to promote automation.

Two beads on the lower part of the tubular pin terminal depress and snap out again when pushed through an accommodating panel hole. The pin snaps into the panel with a positive locking action, eliminating roll-over operations. This locking action retains the pin until additional components are added and until it is permanently soldered.

Resistor, capacitor, and neon pigtailed can be fed into the terminal at either the top or bottom of the panel and held in place by tapered portion of the terminal until solder dipped. External leads from other components, such as tuner, CRT socket, volume control, and speaker, can be wrapped around the pin terminals and spot soldered.

The female contact is for use where quick-connect and disconnect type connections are desired. The solderless wire crimp can be varied to crimp over various size insulated wires. Both the pin and contact can be supplied in chain form for automatic feeding and crimping operations. An automatic inserting machine is available for feeding. Malco Tool and Mfg. Co., Dept. EDN, 4025 W. Lake St., Chicago 24, Ill.

CIRCLE ED-186 ON READER-SERVICE CARD FOR MORE INFORMATION

Soldering Unit

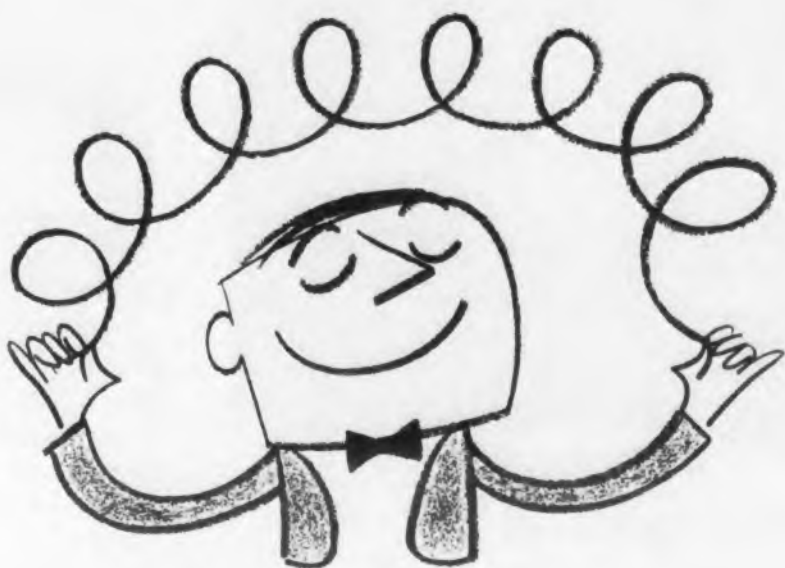
Adjustable for Precision Uses



The Model No. 500 Soldering Unit was developed for soldering of printed circuits, germanium diodes, transistors, and similar precision and sensitive parts. The soldering method employed is designed to eliminate overheating or burning of the parts. Soldering can be controlled by means of the adjustable heat-controller.

The electrode holder, which is extremely light, has a 1/8" diam tip. Vemaline Products Co., Dept. ED, P. O. Box 222, Hawthorne, N. J.

CIRCLE ED-187 ON READER-SERVICE CARD FOR MORE INFORMATION



The things you can do with WIRE

We're going to let you in on a secret that you would normally hear from an electronic components manufacturer only if you caught him talking in his sleep: *specialization is overrated.*

Take I-T-E, for example. Just because we have been producing high-precision, made-to-order, wire-wound resistors for a good many years, and we have customers who won't buy them anywhere else, do we call ourselves resistor specialists? Not by a bootful.

Wire-wound resistors are made of wire—right? Well what are r-f coils, i-f transformers, deflection yokes and focus coils made of? How about chokes, wave traps, torroidal coils? Or reactors, impedance matching devices, magnetic amplifiers?

"Not so fast," you say, "resistor wire is different from coil wire."

True. But while you know that, and we know that, these winding machines of ours don't. All they know is that wire is wire. We can tell them to wind almost any kind of a coil at all, and they go right ahead and do it—so fast and with such precision they make the average time-study man light up like a Christmas tree.

If you're looking for the best buy in wire-wound components, try I-T-E. Remember ours is a strictly do-it-for-you shop. We have no distributors, no top-heavy internal organization. The I-T-E man who discusses your order with you is only a few steps removed from the operator who does the work. Yet I-T-E is a substantial company that you know will still be in business next week. Write I-T-E Circuit Breaker Company, Resistor Division, 19th & Hamilton Sts., Phila. 30, Pa.



I-T-E CIRCUIT BREAKER COMPANY
Resistor Division

CIRCLE ED-188 ON READER-SERVICE CARD FOR MORE INFORMATION



SOLID

ULTRASONIC DELAY LINES by BLILEY...

For use in memory channel sections of electronic computers or other pulsed equipment requiring precise delay intervals with high accuracy and stability. Delay time range is 2 to 3000 microseconds. Incorporates quartz transducers to match modulated carriers in range 5 to 100 mc for ringing lines and 5 to 40 mc for single pulse transmission.

Bliley
CRYSTALS

BLILEY ELECTRIC COMPANY
UNION STATION BUILDING, ERIE, PENNSYLVANIA

CIRCLE ED-189 ON READER-SERVICE CARD FOR MORE INFORMATION



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**DRESS UP YOUR PRODUCT
THIS EASY WAY...**

Attractive equipment often sells better! Now you can give your product that "custom" look simply by installing knobs and dials from Johnson's integrated family line. Dramatic in appearance and functional in design, they are made of tough, scratch resistant black phenolic (to MIL-P-14) with heavy, integral molded brass inserts. Three basic diameters, 1 1/8", 1 3/8" and 2 3/8"—available with matching phenolic skirts or calibrated, satin chromium dial plates.

For more complete information, write to:

E. F. JOHNSON COMPANY
3419 Second Ave. S.W., Waseca, Minn

CIRCLE ED-190 ON READER-SERVICE CARD FOR MORE INFORMATION

96

Deviation Bridge Precisely Compares Resistances



The Type 38 Deviation Bridge compares the resistance of a sample resistor to that of a standard resistor of the same nominal value, and indicates the deviation of the sample from the standard in percent of nominal value. Relay signals are given at two values of deviation each side of zero. The points where the relays operate may be set as desired over the scale of the instrument.

The unit can also monitor a continuous process where a resistance reading is a measure of the process. The instrument control is set to "Control", and the relay outputs can then be used to warn of deviations or to exert a control function when the process goes out of limits.

The indicator scale is 10" long. The standard instrument has two ranges: -2% to +2%, -20% to +20%. Other ranges and up to four scales are available at extra cost. Range is 10 ohms to 100 megohms. Deviation readings are accurate to 0.5% of full scale. Primary power is 115v, 60cy, 100w. Barnes Development Co., Dept. ED, 213 W. Baltimore Pike, Lansdowne, Pa.

The unit can also monitor a continuous process where a resistance reading is a measure of the process. The instrument control is set to "Control", and the relay outputs can then be used to warn of deviations or to exert a control function when the process goes out of limits.

CIRCLE ED-191 ON READER-SERVICE CARD FOR MORE INFORMATION

U-H-F TV Tuner Features Oscillator Radiation Fixes



Model T-90 is a u-h-f TV tuner developed to meet the radio frequency interference objectives of both RETMA and the FCC. It features a rearrangement of the usual TV tuner components and better shielding, which combine to act as oscillator radiation fixes, thereby preventing the oscillator from radiating interference outside the recommended limits. Radio Condenser Co., Dept. ED, Davis & Copewood Sts., Camden 3, N. J.

CIRCLE ED-192 ON READER-SERVICE CARD FOR MORE INFORMATION

Correction

Sorensen & Co., Inc.'s Magnetic Amplifier MA65 is designed to produce a 0-5amp output rather than the 0.5amp reported in *ED*, April 1955, p. 91.

DATA SHEET

FAIRCHILD

PRECISION POTENTIOMETERS

Type 920
1" diameter

Ten-turn Potentiometer (2 1/2" coil length)

This unit has only one-half the diameter and one-third the weight of usual standards. Its all-metal case construction results in greater rigidity and strength, and sustained higher electrical and mechanical accuracy throughout the life of the unit. The Type 920 offers superior resistance to severe environmental conditions. Available with servo, threaded bushing or pilot 3-hole mounting — and ball bearings. 200,000 ohms max. resistance; standard linearity, $\pm 0.25\%$ ($\pm 0.1\%$ special). Low starting torque of 1 oz. in.

SAMPLES AVAILABLE ON ORDER

Fairchild's more complete line can help solve all your precision potentiometer problems. For more information write Fairchild Camera and Instrument Corporation, Potentiometer Division, 225 Park Avenue, Hicksville, L. I., N. Y., Dept. 140-63N1.

CIRCLE ED-193 ON READER-SERVICE CARD FOR MORE INFORMATION

BRUSH "Countess"

Countess

Lower Power • Lower Cost • Versatile Readout

New Digital Counter operates with *one-quarter* the power required by conventional counters. The result is less heat, greater reliability. It's more *versatile*, since data can be presented either electrically or visually. Yet, the Countess is the lowest-priced, high-quality counter available, thanks to advanced design and use of printed circuits. Specify the Countess in your equipment for testing, controlling, computing, etc. For complete information, write Brush Electronics Company, Dept. J-6, 3405 Perkins Avenue, Cleveland 14, Ohio.

Lower Power • Lower Cost • Versatile Readout

New Digital Counter operates with *one-quarter* the power required by conventional counters. The result is less heat, greater reliability. It's more *versatile*, since data can be presented either electrically or visually. Yet, the Countess is the lowest-priced, high-quality

counter available, thanks to advanced design and use of printed circuits. Specify the Countess in your equipment for testing, controlling, computing, etc. For complete information, write Brush Electronics Company, Dept. J-6, 3405 Perkins Avenue, Cleveland 14, Ohio.

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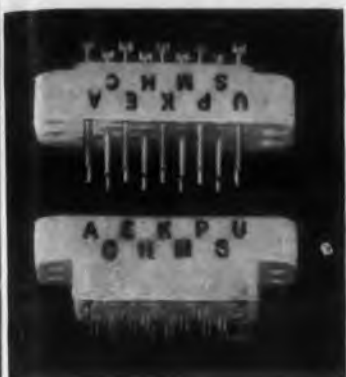
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6
ELECTRONICS

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CIRCLE ED-194 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • June 1955

NEW HIGH INSULATING



performance
WITH
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CONNECTORS

The physical properties of Teflon make it the most nearly perfect high-performance insulating material available. ERIE Teflon 18-pin, 15-pin, and 9-pin Connectors are designed for low-loss, high-frequency service in inter-connection of radio, radar, and other electronic equipment—where connectors must be unaffected by a wide range of ambient temperatures, pressure, altitudes, humidity, high-voltages, and mechanical and shock vibration. Teflon 9-pin Connectors are designed to match with ERIE 9-pin Teflon Tube Sockets. Teflon Connectors meet all RETMA and JAN requirements.

The ERIE Teflon line also includes Stand-off and Feed-thru Insulators, Crystal Sockets, and five sizes of Spaghetti in three colors.

Write for catalog, price list, and the name of your nearest stocking ERIE Electronic Parts Distributor.

ERIE ELECTRONICS DISTRIBUTOR DIVISION
ERIE RESISTOR CORPORATION
Main Offices: ERIE, PA.
Factories: ERIE, PA. • LONDON, ENGLAND • TRENTON, ONTARIO

CIRCLE ED-195 ON READER-SERVICE CARD FOR MORE INFORMATION

Scintillation Counter Tube With 1 μ sec Resolving Time



A scintillation counter tube (shown at right) has been developed for use with "Norelco" X-ray diffraction and spectrographic units. It is 6" long, 1-7/8" in diameter, and weighs approximately 9 oz. Resolving time is 1 μ sec, threshold is 600v to 800v, and plateau is 75v minimum. Operating potential is 600v to 1200v, and background is 45 counts/min with 2" of lead shielding. Life is unlimited.

A sodium iodide crystal is mounted on the end of a photo-multiplier tube which detects light scintillations in the crystal produced by X-ray energy. The output is fed into a pre-amplifier and cathode follower which, with the tube, are mounted on a small chassis.

Also available from this firm are two new proportional counter tubes for use with "Norelco" X-ray diffraction and spectrographic units. One of these units is shown at left in above illustration. Research & Control Instruments Div., North American Philips Co., Dept. ED, Fulton Ave., Mount Vernon, N. Y.

CIRCLE ED-197 ON READER-SERVICE CARD FOR MORE INFORMATION

Grounding Receptacles Low-Cost Three-Prong Units



This 3-prong, parallel-blade layout was developed to meet the new UL requirements eliminating the pigtail for ground-

ing on 110v 15amp line cords. Known as the "Mini-spACE" Grounding Outlet, it is for original equipment manufacturers who supply convenience outlets for power takeoffs as part of their equipment.

Whereas the conventional receptacle design to accommodate the 3-prong plug layout has called for putting the third contact into a molded insulating body, this receptacle uses an adapter plate. This plate simply slips over standard "Mini-spACE" Outlets, providing a low-cost unit, designed for easy installation. Alden Products Co., Dept. ED, 117-L N. Main St., Brockton, Mass.

CIRCLE ED-198 ON READER-SERVICE CARD FOR MORE INFORMATION

Until Sept. 30th!
10%
ALLOWANCE
for
REPLACED
EQUIPMENT



MORE THAN 10 YEARS OLD?

Automobiles 10 years old or more are usually replaced — because they MIGHT cause trouble just at the wrong time!

What About Your Constant Temperature Laboratory Equipment?

Age plus hard usage in an atmosphere that is usually corrosive, plus the factor of extreme heat, is normally conducive to accelerated deterioration. CAN YOU—WITH CONFIDENCE—FACE FUTURE REQUIREMENTS WITH YOUR OLD EQUIPMENT—THIS YEAR? —NEXT YEAR?

Here's How You Get Your Allowance

1. By certifying on Precision certificate that you are REPLACING old constant temperature equipment.
2. You earn a 10% allowance on the price of the new item.
3. If your order is placed on or before September 30th.

WRITE FOR 10% ALLOWANCE CERTIFICATE AND LISTING OF 137 INDIVIDUAL ITEMS, TOGETHER WITH PRICES AND SAVINGS.

If Not, Take Advantage of This Timely Offer—The First of Its Kind to the Laboratory

Precision Scientific Company

3759 West Cortland Street • Chicago 47, Illinois

CIRCLE ED-199 ON READER-SERVICE CARD FOR MORE INFORMATION

Increased Insulation BETTER CONNECTIONS JONES BARRIER TERMINAL STRIPS

Leakage path is increased — direct shorts from frayed terminal wires prevented by bakelite barriers placed between terminals. Binder screws and terminals brass, nickel-plated. Insulation, BM 120 molded bakelite. Finest construction. Add much to equipment's effect.

Jones Means Proven Quality



Illustrated: Screw Terminals—Screw and Solder Terminals—Screw Terminal above Panel with Solder Terminal below. Every type of connection.

Six series meet every requirement: No. 140, 5-40 screws; No. 141, 6-32 screws; No. 142, 8-32 screws; No. 150, 10-32 screws; No. 151, 12-32 screws; No. 152, 1/4-28 screws.

Catalog No. 20 lists complete line of Barrier Strips, and other Jones Electrical Connecting Devices. Send for your copy.

Jones HOWARD B. JONES DIVISION
CINCINNATI MANUFACTURING CORPORATION
SUBSIDIARY OF UNITED CARB FASTENER CO. INC.

CIRCLE ED-200 ON READER-SERVICE CARD FOR MORE INFORMATION

lower costs...
improve design...
save time...
with

GRC die cast GEARS & PINIONS

Cast in one piece, at one time—and one low unit cost! Produced precisely to your specifications, permitting a wide flexibility of design. One-piece assemblies cast with shafts or center holes, or in combination with cams, hubs, spacers and flanges. Maximum size: 1-5/16" outside diameter x 1/16" face width; wider faces for smaller diameters.

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ELECTRONIC DESIGN • June 1955

GAS Filled TUBES

PERFORMANCE TESTED and backed by over THIRTY YEARS OF EXPERIENCE in the manufacture of gas tubes



◀ RADIATION COUNTER TUBES

- CK1020 Thin wall beta, gamma counter, 900 volt
- CK1021 Thin wall beta, gamma counter, 900 volt
- CK1026 Halogen quenched, gamma counter, 900 volt
- CK1049 Halogen quenched beta, gamma counter, 900 volt

Other counter types can be made to your order.

VOLTAGE REGULATOR TUBES ▶

- OA2 150 volts, 5-30 ma.
- OB2-OB2WA 108 volts, 5-30 ma.
- CK5787-CK5787WA 98 volts, 1-25 ma.
- CK6542 150 volts, 5-25 ma.



▶ VOLTAGE REFERENCE TUBES

- CK5651-CK5651WA 85 volts, 1.5-3.5 ma.
- CK5783-CK5783WA 85 volts, 1.5-3.5 ma.
- CK6213 130 volts, 1-2.5 ma.



CORONA VOLTAGE REGULATOR TUBES ▶

- CK5962 700 volts, 2-55 μ a
 - CK6437 (CK1037) 700 volts, 5-100 μ a
 - CK1038 900 volts, 5-100 μ a
 - CK6438 (CK1039) 1200 volts, 5-100 μ a
- 500 to 3000 volt ratings available on special order.



COLD CATHODE RECTIFIER TUBES

- CK1042 2800 volt inverse, 8 ma. dc.
- CK5517 2800 volt inverse, 12 ma. dc.
- CK6174 2800 volt inverse, 3 ma. dc.

All except Radiation Counter Tubes shown actual size.

Listed are representative tubes in each group. All are stable, rugged, reliable — worthy of your complete confidence.



Excellence in Electronics

RAYTHEON MANUFACTURING CO.

RELIABLE SUBMINIATURE AND MINIATURE TUBES
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MICROELECTRONIC TUBES • MICROWAVE TUBES
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For application information write or call the Home Office or: 9501 Grand Avenue, Franklin Park (Chicago), Illinois, TUsend 8-5400
589 Fifth Avenue, New York 17, New York, PLaza 8-3900 • 822 South La Brea Ave., Los Angeles 36, California, WEbster 8-2851

CIRCLE ED-201 ON READER-SERVICE CARD FOR MORE INFORMATION

Splice

For Aircraft Electrical Wiring



A line of self-insulated aircraft splices is available to join cables in sizes from No. 22 to No. 10 AWG. These units permit

complete sub-assemblies of aircraft electrical wiring.

Inside each splice's metal barrel, at its center, is a built-in stop which prevents the conductors from pushing out the opposite end. The splice is staked to each wire at two points simultaneously on the bare conductor and on the wire insulation just behind it. This insulation grip forms a strong joint that splices the wires' insulation as well as the conductors themselves. A center barrel inspection hole permits a quick check of the conductors for proper positioning after staking.

Installation is made with a Sta-kon, WT-145 type tool. The splicer is self-locating in the tool's split die. Color coding of the nylon insulating sleeves provides quick, visual size selection of splices. The Thomas & Betts Co., Dept. ED, 36 Butler St., Elizabeth 1, N. J.

CIRCLE ED-202 ON READER-SERVICE CARD FOR MORE INFORMATION

Breadboard Equipment

Permits Topside Fastening



This breadboard equipment features topside fastening and precision alignment. Plates are reinforced with stainless-steel sheets for extra rigidity, and the hangers

and accessories are fastened to the plate from the top side with special T-nut cap screws. The need for supporting legs or suspensions is eliminated. Slots in the hangers permit additional fine adjustments, ensuring optimum alignment and mesh. Sterling Precision Instrument Corp., Dept. ED, 34-17 Lawrence St., Flushing 54, N. Y.

CIRCLE ED-203 ON READER-SERVICE CARD FOR MORE INFORMATION

If you need a special circuit, component, material, send us your request on company letterhead. We will publish it along with your name and address in the earliest issue possible. Interested readers can answer you directly.

Address brief requests to Bulletin Board, ELECTRONIC DESIGN, 19 E. 62nd St., New York 21, N. Y.

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Means the Finest in Frequency Control in

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Midland makes more frequency control crystals than anybody else. Millions are used in two-way communications throuout the world.

Only a product of the highest quality rates that kind of demand. That's why you *know* your Midland crystal will do a completely dependable job for you.

The quality of Midland crystals is assured by exacting tests and controls through every step of processing. It's quality you can stake your life on — as our men in the armed forces and law enforcement do every day.



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for color television
(also available encapsulated)

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MINIATURES
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conventional or highly specialized...
when it has to be exactly right,
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**WORLD'S LARGEST
PRODUCER OF QUARTZ CRYSTALS**

CIRCLE ED-204 ON READER-SERVICE CARD

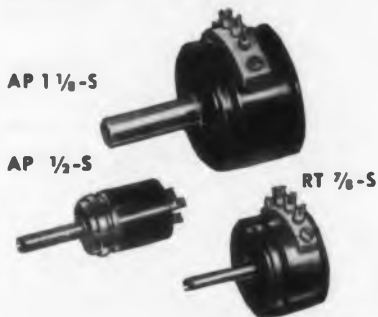
ELECTRONIC DESIGN • June 1955

Aerohm Precision wire-wound Potentiometers



"Lo-TORK" POT LT 7/8

For minimum-torque uses in computer, servo, and selsyn service. Stainless-steel precision ball bearings. Maximum torque is 0.01 inch-ounce. Dissipates one watt at 80°C. Resistances—100 to 100,000 ohms. Weight is only 1/2 ounce. Ganging to six decks; internal clamps hold 7/8" diameter. Standard linearity 0.5%; on special order 0.25%; toroidal winding allows winding angles to 360°; standard 354°.



MICRO-MINIATURE and MINIATURE

Series AP 1/2-S—2 watts continuous at 80°C; resistances 10 to 20,000 ohms, 5% tolerance standard; diameter 1/2", depth 1/2", weight 1/4 ounce; sealed well enough for potting.

Series RT 7/8-S—3 watts continuous at 80°C; resistances 10 to 100,000 ohms; diameter 7/8", depth 3/8", weight 1/2 oz.; standard linearity 2%.

Series AP 1 1/2-S—4 watts continuous at 80°C; resistances 10 to 150,000 ohms; diameter 1 1/8", depth 3/8", wt. less than 3/4 oz.; standard linearity 1%.

All precision-machined, with anodized aluminum bodies, line-reamed phosphor bronze bearings, centerless ground stainless steel shafts, and gold-plated fork terminals. Fully sealed and fungus-proofed. Can be processed, on special order for use at 125°C. Aerohm potentiometers are individually checked for quality and performance.



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Waltham 34, Massachusetts

APPLICATION ENGINEERING OFFICES IN PRINCIPAL CITIES

CIRCLE ED-205 ON READER-SERVICE CARD

Electronic Relay Highly Sensitive Wall Mount



The Model 600A Wall Mount Electronic Relay handles a load of 5500w using an advanced type of mercury plunger relay. Normally-open and normally-

closed operations are selected by means of a convenient switch.

The unit will operate on a closure through a resistance as high as 20 megohms, since the control circuit is exceptionally sensitive. The short-circuit current is less than 1μamp. The open-circuit voltage is approximately 6v. The impedance of the control circuit is purely resistive, preventing arcing across the contacts of the control element. The low short-circuit current and open-circuit voltage prevent carbonizing of sensitive mercury thermoregulators and eliminate contact deteriorations on mechanical contactor control devices, even after millions of operations.

Control circuit leads can be hundreds of feet in length if required. A sensitivity control is provided to set the relay operation at the desired resistance level. The relay comes in a heavy-gage, water and oil proof, weather resistant, J.I.C. wiring box. It is also available in a standard junction box and in an explosion proof housing. Control power is 115v, 50-60cy. Deltron, Inc., Dept. ED, P.O. Box 192, Glenside, Pa.

CIRCLE ED-206 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply

For High-Power Mobile Equipment



This mobile vibrator power supply, Model C-1050, has many applications where dependable high power is required for mobile equipment. It has a maximum power

output of 95w at 450v, and has an incorporated receiver muting relay.

The supply will operate on either 6v to 12v by minor tap changes. The same standard heavy-duty 4-prong vibrators are used for either input voltage. It is sold in completely-wired-and-tested, and in kit forms. James Vibrapower Co., Dept. ED, 4036 N. Rockwell St., Chicago 18, Ill.

CIRCLE ED-207 ON READER-SERVICE CARD FOR MORE INFORMATION

CUSTOM-ENGINEERED TRANSFORMERS



produced under
ONE RESPONSIBILITY
from copper wire to final test...

- Wheeler transformers are custom-engineered to meet your specific requirements. Your needs come first with us.
- Wheeler makes its own magnet wire . . . from the copper rod to the finished, insulated and tested product . . . with quality under our control every step of the way.
- Wheeler uses the most modern winding techniques and equipment.
- Wheeler's facilities for the production of intricate coils and assemblies are unexcelled.
- Wheeler affords fullest protection to its transformers with latest techniques in wax and varnish impregnation and FOSTERITE[®] encapsulation.
- Wheeler transformers are subject to specially devised engineering and test procedures throughout manufacture, and must individually undergo a final comprehensive test before shipment.

To learn what these advantages can mean to you, write:

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Wheeler is constantly adding to its staff of engineers. If you are available and qualify in this field, call us now.

WHEELER MAKES THESE PRODUCTS A *Specialty*

CIRCLE ED-208 ON READER-SERVICE CARD FOR MORE INFORMATION

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AMPERITE
DELAY RELAYS
and
BALLAST REGULATORS

... they're finest ... cost less!

Thermostatic
DELAY RELAYS

Provide delays ranging from 2 to 150 seconds.
MOST COMPACT, HERMETICALLY SEALED

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

Amperite Thermostatic Delay Relays are compensated for ambient temperature changes from -55° to $+70^{\circ}$ C. Heaters consume approximately 2 W. and may be operated continuously. The units are most compact, rugged, explosion-proof, long-lived, and — very inexpensive!
TYPES: Standard Radio Octal, and 9-Pin Miniature.

PROBLEM? Send for Bulletin No. TR-81

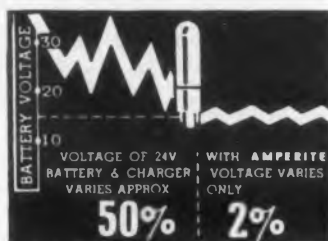
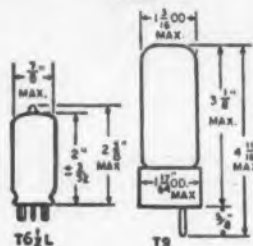
Also — a new line of Amperite Differential Relays — may be used for automatic overload, over-voltage, under-voltage or under-current protection.

BALLAST REGULATORS

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



T9 BULB



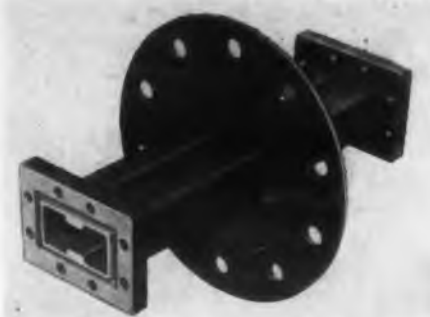
Amperite Regulators are the simplest, most effective method for obtaining automatic regulation of current or voltage. Hermetically sealed, they are not affected by changes in altitude, ambient temperature (-55° to $+90^{\circ}$ C), or humidity. Rugged; no moving parts; changed as easily as a radio tube.

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

AMPERITE CO. Inc., 561 Broadway, New York 12, N. Y.
In Canada: Atlas Radio Corp., Ltd., 560 King St., W., Toronto 7B

CIRCLE ED-242 ON READER-SERVICE CARD FOR MORE INFORMATION

Waveguide Bulkhead Assembly
For C or X-Band Radar



This ridge waveguide bulkhead assembly is for use with C-band or X-band commercial airborne weather penetration radar. It permits passage of a run of ridge wave-

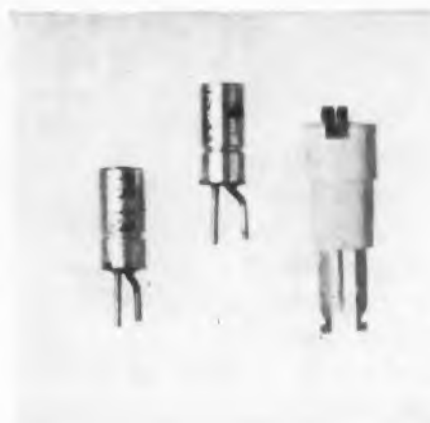
guide through aircraft bulkheads, particularly through pressurized bulkheads where no leakage of air is permissible.

The assembly consists of a section of ridge waveguide with a circular plate brazed radially to its center. A retaining plate of equal diameter is used to bolt the waveguide plate fast to the bulkhead, while an intermediate rubber gasket provides an airtight seal. Vibration-proof stop nuts insure air tightness under all conditions of operation of the aircraft.

The electrical characteristics of the new bulkhead assembly are equivalent to those of similar straight sections of double-ridge waveguide: at 5400Mc (C-band), vswr is 1.05, maximum attenuation is 0.05db/ft, and power capacity at standard atmospheric pressure is 750kw. The equivalent values for 9300Mc (X-band) are: 1.05, 0.05db/ft, and 600kw. Airtron, Inc., Dept. A, 1103 W. Elizabeth Ave., Linden, N. J.

CIRCLE ED-243 ON READER-SERVICE CARD FOR MORE INFORMATION

Point-Contact Transistors
For Amplification and Switching



Imported Siemens transistors for amplifying and switching uses are now available. Type TS13 is a general-purpose amplifier type having nominal ratings of 1.5ma for I_c and $-5v$ for V_c . Power amplification is 20db. Fre-

quency limit is 1Mc. Type TS33 is intended for switching applications. Turn-off time for building up collector impedance is 2μ sec. Maximum ratings are: V_c , $-50v$; I_c , 15ma; V_e , $-100v$; I_e , $-15ma$. Different operating regions and impedance combinations are possible. Metropolitan Overseas Supply Corp., Dept. ED, 133 Broadway, New York 10, N. Y.

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ALLIED stocks for quick shipment the world's largest distributor inventory of special-purpose electron tubes. We specialize in supplying the needs of industrial, broadcast, governmental and other users. To save time, effort and money—phone, wire or write to ALLIED for fast shipment.

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CIRCLE ED-245 ON READER-SERVICE CARD FOR MORE INFORMATION



... ready for YOU

WRITE TODAY for your copy of the new Thomas & Skinner Bulletin No. L-355 on electrical laminations. Complete data with sketches, dimensions, and characteristics charts. Also, complete details on new T&S Test Procedure for Standard EI Laminations.

Call on your Thomas & Skinner engineering staff for expert assistance on your lamination problems.

Specialists in Magnetic Materials



THOMAS & SKINNER
Steel Products Company, Inc.

1157 East 23rd Street, Indianapolis 7, Indiana

CIRCLE ED-246 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • June 1955

announcing

AN IMPORTANT MINIATURE TOROID WINDING SERVICE

We are pleased to announce that new toroidal winding machines of our development enable us to wind #50 (.001") wire in production quantities. The following specifications can be met in two size categories:

- > Minimum inside wound diameter of 1/4" with a wire capacity per unbroken winding of approximately 0.32 grams.
- > Minimum inside wound diameter of 11/32" with a wire capacity per unbroken winding of approximately 0.55 grams.
- > Maximum wound width of 1/4".
- > Minimum wire size nominally #50. We shall attempt to wind finer wire to your specifications if you will supply the wire for trial.
- > Maximum wire size #40.
- > A small unwound sector is required at the present time.
- > Your inquiries are invited.

TIBBETTS LABORATORIES, INC.
Colcord Avenue Camden, Maine

CIRCLE ED-247 ON READER-SERVICE CARD FOR MORE INFORMATION

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



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 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.

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

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-248 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • June 1955

Electrical Switches For Special Applications



A line of electrical switches for special applications is now available from this firm. They are instrument-quality type, and they evolved from switches de-

signed for use in the firm's own line of electrical test equipment.

Among the switches offered is an 81-position 2-circuit model of continuous rotation. This switch is good for over 50,000 operations. Individually spring-loaded contacts are silver plated for low contact resistance. The rotor is of the printed-circuit type with silver plating over copper for low contact resistance and long wear. Voltage breakdown is of the order of 1500v d-c. A printed guard circuit eliminates leakage between contacts. Insulation resistance between contacts and between contacts and rotor is in excess of 25,000 megohms.

Other switches available include rotary, self-cleaning, multi-position switches such as used in decade assemblies. High-voltage sections for these switches with complete shaft insulation are available. Industrial Instruments, Inc., Dept. ED, Cedar Grove, N. J.

CIRCLE ED-249 ON READER-SERVICE CARD FOR MORE INFORMATION

Component Rectifiers Produced by Vacuum Evaporation

The "Vac-u-Sel" line of component rectifiers consists of three cells produced by a vacuum evaporation process to control contaminants. Some cells have a life expectancy of 60,000 hrs. A 26v low-temperature cell, the standard industrial unit, is designed for ambient operating temperatures which do not exceed 55°C.

Another unit, a 26v high-temperature cell, is capable of meeting operating requirements up to 130°C at full voltage; it need not be derated in currents where shorter life is acceptable. The third unit is a 45v high-temperature cell with a 63v peak inverse rating. It frequently can be substituted for a rectifier employing 26v cells. It can be used at ambient temperatures up to 110°C.

All "Vac-u-Sel" rectifiers operate with exceptionally low forward voltage drop and low reverse leakage, and are available in a variety of finishes and mounting arrangements. General Electric Co., Rectifier Dept., Dept. ED, Schenectady 5, N. Y.

CIRCLE ED-250 ON READER-SERVICE CARD FOR MORE INFORMATION



New Mico XXP Laminate gives you much higher Insulation Resistance

Here at last is a uniform, high-quality material with the higher insulation resistance you need for many applications in radar, television, radio, computers, electronic equipment of all kinds. It's MICO's Radar Grade LAMICOID® #6229.

Compare for yourself! Test it together with other laminates under your own test methods for insulation resistance.

Look at these other outstanding values!

WATER ABSORPTION, (%)		DIELECTRIC CONSTANT AT 1 MEGACYCLE	
Precond. E-1/105		1/8" thick	Cond. A 4.42 Cond. D-24/23 4.63
Cond. D1-24/23			
1/16" thick	0.57		
1/8" thick	0.37		
SPECIFIC GRAVITY		DIELECTRIC BREAKDOWN, (Kv.)	
1/16" thick	1.33	Parallel to lamination, S/S	
1/8" thick	1.33	Cond. D-48/50	
FLEXURAL STRENGTH, (psi)		1/16" thick 68.8+	
Tested flatwise, Cond. A		1/8" thick 68.0+	
1/8" thick		cut lengthwise 21,000	
		cut crosswise 16,900	
DISSIPATION FACTOR AT 1 MEGACYCLE		PUNCHING QUALITY	
1/8" thick		1/16" thick	Heated 1 min. Good Heated 2 min. Good Heated 3 min. Good
Cond. A .0314			
Cond. D-24/23 .0316			

Write today for samples — or ask to have a MICO Sales Engineer call.



MICA INSULATOR COMPANY

Schenectady 1, New York

Offices in Principal Cities

In Canada — Micanite Canada, Ltd., Granby, Quebec

LAMICOID® (Laminated Plastic) • MICANITE® (Built-up Mica)
EMPIRE® (Coated Fabrics & Papers) • FABRICATED MICA • ISOMICA®

CIRCLE ED-252 ON READER-SERVICE CARD FOR MORE INFORMATION

to a man
who *Thinks* he knows
glass-to-steel
hermetic terminals

If you're a guy who thinks you must buy a bulky beefed-up terminal to get top performance like 100,000 Megohms at 150° C. it's because you haven't yet accepted our suggestion to test Fusite's new Torture-Proof Terminals with V-24 glass.

This brand new green glass makes possible greatly improved performance, but retains the famous Fusite light weight cap.

All we ask is that you let us send you samples without obligation for testing under your own conditions. We know you will find extreme resistance to thermal and mechanical shock and greatly improved flash-over. These terminals are hot solder dipped for salt spray resistance and easy soldering.

Specify Fusite V-24 glass in the samples you request.



Write Dept. L-2
THE FUSITE CORPORATION
6000 FERNVIEW AVENUE
CINCINNATI 13, OHIO

CIRCLE ED-211 ON READER-SERVICE CARD FOR MORE INFORMATION

Non-Linear Potentiometer A Pressure-Operated Device



The Type 1100 Pressure-Operated Potentiometer is for applications where the output voltage is to be a non-linear function of pressure. It consists of a precision ruggedized pressure-operated potentiometer having taps and provision

for resistance loading across the winding. The instrument mechanism operates in a hermetically-sealed evacuated container inside of the instrument case. The instrument can be made linear with respect to altitude, air speed, and many other aerodynamic functions.

The potentiometer wiper moves linearly with pressure over the range 3.42" to 30.36" of mercury (-400' to +50,000'). A resistor board for loading resistors will accommodate up to six precision wire-wound resistors which may be connected to any of six taps on the potentiometer winding. When the desired voltage ratio versus pressure function is established, instruments can be applied with pre-installed resistors.

The instrument is manufactured in compliance with MIL specs. Accuracy is $\pm 1\%$ of full scale voltage ratio. The pressure transducer has two pressure ports for connecting this instrument to the aircraft's static line and to other pressure-operated instruments. Trans-Sonics, Inc., Dept. ED, Bedford Airport, Bedford, Mass.

CIRCLE ED-212 ON READER-SERVICE CARD FOR MORE INFORMATION

Small Stampings Over 1000 Standard Parts



High production methods used by this firm make it possible to effect cost savings on quantity runs of small stampings for radio, television, and electronic use. Over 1000 different parts are available as standard items, including solder lugs, terminals, contacts, corona rings, and others. They are supplied to specification within minute tolerances. Base metals include brass, copper, beryllium copper, phosphorus bronze, and steel. Maleo Tool and Mfg. Co., Dept. EDN, 4025 W. Lake St., Chicago 24, Ill.

CIRCLE ED-213 ON READER-SERVICE CARD FOR MORE INFORMATION

LOOK HOW EASY... AND **FAST** RIVETING CAN BE WHEN YOU USE **DRIVE RIVETS!**

SOUTHCO

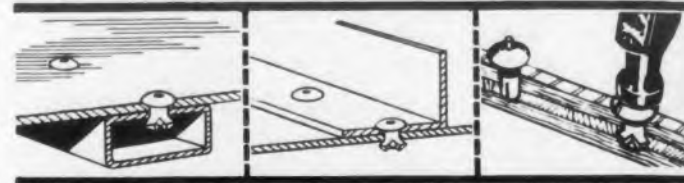


Rivet and
Mfg. Patented.

a hammer is the only tool
...drive like nails
...automatic "pull-up" action

Fastest for:

BLIND APPLICATIONS ACCESS APPLICATIONS METAL-TO-WOOD



SPEED YOUR PRODUCTION LINE . . . CUT COSTS!

For complete data, write Southco Division, South Chester Corporation, 235 Industrial Highway, Lester, Pa.

SOUTHCO

©1955

FASTENERS

Whenever two or more
parts are fastened together.

CIRCLE ED-214 ON READER-SERVICE CARD FOR MORE INFORMATION

Now! A COMPLETE LINE!

SHAKEPROOF®
Plasti-Supports
for supporting shelves and trays

Set . . . drive . . . locked! Non-corrosive Shakeproof Plasti-Supports eliminate need for multiple parts for holding shelves and trays. They fasten from one side, won't chip or craze porcelain, resist loosening from vibration. Available from stock in wide variety of styles, plastic materials, colors, sizes

Send for free booklet today!

SHAKEPROOF
Fastening Headquarters
DIVISION OF ILLINOIS TOOL WORKS
St. Charles Road, Elgin, Illinois • Offices in Principal Cities

CIRCLE ED-215 ON READER-SERVICE CARD FOR MORE INFORMATION



specify
standard

FLEXLOC

SELF-LOCKING NUTS

FLEXLOC DESIGN FEATURES

one-piece, all-metal construction
resilient locking segments
controlled locking torques
lock and stop nut in one every thread carries its full share of load

DO YOU KNOW? Standard FLEXLOCs improve the finish of rough bolts. They smooth off rough threads. And the locking threads on all-metal FLEXLOCs are not chewed up when used on rough bolts. FLEXLOCs are stocked by authorized industrial distributors in a full range of sizes from #4 to 2". Write for Bulletin 866. STANDARD PRESSED STEEL CO., Jenkintown 12, Pa.

FLEXLOC LOCKNUT DIVISION

SPS

JENKINTOWN PENNSYLVANIA

CIRCLE ED-216 ON READER-SERVICE CARD FOR MORE INFORMATION

LEDEX ROTARY SOLENOIDS

GIVE POSITIVE, POWERFUL SNAP-ACTION!



Here's how a LEDEX
ROTARY SOLENOID operates . . .

The magnetic pull moves the armature along the solenoid axis. This axial motion is efficiently converted to a rotary stroke by means of ball bearings on inclined races.

The rotary snap-action power of the compact Ledex can be efficiently harnessed with a minimum of linkages, through the use of one or more standard features available on all models. Available in 7 basic sizes with torques from .4 to 54 lbs-inches.

J.H. Leland
INC.

WRITE FOR DESCRIPTIVE
LITERATURE TODAY!

123 WEBSTER STREET, DAYTON 2, OHIO

In Canada: Marsland Engineering Ltd., Kitchener, Ontario

CIRCLE ED-217 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • June 1955

Plotter

Integrates and Plots Parameters



The "Plottomat" automatically plots and integrates values of any combination of parameters. Its use reduces the time needed to compile data: it takes only minutes where conventional manual methods require weeks. The device can be readily adapted to existing card punch systems; or the data may be fed into IBM or Univac

calculators. If desired, the information may also be read visually.

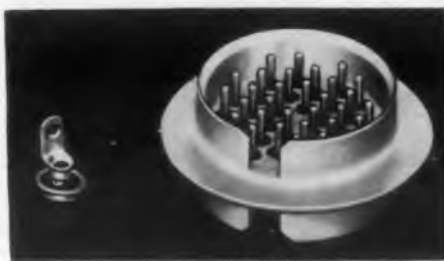
Data compilation and computation are speeded up even more when card punch accessories are actuated. Automatic test programming and provision for constant plotting rate under maximum speed of obtaining data are possible applications.

The Pratt & Whitney Aircraft Division uses the "Plottomat" to speed data recording on experimental turbine test rigs. Similar installations can be used for testing stress or bending loads in steel structures or airframes; in commercial or government labs where temperatures, pressures, or angles are test parameters; in the manufacture of reciprocating, turbo-jet, ram-jet, and rocket engines and associated equipment, especially where test-rig life is limited. Allied Engineering Division, Dept. ED, South Norwalk, Conn.

CIRCLE ED-218 ON READER-SERVICE CARD FOR MORE INFORMATION

Terminals and Headers

In Variety of Shapes and Styles



available for economic reasons. The line includes both individual terminals and multiple electrode headers. Typical are the 30-electrode header and individual terminal illustrated.

New combinations of glass and steel alloys, as well as new sealing techniques, are employed. The units are designed to provide high mechanical strength, a wider-than-ordinary thermal shock range, and a reduction in customer's assembly and material handling costs. These items can be used as direct replacements in current designs or in new design applications. The Hermaseal Co., Inc., Dept. ED, Elkhart, Ind.

CIRCLE ED-219 ON READER-SERVICE CARD FOR MORE INFORMATION



Tubular Rivet

"THE TUBULAR WAY..."

. . . is more than rivets. It's a fast, strong, economical method of fastening things together. It includes rivets and automatic machines to set them — sometimes with spectacular savings of as much as 100%.

Designers know that rivets by *Tubular* belong in their design picture at the drawing board stage because they solve countless fastening and electrical contact problems in nearly all metals, plastics, woods, leathers, papers and fabrics. There's a *Tubular* rivet for every purpose. Send us your blueprint, sketch or sample assembly today. Competent, confidential engineering service available.

Purchasing Agents know that they can turn to *Tubular* now for immediate delivery on stock styles and lengths. "Specials" take a little longer.



Tubular Rivet
Studd Company

WOLLASTON (QUINCY) 70, MASS.

See your local classified directory for phone numbers.

BRANCH OFFICES: BUFFALO • CHICAGO
DALLAS • DETROIT • INDIANAPOLIS
LOS ANGELES • NASHVILLE • NEW YORK CITY
PHILADELPHIA • ST. LOUIS • SO. SAN FRANCISCO

CIRCLE ED-220 ON READER-SERVICE CARD FOR MORE INFORMATION

Available NOW!

New CLARE Type 11 Springdriven Stepping Switch



Small, compact design provides millions of steps without any readjustment

• This new CLARE Type 11 Springdriven Stepping Switch is the latest in the CLARE line of uniselectors, or rotary switches, for completing, interrupting, or changing the connections in a succession of electric circuits in response to momentary impulses of current.

Like the larger and older switches in the CLARE line—Types 20, 26, 40 and 52—this sturdy, fast-stepping little switch is capable of many different applications, such as:

- Selecting any desired point in a series
- Selecting the first unoccupied point in a series
- Sequence controlling: automatically controlling a series of operations in a predetermined manner
- Counting and totalizing
- Generating timed pulses
- Monitoring

The CLARE Type 11 Switch is designed to be free from critical adjustments. The few adjustment points are unusually easy to reach when required, but choice of materials and design provides millions of steps without any readjustment.

Send for Engineering Bulletin No. 121 for complete information on the new CLARE Type 11. Address: C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Ill. In Canada: Canadian Line Materials Ltd., Toronto 13. Cable Address: CLARELAY.

CLARE RELAYS

FIRST IN THE INDUSTRIAL FIELD

CIRCLE ED-221 ON READER-SERVICE CARD FOR MORE INFORMATION

Recorder

Writes Volts, Amps on Same Chart



This wide-strip electronic recorder measures and records both current and voltage simultaneously on one chart. The primary measuring elements are a thermal-voltage converter and a thermal-current converter, a c/d-c transducers. The instrument, a "Dynamaster Electronic Potentiometer", has exceptionally fast response-time, coupled with accuracy within 1% and sensitivity of 1/20% of 1%.

The chart is divided into two zones. Half the chart is used for recording amperes, the other half for volts. The calibration of each follows the law of squares, giving expanded graduations in the normally used section of the range. Chart speeds from 3/4iph to 4ips are available through easily changed gears. The unit can be supplied with pen speeds as fast as 1-1/2-sec for full-scale travel.

Because of high torque output, auxiliary functions such as high-alarm contacts or retransmitting slide-wires can be added without affecting accuracy or sensitivity. The combination of the thermal converters and the "Dynamaster" also provides a basic voltage telemetering system. The Bristol Co., Dept. ED, Waterbury 20, Conn.

CIRCLE ED-222 ON READER-SERVICE CARD FOR MORE INFORMATION

Vacuum Capacitors For Heavy Duty Use

This line of heavy-duty vacuum capacitors features extra-rugged end terminal connectors (1-23/32"OD x 1-3/8"ID x 3/4" long). Units are available in many capacitance ranges including 250mmfd, 100mmfd, and 50mmfd, with voltage ratings of 32kv.

The new, larger, terminal surfaces, plus increased heat dissipation from both interior and exterior of the terminal connectors, allow for cooler operation under heavy load than previously. Conservative current ratings are 100amp rms without external cooling, and 150amp rms with an air blast of 7cfm. The capacitors are of oxygen-free, high-conductivity copper and Pyrex glass construction 6-5/8" long x 2-7/8"OD. Dolinko & Wilkens, Inc., Dept. ED, 1901-1907 Summit Ave., Union City, N. J.

CIRCLE ED-223 ON READER-SERVICE CARD FOR MORE INFORMATION



Short Interval Timing Your Problem?

A. W. HAYDON CAN HELP YOU.



A typical A. W. Haydon Intervalometer which supplies precision pulses.

THREE TYPES OF OPERATION

The operator adjusts a selector switch to determine the type of operation.

OPTION #1. When a starting pulse of 100 Milliseconds is applied, this Intervalometer starts up and energizes 15 Pulsing Circuits at 50 Millisecond intervals. Each circuit is on for 30 Milliseconds. At the end of the period, the unit automatically resets to the starting position.

OPTION #2. When a starting Pulse of 100 Milliseconds is applied, this Intervalometer starts up and energizes 6 Pulsing Circuits, then shuts down. When the next starting pulse is applied, the balance of 9 pulsing Circuits are energized. The unit then resets to the starting position.

OPTION #3. When 1st starting Pulse is applied 5 Pulsing Circuits are energized. When 2nd starting Pulse is applied next 5 circuits are energized. When 3rd starting Pulse is applied next 5 circuits are energized.

WHEN TIMING POSES A PROBLEM CONSULT

WRITE FOR GENERAL CATALOG OR SUBMIT DETAILED PROBLEM STATEMENT.



A. W. HAYDON
COMPANY
227 NORTH ELM STREET
WATERBURY 20, CONNECTICUT

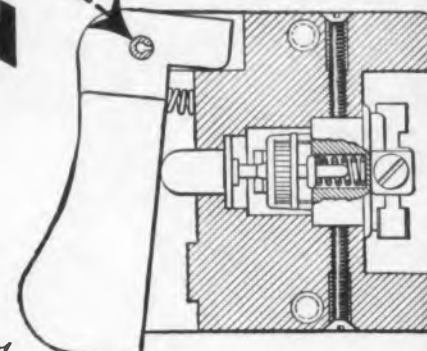
Design and Manufacture of Electro-Mechanical Timing Devices

CIRCLE ED-224 ON READER-SERVICE CARD FOR MORE INFORMATION

ROLLPIN

TRADEMARK

cuts
rejects
on this
plastic
assembly 25%



If your assembly is made of plastics, check up on Rollpin. In applications like the phenolic trigger switch above, it cut production costs and actually reduced, from 25% to zero, rejections due to cracking of the plastic parts during seating of the pivot pin. Rollpin is a slotted, hollow steel spring pin with chamfered ends. Pressed into holes molded or drilled to normal production tolerances, it compresses as inserted. It makes a self-locking, vibration-proof fastener. It is light, easily removable, and reusable. Available in diameters .062, .078, .094, .125, .140, .156, .187, and up to .500 in a broad range of standard lengths.



For detailed information and help with electronic fastening problems, write Dept. R32-657.

**ELASTIC STOP NUT CORPORATION
OF AMERICA**

2330 Vauxhall Road, Union, N. J.

DESIGN HEADQUARTERS FOR SELF-LOCKING FASTENERS
CIRCLE ED-225 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • June 1955



Wrap-around
Etched Circuits

Using an exclusive USECO process, our new "wrap-around" or "plated-thru" circuits provide improved performance, better contact and easier unplugging. They eliminate the possibility of

As a result, these circuits have longer service life. Write for catalog which tells how to prepare master drawings and gives complete information on how to order. Please address Dept. 7.

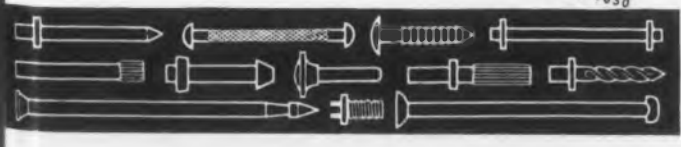
J.S. ENGINEERING CO.
A Division of Litton Industries, Inc.
21 COMMERCIAL ST., GLENDALE 3, CALIF.
CIRCLE ED-226 ON READER-SERVICE CARD FOR MORE INFORMATION

WRITE FOR FREE fastener catalog



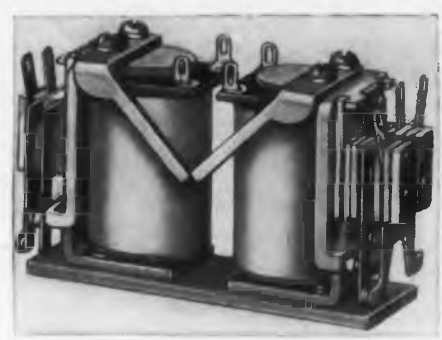
A complete, comprehensive handbook on cold-headed nails, rivets, screws and other special fasteners. Check on ways to improve your assembly cost-wise, appearance-wise and from a standpoint of maximum effectiveness at minimum cost. One hundred years of experience are at your service. Write for price quotations or for suggestions on the redesigning of your present assembly.

JOHN HASSALL, INC.
P.O. Box 2202, Westbury, L. I., N. Y.



CIRCLE ED-227 ON READER-SERVICE CARD FOR MORE INFORMATION
ELECTRONIC DESIGN • June 1955

Latch-In Relay
Holds in Energized Position



In this miniature Latch-In Relay the armature mechanically latches in the energized position. The unit comprises an operating relay and a reset relay with mechanically interlocking arms.

When the operating coil pulls the armature into the energized position the levers mechanically lock the armature in place. The armature may be reset electrically or manually.

Latching levers are alloy steel, heat treated and hard chrome-plated for long wear. Relays are available for 6v, 12v, 24v, 48v, and 115v d-c operation. They can be furnished with a wide variety of contact ratings and combinations. Approximate overall length is 2-5/8"; width, 1"; height, 1-5/8". Magne-craft Electric Co., Dept. ED, 3350D W. Grand Ave., Chicago 51, Ill.

CIRCLE ED-228 ON READER-SERVICE CARD FOR MORE INFORMATION

Microwave Antennas
Cover 380-10,800Mc in 8 Models



In a line of eight models of Microwave Antennas, the frequency spectrum is covered from 380Mc to 10,800Mc. The antennas are of two basic designs and, although they vary in size, adapter

plate arrangements have been made to permit a maximum interchangeability of mounting. Six variations of one design (shown at left) cover the band from 380Mc to 5000Mc. These are helical radiators mounted in flush cavities with coaxial inputs. Two variations of the other design (shown at right) cover the 4750Mc to 10,800Mc region. These have waveguide inputs transitioned into round flush-mounted horns containing phase shifters for producing elliptical polarization. They can also be supplied with rigid waveguide input.

General specification of the standard group include: less than 2:1 voltage standing wave ratio; less than 2:1 voltage ellipticity ratio; and half-power beam width greater than 45°. Special units can be made to more rigorous specifications. Dalmo Victor Co., Dept. ED, 1425 El Camino Real, San Carlos, Calif.

CIRCLE ED-229 ON READER-SERVICE CARD FOR MORE INFORMATION



Transistor Progress



TRANSISTOR TEST SETS
Models 6P4



RESISTIVITY TEST SET
Model JRT



N-P TESTER
Model JRT



MINORITY CARRIER LIFETIME TEST SET
Model JRT

BA-TRANSISTOR TEST SET

A versatile precision instrument designed to analyze transistors at any frequency from 100 cps to 1 mc in terms of well-known standard parameters. Technical Circular #RD 511-A

BA-SEMICONDUCTOR RESISTIVITY TEST SET

Simple, direct measurements of germanium in the range of 0.1—100 ohm-cm. Adaptable to silicon measurements. Technical Circular #RD 517

BA-SEMICONDUCTOR N-P TESTER

Thermo-electric probe determines N or P type conductivity. Technical Circular #RD 516

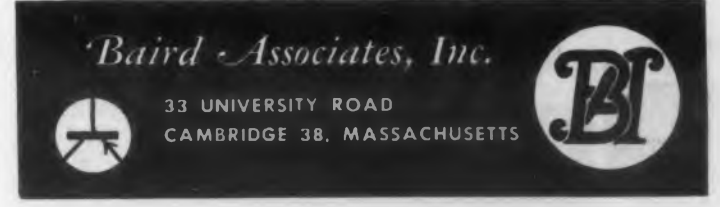
BA-SEMICONDUCTOR MINORITY CARRIER LIFETIME TEST SET

Principle of conductivity modulation stimulated by pulsed light source with decay time of average life of excess carriers on cathode-ray display. Technical Circular #RD 515

Versatile Precision Equipment

Research and Development Facilities available for Consultation, Design and Production of Transistor Test Instrumentation, Transistorized circuitry, Equipment and Devices. Our experience will warrant consideration for your miniaturization and transistorized electronic conversion problems. Similar facilities available to deal with semiconductor materials problems.

Please Request Technical Circulars on Equipment of Interest.



CIRCLE ED-230 ON READER-SERVICE CARD FOR MORE INFORMATION



Gives You More Than Just Long Life!

● You get long life *plus* tolerance stability which gives positive snap-action and accurate repeatability throughout the entire life of the switch . . . even at 1,500,000 cycles and over.

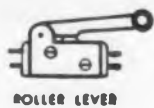
Silver Contacts minimize arcing, assuring precision control and long electrical operation. Patented, self-aligning springs provide contact wiping action seldom found in a switch of this size.

CUT SWITCH COSTS

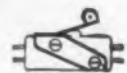
Long life lowers switch costs . . . minimizes "down-time" and increases efficiency of operation. Durable, compact plastic case permits great flexibility of application. Available in a wide selection of models, including "reset." Rated at 10 amps 125/250 v. AC; 30 v. DC inductive.

Write for details in
DATA SHEET STS-6

A few of the
standard
actuators
available.



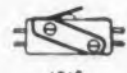
ROLLER LEVER



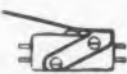
ROLLER



TOGGLE



LEAF



EXTENSION LEAF



PUSH BUTTON

Indicator

Rapidly Displays Variables



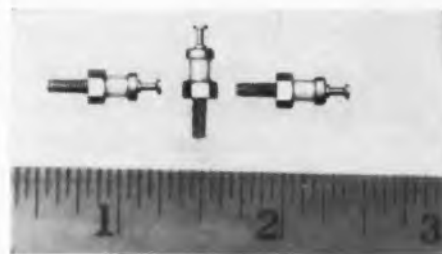
The "DK" is a portable, high-speed, self-contained indicator which gives a quick and accurate indication of pressure, temperature, force, and displacement by means of pickups using the output of 60cy linear variable differential transformers (LVDT). The device contains an internal LVDT, the output of which is balanced against that of an external LVDT. The unit will give a full scale indication of output for as little as 0.005" travel in the external sensing LVDT.

The core of the internal balance transformer is positioned by a cam driven by a servo motor in response to the balance amplifier. A pointer indicates the position of the cam and hence the amount of travel in the external transformer.

A 7" diam dial on the face of the indicator has 200 divisions and is calibrated from 0 to 100 over 300° of rotation. Other dials with special calibrations can be provided. All controls are accessible from the outside of the case, eliminating the need for dismantling except for servicing. A variety of accessory equipment is available. Schaevitz Engineering, Dept. ED, Camden 1, N. J.

CIRCLE ED-232 ON READER-SERVICE CARD FOR MORE INFORMATION

Standoff Terminal Of Solid Ceramic Rod



The X2128 Miniature Insulated Standoff Terminal is constructed of solid ceramic rod, silicone impregnated for maximum moisture resistance. The gold-flashed solder terminal is rolled over a shoulder on the top end of the insulator, and the nickel-plated base is bonded to the bottom end with epoxy resin, to provide greater stability than formerly achieved.

The unit comes with 1/4" long screw stud, 3/48 thd, with grade L-5 ceramic insulator, silicone impregnated. Solder terminal is 24k gold-flashed over copper-plated brass, which provides solder-ability during extended shelf life. Long soldering operations will not loosen or stain the ceramic insulator. Base diameter is 3/16", height when mounted 0.447". Cambridge Thermionic Corp., Dept. ED, Cambridge, Mass.

CIRCLE ED-233 ON READER-SERVICE CARD FOR MORE INFORMATION

A TOUCH OF THE TOE
keeps production stepped-up



5 1/2" x 3 1/4" x 1 1/4"
weighs only 1 lb.

LINEMASTER, JR. FOOT SWITCH

Ideal for women workers!

The hand that pulls the switch wastes time! Sensitive LINEMASTER, JR. Foot SWITCH keeps both hands at work—needs only tip-toe control. Your women workers, especially, will appreciate LINEMASTER, JR.'s instant response to the toe alone—heels remain comfortably on the floor, lessening fatigue and increasing production. Light-weight, streamlined aluminum housing with black crackle enamel finish.

Let us quote on your special switch requirements.

LINEMASTER SWITCH CORP.

130 Putnam Road Woodstock, Conn.

CIRCLE ED-234 ON READER-SERVICE CARD FOR MORE INFORMATION



specify
standard

UNBRAKO

Dryseal-Thread
Pressure Plugs

Use them in place of ordinary pipe plugs, or wherever liquids and gases must be contained under pressure. UNBRAKOS seal without compound. They are made of the same high strength alloy steels, have fully formed threads and the same internal wrenching feature as other UNBRAKO socket screws. Standard sizes—1/16" to 1 1/4"—are stocked by authorized industrial distributors. Ask your UNBRAKO supplier for Bulletin 883. Or write STANDARD PRESSED STEEL CO., Jenkintown 12, Pa.

UNBRAKO SOCKET SCREW DIVISION

SPS

JENKINTOWN PENNSYLVANIA

CIRCLE ED-235 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • June 1955



ELECTRO-SNAP SWITCH AND MFG. CO.
4724 West Lake Street Chicago 24 Illinois



CIRCLE ED-231 ON READER-SERVICE CARD FOR MORE INFORMATION

Transformers for special applications

Need a transformer for a special or unusual application? Check the qualifications of Caledonia Electronics.

- DESIGN EXPERIENCE.** Large staff of design engineers with extensive experience in circuit design—audio, radar, RF, UHF. Engineers who can understand your circuit needs and know how to meet them.
- MANAGEMENT EXPERIENCE.** Caledonia's management represents more than 250 years cumulative experience in the electronics industry . . . almost all associated with the manufacture of communications transformers.
- PRODUCTION EXPERIENCE.** Production and inspection staffs thoroughly trained in every phase of transformer manufacture and quality control.

This experience has solved successfully hundreds of problems in transformer design. For further information and help with your problems, write to

CALEDONIA
ELECTRONICS AND TRANSFORMER CORPORATION

Dept. ED-6, Caledonia, N. Y.

CIRCLE ED-236 ON READER-SERVICE CARD FOR MORE INFORMATION

PENTA TUBES

Here are four time-proven, quality tubes produced by Penta.

PL-6549 Beam Pentode

Filament Voltage	6.0 v
Filament Current	3.5 a.
Screen Grid Rating Voltage (max)	600 v.
Diss. (max)	10 w
Plate Rating Voltage (max)	2000 v
Current (max)	150 ma.
Diss. (max)	75 w



PL-6569 Triode Grounded-Grid Type

Filament Voltage	5.0 v.
Filament Current	14.5 a.
Plate Rating Voltage (max)	4000 v
Current (max)	300 ma.
Diss. (max)	250 w



PL-4D21 Beam Tetrode

Filament Voltage	5.0 v.
Filament Current	6.5 a.
Screen Grid Rating Voltage (max)	600 v
Diss. (max)	20 w
Plate Rating Voltage (max)	3000 v
Current (max)	225 ma
Diss. (max)	125 w



PL-5D22 Beam Tetrode

Filament Voltage	5.0 v.
Filament Current	14.5 a.
Screen Grid Rating Voltage (max)	600 v.
Diss. (max)	35 w.
Plate Rating Voltage (max)	4000 v
Current (max)	350 ma.
Diss. (max)	250 w.



Technical data sheets giving ratings and typical operating conditions are available. Ask for data file 602.

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET
SANTA BARBARA, CALIF

CIRCLE ED-237 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • June 1955

Pulse Generator

Produces Two Independent Pulses



The Pulse Generator and Calibrator, Model PC-100A, produces two rectangular pulses having independently controlled amplitudes and polarities. Polarities are positive or negative, and amplitudes are 0-75v, open circuit from a 220 ohm source. Their repetition frequencies are adjustable at 50-5000pps, and paired interval is adjustable at 5-5000 sec.

Time durations are 1 μ sec for sliding-pulse output, 1 μ sec for fixed-pulse output synchronized from external source, and 1.5 μ sec when operated self-synchronously. Time markers are provided at 1, 10, and 100 μ sec, for amplitudes of 0-10v, open circuit. Square-wave calibrator output is 60cy, 0.1v to 100v. Electronics Laboratory, Inc., Dept. ED, 54 Kinkel St., Westbury, L. I., N. Y.

CIRCLE ED-238 ON READER-SERVICE CARD FOR MORE INFORMATION

Phase Comparator

Accuracy of 0.1 Milliradian at 60cy



The Model 201 Phase Comparator, for accurate phase measurement in the laboratory or on the production line, is designed especially for use in the computer field where phase shift

is an important factor. It is useful for many other applications such as in-phase measurements of transformers, amplifiers, tach generators, resolvers, and synchro control transformers.

The unit permits precision measurement of phase relationship of in-phase and out-of-phase voltages, measuring input voltages from 1.0v to 120v through a frequency range of 60cy to 400cy with an accuracy of 0.33 milliradian at 400cy and 0.1 milliradian at 60cy. Effective angle of phase comparison is ± 1 radian around 0° and 180° . A null voltage measurement on a vacuum tube voltmeter provides the phase angle measurement. Link Aviation, Inc., Dept. ED, Binghamton, N. Y.

CIRCLE ED-239 ON READER-SERVICE CARD FOR MORE INFORMATION

Here's the New

BASIC SUB-MINIATURE SWITCH



E-4 actual size

New Increased Life to 200,000 Operations Guaranteed

New Greater Stability of Characteristics

New Lower Price

This Electro-Snap Sub-Miniature Basic Switch has been improved to give even better performance—and at less cost. Although no thicker than a lead pencil and only 27/32" long, 23/64" high, it does a man-sized job, handling 5 amps at 125v AC or 4 amps resistive, 2.5 amps inductive at 30v DC. Its small size plus low operating force and small movement differential make it ideal for precision control of "feather touch" devices, business machines, aircraft and instrument circuits. Positive snap action resists vibration and shock, has no dead center. Available in normally open and normally closed single-pole models and in single-pole, double-throw models.

TYPICAL MOUNTINGS



Panel Toggle



Panel Push-Button



Hermetically-Sealed Case



Gang Selector Switch

WRITE FOR DETAILS IN DATA SHEET ES-6



ELECTRO-SNAP SWITCH & MFG. COMPANY

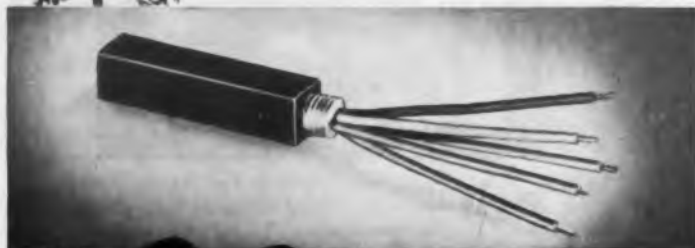
4224 West Lake Street
Chicago 24, Illinois

CIRCLE ED-240 ON READER-SERVICE CARD FOR MORE INFORMATION

THE HEART OF A
MISSILE MUST BE

**SMALL!
SENSITIVE!
SHOCK-RESISTANT!**

AND HUSKY 503 IS IT!



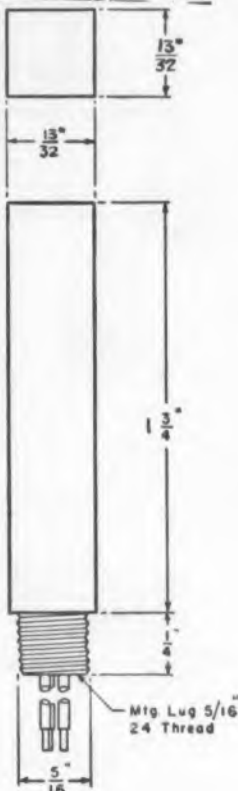
**NEW SUBMINIATURE RELAY
FOR GUIDED MISSILES**

**LESS THAN
2" LONG!**

Hermetically Sealed

- SPDT Contacts
 - New Internal Mechanism*
 - 2,000 foot-pounds Shock Resistance
 - Vibration—30G's up to 2,000 cycles
 - Acceleration—1,000G Rotary
 - Temperature Range—-65C to +160C
 - Weighs only 1 ounce
 - 26.5 Volts D-C operation
 - Sensitivity—0.050 watts
- *Patent applied for

If you're engaged in Guided Missile or Similar Projects with exacting relay requirements, our engineering staff is at your service. Write for Data Sheet on #503. Dept. B, Price Electric Corp., Frederick, Md.



CIRCLE ED-253 ON READER-SERVICE CARD FOR MORE INFORMATION

Stepping Switch Small, Spring-Driven Unit



The Type 11 Spring-driven Stepping Switch is a small, compact unit that can function as either an 11-point or a 10-point switch and provide millions of steps without any readjustment. This sturdy switch is capable of a wide variety of applications, such as: selecting any desired point in a series; selecting the first unoccupied point in a series; sequence controlling; counting and totalizing; generating timed impulses; and monitoring.

The switch may have from one to eight bank levels of 10 or 11 points each. Each bank level is traversed by a pair of wiper springs. The rotor is driven by a durable stainless-steel ratchet wheel having 33 teeth. Wipers can be arranged so that the several bank levels can be used independently to secure 10-point or 11-point operation, or in tandem to secure up to 33-point operation.

Overall length is only 4-13/32". Height is 2-5/16", and width with eight levels is 2-1/8". The switch may be supplied hermetically sealed in an enclosure commonly used to seal one Type C relay. C. P. Clare & Co., Dept. ED, 3101 Pratt Blvd., Chicago 45, Ill.

CIRCLE ED-254 ON READER-SERVICE CARD FOR MORE INFORMATION

Temperature Meter

With —50° to +1000° F Range



"Temp-Check" Model 386H is a portable temperature meter with a range from —50 to +1000°F. It is designed to speed up precision measurements where temperatures in extreme ranges must be immediately ascertained.

Fitted with a sensitive thermocouple,

the instrument quickly measures temperatures of metals, liquids, and air, and eliminates delays caused by waiting for gage blocks or work to return to normal temperature. A quick calculation from the meter reading tells exact dimensions. The unit operates on a flashlight battery and is completely portable. Webber Gage Co., Dept. ED, 12912 Triskett Rd., Cleveland 11, Ohio.

CIRCLE ED-255 ON READER-SERVICE CARD FOR MORE INFORMATION

*Kanthal DR resistance wire
SAVES YOU UP TO 50% because...*

... it is lighter in weight (more feet per pound), and the per pound price is low. Total savings approximately 50%.

... Kanthal DR improves the performance of resistors and precision equipment. Its electrical resistivity is high — 812 ohms per circular mil foot — its temperature coefficient is low ($\pm 0.00002^{\circ}\text{C}$ between -50° and $+150^{\circ}\text{C}$), and it has a low thermal EMF to copper.

Available in fine gages and all types of insulation.

WRITE FOR FURTHER INFORMATION AND PRICES TODAY

KANTHAL THE KANTHAL CORPORATION

8 AMELIA PLACE, STAMFORD, CONN.

CIRCLE ED-256 ON READER-SERVICE CARD FOR MORE INFORMATION

New **LOCKTITE** *
gun-rifled **CLUTCH**
grips like a bull dog



The new improved **LOCKTITE** Clutch utilizes the gun-rifled principle, with diagonal knife-like ribs, to hold the lead in a vice-like grip. No matter how you sharpen your lead in the holder, the jaws of the clutch keep it from slipping, twisting or turning.

This is just one of many reasons why professionals prefer push-button **LOCKTITE**. You will like its easy, one-hand operation, which prevents finger-staining and avoids smudging your drawings. Order from your Dealer. For best results use **LOCKTITE** with Imported **CASTELL** 9030 lead.

*Pat. appd. for (U.S. Pat. Office)

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

CIRCLE ED-257 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • June 1955

New 300-watt Vitrohm ring rheostat with exclusive "twin-shoes"



Ward Leonard's exclusive sintered self-lubricating twin-shoe construction insures uniform contact pressure, plus unusually smooth and trouble-free operation.

Other features of the new 6" Vitrohm ring rheostat eliminate backlash, insure contact pressure, prevent arm over-travel or radial motion. It takes less back-of-panel space, too.

Write for Bulletin 1116, Ward Leonard Electric Company, 77 South St., Mount Vernon, N.Y. 413

WARD LEONARD ELECTRIC CO.

Result-Engineered Controls Since 1892

RESISTORS • RELAYS • MOTOR CONTROLS • CHROMASTER



CIRCLE ED-258 ON READER-SERVICE CARD FOR MORE INFORMATION

DC-AC CHOPPERS

For 60 Cycle Use

Built to rigid commercial specifications.

Twenty-two types, both single and double pole.

Long life.

Low noise level.

Extreme reliability.

Write for Catalog 370.

**STEVENS
INCORPORATED
ARNOLD**

22 ELKINS STREET
SOUTH BOSTON 27, MASS.



CIRCLE ED-259 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscilloscope

Portable and Highly Sensitive



The Model 385 is a lightweight 3" portable oscilloscope similar to equipment manufactured for the Armed Forces. This scope features a six-section unitized circuit construction for minimum interaction between amplifiers and sweeps, as well as provides for replacable circuit sections as individual units. It is only slightly larger than a normal-sized telephone, and is available portable, portable with moisture-proof carrying case, or as a rack mount.

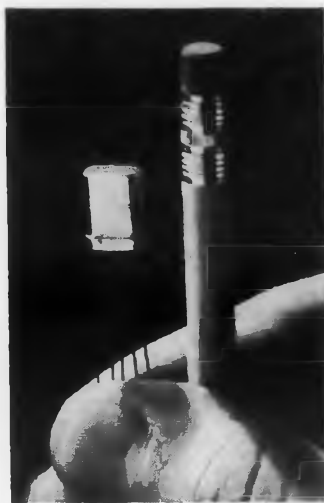
Frequency range is: vertical amplifier, d-c to 4Mc, 3db down; horizontal amplifier, d-c to 500kc, 3db down; and 3cy to 50ke for the sweep circuit oscillator. Deflection sensitivity for each amplifier is 0.075v/in rms, and input impedance is 2.2 megohms, 25mmfd. The Hickok Electrical Instrument Co., Dept. ED, 10525 Dupont Ave., Cleveland 8, Ohio.

Frequency range is: vertical amplifier, d-c to 4Mc, 3db down; horizontal amplifier, d-c to 500kc, 3db down; and 3cy to 50ke for the sweep circuit oscillator. Deflection sensitivity for each amplifier is 0.075v/in rms, and input impedance is 2.2 megohms, 25mmfd. The Hickok Electrical Instrument Co., Dept. ED, 10525 Dupont Ave., Cleveland 8, Ohio.

CIRCLE ED-260 ON READER-SERVICE CARD FOR MORE INFORMATION

Subminiature Relay

Housed in Transistor Case



This "neomite" is a single-pole double-throw relay weighing 0.035 oz. It is housed in a standard transistor case 1/2" high. It has a 1/4amp contact rating (non-inductive) at a 26.5v d-c. Its sensitivity is 100mw and it can be adjusted down to approximately 40mw.

The relay is capable of withstanding shock of 100g and vibration of 15g at 2000cy. It operates at all

temperatures between -55° and 100°C. Contact life is over 1 million operations. Elgin-Neomatic, Inc., Dept. ED, 9010 Bellanca Ave., Los Angeles 45, Calif.

CIRCLE ED-261 ON READER-SERVICE CARD FOR MORE INFORMATION

Wrong Illustration

ELECTRONIC DESIGN, March 1955, page 90, described the Electro-Measurements, Inc., Impedance Bridge but illustrated the company's decade capacitor, Dekapacitor. The 1μfd Dekapacitor, not described, uses polystyrene capacitors and features a dial which gives one thousand incremental steps of 0.001μfd each.

ELECTRONIC DESIGN • June 1955



You can get stable Corning Fused Silica Ultrasonic Delay Lines to your specifications within a wide range of characteristics.

This ultrasonic delay line ignores cold and vibration

Corning Fused Silica Ultrasonic Delay Lines give you stability and versatility not found in mercury types. The extremely high purity of the silica used insures superior electrical and ultrasonic properties.

You can depend on Corning Delay Lines for stability of insertion loss of ±1 db after cycling over a temperature range from -65°C. to +85°C., vibration of 10 to 55 cps at 1/16" excursion, and operation at 100% humidity. This precision performance is assured after normalizing at center frequency with a suitable case design.

You can get this exceptional stability in ultrasonic delay lines ranging from 50 to 3000 microseconds. Center frequencies up to 60 mc are possible with 3 db band widths up to 70% of the center frequency into a 50 ohm resistive termination. Spurious signals range 40 to 60 db below the main output response depending on other performance requirements. Ripples do not exceed ±1/2 db.

We can produce Corning Fused Silica Ultrasonic Delay Lines to your specifications within a wide range of characteristics. For your convenience in evaluating Corning Ultrasonic Delay Lines we have prepared a Specifications Data Outline Sheet. Send for your copy, fill in the requested information, then mail it to us. Or write, wire or phone us.



Corning means research in Glass

CORNING GLASS WORKS, 39-6 Crystal St., Corning, N.Y.
New Products Division

Please send me your Specifications Data Outline Sheet on Corning Ultrasonic Delay Lines.

Name..... Title.....

Company.....

Address.....

City..... Zone..... State.....

CIRCLE ED-262 ON READER-SERVICE CARD FOR MORE INFORMATION

to help you solve set screw problems . . .



YOU CAN OBTAIN THE SETKO JEWEL CASE without cost or obligation

If you are one of those responsible for product improvement, we would like to send you this Setko "Jewel Case" of Set Screw Ideas at no expense to you whatever. It contains over 30 different samples of new ideas in set screws for you to examine—study—and try out. Included are the latest developments in much speedier application . . . tamper-proofing . . . increased holding power . . . self-locking . . . self-tapping . . . two-screw applications . . . etc.

here are 3 out of 30 set screw ideas
from the Setko "Jewel Case"



MULTI-FLUTED SELF-TAPPING SET SCREW. Additional cutting edges making tapping easier.



HOPPER-FED HEADLESS SET SCREWS. Up to 10 times faster application.



SELF-TAPPING FASTENERS. Sizes as small as $2 \times \frac{3}{32}$ ".

If you want the Setko "Jewel Case" sent to you on loan, without cost or obligation, simply write your name and address in the margin, tear out this page and mail to us.

Set Screw & Mfg. Co.

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

We specialize in Solving Puzzling Set Screw Problems

CIRCLE ED-263 ON READER-SERVICE CARD FOR MORE INFORMATION

110

Transient Recorder Can Take Four Signals at Once



The Type 104 Magnetic Transient Recorder is capable of magnetically recording up to four signals simultaneously. Providing a frequency response of d-c to 2kc, a 1sec record period, and simultaneous playback of any two channels, this equipment also features the use of magnetic disks which can readily be removed and stored permanently, or erased and used again.

The equipment should find wide application for recording of transients in aircraft, power lines, electronic analysis, and other related fields. The use of the magnetic disks greatly simplifies analysis of transients recorded, since such recordings can be fed to an oscilloscope without need for searching, splicing, and introducing tape discontinuities. When a dual-beam oscilloscope is available, any two of these transients can be viewed on the scope simultaneously, permitting direct comparison of two recordings.

The recorder records and erases continuously until a transient occurs. Magne-Pulse Corp., Dept. ED, 140 Nassau St., New York 38, N. Y.

CIRCLE ED-264 ON READER-SERVICE CARD FOR MORE INFORMATION

D-C Power Supply 1-35v Valuable Output



The Variable DC Power Supply, K. S. - 2903, was designed to provide a source of continuously variable d-c power for testing 1-35v d-c circuits.

This unit is comprised of an adjustable a-c transformer supplying variable a-c voltage to a step-down transformer, the output feeding a selenium rectifier. This converts the a-c supply to pulsating d-c; the pulsating d-c is then fed through a reactor and capacitor combination which removes most of the pulsations providing a d-c voltage with less than 1-1/2% ripple. Output is 15amp continuous.

Input is 115v a-c, 50-60cy, single phase; 230v is also available. The Kell-Strom Tool Co., Dept. ED, Wethersfield, Conn.

CIRCLE ED-265 ON READER-SERVICE CARD FOR MORE INFORMATION

FRANKE GEARS

fine pitch

AS you want them — WHEN you want them

SPURS & PINIONS
HELICALS
& SPIRALS
SPROCKETS & RACKS
BEVELS & MITRES
WORMS & WORM GEARS
SPLINE SHAFTS & SPLINE FITTINGS

Specialists in manufacture of Fine Pitch Gears to close tolerances . . . from ordinary commercial grades to the most exacting aircraft specifications. Nylon gears with teeth molded or cut. Also gears made from stampings, with teeth stamped or cut. Send blueprints for proposals and/or engineering collaboration. No obligation to you.

FRANKE GEAR WORKS, INC.
1932 W. COLUMBIA AVE., CHICAGO 26, ILL.



CIRCLE ED-266 ON READER-SERVICE CARD FOR MORE INFORMATION

Brew Delay Lines

. . . for applications
requiring exceptional
characteristics



Shown above is a Lumped Constant Delay Line designed, manufactured, and delivered on schedule to a customer who came to us with the following requirements: delay 1.0 usec, reflections 50 db below peak signal, frequency response: from 0-4.5mc less than ± 0.1 db — from 4.5-10mc less than ± 6 db, attenuation less than 6 db, phasing ± 0.1 usec 0-4.2 mc, impedance 150 ohms, max. temp. 150° F., operating temperature 120° F., voltage 350 VDC ± 6 VPP video, source impedance 4 uu 1200 ohm, grid circuit termination 10 uu.

The three main types of delay lines . . . Lumped Constant, Ultrasonic, Distributed Constant . . . are available from Richard D. Brew and Co., and our special techniques and methods, plus rigid quality control measures assure you of the finest and most practicable delay lines to meet your needs. Major consideration is given to proper packaging as well as electrical specifications.

Consult Richard D. Brew and Co. and you'll get enthusiastic cooperation and help.



Send for General Catalog 54

Richard D. Brew and Company, Inc.
Concord, New Hampshire
design · development · manufacture

CIRCLE ED-267 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • June 1955

Two new
for use in
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CIRCLE ED

ELECTE

A-C INDUCTION TYPE New Series 15 and 18 SERVO MOTORS

Two new G-M Miniature Servo Motors are now available for use in electronic control circuits. The motors are standard frame sizes 15 and 18 which are 1.437" and 1.750" in diameter respectively, and are designed for use in a wide variety of equipment such as computers, gun sights, navigation equipment, guided missiles, radar and similar applications. These light weight, high torque, low inertia, two-phase induction motors are available in 2, 4 and 8-pole models for 400 or 60 cycle supply, and can be supplied to meet performance specifications for military servo motors, Mark 7 and Mark 8. The control phase can be wound for connection by the user for either series or parallel operation. The stators of the motors, as in all G-M Servo Motors, are embedded in an insulating compound of high dielectric strength and high temperature stability. This material has a low mechanical coefficient of expansion and great stability at high temperatures. High dielectric strength is maintained between windings and housing when at high altitudes. Write for information on G-M Size 15 and/or Size 18 Servo Motors to



G-M LABORATORIES, INC.
4284 N. Knox Ave., Chicago 41, Ill.

CIRCLE ED-268 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-269 ON READER-SERVICE CARD FOR MORE INFORMATION

Waveguide Coupling Gives Quick Disconnect



This coupling is intended for use with 1.500" x 750" OD rectangular waveguide size and permits fast positive coupling and uncoupling of UG-343A/U or UG-440A/U (and mating type)

flanges without the use of tools. Waveguide flange connections can conveniently be made in cramped quarters, where it would be extremely difficult or impossible to couple or uncouple conventional flanges. The fixture is also useful in the laboratory, wherever speed or convenience in coupling during testing is important.

The coupling can be readily mounted and operated from any one of 12 positions around the waveguide joint and, in addition, there are no loose parts that might be lost when it is disconnected. It is designed to maintain pressurized joints up to 45psi at -55°C, and will remain r-f and pressure tight even under severe vibration. Units are now available to fit waveguide sizes from 1.500" x 0.750" down to 1.000" x 0.500" OD inclusive. Airtron, Inc., Dept. A., 1103 West Elizabeth Ave., Linden, N. J.

CIRCLE ED-270 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscillographic System Makes Logarithmic Measurements



This company's Model 150-1400 Log-Audio Pre-amplifier, used with their basic "150" Oscillographic Recording Assembly, permits recording in either lin-

ear or decibel values, with a basic sensitivity of 1db/mm deflection, a selection of d-c input signals or audio (20cy to 20,000cy) input signals.

The preamplifier is one of several interchangeable "front ends" which plug into the amplifier-power supply units of "150" systems. Applications include audio measurements where the recording covers any 50db interval between -10db and +90db, recording d-c levels or the instantaneous value of the variable; and similar uses. Sanborn Co., Industrial Div., Dept. ED, 195 Massachusetts Ave., Cambridge, Mass.

CIRCLE ED-271 ON READER-SERVICE CARD FOR MORE INFORMATION

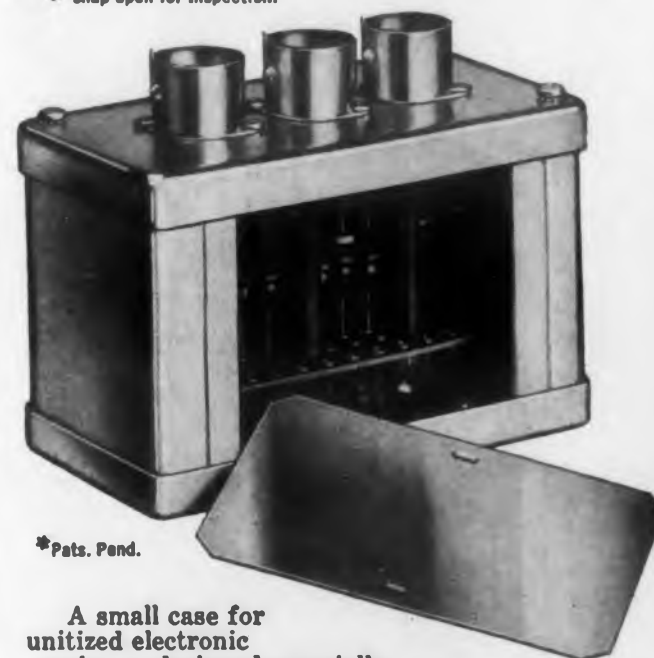
Vector LIP-LOC CASES*



with Snap-open
SIDE PORTS

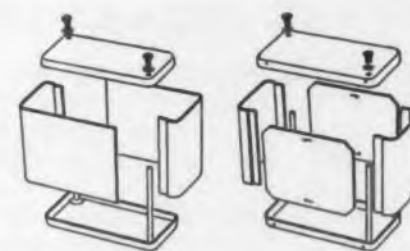
For a perfectly designed, handsome and compact plug-in, assemble your components in Vector Lip-Loc cases. You'll find it quicker, more convenient and economical.

Side ports are optional, snap open for inspection.



*Pats. Pend.

A small case for unitized electronic packages designed especially for plug-in assemblies. Modular turret structures are accessories and are furnished to your requirements.



Lip-Loc cases are also made with the more economical two piece center section where snap open feature is not required. Removal of only two screws allows complete disassembly of both types.

Available with a choice of plugs, quarter turn locks, ventilated or solid wall, and in a variety of sizes. Vector Socket-Turrets are available in many types—Post, Deck, Wall or Tinker-Turrets—provide ideal internal structure to carry circuitry.

Write for free catalog.



VECTOR ELECTRONIC COMPANY
3352 SAN FERNANDO ROAD, LOS ANGELES 65, CALIF.
TELEPHONE Cleveland 7-8237

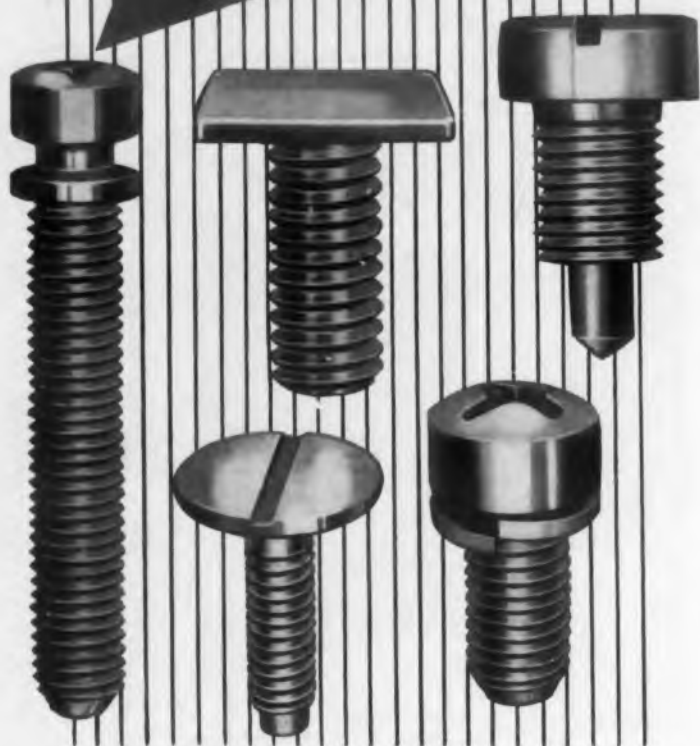
Representatives

New York—B. S. Taylor Co., 241 Sunnyside Highway
Rockville Centre, N.Y. BOckville Centre 6-10145
San Carlos—David H. Row Co., 334 El Camino Real
San Carlos, Calif. LYell 3-8224
Chicago—Harry Hallman, 5500 West Devon
Chicago 30, Illinois ROdney 3-2132

CIRCLE ED-272 ON READER-SERVICE CARD FOR MORE INFORMATION



Specials



FOR EXAMPLE

This special screw was formerly made in two parts and spot-welded together. Elco now produces this part, in one piece, by the Cold Heading method at a savings of \$13.26 per thousand.

OVER 30 YEARS EXPERIENCE MAKING SPECIALS AND STANDARDS

ELCO TOOL AND SCREW CORPORATION
1948 BROADWAY • ROCKFORD, ILLINOIS

CIRCLE ED-273 ON READER-SERVICE CARD FOR MORE INFORMATION

Millivolt Supply Calibrated from 0-100mv



The KC-253 Millivolt Supply provides a calibrated pure d-c voltage from 0-100mv to be used with electronic self-balancing potentiometer recorders and in similar instrumentation applications. Examples of use are: suppressing thermocouple signals so that they can be read on a 0-10mv electronic self-balancing potentiometer recorder, and supplying the voltage for position-indicating potentiometers.

Adjustable over the entire range, output can be set within ± 0.05 mv up to a value of 40mv. Drift does not exceed 0.05mv/hr. The unit is self-calibrating to the accuracy specified.

Dimensions are 8-3/4" x 19" x 13-1/8". The supply is made up in a case with a handle as a completely self-contained portable unit, or can be furnished for rack mounting. It provides four millivolt sources that are completely independent of each other. Models are available with from one to eight sources per panel. The calibration unit can be furnished as a separate instrument or as part of the panel as illustrated. Kahn & Co., Inc., Dept. ED, 541 Windsor St., Hartford 1, Conn.

Adjustable over the entire range, output can be set within ± 0.05 mv up to a value of 40mv. Drift does not exceed 0.05mv/hr. The unit is self-calibrating to the accuracy specified.

CIRCLE ED-274 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistance Bridge Indicator Sensitive to Small Changes



The Model 101 Resistance Bridge Indicator is a versatile and accurate instrument for measuring the output of resistance transducers such as strain gages, accelerometers, pressure pickups, position pickups, and resistance thermometers. It is self-balancing and indicates on an easy-to-read, 10-turn dial.

Outputs from 50 ohms to 1000 ohms full or half bridges, with one, two, or four active gages, can be read. High sensitivity enables resistance changes of 0.0002% to 8% to be measured. Overall accuracy is held to within 1.0%. Response time for 10-turn, full-scale travel is 4sec. Models for analog-to-digital conversion and for indication and control in automation systems are available. American Helicopter Div., Fairchild Engine and Airplane Corp., Dept. ED, 1800 Rosecrans Ave., Manhattan Beach, Calif.

Outputs from 50 ohms to 1000 ohms full or half bridges, with one, two, or four active gages, can be read. High sensitivity enables resistance changes of 0.0002% to 8% to be measured. Overall accuracy is held to within 1.0%. Response time for 10-turn, full-scale travel is 4sec. Models for analog-to-digital conversion and for indication and control in automation systems are available. American Helicopter Div., Fairchild Engine and Airplane Corp., Dept. ED, 1800 Rosecrans Ave., Manhattan Beach, Calif.

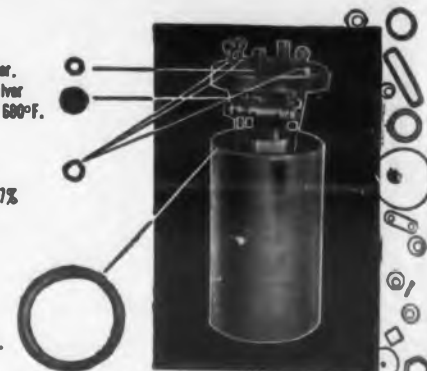
CIRCLE ED-275 ON READER-SERVICE CARD FOR MORE INFORMATION

Soldering Operations in 1 Easy as ABC with KESTER "SOLDERFORMS"

A Solder screws and stud to can cover.
"Solderform" Disc & Rings 5% Silver
—95% Lead Alloy. Melting Point 600°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.



CIRCLE ED-276 ON READER-SERVICE CARD FOR MORE INFORMATION

Linde synthetic sapphire

...for excellent optical transmission

PLUS physical strength and chemical inertness

Sapphire is hard, strong, chemically inert and transmits a high percentage of radiation in the important ultra-violet and infra-red regions. At 1750Å forty per cent of the radiation is transmitted by a .059 inch section; at 5.7 microns forty per cent is transmitted by a .100 inch section. This unique combination of properties makes it ideal for optical systems that require resistance to abrasion and corrosion and high temperature strength as well as excellent optical transmission.

Now single-crystal sapphire windows are available in diameters up to 2 inches in several finishes. For further information, call or write your nearest LINDE office.

LINDE AIR PRODUCTS COMPANY

A DIVISION OF UNION CARBIDE AND CARBON CORPORATION
30 East 42nd Street, New York 17, N. Y. (UL) Offices in Other Principal Cities

In Canada: DOMINION OXYGEN COMPANY
Division of Union Carbide Canada Limited, Toronto

"Linde" is a registered trade-mark of Union Carbide and Carbon Corporation.

CIRCLE ED-277 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • June 1955

METER-RELAYS

For Sensitive and Accurate Control



Model 261-C Range 0/200 DC Microamperes. Price \$33.00

RANGES:

0/20 Ua. to 0/50 A.
0/5 Mv. to 0/500 V.

The trip point is adjustable to any point on the scale arc. These meter-relays are sensitive to changes of as little as 1%. One contact is carried on moving pointer. The other is on a semi-fixed pointer. When two pointers meet contacts close and lock. Holding coil is wound directly over moving coil. Reset can be manual or automatic. Spring action in contacts kicks them apart forcefully. Three sizes of clear plastic case models, 2½, 3¼ and 4½ inches (all rectangular). Two ruggedized and sealed models, 2½ and 3½ inches (round metal cases).

Contact arrangements: High Limit Single, Low Limit Single or Double (both high and low). Contact rating is 5 to 25 milliamperes D.C.

Suggested circuits for meter-relays and complete specifications including prices are covered in new 16-page Bulletin G-6, which you can get by writing Assembly Products, Inc., Chesterland, 17, Ohio.

CIRCLE ED-278 ON READER-SERVICE CARD FOR MORE INFORMATION

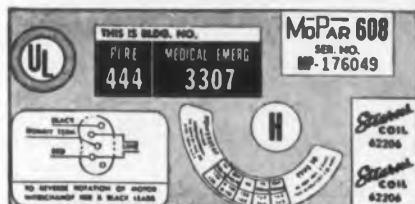
SELF-STICKING MARKERS

FOR WIRES

For marking wires, harnesses, circuits, coils, assemblies, etc. Stick and stay stuck up to 300°F. Fast, foolproof, low cost identification for any size wire. 2000 NEMA-ASA markers in stock.



FOR SPECIAL APPLICATIONS



Instructions, trade marks, wiring diagrams, serial numbers, part numbers, etc. Any wording, size, color and die-cut shape you need. Cut to exact tolerances.

SELF-STICKING • FAST • LOW COST

Informative literature and free samples. Write:

MANUFACTURERS OF SELF-STICKING INDUSTRIAL PRODUCTS

W. H. BRADY CO.

776 WEST GLENDALE AVE. • MILWAUKEE 12, WIS.

CIRCLE ED-279 ON READER-SERVICE CARD FOR MORE INFORMATION
ELECTRONIC DESIGN • June 1955

Plastic-Tubing Clamp

For AN Type Connectors



This clamp provides a simple, inexpensive method to protect open wiring in connection with the AN type connectors. In use on engines of a leading air-

line, it has provided estimated savings of 2000 man-hours per fleet of 76 planes. Savings are based on tear-down, repairing of conduit, and replacing of conduit at scheduled service periods during the year.

The clamping device permits tightening by hand, thereby eliminating the need for tools. It holds flexible plastic tubing securely in place to protect critical wiring connections as well as preventing injury to the conduit in service.

The clamp is manufactured in sizes to accommodate AN connector application from 12 to 48 inclusive. It is machined from aluminum and has an anodized finish that is rustproof, and it is light in weight. In addition, when it is used in connection with a gasketed adapter, a waterproof joint is provided between the connector and the protective flexible plastic tubing. H. H. Buggie, Inc., Dept. ED, 726 Stanton St., Toledo 4, Ohio.

CIRCLE ED-280 ON READER-SERVICE CARD FOR MORE INFORMATION

Thermostat Test Unit

Performs Cycle Testing



The Model TT-1 Thermostat Test Unit features a low-heat-inertia test chamber which allows the temperature to reach equilibrium rapidly for any test condition.

The temperature may be controlled manually, or controlled automatically by the thermostat under test. Up to five small thermostats may be loaded in the test chamber and tested individually. The action of the thermostat may be observed by an indicator light on the front panel.

Operating on 115v 50-60cy and requiring 440w, the unit is contained within a metal cabinet 12-1/2" x 21" x 15" and weighs 55 lb complete. Statham Development Corp., Dept. ED, 12411 Olympic Blvd., Los Angeles 64, Calif.

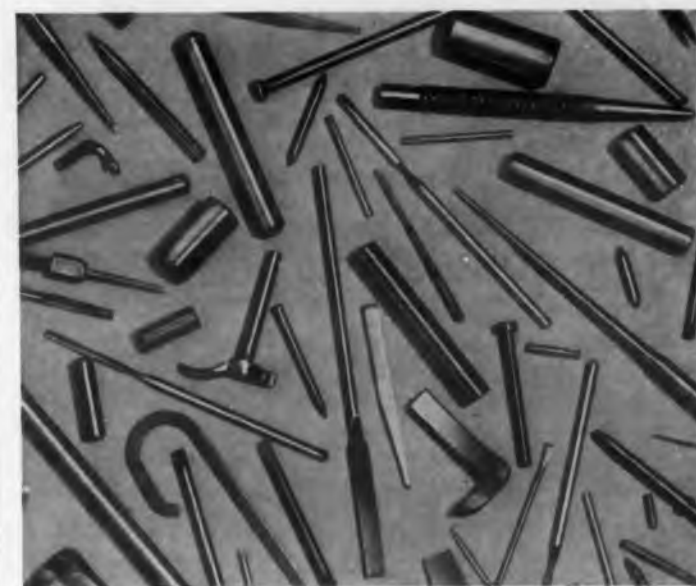
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Rely on



TORRINGTON

for Volume Production of small precision parts



Volume production of small precision parts is a habit at Torrington. Each day we produce millions of pieces...exactly to customers' specifications of tolerance, hardness, temper and finish.

And we do it faster, better and for less than they can do it themselves. Send us a sample part or blueprint for a prompt quotation. And ask for our Condensed Catalog which shows hundreds of typical parts on which we can save you money.

THE TORRINGTON COMPANY
Specialties Division
37 Field Street, Torrington, Conn.

TORRINGTON SPECIAL METAL PARTS

Makers of Torrington Needle Bearings

CIRCLE ED-282 ON READER-SERVICE CARD FOR MORE INFORMATION

NEWLY-
DEVELOPED
Sub Miniature
Type 10
H-SERIES

hermetically sealed resistors

The "H" Series Precision Resistors are encapsulated in a tough plastic compound. The result is a solid, homogeneous unit with unparalleled ruggedness, impervious to the effects of moisture, thermal shock and mechanical shock. The plastic is filled with heat conducting mineral which dissipates the heat and equalizes the "hot spots" in the resistor winding. The sealed-in terminal connections are welded.



SPECIFICATIONS:

MILITARY SPECIFICATIONS:
Performance characteristics satisfy all requirements of MIL-R-93A & JAN-R-93.

TEMPERATURE COEFFICIENT: $\pm 0.0022\%$ per degree C.

OPERATING TEMPERATURE:
-65°C. to +125°C.

RESISTANCE ACCURACY:
Standard resistance tolerances are 1%, 0.5%, 0.25% and 0.1%.

TYPE 10 (Illustrated):
 $\frac{1}{4}$ " dia. x $\frac{1}{2}$ " long.

Resistance range: 1.0 ohm - 0.35 meg.

Send for Bulletin H for complete description on other physical sizes and wattage ranges.

11423 VANOWEN ST., N. HOLLYWOOD 4, CALIF.
Subsidiary of International Resistance Company

HYCOR
Company, Inc.

CIRCLE ED-333 ON READER-SERVICE CARD FOR MORE INFORMATION



Get This Informative Free Booklet on New Uses for Straits Tin

New, 20-page booklet tells important story of Straits Tin and its many new uses today. Fully illustrated. Includes sections on new tin alloys, new tin solders, new tin chemicals. Covers tin resources and supply, Malayan mining. Booklet is factual, informative—could well prove profitable to you. Mail coupon now.

THE MALAYAN TIN BUREAU

Dept. E, 1028 Connecticut Ave., Washington 6, D.C.

Please send me a copy of your free booklet on new uses for Straits Tin.

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Firm Name _____

Street _____

City _____ Zone _____ State _____

CIRCLE ED-283 ON READER-SERVICE CARD FOR MORE INFORMATION

114

New Literature ...

Low Friction Treatment

284

Gorlube, a low friction treatment for application to O-rings and other parts made of natural, synthetic and silicone rubbers, is described in a technical data sheet. Depending on the function and the part, the Gorlube treatment is given either by impregnation or coating. Goshen Rubber Co., Inc., P. O. Box 517, Goshen, Ind.

Condenser Microphones

285

An 8-page brochure, "Technical Information on Condenser Microphones", is aimed at helping engineers use condenser microphones to their best advantage. The publication details the basic construction of condenser microphones, their operational theory and gives in charts typical characteristics of this firm's condenser microphones. Nine formulas and four charts are included. Frank L. Capps & Co., 20 Addison Pl., Valley Stream, N. Y.

Measurement and Control System

286

A new catalog illustrates and describes this company's inductronic system for measurement and control. The catalog gives technical information, as well as application data, on the basic inductronic d-c amplifying unit and on its companion models such as multi-range d-c amplifiers, sensitizing amplifiers, integrating fluxmeters, limit and knife-edge control units, and product resolvers. Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.

Mountings

287

A 6-page technical bulletin provides complete data on Temproof mountings for vibration isolation. These mountings are resistant to temperature over the range from -80° to 250°F. Dimension drawings and charts are included. Lord Manufacturing Co., 1635 W. 12th St., Erie, Pa.

Thermistor-Varistor Catalog

288

A new catalog on thermistor-varistor components and products is available. The catalog contains valuable technical data and lists the characteristics and specifications of thermistors, varistors, gas analysis cells, thermistor hypodermic needles, assemblies, specialties, and mounting accessories. Victory Engineering Corp., Springfield Rd., Union, N. J.

Time Totalizers

289

Time totalizers are the subject of a new 8-page bulletin. Units covered are the type 690 electrical stop clock for nuclear research, laboratory testing, and checking communications equipment and systems; and types 630 and 640 running time meters to check operating characteristics. The bulletin includes complete descriptions of each unit, time ranges, housing information, dimensions and wiring diagrams. R. W. Cramer Co., Inc., Centerbrook, Conn.

Vacuum Pumps and Compressors

290

Compressors and vacuum pumps are described and illustrated in this 8-page brochure. Charts giving specifications and dimensional drawings are provided. Lammert & Mann Co., Inc., 1753 Walnut St., Chicago 12, Ill.

Continuous-Flow Reducing Camera

291

A detailed description of how reduced-size photocopies made with the Neoflow continuous-flow reducing camera save reproduction materials, speed up print production, facilitate assembly operations, and save filing space and shipping costs is presented in a new 8-page brochure. The brochure also gives complete operating instructions and specifications for the camera and the special continuous processing unit designed for use with it. Peerless Photo Products, Inc., Shoreham, L. I., N. Y.

SUB-MINIATURE SWITCH

- 5 amperes
125/250 v. a-c
- 4 amperes
30 v. d-c



ACTUAL SIZE

UNIMAX type USM

This compact, single-pole double-throw, snap-acting switch is built for easy wiring in miniaturized apparatus. Its sturdy, phenolic case is 25/32 x 23/64 x 1/4 inch, with sturdy, standard flat terminals widely spaced for rapid wiring and easy soldering. Available in plain or leaf-actuator styles.

Free detailed data sheet on request.

UNIMAX

Division of the W. L. Maxson Corporation

460 WEST 34th STREET, NEW YORK 1, NEW YORK

CIRCLE ED-292 ON READER-SERVICE CARD FOR MORE INFORMATION

**FOR HIGH FREQUENCY—HIGH VOLTAGE
SPACE SAVING APPLICATIONS**

**GARDE Miniature & Sub-Miniature
INSULATED STAND-OFFS, FEED THROUGH
& SPACERS**



Choice of insulation characteristics in accordance with latest Mil-P-14 specifications

HERMETICALLY SEALED HEADERS

COIL FORMS

BARRIER STRIPS

Molded as a unit with Bus Bars require no insulating backing.

MULTIPLE TERMINAL CONNECTOR HEADS

For users to properly assess the outstanding features and advantages of Garde Components, samples will be sent on request. A detailed technical catalog is now available. Be sure your name is on our mailing list.

We have complete facilities to accommodate your special requirements, ranging from Engineering Consulting Service to Precision Design and Production.

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MOLDERS OF THERMOPLASTIC AND THERMOSETTING MATERIALS
588 Eddy Street, Providence 3, Rhode Island
Sales Representatives in Principal Cities

CIRCLE ED-293 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • June 1955

Adhesives for Transparent Films 294

A revised edition of "How to Handle Adhesives for Transparent Films" is now available. One of the outstanding features of the booklet is a new chart describing the properties and characteristics of all principal types of transparent film including Mylar, cellophane, pliofilm, polyethylene, and cellulose acetate. National Adhesives Div., National Starch Products, Inc., 270 Madison Ave., New York 16, N. Y.

Spectrum Analyzer Techniques

"Handbook of Spectrum Analyzer Techniques" covers the spectrum analyzer as to its theory of operation, design considerations, and applications. The handbook is illustrated with block diagrams, test setups, representative spectra, and models of various types of spectrum analyzers. \$0.50. Polarad Electronics Corp., 43-20 34th St., Long Island City, N. Y.

Miniaturized Power Packs 295

A catalog sheet covers this firm's line of miniaturized power packs. This catalog includes new models covering both 60 and 400cy types as well as a new series of models which supply a combination of constant voltage and constant current specifically for transistor application. Electronic Research Associates, Inc., 67 E. Centre St., Nutley, N. J.

Panel Instruments 296

This firm's line of panel instruments are described and illustrated in a new catalog. Dimensional drawings and charts are provided as well as price lists. Burlington Instrument Co., Burlington, Iowa.

Equipment Catalog 297

This 56-page supplement to this company's general catalog includes new product equipment for radio, television, high-fidelity, and industrial electronic applications. Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

Computational Facilities 298

A 16-page brochure describes the computational facilities and code library of this Institute. The brochure describes how the facilities can be used by firms throughout the country and the specialized equipment available to handle all types of problems. Computation Center, Midwest Research Institute, 425 Volker Blvd., Kansas City, Mo.

TOROIDS TOROIDS TOROIDS TOROIDS TOROIDS TOROIDS TOROIDS TOROIDS TOROIDS TOROIDS TOROIDS



PDOQ with CAC

Your answer pertaining to Production — Delivery — Quality in toroidal components may be obtained promptly by calling the CAC man nearest you.

Perhaps you need engineering assistance — CAC offers it — plus know-how which is backed by high-volume production facilities at CAC.

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PHILADELPHIA - C. R. Hile Co. - Elgin 6-2266 - Hillview Rd., Box 144, Paoli, Pa.
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CLEVELAND - E. Kohler Assoc. - Olympic 1-1242 - 8905 Lake Ave., Cleveland 2, O.
SEATTLE - Testco-Mohawk 4895 - D. Thompson, Boeing Field, Room 105, Seattle 8 Wn.
INDIANAPOLIS - R. O. Whitesell & Assoc. - Melrose 2-8517 - 2208 E. Wash., Ind. 1, Ind.
DALLAS - Norvell Assoc. - Forest 8-4180 - 5622 Dyer St., Dallas 6, Tex.
ST. PAUL - Northport Co. - Midway 7884 - 1838 Ashland Ave., St. Paul 4, Minn.

FOR ADDITIONAL INFORMATION CONTACT
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HICKMAN MILLS, MISSOURI • PHONE KANSAS CITY, SOUTH 5528

CIRCLE ED-299 ON READER-SERVICE CARD FOR MORE INFORMATION

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

ACE NYLON BALLS

KEEP THINGS MOVING SMOOTHLY IN
HUNDREDS OF INDUSTRIAL APPLICATIONS!

MASS-PRODUCED OF DUPONT NYLON FM. No. 10001
TO CLOSE TOLERANCES OF $\pm .001$. Sizes $\frac{1}{8}$ " to $\frac{3}{4}$ "

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

Write for samples, bulletin, price list today.

WHY NOT LET
OUR ENGINEERS
ADVISE YOU?

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

ACE PLASTIC COMPANY

Precision Plastic Fabricators and Extruders

91-58 Van Wyck Expressway • Jamaica 35, N. Y.
CIRCLE ED-300 ON READER-SERVICE CARD FOR MORE INFORMATION



**AT LAST... S-BAND DIODE
IMPEDANCE NAILED DOWN!**

The new Microwave 1N21D Diode provides reproducible performance not approached by 1N21B and 1N21C types. In addition, close to 1 db improvement in noise figure can be realized over limit 1N21C diodes. This diode is a direct replacement for 1N21B and 1N21C diodes from 1000 to 4000 mcs where super performance is required. Available from stock in production quantities at reasonable prices.

Type	Center Freq. (mc)	Max. Conv. Loss (db)	Max. Noise Ratio (times)	VSWR (max)	IF Imped. (ohms)
1N21D	3060	5.0	1.3	1.5	325-475

ATR - TR - AND MAGNETRON TUBES
WAVEGUIDE COMPONENTS AND
TEST EQUIPMENT - SILICON DIODES



22 CUMMINGTON STREET
BOSTON 15, MASSACHUSETTS
COPLEY 7-7577

CIRCLE ED-301 ON READER-SERVICE CARD FOR MORE INFORMATION

116

Automatic Packaging Equipment 302

A two-color, 4-page folder illustrates and describes this firm's line of automatic packaging equipment. The folder explains how the equipment performs many packaging operations and meets and exceeds the requirements of many different industries packaging a variety of products. Pak-Rapid, Inc., 530 N. 21st St., Philadelphia 30, Pa.

Remote Control Switch 303

Two new features available on an ASCO remote control switch are shown in a new technical bulletin. These features are a contact hood to shield remote control switch contacts and a reduced width 2-pole 920 remote control switch. Automatic Switch Co., 391 Lakeside Ave., Orange, N. J.

Turns-Counting Dial 304

The Duodial series RB turns-counting dial is the subject of data sheet No. 54-76. The Duodial, which consists of two coaxial dials, can be used in electrical, mechanical, hydraulic, and pneumatic application. Technical Information Service, Helipot Corp., 916 Meridian, S. Pasadena, Calif.

Phase Meters 305

Laboratory Report No. 15 deals with the use of phase meters in production testing. It discusses methods for production testing of helicopter altitude control, amplifier phase shift, accelerometer resonance, gyro table phasing, and synchro phase shift through use of the various types of phase meters. Technology Instrument Corp., Acton, Mass.

Components Catalog 306

A new condensed catalog of components of the Autronic Control System illustrates and gives a brief description of the function and working principles of each unit in the system. Swartwout Co., 18511 Euclid Ave., Cleveland 12, Ohio.

Temperature Indication Systems 307

High accuracy temperature indication systems for aircraft jet engines are described in a 4-page brochure. Schematic of the system, chart of the voltage reference source, and dimensional data are given. Avien, Inc., 58-15 Northern Blvd., Woodside 77, N. Y.

New Bulletin

**ON FENWAL
THERMOSWITCH®
CONTROLS
MIDGET AND
MINIATURE...**



YOURS FREE NOW

To solve temperature control and detection problems in "tight spots" these controls are truly miniaturized... space-saving, sturdy, versatile and adaptable for compact, modern design... with the same positive action and instant sensitivity to temperature change as Fenwal's larger size standards.

MIDGET: Single wire and two wire types; wide range from -50°F to 500°F ; $\frac{1}{4}$ " outside shell diameter, sensitive to temperature changes over entire shell; high sensitivity; shock and vibration resistant. Units which either make or break on temperature rise for temperature control in gases, solids, liquids. Applications include: Antennas, Electronic Equipment, Reciprocating Engines, Molding Presses or Platens.

MINIATURE: Control within 2° to 6°F is typical, even under 5G acceleration. Fully adjustable ranges of from -20° to 200°F or -20° to 275°F . Hermetically sealed units -20° to 200°F . For control or detection in Crystal Ovens, Precision Instruments, Radar, Antennas, Computers, Aircraft, Guided Missiles, Motors, Wave Guides.

For "tight spot" temperature control information, get latest bulletin now. Your free copy will be sent upon request. Write for bulletin MC-124, Aviation Products Division, Fenwal Incorporated, 96 Pleasant Street, Ashland, Mass.

Fenwal THERMOSWITCH®
Controls Temperature... Precisely

CIRCLE ED-308 ON READER-SERVICE CARD FOR MORE INFORMATION



★ Sweep Speed Continuously-Adjustable Over Full Range in Over 10 Seconds to Less Than One Second

★ Sweep Range Continuously-Adjustable From 1 Cm to 46 Cm
★ Both Adjustments Possible While Carriage is Traveling

★ Signal For CRO Horizontal Plates provided by Voltage Divider with Sliding Contact on Carriage

Type 874-MD Sweep Drive (includes motor and drive mechanism, speed control, tubular potentiometer and adjustable stops)...\$220.00

Type 874-LBA Slotted Line (with adjustable stub for tuning crystal rectifier)...\$231.00

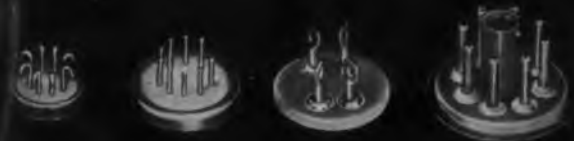
GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Massachusetts, U. S. A.
90 West Street NEW YORK 6 York Road & Guernsey Avenue, Abington, Pa. PHILADELPHIA
8055 13th St., Silver Spring, Md. WASHINGTON, D. C.
920 S. Michigan Ave. CHICAGO 5 1000 N. Seward St. LOS ANGELES 36

CIRCLE ED-309 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • June 1955

BRING US YOUR HEADER PROBLEMS!



SIMPLE OR COMPLEX—We make them all, ranging from 2- and 3-electrode crystal holder bases and standard octal headers, to 14- and 18-terminal headers for sealed Transformer and Relay applications—with a wide selection of styles and sizes in our series of basic designs.

SPECIAL DESIGNS—We also manufacture Sealed Headers and Terminals to meet special requirements, and will be glad to quote upon receiving your specifications.

COMPLETE ASSEMBLIES—We have facilities for handling the complete assembly of many units—including evacuating and pressure-filled enclosures.

NEW CATALOG—Just off the press, a new Hermaseal catalog, with descriptions and specifications of some of our standard Sealed Headers and Terminals. Write for your copy today!



THE HERMASEAL CO., Inc.
Elkhart 45, Indiana

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

For ANY speed...

use **Metron** MINIATURE VARIABLE SPEED DRIVES

Variable speed drives give you variable speeds from 1-5 increase through 1-1, to 5-1 decrease! Just move the lever to the desired speed ratio and the miniature variable instantly produces the speed you want!

- Speeds up to 10,000 Rev/minute or down to 1/4 Rev/day
- Small — to fit into your product
- Permanently lubricated
- Your choice of 6 controls
- Output up to .025 HP

*representative speeds only

for details write for Bulletin No. 99A

Metron INSTRUMENT CO.
450 Lincoln St., Denver 3, Colorado
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CIRCLE ED-311 ON READER-SERVICE CARD FOR MORE INFORMATION

Engineering Materials 312

"Engineering Materials for Modern Industry" is the title of a new 16-page, 2-color bulletin which covers the properties, grades, and uses of National vulcanized fibre and Phenolite laminated plastic. Tables list the general properties of the several grades of vulcanized fibre and the 40 grades of Phenolite laminated plastic. Case studies match physical properties to typical uses. National Vulcanized Fibre Co., 1055 Beech St., Wilmington 99, Del.

Roller Drives 313

High-speed, precision indexing roller drives are the subject of this 4-page bulletin. Dimensions and load ratings are given. Roller Gear Div., Ferguson Machine & Tool Co., P. O. Box 191, St. Louis 21, Mo.

Air Tool Catalog 314

The Air Impactool Catalog No. 5200-A contains the complete line of Air Impactools made by this firm. A two-page spread is devoted to each size. It contains illustrations, specifications, and the equipment furnished with each tool. On-the-job application pictures and case history studies are also found on these spreads. Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

Printed Circuitry 315

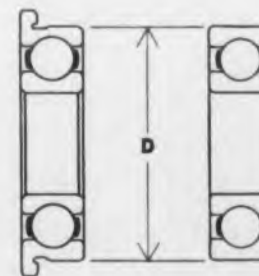
"Printed Circuitry", an 8-page, illustrated booklet, describes in detail the application, uses, and advantages of printed circuits as well as technical information to aid in design or planning of printed circuitry. The booklet explains the different types of base materials, laminate characteristics and circuit designs. Preparation of master drawings, soldering techniques, and pricing variables are explained. Printed Wiring Div., Cornell-Dubilier Electric Corp., S. Plainfield, N. J.

Lock Nuts and Fasteners 316

A new 16-page catalog describes and illustrates lock nuts and fasteners for radio, television, and electronic assembly. Included are complete details of advantages, dimensions, and applications of lock nuts for assembly of chassis, speakers, controls, switches, record changers, tone arms, transformers, and rectifier stacks. Also included are wing lock nuts for antennas and focus coils; shield can fasteners; coil tube fasteners; and tension type lock nuts for tuners. Palnut Co., 61 Cordier St., Irvington 11, N. J.

A NEW COST-SAVING FEATURE of Fafnir Flanged Instrument Bearings

Simplification of housing designs is made possible by the addition of flanged bearings with *straight outside diameters* in several sizes that match those of Fafnir unflanged or plain radial ball bearings. Now, one-size, straight bored housings may be planned. This new series of flanged bearings is available with or without shields. For additional information, write The Fafnir Bearing Company, New Britain, Connecticut.



FLANGED BEARING NUMBERS	OUTSIDE DIAMETERS	BORE	EXTRA SMALL SERIES RADIAL BEARING NOS.
F33K3	.3750	.1250	33K3
F33K5	.5000	.1875	33K5
FS1K7	.6250	.2500	S1K7
FS3K	.8750	.3750	S3K



Atomizer Wash

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607

The Precision Potentiometer as a Voltage Divider

BY H. A. SCHMIDT
Sales Engineer, Helipot Corporation

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

389

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Varnished Fabrics 321

A 4-page folder gives data on standard Fiberglass-base varnished fabrics. It includes dielectric strengths of fabrics of various constructions impregnated with yellow varnish, black varnish, Teflon, silicone rubber, and silicone varnish. Dept. P, Electrical Div., Owens-Corning Fiberglass Corp., 598 Madison Ave., New York 22, N. Y.

Klystron Facts 322

"Klystron Facts—Case No. 2" is a discussion of klystron power amplifier applications and new developments in the klystron field. The pamphlet is a collection of questions and answers and is illustrated. Eitel-McCullough, Inc., San Bruno, Calif.

Miniature Coaxial Connectors 323

This company's line of microminiature coaxial connectors, cables, and assemblies are described and illustrated in a 4-page illustrated folder. Specifications and applications are given. Microdot Div., Felts Corp., 1826 Fremont Ave., S. Pasadena, Calif.

Packaging 324

This folder, "Pillowed Packaging" describes how Hairflex, rubberized curled hair, can protect shipment of precision instruments and fragile apparatus. Hairflex is resistant to shock and vibration and is dust-free, moisture resistant, economical. Curled Hair Div., Armour and Co., N. Benton Rd., Alliance, Ohio.

Electronic Test Equipment 325

A 28-page catalog describes and illustrates this firm's line of microwave test equipment, bolometers, and thermistors. New features include high power impedance meters, variable reactances, and terminations, as well as coaxial slotted lines, attenuators, terminations, and couplers. Narda Corp., 66 Main St., Mineola, L. I., N. Y.

Control Element 326

The magnetically operated, glass enclosed Glaswitch, a sensitive control element for general industrial applications, is described in Engineering Bulletin No. 1057. The 20-page booklet covers operation, performance, and characteristics of the switch. Calibration data, temperature, life, and vibration characteristics, and installation information are included. Revere Corp. of America, Wallingford, Conn.

Screw Machine Products

327

Complete facilities for the manufacture of a wide range of custom-made, precision screw machine products are described in an illustrated 8-page brochure. Shown is the automatic equipment used, as well as typical products made, such as screws and threaded parts, contact pins, balls, shafts, pinion blanks, bushings, and discs. Beameo, Inc., Box 308, Irving Park & Church Rds., Bensenville, Ill.

Tube Handbook

A new edition of "Essential Characteristics", a handbook on receiving tubes, picture tubes, special purpose tubes, and germanium diodes, is available. The 192-page book gives the characteristics of some 2,000 tube types of which over 150 are new. Other new features include a classification chart on receiving tubes which permits selecting a tube by the type of application; characteristic curves of representative types; and a thumb index. \$0.50. Tube Dept., General Electric Co., Schenectady 5, N. Y.

Vulcanized Fibre

328

"Vulcanized Fibre: New Look At An Old Plastic" is the title of this 6-page reprint. The article presents detailed specifications covering the physical and chemical properties of the various grades of this material. Also contained in the reprint are several illustrated case history applications showing how vulcanized fibre solved design and manufacturing problems for companies. National Vulcanized Fibre Co., 1055 Beech St., Wilmington 99, Del.

Microwave Components

329

Bulletin No. 100-A illustrates and describes this firm's line of precision microwave components. Included are attenuators, double slug tuners, pedestals, precision slotted sections, terminations, tube mounts, tunable crystal mounts, tuning plungers, waveguide-to-coaxial adapters, and waveguide clamps. Custom-built components are also available. Graham Manufacturing Co., Inc., E. Greenwich, R. I.

R-F Gaskets

330

A 16-page design brochure, "Suppressing Radio Interference with Metex Electronic Weatherstrip and R-F Gaskets" deals with the problems of suppressing r-f leakage at its source. The design section gives full design procedures, methods of installation, and lists standard stock items. Electronics Dept., Metal Textile Corp., Roselle, N. J.



Arrows point to Paliney #7 contacts used in this Fairchild Type 746 Precision Potentiometer.

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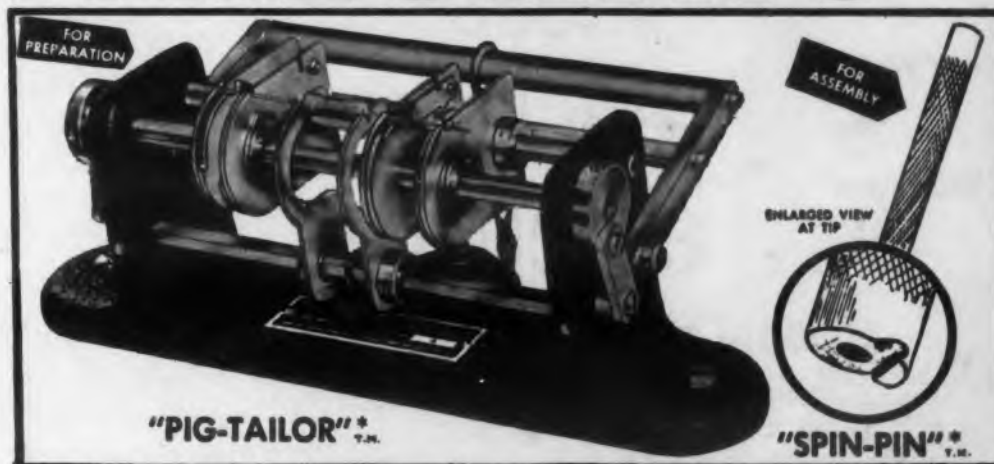
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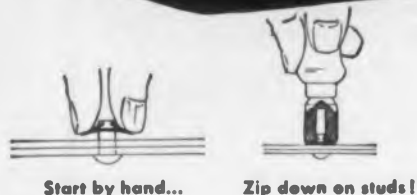
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CIRCLE ED-336 ON READER-SERVICE CARD FOR MORE INFORMATION

120

Current Transformers 337

A complete series of Donut type current transformers for metering applications is described and illustrated in 4-page Bulletin No. 365-1. Specifications on dimensions and accuracy are given and methods of extending the range of indicating ammeters through use of these transformers discussed. Associated Research, Inc., 3758 Belmont Ave., Chicago 18, Ill.

Instruction Kit 338

"How to teach Rotating Electric Machinery courses without advanced technical training" is the subject of this 4-page folder. It gives full details about the company's Electri-Kit Model 700 that simplifies d-c/a-c motor construction and operation for both teacher and students. Crow Electri-Craft Corp., 1102 Shelby St., Vincennes, Ind.

Tube Data Sheets 339

Revised editions of data sheets on the Eimac 4-400A radial-beam power tetrode and 4-400A/4000 air system socket have been published. These sheets provide data on ratings, typical operation, and characteristics. Also available is Application Bulletin No. 3 "Pulse", dealing with pulse applications of tubes. Eitel-McCullough, Inc., San Bruno, Calif.

Induction Motor 340

One of a series of design data sheets covers a miniature sub-fractional 400cy induction motor. Illustrated and provided with detailed and dimensioned outlines, the sheet describes the motor fully, giving technical specifications and performance curves showing rpm, power input, and power output. Dalmotor Co., 1326 Clay St., Santa Clara, Calif.

Dry Cells and Batteries

This is the sixth edition of the American Standards Specification for Dry Cells and Batteries. This edition of the specification includes specifications on flat cells and new alkaline primary cells known as "mercury cells". Also air-depolarized cells in miniature size are covered. \$0.25. Government Printing Office, Washington 25, D. C.

TV Alignment Equipment 341

A new 8-page booklet describes TV alignment equipment. Of special interest are reprinted articles on the use of the Model 691 Marker Adder and the Model 690 Marker Generator in TV alignment and conversion of the Model 650 Video Generator to the color-compatible Model 650C. Hickok Electrical Instrument Co., 10525 Dupont Ave., Cleveland 8, Ohio.

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ELECTRONIC DESIGN • June 1955

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CIRCLE ED-345 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • June 1955

Electronic Grinding 346

A brochure entitled, "Automatic Electrolytic Shaping With Electronic Control", is now available. The brochure explains how standard grinders, equipped with electronic control and using Anocut electrolytic salts, increases removal efficiency and saves costs. Anocut Engineering Co., 531 W. Washington Blvd., Chicago 6, Ill.

Stainless Fasteners 347

A comprehensive 8-page brochure, No. P64A, lists stainless fasteners available through this firm. Included are style and size data about stainless screws, bolts, nuts, washers, rivets, AN fasteners, etc. Available body and head styles are illustrated. Allmetal Screw Products Co., Inc., 821 Stewart Ave., Garden City, L. I., N. Y.

Pulse System Assembly 348

A simplified approach to rapid assembly of pulse test and control systems and the equipment needed to do the job are outlined in a 6-page brochure. The illustrated brochure, "The Unitized Approach", reviews the entire line of pulse control equipment made by this company. Electronic Instruments Div., Burroughs Corp., 1209 Vine St., Philadelphia 7, Pa.



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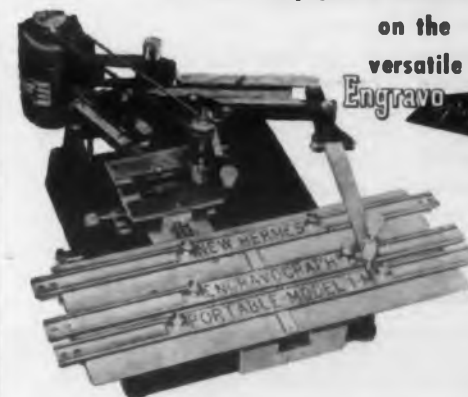
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3. 0-1 mc period meter
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Photographic Lighting

A new manual covers the technical aspects of the various products used in the photographic lighting field. Some of the lamps covered are photoflash, projection, enlarger, darkroom, reflectorflood, and photo-flood. Data on color temperature, light output, recommended synchronization time, shutter speeds, and lumen seconds are included. \$2.00. Dept. JO, Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.

Electro-Magnetic Components 356

A new catalog covers electro-magnetic components for radio and television applications. Illustrated and described are a full line of ion traps, centering devices, speakers, flybacks, TV focusing magnets, field neutralizing assemblies, purity ring, blue beam bender, and Barkhausen oscillation eliminator. Heppner Manufacturing Co., Round Lake, Ill.

Shielded Enclosures 357

A new catalog provides engineering and application data on r-f shielded enclosures. Every type of screened and sheet metal standard enclosure is covered individually with insertion loss or attenuation curves for each, and complete construction details are illustrated by drawings. Ace Engineering & Machine Co., 3644 N. Lawrence St., Philadelphia 40, Pa.

Fastening Devices 358

A new eyelet folder illustrates more than 60 different standardized eyelets. Used primarily as industrial fastening devices, the eyelets are cross-charted for quick identification of sizes. The folder also lists the maximum thickness of noncompressible material in which the eyelet can be set to give normal roll. United Shoe Machinery Corp., 140 Federal St., Boston, Mass.

3-D Microscopes 359

The value of 3-dimensional microscopes for industrial assembly lines and research laboratories is described in this 38-page brochure. The brochure features three photographs which can be observed through a viewer that produces a three-dimensional effect. The value of wide-field 3-dimensional magnification for various assembly and inspection operations is explained in detail. Bausch & Lomb Optical Co., 635 St. Paul St., Rochester, N. Y.



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Refractory Grains

361

Various types of refractory grains are described and illustrated in a 24-page booklet. Applications are illustrated and charts on size of grains, thermal conductivity and expansion, melting temperatures, and characteristics are included. The fused alumina may be used in coating heating elements in electronic tubes. Norton Co., Refractories Div., Worcester 6, Mass.

Component Catalog

362

Basic data on cathodes and other vacuum tube components are provided in a 20-page illustrated catalog. The products include cathodes for receiving type tubes, electronic parts for cathode-ray tubes, tubing and tubular parts for transmitter and special purpose tubes and semiconductor devices, and special tubular parts. Superior Tube Co., Germantown Ave., Norristown, Pa.

Potentiometer

363

The 1-1/2" long x 7/8" diam, 1 oz series AJ Helipot precision potentiometer is the subject of data sheet 54-06. The sheet illustrates and lists specifications, construction, coil characteristics, and available modifications. Technical Information Service, Helipot Corp., 916 Meridian Ave., S. Pasadena, Calif.

Heating Equipment

364

A bulletin (No. GEA-6285) describes specialty heating equipment for use when low temperatures affect operating characteristics. The bulletin lists applications, construction details, and specifications of both a-c and d-c heating equipment, and includes photographs of some typical custom-built units. Apparatus Sales Div., General Electric Co., Schenectady 5, N. Y.

Industrial Ovens

365

Standard ovens that respond with straight line temperature control and employ automatic proportional wattage input are described in a 4-page brochure. A condensed description is given for five units, as well as listings of various sizes, operating ranges, power requirements, and prices. Blue M Electric Co., 138th & Chatham St., Blue Island, Ill.

Technical Plastics

366

Properties of Synthane sheets, rods, tubes, etc., are described in this bulletin. Charts show characteristics and properties of various grades of Synthane and applications are illustrated. Synthane Corp., Oaks, Pa.

CIRCLE ED-360 ON READER-SERVICE CARD

ELECTRONIC DESIGN • June 1955

UNIQUE SENSITIVE RELAY

**incredibly small,
lightweight and
adjustable!**

ADVANCE "SO" SERIES

Here for the first time is a sensitive relay only 1-7/32" x 1-1/8" x 1-1/4"... weighing only 1-1/2 ounces, and adjustable over a wide range. You get much more latitude with this relay in designing for tiny areas.

The Advance "SO" is set at the factory to operate on 10 milliwatts. User can adjust it down to 2 milliwatts, or any desired pick-up or drop-out, by means of fine screw contacts. A balanced armature provides extremely sensitive operation. The unit is highly efficient, ruggedly built, and offers excellent shock and vibration-resistant characteristics.

Contact arrangement is SPDT.

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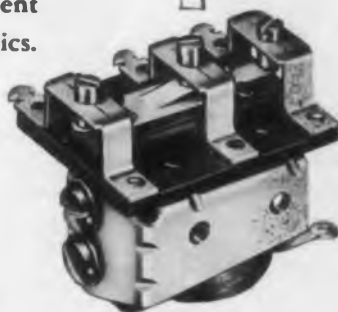
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6500	8.1 V	1.25 MA	3.9 V	.6 MA	140 V	.0015	.002/.003
10,000	10 V	1 MA	5 V	.5 MA	175 V	.0015	.002/.003

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CIRCLE ED-367 ON READER-SERVICE CARD FOR MORE INFORMATION

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Manufacturers of Special-Purpose Electron Tubes, Inverters, Dynamotors, AC-DC Generators, Voltage Regulators and Fractional H.P. DC Motors.

DESIGNATION AND TYPE					TYPICAL OPERATING CONDITIONS		
Type	Proto-type	Bendix No.	Description	Base And Bulb	Heater Voltage	Plate Voltage Per Plate	M.A. Load
5838	6X5	TE-3	Full Wave Rectifier	Octal T-9	12.6	350.	70.
5839	6X5	TE-2	Full Wave Rectifier	Octal T-9	26.5	350.	70.
5852	6X5	TE-5	Full Wave Rectifier	Octal T-9	6.3	350.	70.
5993	6X4	TE-10	Full Wave Rectifier	9-Pin Miniature	6.3	350.	70.
6106	5Y3	TE-22	Full Wave Rectifier	Octal T-9	5.0	350.	100.

Type	Proto-type	Bendix No.	Description	Base And Bulb	Heater Voltage	Plate Voltage	Screen Voltage	Grid Voltage	Gm	Plate Current	Power Output
5992	6V6	TE-8	Beam Power Amplifier	Octal T-9	6.3	250.	250.	12.5	4000	45. MA	3.5 W
*6094	6A05 6005	TE-18	Beam Power Amplifier	9-Pin Miniature	6.3	250.	250.	12.5	4500	45. MA	3.5 W
6385	2C51 5670	TE-21	Double Triode	9-Pin Miniature	6.3	150.	—	-2.0	5000	8. MA	—

*Tube Manufactured with Hard (Nonex) Glass for High Temperature Operation (Max. Bulb Temp. 300°C.)



DIVISION OF



EATONTOWN, N. J.

West Coast Sales and Service:
117 E. Prevedencia Ave., Burbank, Calif.

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

Canadian Distributor: Aviation Electric Ltd., P.O. Box 6102, Montreal, P. Q.

CIRCLE ED-377 ON READER-SERVICE CARD FOR MORE INFORMATION

Metallizing Equipment 378

Catalog N. 551 describes and illustrates this firm's mass production and experimental type metallizing units. Included is a description of the vacuum metallizing process. High Vacuum Equipment Corp., 349 Lincoln St., Hingham, Mass.

Compression Plugs 379

A new 12-page Vac-Tite Compression Plugs Catalog furnishes complete technical data and drawings on this firm's polarized plugs. These include octals, loctals, miniatures, and rectangular types of all-glass and all-metal construction. Hermetic Seal Products Co., 29-37 S. Sixth St., Newark 7, N. J.

Electronic Components 380

A new condensed 4-page catalog contains descriptions and specifications of over 200 electronic components, including recent additions to the line. Switchcraft, Inc., 1328 N. Halsted St., Chicago 22, Ill.

Hermetic Seal Bulletin 371

A new type of engineering bulletin includes in one catalog all current material on hermetically sealed connectors. The 20-page bulletin includes standard AN types, K-general electronic series, miniature, sub-miniature, and rack and panel designs. Cannon Electric Co., 420 W. Ave. 33, Los Angeles, Calif.

Panel Meters 372

Bulletin No. G-9 describes and illustrates this company's line of electrical indicating panel meters and pyrometers. It lists various types of clear plastic case panel mounting meters as well as black bakelite case styles. Assembly Products, Inc., Chesterland, Ohio.

Equipment Catalog 373

A 16-page catalog describes and illustrates this company's line of lockers, ladders, steel shelving and other industrial storage and maintenance equipment. The inside cover of this catalog features a list of conversion factors. Precision Equipment Co., 3666 Milwaukee Ave., Chicago 41, Ill.

Electrical Laminations 381

This 40-page bulletin provides full information on special, standard, and MIL-T electrical laminations by product dimensional drawings, graphs, and charts. Included in the bulletin is the company's test procedure for standard E and I laminations. Thomas & Skinner Steel Products, Inc., 1157 E. 23rd St., Indianapolis 7, Ind.

Polyethylene Products 382

A data sheet gives typical properties of "Epolene-E" and "Epolene-N", new polyethylene wax products in emulsifiable and non-emulsifiable form. Eastman Chemical Products, Inc., Kingsport, Tenn.

Relays 383

This 18-page catalog lists specifications and prices of hundreds of types of standard brand relays immediately available from stock. Relay Sales, 4721 W. Madison St., Chicago 44, Ill.

Bearings and Rod Ends 374

A new line of two-piece spherical bearing rod ends is described and illustrated in a new catalog. The rod ends feature simplified two-piece construction with the lubrication fitting an integral part of the rod end member. Other types of bearings and rod ends are also included in the catalog. Spherical Bearing Corp., 405 Woodend Rd., Stratford, Conn.

Symbolic Logic 375

This 16-page booklet discusses symbolic logic and binary calculation. It is illustrated with charts and drawings. Computer Control Co., Inc., 92 Broad St., Wellesley 57, Mass.

Computer Tubes 376

This 50-page booklet is designed for electronic computer designers and manufacturers. The guide and reference outlines the company's computer tube program, gives complete technical data on the five types in the line and includes a review of special computer tube design considerations and application notes. Tube Dept., General Electric Co., Schenectady, N. Y.

Diction

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Dictionary of Steel Terms 385

A 32-page dictionary covers steel terms of particular value to men who buy or use cold finished steel bars. Included are more than 180 relatively detailed definitions frequently used. More than 30 photographs, curves, and tables are provided. LaSalle Steel Co., Chicago 80, Ill.

Layout Tapes 386

An 8-page, illustrated booklet, "Layout Tapes for Industrial Planning," discusses the advantages of using layout tape in making up both transparent and opaque plant layouts and gives a description of the correct procedures. Labelon Tape Co., 450 Atlantic Ave., Rochester 9, N. Y.

Gel Time Meter 387

An automatic gel time meter is described in detail in Catalog No. 22. Specifications, operating data, applications, and description are given. Sunshine Scientific Instrument, 1810 Grant Ave., Philadelphia 15, Pa.

Transformers 388

An engineering bulletin on linear variable differential transformers is available. Complete data includes dimensional drawings, test circuit diagram, and characteristics. Gudeman Co., 340 W. Huron St., Chicago 10, Ill.

Drawn Metal Boxes 389

Catalog No. 5 lists over 1000 sizes of drawn metal boxes, all available without tooling charges. Precision drawn aluminum boxes are used by manufacturers of electrical and electronic instruments as cases and housings. Zero Manufacturing Co., P. O. Box 509E, Burbank, Calif.

Thrust Retainers 390

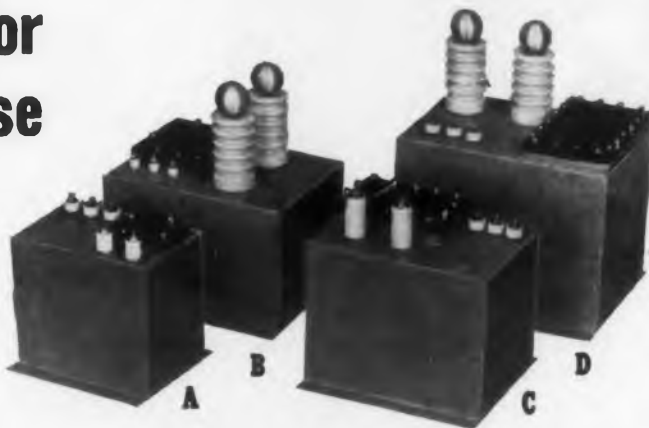
This 4-page brochure on thrust retainers and washers contains information on retainer selection, uses, applications and advantages, installations, and lubrication as well as charts on dimensions and thrust capacities. Hartford Steel Ball Co., Drawer Q, Station A, Hartford 6, Conn.

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A FEW EXAMPLES OF CONTACT TERMINATIONS:

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CIRCLE ED-393 ON READER-SERVICE CARD FOR MORE INFORMATION

Portable Cords 395

A complete line of portable electrical power cords for rugged applications is described and illustrated in this 8-page catalog. Three types are discussed in detail and typical applications suggested. Anaconda Wire & Cable Co., 25 Broadway, New York 4, N. Y.

Automatic Pyrometers 396

This 4-page bulletin lists standard ranges and specifications of Simplytrol automatic pyrometers for control of temperature in furnaces and ovens. Ordering information is included. Assembly Products Inc., Chesterland, Ohio.

Special Design Connectors 397

Data sheets describe several unusual special design connectors. Among the types illustrated are printed circuit connectors, hermetic receptacle with cable plug, hermetic seal plugs. DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.

Terminal Boards 398

A new catalog illustrates and describes this firm's complete line of barrier type terminal boards with "molded in" studs, available from stock. Also included is information on new miniature molded terminal boards. General Products Corp., Union Springs, N. Y.

Wire and Cable 399

Catalog No. 105 describes and illustrates this firm's complete line of Permaline products, electrical wire, cord sets, TV wire and cable, and wire accessories. Columbia Wire & Supply Co., 2850 Irving Park Rd., Chicago 18, Ill.

Plastic Instrument Charts 400

A new Permochart stock list includes 3000 widely used types of these all-plastic recording instrument charts. These charts are washable, reusable and can replace any circular charts with no changes in equipment or ink. Allegheny Plastics, Inc., Thorn Run Rd., Coraopolis, Pa.

NEW! Davohm Series 850 Metal Film Resistor

Perfect compromise between precision wire wound—and composition type

This new precision film type resistor is hermetically sealed, highly stable, and has a temperature coefficient independent of resistance value. The Davohm Series 850 is available in 1/2, 1 and 2 watt sizes; to tolerances of $\pm 1.0\%$, $\pm 0.5\%$, $\pm 0.25\%$; and, to any desired value.

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Temperature Cycling	1.0%	0.02%
Low Temperature Exposure	3.0%	0.04%
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Effect of Soldering	0.5%	0.02%
Moisture Resistance	5.0%	0.00%
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CIRCLE ED-401 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • June 1955

Dimming System 402

A new bulletin and data sheet discusses "Dimming System for Hot Cathode Fluorescent Lamps". Schematics and wiring diagrams are included. Ward Leonard Electric Co., 115 MacQuestin Parkway South, Mount Vernon, N. Y.

Cleaning Technique 403

An 8-page illustrated bulletin describes a high-velocity spray technique for the critical cleaning of precision parts. The booklet illustrates the equipment and its method of use and outlines the advantages of this specially prepared solvent. Cobehn, Inc., Passaic Ave., Caldwell, N. J.

Amplifier System 404

Bulletin No. 1403D describes a high-gain, lightweight precision amplifier system for use as a companion unit to recording oscillographs. Operating principles and specifications are detailed. Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif.

Coupling System 405

A data sheet describes a compact system for measurement of vibrational amplitudes in the 8- to 800cy range. Particular instruments discussed are integrating galvanometers and matching networks. Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif.

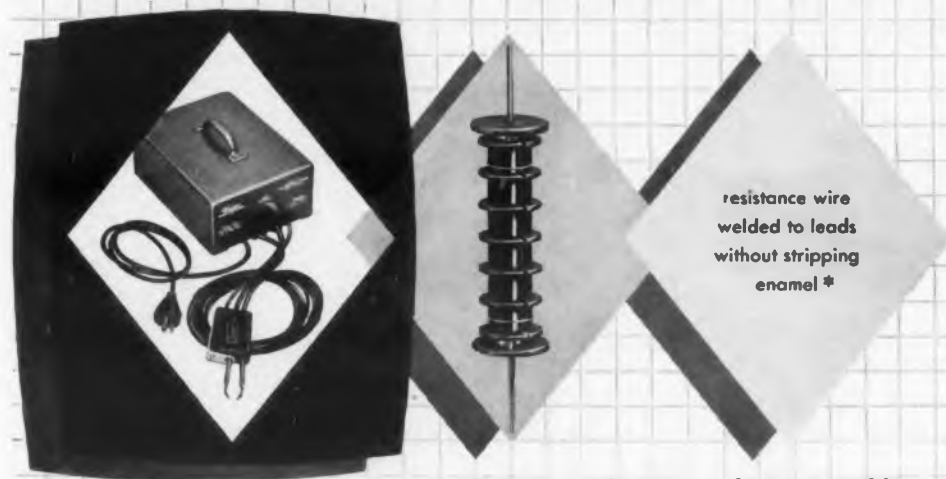
Product Identification 406

"Color Brand Your Products for Life" is a guide for trade-marking, decoration and identification of products by hot die stamping. The booklet lists 101 product applications in a variety of markets. M. Swift & Sons, Inc., 10 Love Land, Hartford 1, Conn.

Sine-Cosine Tables

An extended and corrected reissue of "Tables of Sines and Cosines for Radian Arguments" has been published by the National Bureau of Standards Applied Mathematics Series 43. \$3.00. Government Printing Office, Washington 25, D. C.

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CIRCLE ED-407 ON READER-SERVICE CARD FOR MORE INFORMATION



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And TEFLON Insulated Components are now competitively priced with those of lesser quality—due to simplified manufacturing techniques, mass production methods and declining material costs. Investigate "price-wise", too.

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Fluorocarbon Products, Inc.
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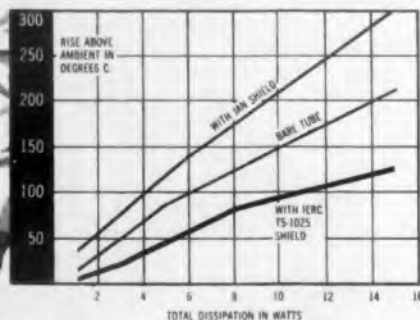
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CIRCLE ED-408 ON READER-SERVICE CARD FOR MORE INFORMATION

...ever SUSPECT those "normal" tube failures?

You should... because the service life of a tube you now accept as normal can be greatly extended with IERC mounting techniques. With other methods, high operating temperatures deteriorate the tube... causing those premature, so-called "normal" failures!



Graphic evidence of IERC's effective tube cooling is shown in comparison with harmful temperature increases that occur with use of JAN type shields. IERC shields are designed to meet requirements of MIL-S-9372B (USAF).



HEAT-REDUCING, VIBRATION-PROOF PERFORMANCE

IERC's complete line of miniature tube shields have proved so efficient in reducing bulb temperatures and prolonging tube life that they have become the first choice of almost every leading manufacturer of aircraft radio, missiles, radar, computers and other types of precision electronic equipment!



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Patent pending

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CIRCLE ED-465 ON READER-SERVICE CARD FOR MORE INFORMATION

Patents . . .

By John Montstream

Color Television Electron Beam Deflection Control System . . . Patent No. 2,685,027. D. G. Moore. (Assigned to Radio Corp. of America, New York, N. Y.)

In the color television system that requires strips of phosphors arranged horizontally across the screen of the picture tube for producing a color picture, it is essential that the beam of the cathode ray tube scan the proper color strip so that the reproduced picture correspond in color with the broadcast scene. In order to assure precise registration of the beam with the proper strip of phosphors it has been found necessary to devise a system that corrects for any mis-registration of the beam with the proper color strip.

The illustrated cathode ray tube (15) has a screen with horizontal strips of color phosphors on the surface of the screen marked *R*, *G*, *B*. In traversing the screen, the beam impinges on these strips in conventional manner under control of a deflection system provided by a synchronizing channel (14) and the yoke (31). In order to provide registration of the beam with the color strips, the tube is provided with auxiliary deflecting plates (32). These deflecting plates are given incremental stepped voltages (50) that deflect the

beam sufficiently to impinge a color strip.

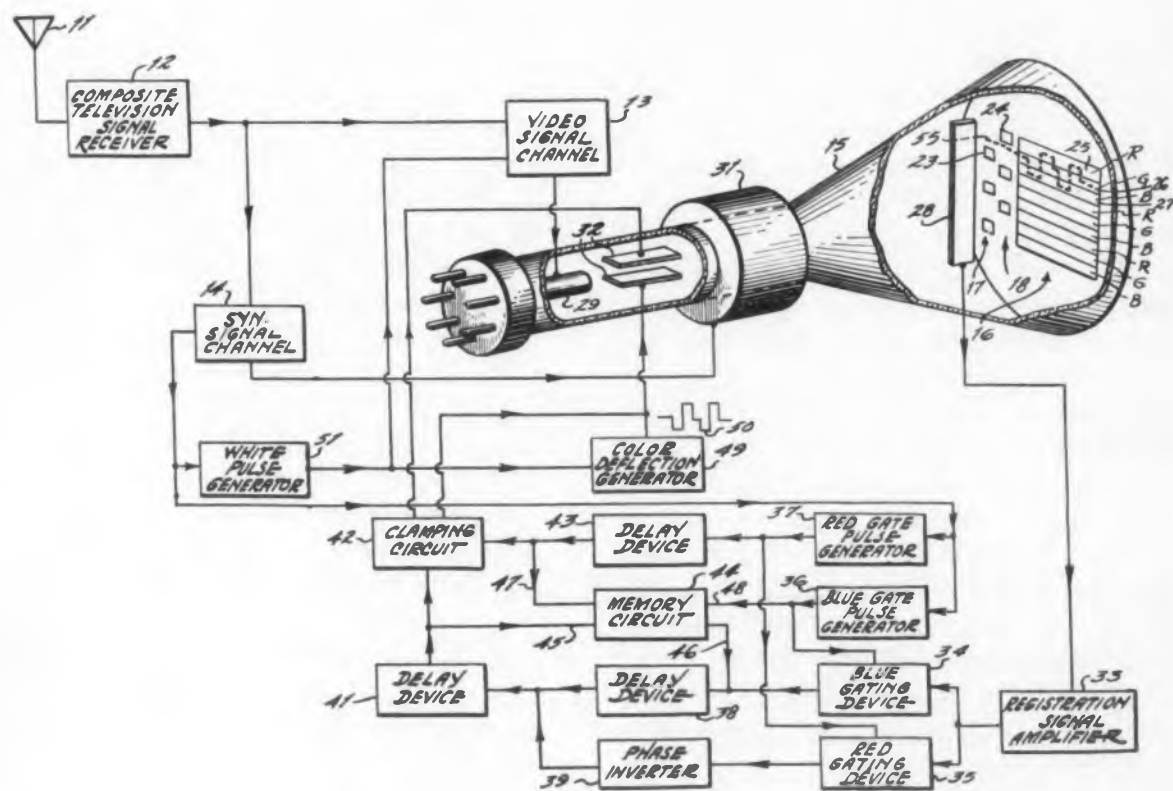
Precise color registration is secured by providing two spaced vertical rows of targets (23 and 24) at the margin of the screen. Targets 24 in one row correspond in position with the red phosphor strips and the other row of targets 23 corresponds in position with the blue phosphor strips. No targets are provided corresponding with the green color strips (*G*). The targets are impinged when the beam is on its blanking or return traversal so that a white pulse generator (51) controls the video signal channel (13) to give a beam of great or maximum intensity. If now the beam is traversing the screen on a green strip, and the beam is out of register upwardly, the beam impinges targets 23 and 24 so that secondary electrons are emitted thereby. This secondary emission is collected by a collector strip (28) and produces a pair of spaced pulses due to the horizontal spacing of these targets. Since this mis-register is towards the red strip, the secondary electrons emitted from target 24 will be greater to produce a pulse of greater amplitude. The pulses are amplified at point 33 and passed to a circuit arrangement for controlling registration of the beam.

The registration signal from target 24

is transmitted through a red gating device (35) the function of which is to block transmission through it except for the red target pulse. A similar blue gating device (34) is provided for the registration signal or pulse from blue target 23. Transmission through each gating device is controlled by its gate pulse generator (36 and 37, respectively) which are controlled in turn by the synchronization signal being broadcast. Each gate pulse generator produces a pulse timed to trigger its respective gating device for the transmission of its particular registering pulse. The pulse passing through the red gating device is applied to a phase inverter and the pulse passing through the blue gating device is delayed. The two signals are then com-

ined to form a registration correcting signal. This signal is applied to deflecting plates 32 to correct the register of the beam through a clamping circuit (42) which retains the corrected signal for the duration of the traversal of the beam. A memory circuit (44) stores the corrected signal so that it may be combined with later incremental registering information for creating a new correcting signal.

The patent gives the details of the particular circuits that form the color gate pulse generators and the memory circuit. It is pointed out, too, that the registration system may be used with camera tubes as well. The registering system described is applicable to field and line-sequential systems of color television.



Roth Rubber Solves Rubber Problem for West Coast Manufacturer!



A viewing hood for an oscilloscope seems like a simple problem for the rubber technologist, yet it is significant that Tektronix, Inc., of Portland, had Roth Rubber, in Chicago, provide the solution. The viewing hood must not crack or buckle, has to adjust to any face and must exactly fit the Tektronix scope. Roth engineers solved this problem—they can solve yours.

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For the first time, a paper tube like this—developed and perfected by PARAMOUNT after years of research! No artificial heat or pressure is used in its manufacture—"PARAFORMING" takes place at the time of actual winding. No sharp outside edges to cut the wire during winding of coils. Has great rigidity and physical strength. Permits coil manufacturers to hold much closer tolerances. No need for wedges to tighten the winding on the laminated core. Coils can be automatically stacked much faster, too. The new "PARAFORMED" tubes are approved and used by leading manufacturers. And they cost no more!

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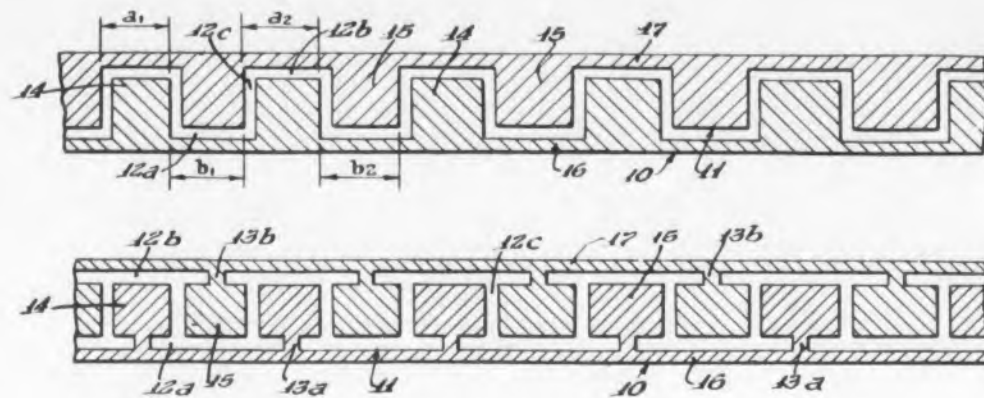
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58 Mountain Grove St., Bridgeport, Conn.

CIRCLE ED-468 ON READER-SERVICE CARD FOR MORE INFORMATION



Capacitor electrode areas stencilled in two ways.

Means for Making Metallized Electrical Condensers . . . Patent No. 2,683,792.
William Dubilier. (Assigned to Cornell-Dubilier Electric Corp., Plainfield, N. J.)

Rolled or wound capacitors are made of tape of dielectric material such as paper having a metallized surface. A strip or track of the metallized surface is burned off in a zig-zag pattern (12a, 12b, and 12c, above) so that connected staggered electrode areas 14 form one plate of the condenser and alternate staggered areas (15 above) so that connected staggered electrode areas 14 form one plate of the capacitor and alternate staggered areas 15 overlies an electrode area 14 of opposite polarity. Because the tape is wound cylindrically upon itself, the staggered electrode areas must be spaced with a progressively increasing spacing such as provided by progressively increasing dimension of the electrode areas along the tape. The zig-zag separating track or strip between electrode areas of the metallized surface has been burned into the metallized surface by pressing the surface against a patterned branding wheel carrying the pattern of the track. A different branding wheel must be provided, therefore, for each different type of capacitor and for each length of capacitor tape. The number of such branding wheels becomes impractically large for a manufacturer who wishes to make a complete line of capacitor. Another method used is described in an earlier filed application of the patentee. This method controls the timing of an electric spark used in the branding process so that the progressively increased spacing and electrode area is secured.

An improved method of burning the zig-zag insulating track between electrode areas of opposite polarity has been devised. This improved method utilizes a tape having

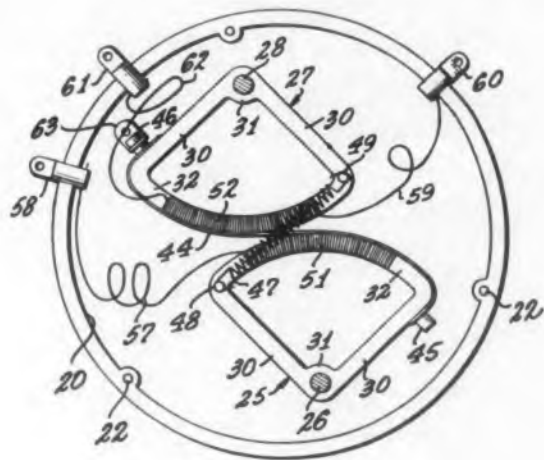
a pattern punched through the tape corresponding generally but not completely to the pattern of the insulating track to be formed between the electrode areas. This patterned tape forms a stencil. The metallized surface of the capacitor tape is then run over a series of guide wheels and the patterned stencil is mounted to run with this tape and in contact with or over its metallized surface. An electric sparking device is placed on the stencil and electrical contact is established with the metallized surface so that the electric sparking device burns or vaporizes the metallized surface only at the punched holes in the stencil. The stencil can be wound upon itself when not in use and stored in very little space as compared with that required for a branding wheel.

The stencil cannot have punched openings corresponding completely with the insulating track between the electrode areas of opposite polarity. As a consequence the punched holes are of Z shapes alternately directed and correspond with cross track 12c and a portion of the longitudinal track (12a and 12b). The stencil tape so punched is joined together rather than being separated as would be the case if the insulating strip or track were continuous in the stencil. A control tape with properly located holes follows the stencil tape and burns or vaporizes out the connected portions between the Z configurations previously burned in the metallized tape so that the insulating track becomes continuous. For very large capacitors a long stencil tape is used, but since it may be wound upon itself it occupies a great deal of space then would be necessary to store branding wheel for the same capacitor tape. After the metallized tape has had the insulating track burned into the metallized surface, the tape is wound into a cylinder to form the ultimate capacitor.

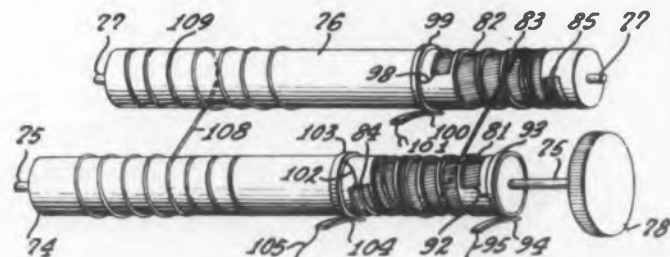
Variable Resistance Device . . . Patent No. 2,683,202. R. E. Brown. (Assigned to Genisco, Inc., Los Angeles, Calif.)

An interesting new form of variable resistance device is described in the patent. In view of the fact that thirty-one claims appear in the patent there is considerable patentable matter in the structure. The device avoids the wear of the usual variable resistor which occurs when a sliding contact slides over the resistance wire. In order to reduce this wear, the contact area may be reduced; however, this increases the possibility of isolating the sliding contact or wiper on a dead spot or of an insulating particle separating the contact from the resistance wire.

The resistance device is shown in one form below. It includes a case in which is mounted a segment (30) which is pivotally or rotatively mounted in the case on a pivot (28). A similar segment is mounted on a pivot (26) adjacent to the first so that their peripheries are adjacent. The resistance wires (51 and 52) are wound as coils on the periphery of their respective segment. The contact element is shown as a pair of flexible wires (44) having one end secured to a lug (46) on one segment. The wires extend over a portion of the periphery of one segment and the coils (52) thereon, after which they leave the first segment and follow the periphery of the other segment and contact the coils of



Two forms of variable resistance devices. The one above is more extensively discussed on this page.



the resistance wire wound thereon. The ends of the wires are secured to the second segment by a lug (45). The flexible wires do not slide on the coils of the resistance wires and hence do not wear.

Springs are employed to drive the segments in opposite rotary directions so that the contact element always remains taut. The spring system illustrated is a coil spring (47) which has one end secured to a lug (48) on one segment and the other end of the spring is secured to a lug (49) on the other segment. One end of the resistance wire or coil 52 is looped and secured to a terminal (61) on the case, the loop permitting movement of the segment. The other end of the resistance wire 52 is connected by a wire (59) to a second terminal (60) carried on the case. One end of the resistance wire or coil 51 on the other segment is similarly connected to a terminal (58) on the case by a wire (57).

As the segments are rotated around their pivots in opposite directions, which means that their outer peripheries move together or in the same direction, the shorting flexible contact wires 44 either contact more or less in number of the turns of the resistance coil 52. As a greater number of turns are shorted on the resistance coil 52 a lesser number are shorted on the resistance coil 51 on the other segment. It will be seen, therefore, that the resistance between terminals 58 and 60 varies as well as the resistance between terminals 61 and 58. Similarly the ratio of resistance wire which is unshorted in the coil 52 and that unshorted in the coil 51 changes as the segments turn. As a consequence, the device may serve as a voltage divider between terminals 58 and 60 with terminal 61 serving as the intermediate terminal. It is obvious that for a variable resistance alone, a coil need be provided solely on one of the segments.

The variable resistance discussed above is one form in which it may be constructed. The patent also illustrates a construction

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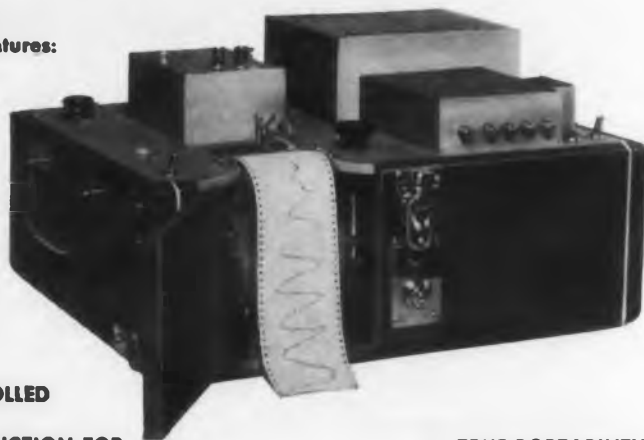
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that uses the basic principles of the variable resistor or voltage divider shown by providing the resistance wires on two rotatable cylinders mounted parallel to each other. The resistance wire is wound around the cylinders. By turning the cylinders the resistance wire is wound up upon one cylinder as it unwinds from the other. This increases or decreases the length of the resistance wire which is shorted by one of the cylinders.

Amplifier . . . Patent No. 2,686,258. C. J. Miller. (Assigned to Westinghouse Electric Corp., Pittsburgh, Pa.)

Where high gain and compactness is desired a super-regenerative amplifier is a useful circuit. This circuit, however, lacks a high degree of selectivity and sensitivity and also feeds energy back into the antenna. The illustrated circuit secures improved selectivity and sensitivity in this type of amplifier, but of greater importance is the fact that any re-radiation to the antenna is reduced to a minimum without reduction in the gain.

The amplifier circuit secures negligible

re-radiation by isolating the antenna from the oscillator plate circuit. This construction is accomplished by connecting the antenna circuit to the control grid of the amplifier tube (22) by means of a coil (16) and to the control grid of a detector tube (23), or it may be an amplifier tube, by means of a coil (17). Feedback is secured from the anode of amplifier tube 22 through the coil (26) that is coupled to coils 16 and 17. By balancing the circuit including coil 16 and tube 22 with respect to coil 17 and tube 23, any energy that would feed back to the antenna is balanced out at the junction point of these coils.

With the antenna isolated from the oscillator of the circuit, improvement in the selectivity and sensitivity of the circuit can be accomplished by using a tuning circuit (10, 11, 13, and 14). The circuit functions as a super-regenerative amplifier in that squeelch oscillations generated in the squeelch circuit formed by resistor 15, coil 20, capacitor 19 and tube 22 periodically stops regeneration. The additions made to the circuit in order to secure the improved results have not greatly changed its ability to be made compact.

WIDE-RANGE FAST-PULSE GENERATOR



Model PG-200AA Pulse Generator • PGA-210 Range Extenders



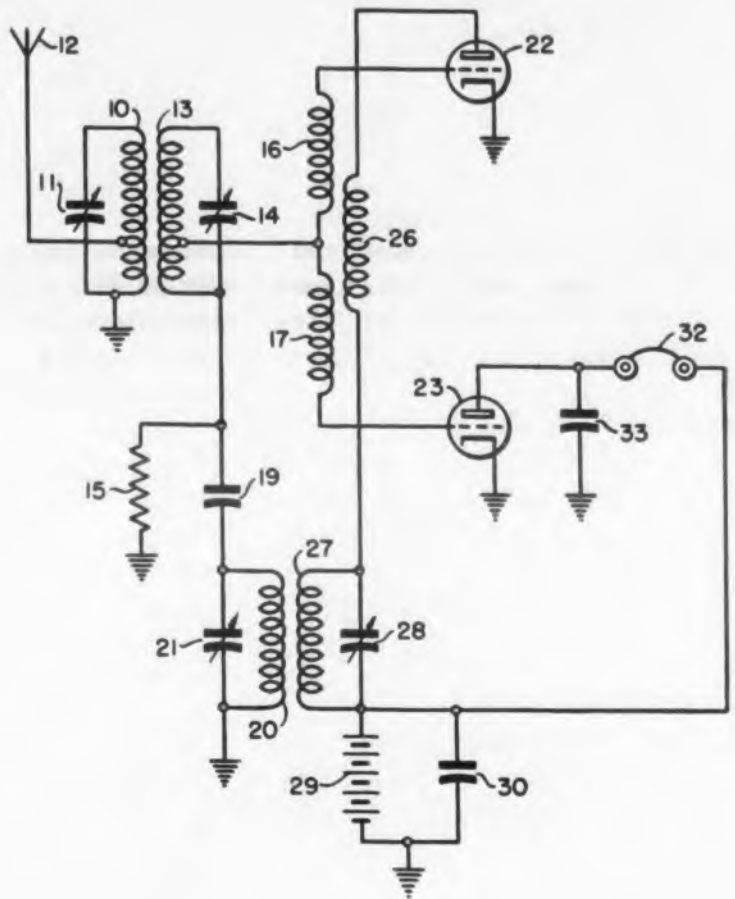
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Re-radiation to the antenna is reduced by this super-regenerative circuit.



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Further Proof of

Getting to the bottom of things

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One of the many things you as users are interested in is the "LIFE OF THE CAPACITOR" under a multitude of operating conditions. We in the FAST organization have spared no expense to give you HONEST-to-goodness answers on this important factor in providing quality capacitors.

What follows is a summary of what we are doing to give you just that...

I: RESEARCH and DEVELOPMENT TESTS

AC and DC tests at various temperatures and voltages.

1—Investigation of Impregnants: (a) New impregnants AC/DC—synthetic and natural oils, resins and waxes. (b) Studies of impurities and additives.

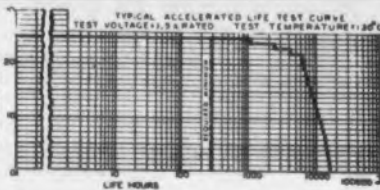
2—Investigation of electrode separators and electrode materials: (a) Kraft papers—standard, low PF varieties, sundry densities and de-ionized. (b) Films—regenerated cellulose, polystyrene, teflon, "Mylar"®, Etc. (c) Electrodes—Dry annealed and neutral aluminum; and tin.

3—Number of groups tested: AC; over 800 involving more than 8000 units. DC; over 3700 involving more than 78,000 units.

4—Duration of tests for AC; many have been continuously under test for over 6 years. DC; many have been continuously under test for over 10 years.

5—Voltage range of tests: AC; 70 to 2400 volts at 60 and 400 cycles. DC; 140 to 44,000 volts.

6—Temperature range of tests: AC; Room to 130°C. DC;—55°C to +150°C.



II: PRODUCTION TESTS

A. Alternating Current

1—Heat runs on production lots — ultimate surface temperature rise.

2—Ultimate life hours of current production (periodic tests run).

B. Direct Current

1—Civilian Production: (a) ultimate life hours of capacitors taken from current production. (These test runs comprise over 1800 groups involving more than 21,000 units).

(b) Ultimate life hours of capacitors after being stored in cartons from 1 to 24 months under normal variations in humidity and temperature. (These test runs comprise over 324 groups involving more than 3240 units).

2—Military Production: (a) Test to applicable specifications (Mil-C-25; Mil-C-91; U. S. Army 71-1667; Etc).

(b) These test runs comprise over 4200 groups involving more than 24,500 capacitors.

Please note Carefully: at least 75% of the 134,740 capacitors included in the above tests were tested to ultimate destruction at voltages ranging from rated to 4 times rated and at operating temperatures from lower than, to maximum rated or in excess of. Many outside this group have not failed to date. Importantly too, this is a continuous policy of the company in sustaining its testing program throughout every day—year after year.

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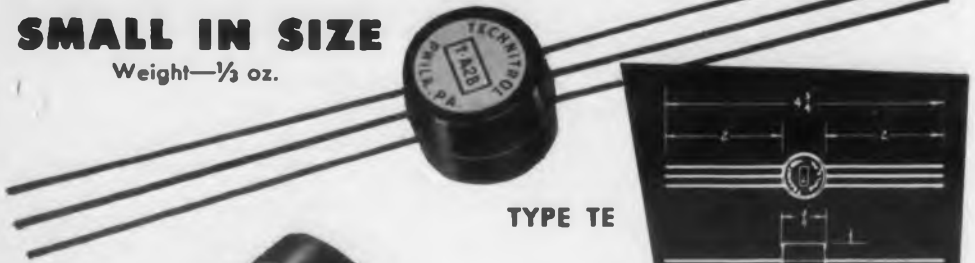
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PULSE TRANSFORMERS

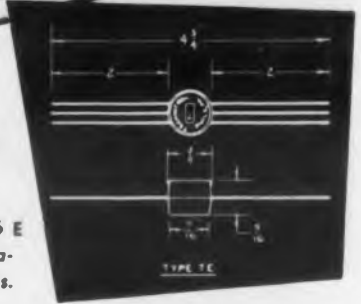
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Weight— $\frac{1}{3}$ oz.



TYPE TE



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TYPE TP



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Television Tube . . . Patent No. 2,685,660.
D. E. Norgaard. (Assigned to General Electric Co., Schenectady, N. Y.)

One of the difficulties that arises with the shadow-mask type of color television tube is registry of the holes of the mask with the dots upon the tube screen. Thermal expansion of a separate mask and screen is not the same, which introduces errors in selection of the proper dot. The design of the illustrated picture tube avoids these difficulties

The picture tube has what is termed a viewing plate (2) since it does not serve the usual purpose of providing the screen. The inner surface of this plate has a transparent conducting coating (17) over which there is a layer (18) which emits secondary electrons when impinged by the beam. This layer must be transparent as well. A coating of magnesium oxide or fluoride, aluminum oxide or calcium fluoride has been found suitable when evaporated and condensed on the conducting surface. The conducting surface has a potential of about 500v applied to it.

A mask (4) is mounted near the view-

ing plate (2) and has the usual perforations (16) through it. The viewing plate and mask are arcuate. The surface of the mask facing viewing plate 2 carries a cluster of dots of color phosphors around each perforation. The electron beam in passing through a perforation 16 strikes secondary emission layer 18 and the secondary electrons emitted from the layer impinge on a color dot. Mask 4 has a potential of the order of 10,000v applied there to it so that the electrons of the beam enter a decelerating field between the mask and conducting layer 17. This field curves the beam and results in a substantial deviation in the point of impingement of the beam on the plate as compared to the deviation of a beam traveling in a straight path. Therefore, even though the beam enters a hole 16 at a relatively slight angle the curvature of travel is such that the beam strikes layer 18 opposite a selected phosphor dot. As a consequence considerably less power is required to make a selection of the color dot. The secondary electrons emitted by layer 18 impinge on the dot to give the selected color.

With the color phosphor dots on the

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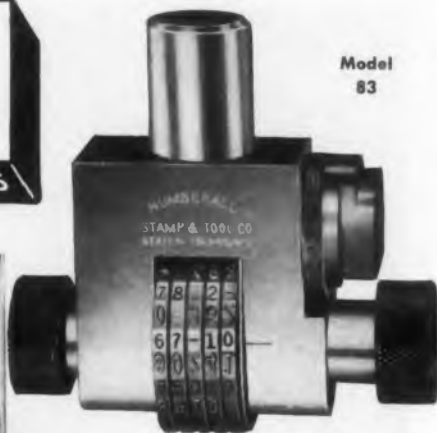
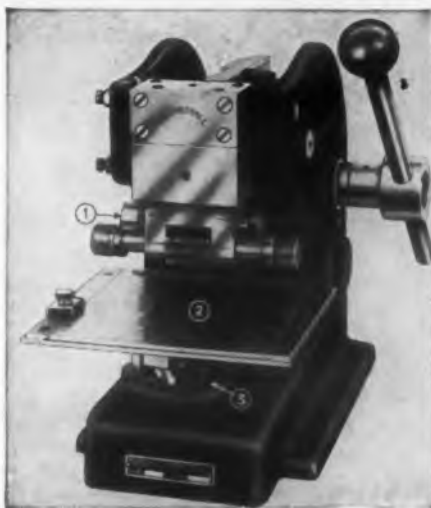
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This new small, light compact Press was designed for stamping small Name Plates and small flat articles with up to 1/8" high characters.

It weighs only 65 lbs. yet has the power and strength of a press much larger in size.

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SPECIFICATIONS

VOLTAGE RANGES (peak volts full scale):
Single Ended: 2.5, 5, 10, 25, 50 KV
Double Ended: 5, 10, 25, 50, 100 KV
FREQUENCY RESPONSE: 20 cps — 50 mc
INPUT IMPEDANCE:
Resistance: above 10^{12} ohms
Capacitance: less than 4 mmfd
CALIBRATION ACCURACY: $\pm 3\%$ of f. s.
POWER SUPPLY: 117 v., 50/60 c., 20 w.
DIMENSIONS: 16" x 10" x 10 3/4"
NET WEIGHT: 11 pounds



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Chatham Electronic Switch Type 650 is a portable instrument which makes possible simultaneous observation of two recurrent patterns on the screen of a single cathode-ray oscilloscope. Relative positions of the patterns on the oscilloscope may be varied so that they are superimposed on each other, or separated by a desired amount. Direct comparison of amplitudes, wave-forms, frequencies, and phase relationships may be observed. A square-wave voltage of variable frequency and amplitude is available at the output terminals for use as a test signal. Direct-coupled inputs to the amplifiers are alternately operative and inoperative at a rate determined by the switching frequency. The instrument is therefore effective for chopping a d-c signal, making it suitable for transmission through the a-c amplifiers which are usually found in cathode-ray oscilloscopes. Write for new Bulletin.

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Books . . .

Handbook of Piezoelectric Crystals for Radio Equipment Designers (WADC Technical Report 54-248) . . . by John P. Buchanan. 601 pages, paper-bound. Prepared for Wright Air Development Center. Available from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., as publication PB 111586. \$6.00.

Designers of sensitive communications equipment will find this handbook to be of immense value. It is a definitive work on the use of crystals for frequency control. Not only does it present a complete discussion of the theory and manufacture of piezoelectric crystals for frequency control, but dozens of practical circuits utilizing these crystals are presented. For the designer of military equipment, descriptions of all military standard crystals, crystal holders, and crystal ovens are of particular interest.

Among the many circuits presented, is one for a crystal controlled transistor oscillator. The bibliography includes 883 references. Lists of manufacturers of crystals and related accessories, and specifications, standards, and publications applying to crystals are also given. A 20-page appendix defines abbreviations and symbols used in the book. The author is with the Philco Corp., Philadelphia, Pa.

Storage Batteries, fourth edition . . . George Vinal Wood. 446 pages. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. \$10.00.

The development of the transistor and the need for many types of portable and mobile equipment has given a new importance to all types of batteries including storage batteries. Electronic designers who

have had few opportunities to specify batteries in their professional careers must now have an intimate knowledge of the characteristics of batteries. This standard work, newly revised, is one of the important sources of data on storage batteries.

The advance in battery technology in the 14 years since the third edition was published has led to extensive revision. New information on improved lead alloys, new types of silver-oxide cells, applying batteries to radio-relay stations, and the use of higher voltage systems in airplanes has been added. All obsolete material has been eliminated.

As in the earlier editions, the chemistry and construction of storage batteries is treated extensively. Of greatest interest to designers are the chapters on operation, resistance, efficiency, and testing, respectively, of storage batteries. The last chapter on applications, however, contains little of interest to electronic engineers. The author was connected with the National Bureau of Standards for 32 years as Chief, Section of Electrochemistry.

Computer Development (SEAC and DYSEAC) at the National Bureau of Standards, Washington, D. C. . . . 146 pages. NBS Circular 551. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. \$2.00.

Some of the most fruitful designs and concepts in digital computation have come out of the National Bureau of Standards. The story of SEAC, the bureau's first digital computer, and DYSEAC, the unusual mobile computer, is told here. The volume is not only of interest to computer designers, but to all electronic design engineers who strive to attain reliability in their

creations. Much of this material has already been published in one form or another, but it is assembled here for the first time.

The dynamic circuitry techniques, system design, and input-output devices of the two computers, high-speed memory development at the Bureau, and operational experience with SEAC are considered in separate chapters. All designers will find the analysis of the nature of failures of vital interest. The discussion of the difficulties obtained with using cathode-ray tubes designed for other purposes for Williams-type memories is of particular value. Many charts and photographs are used to illuminate the text.

Feedback Control Systems . . . by Gilbert Howard Fett. 361 pages. Prentice-Hall, Inc., 70 Fifth Ave., New York, N. Y. \$10.00.

Written as a textbook, this book is useful to the practicing electronic design engineer who is approaching feedback control for the first time. It is also valuable as a review for engineers who have been away from the subject for some time. In fact chapter two, "Components of Feedback Control Systems", is a review of the mechanics, electric power machinery, heat transfer, and magnetic amplifier considerations necessary to grapple with feedback control problems.

The remaining chapters are entitled, respectively: "Steady State and Transient Solutions of Feedback Control System Differential Equations"; "Nyquist Criterion for Stability"; "Stability Diagrams"; "Analysis and Synthesis of Complex Control Systems"; and "Nonlinear Feedback Control System Analysis". The author is a professor of electrical engineering at Illinois University.

Basic Electricity, five volumes . . . paper-bound. Prepared by Van Valkenburgh, Nooger, & Neville, Inc., New York, N. Y. John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y. \$2.00 (\$9.00 for the set).

Electronic engineers who may be required to recommend a basic course in electricity to a technician should know about these five slim volumes. As is the case with this publisher's *Basic Electronics*

(review in *ED*, May, 1955, p. 156), these five books were originally prepared for the U. S. Navy's courses in these fields. They are written in the simplest possible language with drawings or charts on every page.

Visual Presentation of Information (WADC Technical Report 54-160) . . . by Charles F. Baker and Walter F. Grether, 111 pages, paper bound. Wright Air Development Center. Available from the Office of Technical Services, U. S. Department of Commerce, Washington, D. C. \$3.00.

Although this book was written for the designers of aircraft equipment, it will be valuable to all electronic designers because it is based on human engineering principles. All designers of complete equipments are concerned that their products be read or manipulated properly. The chapters in this handbook on dials, indicators, and warning devices are of general interest, while the section on instrument panel layout would prove useful to designers of control consoles for computers, automatic factory controls, and sound and broadcast studios.

In addition to the above material, there are chapters on cathode-ray tubes, legibility of printed materials, lighting, and visual detection and identification. Each chapter is extensively illustrated and also supplied with graphs and tables on applicable human characteristics and reaction times. The authors are members of the Aero Medical Laboratory, Wright Air Development Center.

This book is being issued as a preliminary draft of part of the Human Engineering Guide to Equipment Design now under preparation. It is hoped that users of this book will submit comments to the authors to aid in revising or adding to this material before it is published in the Guide.

Bibliography on Telemetry . . . 46 pages. American Institute of Electrical Engineers, 33 West 39th St., New York, N. Y. \$5.00.

Both mobile and stationary telemetry are considered in this bibliography. Bibliographies on carrier-current transmission and supervisory control are in preparation. The items are arranged by year from 1920. A list of the publications covered is included.

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Abstracts . . .

Thousands of articles of interest to electronic designers are published each year. Many more thousands of reports get filed in government archives with slim chance of even the titles becoming known.

No doubt the quantity already published by just a few leading technical magazines is enough to saturate the average reader, but the selective and discriminating engineer-reader could, unquestionably, increase his efficiency and output if he could draw from, rather than duplicate, the efforts of his colleagues. Unfortunately extensive reading often produces only marginal returns. There is too much nice-to-know but not enough must-know information. Time might better be spent in the lab.

ELECTRONIC DESIGN editors feel that there are many really helpful articles and reports that, because of restricted circulations, escape the attention of design engineers. We hope to aid our readers by surveying such published material and condensing those which we feel will be of interest to the greatest number of our readers. We will be interested in your reactions.

Ferrite Inductive Antennas

(Editor's Note: Europeans have greater problems in antenna design than Americans. Their diversity of wave lengths require long and short wave reception in home receivers in addition to the medium band used in this country. The multi-turn frame antenna found in almost all of our radio sets exhibits a large capacitive effect. This means electric fields are picked up as well as magnetic fields and radiations from electric motors, switches, and the atmosphere cause interference which is intolerably excessive for long wave reception.)

ALTHOUGH single-frame antennas have been used successfully since 1939, inductive antennas consisting of a small coil wound on a ferrite rod show the greater promise. Because of the high permeability of such ferrites as Ferroxcube, the magnetic field of a large area is concentrated in the core.

The coil may have high impedance and with a tuning capacitor becomes the first resonant circuit without any intermediate transformer. Two coils may be used on the same rod, one for long waves and another for medium waves. (Some larger sets use two rods which can be rotated in a horizontal plane.) The capacitive effect (sometimes called aerial effect) to electric fields is low in spite of the large number of turns on the coil because of its small dimensions. Capacitive reception can be reduced by compensa-

tion and electrical screening. Compensation is accomplished by means of a second coil L' coupled to the antenna coil and having a capacitance so that the interference current through L' induces a bucking or cancelling voltage in the antenna coil. No compensation is needed in the medium-wave range. Electrical screening may be achieved by a grounded metal plate. An improved screening method has the ferrite antenna surrounded with a cage made of copper wire running parallel to the core interwoven with nylon threads in the perpendicular direction (to avoid magnetic shielding).

Sensitivity, signal-to-noise ratio, and effective height are important design factors. Sensitivity may be defined as the signal voltage at the grid of the first tube per unit electric field strength E of the local radiation field. This grid voltage is Q times the voltage induced in the antenna; induced voltage is hE where, by definition, h is the effective height of an inductive antenna. (Effective height of an inductive antenna has no concrete physical meaning. It is defined as the effective height of a capacitive antenna, which, placed in the same field of radiation, would produce the same signal voltage V_o as the inductive antenna. For capacitive antennas $h = V_o/E$.) Sensitivity S is therefore

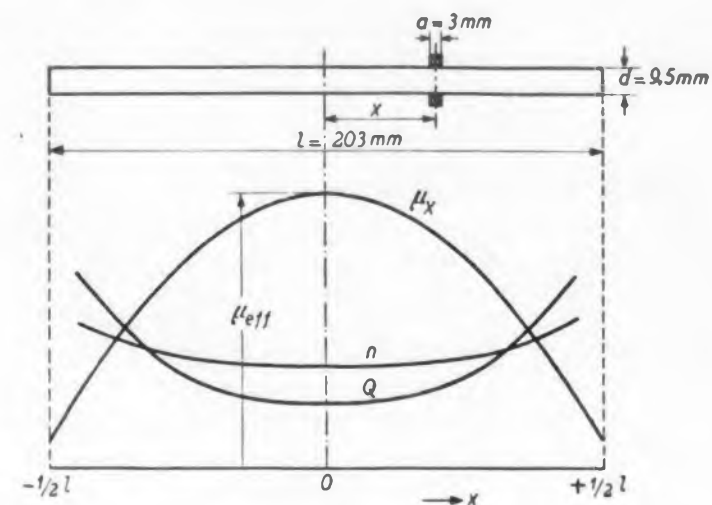
$$S = QhE/E = Qh.$$

Defining the signal-to-noise factor, N , as the variable term in the signal to noise ratio, it can be proven that

$$N = Qh^2.$$

Since the quality factor, Q , and the induced voltage per unit of field strength can be calculated as well as measured, sensitivity, and signal-to-noise can be determined.

Relative permeability $\mu_x = B_x/H$ of a Ferroxcube rod (length l , diameter d) having a flat wound coil (width $a < d$) is given in Fig. 1. B_x is the magnetic induction at position x due to the transmitter field H . For small values of l/d , this curve approximates a parabola, where μ_{eff} is the maximum value of μ_x , Fig. 2. The number of turns required for a coil of a given self-inductance and the quality factor, Q , of such a coil at a given frequency are also shown in Fig. 1.



$$\mu_x = \mu_{eff} \left(1 - 3.6 \frac{x^2}{l^2} \right).$$

Fig. 1. Ferroxcube rod with flat coil 200 μ h at 1Mc.

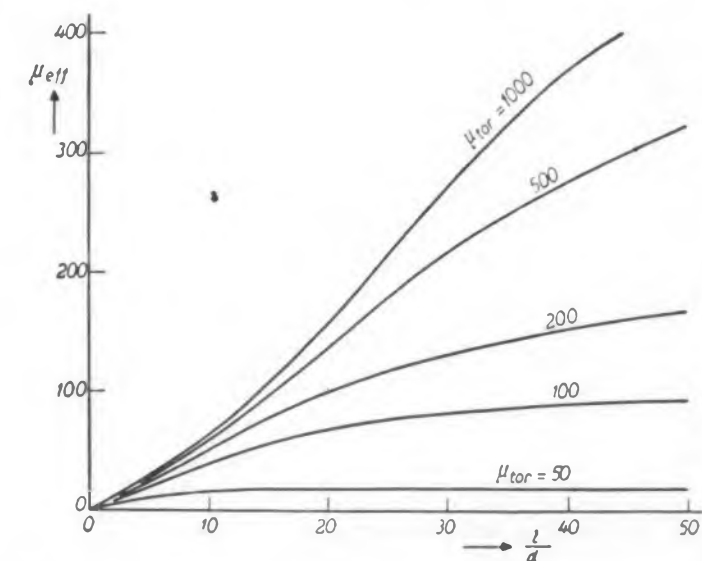


Fig. 2. Maximum permeability as a function of μ toroid.

For the effective height, h , the formula is

$$h = 2\pi \mu_x n A / \lambda$$

where A is the area of a turn and λ is the wavelength.

From this, the sensitivity and signal-to-noise equations are

$$S = Qh = (2\pi/x) (\mu_x n Q)$$

$$N = Qh^2 = (4\pi^2/\lambda^2) \mu_x^2 n^2 Q$$

where μ_x , n , and Q are functions of x shown in Fig. 1.

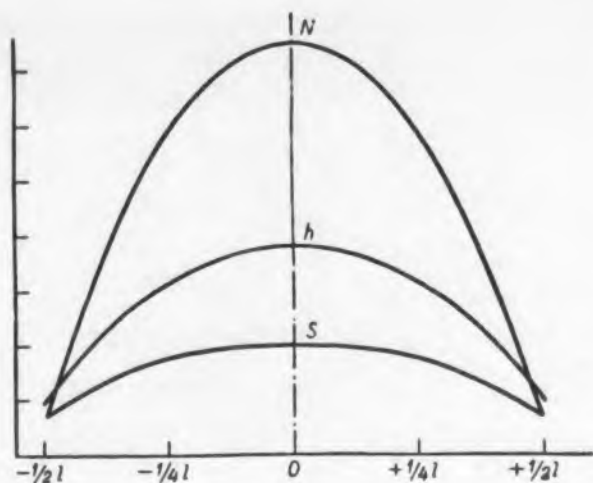


Fig. 3. S, N, and h as function of x for narrow coil.

From this data, curves of S and N can be plotted, Fig. 3. At the middle of the rod the sensitivity is broad, but the signal-to-noise factor is fairly sharp. This applies to a rod with a flat coil. As a further variable, the coil width, a , may be introduced. Both graphical analysis and actual experiments indicate that the optimum design is a coil of width $1/2$ situated in the middle of the rod. (European practice often put two coils on one rod for long-and medium-wave reception. The long-wave coil with its self-capacitance absorbs some energy. To avoid this, the practice is to short circuit the long-wave coil or to parallel the long-wave coil with the medium-wave coil for medium-wave reception. The former method renders part of the rod useless reducing μ_{eff} and h . The latter method overcomes the apparent shortening of the rod but increases self-capacitance which may be too much.)

The effective height of a coil situated in the middle of the rod is proportional to $l\sqrt{d}$. From this fact, it is clear that the length should be as long as possible; h increases only as the fourth root of volume. In order to double h by a thicker rod, 16 times as much ferrite is required.

The ratio of l/d should be large as possible within magnetic and mechanical limits. If μ of a toroid = 40, there is no point in choosing l/d greater than 15 since greater values hardly increase μ_{eff} , Fig. 2. With other materials of higher permeabilities, brittleness may be the limiting factor.

Core losses and temperature coefficients of permeability are other points to consider. Rods of mixtures may be fabricated for long or medium wave combinations.

A commonly applied method for obtaining greater effective height for a given volume of ferrite employs several rods in parallel with series connected coils. Rods are spaced far enough apart so there is little mutual interaction (separation $D > d\sqrt{\mu_{eff}}$, e.g. 8 cm.). —“Inductive Aerials . . .” Blok and Rietveld, Philips Technical Review, January 1955, Courtesy of North American Philips Co., Inc.

ELECTRONIC DESIGN • June 1955

Communications



At Ramo-Wooldridge New Techniques in Communications Are Being Developed

In this age of fast moving transportation and shrinking distances, communication of ideas, plans, and actions becomes steadily more critical. New techniques are urgently needed to provide better means for transmitting information from point to point. Engineers and Physicists of the Communications Division of The Ramo-Wooldridge Corporation are applying advanced methods of system analysis to complex military communication problems. Basically new techniques are being developed to provide better answers to long standing needs for greater transmission capacity, better presentation of information, and higher system reliability in communication systems.

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Digital To Analog Converter

DECADE scalars can be made to produce voltage outputs proportional to their total count. Such a scalar operates relays to switch current increments into an output resistor. The IR drop across the resistor drives a strip chart recorder to automatically plot the information to an accuracy of 0.1%.

The principle of the digital to analog converter is shown in Fig. 1. Relay contacts X_1 , X_2 , X_4 , and X_8 are substituted for conventional indicating lights. Closed relay contacts correspond to illuminated lights (relays are shown in the zero position). This circuit is based on a binary scale of 16.

The first count closes X_1 and a certain current I_1 flows in R_m having a magnitude of E/R_1 assuming R_m is small. The IR drop is plotted by the recorder.

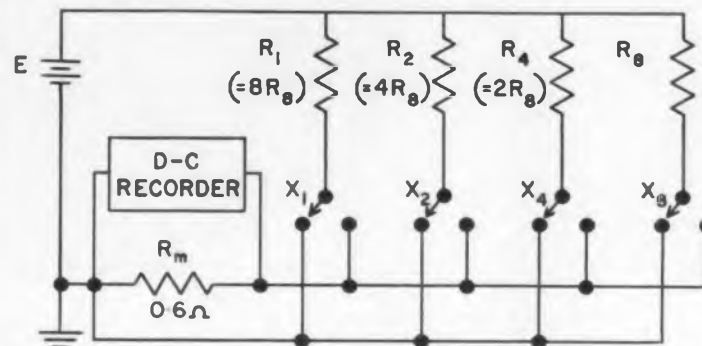


Fig. 1. Simplified diagram showing principle of operation of digital to analog conversion. Relays are switched in corresponding to count on scalar. Current is proportional to count in scalar.

A second count in the scalar operates X_2 and X_1 returns to normal. $I_2 = E/R_2$. If $R_1 = 2R_2 = 4R_4 = 8R_8$, the total current is proportional to the number of counts indicated by the scalar. Additional scalars can be added provided proper ratios of resistors are maintained.

It is not desirable to record binary numbers as strip charts are graduated in decimal divisions. Therefore, a decade scalar should be used; the decade system should be chosen so that the true count is always indicated by the position of the four relays within the decade.

A diode-coupled binary scale of 16 consisting of 4 stages of Eccles-Jordan trigger circuits has been modified to act as a decade scalar in the desired manner, Fig. 2.

The diode coupling between stages 1 and 2 is replaced by a gating circuit controlled by stage 4. If stage 4, which operates number 8 relay, is in a reset or normal condition, output pulses from stage 1 are allowed to pass to 2 normally. When stage 4 is triggered on the 8th pulse, the gating circuit will

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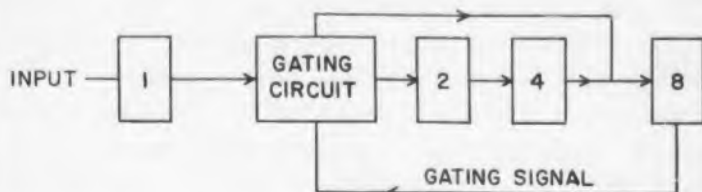


Fig. 2. Binary counter modified with gating circuit between stages 1 and 2 acts as decade scaler. Four relays indicate count.

operate and prevent subsequent pulses from entering stage 2, while allowing pulses from stage 1 to pass directly to stage 4. The scaling action is identical to a binary scaler for the first nine pulses entering the system. The tenth pulse causes all stages to be reset to zero.

If X_1 , X_2 , X_4 , and X_8 follow action of corresponding stages of the decade scaler as described earlier, the analog converter operation remains the same and true digital counts are recorded.

Full scale values on the recorder are decade resultants and absolute values can be easily read from conventional strip charts. Additional decade units increase full scale capacity.

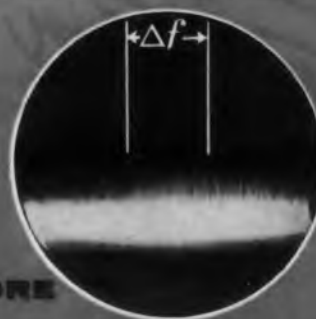
Sixteen analog resistors insures an analog voltage more accurate than a recorder can indicate. For accuracies of 0.1% only 12 analog resistors are necessary. In the decade scaler used by the authors, relay coils are a part of the plate load of the trigger pairs. Decade indicating light systems may be added.

Resolving times of $500\mu\text{sec}$ can be obtained this way. Cathode follower relay drivers would shorten the time. Resolving times of $0.8\mu\text{sec}$ can be achieved.

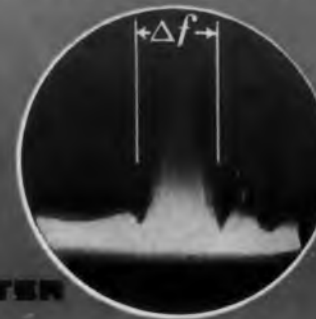
The complete decade circuit diagram including component values may be obtained at a nominal charge (about \$2.70) by requesting a photocopy of report ISC-578 "An Accurate Digital Count-To-Analog Voltage Converter Employing a Reliable Decade Scaler", Rhinehart, Zaffarano, and Prior. Feb. 10, 1955, 15 p. from one of the following depositories: Atomic Industrial Forum, Inc., 260 Madison Ave., New York 16, N. Y.; Georgia Institute of Technology Library, Atlanta, Georgia; The John Crerar Library, 86 E. Randolph St., Chicago 1, Ill.; and Stanford Research Institute, Stanford, Calif. Printed copies are not available.

The accuracy of the conversion is limited only by the accuracy of the components in the circuit. Nobel-type resistors were selected to within 0.1% of their indicated value. The multiplier resistor is a precision, wire-wound, low-temperature-coefficient resistor. By suitable switches, full-scale ranges from 200 up to 80,000 counts are possible. Leeds and Northrup Speedomax Type G recorder or equivalent is suitable—U. S. Atomic Energy Commission Report.

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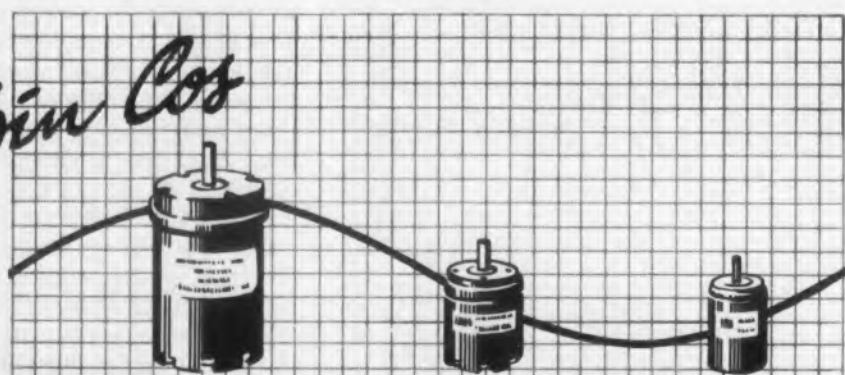
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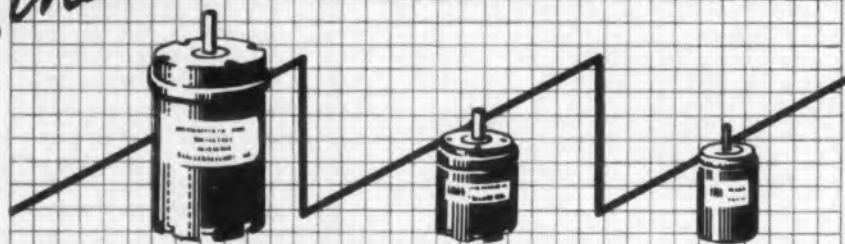
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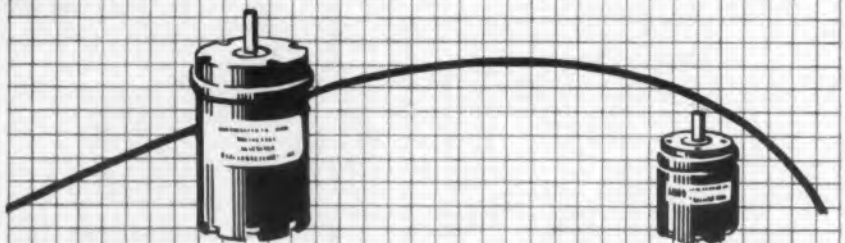
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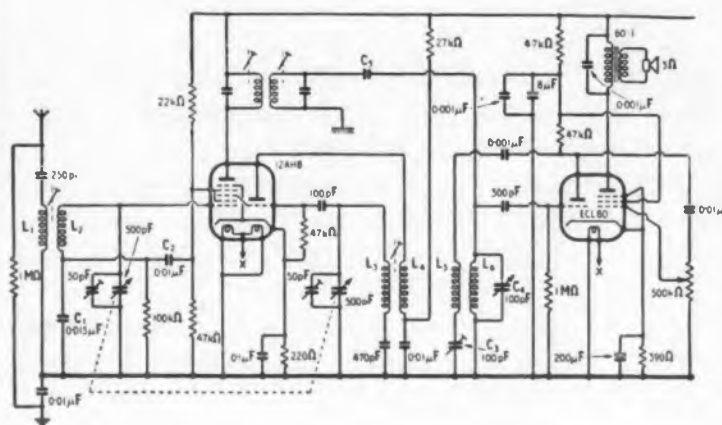
Two-Tube Superhet

COMBINING both t-r-f and superhetrodyne principles, only two tubes are needed in this low-cost radio. The circuit achieves the sensitivity of the t-r-f and approaches the selectivity of a superhet.

A triode heptode is used as an oscillator-mixer, and a triode pentode as a detector and audio amplifier. There is no i-f amplifier. The i-f signal is fed directly into the triode section of the second tube which acts as a grid-leak detector tuned to the i-f frequency by L_6C_4 .

Gain is maintained by regeneration fed back to the grid detector by L_5C_3 . Either gain or sharpness of selectivity is emphasized depending on adjustment of C_3 .

To further improve gain (which could not be made adequate with regeneration at the detector stage, a specific amount of positive feedback is added in the



frequency converter to improve gain, image rejection, and signal-to-noise ratio. Screen bypass capacitor C_2 is returned to ground through the 0.015mfd capacitor, C_1 . Thus, amplified signal-frequency voltage is injected into the grid circuit.

Although regeneration, and gain, is greater at low frequencies (4db gain; 2db signal-to-noise ratio) useful gain is achieved at the high frequency end of the band. The value of C_1 is critical; too low a value may cause self-oscillation in the mixer, and conversely if C_1 is increased, gain is reduced.

The antenna and oscillator coils and i-f transformer are standard types suitable for the British medium-wave band (roughly 550 to 1500kc). For the detector coils L_5L_6 , an Osmor long-wave (150 to 325kc) coil type OA12 is used. The powdered iron core was removed; the antenna winding is connected to the grid and the normal grid circuit winding is used as the feedback coil. This arrangement produces smooth adjustable regeneration between 450 and 480kc.

For a 50mw output, the sensitivity at the grid is $100\mu\text{v}$. No a-g-c is used, but the detector does not overload appreciably. Total d-c current drain is less than 32ma.—"Two-Valve Superhet", R. C. Lever, Wireless World, p. 145, Mar. 1955.

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Standards and Specs

By Sherman H. Hubelbank

This department surveys new issues, revisions, and amendments, covering military and industry standards and specifications. Our sources of information include the Armed Services Electro-Standards Agency (ASESA), the cumulative indexes to Military Specifications, Vols. II, III, and IV, and American Standards Association (ASA).

Capacitors

MIL-C-81A, CAPACITORS, VARIABLE, CERAMIC-DIELECTRIC, 15 FEBRUARY 1955... Spec JAN-C-81 has been superseded by this revision. The requirements for capacitance change with temperature have been relaxed to be more in agreement with manufacturing ability. The methods of packaging have been simplified to three groupings: immediate use, short time storage, and overseas shipment. Standard MIL-STD-105 may be used as an alternate to 100% inspection.

Connectors

MIL-C-3767, CONNECTORS (ELECTRICAL, POWER, BLADED TYPE), AMENDMENT No. 1, 25 JANUARY 1955. The inspection test procedure has been revised and the text rewritten to clarify its meaning.

The Armed Services Electro-Standards Agency, Fort Monmouth, N. J., has issued a listing of the current drawings entitled RF Transmission Lines, RF Fittings, and Audio Connectors that are available as of 31 January 1955. Copies of this listing are available from the above agency. Request ASESA Information Bulletin No. 31.

Electrical Instruments

The American Standards Association is in the process of revising the American Standard C39.1-1950, entitled *Electrical Indicating Instruments*, and plans to bring the American Standard *Direct Acting Recording Instruments*, C39.2-1953, up to date as soon as possible. The Committee wants the opinion of instrument users and manufacturers to help it improve these standards. If you have any comment regarding these standards, write to Herman Koenig, Chairman, Sectional Committee C39, c/o Electrical Testing Laboratories, 2 East End Ave., New York N. Y.

Electron Tubes

MIL-STD-200B, ELECTRON TUBES, 2 FEBRUARY 1955... This issue supersedes MIL-STD-200A. A new section has been added to show a copy of the standard form for reporting electron tube complements in new equipment designs. Two new crystals have been added to the preferred list and five phototubes have been removed.

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Resistors

MIL-R-93A, RESISTORS, FIXED, WIREWOUND, (ACCURATE), AMENDMENT No. 3, 18 JANUARY 1955 . . . This spec was amended to delete characteristic B, resistance to moisture, from the specification. The individual specification sheets were revised to remove the characteristic and temperature coefficient tables, since they now appear in the specification paper.

Switches

MIL-S-3786, SWITCHES, ROTARY (CIRCUIT SELECTOR, LOW CURRENT CAPACITY), AMENDMENT No. 1, 14 FEBRUARY 1955 . . . This spec has been amended to revise the list of referenced specifications and publications. In addition the basic design drawings of the switches, Figs. 1 and 2, have been corrected and the previously omitted overall dimensions have been added.

The Armed Services Electro-Standards Agency has announced that specification JAN-S-63 for sensitive-type switches is no longer under their purview. Therefore, the preferred parts list PPL-63-SS has been canceled.

Preferred Parts Lists

This is a listing of those preferred standard electronic components covered by those specs under the purview of ASES. Only the most commonly used electronic components with preferred physical dimensions, values, and tolerances have been selected. A listing of the most recent issues follows:

Component	PPL No. & Date	
Hook-up Wire & Cable	76-MW	11 Feb 55
Capacitors, Ceramic, Fixed (Temp Comp)	20-CC	3 Jan 55
Capacitors, Ceramic, Fixed, General Purpose	11015-CR	17 Jan 55
Capacitors, Mica, Fixed	10950-CB	11 Feb 55
Capacitors, Fixed, Glass Dielectric	11272-CY	11 Feb 55
Capacitors, Dry-Electrolytic	62-CE	3 Jan 55
Resistors, External Meter	29-MF	11 Feb 55
Resistors, Fixed, Composition Film	10683-RF	11 Feb 55
Resistors, Fixed, Film	10509-RN	11 Feb 55
Resistors, Fixed, Wirewound, Accurate	93-RB	17 Jan 55
Resistors, Fixed, Wirewound	184-RU	11 Feb 55

Copies of these Preferred Parts Lists may be obtained from ASES.

Specifications listed on these pages are for information only and government contractors should be guided by their contracts. Copies of military specs should be obtained from sources recommended by procuring officers. ASA standards may be obtained from American Standards Agency, 70 E 45th St., New York 17, N.Y. unless otherwise noted.

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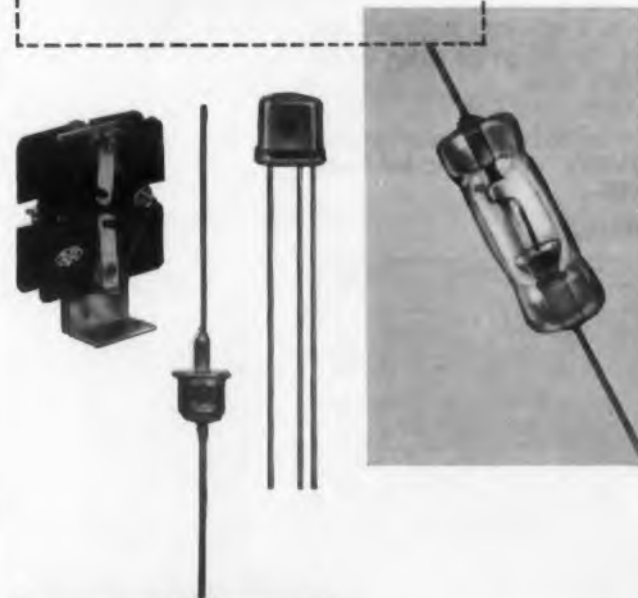
As semiconductor specialists we often receive such sketchy material from companies engaged in classified work that *no* one can help them much.

This might possibly hoodwink an enemy but it certainly delays design and manufacturing progress on guided missiles or whatever the defense project may be.

Naturally, occasional circuits are dead giveaways from which competent engineers could design a complete assembly — just as paleontologists might reconstruct a dinosaur from a single bone. Yet this is remote.

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 - Silicon alloyed junction types.
- ▶ HERMETICALLY SEALED PNP JUNCTION TRANSISTORS
- ▶ SILICON AND GERMANIUM POWER DIODES
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STOPS ON A CHARACTER!*



New, Unique
PERFORATED TAPE READER
 with take-up reels



MODEL 903

The new Potter High Speed Perforated Tape Handler is patterned after the Potter Magnetic Tape Handler which has been so enthusiastically received by the computing and data handling fields. It provides an inexpensive means for intermittent or continuous playback of perforated tape data.

A servo controlled tape drive provides fast starts and stops without tearing or spilling tape. Straight line threading permits changing of tapes in seconds.

Three separate motors are used. A continuously-running hysteresis-type motor drives two capstans in opposite directions. Solenoid-operated nylon idlers press tape against the appropriate capstan for the desired direction of travel. Spring loaded tension arms sense tape tension on either side of the tape drive mechanism and through a unique photoelectric bridge circuit, control reel-drive servo motors to maintain constant tape tension.

- Character Reading Speeds of 600, 300 or 150 per second.
- Five millisec start time.
- Simple Photo-Diode Reading Head.
- Bi-directional.
- Easy to thread.
- Reads 5, 6, 7 or 8 level perforated tape.
- Long tape life through use of low tension photoelectric servo.
- Remote control by pulses.
- Tape Drive and start-stop mechanism available separately for tape loop and basket applications.

DETAILED SPECIFICATIONS

MODEL	903JA	903JB	903JC	903KA	903KB	903KC
No. of Channels	5	6 or 7	8	5	6 or 7	8
Tape Width	11/16	7/8	1"	11/16	7/8	1"
Tape Speed in./sec	15/30	15/30	15/30	15/60	15/60	15/60
Character reading rate/sec	150/300	150/300	150/300	150/600	150/600	150/600
Reel Size	10-1/2	10-1/2	10-1/2	10-1/2	10-1/2	10-1/2
Reel Capacity	1,000'	1,000'	1,000'	1,000'	1,000'	1,000'
Start Time	5 millisec.	5 ms	5 ms	5 ms	5 ms	5 ms
*Stopping Distance	On the stop character at 150 and 300 characters/second.			On the stop character at 150 characters/second. On the character following the stop character at 600 characters/second.		
Control	By panel switch or remote pulses (25 v).					
Weight	100 pounds; Panel dimensions—24-1/2 x 19".					
Power Requirements	110-120 volts, 6 c.p.s., 400 watts.					
Note: For Tape loop and basket applications, the center panel containing the drive capstans and the start-stop mechanism without the reel servos may be purchased separately.						



115 Cutter Mill Road, Great Neck, N. Y.

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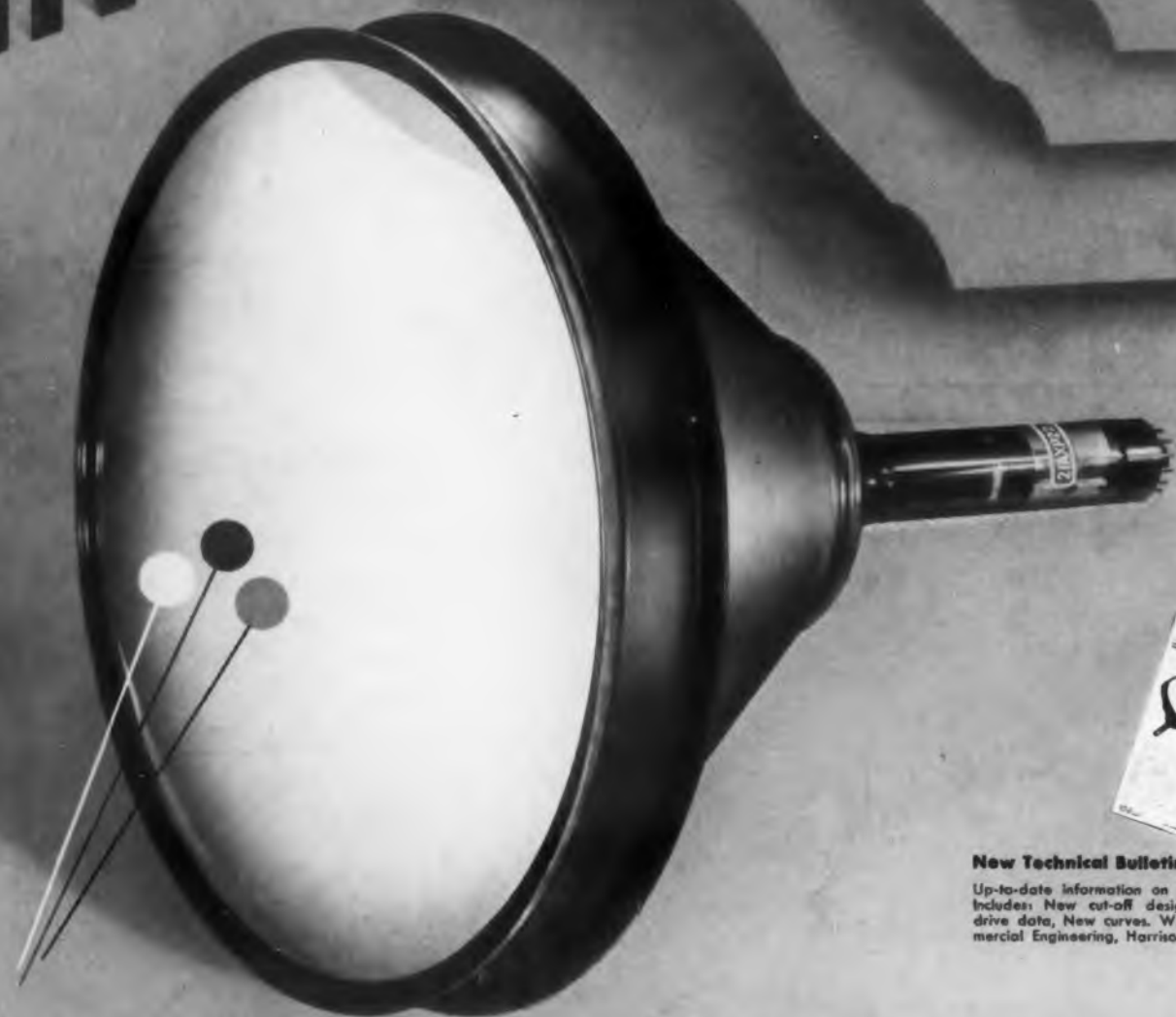
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- **Compact overall size for attractive cabinet styling**—70° deflection, plus short electron gun.
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