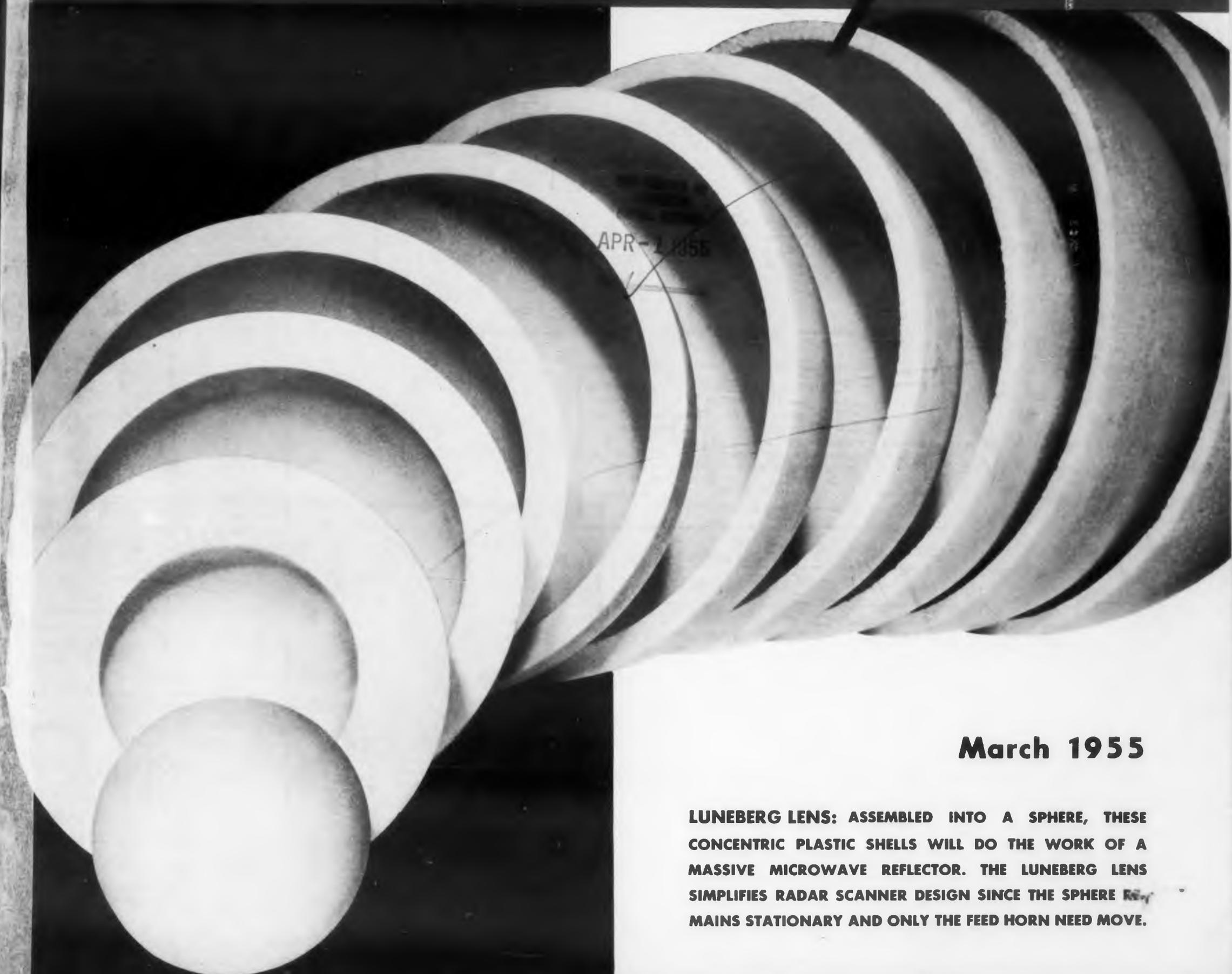


ELECTRONIC

MARCH 1955

DESIGN

ELECTRONIC



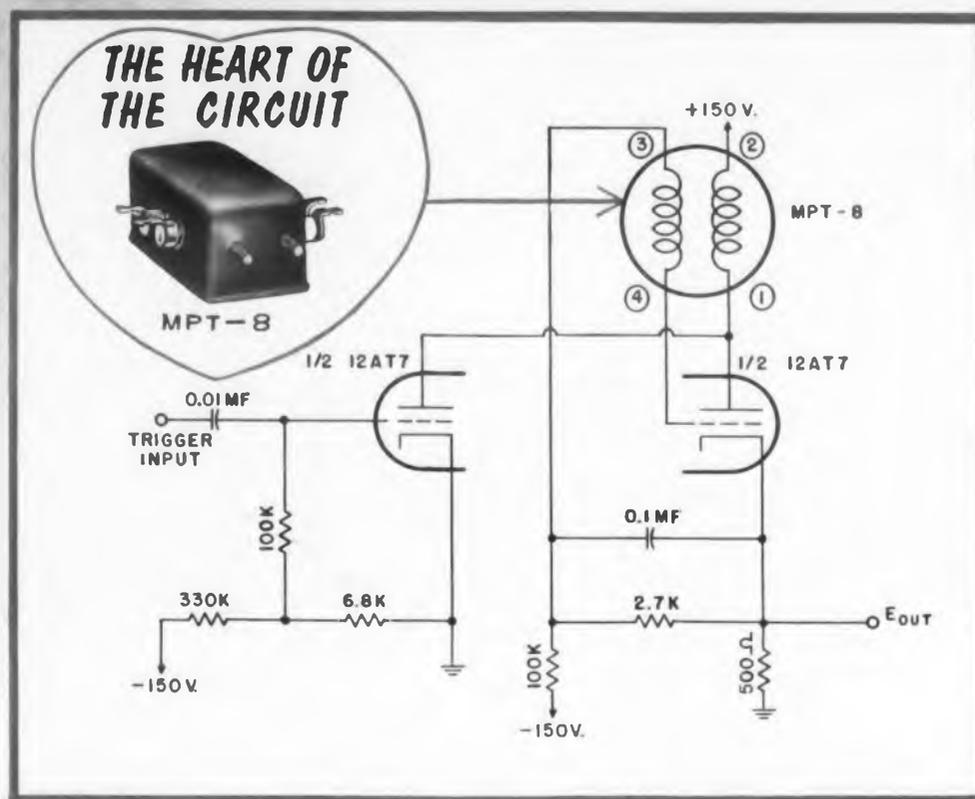
March 1955

LUNEBERG LENS: ASSEMBLED INTO A SPHERE, THESE CONCENTRIC PLASTIC SHELLS WILL DO THE WORK OF A MASSIVE MICROWAVE REFLECTOR. THE LUNEBERG LENS SIMPLIFIES RADAR SCANNER DESIGN SINCE THE SPHERE REMAINS STATIONARY AND ONLY THE FEED HORN NEED MOVE.

FREED MINIATURE PULSE TRANSFORMERS

USED IN UNIQUE BLOCKING OSCILLATOR CIRCUIT CAN PASS UP TO 200,000 PULSES PER SECOND.

Freed Miniature Pulse Transformers are being used in a novel blocking oscillator circuit which produces sharp pulses at repetition rates up to 200,000 pulses per second. With the circuit constants shown, an output pulse of two microseconds duration, 65 volts amplitude can be obtained with a p.r.f. of 20,000. The rise time obtained with the FREED MPT-8 is less than 0.05 microsecond. This fast repetition rate circuit can be triggered with either a sine or a square wave, and requires a driving voltage of anywhere from one to fifty volts. The bias voltages need not be obtained from a low impedance supply. If a negative pulse output is required, the FREED MPT-7 transformer provides a tertiary winding for this purpose.



HERMETICALLY SEALED PULSE TRANSFORMERS for use in blocking oscillators, low level interstage coupling, and modulator outputs. Made in accordance with MIL-T-27 specifications. These pulse transformers are designed for maximum power, efficiency and optimum pulse performance. Balanced coil structures permit series or parallel connection of windings for turn ratios other than unity. Pulse characteristics, voltages and impedance levels will depend upon interconnections made.

OTHER FREED PRODUCTS TRANSFORMERS

- High Fidelity
- High Level Pulse
- High Q Toroids
- Power
- Slug-Tuned
- Hermetically Sealed
- Step-down
- Magnetic Amplifiers
- Miniature Transistor
- High Q Reactors
- High Temperature
- Miniature Audio
- Charging Reactors
- Sub-Miniature
- Precision Reactors
- Precision Filters

INSTRUMENTS

- Comparison and Limit Bridges
- Low Frequency "Q" Indicators
- Incremental Inductance Bridges
- Universal Bridges
- Null Detectors and V.T. Voltmeters
- Power Supplies
- A.C. Bridges and Accessories
- Differential Voltmeters
- Harmonic Distortion Meters
- Wide Band Amplifiers
- Decade Amplifiers
- Decade Inductors
- Decade Capacitors
- Megohmmeters
- Filters
- Magnetic Voltage Regulators

Catalog Number	Application	Pulse Voltage Kilovolts	Pulse Duration Microseconds	Duty Ratio	Test Voltage KV., RMS	Characteristic Impedance Ohms	Case Size
MPT-1	Blocking oscillator or interstage coupling.	0.25/0.25/0.25	0.2-1.0	.004	0.7	250	DM-12
MPT-2	Blocking oscillator or interstage coupling.	.025/0.25	0.2-1.0	.004	0.7	250	DM-12
MPT-3	Blocking oscillator or interstage coupling.	0.5/0.5/0.5	0.2-1.5	.002	1.0	250	DM-18
MPT-4	Blocking oscillator or interstage coupling.	0.5/0.5	0.2-1.5	.002	1.0	250	DM-18
MPT-5	Blocking oscillator or interstage coupling.	0.5/0.5/0.5	0.5-2.0	.002	1.0	500	DM-12
MPT-6	Blocking oscillator or interstage coupling.	0.5/0.5	0.5-2.0	.002	1.0	500	DM-12
MPT-7	Blocking oscillator, interstage coupling or low power output.	0.7/0.7/0.7	0.5-1.5	.002	1.5	200	DM-18
MPT-8	Blocking oscillator interstage coupling or low power output.	0.7/0.7	0.5-1.5	.002	1.5	200	DM-18
MPT-9	Blocking oscillator, interstage coupling or low power output.	1.0/1.0/1.0	0.7-3.5	.002	2.0	200	DM-18
MPT-10	Blocking oscillator, interstage coupling or low power output.	1.0/1.0	0.7-3.5	.002	2.0	200	DM-18
MPT-11	Blocking oscillator, interstage coupling or low power output.	1.0/1.0/1.0	1.0-5.0	.002	2.0	500	DM-01
MPT-12	Blocking oscillator, interstage coupling or low power output.	0.15/0.15 0.3/0.3	0.2-1.0	.004	0.7	700	DM-8

Send for further information and catalog

FREED TRANSFORMER CO., INC.

1727 Weirfield St., Brooklyn (Ridgewood) 27, N. Y.

Staff

Edward E. Grazda Editor
M. Mandell Associate Editor
J. A. Lippke Associate Editor
D. S. Viebig Assistant Editor
R. Graham Contributing Editor
J. M. Montstream Contributing Editor
G. C. Foster Editorial Assistant
M. L. Bradley Editorial Assistant
E. Dadinis Production Manager
P. L. Canfield Business Manager
J. B. Gilchrist Circulation Manager
A. Farnsworth Reader Service

Co-Publishers

T. Richard Gascoigne
James S. Mulholland, Jr.

Advertising Representatives

New York: T. Richard Gascoigne,
James S. Mulholland, Jr.
Blair McClenahan
B. Wesley Olson
Owen A. Kean
19 East 62nd St.
New York 21, N. Y.
TEmpleton 8-1940

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

Los Angeles: Robert E. Ahrensford
1140 Wilshire Blvd.
Los Angeles 17, Calif.
MAdison 9-2681

Circulation Policy

ELECTRONIC DESIGN is circulated only to qualified electronic design engineers of U. S. manufacturing companies, industrial consultants, and government agencies.

If design for manufacturing is your responsibility, you qualify for a subscription without charge provided you send us the following information on your company letterhead: your name and title; your company's name, address, and main product. Electronic, research, development, project, electrical, and chief engineer are typical qualifying titles.

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

Any job change requires requalification.

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

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

← CIRCLE ED-1 ON READER-SERVICE CARD

ELECTRONIC

design

Vol. 3, No. 3
March 1955

Contents

Cover	(see page 46)
Editorial	4
Engineering Review	5
Features	
Designing Reliable Transistor Circuits, by Norman B. Saunder	24
Component Mounting Posts	28
Unitized Tape Recorder	30
New Thermistor Applications, by Sherman H. Hubelbank	32
Fast-Response Thermocouple	36
Designing Potted Circuits, by Frank J. Davidson	38
Radio Frequency Permeameter	44
Luneberg Lens	46
Encapsulated Trimming Potentiometer	48
Solderless Breadboard System	50
Ellipse Drawing Tool	54
Shielding Beads	58
Small Variable Capacitor	60
Midget Power Resistors	62
Microstrip Microwave Receiver	64
One-Piece Miniature Tube Shields	66
Impedance-Admittance Matching Chart, by Milton H. Crothers	68
Design Forum	
Control Area for a Giant Computer	40
Hearing Aid in Eyeglass Frames	52
Ideas for Design	
Technical Problems Affecting National Defense: Supplementary List	56
Departments	
New Products	70
New Literature	148
Patents	164
Books	170
Advertisers' Index	173



ELECTRONIC DESIGN is published monthly by Hayden Publishing Company, Inc. at 19 E. 62nd Street, New York 21, N. Y., T. Richard Gascoigne, President; James S. Mulholland, Jr., Vice-President & Treasurer, and Ralph E. Marson, Secretary.



Printed at Publishers Printing Company, New York, N. Y., ELECTRONIC DESIGN is circulated monthly without charge to men in the electronic industries who are responsible for the design and specification of manufactured devices, including development and design men of consulting laboratories and government agencies. Acceptance under section 34.64 P. L. & R. authorized. Copyright 1955 Hayden Publishing Company, Inc. 24,000 copies this issue.

836.0

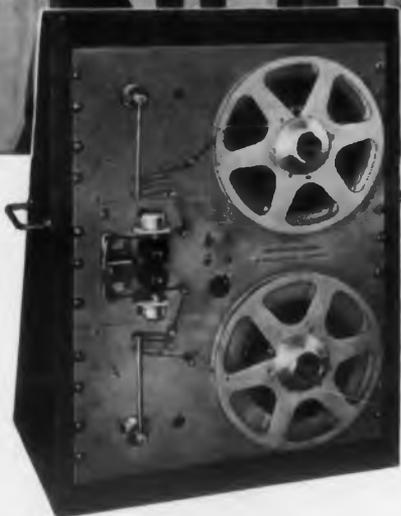
864.9

483.6

167.93

999.9

291.83



**faster! more channels!
more versatile!**

THE NEW POTTER DIGITAL MAGNETIC-TAPE HANDLER

0 to 60 inches/sec. in 5 msec! 2, 6 or 8 channels

High-speed magnetic tape recorders with low start-stop times bring a new dimension to data handling by absorbing and dispensing digital information when and where it's needed! Any phenomenon can be recorded as it occurs, continuously or intermittently, fast or slow. It can later be fed into computers, punch cards, printers, etc.

Speeds of 60 inches per second with 5-millisecond start-stop times permit digital techniques with jobs previously requiring more expensive, less reliable methods. Typical applications include business problems, high-speed industrial control processes, missile study, and telemetering.

In addition, Potter Magnetic Tape Handlers offer wider tape widths for more channels with lower tape tension controlled by photoelectric servos. Yet, the price is a fraction of much less versatile recorders. Other data handling components and complete systems are available for special problems.

DETAILED SPECIFICATIONS

Model	902AJ	902BJ	902BK	902CJ	902CK
Number of Channels	2	6	6	8	8
Tape Width (Inches)	¼	½	½	¾	¾
Tape Speed (in./sec.)	15/30	15/30	15/60	15/30	15/60
Reel Size (dia. in inches)	10½	10½	8	10½	8
Reel Capacity (feet)	2,400	2,400	1,200	2,400	1,200
Start Time	5 Milliseconds				
Stop Time	5 Milliseconds				

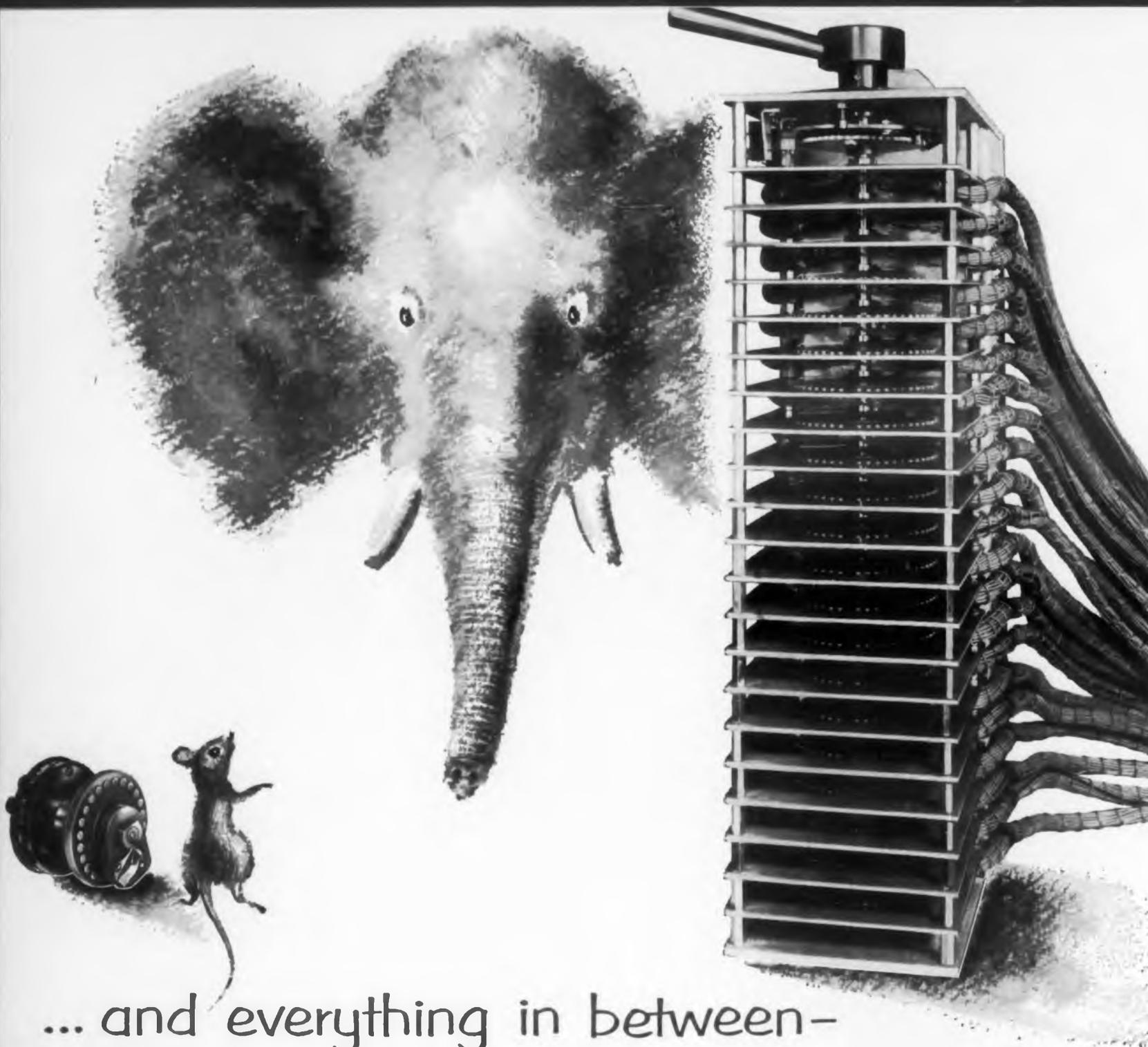
For complete information, write to Department 10-F.



POTTER INSTRUMENT CO., INC.
115 Cutter Mill Road, Great Neck, N. Y.

See us at the I.R.E. SHOW—Booth 346

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



... and everything in between—

With Over 3500 Standard Switches In The Daven Line From Which To Choose—and which in turn can be modified to provide countless additional switch combinations—it's easy to see why *Daven* is equipped to meet your most exacting switch requirements on snort notice.

Knee-Action Rotor Lowers Contact Resistance . . . Gives Longer, Trouble-Free Switch Life! Every *Daven* switch features the exclusive, patented *Knee-Action* rotor arm with two separate wiper blades, each individually spring-loaded—to insure extremely low and uniform contact resistance throughout the life of the switch.

Daven's special design renders these blades tamper-proof . . . they withstand rugged treatment in the field. Because of their self-wiping action, little or no servicing is required.

Compact Design for Smaller-Size Components—With *Daven's* space-saving design, up to 8 poles per deck can be supplied . . . a significant factor for maximum performance where depth and mounting space are at a premium. *Daven* switch sizes start at 1-3/8" diameter x 1-11/16" in depth. Solid silver alloy rotors, slip rings, and contacts are used exclusively. These switches meet all applicable military specifications.

Visit *Daven* at the I.R.E. Show
543 & 545 Components Ave.

Write today
for **FREE**
catalog.



THE DAVEN co. 169 Central Avenue
Newark 4, New Jersey

WORLD'S LARGEST MANUFACTURERS OF ATTENUATORS

Editorial

Show Time Again

Every year in March we register our annual gripe about the IRE Convention and the Radio Engineering Show. We usually say that there are too many sessions and technical papers at the convention, and that there are too many exhibits at the show. It appears that this year will be no exception.

A glance at the advance notice of this year's plans indicates that during the four-day convention, 55 technical sessions consisting of about six technical papers each are scheduled. The "parallel sessions" problem is really going to be acute this year. As for the show, the more than 700 exhibits planned cannot even be housed in the Kingsbridge Armory. Additional space in an "annex" has to be provided.

Taking in all these exhibits is going to be a superhuman task. We think the time has come for the Institute to make a careful, detailed study of both the convention and the show to see if the point of diminishing returns has been reached. A great deal of time, effort, and money goes into the preparation and execution of these events. The prospect of expending more time and more effort and more money for still larger conventions and shows in future years would seem to justify such a study at this time.

* * *

To help our readers find items of special interest to them at the show, each product in the New Product Department of this issue being exhibited for the first time is identified with a special marking and the number of the booth where it can be seen. Over 100 products are so keyed, including several in the feature section merited special attention.

◀ CIRCLE ED-3 ON READER-SERVICE CARD

Engineering Review . . .

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

Robot Makes Transistors . . . An experimental robot machine has been developed that performs some of the most critical steps in the manufacture of junction transistors. Still a laboratory device, the robot points to future automatic production of both germanium and silicon transistors. It is illustrated on this page.

The machine accurately positions and welds gold collector and emitter wires to their respective semiconductor layers. After welding the wires, the machine performs a series of electrical tests. If the transistor fails any of the tests, it can be automatically rejected. If it is desired to hermetically seal the transistor, this operation must be performed on another machine.

The process starts with the insertion of a tiny semiconductor bar of the proper size into a clamp in the machine. The machine presses a gold wire against one layer of the disc. The wire is rapidly moved across the layer in 1/20,000 steps. After each step an electrical check is performed to determine if the "n" layer of germanium has been reached. As soon as the wire touches this layer, the machine starts measuring width until the wire reaches the far side of the layer. The machine then decides whether the bar is satisfactory. If it is not, it can be automatically rejected.

If the bar is satisfactory, the machine retraces its steps to the other side of the central layer and counts forward a predetermined number of steps. At this point a pulse of current through the gold wire welds the wire to the germanium. The machine then attaches this wire to one of the four leads of the transistor mount. It then rotates the bar end over end and automatically goes through the same series of operations on the other side of the bar.

The robot has been assembling tetrode transistors

for research purposes. It was developed at the Bell Telephone Laboratories, 463 West St., New York 14, N. Y., by R. L. Wallace.

Support for NBS . . . During 1954, 12 technical area advisory committees have been established to provide a direct, continuing link between the National Bureau of Standards, Washington 25, D. C., and organized science and technology in the nation. Nine scientific and engineering societies have nominated advisory committees to the Bureau in the fields of physics,

chemistry, mathematics, metallurgy, ceramics, and electrical, radio, civil, and mechanical engineering.

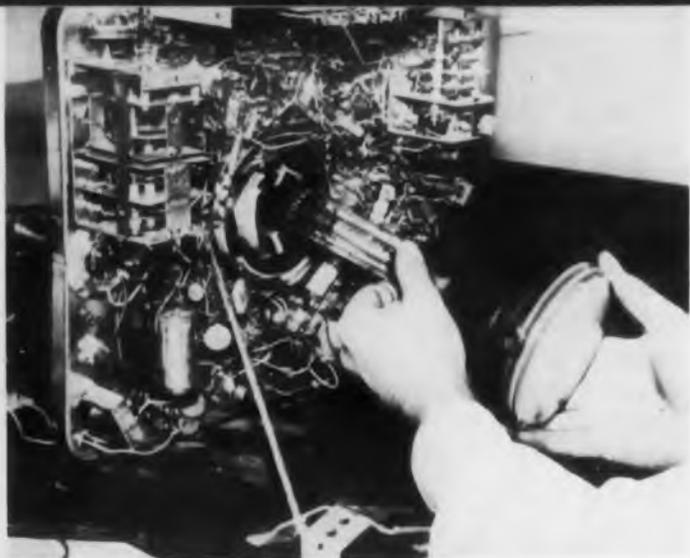
The AIEE has appointed an advisory committee, under the chairmanship of Dr. Ralph Bown, Bell Telephone Laboratories, to consider programs in electricity and electronics. Research in electronics at NBS is directed toward obtaining knowledge of basic electronic phenomena and the properties of materials of potential significance to electronics. Development work includes not only the design of circuitry for new functions but also the broader phases of fabrication technology by which optimum designs for electronic equipment may be achieved.

An advisory committee appointed by the IRE has as its principal interest the NBS Central Radio Propagation Laboratory, Boulder, Colo. Chairman of this group is Dr. A. W. Straiton, University of Texas. The laboratory investigates phenomena affecting the propagation of radio waves, develops primary standards and measurement techniques for electrical quantities at radio frequencies, and prepares radio propagation predictions necessary for effective radio communications.

In general, the advisory committees have two functions. First, each committee plays an external role in which its members represent formally the interests and needs of their society and interpret its point of view in terms of the NBS program. The second function involves assistance to the Bureau on problems of program formulation and evaluation.

The transistor-making robot is being observed by a Bell Telephone Laboratories scientist while in operation. It has been named "Mr. Meticulous". One of the transistors it assembled is shown in the inserted photograph.





The original picture tube for this TV receiver chassis has been left behind while it is being operated at the shop with a new 5" checking tube.

TV Checking Tube . . . Television servicing is greatly expedited by means of a new small checking picture tube. The large installed picture tube can be left in the cabinet while the chassis is brought to the servicing shop and operated with the checking tube, as illustrated above.

Manufactured by Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y., the 5" tube is designated the 5AXP4. It is a magnetically deflected tube using electrostatic self-focusing. Since the tube has a focus system built into it, no focus mechanism is required nor does the ion trap need to be installed while making tests on the receiver.

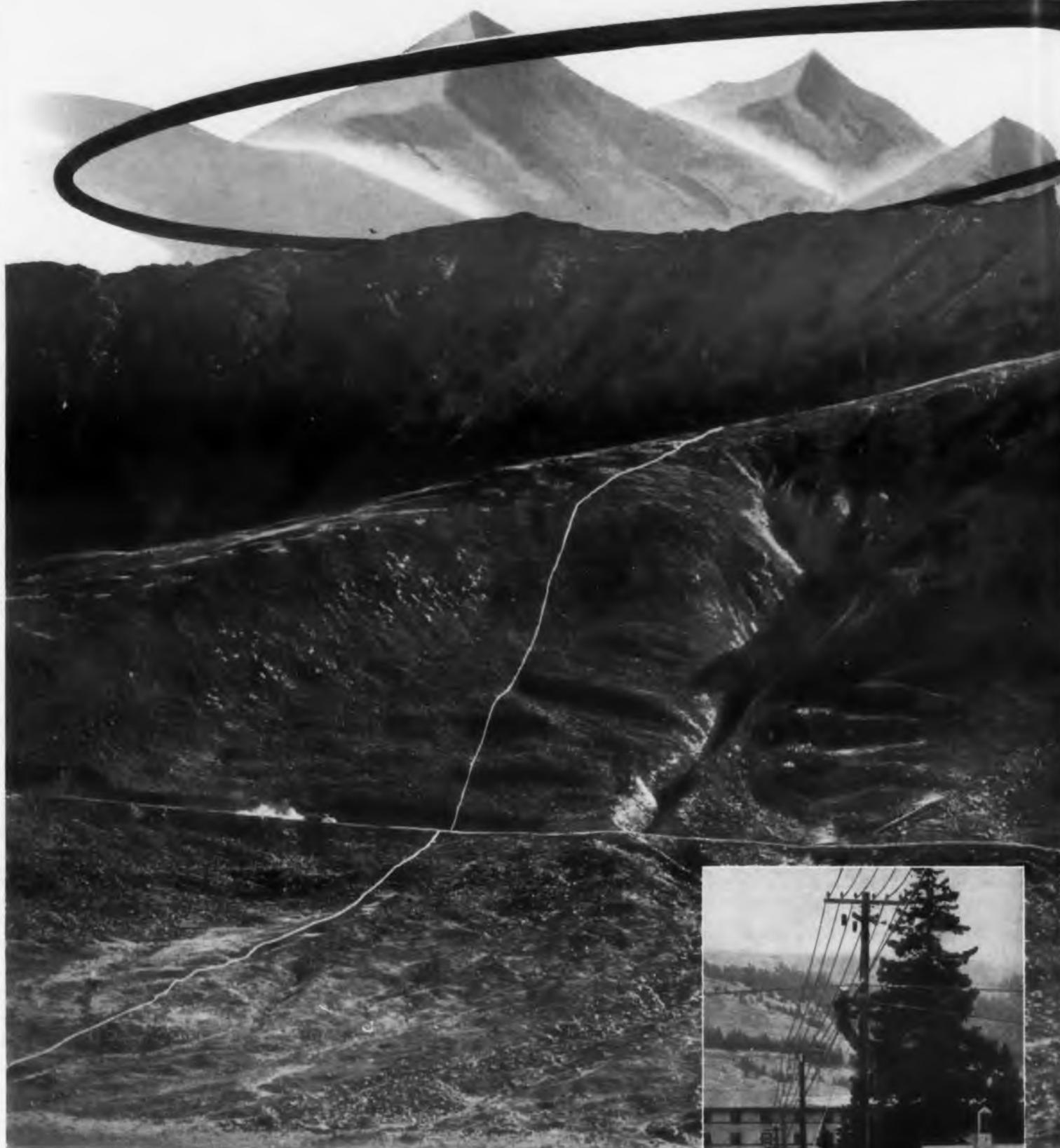
The tube is so light that the yoke of the receiver will very easily support the tube. The only electrical connections required are the high-voltage lead and the picture tube socket. The tube may be used in any receiver regardless of the deflection angle.

New Uses for Closed Circuit TV . . . Closed circuit TV is being used by the University of Kansas City as a classroom aid in teaching dental surgery. The equipment enables surgeons at the university's School of Dentistry to project close-up details of oral operations to more than 100 students seated in a lecture hall a floor away.

The camera and control unit are installed in the dental surgery. TV projections are made on a 4' x 5' screen mounted in the lecture hall. The camera is fitted with a telescopic lens which enables the camera to "get inside" the patient's mouth without intruding on the surgeon's working area. The installation also includes a 2-way intercommunications system which enables the surgeon to describe the operation as he performs it, and to hear and answer questions from students viewing the operation.

In Oakland, Calif., closed-circuit TV is being used at a parking lot to enable the attendant at the entrance

THE WORLD'S HIGHEST COMMUNITY TV



Reflected sunlight makes the primary cable look like a white line running down the slopes of Mt. McNamee. Except for a section of conduit that is buried beneath the road, at center, the entire 4300 ft. of cable between summit and mine lies exposed on the ground.



Stringing RG-11U cable on existing telephone poles. RG-11U was used as secondary lead, and as drop cable to individual outlets.

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

ELECTRONIC DESIGN • March 1955

TV SYSTEM IS ROUGH ON CABLE

COAXIALS MUST WITHSTAND RUGGED TERRAIN, SNOW, HIGH WINDS, AND LIGHTNING IN THE 13,803 FT. INSTALLATION AT CLIMAX, COLORADO

This unique TV distribution system, provided for its employees by the Climax Molybdenum Co., makes use of two transmission cable types. Both are insulated with BAKELITE Polyethylene and jacketed with BAKELITE Vinyl Plastic—providing service that underscores the outstanding electrical and mechanical properties of these wire covering materials.

From the antenna site at the peak of nearby Mt. McNamee, the primary lead—Federal K-14 cable—descends 11,000 linear ft. to the community. During its course, this cable lies on the ground, exposed to the elements . . . is buried in conduit . . . and for 4900 ft. runs through the underground workings of the mine in conduit and on messenger. From the edge of town, 80,000 ft. of pole-strung Federal RG-11U cable,

serving as secondary lead and drop cable continues the transmission to some 500 TV receivers. Throughout these long cable runs, the superior mechanical characteristics, the constant impedance, low line loss, and low power factor of BAKELITE Vinyl Plastics and BAKELITE Polyethylene prove big factors in maintaining the TV signal at essentially the same quality as received at the antennas. The first amplifier necessary in the primary lead is 2400 ft. from the front end equipment on the mountain peak.

Wire and cable jacketing made of BAKELITE Vinyl Plastics is wax-smooth—for easier pulling and stripping. Compounds can be formulated to stay pliable in very low temperatures . . . resist deformation in extreme heat. Lasting colors provide permanent coding. BAKELITE Polyethylene is light, permits smaller diameters—for easier handling, savings in space and weight. Cores . . . hold their excellent electrical properties through a wide temperature range.

For all the facts on BAKELITE Vinyl Plastics and BAKELITE Polyethylene for wire coverings, and names of your nearest suppliers, write Dept. BY92.

Data courtesy of: **Climax Molybdenum Co.**, Climax, Colorado; **Federal Telephone and Radio Company**, Clifton, N. J., a division of IT&T.



Two antenna groups receive channels 2, 4, 7, and 9 from Denver stations, about 60 air miles away. The first antennas suffered considerable damage from icing and high winds, and had to be replaced with sturdier structures. The coaxial cables however, insulated with BAKELITE Polyethylene and jacketed with BAKELITE Vinyl Plastic, measured up to expectations from the very first. Note the loose, broken rock, typical of the terrain along the course of the primary lead cable.



Taking antenna field strength readings atop 13,783 ft. Mt. McNamee.



Installation crew watching the first TV reception on test equipment in the amplifier shack. In normal operation, the insulated 6' x 6' metal building houses the front end amplifier equipment for the community antenna system.

BAKELITE COMPANY, A Division of Union Carbide and Carbon Corporation 30 East 42nd Street, New York 17, N. Y. The term BAKELITE and the Trefoil Symbol are registered trade-marks of UCC

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

booth to hasten spotting as he directs motorists to vacancies on the 225' x 300' car lot. The camera is mounted atop a light standard overlooking the lot and is connected to a 21" TV receiver installed in the entrance booth. A special pan and tilt mechanism enables the camera automatically and continuously to scan the parking area and project what it sees to the receiver in the booth. The camera also can be operated manually.

The closed-circuit TV equipment used in these installations was made by Radio Corp. of America, Camden, N. J.



Radio-Flashlight Combination

This portable radio has a built-in flashlight for outdoor trips. Two sizes of built-in flashlights—penlite and regular—are available in these radios made by Philco Corp., 445 E. Tioga St., Philadelphia, Pa. Both flashlight and radio operate from two double-sized batteries.

Man-Made Diamonds . . . True diamonds are now being made experimentally in the General Electric Research Laboratory, Schenectady, N. Y. The stones, which duplicate the structure of natural diamonds by every test, could conceivably be used for industrial purposes if a comparatively inexpensive manufacturing process could be evolved.

Diamonds as long as 1/16" have been produced in the process in which a carbonaceous compound is subjected to 1,500,000psi at temperatures above 5000°F. Up to 1/10 carat have been made in one run.

The scientists responsible for the project were Drs. Francis P. Bundy, H. Tracy Hall, Herbert M. Strong, and Robert Wentorf. There is little likelihood that diamonds of gem quality will ever be produced by this process. The diamonds were made in the laboratory's 1000-ton press.

Have you returned your subscription renewal and qualification form?

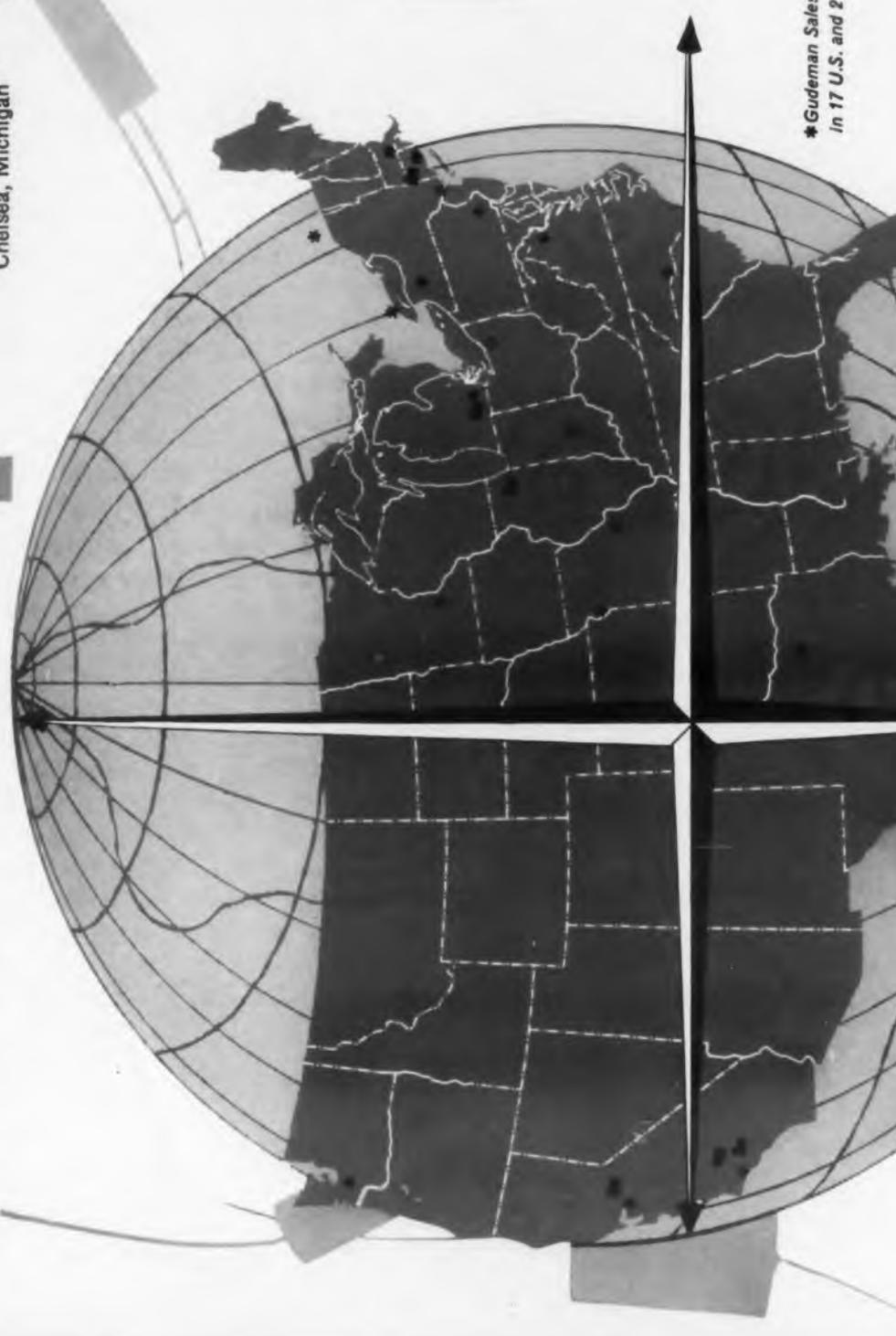
See Page 100

GUDEMAN COAST-TO-COAST SERVICE

Manufacturers of Capacitors, Filters, Pulse Transformers, Delay Lines and Linear Variable Differential Transformers.

- 6 Plants • Main Plant
340 West Huron Street
Chicago 10, Illinois
- 20401 Old U.S. 12 W.
Chelsea, Michigan

- 190 Commercial Street
Sunnyvale, California
- Dilectron Division
2661 South Myrtle
Monrovia, California
- 9200 Exposition Boulevard
Los Angeles 34, California
- Terryville, Connecticut



Write for latest technical data on any of the following:

- MIL-C-25A Capacitors
- High Voltage Glass Cased Capacitors (GC Type)
- Motor Starting Capacitors (Paper Dielectric-Oil Impregnated)
- Paper Tubular Capacitors
- Hi-Temperature-Plastic Dielectric Capacitors (XC Types-165°C)
- Miniature Hi-Temp Capacitors (XH Types-125°C)
- Dry Electrolytic Capacitors
- Noise Suppression Filters
- Delay Lines
- Pulse Transformers
- Ceramic Capacitors
- Plastic Dielectric Capacitors (337 & 338 Types)
- Linear Variable Differential Transformers
- Metallized Paper Capacitors

See these products at Booth 407 I.R.E. Show

*Gudeman Sales Offices and Representatives
in 17 U.S. and 2 Canadian Cities.



MAIN OFFICE: 340 WEST HURON STREET • CHICAGO 10, ILLINOIS
PHONE DELAWARE 7-7400

Manufacturers of Electronic Components for Military and Commercial Applications.

THE
Gudeman
COMPANY

Microwave Cooking Improved . . .

A method of "browning" food surfaces during microwave cooking has been developed. In order to promote the sales and extend the usefulness of their microwave cooking equipment, the Raytheon Manufacturing Co., Waltham 54, Mass., has been engaged in a microwave cooking research program.

This firm's microwave cooking equipment, known as "Radaranges", does not ordinarily brown surfaces because heat is produced within the food by molecular friction rather than being applied to the outer surface. However, food is cooked, reheated, or thawed much quicker by microwaves than by conventional cooking. In addition, the food container and oven walls do not become hot.

Two new models of the "Radarange" have been put in production. The larger version, Model 1161, utilizes two type *QK-390* continuous-wave, air-cooled magnetrons. They produce 1600w at 2450Mc. The smaller counter type, Model 1170, which is illustrated, incorporates one *QK-390* producing a maximum of 800w output. These ranges are utilized in commercial kitchens to supplement conventional equipment.

The only tubes in the units besides the magnetrons are the rectifier tubes in the power supply. The power supplies furnish 320ma at 5000v to each magnetron in the form of pulsating direct current. Magnetrons are more stable with this sort of supply than with direct current.

Another Wireless Microphone . . .

Another "wireless" microphone has been developed. Employing five sub-miniature tubes mounted on a printed-circuit board, the unit produces 200mw at 27.51Mc. A recently developed wireless microphone (*ED, November, 1955, p. 14*) incorporates eight transistors.

Manufactured by Port-O-Vox Corp., 521 W. 43rd St., New York 36, N. Y., the f-m microphone is marketed with a companion receiver that feeds into public-address systems or recorders.

← CIRCLE ED-5 ON READER-SERVICE CARD

Medi
espec
teach
has l
Sixth
empl
with
an a

Th
utili
The
plied
relea
chan

Th
1.0en
as a
mour
comp
and

Th
conn
is in
ampl
a pl
prov

Th
5cy t
The
mate
on a

Th
low p
and
equiv
Thes
type
galva
tape,

Com

and
Dr.
tory,
for
phot
Gern
plan
but t
wher
mino

W
the c
nomi
chinc
Aire
orbit
Indi
ment

ELEC

Medical Microphone . . . A microphone system especially adaptable for auscultation in research, teaching, and the diagnostic problems of cardiology has been demonstrated by Altec Lansing Corp., 161 Sixth Ave., New York 13, N. Y. The "M16 System" employs an extremely sensitive microphone coupled with an electrical stethoscope, a power supply, and an amplifier.

The microphone is a pressure operated transducer utilizing the capacitor or capacity variation principle. The diaphragm displacement is proportional to applied pressure down to a few cycles. Static pressure release reduces the output below 10cy, and pressure changes of about 2cy are the lower limit of operation.

The capacitor-microphone unit is 1.5cm x diam 1.0cm thick. It is coupled to a subminiature tube used as a cathode follower. The microphone and tube are mounted on a base 1.5cm in diam and 8cm long. This compact mounting reduces the effects of cable noise and microphonics. Its weight is 75gr.

The output of the microphone system should be connected to a load in excess of 10,000 ohms and is intended to work into a high impedance input amplifier. If a low impedance output is required, a plug-in matching transformer may be used to provide a range of 30 to 600 ohms.

The frequency range of the microphone in air is 5cy to 18kc and sensitivity is $-56\text{db re } 1 \text{ v/dyne/cm}^2$. The peak of response of the microphone is approximately 18kc, so that a rise time of $50\mu\text{sec}$ is available on a pressure pulse.

The range of frequencies, pressure changes, and low phase shift enables the research worker to measure and listen to pressure variations and their acoustical equivalent in sound, in both animals and humans. These variations can be analyzed with sharp filter type or octave band analyzers, and displayed on galvanometers, oscilloscopes, recorded on magnetic tape, and reproduced over loudspeakers.

Computer Figures Planet's Orbit . . . A telescope and an electronic computer were used recently by Dr. Paul Herget, director of the Cincinnati Observatory, when he rediscovered the planet Athalia, "lost" for 50 years. The planet was originally discovered photographically at the Heidelberg Observatory in Germany in 1903. The orbit was computed for this planet from the observations in the usual manner, but the planet was not photographed again until 1948 when Indiana University took about 2,000 plates of minor planets.

While checking these plates recently to determine the orbits of the planets, Dr. Herget solved the astronomical problems on the International Business Machine Corp. 701 computer at the General Electric Co., Aircraft Gas Turbine Div., Cincinnati, Ohio. The orbit path shown by the computer revealed that the Indiana observations could be brought into full agreement with the observations of Athalia.

Find the Newest Answer to CORROSION CONTROL

in this 20-page **KEL-F[®]**
Dispersions Manual

Learn how you can get the advantages of KEL-F fluorocarbon plastic: corrosion and heat resistance, anti-adhesion, abrasive resistance, excellent electrical properties, moisture resistance *in a dispersion coating,*

for application by
spraying, dipping
or spreading



© Registered trademark of The M. W. Kellogg Company's fluorocarbon polymers



THE M. W. KELLOGG COMPANY

Chemical Manufacturing Division
P. O. Box 469, Jersey City 3, N. J.

Please send me my copy of the new Kellogg Manual, "Application Techniques for KEL-F[®] Fluorocarbon Polymer Dispersions."

Name _____
Title _____
Company _____
Address _____
City _____ State _____

I am interested in Dispersion Coating Applications for:

- | | |
|--|--|
| <input type="checkbox"/> trailer tanks | <input type="checkbox"/> calendaring rolls |
| <input type="checkbox"/> tankcars | <input type="checkbox"/> forming dies |
| <input type="checkbox"/> storage tanks | <input type="checkbox"/> guide rolls |
| <input type="checkbox"/> pipe lines | <input type="checkbox"/> mattress molds |
| <input type="checkbox"/> pumps | <input type="checkbox"/> tire molds |
| <input type="checkbox"/> mixers | <input type="checkbox"/> ribbon blenders |
| <input type="checkbox"/> valves | <input type="checkbox"/> cone blenders |
| <input type="checkbox"/> flowmeters | <input type="checkbox"/> hoppers |
| <input type="checkbox"/> reactors | <input type="checkbox"/> casting molds |
| <input type="checkbox"/> shipping containers | <input type="checkbox"/> coated glass tape |
| <input type="checkbox"/> waste neutralizers | <input type="checkbox"/> miniaturized stators |
| <input type="checkbox"/> agitators | <input type="checkbox"/> distribution transformers |
| | <input type="checkbox"/> miniaturized relays |

Other applications (please list) _____

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



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

No. 1

1955

"Teflon" and "Zytel"† nylon combine to make a better relay

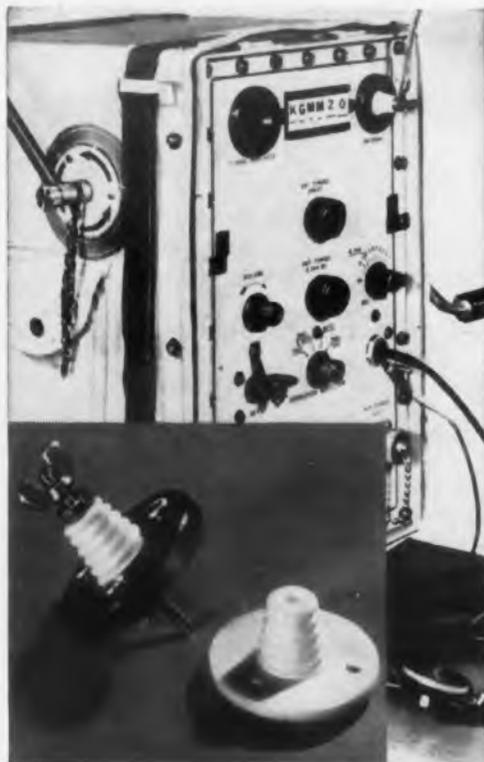
Type "TQ" miniature telephone-type relays operate at about 150°F. and are used for power-switching duties — solenoids, valves and magnetic motors. The bobbin is molded of Du Pont "Zytel" nylon — chosen because of its lightness, strength in thin sections, and high insulating properties. It will not gas at operating temperatures.



Miniature telephone-type relays use "Zytel" nylon resin for the bobbin, and wire coated with "Teflon", to assure superior performance. Use the coupon below for complete property information on these Du Pont engineering materials.

The wire is coated with Du Pont "Teflon" tetrafluoroethylene resin. "Teflon" is an electrical insulating material that's especially suited for tough operating conditions. It has good thermal expansion properties and will not gas. The "TQ" miniature relay pictured here is the product of Advance Electric and Relay Company, Burbank, California.

Two-Way Portable Lifeboat Radio Uses Tough TEFLON® for Antenna Post



This antenna post of Du Pont "Teflon" tetrafluoroethylene resin has high dielectric properties, resists salt water and can take rough handling. (Radio manufactured by Marine Division, Mackay Radio and Telegraph Company, Inc., New York City, New York. Insulator of "Teflon" made by Tri-point Manufacturing & Developing Company, Brooklyn, New York.)

Resists cracking and chipping, won't corrode from salt spray

Designers have found another use for Du Pont "Teflon"— as the antenna post on a portable lifeboat radio. This radio for emergency use is buoyed up by encased air when it's in the water.

Conventional insulating materials tested for this antenna post failed. Some would chip or crack under the especially rough service this radio encounters. Other materials deteriorated from salt spray. Only Du Pont "Teflon" had the dielectric properties, strength and corrosion resistance to do this job dependably.

The superior properties of versatile Du Pont "Teflon" tetrafluoroethylene resin find a wide use in the electronics field. Fill out the coupon below for full property data about this versatile engineering material.



These wire supports molded of "Zytel" nylon resin (named "tombstones" because of their shape) can take any size wire bundle and eliminate the disadvantages of metal clamps. Besides saving many man-hours in installing airplane wiring, "Zytel" nylon standoff insulators are lightweight, take stress in all directions and are impervious to solvents — including gasoline and jet fuels. "Zytel" is also fungus-resistant, an excellent insulator and won't carbonize. (Stand-off insulators are manufactured by the Nylon Molding Corporation, Garwood, New Jersey, under license of Boeing Airplane Company, Seattle, Washington.)

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 413, Du Pont Building, Wilmington 98, Delaware

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" and "Lucite" are registered trade-marks of E. I. du Pont de Nemours & Co. (Inc.)

†"Zytel" is the new trade-mark for Du Pont nylon resin.

More Cars With Radios . . . Two out of three cars on the highway today are equipped with radios, compared with only one out of three in 1941. As late as 1947, sale of 3.5 million auto radios accounted for just 17.3% of the total set market. In 1954, car radio sales reached 5 million plus and 38.7% of total radio production, according to the December, 1954 issue of Automobile Facts, published by Automobile Manufacturers Association, 320 New Center Bldg., Detroit, Mich.

Computer Scholarship Program . . .

The second annual University Scholarship Program in computers will be held June 7, through Sept. 2, 1955. The financial aid program, for selected students at leading universities, will comprise training in the structure and operation of digital computers, practical numerical analysis, the theory of programing and coding, industrial computer applications, and management of computer companies.

Students will take the 10-week course at ElectroData Corp., Pasadena, Calif. Records of no more than two students from any one university should be submitted before April 15 for evaluation by department heads. Address applications to Dr. Paul Brock, ElectroData Corp., 717 N. Lake Ave., Pasadena, Calif. For each student selected to attend the course, ElectroData will grant \$500 to the individual's university.

Human Engineering Institute . . .

For the third successive year Dunlap and Associates, Inc., a management consultant firm, have organized a 5-day "Human Engineering Institute." This year's course will be pitched at an advanced level, in conformance with recent developments in human engineering and the increasing sophistication of people who do human engineering work. It will take place during the week of June 6 in Stamford, Conn.

Of particular interest to designers are lectures entitled "Determining

◀ CIRCLE ED-7 ON READER-SERVICE CARD

Design Requirements", "Human Perception Data" (visual and auditory capabilities are related to instrumentation), "Experimentation as a Basis for Design", "Optimizing Design Decisions", and "Effects of Operator and Maintenance Personnel Specifications on Design".

Enrollment is limited and the deadline for enrolling is May 6. The tuition is \$290.00. For further information, contact Dr. Martin A. Tolcott, Director, Human Engineering Institute, Dunlap & Associates, Inc., 429 Atlantic St., Stamford, Conn.

Vacuum Machine . . . A newly developed tube evacuating and sealing machine can process subminiature tubes at rates up to 1800 per hour. It produces a vacuum with a pressure of one micron of mercury. The device is manufactured by Consolidated Vacuum Corp., Rochester, N. Y. It has 16 pumping heads.

Automatic Direction Finder . . . A newly developed radio direction finder automatically remains pointed towards any beacon station to which it is tuned. It was developed in cooperation with the U. S. Coast Guard for search-and-rescue missions, but is useful in any navigation problem.

Designated the RD-132, the equipment is made by Raytheon Manufacturing Co., Waltham, Mass. The unit has two tuning ranges: 275-510kc, and 2-3.5Mc.

Simplified Uranium Mining . . . A new developed scintillator for uranium mining indicates the percentage of uranium in the ore at the point of discovery. The only other method of determining such percentages is by chemical assay.

Utilizing an 8-tube circuit, the portable instrument weighs 7-3/4 lb. It is manufactured by Precision Radiation Instruments, Inc., 4223 W. Jefferson Blvd., Los Angeles 16, Calif. The sensitive element is a 1-1/2" diam sodium iodide crystal.

CIRCLE ED-8 ON READER-SERVICE CARD ➤

TELEMETERING

• BAND PASS

• LOW PASS

FILTERS

in Standard
Miniature
Subminiature
sizes



COMPLETE LINE of filters for every channel and band width . . . in Standard, Miniature, Subminiature and "Tom Thumb" sizes . . . many available from stock.

MINIATURIZED filters that save 80% space . . . retain all desired attenuation characteristics.

HERMETIC SEALING, OCTAL PLUGS and other new features.

only Burnell offers you . . .

SPECIAL PHASE LINEARITY characteristics to conform to new concepts of high accuracy telemetering practice.

SPECIFICALLY DESIGNED for telemetering, these filters have found great utility in a wide variety of communications and control applications.

APPLICATION ENGINEERING service plus complete technical literature. Write Dept. A, for Catalog 102A.



Teletype: Yonkers, N. Y. 3633

BURNELL & CO., INC.

YONKERS 2, NEW YORK

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

*First in Toroid
and Related
Networks*

PARTIAL LISTING OF MINIATURE TELEMETERING BAND PASS FILTERS								
Channel Freq.	15% Band Width	30% Band Width	Case Size			Approx. Weight	Attenuation	
			Type No.	Type No.	W. L. H.		15% B. W.	30% B. W.
400 CPS.	S-15456		2 x 6 x 2 3/4			3 lb.	40dB - 15%	40dB - 30%
560 "	S-15457	S-15477					20dB - 23%	20dB - 46%
730 "	S-15458	S-15478					40dB - 27%	40dB - 54%
960 "	S-15459							
1300 "	S-15460		1 3/8 x 4 1/2 x 2 1/4			1 lb. 7 oz.	3.5DB - 15%	3.5DB - 30%
1700 "	S-15461						20DB - 23%	20DB - 46%
2300 "	S-15462						40DB - 27%	40DB - 54%
2570 "	S-15463		1 3/8 x 3 x 2 1/4			9 3/4 oz.		
3000 "	S-15464							
3900 "	S-15465	S-15479						
4500 "	S-15466							
5400 "	S-15467	S-15480						
7350 "	S-15468	S-15481						
10500 "	S-15469	S-15482						
12300 "	S-15470	S-						
14500 "	S-15471	S-15483						
22000 "	S-15472	S-15484						
27000 "		S-15485						
30000 "	S-15473	S-15486						
40000 "	S-15474	S-15487						
52500 "	S-15475							
70000 "	S-15476	S-15488						
OPTIMUM OPERATING IMPEDANCES				SOCKET TERMINAL CONNECTIONS				
INPUT				OUTPUT				
Terminals 1 & 2 500 ohms				Terminals 1 & 6 500 ohms				
Terminals 1 & 3 10000 ohms				Terminals 1 & 7 50000 ohms				

FOR HIGH RELIABILITY



THE NEWEST in G.E.'s wide germanium rectifier line is the 1N315. Specifically designed for *high* operating temperatures—up to 85°C.—and for *low* reverse current. (Note: The 1N315A *exceptionally* low-leakage design is also available.) Ideal for use in magnetic amplifiers or other circuits where low-leakage current is important. Write today for details. *General Electric Company, Section X7435, Germanium Products, Electronics Park, Syracuse, N.Y.*

Production quantities are now available!

Automatic Studio . . . The possibility of operating unattended broadcasting studios is offered by a newly developed programming system. It can supply more than 10hr of material for a broadcasting schedule without human assistance.

Basically the system consists of two electronically interlocked tape playback units, one capable of playing eight hours of recorded material from a single tape, and the other, up to four hours. The first tape carries program material, either from the studio's library or from a network or commercial transcription service. Spot announcements, local programs, and station breaks are recorded daily in the station's own studio and recorded on the second machine. After each segment of program material and after each local announcement, a subaudible tone is recorded. At the end of a program segment, an electronic device is actuated by this tone and starts the announcement machine.

After the announcement another tone starts the program. This see-saw action continues until, at each half-hour, a timing device corrects for any slight time deviation in the system and inserts a station break.

Developed by Ampex Corp., 934 Charter St., Redwood City, Calif., the system was tested successfully for six weeks by station KEEN, San Jose, Calif.

The system offers many advantages to the station operator. For example, the duty announcer could devote himself solely to the preparation of newcasts without interrupting his train of thought whenever an announcement has to be made. In addition, the voices of two or three announcers could be used to add variety without all of the announcers having to be in the studio at the same time.

Electronic Germ Counter . . . An electronic instrument that measures and counts microscopic airborne germs, dust, and moisture particles has been developed. It is capable of counting and measuring radioactive particles. The device can be used by public health officials in studying air pollution as well as by the military.

Known as the "aerosoloscope", the device was developed by Nelson E. Alexander, an Army Chemical Corps engineer, at Camp Detrick, Md. Airborne particles ranging in size from one micron (forty millionths of an inch) to 64 microns are counted and measured by the instrument many times faster than by the ordinary method of collecting them in a medium or on a suitable surface and then examining them under a microscope.

The instrument successfully eliminates many of the inaccuracies caused by particle insta-



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

ELECTRONIC DESIGN • March 1955

AT HIGH TEMPERATURES...

NEW G-E GERMANIUM JUNCTION RECTIFIER

SPECIFICATIONS FOR 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 Drop	.48	.46	.44	V
Continuous Reverse Working Voltage	150	100	50	V
Minimum Forward to Reverse Current Ratio (Average Forward/Average Reverse at Full Load)	2000	800	500	
Maximum Operating Frequency (70% Rectification Efficiency)	50	50	50	KC
Storage Temperature	95	95	95	°C

● Tell your secretary to mark the calendar now. See the G-E Germanium Products Exhibit at I.R.E. Convention, Booths 192 and 194 at Kingsbridge Armory, N.Y.C. March 21st to 24th.

MARCH						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		



Progress Is Our Most Important Product

GENERAL ELECTRIC

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

bility, evaporation, agglomeration, and mechanical distortion in counting with a microscope.

The basic principle of the aerosoloscope is relatively simple. It is based on the phenomenon that dust particles seen in a shaft of light are in fact only reflections of the particles themselves. As airborne particles in concentrations of up to 15,000 per milliliter pass through the instrument they are diluted and their flow rate is controlled in such a way that each one is individually illuminated.

The reflection caused by the illumination is detected by a photomultiplier tube. Since large particles reflect more light than small ones, the device can determine the size of each particle. The counts for the various sizes are noted on different dials. This instrument represents a significant electronic advance over tedious and less accurate hand methods.

Electronic Refrigerator . . . Based on the well-known "Peltier" effect, an experimental electronic refrigerator has been developed. More than 120 years ago the French scientist Jean Charles Peltier discovered that an electric current passed through a junction of two dissimilar metals produces a cooling or heating effect in the region of the junction depending on the direction of the current. The electronic refrigerator utilizes banks of closely mounted thermocouples with junctions which are made of specially developed alloys.

The heat is carried away from the junctions by tap water. At present the cooling water is disposed of, but continued research is pointed towards a closed recirculating system. The refrigerator has no moving parts. As a result it is noiseless. It was developed at the RCA Laboratories, Radio Corporation of America, Princeton, N. J.

Investigations of cooling by the Peltier effect are not new. Prior to the development of this refrigerator, a temperature drop of 9°C had been achieved. The materials used in the new device produce a temperature drop that is several times greater.

Cathode-Ray Tube Record . . . Nearly ten million cathode-ray tubes were sold by manufacturers during 1954 for a new sales record, according to the Radio-Electronics-Television Manufacturers Association, 777 14th St., N. W., Washington 5, D. C. This number represents a small increase over the total for 1953. Receiving tube sales dropped from 437,091,555 in 1953 to 385,089,458 in 1954.

Here is the original miracle upon which all wireless telephony is founded... Lee de Forest's Audion tube.

Today of course it has been improved a thousand-fold...in sensitivity, in power, in range. But this one still stands as the granddaddy of them all.

And what has this to do with Driver-Harris? Simply this:

The improvements on the Audion have come about through the combined efforts of thousands of devoted physicists, metallurgists, and engineers, whose increasing skills have in turn been made possible by the production of ever more effective radio alloys. Since the very beginnings of radio, the Driver-Harris metallurgists have led the way in developing these special purpose alloys conforming to rigid specifications, upon which the performance of electron tubes so largely depends.

With the result that today Driver-Harris sells annually more tons of radio alloys to the makers of electron tubes than does any other supplier.

Driver-Harris makes alloys for every electronic tube requirement: for grids, plates, side rods, glass seals, cathode sleeves and tabs, socket prongs, mica straps. We offer over 80 electrical heat- and corrosion-resistant alloys for various electrical and electronic applications.

If the alloy you need hasn't already been developed, send us your specifications. Our engineers with 48 years of experience are at your service.

The Audion electron tube, invented by Lee de Forest in 1906

SOME PROMINENT DRIVER-HARRIS RADIO ALLOYS: Nichrome* • Gridnic* • Nickel "A", "D", "E", "Z", 330, 499, 599 • Therlo* • 152 Alloy • 142 Alloy • 146 Alloy

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

Driver-Harris Company HARRISON, NEW JERSEY

BRANCHES: Chicago, Detroit, Cleveland, Louisville, Los Angeles, San Francisco

In Canada: The B. GREENING WIRE COMPANY, Ltd., Hamilton, Ontario.

"SEE US AT BOOTH 607 RADIO ENGINEERING SHOW"

MAKERS OF THE MOST COMPLETE LINE OF ELECTRIC HEATING, RESISTANCE, AND ELECTRONIC ALLOYS IN THE WORLD
CIRCLE ED-10 ON READER-SERVICE CARD FOR MORE INFORMATION



This Bell Telephone Laboratories engineer is testing various long-distance waveguides to determine the optimum diameter.

Long-Distance Waveguide . . . Experiments are being conducted in long-distance telephone transmission over waveguides at 50,000Mc. It is believed that the new method will be able to carry tens of thousands of telephone conversations and hundreds of TV broadcasts simultaneously. Present co-axial cables carry 1800 telephone conversations each.

The experiments are being carried out at the Bell Telephone Laboratories, Holmdel, N. J. Waveguides of solid metal tubing have been in telephone service for some time for short distances. It would be possible to use these solid tubes for long distances if they were perfectly straight. The new long-distance waveguide is constructed of thin copper wire, very tightly coiled—like a spring under pressure—and wrapped inside a flexible outer coating that holds the coiled wire in place. This type need not be straight and can actually carry signals around corners. Both the solid-tube and coiled-wire waveguide can be used together in one transmission line.

New Lightning Theory . . . A new theory to explain lightning has been proposed. The theory, advanced by Dr. Bernard Vonnegut, physicist, of Arthur D. Little, Inc., 30 Memorial Drive, Cambridge, Mass., is not dependent on precipitation and states that electrification occurs long before precipitation.

According to the theory, the air in the lower atmosphere near the earth's surface, which carries a positive charge, rises with strong updrafts to upper levels to form positively charged clouds. Fast negative ions from the upper atmosphere are attracted to the surface of a positively charged cloud and attach themselves to the cloud particles and become changed into ions of low mobility. These negatively

charged
lower part
ous process
is accumu

When
large it c
points on
become a
the air a
into ions
carried u
updrafts
tually en
of the clo

Portable
recording
up audib
"Walkie-
comes equ
models c
one time.

Unlike
(ED, No
produced
record on
Like con
records b
bands sir
factured
New Yor
models w
respective
9 lb each
and one

Sole
producers
of world-famous
Nichrome



charged particles are swept by downdrafts to the lower part of the cloud. This movement is a continuous process, and after a time a strong negative charge is accumulated in the lower part of the cloud.

When this negative charge becomes sufficiently large it causes a discharge of fast positive ions from points on the earth's surface. These positive ions become attached to fine particles, always present in the air at low levels, and are thereby transformed into ions of low mobility. These positive ions are then carried up into the upper portion of the cloud by updrafts in a repetition of the earlier process. Eventually enough charge is accumulated in the lower part of the cloud to produce lightning.

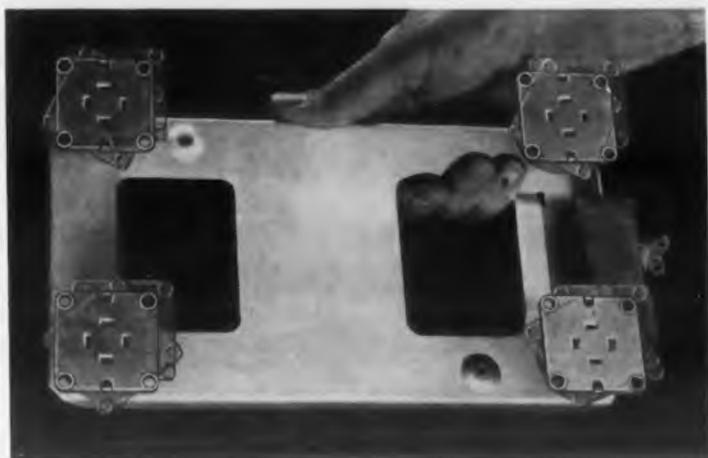
Portable Recorder . . . A newly developed portable recording device has a sensitive microphone that picks up audible speech up to 60' away. Known as the "Walkie-Recordall", the recorder, illustrated below, comes equipped with a carrying briefcase. The larger models can record continuously for up to 4hr at one time.

Unlike most other portable recorders on the market (*ED*, November, 1954, pp. 34-35), the recordings produced are permanent. Other small recorders record on magnetic tape or wire, which can be erased. Like conventional recording equipment, this unit records by means of a stylus—on endless safety film bands similar to those in dictation machines. Manufactured by Miles Reproducer Co., 812 Broadway, New York 3, N. Y., it is available in two series of models with total recording capacities of 3 and 8hr, respectively. The smaller-series models weigh about 9 lb each. They are powered by 6 flashlight batteries and one "B" battery.



PLAIN FACTS ABOUT VIBRATION AND SHOCK MOUNTINGS

FOR AIRBORNE ELECTRONIC EQUIPMENT

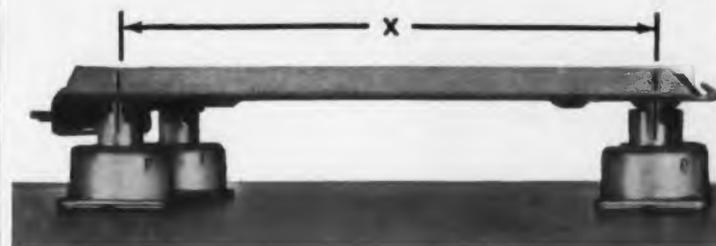


OUT-DATED UNIT MOUNT BASE

16 mounting holes and 16 bolts required.

Unit mountings may be improperly attached to the rack, and are very likely to be seriously misaligned during attachment to aircraft or missile structure.

Even minor discrepancies in spacing and attachment of unit mounts can defeat the whole purpose of the mounting base, and result in poor performance and deterioration of equipment.



Excessive height required. Unit mount bulk imposes reduced spacing (X) between support centers, resulting in impaired stability (critical in lateral direction). Greater sway space required.

Well Designed Electronic Equipment, If Poorly Mounted, Too Often Operates Inefficiently and Unreliably

Failure also can result from use of inadequate mountings which are not engineered for the particular equipment and purpose. Conventional shock mounts or so called "isolators", reasonably effective when installed under ideal laboratory conditions, become dangerous trouble makers when installed by usual production line methods.

Attachment of a base plate to unit mounts to achieve spacing control is a makeshift arrangement resulting in excessive weight with no height reduction.

Failure also can result from obsolescent unit mounts employing internal rubber, organic or synthetic materials which deteriorate rapidly and are susceptible to temperature and environmental changes.

The importance of today's electronic equipment surely justifies the use of integrated mounting systems designed to meet specific problems rather than the unreliable application of assembled "catalogue" mounts.

USE OF ROBINSON ENGINEERED MOUNTING SYSTEMS results in:

- A. Reliable and uniform performance in every installation under all types of environmental conditions.
- B. Reduced cost through "de"ruggedization of equipment — substantial reduction of size and weight is possible by simplified and compact design.
- C. Simplified installation — only four attachment holes required—pre-spaced to save time and assure accuracy.

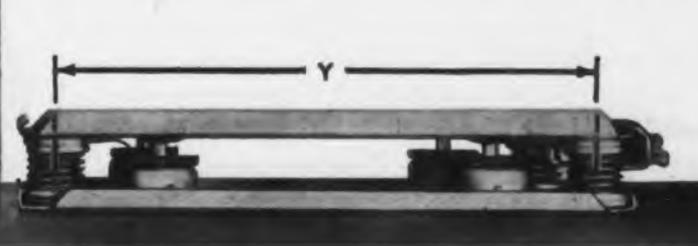


TODAY'S ENGINEERED MOUNTING SYSTEM

Only 4 mounting holes required.

Prespaced holes in a one piece base plate assure quick, accurate attachment. Relationship of all 4 holes is definitely fixed (holes spaced for interchangeability with unit mounts).

No installation errors or misalignment can occur to disturb the precise performance of the mounting system as checked and approved on acceptance tests.



Note reduction in mounting height. Important space saved. Maximum spacing (Y) of resilient elements at extreme corners provides stability. Less sway space required.

Robinson All-Metal Engineered Mounting Systems Assure Outstanding Performance and Reliability of Equipment

The Robinson concept of vibration and shock control is the design and application of 100% all-metal mounting systems. Engineered with careful understanding of the equipment to be protected and performance expected, Robinson mounting systems come to you completely manufactured, ready to receive the electronic equipment or instrument.

The integration of these mounting systems into the electronic equipment of aircraft and missiles results in reduction of elapsed design time and basic development cost.

Robinson Mountings utilize, as main resilient elements, metal wire cushions (MET-L-FLEX), exclusive with Robinson. This construction has been thoroughly proven by years of use in nearly all military and commercial aircraft.

Some other important characteristics of Robinson Mountings: inherent high damping, non-linear spring rate, performance unaffected by grease, oil, water, dust, extreme temperatures or environmental changes.

For full information about this new concept of vibration and shock control, write or wire today.



West Coast Engineering Office:
3006 Wilshire Boulevard, Santa Monica, California

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

Light Amplifier . . . Another light amplifier has been developed closely following the announcement of an earlier light amplifier (*ED*, January, 1955, p. 5). The newer unit amplifies light more than 20 times.

The amplifier consists of two layers of light-sensitive and electroluminescent materials, respectively, sandwiched between transparent electrodes. An alternating current is applied across the electrodes. A projected light or image striking the light-sensitive layer causes current to flow through the electro-luminescent layer. The latter layer then emits light in a pattern corresponding to that of the original light or image. The emitted light intensity can be increased by increasing the alternating voltage.

The light amplifier was produced at the RCA Laboratories, Radio Corporation of America, Princeton, N. J. The scientists who developed the amplifier believe that the device must amplify light at least 100 times before it has any practical applications. It points towards "mural" television picture tubes.

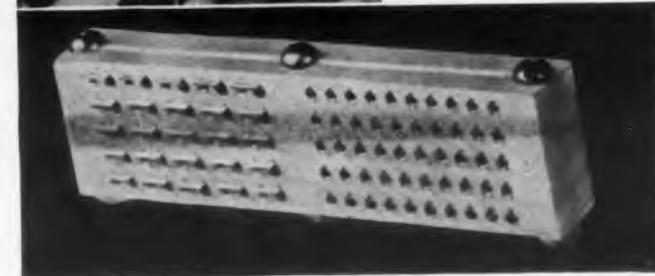
Speed of Light Checked . . . Confirmation for the higher values of electromagnetic wave velocity that have been consistently obtained by microwave measurements since World War II is one of the results of two new determinations of the speed of light. Although carried out independently by widely different methods, the two determinations give precise values that are in close agreement.

In one method, the velocity of light was determined from measurement of the molecular constants of carbon monoxide by infrared spectroscopy. This work was carried out in the National Bureau of Standard's Washington, D. C. laboratories by E. K. Plyler, L. R. Blaine, and W. S. Connor of the Bureau's staff. The other determination made use of phase-shift measurements on VHF radio waves to obtain their velocity of propagation. These measurements were made with a radio interferometer by E. F. Florman of the NBS Boulder, Colo., Laboratories, on a dry lake bed in southeastern Arizona. The Bureau's statistical engineering laboratory cooperated with both groups in analyzing the resulting data, and the Bureau's high-speed computer, SEAC, aided the work.

In the period preceding World War II, the value of $299,776 \pm 4$ km per sec was generally accepted as an average of the findings of the various laboratories. However, since the war, higher values have been obtained by most investigators, largely through measurement of the velocity of propagation of microwaves. Consideration of this more recent work has led to



AMP
Taper Pins
for wire sizes
26 to 16



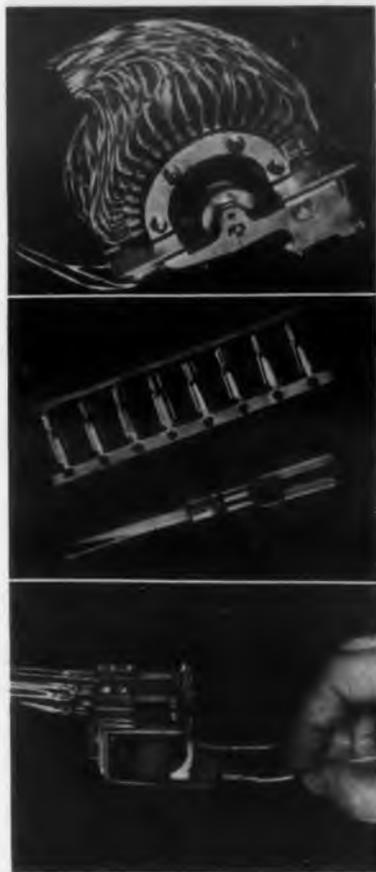
less cube
WITH ADDED

Another example of AMP's Creative Approach to Better Wiring

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

ELECTRONIC DESIGN • March 1955

AMP
Taper Tab receptacles
for wire
sizes 26 to 18



and cost
RELIABILITY

Cubic restrictions have brought about a whole new concept of wire termination. The AMP Taper Technique with AMP taper pins, tab receptacles, blocks and modified miniature components will help you take full advantage of small wire, small insulation and small space for your wire terminations.

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



*You are cordially invited
to visit the AMP booth
at the J. R. E. show.
Booths 770 and 772*

Send today for your copy of
our brochure, AMP's Creative
Approach to Better Wiring.



AIRCRAFT-MARINE PRODUCTS, INC., 2100 Paxton Street, Harrisburg, Pa.
In Canada: AIRCRAFT-MARINE PRODUCTS OF CANADA, LTD., 1764 Avenue Road, Toronto 12, Ontario, Canada

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

an average value of 299, 793 \pm 1km per sec. The results obtained by the Bureau give 299,792 \pm 6km per sec by the molecular constants method and 299,795.1 \pm 3.1km per sec by the radio interferometer.

The molecular constants method was originally suggested by Dr. A. E. Douglas of Ottawa, Canada. As applied at the Bureau it involved measurement of the frequencies not only of lines in the infrared absorption spectrum of carbon monoxide but also of infrared emission spectral lines obtained when CO is produced in the flame of a burning gas. Spectral lines corresponding to the rotational states only of the excited CO molecule were already available from microwave spectroscopy.

Rapid-Access Computer . . . Data can be entered or removed from a newly developed computer by a single operation. The unit can process simultaneously several unrelated types of transactions such as inventory control, payroll, and cost distribution.

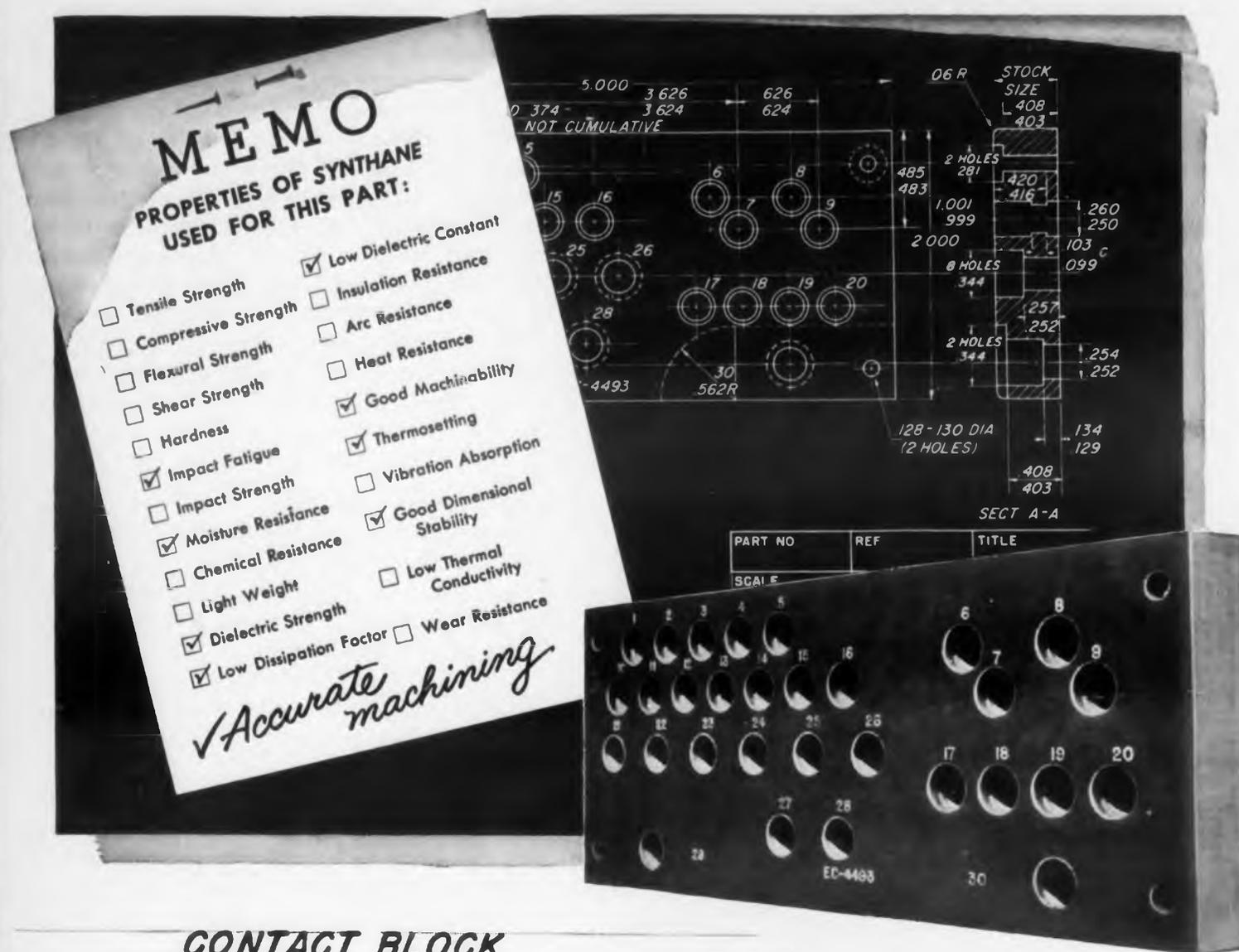
Various types of input media, paper or magnetic tape, punched cards, and key devices, may be used. Known as the "Univac File-Computer", it does not require sorting, merging, collating, reproducing, or pulling cards from a tub file before the processing can begin, and does away with the necessity for waiting until an economic batch of data has been accumulated. The computer is manufactured by Remington Rand Inc. 315 Fourth Ave., New York 10, N. Y.

In an eight-hour day, up to 100,000 unsorted items can be entered in the device in their order of arrival, each matched automatically with its related file data, and processed as needed to finish several record-keeping tasks in a single program.

TV-Movie Camera . . . A combination television and motion-picture camera is under development. The camera is basically a conventional motion-picture camera with a small TV camera mounted alongside. The combination could be used to record film versions of live TV shows and to aid motion-picture directors in the production of movies.

The combination camera is being developed by Allen B. Du Mont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N. J. Dr. Du Mont believes that the camera will greatly reduce motion-picture production costs. By means of these cameras, a director can sit at a central monitoring location and select among the outputs of several cameras in much the same manner that TV directors direct live shows now.

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.

Name _____

Title _____

Company _____

Address _____

City _____ Zone _____ State _____

SYNTHANE
LAMINATED **S** PLASTICS

SYNTHANE CORPORATION • OAKS, PENNSYLVANIA

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



Aeronautical engineers can solve their design problems on this Aerolog analog computer without special training in programming.

Simplified Computer Programming . . . Aeronautical engineers can directly solve design problems on a newly developed analog computer without the need for programming specialists or mathematicians. All inputs are in forms familiar to aeronautical engineers. Of course, the computer couldn't be used for any other application.

Known as the "Aerolog", the instrument is made by Link Aviation, Inc., Binghamton, N. Y. Rescaling is automatic. It is significant that the market for computers has grown to the extent that specialized machines can be produced.

Spiral Scanning . . . Spiral scanning has been adapted for use in industrial TV equipment in France, according to the January, 1955, issue of *Wireless World* (p. 2), a British publication. The scanning waveform is a 15kc sine wave modulated by a 50cy sawtooth.

One such signal is applied to the horizontal deflection coils of the camera tube and the receiving tube, and another signal 90° out of phase, is applied to the vertical deflection coils. Each tooth of the sawtooth waveform encloses 300 cycles of the carrier. This means that one complete sweep of the spiral.

Have you returned your subscription renewal and qualification form?

See Page 100

from the center of the tube out, involves 300 revolutions of the spot. If the tube face is bisected by an imaginary line, this gives the equivalent of 600 lines in the conventional rectangular raster.

The two components of the scanning waveform have to be kept in very strict phase and frequency relationship. Therefore, the 50cy sawtooth is produced by frequency dividing from the 50kc signal source. In addition it is necessary to apply a sawtooth brightness correction waveform to compensate for the lower tracking speed of the spot in the center. The picture has better resolution in the center, which may be an advantage in some applications.

The equipment is produced by Laboratories Derveaux. The circular picture is unsuitable for broadcast, but not so for industrial use.

Long-Distance Data Processing . . . By means of electronic data-transmitting networks, two expensive computers will never be out of work. The General Electric Co. has already installed such a network between plants to feed data to an IBM 701 computer at its Aircraft Gas Turbine Div. plant, Evendale, Ohio. Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y., will establish a network to feed into a Remington-Rand Univac.

In addition to speeding engineering and research problems to the Evendale computer, the GE network extends to International Business Machines Corp. own 701 computer at 590 Madison Ave., New York City, where GE rents the computer for 8 hours daily. IBM Electronic Data Transceivers (*ED, Sept. '54, p. 8*) convert information on punched cards into electrical signals at one plant and punch new cards at the computer. Plants at Lynn, Mass., and Schenectady, N. Y., are included in the network. Where the problem is not urgent, the original cards can be mailed to the computing center.

The Sylvania data-transmitting network will connect this firm's 45 plants and 12 laboratories all over the nation to a centrally located Data Processing Center, which should start operating in about a year. When in full production, the center will handle all of this firm's production and financial record processing and keeping, and it is expected to employ about 300 persons.

Correction

An omission was inadvertently made in the tabulation of tube complements in the "Audio Goes Flat" article which appeared in the January issue on page 24.

The list of tubes in the Scott "99-A" amplifier manufactured by Herman Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass., did not include a 12AX7 voltage amplifier. The correct tube complement is: 12AX7 phono preamplifier; 12AX7 voltage amplifier; 12AU7 voltage amplifier and phono inverter; two 6V6GT power tubes; and a 5Y3 rectifier.

NEW! GLOBAR® THERMISTOR-VARISTOR TEST KITS

for evaluating your circuitry problems



These new Test Kits of GLOBAR® Ceramic Varistors and Thermistors offer the most favorable combination of properties to satisfy all circuit requirements . . . give you a most economical means of evaluating your circuitry problems—and finding the answers. Widest range of characteristics within each kit—at a minimum investment.

**ORDER
YOUR KITS
NOW...**

use this Handy Coupon

THE CARBORUNDUM COMPANY
Dept. ED 87-54, 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-14 ON READER-SERVICE CARD FOR MORE INFORMATION

KIT No. 1 PRICE \$29.25 Type F THERMISTORS

- To evaluate series filament circuit applications 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 delay in relay and solenoid circuits; stabilization of television oscillator circuitry during warm-up.

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. 3 PRICE \$20.00 Type BNR VARISTORS

- To evaluate reduction of surge voltage peaks and contact arcing; stabilizing voltage and amplifier gain.

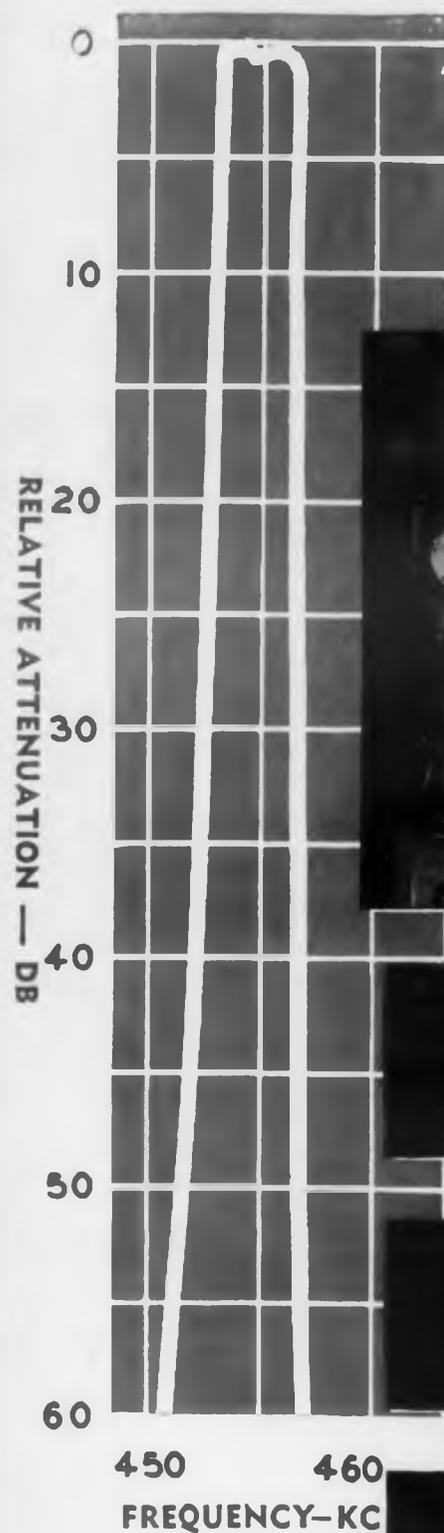
Quantity	Cat. No.	R @ Calibration Voltage	Load Watts
6	432	100000 @ 10 volts	0.25
6	479	100000 @ 100 volts	0.3
6	328	10000 @ 40 volts	0.5
6	463	24000 @ 40 volts	1.0
6	524	24000 @ 100 volts	1.5
6	430	17500 @ 175 volts	2.7

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

- A selection of smaller size thermistors and varistors for overall usage evaluation.

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	
Quantity	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. Pertinent engineering bulletins giving detailed engineering data are sent with each kit. Kits will be shipped postpaid to any point in the United States and Canada.

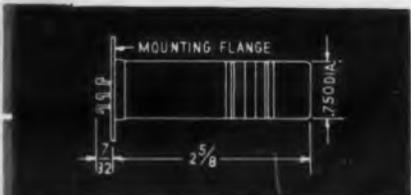


new MECHANICAL FILTER

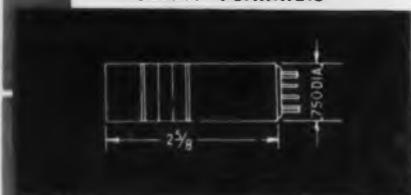
designs by *Collins*



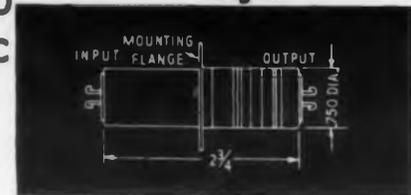
- new low insertion loss
- temperature compensated
- new compact tubular design



F455H-Series, Single-Ended Solder Terminals



F455J-Series, 9-Pin Miniature Plug-In



F455K-Series, Double-Ended Solder Terminals

COLLINS Mechanical Filters have become the byword to electronics people looking for superior selectivity characteristics, compact design, simplified circuitry and maintenance-free service in IF passband filters. Utilizing magnetostrictive principles of mechanical resonance to provide high attenuation of unwanted signals, Collins has established a wide margin of leadership maintained by an intensive research program. The important developments of this research are now available to the electronic industry.

Most significant of these new developments are the lowering of transmission loss to 10 db or less, and temperature compensation of the Filter for operation over a range of -40°C to $+85^{\circ}\text{C}$. Shape factors are now nearer to the ideal "square" curve than ever before thought possible. And a new tubular style case, permitting greater conservation of space in new equipment designs, has been developed with three options in terminal style.

In addition to producing a comprehensive line of standard Filters ranging from 250 kc to 500 kc, Collins welcomes your special filtering problems. Filters can be designed for IF frequencies from 100 kc to 500 kc, and with bandwidths from 500 cps to 15 kc.

To apply our experience to your particular problems or for further information on existing designs, contact the nearest Collins office.

Sharp selectivity characteristics, compactness of tubular design and choice of terminal style illustrated above are among top features of the new designs.

COLLINS RADIO COMPANY

Cedar Rapids, Iowa

261 Madison Ave., NEW YORK 16

1930 Hi-Line Dr., DALLAS 2

2700 W. Olive Ave., BURBANK

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



Automatic Dispatcher for Power Stations . . . A new electronic control system capable of automatically regulating the operation of power generating stations was demonstrated at the national exposition of Power and Mechanical Engineering recently. Developed by the Industrial Div., Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa., the new system uses self-correcting electronic controls to regulate a power plant's output and frequency in accordance with electrical demand changes. Similar types of equipment are in use in various cities (*ED, July, 1954, p. 12*).

Functioning much like an "automatic dispatcher", the new system achieves accurate, high-speed control through individual servo units which supervise three different methods of control. Signals characterizing load swings are telemetered to the servo units which electronically compare the signals with standard operating levels. If a discrepancy is detected, the servos initiate control action by adjusting the turbine governors to bring the system load and frequency back to normal. The individual servos are interlocked to provide cumulative control of the system. Telemetering totalizers are used in the system to tally up the power measurements.

The system has an unlimited range and can be built into new or existing power plants. It uses wire, carrier, or microwave forms of transmission. Signals to each station require only one channel.

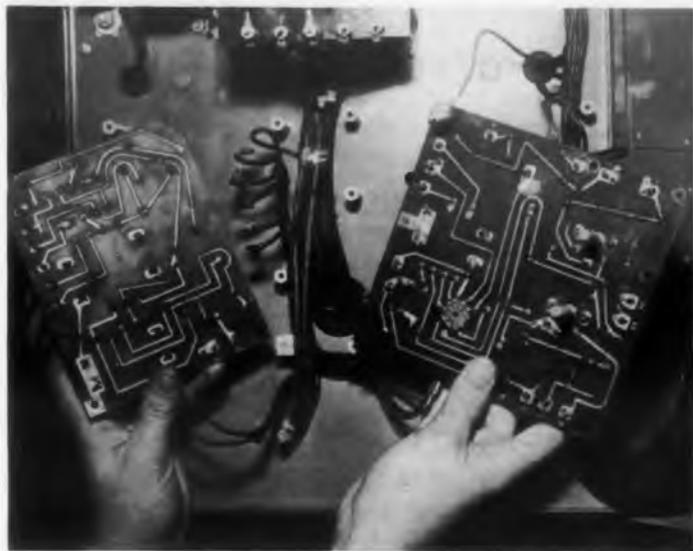
Photosensitive Paper for Computers . . . A low-cost coated paper that is so photosensitive that it can make contact prints as exposures of a fraction of a second has been developed for use in a new simplified dry photographic process known as Electrofax. The speed with which images can be photographed and printed with the new paper and technique has permitted experimental development of a mechanized system of continuous-strip reproduction that may be adapted for use with electronic computers or other devices that produce a flow of visual information.

The Electrofax process, developed by the Radio Corp. of America, David Sarnoff Research Center, Princeton, N. J., is also regarded as a practical and inexpensive method of producing master copies of and microfilm records.

Noiseless Transformer . . . A "beam of silence" may be the answer to the transformer noise problem. Cancellation of transformer noise can be accomplished by injecting an equal and opposite noise into the troublesome area, W. B. Conover and R. J. Ringlee, General Electric Co., Pittsfield, Mass., reported in a paper, "Recent Contributions to Transformer Audible Noise Control" given at the AIEE Winter General Meeting.

Recent tests have demonstrated the practicability

of projecting a beam of silence through the complex sound field that surrounds a transformer, they said. Although at the present stage of development, the beam is limited to a width of about 30°, this is sufficient to eliminate complaints in some installation. The equipment required to do this consists of from one to four loudspeakers, a source of a fraction of a watt of electrical power containing the harmonics of noise to be eliminated, and a means of adjusting the phase and amplitude of each harmonic. The cost of the equipment is a small fraction of the cost of conventional sound barriers.



Printed Motor Control

The General Electric Co., Schenectady, N. Y., has redesigned its "Thy-mo-trol" electronic adjustable speed drives by substituting printed for conventional wiring, as shown above. In addition, the circuitry was simplified by reducing the number of tubes from three to one subminiature. The unit converts alternating current to direct current for motor control.

Autopilot Launching . . . An electronic autopilot has been successfully used to control a pilot-carrying jet while it was being launched from a truck platform by rockets. The test pilot stated that the controlled launches were very satisfactory and in some respects smoother than those under his own manual control.

A standard, unmodified F-5 autopilot, manufactured by Lear, Inc., Grand Rapids, Mich., was employed. The "zero length" launching technique was developed by Glen L. Martin Co., Baltimore, Md., for the Air Force as a means of launching Matador guided missiles. The demonstration of the autopilot's ability to control the plane during the rocket launches extends the possibility of using this unconventional take-off under all weather conditions.

Let's stop *expensive* double-talk *about* Regulated Power Supplies!



WRITE FOR OUR CATALOG . . .

"A Sensible Approach to Regulated Power Supply Design". It Contains Engineering Data, Prices, And Good News About Our Fast Delivery In-Stock Plan.

NEW JERSEY ELECTRONICS CORP.

345 Carnegie Avenue, Kenilworth, New Jersey
Competent Engineering Representation Everywhere

Our custom quotes are rapid, complete, competitive. We custom-build from 500 amperes (low voltage) to 100 KV (low current).

WILL BE AT THE I.R.E. SHOW AT 234-236 INSTRUMENT AVENUE

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

**MOST REQUIREMENTS ARE
BEST SATISFIED BY A
CLEAN-CUT, STRAIGHTFORWARD,
LOW-COST, STANDARD DESIGN . . .**



NJE Standard-Grade Model S-300-R

Typical of our 32 Standard Grade models is the S-300-R (200-500 volts, 0-300 ma, 0.3% load regulation). Has no electrolytics, generous transformer design, clean layout, solid construction, all first quality commercial-grade components, fine workmanship . . . (Less Meters) **\$149.50**

Our mass-produced, standardized designs guarantee you more for your power-supply dollar than ever before. From \$52.50 to \$299.50, from 200-325V at 100 ma to 0-600V at 0-300 ma, you can't buy better, watt-for-watt and dollar-for-dollar, than NJE!

**... BUT, IF YOUR APPLICATION
REQUIRES THE MAXIMUM
IN LIFE EXPECTANCY:**



NJE Laboratory-Grade Model L-800-CM

The 32 models in our Laboratory Grade are the ultimate in dependability . . . at a sensible price. Illustrated is Model L-800-RM (0-600 volts, 0-600 ma, 0.3% load regulation) . . . (Less Meters) **\$440.00**

Our Laboratory Grade line incorporates every possible safeguard against any failure in the first five years of service: selenium power rectifiers, blower cooled 10,000 hour tubes, oil-filled capacitors, no carbon resistors or carbon pots, magnetic circuit-breakers, sealed transformers. Every component derated at least 30% . . . From 0-300V, 0-300 ma to 0-600V, 0-1200 ma. Priced—\$315.00 to \$935.00

Meetings

March 21-24: *Radio Engineering Show and IRE National Convention*, Waldorf-Astoria Hotel and Kingsbridge Armory, New York, N. Y.

March 22: *ECDA (Electronic Commercial Development Association) Spring Meeting*, New York, N. Y. For information write to J. S. Mulholland, Jr., Secretary, ELECTRONIC DESIGN, 19 E. 62nd St., New York 21, N. Y.

March 30: *Society of Technical Writers and Editors*, Hunter College, Room 910, New York, N. Y. For information, write Helen Cressman, Electronics Research Laboratories, Columbia University, New York, N. Y.

April 6-10: *World Plastics Fair and Trade Exposition*, National Guard Armory, Los Angeles, Calif.

April 12-15: *Symposium on Modern Network Synthesis*, Engineering Societies Building, New York City, N. Y. For information, write to IRE, 1 E. 79th St., New York 21, N. Y.

April 27-29: *Seventh Region Technical Conference and Trade Show*, Hotel Westward Ho, Phoenix, Ariz. Sponsored by the IRE. For information, write to A. M. Creighton, c/o Motorola, Inc., 3102 N. 56th St., Phoenix, Ariz.

April 29-30: *New England Radio-Electronics Meeting*, Sheraton Plaza Hotel, Boston, Mass. Sponsored by the Boston and Connecticut Valley Sections of the IRE. For information, write to Robert A. Waters, Robert A. Waters, Inc., 4 Gordon St., Waltham, Mass.

May 2-5: *Semiconductor Symposium*, Cincinnati, Ohio. For information, write to F. J. Biondi, Bell Telephone Laboratories, Murray Hill, N. J.

May 4-6: *International Aviation Trade Show*, 69th Regiment Armory, New York, N. Y. For information, write to Aircraft Trade Shows, Inc., Hotel McAlpin, New York 1, N. Y.

May 9-11: *National Aeronautical Electronics Conference*, Biltmore Hotel, Dayton, Ohio.

May 10-12: *Metal Powder Show and Metal Powder Association Annual Meeting*, Bellevue-Stratford Hotel, Philadelphia, Pa. For information, write to Metal Powder Association, 420 Lexington Ave., New York 17, N. Y.

GENERAL ELECTRIC ANNOUNCES

Vac-u-Sel RECTIFIERS

New Line of G-E Component Rectifiers Achieves 3 Performance Highs

- 63 VOLT PEAK INVERSE
- 130 C AMBIENT OPERATION
- 60,000 HOUR LIFE EXPECTANCY

General Electric's new line of Vac-u-Sel Component rectifiers offer greater application flexibility than any other rectifiers in history. You can now obtain a rectifier cell with a peak inverse rating of 63 volts, or a rectifier which will operate up to 130 C ambient temperature, or a rectifier which has a life expectancy of 60,000 hours.

New G-E Vac-u-Sel rectifiers now make it possible to match performance requirements for life expectancy, ambient operating temperature, and atmospheric protection, as well as electrical characteristics.

THREE NEW RECTIFIER CELLS make up the new line of Vac-u-Sel rectifiers; a 26-volt low temperature cell, a 26-volt high temperature cell, and a 45-volt high temperature cell. All three are produced by the vacuum evaporation process described at the right, but special variations in the manufacturing give them distinctly different electrical characteristics.

26-VOLT LOW TEMPERATURE CELL is the standard industrial cell, used on applications where ambient operating temperature will not exceed 55 C. Rectifiers using this cell have a life expectancy of 60,000 hours at normal current rating.

26-VOLT HIGH TEMPERATURE CELL can meet operating requirements up to 130 C at full voltage. Current need not be derated where shorter life is acceptable. Life expectancy at 130 C is 1000 hours.

45-VOLT HIGH TEMPERATURE CELL has a 63-volt peak inverse voltage. Unlike most 45-volt rectifiers, this is a true, long-life industrial cell. Frequently this rectifier may be substituted for ones employing 26-volt cells. Since fewer cells are required, savings of up to 30% in cost, and up to 35% in the size of the stacks are possible. Life expectancy of this 45-volt cell is 40,000 hours, and the cells 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 their margin of superiority in these characteristics increases in service. All Vac-u-Sel rectifiers undergo extensive testing and grading, and matched cells are used in assembling stacks. A variety of finishes and mounting arrangements are available to meet virtually any requirements.

MORE INFORMATION on these new Vac-u-Sel rectifiers is available from your nearest General Electric Apparatus Sales Office, or by writing Section 461-36, General Electric Co., Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

RECTIFIER DEPARTMENT

METALLIC RECTIFIER COMPONENTS FOR PRACTICALLY EVERY DC REQUIREMENT



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

ELECTRONIC DESIGN • March 1955

WHAT IS VAC-U-SEL?

Vac-u-Sel is the General Electric trademark for a new line of metallic component rectifiers with exceptional electrical characteristics. The name Vac-u-Sel is used because these new rectifiers are produced by a vacuum evaporation process.

WHAT IS THE VAC-U-SEL PROCESS?

In the Vac-u-Sel process, cells are loaded on the inside of a sphere and a vacuum of over one-millionth of an atmosphere is drawn on the sphere. Selenium is then evaporated inside the sphere onto the rectifier plates.

WHY USE A VACUUM?

The vacuum permits greatest control over contaminants which affect the quality of the finished rectifier. There are more than 100 variables involved in making selenium rectifiers.

WHY IS THIS PROCESS BETTER?

Vacuum evaporation provides greater uniformity between individual cells and stacks. It produces a more even deposition over the entire surface of each cell, eliminating cracks and thin spots. The electrical characteristics of a rectifier are highly dependent on the thickness of the deposit, and vacuum evaporation permits greater accuracy in controlling this thickness. In addition, it fosters better crystalline orientation, allowing natural rather than pressed formation.

ARE VAC-U-SEL RECTIFIERS BETTER?

The electrical characteristics of new General Electric Vac-u-Sel rectifiers are greatly superior to ordinary commercial selenium rectifiers. Full details of Vac-u-Sel rectifier performance are given on opposite page.



GENERAL  ELECTRIC

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

May 16-19: *Electronics Parts Distributor Show*, Conrad Hilton Hotel, Chicago, Ill. For information, write to S. I. Neiman, 1 N. La Salle, Chicago 2, Ill.

May 18-20: *National Telemetering Conference*, Hotel Morrison, Chicago, Ill. For information, write to IRE, 1 E. 79th St., New York 21, N. Y.

May 19-21: *Global Communications Conference*, Hotel Commodore, New York, N. Y. Sponsored by the Armed Forces Communication Association.

May 23-25: *Ninth Annual Convention of the American Society for Quality Control*, Hotels Statler and New Yorker, New York, N. Y. For information, write to W. E. Gaunt, E. R. Squibb and Sons, New Brunswick, N. J.

May 26-27: *Electronic Components Conference*, Ambassador Hotel, Los Angeles, Calif. Abstracts of papers and requests for information should be addressed to Dr. Lester M. Field, 8820 Bellanca St., Los Angeles, Calif.

May 31-June 3: *Basic Materials Exposition*, Convention Hall, Philadelphia, Pa. For information, write to Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

May 31: *Symposium on Elementary Particles*, Pisa, Italy. Sponsored by the International Union of Pure and Applied Physics. For information, write to Dr. H. A. Barton, Secretary, U. S. National Committee, International Union of Pure and Applied Physics, 57 E. 55th St., New York 22, N. Y.

June 14-16: *Conference and Exhibit on Magnetism*, William Penn Hotel, Pittsburgh, Pa. Sponsored by the AIME, American Institute of Mining and Metallurgical Engineers, and American Physical Society.

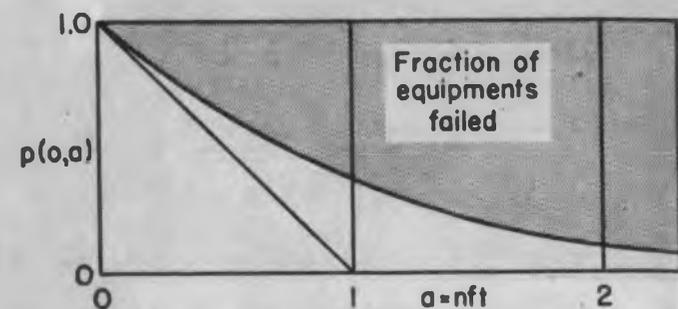
June 20-25: *International Symposium on Electromagnetic Wave Theory*, Univ. of Michigan, Ann Arbor, Mich. Sponsored by Commission VI of URSI. For information, write to J. W. Crispin, Jr., Univ. of Michigan, Ann Arbor, Mich.

June 27-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.

September 12-16: *10th Annual Instrument Conference*, Shrine Exposition Hall, Los Angeles, Calif. For information, write to Fred Tabery, Exhibit Manager, 3443 S. Hill St., Los Angeles, Calif.

Designing Reliable Transistor Circuits—I

by Norman B. Saunder
Circuit Engineering Consultant
Weston, Mass.



Probable fraction of
equipment failure.

THE USEABLE life span of transistors depends largely on the wisdom of the circuit designer. To achieve reliability for a suitable period of time, the designer should be familiar with solid state physics theory and transistor construction so that he can evaluate transistor behavior. It is particularly important to be aware of surface phenomena such as hysteresis, creep, increase in I_{co} , contact cleanliness, and so on as these factors affect the useable life of a transistor. The transfer characteristics of the semiconductor body itself do not appear to change.

This article (and Part 2 to be published in a succeeding issue) reports on the author's observations as well as what has been previously published on transistor variations (see bibliography). A number of solutions to transistor instabilities that may be encountered are suggested. At present, not enough is known about any particular circuit to make categorical recommendations.

Reliability of an element, such as a transistor, is described by its normalized or fractional failure rate. The probable fraction of equipment failures, $p(0,a)$, for the first few element failures, is determined approximately from the expectation of element failures, a . The value, a , is the product of the number of elements used, their failure rate (e.g., 0.0002 per hr.), and time elapsed. To minimize these failures, it is essential to allow sufficient time for development and evaluation, and testing including simulated full-scale field trials.

The objective for military and computer circuits of one failure in a circuit per thousand used per year of operation can probably be obtained by using 5v on the collectors and allowing for collector cut-off currents up to 1 milliampere, collector resistances down to 10 kilohms, and alphas between 0.85 and 1.05. For a consumer radio, an objective of one failure per six transistors used per five years of opera-

tion may be adequate and hence the derating need not be so stringent.

Characteristics of the Transistor

Words used to describe transistors take on different meanings depending on whether you take the viewpoint of a transistor manufacturer or a circuit designer. This article looks at transistors from the viewpoint of a designer and transistor characteristics that are under the control of the manufacturer and beyond the control of the user such as r_b , r_e , and alpha are called coefficients or constants. Bias conditions and operating frequencies are under the control of the designer and are more precisely referred to as parameters. But, of course, once the operating point and frequency has been set, these factors become simply coefficients.

Considering the transistor as a physical device, it has a body and an exterior. The properties of the body are determined by the pure semi-conducting crystals and added impurities, donors and acceptors. The exterior of the transistor includes leads and protective coatings. The physicist may view the transistor in terms of widths, areas, conductivities, etc. The circuit engineer can use all of these viewpoints to give structure and solidity to his concept of the device.⁸

Generally, the characteristics of the body are stable; r_e , r_b , alpha, c_c , f_{alpha} , and I_s do not change. The less stable characteristics can be attributed to the exterior surface.⁹ These in order of decreasing⁸ importance are: an excess of noise; too large a collector cut-off current, $I_{co}-I_s$; an excessive collector conductance, $1/r_c$ (the real or low frequency portion of h_{22}); and rounding of the Townsend breakdown voltage. The constant reverse diode voltage of breakdown or seemingly limitless current increase over I_{co} is often

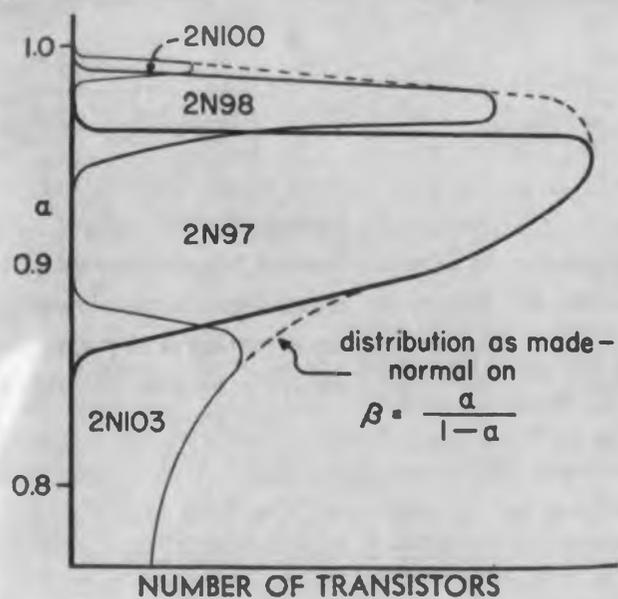
called the Zener voltage. In this paper, the phenomena will be called the Townsend voltage because, it is believed to occur as a result of a Townsend avalanche type of breakdown. The total influence of the surface is too complicated^{4,9} to treat here, but a poor surface may also be detrimental to the base resistance, r_b ; collector capacitance, c_c ; and other coefficients.

The manufacturers' power rating is based primarily upon junction temperature and the dissipation constant, a typical value being one half milliwatt per degree Centigrade. The permissible junction temperature depends upon such things as the mechanical rigidity of the lead connections and the temperature at which alpha exceeds one.

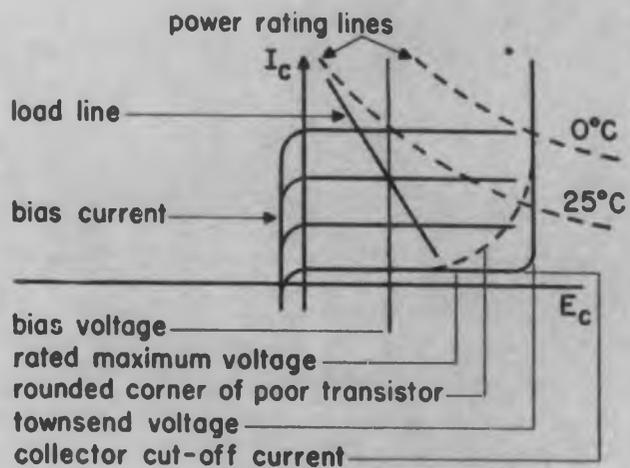
Considering the transistor as an electrical entity, it may be characterized by its large signal coefficients and its small signal coefficients⁸. The large signal coefficients show the basically exponential and reciprocal characteristics of the transistor and are used for d-c and bias considerations, while the small signal coefficients show its active character. These coefficients may be of impedance, admittance, general circuit, or hybrid form; the latter being the easiest to measure. The author feels it is easier to design an individual stage using hybrid coefficients. Transformations between forms and within a form are possible by considering any terminal common to the input and output circuits⁸.

Expected Transistor Variations

Most transistors in the past varied from one another. Alloy transistors are perhaps most affected by surface changes. In the grown junction transistors the surface phenomena show up as a floating potential or channel. The problems seem to be overcome in the devices being produced today. Hermetic sealing is an important step toward removing the surface



Grouping of transistor coefficients determine type number.



Collector current versus collector voltage.

$$W_{c \max} = \frac{T_j - T_a}{g}$$

- $W_{c \max}$ = maximum permissible power input
 T_j = junction temperature
 T_a = ambient temperature
 g = thermal conductance

$$W_c = (I_b + I_{co}) \left(\frac{\alpha}{1-\alpha} \right) V_c$$

- W_c = power input to collector
 α = forward current ratio (h_{21})
 I_b = base current applied
 I_{co} = collector cut-off current
 V_c = collector bias voltage

difficulties. However, the problem of cleanliness within the seal may still be with us. On the other hand, plastic encapsulated transistors are suitable for certain applications. The rate grown transistors, to date, have either a low alpha or an alpha cut-off frequency between that of the alloy and the more common grown junction type. Point contact transistors have had a low gain, high noise, and high power drain. In a short time we should have intrinsic transistors, probably of the compensated variety, which, in addition to a potentially high frequency of alpha cut-off, may not suffer from alpha runaway^{1, 5}.

The data on variations from transistor to transistor within one given type number are meager. In general, the distribution of coefficients of mass-manufactured transistors seems to be roughly normal. The characteristics usually show a truncation of the current amplification factor, due to selection and sorting into different grades. Similarly, other constants may also show this truncation. Transistors having the same type number but made by different manufacturers often are not equivalent. On the other hand, there are several makes having different type numbers which are directly interchangeable. That is, transistors of the same basic type may have characteristics so similar that if the lots were mixed they could not possibly be separated by electrical characteristics alone.

The complete variation of the transistor coefficients with frequency is quite complicated⁴. Even a simplified and relatively clear exposition is heavy reading and is beyond the scope of this article.

The properties of the transistor vary with its environment. Moisture in the environment is not important with hermetically sealed units. With plastic encapsulation the relative humidity may determine the equilibrium water concentration within the plastic but the absolute humidity determines the driving

potential for moisture penetration and the temperature determines the rate of penetration³. Thermal shock, such as plunging a grown n-p-n at room temperature into a bath of dry ice, may damage the transistor¹. (3). High temperature will melt one or more of the leads off, though fracture may occur first.

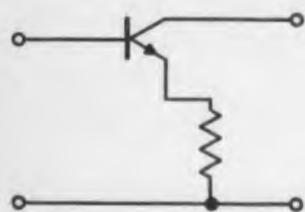
The temperature of the body of the transistor determines the electrical properties to a very large degree. All of its properties are affected. "It does not matter as a first order effect whether the temperature is ambient or created by dissipation. There is little doubt that in applications critical to noise or cut-off current, reliability begins to fall off at 50°C and is serious at 65°C. However, if a circuit is well stabilized for the effect of cut-off current, is well degenerated or non-critical for gain and can tolerate noise factors of 25db, then reliable operation of the 2% order can be achieved at 65°C."⁸ Of course, new developments may decrease the effect of temperature. This article treats, primarily, the effect of temperature on alpha and collector conductance changes and the increase of collector cut-off current.

The variation of a transistor's properties with life may be slow, abrupt, or may die out. Those characteristics coming from the body of the semi-conductor, such as its forward transfer characteristics, including hole storage, tend to remain the same over the full life while, as mentioned earlier, surface phenomena such as hysteresis, creep, increase of I_{co} , and decrease of the collector resistance, r_c , may occur slowly with life. This is probably caused by moisture or other ions affecting the surface, even in hermetically sealed units in which flux or welding fumes gradually reach and alter the surface of the transistor. An absolutely clean surface cannot be obtained so that other approaches to achieve stability are necessary. Within the germanium itself, at less than 200°C, the deliber-

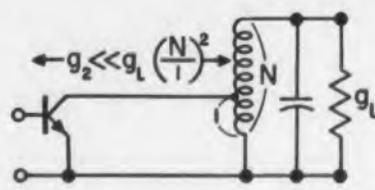
ately introduced doping agents will not move appreciably in a lifetime, thus explaining the stability of the forward phenomena. Although the change in characteristics which die out might be explained by nickel or copper diffusion within the body of the transistor, it is most unlikely that this is the cause. Such a change would probably be most noticeable in the hole storage effects. Early changes, as are now found, are believed to be changes in surface structure. Some manufacturers are cycling their units at high power levels, or temperatures to stabilize them. Predictions that transistors will be out of limits after three months storage do not apply to typical units being made today. It is more likely to find that even after a year only a small fraction will be out of limits and that this fraction can be entirely attributed to expected inaccuracy of meter reading in testing¹. The abrupt changes are mechanical, such as leads coming off. However, after actual flaking at the collector diode, a grown junction n-p-n may still work¹.

The variation of the transistor coefficients with bias may not be neglected. The emitter resistance and the principal part of the collector resistance each vary inversely with emitter current. Both real and imaginary parts of the collector admittance vary inversely approximately as the square root of the collector voltage. Although the effect of bias on the other coefficients is less, the safest assumption is that change of bias will change the coefficients at least somewhat and the safest and easiest procedure is to measure the coefficients at the exact biases and exact frequency at which the transistor will be operated. At least one suitable tester is commercially available¹⁰.

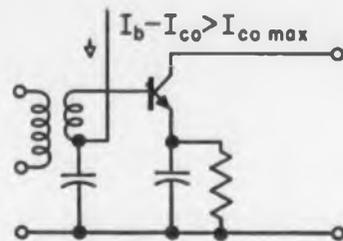
A large portion of the transistor failures are due solely to the design engineer, the maintenance man, or the installer. Failures due to people are usually of the abrupt type. The leads fail from over-heating but



Feedback bias and signal stabilization.



Swamping collector admittance.



Swamping collector cut-off current.

$$G_{12} \cdot G_{21} = \left[\frac{\alpha \beta}{1 - \alpha \beta} \right]$$

for stability $1 > \alpha \beta \rightarrow 0$
and $\omega > G_{12} G_{21} \rightarrow 0$

G_{12} = closed loop forward gain
 G_{21} = closed loop reverse gain
 α = open loop forward gain
 β = open loop reverse gain

$$G_{12AV} \cdot G_{21AV} = \left[\frac{h_{21} h_{12}}{(h_{22} + y_L)(h_{11} + z_g)} \right]^2$$

h_{11} = short circuit input impedance
 h_{12} = reverse transfer voltage ratio
 h_{21} = forward transfer current ratio
 h_{22} = open circuit output impedance
 z_g = input generator impedance
 y_L = output generator admittance

usually far below their fusing currents because of heat coming from the power dissipated in the adjacent junction. When grown junction transistors are grossly over-heated the base lead is usually the first to go.

Sometimes thermal runaway occurs suddenly after considerable service. This is caused by a gradual deterioration of one or more of the transistors characteristics until the internal heating has increased to the point that the resulting increased power input supplies more than enough heat to cause that increase in power input.

Installation of equipment in environmental conditions beyond those for which the device was designed may cause transistor variations or even failures. High ambient temperature or inadequate rate of heat removal are typical causes.

During servicing, reversal of the polarities of the transistors or the power supply, and plugging-in of transistors with the power on may cause damage. A one microfarad capacitor in the base lead charged to forty-five volts is almost sure to blow a transistor if the collector supply is also on when it is plugged in. Things like a-c leakage current from a hot soldering iron, which may amount to 100 milliamperes, may blow transistors.

In assessing the probable contribution of humans to the failure of transistors, we have vacuum tube experience as a guide². Roughly, the following were found to be equally likely to cause failure; circuit misapplication; circuit and component deficiencies; inadequate components; unstable materials and unsatisfactory parts; accident; operational manhandling; faulty maintenance; faulty workmanship; inspection and control. The circuit designer might have prevented about half of the failures due to people.

Designing to Allow for Transistor Variations

The designer's first responsibility is in the selection of the transistors to be used. The transistor type must in itself be reliable and have adequate ratings for the job at hand. Adequate power level and a high frequency before alpha cut-off are probably most important for radio work with low collector capacitance following. Low reverse transfer voltage ratio and low collector cut-off current are of secondary importance. As better transistors are produced the low frequency alpha will become of importance but today it can generally be ignored. Even today, alpha and the fre-

quency of alpha cut-off are partially independent in graded junction transistors. In any case: "Design within the manufacturers' specifications should give ten thousand hours operation for any good transistor today."¹ Selection within a manufacturers' type number for the particular case at hand may be desirable. If a type number is chosen which requires neutralization, it may be desirable to make further selections within that type. Such selections may mean only one size of neutralizing capacitor will be required instead of eight or so, which have to be further matched to the individual transistors. If it is essential to work near the collector voltage rating, it is advisable that the transistors selected have a sharp corner on the Townsend voltage as shown on a current-voltage plot. A transistor with a "rounded corner" characteristic is suspect.

The designer would do well to derate the transistor as well as to allow for power supply variations. Reducing the collector voltage supply not only reduces the power input directly but also keeps operation from being influenced by a possible rounding of the Townsend voltage corner. Furthermore, at high temperatures, the lower collector voltage reduces the likelihood of alpha exceeding unity. It is probably adequate to have the peak of the swing along the load line differ by a factor of two from the rated voltage. Typical voltages are six, nine, and twelve volts.

With proper circuit design, so that an alpha exceeding one were not detrimental, a higher junction temperature rating might be given. This would have to be explored thoroughly in the circuit and with the manufacturer before being used. From the permissible junction temperature and the dissipation constant (which should be given by the manufacturer), the permissible power input for any given ambient temperature is readily computed. If the power handling margin is inadequate, a germanium transistor having a large area or special cooling provisions should be used. Possibly a silicon transistor will be required.

As mentioned before, thermal runaway can occur because of a slow change in a transistor's characteristics and an inadequate design margin. With the collector voltage fixed, it is still necessary to limit the product of this voltage and the total collector current.

The collector cut-off current in particular must be watched since it increases with temperature (and in a poor transistor, with time) and is often, because of the circuit configuration, multiplied by the base col-

lector current gain, beta as shown in accompanying equations. The lower alpha is, the higher the temperature can be before the second term of the equation causes trouble. Thus, at high frequencies, a relatively low alpha transistor may be advantageous so long as the alpha cut-off frequency is high enough. The graded junction transistor is particularly useful here. There is no excuse, except perhaps in radio output circuits, for circuits which allow thermal runaway. In the absence of high power transistors, there is quite a temptation to design output circuits to or beyond safe heating limits. In enantiomorphic output stages (that is where a p-n-p and n-p-n transistor are used in push-pull for signal but in series across the direct current supply) it is particularly important to keep the supply voltage down.

Collector currents are specified to keep power dissipation and alpha decreases within tolerable limits. Current ratings appear to be someone's evaluation of what decrease in alpha is permissible and an estimation of what current would cause excessive temperature rises. Limitation of collector current as a means of reducing power input will be discussed extensively later. Other than for these considerations, current ratings can probably be ignored.

One of the simpler ways to design the circuit so as to make it insensitive to transistor variations, is to swamp those variations at the point at which they occur. This technique should not be applied crudely to bias and signal together, because it is too wasteful.

In the feedback stabilized circuit, the emitter resistor degenerates or reduces the gain of the bias circuit but also degenerates the signal circuit by an equal amount. Since the output admittance varies from transistor to transistor and may increase with both temperature and time, it may well be swamped with a considerable mis-match. Generally it is quite easy to make the conductance of the element coupling to the next stage large enough, relative to the output conductance, to control the signal voltage generated. This is essentially stabilization by loading as illustrated.

When the output is a transformer or a tuned circuit, the collector winding can be tapped down to accomplish swamping. The tank capacitance then also swamps the output susceptance. This susceptance is particularly troublesome since it varies with voltage as well as varying from transistor to transistor. Whenever matching conductances, it is generally advisable to tap into the tank if at all possible. This

will minimize susceptance variation effects and is especially important if the overall gain varies due to automatic volume control.

Considering the transistor as a three-terminal network with one negative resistor⁷, the technique of swamping or mismatching is useful as it generally reduces internal loop gain. The input and output impedances vary less than they would if the transistor were matched at both the input and the output.

A small signal arising in the transistor's generator impedance is amplified by the forward gain, (with open loop or no reverse gain), producing a larger signal in the load. This can, in turn, be looked upon as an applied signal which is amplified in the reverse direction by the reverse gain (with open loop or no forward gain) to produce a signal in the generator impedance. The product of these gains is then the internal loop gain which is a measure of the stability as well as an indication of the amount that the actual gains exceed these theoretical gains. Thus the product of the closed loop forward and reverse gains is a function of the product of the open loop gains. Equations for the available gain product are included here since this product is easy to calculate. Use of this value in the stability criterion will be conservative to the extent of mismatching either the input or output. With the output loaded by a relatively large conductance, the input impedance is essentially h_{11} , which is somewhat less variable than h_{22} . However, a higher source impedance than input impedance would tend to stabilize the circuit against transistor input impedance variations.

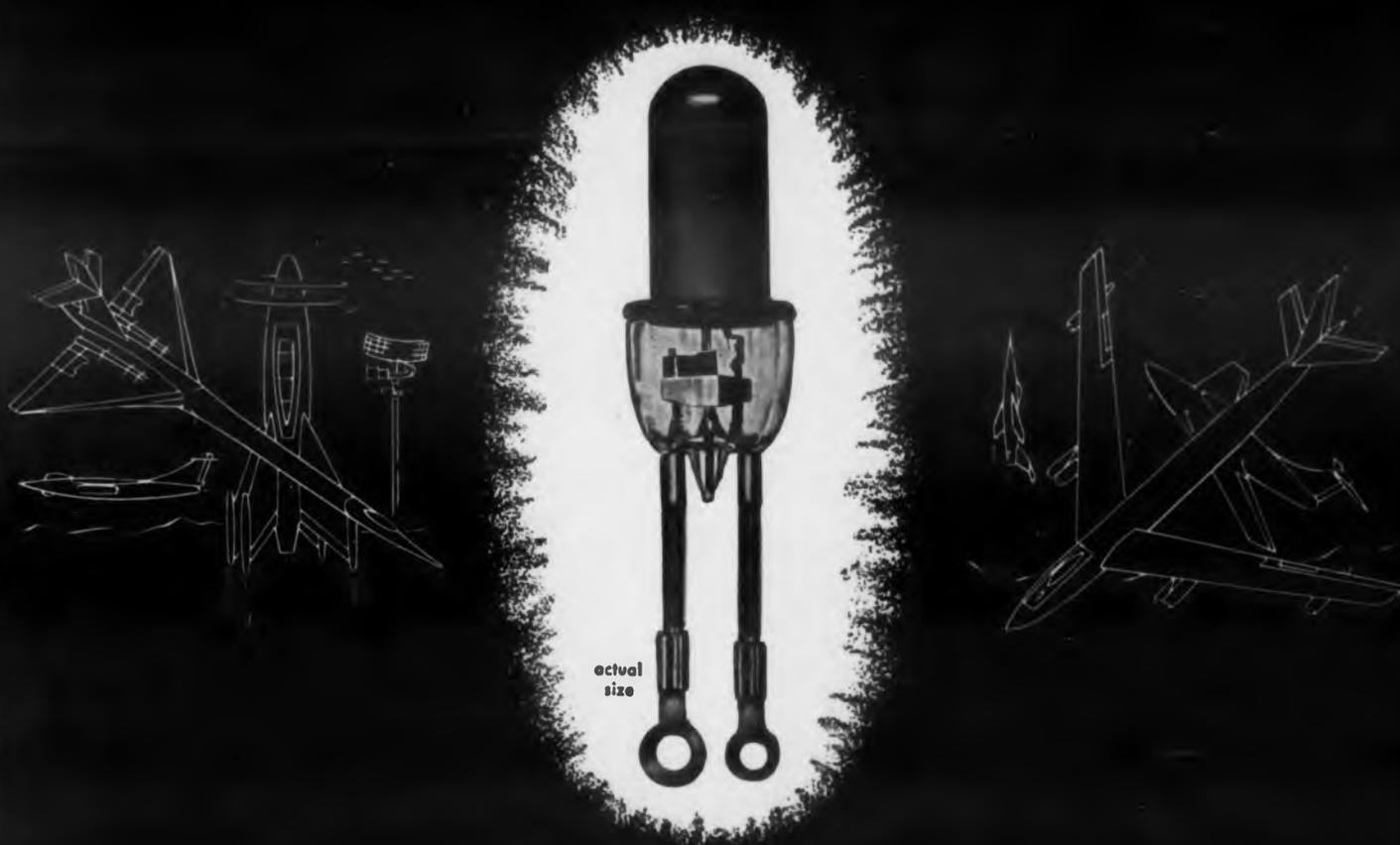
Stabilizing the collector current by making the base current equal to two or more times the expected maximum collector cut-off current can also be looked at as an example of swamping. The technique for doing this will be discussed later.

Further design considerations will be discussed in Part II.

References

1. Ratner, M., private communication, Germanium Products Co.
2. Clement, L. M., "The Program on Reliability of Electronic Equipment". Trans. IRE PGQC-3 Feb. 1954, pp. 1-9.
3. Dukat, F. M., "Transistor Reliability in Low Power Audio Uses". Tele-Tech, Oct. 1954, pp. 77-79.
4. Pritchard, R. L., "Frequency Variations of Junction Transistor Parameters". Proc. IRE, Vol. 42, No. 5, May 1954, pp. 786-99.
5. Early, J. M., "PNIP and NPIN Junction Transistor Triodes" Bell System Tech. J., Vol. 33, No. 3, May 1954, pp. 517-33.
6. Loeb, H. W., "Transistor Versus Thermionic Valves". ATE J1, 10:194-217, July 1954.
7. Shekel, J., "Reciprocity Relations in Active 3-Terminal Elements". Proc. IRE, Aug. 1954, pp. 1268-1270.
8. Pritchard, R. L., "Small Signal Parameters for Transistors". Elect. Engr., Vol. 73, No. 10, Oct. 1954, pp. 902-905.
9. Cutler, M. and Bath, H. M., "Surface Leakage Current in Rectifiers". J. App. Physics, Vol. 25, No. 11, Nov. 1954, pp. 1440-1441.
10. Baird Associates, 34 University Rd., Cambridge 83, Mass.

DESIGN IS OUR BUSINESS



actual size

ANNOUNCING UNITED TYPE 589 CLIPPER-DIODE RECTIFIER

Ever so small, and light for its power capabilities, our new type 589 electron tube will help immeasurably in concluding many electronic design problems, especially for aircraft and missile environment.

This new external anode tube weighs only a little over $\frac{3}{4}$ of an ounce, is less than 2 inches long, yet is rated as a clipper diode for 10,000 volts epv, and for peak plate current of 8 amperes.

For oil emersed rectifier operation rated epv is 16,000 volts and average plate current rating is 65 mA dc.

For convection cooled rectifier operation rated epv is 10,000 volts and average plate current rating is 30 mA dc.

Shock rating is 300 g.

MECHANICAL DATA

Nominal Overall Dimensions:	
Length (Less lead).....	1.9 inches
Lead Length.....	1.5 inches
Diameter.....	.9 inches
Anode Dimensions:	
Length (for contact).....	.8 inches
Diameter.....	.6 inches
Bulb.....	Per illustrations
Mounting and Anode Contact.....	Per illustrations
Filament Terminals.....	Per illustrations

Type of Cooling.....	Liquid
Net Weight.....	.08 oz.
Shock Rating.....	300 g.
Vibration Rating at 500 cps.....	10 g.

ELECTRICAL DATA

General:	
Heater Voltage.....	6.3 Vac.
Heater Current.....	1.6 Acc.
Cathode.....	Coated Unipotential
Maximum Rectifier Ratings (Liquid Cooled):	
Peak Inverse Voltage.....	16.0 kv.

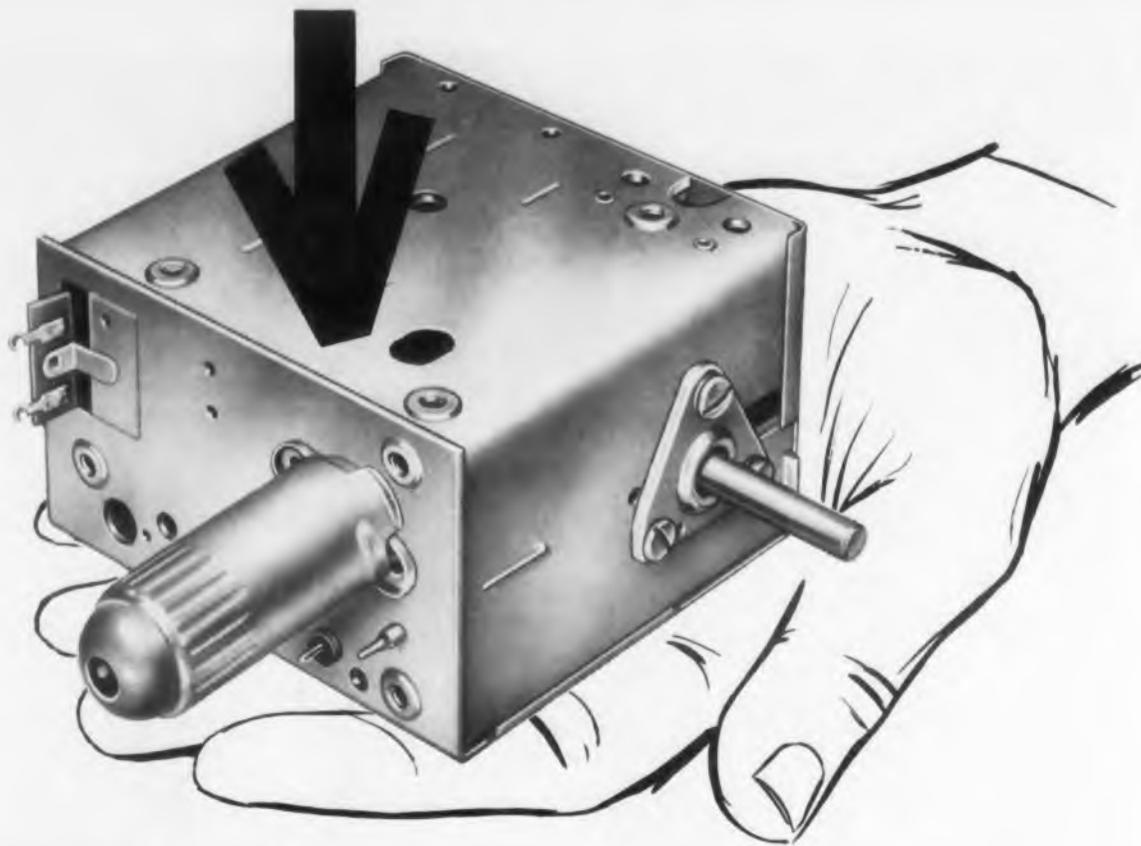
Peak Plate Current.....	250 ma.
Average Plate Current.....	65 mA dc.
Maximum Coolant Temperature Range -65° C to +165° C	
Maximum Rectifier Ratings (Radiation Cooled):	
Peak Inverse Voltage.....	16.0 kv.
Peak Plate Current.....	120 ma.
Average Plate Current.....	30 ma.
Maximum Clipper Diode Ratings (Liquid Cooled):	
Peak Inverse Voltage.....	10.0 kv.
Peak Current.....	8 a.
Average Plate Current.....	20 ma.

UNITED



ELECTRONICS, 42 Spring Street, Newark 2, N. J.

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



NEW

low cost UHF tuner

FEATURES OSCILLATOR RADIATION FIXES

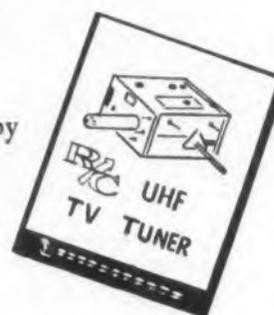
Here's famous R/C quality at the lowest price ever! The new T-90 Series uhf t-v tuner meets all RETMA spurious radiation requirements. Yet it costs less than any previous Radio Condenser uhf tuner.

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.

Or, see it at the IRE Show, 780 Airborne Ave.

Get Complete Engineering and Performance Data.
Write Radio Condenser for your free copy of Bulletin T-90.



RADIO CONDENSER Co.

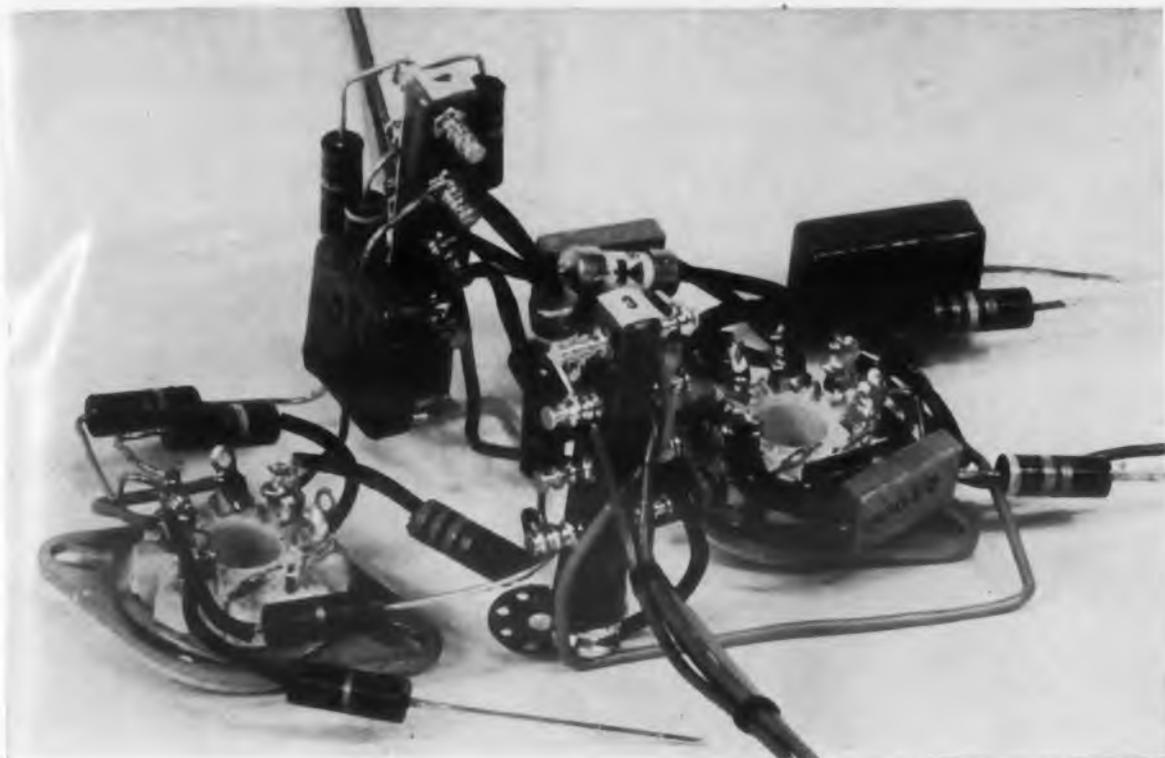
Davis & Copewood Streets • Camden 3, New Jersey
EXPORT: Radio Condenser Co., International Div., 15 Moore St., N.Y. 4, N.Y. CABLE: MINTHORNE

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



This oversize close-up shows use of flat terminals.

Component Mounting Posts



CRITICAL leads need be no longer than the pigtail of a component itself when the components are mounted on Tote-m-pole mounting posts. Small components such as resistors, capacitors, diodes, and transistors can be assembled into extremely compact subassemblies. The several inches of lead wire ordinarily necessary to connect conventional terminal boards to tube sockets are eliminated and point to point wiring benefits are gained. A reduction of as much as five feet of wire per subassembly is not unusual.

Tote-m-poles, as manufactured by Sangamo Electric Co., Springfield, Ill., are made of melamine, and are available with 4, 3, or 2 terminals. Once a pigtail is clamped around the staked flat terminal, the component is held rigid. Melamine properties of low tracking and heat resistance are desirable. There is practically no danger of breakage of the insulator post from expansion during the soldering operation.

The efficient use of space as a result of vertical mounting means chassis size can be reduced. At the same time, ventilation is improved. The posts can be set up on a breadboard in various ways to determine the best arrangement depending on requirements of total space, accessibility for test probes or soldering irons, and performance. The pole is attached by a single screw.

By following engineering models, semi-skilled wiremen can build subassemblies. The pigtails need not be kinked to provide for expansion and contraction. For more data about these posts, turn to the Reader's Service Card and circle **ED-24**.

SMALL PARTS can play a BIG PART in...



Lower Production Costs!

Leading manufacturers in the electronics, machinery, appliance and toy fields have been saving substantially by using precision Multi-Swage parts instead of those previously made by turning, drilling, stamping or forming.

HERE ARE ONLY A FEW TYPICAL TINY PARTS MADE BY BEAD CHAIN'S Economical, Dependable MULTI-SWAGE METHOD

LET BEAD CHAIN MAKE YOUR

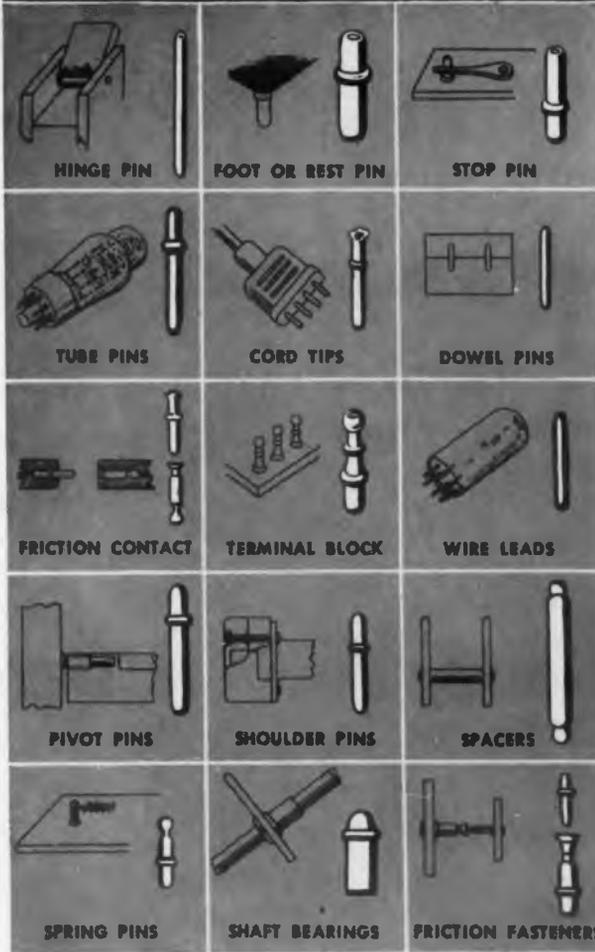
Tiny Parts to your Specifications at far less cost!

The advanced manufacturing method developed and used exclusively by Bead Chain swages practically any type of small tubular part from flat stock into precision forms with positive, tight seams . . . and does it Automatically. If you can use high-volume production . . . we can deliver it at a much faster rate . . . and at far less cost! Scrap is eliminated! Deliveries to you are dependably prompt!

We can supply you with parts that are beaded, grooved, shouldered and made with almost any metal. Diameters up to 1/4", lengths to 1 1/2"

This catalog can save you a lot of production time and money! Write for it

today!



GET PROOF-POSITIVE COST COMPARISONS!

Send us a blueprint or sample and quantity requirements. We will quickly show you the big economies we can deliver.

BEAD CHAIN

Original and World's

Largest Producer of Bead Chain



THE BEAD CHAIN MFG. CO.
BRIDGEPORT 5, CONNECTICUT

Please send me your Catalog of Multi-Swage Parts

NAME

TITLE

COMPANY

ADDRESS

KEY NO. 58

THE BEAD CHAIN MANUFACTURING CO., BRIDGEPORT 5, CONN.

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

Measure Frequency to 515 mc

READ IT DIGITALLY, PRINT IT AUTOMATICALLY! Add a Model 5580 VHF-UHF Converter and 1452 Printer (below) to a BERKELEY Frequency Meter*—get the most convenient, inexpensive means yet devised for frequency measurement to 515 mc. Exclusive BERKELEY Modular design uses low cost fixed-band plug-in units in place of costly wide-band amplifiers. Accuracy of measurement is ± 1 cycle, \pm crystal stability (1 part in 10^7).

*Model 5580 connects directly to BERKELEY Model 5570 or 5571.



BERKELEY Model 5580 VHF and UHF Converter Unit extends range of Models 5570 or 5571 to 515 mc by use of plug-in units (below). Dimensions 21" x 11" x 15"; Price \$300.00 f.o.b. factory.

Plug-in units covering 13 fixed bands from 42-515 mc eliminate costly wide-band amplifiers. Price, \$100.00 each except for 42-155 mc Model 5581/4, which is \$150.00 f.o.b. factory.

Automatic Digital Recorder Completes System



Model 1452 prints 6 digits (8 or 10 on special order) on standard adding machine tape. Only 19" wide x 10½" high x 14" deep, weighs 60 lbs. Price, \$750.00 f.o.b. factory.

BERKELEY Model 1452 Digital Recorder operates directly from any late model BERKELEY meter, automatically prints up to 10-digit read-out on standard adding machine tape. Scanner and printer are combined in one compact unit. Can be modified to print "Time" or "Code" information simultaneously with count data on same tape.

Write for complete specifications and data; please address Dept. D-3

Berkeley

division

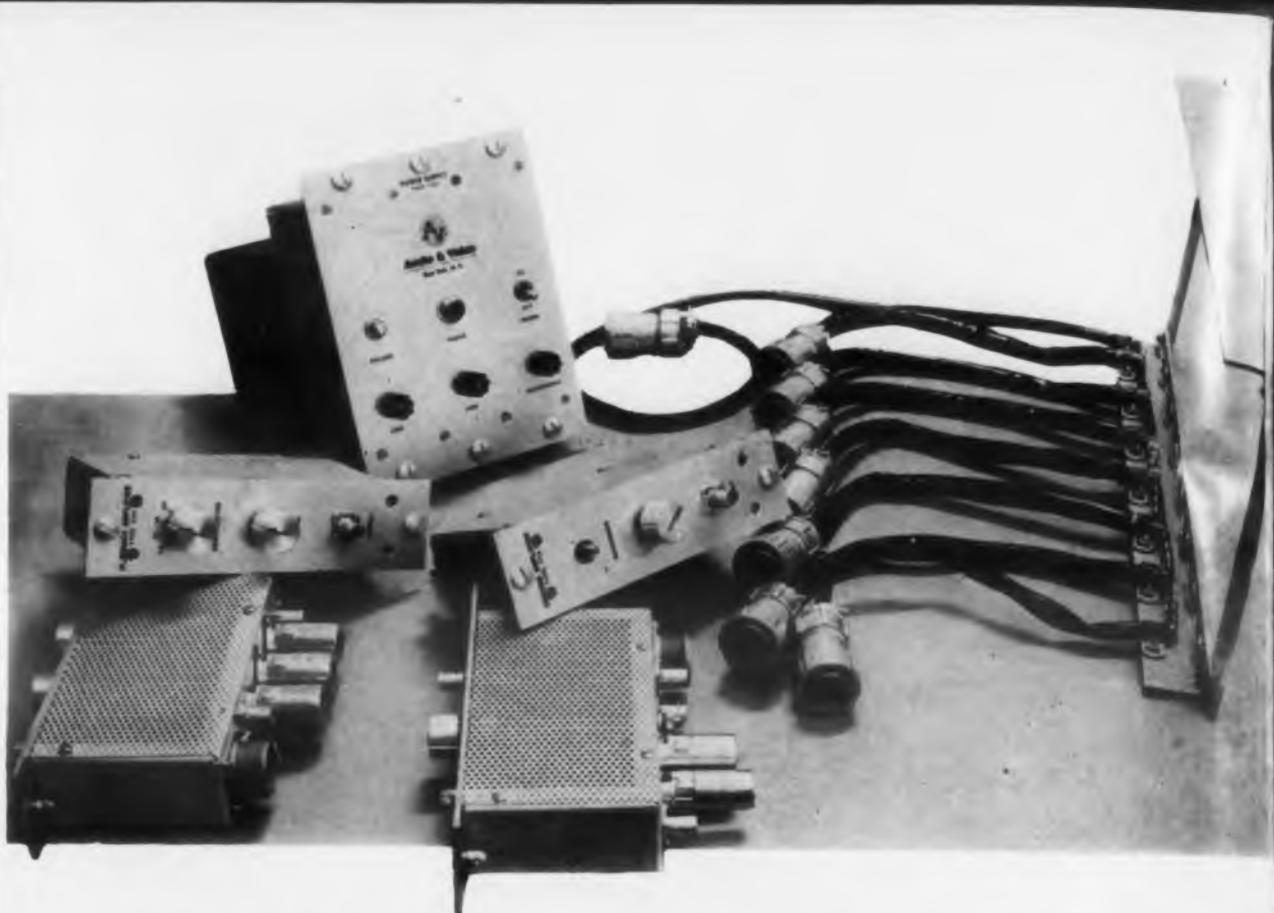
M-52

BECKMAN INSTRUMENTS INC.
2200 WRIGHT AVE., RICHMOND 3, CALIF.

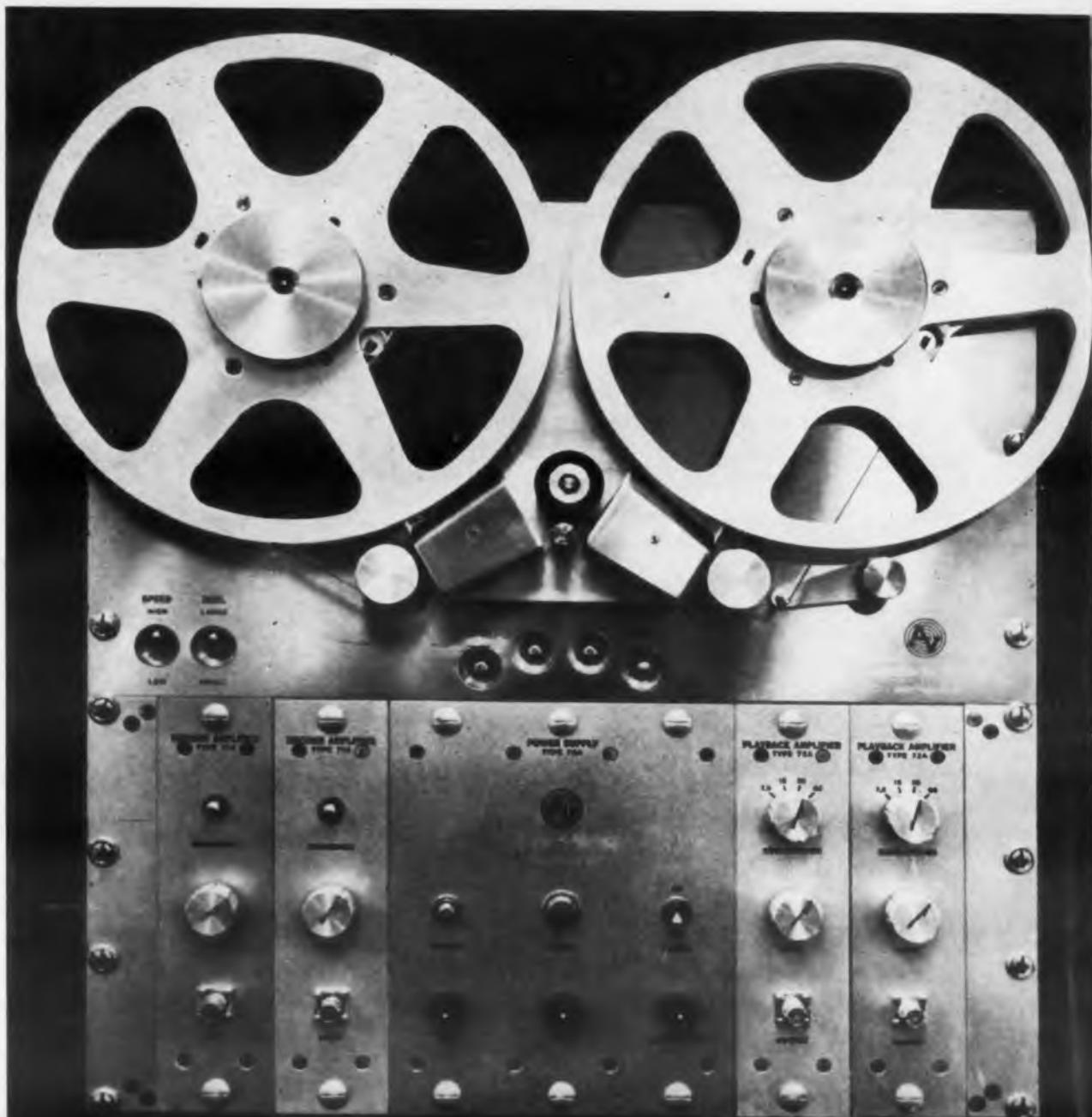
INDUSTRIAL INSTRUMENTATION AND

CONTROL SYSTEMS • COMPUTERS • COUNTERS • TEST INSTRUMENTS • NUCLEAR SCALERS

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



Components can readily be rearranged to fit new and different applications.



U
ity.
and
incor
driv
cord
T
unit
reco
els,
a sy
Late
T
reco
Mfg
Cor
tain
mic
with
ing
high
only
T
8 to
to p
the
also
cap
cap
not
sion
idle
flut
dow
in t
F
seco
por
and
on
this
and
at
ELE

Unitized Tape Recorder

UNITIZED "building block" construction of this tape recorder provides maximum flexibility, and cost-saving economies for instrumentation and data recording. The equipment illustrated also incorporates a recording-head design and a tape drive system especially suitable for accurate recording from 100 to 100,000cy.

The building-block components include all basic units such as tape transports, head assemblies, record amplifiers, playback amplifiers, control panels, and so on. The user can procure and assemble a system most appropriate for his application. Later expansion is easy.

The magnetic heads of the type 7 magnetic tape recording equipment manufactured by the A-V Mfg. Corp., Division of Audio & Video Products Corp., 730 Fifth Ave., New York 19, N. Y., maintain vertical alignment of track gaps to within 15 microns regardless of the number of tracks (heads with up to 14 tracks are available). As a result, timing errors among tracks are eliminated. To reduce high frequency losses, head stack laminations are only 0.003 inches thick.

To reduce peak-to-peak flutter, which is often 8 to 10 times higher than the rms values converted to peak readings, unsupported tape length across the head is reduced to a minimum. The tape drive also uses a high degree of tape wrap around the capstan so that the tape arrives and leaves on the capstan rather than on an idler. Since tape does not ride the idler, it is not stressed by the dimensional changes that frequently occur in rubber idlers due to capstan pressure. High frequency flutter, due to such stress vibrations being reflected down the tape to the heads, is noticeably absent in this equipment.

Four speeds, 7-1/2, 15, 30, and 60 inches per second are available. Controls on the tape transport are countersunk to avoid accidental operation and to eliminate projections which tape might snag on while loading. For further information about this equipment turn to the Reader's Service Card and circle **ED-27**. This product will be on display at the Radio Engineering Show, Booth 74-78.

An Exclusive New Design

BY **ASTRON**

**THE
COMET**

**FIRST METALLIZED
Paper Molded Plastic
Miniature Tubular.. EVER!**

CREATED BY the thinking of tomorrow, Astron's newest capacitor gives you features never before possible. All the important operating characteristics of a metallized paper capacitor are combined with the absolute protection of a molded plastic shell and bonded seal... an Astron exclusive.

THE NEW Comet has the unique properties that add extra protection against over-loads and momentary surges... small size and light weight due to metallized paper construction... low R.F. impedance... new solid thermosetting impregnant for high dielectric strength... improved insulation resistance and dependable operation up to 125° C.

THE ATTRACTIVE bonded shell and patented seal are impervious to all extremes of heat, cold and moisture. Leads are locked in... can't pull or melt out. Clearly marked units completely immersion-proof... individually tested and guaranteed.

YEARS OF intensive engineering research culminate in this first really successful combination of miniaturized metallized paper sections with a tough, tight bonded shell and seal... another industry first, by Astron, the pioneer in advanced capacitor and R.F. filter design.

THE NEW Astron Comet can reduce your costs while saving space and weight... write for Bulletin AB-21 TODAY!

ASTRON

C O R P O R A T I O N
255 GRANT AVENUE EAST NEWARK, N. J.

Export Division: Roche International Corp., 1155 Avenue of the Americas, New York 10020, N. Y.
in Canada: Charles W. Poitrel, 100 St. James Street, Montreal, P. Q.

ASTRON

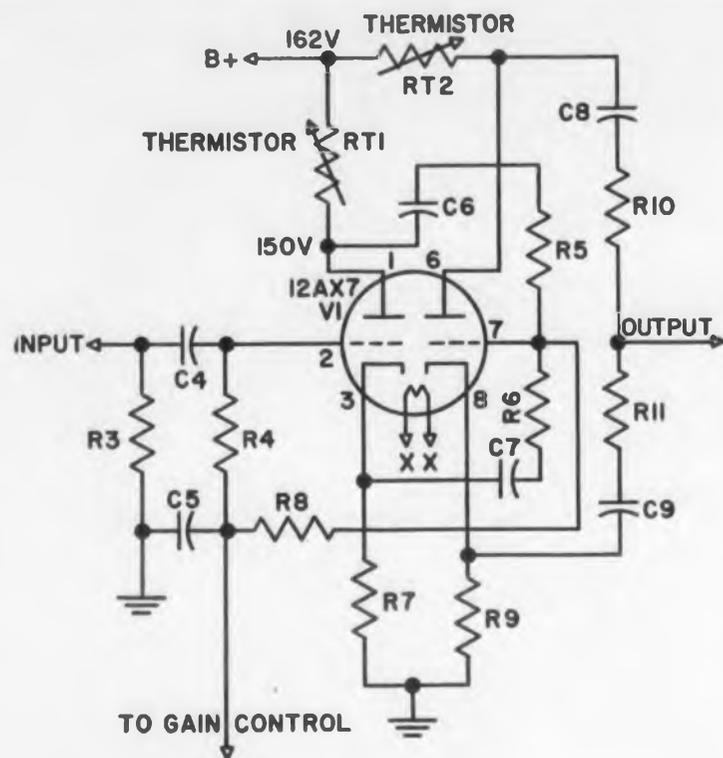


Fig. 1. A volume limiter in which thermistors replace resistors in the plate circuits of two stages.

New Thermistor Applications

By Sherman H. Hubelbank

Connecticut Telephone and Electric Corp.,
Meriden, Connecticut

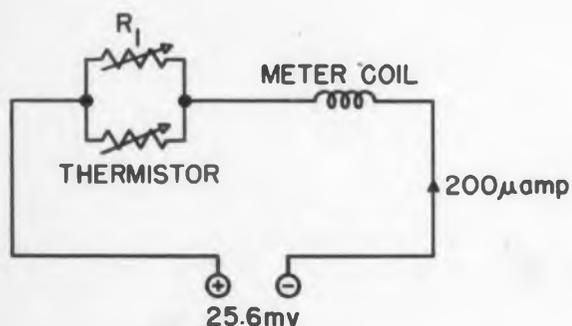


Fig. 2. Thermistors are used in this meter circuit to prevent calibration drifts.

Fig. 3. Illumination is controlled automatically by this circuit in which the thermistor is a delay.

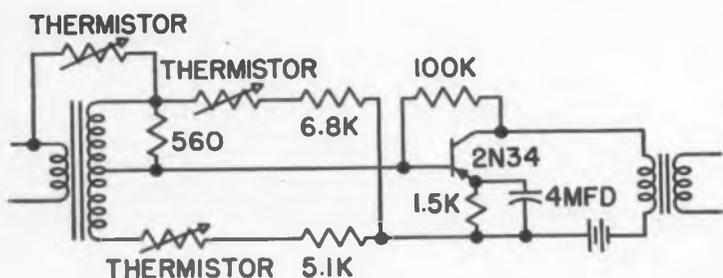
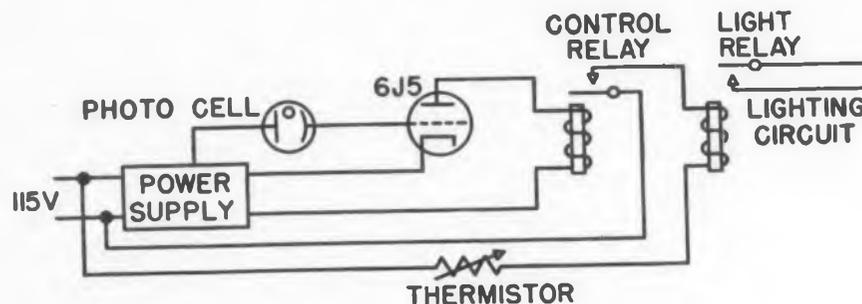


Fig. 4. This circuit produces a flat output response. It is used as a limiting device.

THERMISTORS offer electronic design engineers a relatively simple method of achieving a highly sensitive response to minute temperature changes. The two most important characteristics of thermistors that enable them to be utilized in this type of circuit application are non-linearity and negative resistivity. Nine different devices utilizing thermistors and some future uses for thermistors are discussed in this article.

Calibration drifts due to meter resistance are prevented by thermistors in the "Tektolog" electrical quantity recorder manufactured by Fielden Instrument Div., Robertshaw-Fulton Controls Co., 2920 N. 4th St., Philadelphia 33, Pa. This device operates on a unique principle. The electrical input actuates a meter coil which assumes different angular positions dependent upon the input signal. A follower vane (servo type) creates a capacity effect between the meter coil's vane and the follower vane. When the meter vane moves it creates a different capacity, which is detected by an electronic circuit driving an electric servo motor. The output shaft of the motor drives a suitable recording pen. Consequently, the motor will record the small electrical inputs.

If the electrical meter is required to measure small signals produced by thermocouples in the order of millivolts, it is necessary to have a stable circuit resistance, since the meter itself is basically a current-measuring device. Using conventional swamping resistors on low range inputs is not satisfactory, since a large portion of the available voltage is lost across the swamper. Therefore, to prevent calibration drifts due to meter resistance change with temperature, a thermistor is used. As shown in Fig. 2, the negative coefficient of the thermistor plus the positive coefficient of the meter are matched by shunting with a manganin resistor. The thermistor is lagged so as to have approximately the same time constant as the meter coil. Tests indicate that there is a net circuit change of less than ± 0.5 ohms from 32°F to 150°F .

A time-delay circuit for an automatic lighting system for schools that uses thermistors as one of the controlling elements has been developed by Keystone Carbon Co., St. Marys, Pa. The basic circuit shown in Fig. 3 controls the school lights automatically according to the lighting conditions. The thermistor delays action of the light relay for approximately 25sec until the 6J5 tube warms up. With the room

light at a low level, there is little conduction of the photoelectric eye. Therefore, the contacts of the control relay remain closed and permit the light relay to energize as soon as the thermistor is heated sufficiently by current flow.

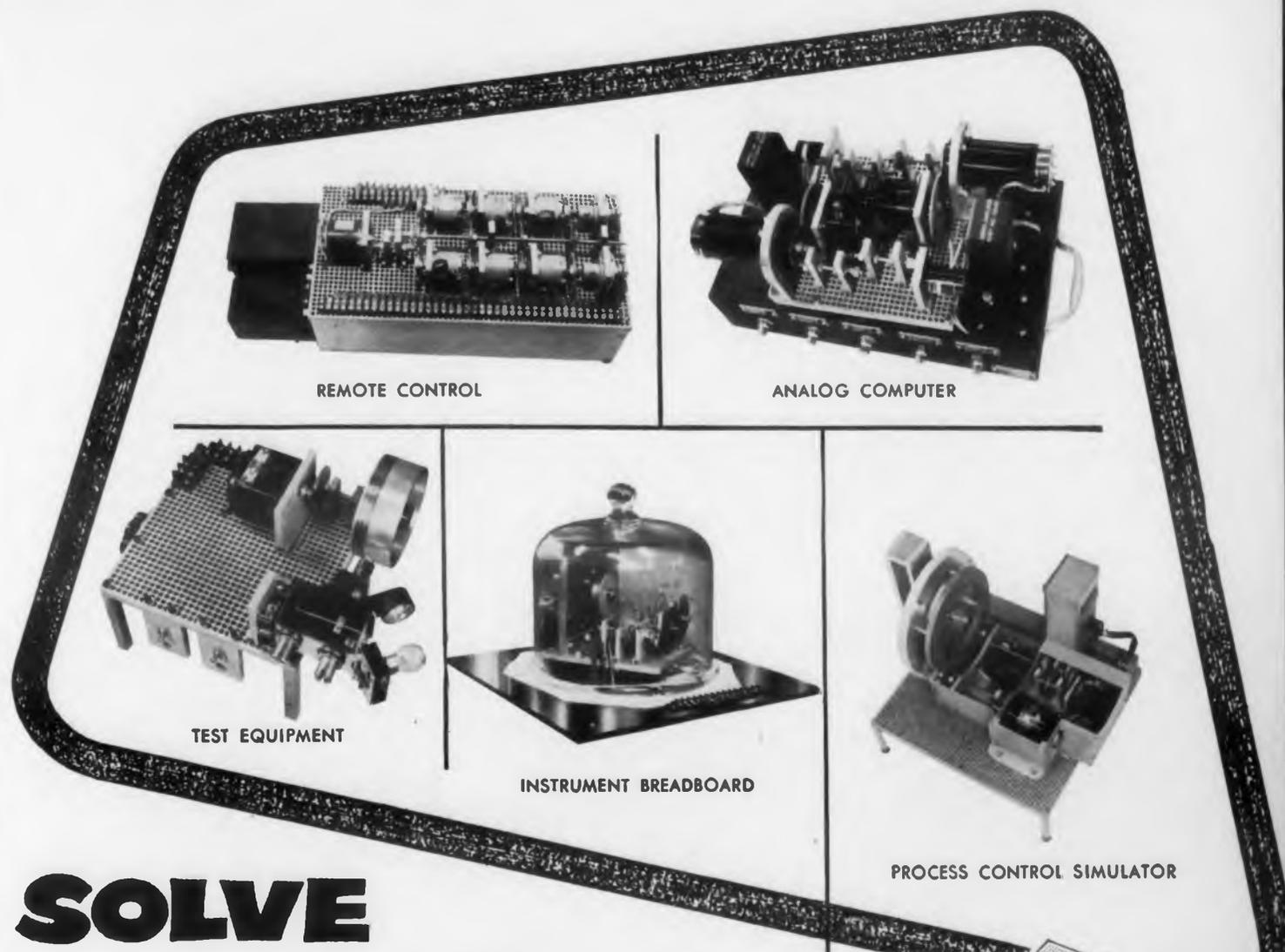
When the room light is at a high level, the thermistor delays energizing the lighting circuit until the 6J5 tube has time to warm up and pass sufficient current to energize the control relay. This delay prevents the light relay from closing its contacts and turning on the overhead lights.

The thermistor delay action prevents the lights from being turned on and then immediately turned "off" by the action of the photoelectric eye, which would occur when the master switch is thrown on when the room light is already at a high level. In addition, the delay action of the thermistor prevents flickering on and off of lights due to passing shadows of clouds on otherwise bright days.

In the electronic volume limiter shown in Fig. 1, thermistors replace resistors in the plate circuit of two stages of amplification. Since the thermistors act as plate load resistors, variations in plate current cause variations in output that are not a result of the characteristics of the tube. As the input signal decreases, the thermistors change resistance due to the change in plate current, thereby causing greater amplification. The thermistor action will conversely lower amplification if the incoming signal is high.

The transistor-thermistor automatic level control circuit shown in Fig. 4 consists basically of three thermistors and one transistor. It is designed to produce a flat output response for given input variations. With an increase in the input signal, the resistance of each thermistor decreases, causing the circuit to approach a balanced condition. This condition causes the input signal to the grounded emitter transistor to decrease. At the same time, the feedback is increased by the action of the coupling thermistor between the two transformer windings, creating a mis-match between the secondary and primary of the transformer. This action lowers the efficiency of the circuit and does not allow all the available signal to pass. This combined action determines the limiting effect of the circuit. These last two units were developed by Connecticut Telephone & Electric Corp., 70 Britannia St., Meriden, Conn.

Maintaining a gyro housing block at a calibrated



SOLVE

Electro-mechanical problems... IN THE LAB! with Servomechanisms' efficient, economical Mechanical Development Apparatus

Pictured above are typical Mechanical Development Apparatus (MDA) assemblies, complete with electrical components. MDA is an assortment of standardized, precision-built, mechanical components designed for the purpose of simulating instrument and control systems in the breadboard phase of development. The apparatus makes designing extremely fast and economical. An appropriate group of these versatile units can be quickly assembled into a desired mechanism. The components lend themselves to endless use and re-use due to the flexibility of its design. Only a small assortment is needed to cover a multitude of problems. Prove out your design, quickly and economically with these versatile "tools"

Limit Stop, Couplings

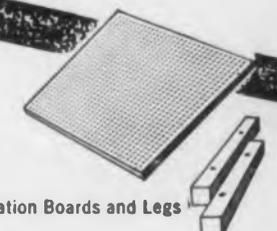
Dials, Cams, Switch

Lead Screws, Clutch

Stainless Steel Shafts
and Gears

Mounting and Bearing Blocks

Foundation Boards and Legs



SERVOMECHANISMS
INC.

For complete information
write for catalog to...
COMPONENTS DIVISION
625 Main Street
Westbury, L. I., N. Y.

SEE US AT THE I.R.E. SHOW
BOOTH NO. 740-742

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

data. The thermistor is treated with a reflective coating to ensure that it be unaffected by radiant energy. In addition, it is coated with a silicone water proofing agent to render it insensitive to humidity changes. This thermistor is supplied by Ferroxcube Corp., Saugerties, N. Y.

X-Ray Calorimeter

An X-ray calorimeter recently developed by the National Bureau of Standards, Washington 25, D. C., incorporates two thermistors. The instrument measures the intensity of high-energy X-ray beams. The temperature rise in a lead cylinder due to absorbed X-rays is compared with the temperature rise produced by a measurable quantity of electrical energy dissipated in the cylinder. In order to detect the small temperature changes, two thermistors are used whose temperature coefficient of resistance is approximately -3.6% per $^{\circ}\text{C}$. They are connected in a Wheatstone bridge circuit. X-radiation power of the order of 0.1mw for five minutes results in a temperature rise of 2×10^{-4} degree C, and can be readily measured to an accuracy of a few percent.

The Type 604 Electronic Calculator, a 1400-tube general purpose digital computing machine, produced by the International Business Machines Corp., Poughkeepsie, N. Y., uses thermistors in the power supply. A thermistor provides a voltage standard which is compared to the voltage to be controlled. The difference between the standard voltage and voltage to be controlled is then amplified and used to control the bias on a current regulating tube, which determines the amount of current that is furnished to a saturable reactor. The operation of the saturable reactor counteracts any attempt to change the voltage being controlled.

Future Uses

More uniform temperature control of the home by utilizing thermistors to measure the temperature in each room is predicted by Keystone Carbon Co., St. Marys, Pa. In addition, one thermistor would be mounted on the outside wall to anticipate indoor temperature changes. A third unit would be mounted with a radiant heating panel in each room to supply compensating heat. The response of the three units can then be integrated to provide good uniform heat control. This firm also suggests that thermistors can be used to quite an advantage in motor windings to provide overload protection. By imbedding a number of thermistors elements throughout the windings to obtain an average or maximum temperature effect, the thermistors will provide a fast response to the temperature change of the motor winding. This response is possible since thermistors are responsive to the temperature, regardless of whether the condition is caused by high current, a locked rotor, or the high ambient temperature.

LARGE SCREEN

Illustrated is Electromec 21 inch Rectangular Tube Large Screen Laboratory Oscilloscope. Standard 19 inch Rack Mounting models are also available with 17 inch rectangular tube.



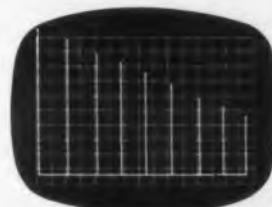
RCA Licensed

NOW... You can get MORE INFORMATION in a MORE READABLE FORM ...with Electromec Large Screen Oscilloscopes!

TYPICAL APPLICATIONS:

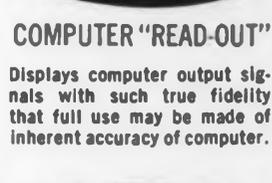
TELEMETERING

Illustrated is display of telemetered pulse width modulated signals, which appear clearly separated, permitting accurate observation.



PRODUCTION TESTING

Speeds up tests and reduces errors and eye strain. Shown is response curve with production tolerances marked on tube face.



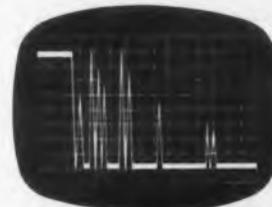
COMPUTER "READ-OUT"

Displays computer output signals with such true fidelity that full use may be made of inherent accuracy of computer.



WAVEFORM ANALYSIS

Permits observation of minute details, as in this display of relay contact chatter. Valuable for study of transient phenomena.



Electromec Large Screen Oscilloscopes are precision instruments with high resolution, and permit detailed observation of large quantities of data or complex signals, thus reducing guesswork and reading error to a minimum.

Use of Magnetic deflection systems makes large screen display practical and permits close control over linearity and orthogonality. The Electromec Large Screen Oscilloscope permits examination of the most minute details without sacrificing observation of the overall display.

With this equipment, it is therefore no longer necessary to expand portions of the waveform for a detailed analysis, although 2 to 1 magnification is available.

PRECISION ENGINEERED FOR:

- Data Plotting
- Production Testing
- Waveform Analysis
- Education
- Display

IMPORTANT FEATURES:

- High Resolution
- $\pm 1\%$ Linearity
- Calibrated Time Base — 10 micro-sec./in. to 1 sec./in.
- Gain Controls calibrated in volts/in.
- 10 milli-volt or 1 milli-volt peak to peak/in. sensitivity
- Frequency Response ... ± 0.1 db. from DC to 50 kc, down 1 db. at 100 kc or ± 0.1 db. from DC to 300 kc, down 2 db. at 500 kc with a reduction of maximum vertical deflection amplitude to approximately 7 in.
- Long-term constancy and accurate voltage calibration, $\pm 1\%$ linearity and constant deflection sensitivity eliminate the need for an internal voltage calibrator.
- Performance unaffected by line voltage changes from 105-125 volts.

Write or call today for complete Engineering Data...



Electromec, Inc.

3206 NORTH SAN FERNANDO BLVD., BURBANK, CALIFORNIA
TELEPHONE: VICTORIA 9-2248

REPRESENTATIVES:

ELECTRO-MEC ASSOC.
109 E. Nine Mile Rd.
Ferndale, Michigan
Lincoln 7-1422

RUSSELL F. HARDY
Hulman Building
Dayton 2, Ohio
HEmlock 1265

GERARD G. LEEDS CO.
12 Crampton Lane
Great Neck, N.Y.
HUnter 2-7784

WRIGHT ASSOC.
Professional Bldg.
Rome, New York
ROme 6500

W. A. BROWN & ASSOC.
3610 Mt. Vernon Ave.
Alexandria, Va.
OVerlook 3-6100

TECHNICAL SERVICES CO.
150 Causeway Street
Boston 14, Mass.
CApitol 7-9797

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

Staver

NOW!

CAPTIVATED MINI-SHIELDS

flanged
base
for top
mounting



(patent pending)

NO ROCK

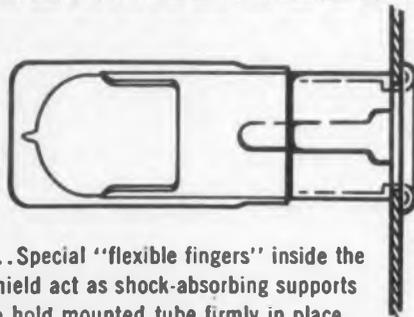
NO OSCILLATION

NO RADIATION

SINGLE UNIT CONSTRUCTION



... For easy tube replacement, top half of shield telescopes, exposing tube. Shield is quickly locked back in place.



... Special "flexible fingers" inside the shield act as shock-absorbing supports to hold mounted tube firmly in place, providing high shock resistance.

Staver's NEW CapTiVated Mini-Shields end short circuit problems in "hot" chassis due to loose tube shielding, because these new shields are permanently mounted, with a unique telescoping feature permitting quick access to tubes.

Staver's single-unit shield construction permits simplified assembly... cuts production line costs... provides safe tube shielding in "hot" chassis metal cabinet receivers.

Staver's CapTiVated roll-over base model, specifically designed for UHF applications, is a single-unit, shield-socket combination, providing complete shielding of both tube and socket... no part of the socket is exposed above the chassis.

Both flanged base and roll-over base designs of CapTiVated Mini-Shields are available for 7 and 9-pin miniature electronic tubes — as separate shields or as complete shield-and-socket units ready for chassis installation. Complete technical data, prices and delivery information sent on request.

THE
Staver
COMPANY
INCORPORATED

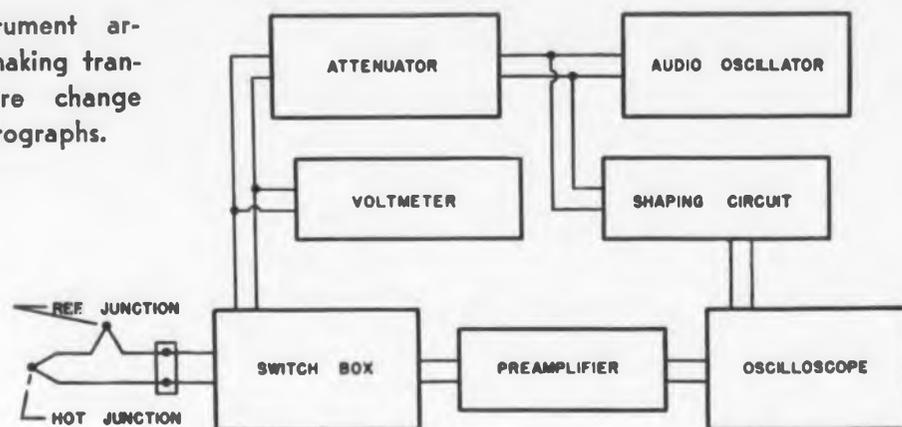
47 N. SAXON AVE.,
BAY SHORE, L. I., N. Y.

Fast-Response Thermocouple

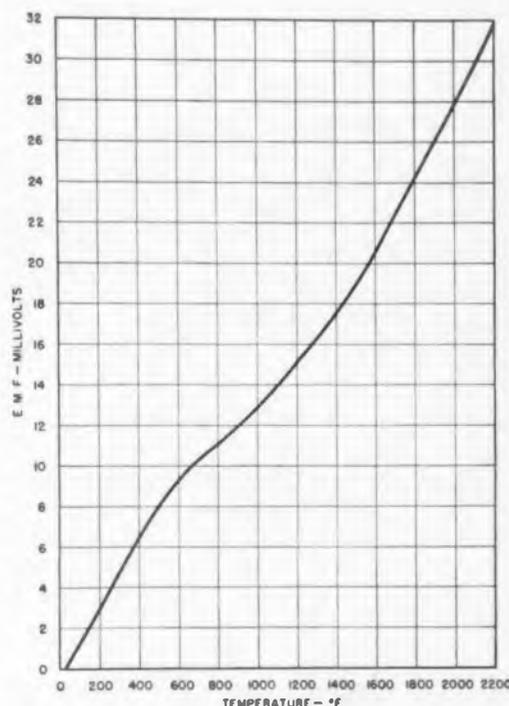
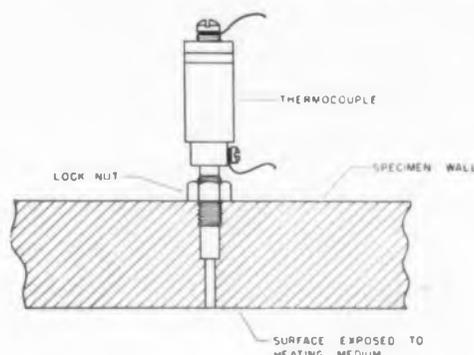


The two standard models of thermocouples are shown here twice actual length. The lower end is the sensitive element.

Laboratory instrument arrangement for making transient temperature change records and photographs.



The thermocouple is mounted in a thick wall in this manner



Thermocouple calibration curve
—reference-junction at 32° F.

RESPONDING to temperature changes in times as short as 1/4 microsecond, the transient-temperature-measuring thermocouple illustrated on these pages can become a valuable laboratory tool. Rapid changes in the temperature of tubes and components can be studied as a means of improving thermal shock resistance. In addition, the unit could be incorporated in many automatic control systems for liquid-flow processes.

The sensing element is made up of a 1-micron-thick layer of nickel plated on the end of a steel rod. The entire thermocouple is extremely rugged. It was developed by Midwest Research Institute, 4049 Pennsylvania, Kansas City 11, Mo.,

under a contract from the U. S. Army's Chief of Ordnance as a means of measuring gun-barrel temperatures.

Two standard models of the thermocouple have been developed: a small one for use in thin walls and a large one for use in thick walls. Other uses for the unit are in recording the temperatures in cylinder and piston walls, brake drums, aircraft skins, and air ducts. Since the sensing element of the thermocouple is flush with the wall into which it extends, as shown by the mounting diagram, the thermocouple does not disturb the heat flow pattern of the heat source it is measuring. For added information, turn to the Reader's Service Card and circle **ED-32**.

New! **COMP-U-TRIM[®]**



OVERALL DIMENSIONS
7/16 x 7/16 x 1 1/4

THE **ONLY** TRIMMING POTENTIOMETER THAT'S ENCAPSULATED

Now, you can have it! Now, you can have a trimming potentiometer that's protected against humidity. It's an EPR "exclusive" made possible by EPR research. What's more—in addition to real protection against humidity, COMP-U-TRIM provides greater resolution. The exclusive EPR internal tap plus larger winding area provide resolution unequalled in the field today.

If you use trimming potentiometers you'll be glad you've learned about COMP-U-TRIM.



**WIDE RANGE OF
TEMPERATURE
COEFFICIENTS**

Write, Wire or Phone for
Data Sheets, now.

STANDARD VALUES
50 Ohms 1000 Ohms
100 Ohms 2000 Ohms
250 Ohms 5000 Ohms
500 Ohms 10000 Ohms

Resolution
.15% to .5%
High resolution and resistance
values available upon special
request.

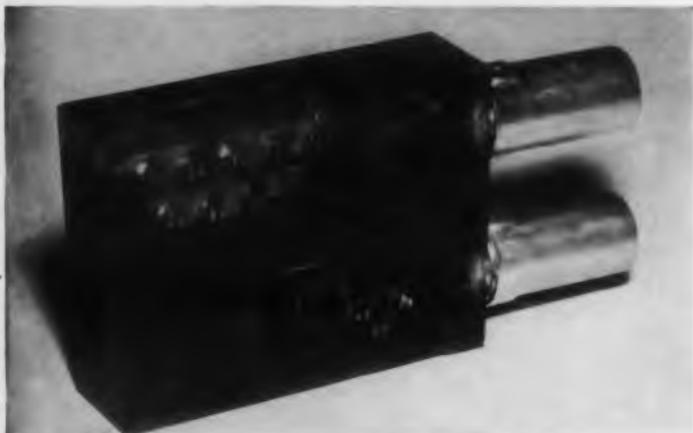
See Us At BOOTH #686 I.R.E.



EASTERN PRECISION RESISTOR CORP.

Richmond Hill 18, New York

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



Both sides of a potted instrument amplifier incorporating three potentiometers and precision resistors. The various terminals protruding from the surface shown above are of the plug-in type.



Designing Potted Circuits

By Frank J. Davidson, Vice-President for Engineering

Topper Manufacturing Co., Mineola, N. Y.

ENCAPSULATION should be considered by electronic designers whenever miniaturization, rugged construction, sealing, resistance to fungus and moisture, plug-in construction, and cost reduction are desired. Great mechanical stability is achieved by potting, which can also eliminate mounting hardware and chassis.

Practically any component incorporated in electronic equipment can be encapsulated. The possible arrangements of components and the possible shapes of the overall encapsulated circuit are limited only by the ingenuity and imagination of the designer.

In order to design successful encapsulated units, the designer should be familiar with the potting process. Before assembling begins, components with moving parts, such as potentiometers and relays, must be "pre-sealed" to prevent the resin from en-

tering the inner workings. Conventional tube sockets must also be pre-sealed to prevent resin from entering the slots where the tube base pins are received. The pre-sealing operation involves the application of a coating of plastic in a highly viscous state over the openings to be sealed off and subsequent curing of this plastic before encapsulation. After assembly, the circuit is checked electrically.

Where maximum resistance to temperature changes is required, the circuit should be pre-coated with a layer of "Silastic" rubber to provide a cushion to the changing thermal stresses*. All encapsulated vacuum tubes should be treated with this cushion

* For one method of applying a protective pre-coating, see "Experimental Encapsulation Technique", Quayle & Hubelbank, ELECTRONIC DESIGN, January, 1954, pp. 50-51.

Comparative tabulation of three representative epoxy resins.

Epoxy Resin	Ari-Temp 201	"Colplast"	Ciba 505
Temperature Limitation	-65°C to 200°C	-80°C to 150°C	-100°C to 250°C
Shrinkage During Cure (Max.)	5%	3%	1.5%
Heat Distortion Temp.	60°C	90°C	125°C
Coef. of Expansion (per °F)	40x10 ⁻⁶	50x10 ⁻⁶	20x10 ⁻⁶
Tensile Strength	13,000psi	12,000psi	12,000psi
Moisture Absorption	0.10%	0.10%	0.10%
Dielectric Constant (at 60cy)	3.6	3.9	3.8
Dielectric Strength (volts/mil)	700	500	500
Curing Temperature	275°F	Room temp.	300°F
Curing Time (hours)	10	12	5

Each of these resins can be vacuum-impregnated.

"Ari-Temp 201" is manufactured by Aries Laboratories, Inc., 270 Park Ave., New York 17, N. Y. It is typically applied in the encapsulation of vacuum-tube amplifiers.

"Colplast" is made by Topper Manufacturing Co., Inc., 43 Roselle St., Mineola, N. Y. It was specially formulated for the potting of circuits containing semiconductor devices requiring low curing temperatures.

"Ciba 505" is manufactured by Ciba Co., Inc., 627 Greenwich St., New York 14, N. Y. It is specially suited for potting high-voltage transformers.

coat prior to potting because the coefficient of thermal expansion of their glass envelopes is so low. Tubes with metal enclosures do not require this treatment.

After all the steps prior to encapsulation are completed, the unit is mounted in a mold made of metal or some other suitable material. Both unit and mold are then placed in an oven to drive out any moisture or volatiles. The required amount of resin is then slowly poured into the preheated mold, and the encapsulated unit is then allowed to cure. Curing generally takes place at some elevated temperature.

Design Procedure

Design of potted circuits begins with a thorough knowledge of the thermal and electrical characteristics of the circuit. A comparison of these character-

ties with the limitations of the many available potting compounds under the operational conditions to be encountered, should indicate whether or not a suitable potting plastic can be selected.

The accompanying table lists the most important design selection factors for three representative potting compounds. If temperature-sensitive components such as diodes or transistors are to be encapsulated, low-temperature curing plastics are in order. If the temperature range over which the equipment will operate is significant, the coefficient of thermal expansion of the plastic is the determining factor.

Once the proper potting plastic has been chosen, the designer is then most obviously concerned with the overall configuration of the completed circuit. Since stacking of components to save space is desirable, the effects of heat dissipation and electrical interaction must be considered. The plastic tends to distribute local hot spots throughout the entire encapsulated unit. Where extreme hot spots are developed by the circuit components, the designer must provide for heat transfer to a metal heat sink. One of the most effective types of heat sinks is simply embedded in an exposed surface of the potted circuit. The heat sink should be given a chemical black dip for maximum heat transfer. A general standard for specifying heat sinks is to connect a sink to components dissipating 2w or more.

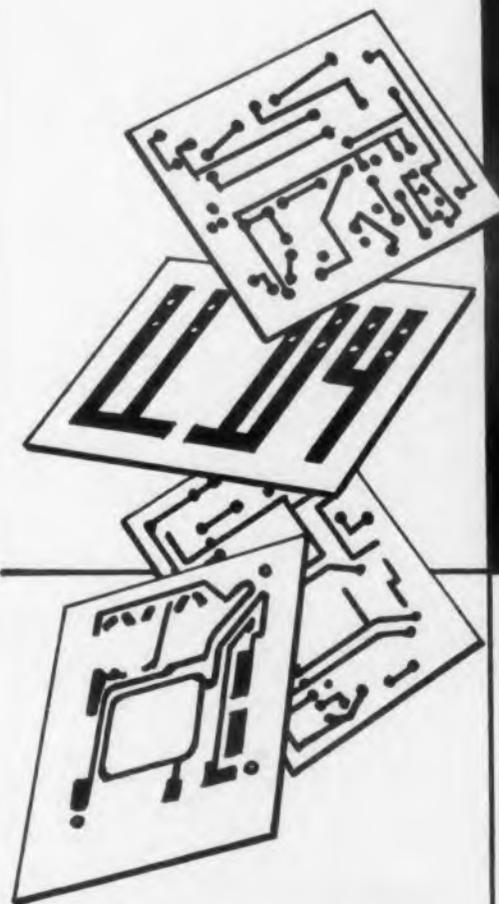
To remove heat effectively from potted tubes, the tubes should be mounted in shields connected to heat sinks. Before adding the shield, the tube should receive a pre-coating of "Silastic". The heat sink is soldered across the top of the shield. This heat sink can form one wall of the mold, which means that the tube must be placed close to and perpendicular to one outer surface of the potted circuit. If more than one tube is potted, the heat sink should run across the tops of their shields, which practically dictates a parallel arrangement of the tubes.

Where abnormally high temperatures are encountered in a component, that component can be mounted externally. This technique is specially suited to vacuum tubes, which require more frequent replacement than other components.

Stray Capacitance Magnification

Because of the greater dielectric constant of the potting compound over air, magnification of stray capacitance with potting must be considered by the designer. Where stray capacitance is of significance, critical leads and components must be four times as far apart as they would have been placed in a conventional chassis.

Where a circuit is known to be sensitive to electrical interaction, it is often advisable to breadboard the circuit and operate it in an oil envelope to simulate embedment as a means of determining the proper location of components.



ASK FOR BULLETIN
ON COPPER-CLAD

INSUROK®



For superior printed
or etched circuits
use copper-clad

INSUROK T-725 and T-812 plastic laminates

For printed circuits, the important consideration is the laminate base since other characteristics are often similar. In buying printed circuits, therefore, it pays to insist on the best—INSUROK T-725 or T-812—because of their outstanding electrical properties which remain remarkably stable under repeated temperature and humidity cycling.

Laminated INSUROK Grades T-725 and T-812 have made history ever since they were first introduced to the electronics industry. Possessing a unique combination of properties, they have been used successfully for many years in critical high-frequency applications.

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

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

The RICHARDSON COMPANY

FOUNDED 1858

2682 Lake Street, Melrose Park, Illinois (Chicago District)

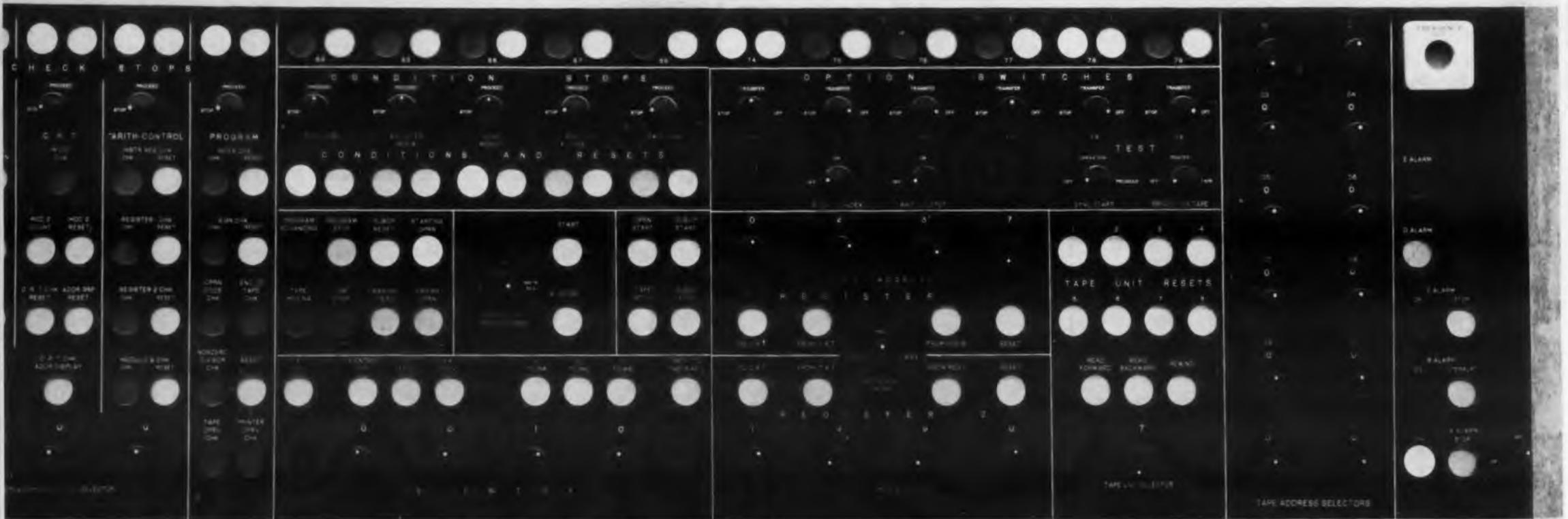
SALES OFFICES IN PRINCIPAL CITIES
CIRCLE ED-34 ON READER-SERVICE CARD FOR MORE INFORMATION

Design Forum

Control Area for a Giant Computer

IBM

NAVAL ORDNANCE RESEARCH CALCULATOR





The control area. One of the intermediate-result printers is at the left. The other one is to the right of the console out of camera range. The operator is checking by means of the console's cathode-ray tube display. Some of the calculation circuits are at the right.

DUE TO the size of the machine and the magnitude of its calculations, IBM's NORC digital computer (*ED, December, 1954, p. 5*) is controlled from a "control area" rather than from a console. The large area also provides accessibility for maintenance of its parts and enough room for more than one operator.

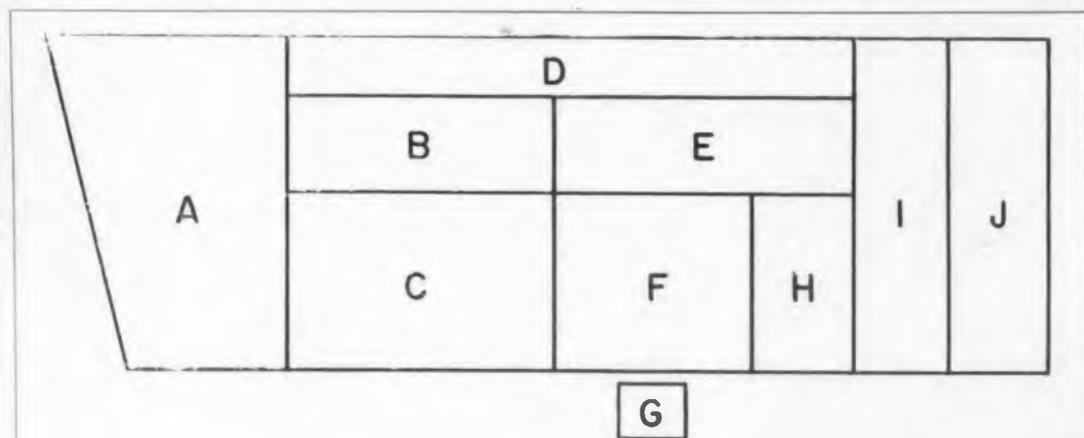
Actually NORC (Naval Ordnance Research Calculator) is not controlled in the sense that an operator participates in the progress of the calculations. How can he when the program is proceeding at the

rate of 15,000 complete operations a second? The operator only starts, checks, and, when necessary, modifies the program. Under best conditions, the program is started by one pushbutton, with no human intervention until the calculations are completed.

For most efficient operation of the computer, the control area was designed with reference to the characteristics and deficiencies of its human operators as well as the needs of the machine. The control area, shown at the left, includes two fast printers (only one is illustrated), a wall-mounted indicator panel, and

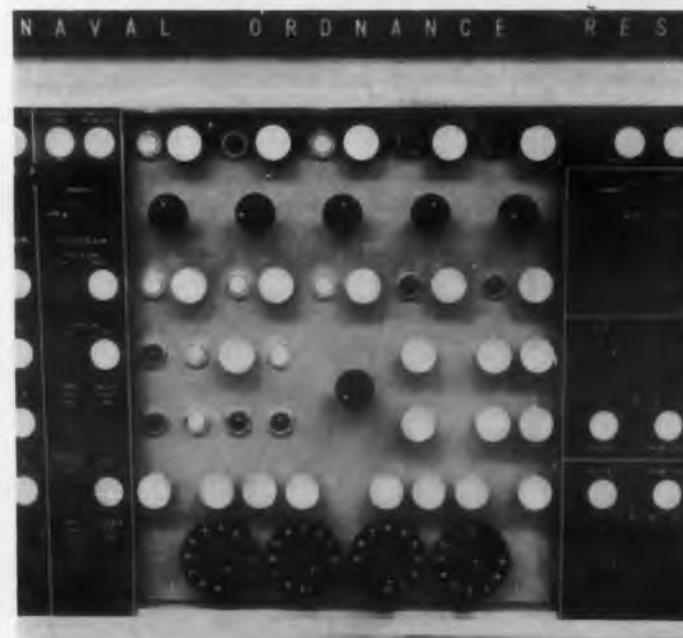
a control console. The area and its components were designed or selected so that a single operator can move from one part to another, or clear across the room to the tape readers, and still be able to observe the functioning of the calculator and the progress of the program as revealed by the indicator lights.

Although each is capable of printing at the rate of 18,000 characters per minute, the two printers are only fast enough to record intermediate results and are employed to check the progress of the program. The final results of the calculations are recorded by



Key to functions of each part of the control panel.

- | | |
|--------------------------------------|---|
| A Checking | G Manual Modification Keyboard |
| B Program Conditions | H Manual Tape Unit Control |
| C Program Start | I Tape Address Selection for Automatic Operation |
| D Program Progress | J Alarms |
| E Program Modification | |
| F Manual Read-In and Read-Out | |



Held in place only by their own weight, sections of the control panel face are easily removed for replacing indicator lights and controls.

Doelcam joins MINNEAPOLIS Honeywell



WE ARE PROUD to become the newest division of the world's largest producer of automatic controls. Our experienced staff of design engineers, our modern manufacturing facilities and our precision instruments all match the high standards set by Minneapolis-Honeywell. We shall continue to maintain our leadership as a quality manufacturer of servo components for bombing and navigational computers, fire control systems and missile stabilization and guidance systems. Whether your applications are of a military, laboratory or industrial nature, you may rely upon our instruments for measurement and control to continue to remain unsurpassed in a precision industry.

Doelcam
A DIVISION OF MINNEAPOLIS-HONEYWELL

H SOLDIERS FIELD ROAD
BOSTON 35, MASS.

Instruments for Measurement and Control
Synchros • Gyros • Amplifiers • Microsyns • Servo Motors



AMPLIFIERS—D-C Indicating Amplifier (shown here), Selected Range D-C Amplifier and Magnetic Null Indicator all use Doelcam Second-Harmonic Magnetic Converter in input stage for low drift and high sensitivity.

Write for Bulletin A 10



GYROSCOPES—Cageable Free Gyro (shown here), Junior Rate Gyro, K Rate Gyro, Gyro Stable Platforms — used in guided missiles, aircraft flight evaluation systems and bombing and navigational computers.

Write for Bulletins K, JR, and CFG10



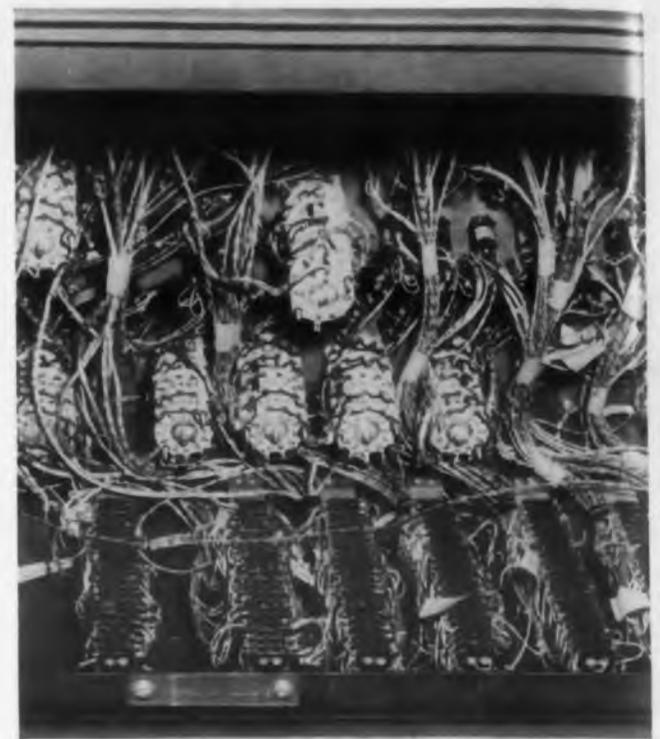
SERVO MOTORS—All Navy Bureau of Ordnance Types —115 volts, 400 cps—fulfill rigid requirements of MIL-S-17087.

Write for Bulletin SM 10



SYNCHROS—Sizes 11 through 31—115 volts, 400 or 60 cps—meet exacting requirements of MIL-S-16892 or FXS-1066.

Write for Bulletin S 10



high-speed tape units. Generally only one printer is in operation at a time, and usually it is the one closest to the console for convenience. However, they are interchangeable. They are modified Type 407 printers made by International Business Machines Corp., 590 Madison Ave., New York 22, N. Y.

The wall indicator panel does not carry markings on any of its 190 lights because it was designed to be read at a distance. The large markings necessary would make the panel too large. A chart indicating the significance of each light is available, but operators soon learn to recognize each light without the chart. The indicator lights on the console duplicate, supplement, or summarize some of the lights on the wall panel.

The console mounts two main parts: the control panel and the bank of cathode-ray tube displays. This display bank is used mainly while the machine is being started and for testing in repeat or "slow motion" operation. The display is tilted back for easy reading by an operator standing some distance away. The control panel is logically arranged for easiest use. The most frequently manipulated controls and the lights concerned with the progress of the program are in the center, while the alarms, tape reader selection controls, and checking controls are on the outside. In addition, the panel is designed for ease of servicing and incorporates certain features to help prevent human error.

The drawing indicates the function of each area of the panel. Areas B and D are at the top because their lights may have to be read at a distance. C, F, H, and G are at the bottom because they contain the

Part of the back of the control panel. Each pushbutton or rotary switch and light runs out to a terminal board for quick replacement.

controls most frequently manipulated by an operator sitting at the console.

Area *A*, "Checking" is logically placed at the left near the cathode-ray-tube display. *J* is rarely observed. *I*, "Tape Address Selection", is only considered before the program begins. *G*, the "Manual Modification Keyboard", must be close to *F*, which contains the control for entry of data from the keyboard. (The keyboard is a standard component designed for card-punching machines.)

To prevent accidental changes, none of the pushbuttons project beyond the face of the panel. As shown by the photo of the panel with one section removed, the holes in the panels are slightly smaller than the faces of the pushbuttons to avoid the need for exact centering of the pushbuttons. The rotary controls are 12-position switches with only 10 detent positions. The extra two detents were removed between "9" and "0" so that the operator would feel decade changes. Left is the "normal" position for all rotary switches. There is some projection of the top of the console over the panel to help prevent anyone from accidentally brushing against and changing one of the rotary controls.

For ease of servicing, all the indicator lights are replaced from the front of the panel by removing section boards. The boards can be removed with a fingernail, and are held in place only by their own weight. As illustrated above, each control switch, and light is connected to an accessible terminal board. They can be replaced very rapidly.

Human engineering is becoming more and more important to the electronic designer. To achieve optimum results in the physical layout of equipment that must be easily used by laymen, technicians, or even highly trained engineers, the services of a human engineer or experimental psychologist should be obtained. However, designers can achieve striking results without outside assistance by closely considering the needs and deficiencies of the human operator. The NORC control area represents a very workmanlike solution to a problem in human engineering.

KEPCO

presents a New versatile
VOLTAGE REGULATED
Multiple
POWER SUPPLY
FOR TRANSISTOR AND ELECTRON TUBE CIRCUITRY

Special Features

5651 Reference tube and wire wound precision resistors in divider network for maximum stability

Precision 10 turn voltage controls

Supplies isolated from each other

Rack and bench mounting

KEPCO Voltage Regulated Power Supplies are conservatively rated. The regulation specified for each unit is available under all line and load conditions within the range of the instrument.



Model 450D

OUTPUT	VOLTS	CURRENT	REGULATION	RIPPLE
1	0-150	0-75 ma.	0.1 volts	3 mv.
2	0-150	0-75 ma.	0.1 volts	3 mv.
1 + 2 series	0-300	0-75 ma.	0.1 volts	3 mv.
3	6.3 AC	10 amp.	†	

REGULATION: As shown in table for both line fluctuations from 105-125 volts and load variation from minimum to maximum current.

† AC Voltage unregulated.

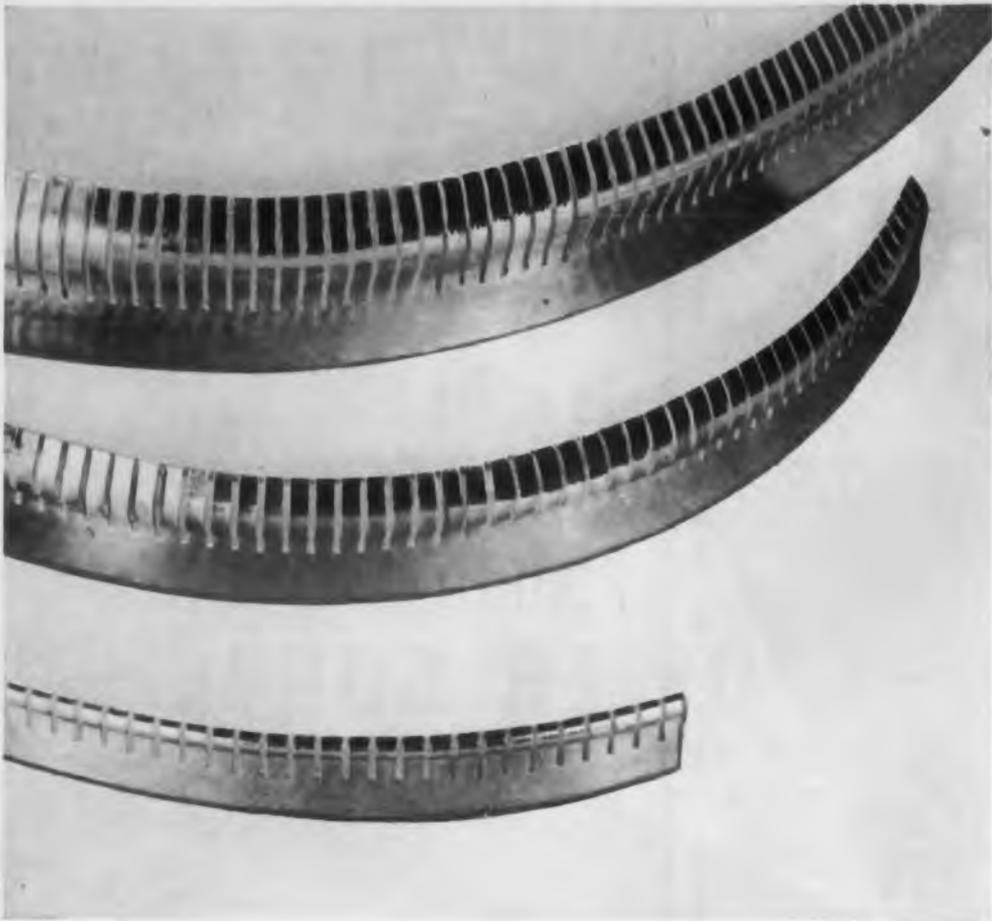
30 ADDITIONAL MODELS
AVAILABLE FROM STOCK
Complete Catalog on request
WRITE DEPT. 68



KEPCO LABORATORIES

131-38 SANFORD AVENUE • FLUSHING 55, N. Y. • INDEPENDENCE 1-7000

VISIT OUR BOOTHS AT I.R.E. SHOW—#342-344 COMPUTER AVENUE
CIRCLE ED-37 ON READER-SERVICE CARD FOR MORE INFORMATION



Eimac finger stock

... IDEALLY SUITED FOR

- providing good circuit continuity with adjustable or moving contact surface components
- making connections to tubes with coaxial terminals
- electrical weather stripping around access doors to equipment cabinets
- making connections to moving parts such as long line and cavity type circuits

Eimac preformed contact finger stock is a prepared strip of heat treated alloy spring material slotted and formed into a series of fingers. Silver plated for efficient RF conductivity, it comes in widths of $\frac{1}{32}$ ", $\frac{3}{32}$ " and $1\frac{1}{16}$ ".

For a complete Eimac Finger Stock data sheet, contact our Technical Services department.

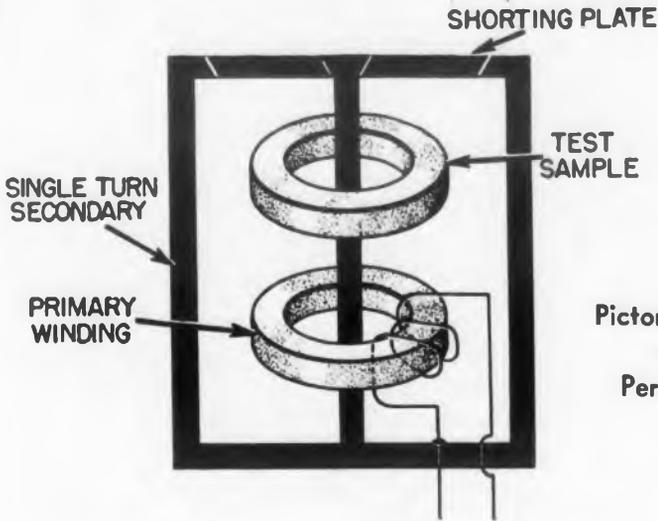


EITEL-McCULLOUGH, INC.
SAN BRUNO • CALIFORNIA

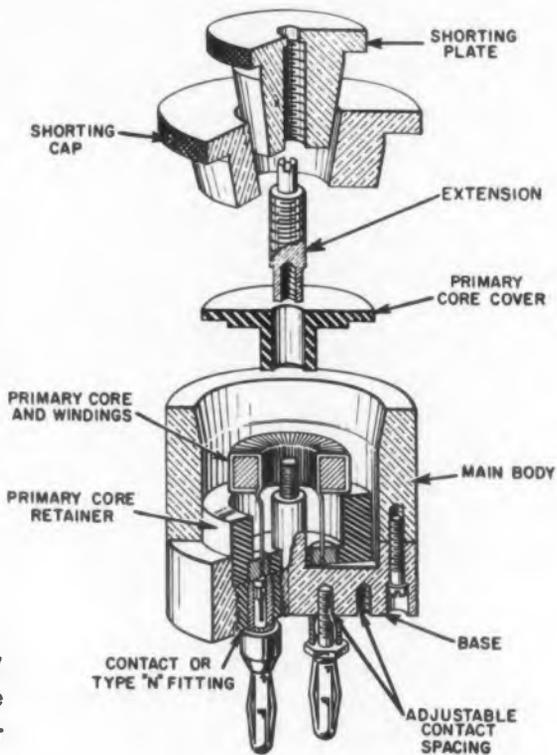
CIRCLE ED-38 ON READER-SERVICE CARD FOR MORE INFORMATION

Radio-Frequency

Permeameter



Pictorial diagram of the Permeameter



Exploded cutaway view of the R-F Permeameter

MA
 Radio-
 and m
 als ca
 sampl
 places
 capaci
 quene
 physi
 magn
 simpl
 The
 forme
 cyclin
 samp
 (shor
 is co
 fleets
 ing t
 Th
 short
 short
 readi
 magn
 equa
 in so
 De
 Bur
 mean
 tion
 Rd.,
 obta
 (± 5
 also
 mea
 ily
 800
 F
 ran
 max
 is e
 mov
 For
 acc
 tur
 ELE



MAGNETIC properties of toroidal cores in the r-f range are easily determined with the Radio-Frequency Permeameter. Both permeability and magnetic loss factor of ferromagnetic materials can be found. No windings are needed on the sample test core—the r-f coil designer merely places the core in the permeameter and reads capacitance change with a Q-meter or radio frequency bridge. From these measurements and the physical dimensions of the core, permeability and magnetic loss factor can be determined by solving simple equations.

The permeameter consists of a toroidal transformer having a single-turn secondary loop (brass cylinder). The secondary loop encloses the test sample, or becomes an open circuit when the cap (shorting plate) is removed. The primary winding is connected to a Q-meter. The test sample reflects a change of impedance in the primary winding thereby affecting the Q-meter.

Three measurements are necessary: open- and short-circuit readings without the sample, and a short-circuit reading with the sample. Values of readings are substituted in simple equations and magnetic properties are determined by solving the equations. A special slide rule is available to aid in solving the permeability equation.

Developed by Peter H. Hass of the National Bureau of Standards, the Radio-Frequency Permeameter is manufactured in two sizes by National Electronics Laboratories, Inc., Kalorama Rd., Washington 9, D. C. Toroid coil designers can obtain magnetic properties of cores accurately ($\pm 3\%$) as well as quickly with the device (it may also be used in production quality control). Permeabilities from 2.0 to well over 500 may be readily measured over the entire frequency range of 800kc to 18Mc.

Four different primary coils cover the frequency range. Core sizes accommodated are: 1.6" OD max; 0.250" ID min; 0.375" height max. The unit is equipped with banana plugs which may be removed for a standard "N" connection if preferred. For more information about the applications and accessories of the Radio-Frequency Permeameter, turn to the Reader Service Card and circle **ED-39**.



Like to have your brain tickled?

Then Centralab's new monthly Electroni-Kwiz is your dish — for fun and prizes*

Answer the Electroni-Kwiz question in 50 words, more or less (who counts?), and you're eligible to win a prize.

Now, we're not giving away any oil wells (a big national advertiser beat us to that), but we do promise awards well worth your time and effort. This month's major prize is a wardrobe of fine men's shoes. A leading editor in this field will pick the winner.

Here's this month's question: If you were to make like Webster, how would you define "automation"?

Sharpen that pencil — flex those mental muscles — and mail your entry to us before March 30.

*Nothing to buy. Employees of Centralab and their advertising agency not eligible. Duplicate prizes awarded in case of tie.



Speaking of automation, here's one Centralab component that fits right into the picture:

When manufacturers worked Centralab's Snap-Tite into their designs... they cut the cost of installing rear-end controls as much as 73%!

More proof that if it's a job for electronic components, it's a job for Centralab

Centralab's creative engineering and production methods pay off for many users of standard and special electronic components



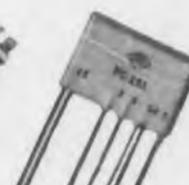
Volume Controls



Capacitors



Switches



Printed Electronic Circuits



Ceramics

Centralab

A DIVISION OF GLOBE-UNION INC.

960C E. Keefe Avenue • Milwaukee 1, Wisconsin
In Canada: 804 Mt. Pleasant Road, Toronto, Ontario

SINCE 1922, INDUSTRY'S GREATEST SOURCE OF STANDARD AND SPECIAL ELECTRONIC COMPONENTS

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

high quality

TEFLON TAPE



● TEFLON'S superior insulating properties make Chemelec tape better for high frequency, high voltage, high temperature service. Surface resistivity 3.5×10^{13} ohms. Loss factor less than 0.0005. Dielectric constant 2.0 (60 cycles to 30,000 megacycles). Serviceable at temperatures from minus 110°F to plus 500°F. Won't carbonize under arcing or DC plate. Zero water absorption by ASTM Test. Chemically inert, non-gassing, immune to corrosive atmospheres, fungus, oil and solvents. Non-flammable.

Available in thicknesses from .002" to .06", in widths from 1/4" to 12" and in standard N.E.M.A colors for circuit identification.

Write for Catalog No. 300.

- See our exhibit at the Radio Engineering Show. Booth 68-70. Kingsbridge Palace.



USG

Fluorocarbon Products, Inc.
Division of
UNITED STATES GASKET COMPANY
Camden, 1, New Jersey

FABRICATORS OF
FLUOROCARBONS & OTHER PLASTICS
Representatives in principal
cities throughout the world



Luneberg Lens

Assembled with their corresponding half-shells, these pieces make an 18" sphere which focuses 3.10cm electromagnetic waves.



LUNEBERG
(STATI

MI

these
electro
can be
can be
Scann
lens e
horn

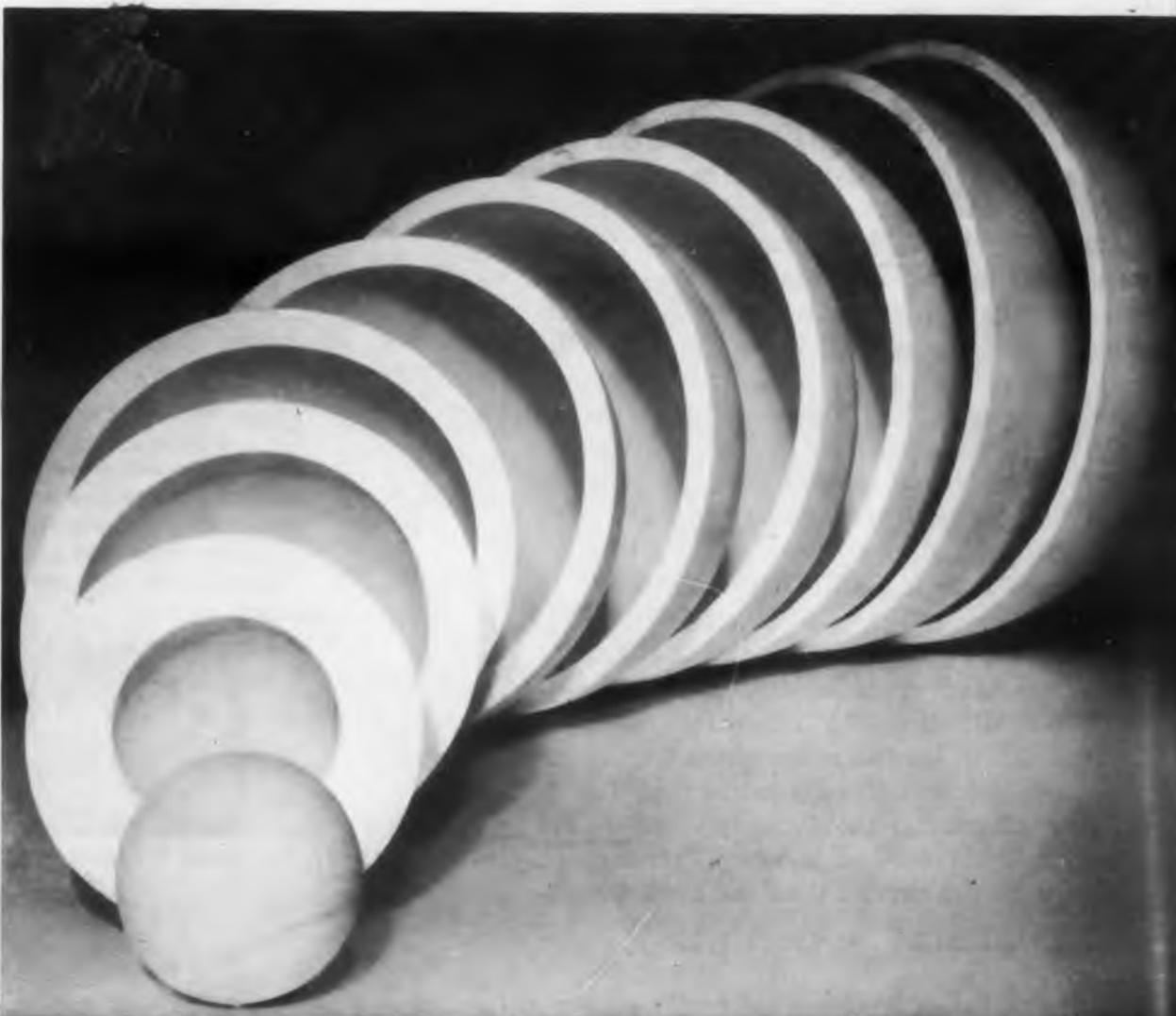
The
possib
ington
consta
consta
tolera

In
the co
ing s
incre
const
electr
outer

Th
Lens
unde
John
use o
For
lined
lens

Th
foam
is 0.
and
Caré
disp

ELEC



LUNEBERG LENS
(STATIONARY)

MICROWAVE energy from a point source can be formed into a narrow beam with a set of these concentric plastic shells. Conversely, plane electromagnetic waves striking the spherical lens can be focused to a point. This 18" Luneberg Lens can be used to replace more cumbersome reflectors. Scanning can be made simple since the spherical lens can remain stationary and only the small feed horn need move.

The concentric shell-type construction made it possible for Emerson & Cuming, Inc., 869 Washington St., Canton, Mass., to control the dielectric constant in ten steps. Hence the total dielectric constant, or index of refraction, is held to a close tolerance.

In the lens shown here, the dielectric constant of the core of the lens is $2.0 \pm .02$, and each succeeding shell decreases in dielectric constant by an increment of 0.1. The outside shell has a dielectric constant of $1.1 \pm .02$, closely approaching the dielectric constant of the air surrounding the lens' outer surface.

The successful development of the Luneberg Lens sponsored by the Naval Research Laboratory under the direction of Mr. George Peeler and Dr. John Bohnert opens up new possibilities for the use of the variable index of refraction materials. For example, in aircraft or missile work, a streamlined version of the variable index of refraction lens might become the physical nose of a radome.

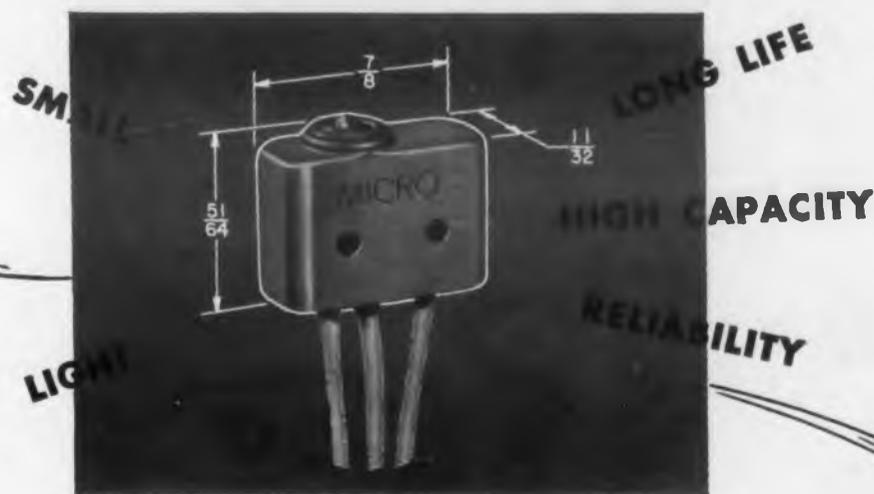
The lens is made from an extremely low loss foam-type plastic. The maximum dissipation factor is 0.0002. For more information on the properties and uses of the lens, turn to the Reader Service Card and circle **ED-42**. This product will be on display at the Radio Engineering Show, Booth 676.

ELECTRONIC DESIGN • March 1955

MICRO SWITCH Precision Switches

A PRINCIPLE OF GOOD DESIGN

**This switch has
ALL you have asked for
in a sealed subminiature switch!**



*Check these features against
your most critical requirements*

Absolutely environment-proof:

Switching element is sealed with an elastomer plunger seal. This is bonded to both the pin plunger and the metal housing. The switch element is embedded in an epoxy casting resin which also seals the leads. The exterior is of corrosion-resistant, treated aluminum.

Light weight—small size:

Unit is $7/8$ " long and $11/32$ " thick. Weight is less than .03 oz.

Wide temperature range:

Designed to give trouble-free operation in a temperature range of from -65° F. to plus 180° F.

High electrical ratings:

Electrical rating is 30 volts d-c, 2.5 amperes inductive, 4 amperes resistive. Maximum inrush is 15 amperes.

Long life:

Minimum mechanical life, 300,000 operations under average use conditions.

See MICRO SWITCH Exhibit
Radio Engineering Show • March 21-24
Kingsbridge Armory • New York, N. Y.

There are always new switches and new assemblies on the drawing boards and on test at MICRO SWITCH. Don't experiment. Call MICRO SWITCH first. It is the short cut to getting THE switch for your application.

A complete line of snap-action switches for aircraft



MICRO SWITCH

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

In Canada, Leaside, Toronto 17, Ontario • FREEPORT, ILLINOIS



MICRO SWITCH provides a complete line of extremely reliable, small-size, high-capacity, snap-action precision switches and mercury switches. Available in a wide variety of sizes, shapes, weights, actuators and electrical characteristics. For all types of electrical controls.

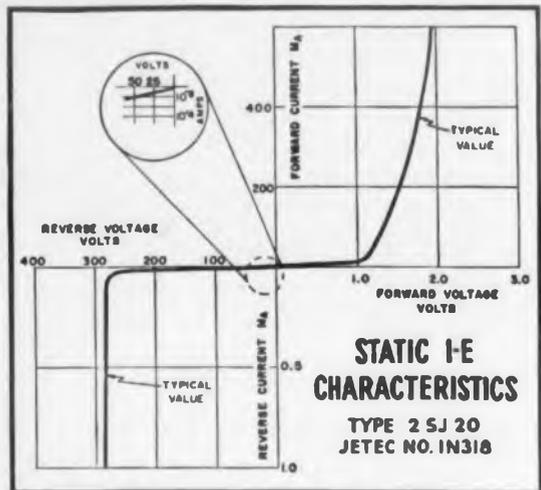
CIRCLE ED-43 ON READER-SERVICE CARD FOR MORE INFORMATION

An Important Announcement to Industry



New SILICON POWER RECTIFIERS

AVAILABLE FOR THE FIRST TIME
IN PRODUCTION QUANTITIES



Jetec No.	TYPE	Forward Drop @ 200 MA	Forward Current Continuous	Power Current Peak	Peak Inverse
1N 316	2SJ5	2V Max	200 MA	2A	50V
1N 317	2SJ10	2V Max	200 MA	2A	100V
1N 318	2SJ20	2V Max	200 MA	2A	200V
1N 319	2SJ30	2V Max	200 MA	2A	350V
1N 320	2SJ50	2V Max	200 MA	2A	500V

Units with peak inverse rating of 850 volts available in sample quantities.

Characteristics:

1. Highest Efficiency
2. High Current
3. High Voltage
4. High Ambient Operation
5. Hermetically Sealed
6. Small in Size
7. Light in Weight
8. Rugged - All Welded
9. Low Forward Drop
10. Low Leakage

Performance:

1. Rectification Efficiency Over 99%
2. Forward Voltage Drops Averaging 1.5 Volts at 200 MA
3. Peak Inverse Voltages to 1,000 Volts
4. Operates Continuously up to 200° C
5. Leakage Current as Low as 10-10 amperes
6. Rectification Ratios as High as 10⁶
7. Practically Flat Zener Characteristics

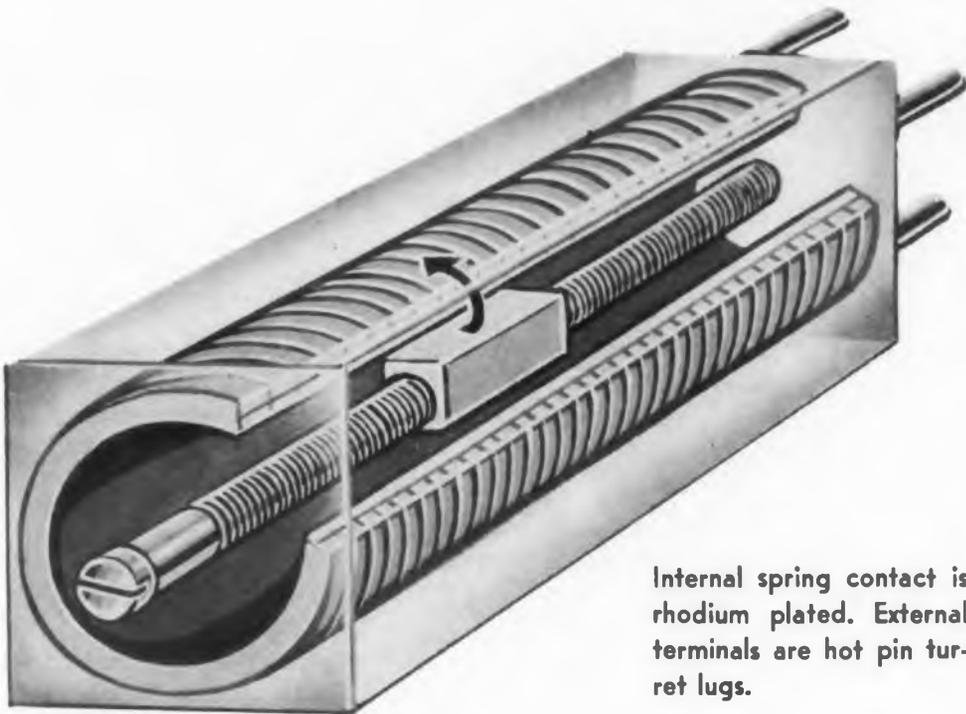
Write for fully illustrated and informative Bulletin SR-18-4

BOGUE

BOGUE ELECTRIC MANUFACTURING COMPANY
PATERSON 3, NEW JERSEY

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

Encapsulated Trimming Potentiometer



Internal spring contact is rhodium plated. External terminals are hot pin turret lugs.

ENCAPSULATED
the
again
indric
poten
Prop
wire
orden
The
stabi
50 to
 $\pm 1\%$
coeff
degr
The
ome
sist
the
squa
T
ope
the
tefl
T
and
for
to
Th
gin
ELE



Rectangular-shaped potentiometers can be easily stacked.

ENCAPSULATED in a thermosetting plastic, these trimming potentiometers are protected against humidity effects. By incorporating a cylindrical wire form and an internal tap design, the potentiometer uses relatively large area wire. Proper tap design coupled with this larger area wire make it possible to obtain resolutions in the order of 0.15% to 0.5%, whichever is desired.

The large diameter wire gives a maximum of stability. Standard resistance values range from 50 to 10,000 ohms. Resistance tolerances of $\pm 5\%$, $\pm 1\%$ or $\pm 0.1\%$ may be specified. Temperature coefficients as low as 0.00002-ohm per ohm per degree Centigrade can be ordered.

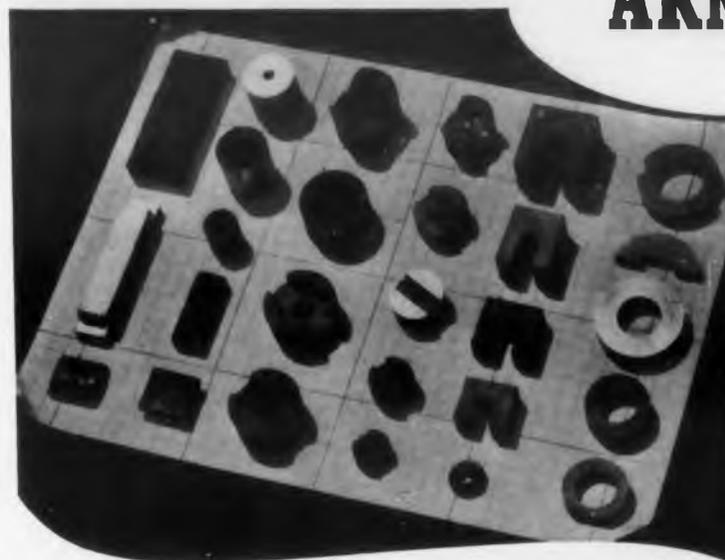
The actual size of the tiny trimming potentiometer, manufactured by Eastern Precision Resistor Corp., Richmond Hill 18, N. Y., is shown by the outline silhouette. The dimensions are $7/16''$ square by $1-9/32''$ long.

The interior of the unit is sealed at the shaft opening by an O-ring; for extremely tight seals, the lead screw can be made of slightly oversize teflon.

The potentiometers are rated at $1/4w$ at 100°C and derate linearly to $0w$ at 125°C . For more information on these trimming potentiometers, turn to the Reader's Service Card and circle **ED-45**. This product will be on display at the Radio Engineering Show, Booth 686.



ARNOLD



YOUR ONLY SOURCE

of a Complete Line of MAGNETIC MATERIALS

**TECHNICAL DATA ON
ARNOLD PRODUCTS... Write
for your copy.**

Bulletin GC-106 . . . General information on all Arnold magnetic materials: permanent magnets, tape-wound and powder cores, etc.

Bulletin TC-101 A . . . "Properties of Deltamax, 4-79 Mo-Permalloy and Supermalloy"—28 pages of technical data on Arnold Tape-Wound Cores.

Bulletin PC-104 . . . "Molybdenum Permalloy Powder Cores"—16 pages, complete technical data.

Bulletin SC-107 . . . "Arnold Silectron Cores"—52 pages of valuable data, covering a complete range of core shapes, sizes, tape gauges, etc.

ADDRESS DEPT. ED-53

Arnold products include all grades of Alnico permanent magnets (cast and sintered) . . . tape-wound cores of high-permeability alloys, such as Deltamax, Permalloy and Supermalloy . . . types "C" and "E" cut cores of Silectron in any size or weight range from a fraction of an ounce to hundreds of pounds (50 lbs. max. on 12-mil C cores); also round, square and rectangular Silectron cores . . . powdered Mo-Permalloy cores . . . Cunife, Vicalloy, Permendur and other magnetic materials. Special magnetic components can be produced to meet your specific requirements; and such products as powder cores, tape-wound cores, and C and E cores are carried in stock in a wide range of standard sizes for immediate delivery. Many sizes of cast and sintered Alnico magnets also are stocked.

In other words, Arnold magnetic materials can answer *any* requirement you may have. It is the *only* complete line in the industry; and in addition, Arnold maintains complete control over every production step from raw materials to finished products. Such a source can bring you advantages in long experience and undivided responsibility, and in unequalled facilities for quality production and control. ● *Let us supply your needs.*

WAD 5548

THE ARNOLD ENGINEERING COMPANY



SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

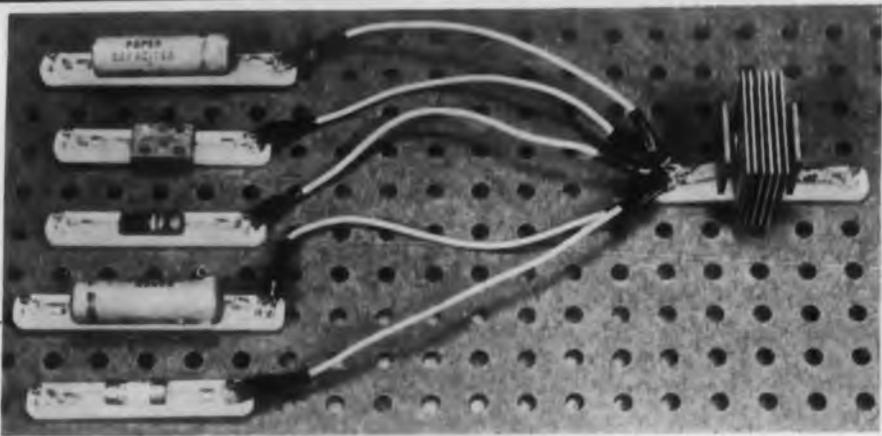
General Office & Plant: Marengo, Illinois

DISTRICT SALES OFFICES . . . New York: 350 Fifth Ave.

Los Angeles: 3450 Wilshire Blvd.

Boston: 200 Berkeley St.

CIRCLE ED-46 ON READER-SERVICE CARD FOR MORE INFORMATION

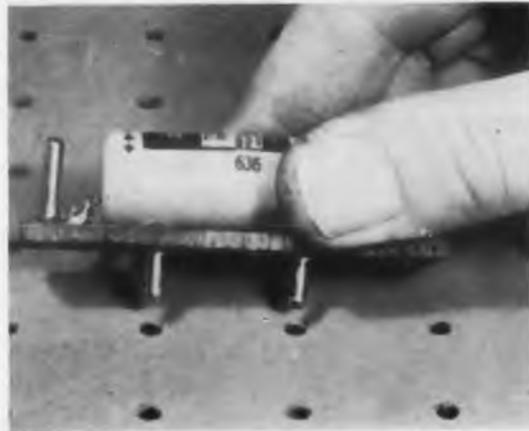


Solderless Breadboard System

CIRCUIT construction time can be reduced 90% by using "floating" components and Jiffy-connectors. Mechanical operations such as chassis fabrication and soldering have been completely eliminated in this tested breadboard system. The circuit designer can connect at least a dozen components and start running evaluation tests in less than ten minutes.

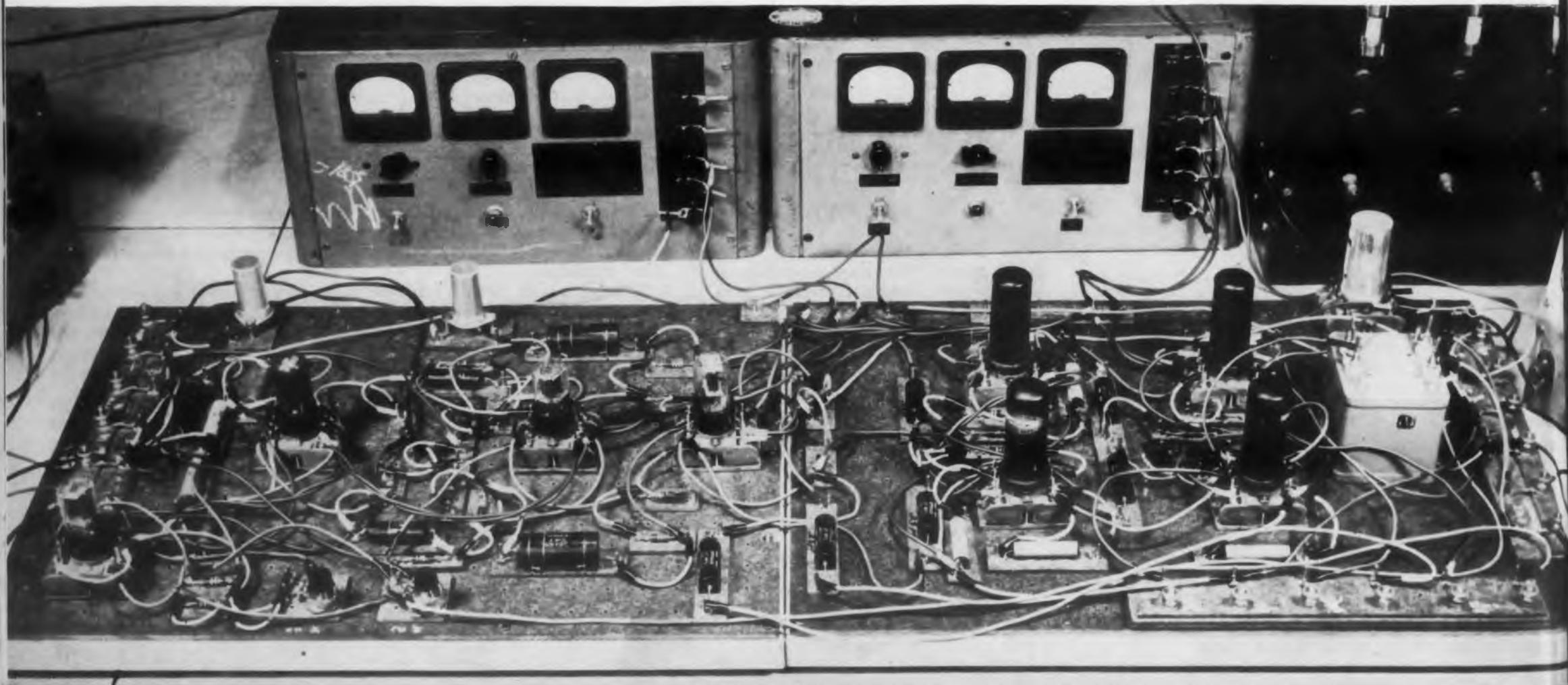
In this system, developed by Science Electronics, Inc., 485 Main Street, Cambridge 42, Mass., the component becomes a self-supporting and reusable unit equipped with binding posts tailored for the solderless Jiffy-connectors. A variety of different-sized mounting blocks are available to accommodate most components such as, resistors, capacitors, tubes, potentiometers, and inductances. To interconnect these circuit elements, Jiffy-connectors are simply clipped to the binding posts. The U-shaped phosphor bronze clip of the connector has a specially swaged notch that grips the cylindrical binding post.

Up to seven connectors can be clipped to any one binding post. Any connector can be removed with a slight pull without disconnecting other leads, a decided advantage when experimenting to find component values which give proper circuit performance.



Circuit shown below is cross-coupled phase inverter feeding cascade driver operating into bridge-type output stage. Construction time 1-1/2 hrs.

Connectors are well insulated.



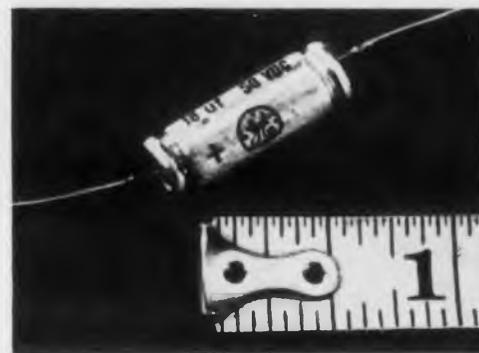
The bottom blocks the pu circuit, as they can be between Com in a fe stand times. durabl nector resista have of trou This the m found Adapt screw Auxil grip tips" than there most Be opera are n his o all of sis. turn ELEC

CAPACITORS by General Electric



MICRO-MINIATURE

For low voltage d-c miniaturized electronic equipment (hearing aids, walkie-talkies, paging systems). Ideal for transistorized assemblies. **Ratings** 1-8 uf at 4 v. d-c, 1 uf at 8 v. d-c, 0.5 uf at 16 v. d-c. **Tolerance** -0 to +200%. **Temp. range** -20 to +50° C. **BULLETIN** GEA-6065.



TANTALYTIC*

For electronic equipment requiring small size, low leakage current, long shelf life, wide temperature range. Plain or etched foil, and polar or non-polar types, suitable for a-c or d-c. **Ratings** 0.25-580 uf, 3.75-150 v. **Tolerance** ±20% (plain foil), -15 to +75% (etched). **Temp. range** -55 to +85° C. **BULLETIN** GEC-808.



METAL-CLAD TUBULAR

For d-c uses where reliability under severe operating conditions is required (military electronic equipment). **Ratings** 0.001-1 uf at 100, 200, 300, 400 and 600 working v. d-c. (Can be applied to a-c circuits with adequate derating.) **Tolerances** ±5, ±10, or ±20%. **Temp. range** -55 to +125° C. **BULLETIN** GEC-987.



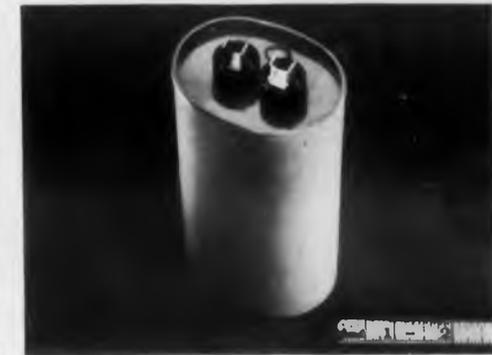
PERMAFIL-IMPREGNATED

Designed to meet requirements of MIL-C-25A, characteristic K specifications, and are suitable for high-temperature operation. **Ratings** 0.05-1 uf at 400 v. d-c. **Tolerance** ±10%. **Temp. range** -55 to +125° C. **BULLETIN** GEC-811.



STANDARD COMMERCIAL

For motors, filters, communication equipment, luminous-tube transformers, industrial control. **Ratings** dual rated units (a-c or d-c) rated at 0.01-50 uf, at 236-660 v. a-c, 400-1500 v. d-c. Single rated units also available. **Tolerance** ±10%. **Temp. range** -55 to +85° C. **BULLETIN** GEC-809.



DRAWN-OVAL

For air conditioning and refrigeration equipment, fluorescent lamp ballasts, business machines, voltage stabilizers. Single, dual or triple-section types. **Ratings** 1-20 uf at 236-660 v. a-c, and 1-15 uf at 600-1500 v. d-c. **Tolerance** ±10%. **Temp. range** -30 to +70° C. **BULLETIN** GEA-5777.

*Reg. trademark of General Electric Company.



ENERGY STORAGE

For use in high magnetic fields and high intensity arc discharge. **Ratings:** may be built as high as 2000 joules (watt-seconds). **Tolerance** ±10%. **BULLETIN** GEA-4646.



NETWORK

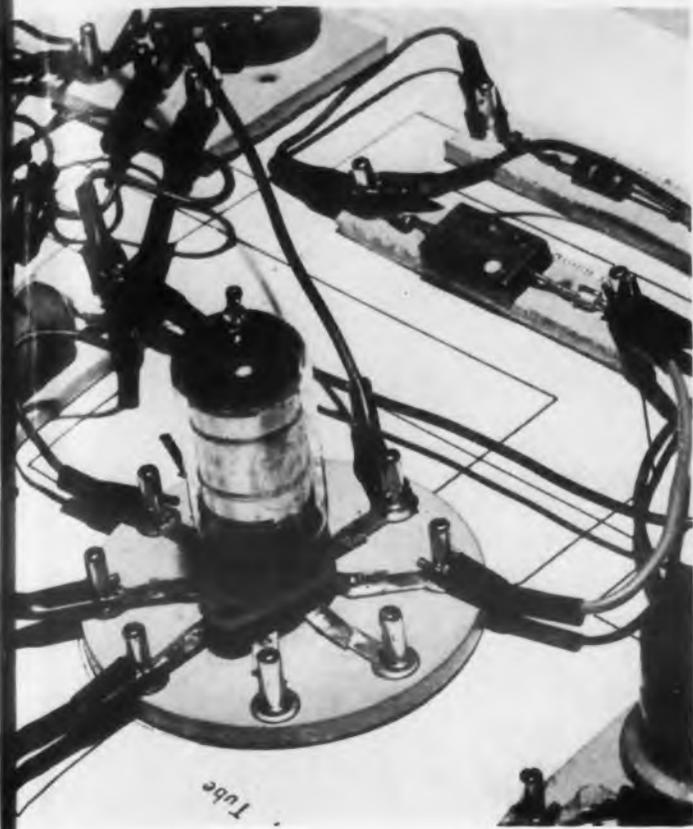
For guided missiles, aircraft, radar equipment. **Ratings:** built to user specifications. **Temp. range** -55 to +125° C, or to user specifications. **BULLETIN** GEA-4996.

NOTE: All capacitance tolerances are given at +25° C.

Progress Is Our Most Important Product

GENERAL ELECTRIC

CIRCLE ED-146 ON READER-SERVICE CARD FOR MORE INFORMATION



The mounting blocks include accurately spaced bottom studs so that the components affixed to the blocks can be inserted into any pair of holes of the punched baseboards. In laying out a new circuit, the components can be located side by side as they might occur on a terminal board, or they can be separated to preclude coupling or pickup between leads.

Complex circuits can be completely dismantled in a few seconds. The component blocks can withstand rough handling and can be reused many times. The Jiffy-connectors are as strong and durable as the wire they are made of. The connector can carry up to 30 amperes. The contact resistance is extremely low and cascaded r-f stages have worked for long periods with no evidence of trouble.

This system becomes extremely effective when the majority of the most often used components found in the laboratory stockroom are converted. Adapters are available so that test equipment with screw terminals can be used with Jiffy-connectors. Auxiliary connectors with miniature clips that grip pigtail leads are also available. These "grip tips" lock securely on leads and are less bothersome than alligator clips. They require less space and there is no danger of inadvertent shock because most of the tip is insulated.

Because time consuming and tedious mechanical operations are obviated by this design, technicians are not needed. The circuit designer can construct his own circuits in such short order that practically all of his attention can be devoted to circuit analysis. For more information about this new product, turn to the Reader's Service Card and circle **ED-145**.

SEND COUPON BELOW for complete information about G-E capacitors.

General Electric Co.
Section C 442-25
Schenectady 5, N. Y.

Please send me capacitor bulletins checked below.

- | | |
|-----------------------------------|----------------------------------|
| <input type="checkbox"/> GEA-4646 | <input type="checkbox"/> GEC-808 |
| <input type="checkbox"/> GEA-4996 | <input type="checkbox"/> GEC-809 |
| <input type="checkbox"/> GEA-5777 | <input type="checkbox"/> GEC-811 |
| <input type="checkbox"/> GEA-6065 | <input type="checkbox"/> GEC-987 |

Name.....

Position.....

Company.....

Address.....

City..... Zone..... State.....

Hearing Aid in Eye-Glass Frames

MANY persons afflicted with defective hearing have refused to purchase hearing aids because they consider conventional hearing aids, small as they are, unsightly or clumsy. The development of a hearing aid that fits inside eye-glass frames should lead many of the hard of hearing to accept the electronic hearing aid.

Known as "Listeners", these hearing aids weigh only 3 oz. The electronic parts weigh only 1-1/2 oz. They were developed by Otarion, Inc., 185-7 Ashford Ave., Dobbs Ferry, N. Y.

The parts of the hearing aid fill 35 different cavities in a pair of specially designed eye-glass frames. If the purchaser wears glasses, he can have prescription glasses fitted into the frames by an optometrist. If not, "window panes" can be mounted in the frame. The circuitry, microphone, and four-position sensitivity switch fit into one of the "temples", while the battery and sound reproducer are mounted in the other temple. There are three wires running between the two temples through the frame. The hinges between the temples and the frame are the connectors for one wire. Two wiping contacts at each hinge are the connections for the other two wires, respectively. When the device is removed from the head and the temples closed in the normal manner, the four wiping contacts are opened and power to the hearing aid is interrupted. The sound is carried from the sound reproducer through a short, hollow transparent plastic tube to the conventional molded-plastic ear-piece.

The circuitry for this firm's conventional hearing aid was adapted for use in the Listeners. Three transistors are employed in a three-stage design. The two voltage-amplifier stages employ *CK 784* transistors, while the output stage is a *CK 784* transistor. All three transistors are made by Raytheon Manufacturing Co., 55 Chapel St., Newton 58, Mass. Gains per stage are 20db, 20db, and 20db, respectively, for

a total gain of 60db. Each stage is compensated for temperature and resistance changes to make the selection of transistors simple and the circuit stable.

Most of the components are mounted on two sections of melamine impregnated canvas. The sensitivity switch is made up of a ceramic base with silver printed and fired on it. This switch is fabricated by Centralab, Div. of Glove-Union, Inc., 9201 E. Keefe Ave., Milwaukee 1, Wis.

Transformer coupling is employed. The two miniature transformers are supplied by Chicago Standard Transformer Corp., 3501 Addison St., Chicago 18, Ill. The tantalum coupling capacitors are made by either General Electric Co., Syracuse, N. Y., or Sprague Electric Co., 97 Marshall St., N. Adams Mass. The microphone is manufactured by Knowles Electronics Co., Franklin Park, Ill. The 1.3v mercury battery is supplied by either General Dry Batteries, Inc., 13000 Athens Ave., Cleveland 7, Ohio; P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis, Ind.; or National Carbon Co., 30 E. 42nd St., New York 17, N. Y. The sound reproducer is of Otarion's own design.

Designing the enclosure for this hearing aid is obviously far more complicated than is the case for other electronic devices. The style and general appearance are determined by the design of eye-glass frames. There is also a considerable variation in head size among potential customers. The solution was to have eight different sets of plastic molds prepared, four for men's sizes and four for women's sizes. The cavities that hold the hearing aid are standard, so that the electronic parts are standard, but the frames and the length of the temples vary.

The variation in customers' head size makes the fitting of Listeners a job for the optometrist. In order to purchase this hearing aid, the customer must first take a hearing test in order to determine the proper

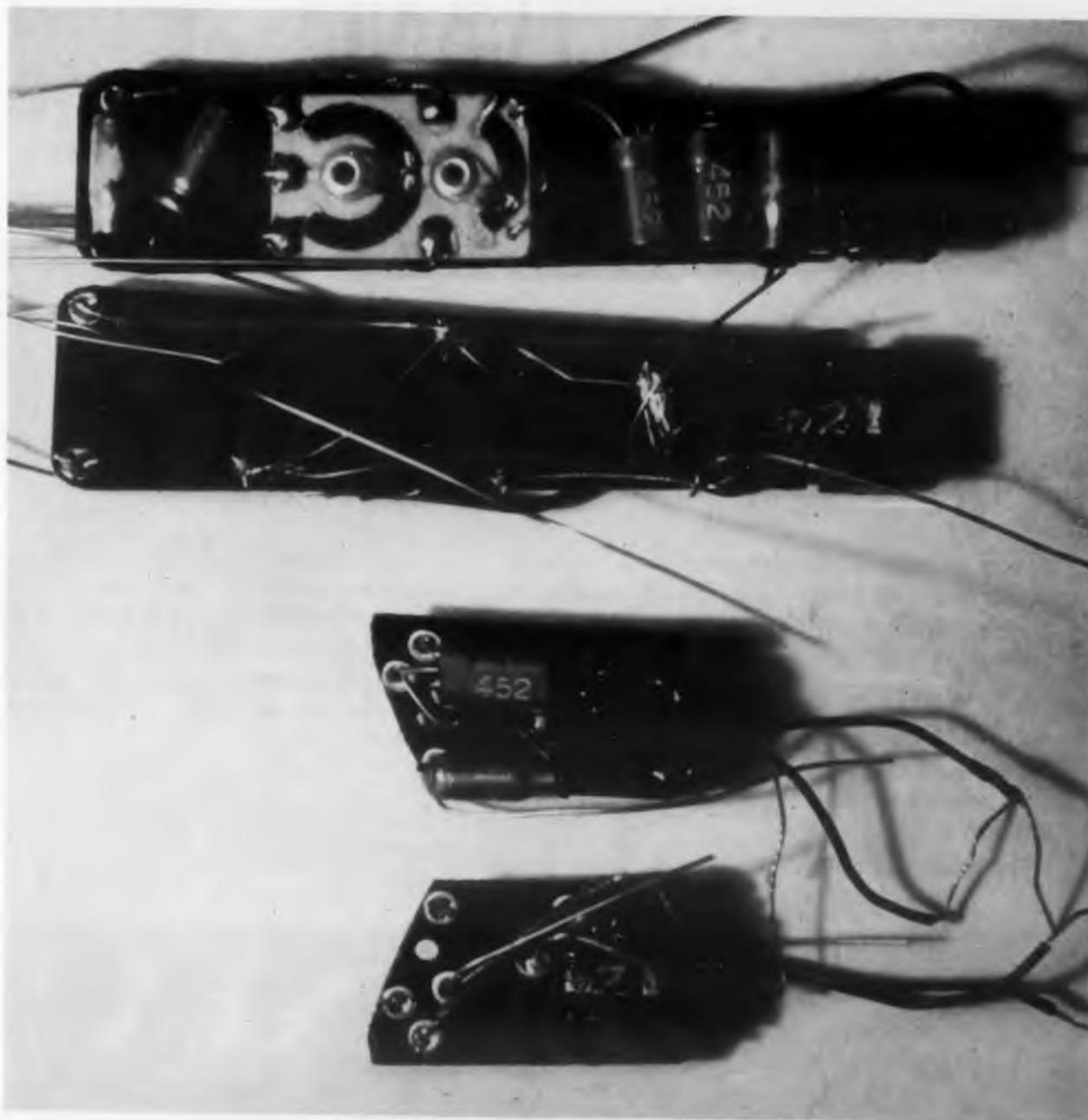




The two "temples" containing the circuitry are connected by three wires running through the frame.



The battery and sound reproducer are mounted in the upper temple, while the microphone, switches, and amplifier are in the lower one.



Top and bottom views of the main subchassis. The printed-circuit sensitivity switch is mounted

on the upper melamine-canvas chassis. These chassis are standard for all models.

sensitivity level for his instrument. (The sensitivity and volume-compression adjustment is made only at the factory.) The patient then goes to an optometrist, who measures his head size and may also prescribe any required glasses. The optometrist forwards the measurements to the Otarion factory where the hearing aid is assembled in the correct frames and shipped to the optometrist, who mounts the lenses and makes the final fitting. The plastic frames bend slightly. The entire procedure takes about two to three weeks, or about as long as it takes to have glasses prescribed. The frames are made of "Tenite", a plastic manufactured by Tennessee Eastman Co., 260 Madison Ave., New York, N. Y.

The frames are now made in two colors, tortoise and black, but additional colors will be available. The temples are designed so that the sound reproducer can be placed in the left or right temple, depending on which ear is defective.

This instrument was first conceived five years ago by C. R. Mackay, Chief Engineer and Vice-President of Otarion, and a working model was built 18 months ago. Development of a production model was delayed by the lack of proper transformers and a suitable magnetic microphone. Transformers of the necessary small size were available, but were not efficient enough. In the past 18 months, smaller transistors have also been placed on the market.

Electronic devices are contributing to our health and well-being in many ways, both direct and indirect. Mr. Mackay and the Otarion organization are to be congratulated for making the hearing aid acceptable to many more people than ever before. They are also to be commended for producing a triumph of miniaturization. This device not only extends the market for hearing aids, but points to other miniature designs for the consumer, such as a radio receiver in eye-glass frames.



•rod•



•parts•



•plated wire•



•wire•

IT'S HERE!



•powder•

SYLVANIA MOLYBDENUM

IF YOU ARE LOOKING for *high uniformity* molybdenum to help you reduce vacuum tube costs—Sylvania is now your dependable source!

Sylvania's exacting quality control assures you of excellent uniformity, in both physical properties and dimension—today or a year from today. Every step in the production of molybdenum . . . from crude oxide to finished form . . . is carried on in Sylvania's own plants. Your orders are filled to your exact specifications by Sylvania, and Sylvania alone.

The superior elongation, ductility and machinability of Sylvania molybdenum has made it a preferred metal

for many vacuum tube applications . . . support, mandrel and grid wires; heat shields; heating elements. It has an outstanding record of success in heavy emission tube types where high heat resistance is essential.

Sylvania's engineering department will gladly help you explore the advantages of molybdenum for your specific applications.

Write for complete information.

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.

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

SYLVANIA



Lighting • Radio • Electronics • Television • Atomic Energy

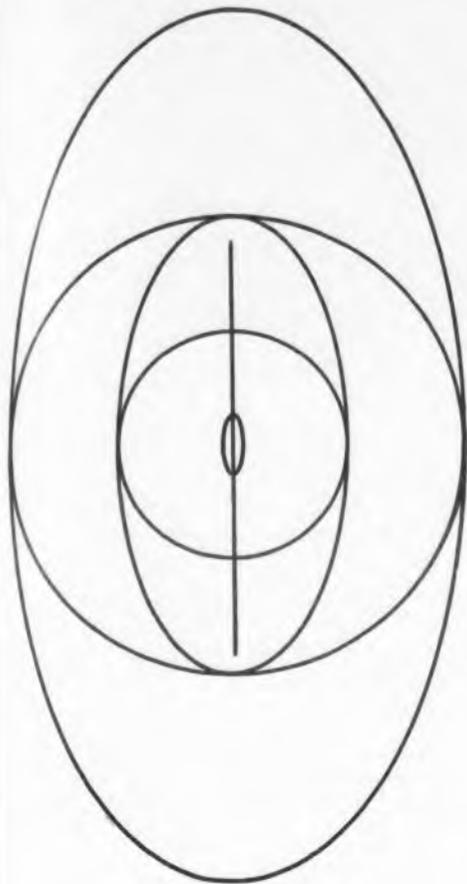
CIRCLE ED-50 ON READER-SERVICE CARD FOR MORE INFORMATION

Ellipse-Drawing Tool

ISOMETRIC drawings can be more rapidly made from orthographic engineering drawings by means of the instrument illustrated on these pages. Known as the "Ellipsograph", it quickly and accurately draws ellipses up to 7" long without the aid of templates.

The instrument can draw the proper ellipses in the following three situations: both major and minor axes known; major axis known; degree of ellipse known, but minor axis unknown; and minor axis known, degree of ellipse known, but major axis unknown. It draws in either pencil or ink.

The Ellipsograph is manufactured by Fowler Engineering Co., 1109 Maple St., Whittier 2, Calif. It is supplied with instructions for its use and all necessary calculation charts. The unit is 5-3/4" wide x 13-1/2" long. All working parts are chrome-plated. For more information and applications, turn to the Reader's Service Card and circle **ED-51**.



Making ellipses with the Ellipsograph. Some examples are shown above.

If your specialized design requires cathode-ray tube characteristics beyond the capabilities of a standard RETMA tube, only disappointment or excessive cost can result from "making do" with a cathode-ray tube that only approximates design requirements. For such problems Du Mont special cathode-ray tubes—tailor-made to your specific requirements—provide the answer. Either by modifying an existing design or by developing a wholly new tube, Du Mont will create an indicating element to match your requirements *perfectly*. Moreover, the vast production facilities of Du Mont are at your disposal, so that whether your requirements are for a single tube, or for production quantities, Du Mont can DELIVER. And you may be sure that, regardless of the quantity, all tubes will be built to the same rigid specifications as the original hand-made model.

Cathode-ray Tubes

Whether you require a special cathode-ray tube, or one of the complete line of standard, RETMA types, or one built to MIL-E-1 specifications, turn to Du Mont. The longest and most varied experience in this country in designing and building cathode-ray tubes of all types assure you the consistently high quality and reliability that have made Du Mont *THE* name in cathode-ray equipment for twenty-five years.

For information on Du Mont's Special Tube facilities, write:

TECHNICAL SALES DEPARTMENT, ALLEN B. DU MONT LABORATORIES, INC. 760 BLOOMFIELD AVENUE, CLIFTON, NEW JERSEY

SEE THE DU MONT EXHIBIT AT THE IRE SHOW BOOTHS 264-266-286

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

DU MONT

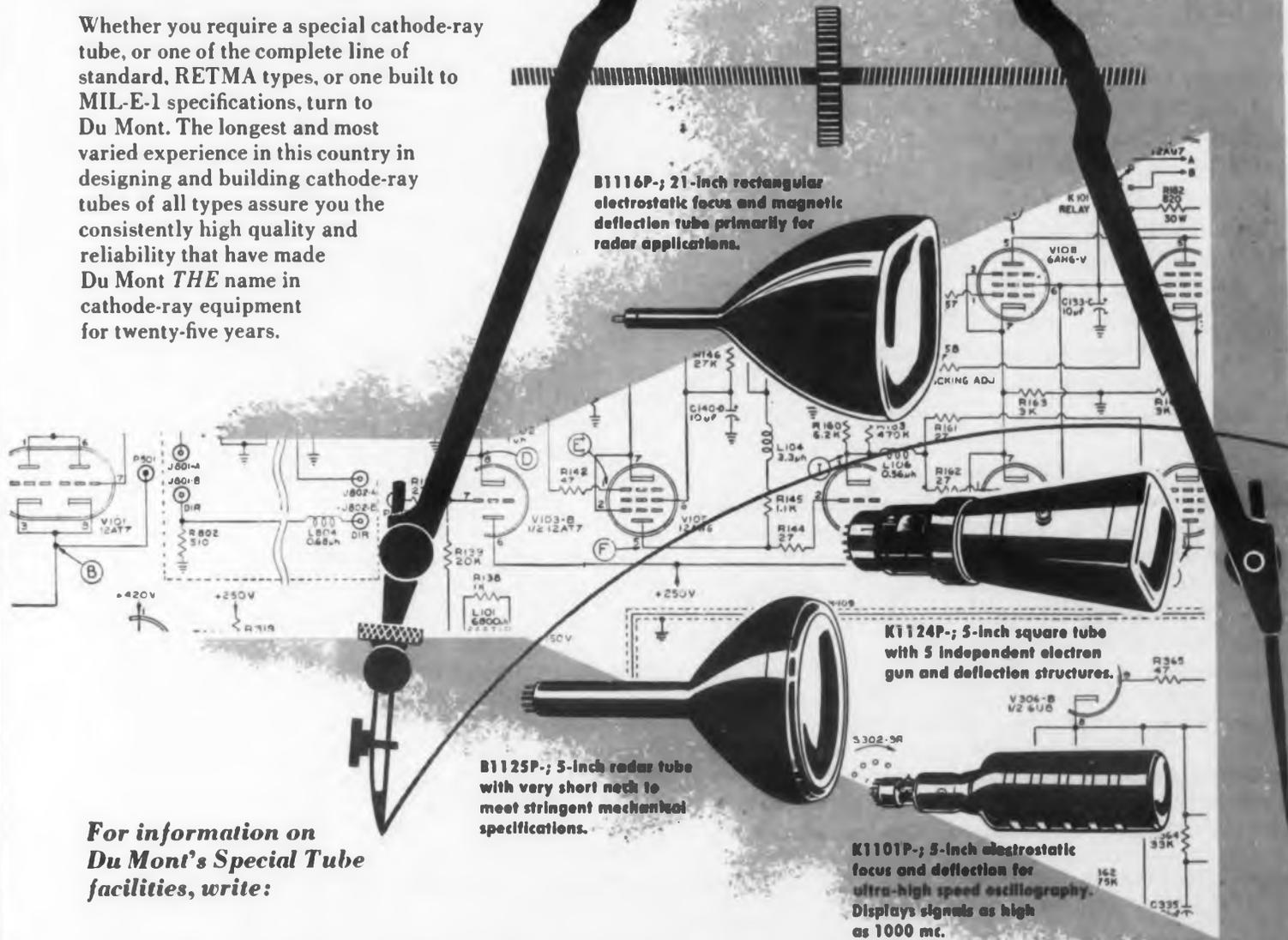
TAILOR-MADE

B1116P; 21-inch rectangular electrostatic focus and magnetic deflection tube primarily for radar applications.

K1124P; 5-inch square tube with 5 independent electron gun and deflection structures.

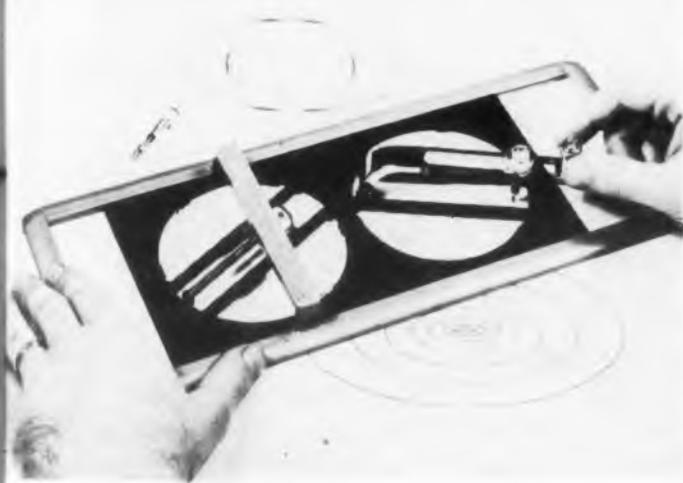
B1125P; 5-inch radar tube with very short neck to meet stringent mechanical specifications.

K1101P; 5-inch electrostatic focus and deflection for ultra-high speed oscillography. Displays signals as high as 1000 mc.



made
s by
pages.
d ac-
t the

ses in
and
ree of
minor
major
nk.
owler
Calif.
nd all
-3/4"
rome-
, turn
D-51.



Technical Problems Affecting National Defense:

Supplementary List

THE National Inventors Council has published a supplementary list to the 1954 edition of "Technical Problems Affecting National Defense", from which problems of interest to electronic designers were abstracted in the November, 1954, issue of *ELECTRONIC DESIGN* (pp. 26-27). Similar problems abstracted from the supplement are listed below. Actual or suggested solutions to any of the problems are welcomed by the Council.

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

Copies of the list and the supplement will be supplied free of charge to any individual or organization. The address of the Council is as follows:

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

Components

Ball Bearing. Greaseless ball bearings suitable for use at temperatures from -65°C to $+535^{\circ}\text{C}$ for high temperature electronic applications.

High-Altitude Brushes for Electromechanical Equipment.

Rectifier. Rectifiers that are rugged, reliable and will operate at temperatures up to 500°C .

Waveguide Components. Lightweight waveguide components made of high-impact, resistance-reinforced plastic and having very smooth, flat, conductive inner surfaces. These waveguides will be of either round or rectangular cross-section, some ridged, some stepped, and all lighter than metallic waveguides and containing a minimum of critical or strategic materials.

Capacitors. Capacitors that will operate at 200°C continuously, preferably of small size, for applications that require performance at established electrical ratings over the wide temperature range of -55°C to $+200^{\circ}\text{C}$.

Tuning Capacitor. A small, easily producible, variable tuning capacitor, hermetically sealed, of a 3-gang variety, smaller than corresponding type air dielectric capacitors, capable of operation at rated voltage over a range of -55°C to $+160^{\circ}\text{C}$, and at atmospheric pressure down to 1" of mercury.

Miniature I-F Transformers. Low cost, easily manufactured, tunable miniature i-f transformers of less than 1/4 of a cubic inch in volume with rugged mechanical features and improved frequency stability for operation at high and low temperatures over a frequency range of 456kc and 4.3Mc, and miniature open core and coil, hermetically sealed transformers.

Broadband Directional Couplers. Broadband directional couplers of constant attenuation over an entire waveguide size.

Improved Strain Gage. Strain gage suitable for use in the very wide temperature range from -70°F to $+1500^{\circ}\text{F}$. This strain gage must (1) be stable, (2) have no zero shift over the temperature range and, (3) be suitable for use on aluminum alloys and on steel. Attachment of the gage to a test specimen should not affect the structural characteristics of the specimen.

Instrument Rectifier. Development of a low-current instrument rectifier (up to 200ma, d-c) that will function properly within the temperature range of -60° to $+160^{\circ}\text{F}$.

Strain Gage. High-temperature strain gages for the measurement of forces, performing within an accuracy of 1% or better at temperatures up to 1500°F . (This is directly related to problem No. 429 on the list of 1954 Technical Problems.)

Electronic Devices

Amplifier. An amplifying device suitable for use in servo systems capable of operating reliably at 500°C .

Broadband Detectors. Broadband detectors for h-f, v-h-f, u-h-f, centimeter and millimeter wavelengths with sensitivities 10 to 40db better than present crystal detectors.

L-C Circuits. Small, stable, variable-frequency, resonant L-C circuits, with at least a 10 to 1 frequency tuning ratio, and inherently stable over a temperature range of -55°C to $+85^{\circ}\text{C}$.

Instruments

Microwave Frequency Discriminator. There is interest in a frequency discriminator that would be useful and practical in laboratory microwave oscillator measurements.

Radar Performance Measurement. Development of a simple means or method to measure the performance of radar systems operating above 10,000Mc. Echo boxes and their radar ring time are used to measure the frequency, relative power output, and spectrum of the radar transmitter and also indicate the merit of receiver sensitivity. At the higher frequencies, echo boxes have inherent limitations that make them impractical.

Temperature Measurement. A simple device is needed to measure within 5°C the maximum and mean temperatures of combustion gases of jet engines with and without afterburners.

Instrumentation. Instrumentation having a response time of the order of 100microsecs for detecting temperature, pressures or strains.

Airspeed Instrumentation. Instrumentation is needed that will permit measurement of airspeed through means other than the

sensing of static and dynamic pressures. The instrumentation should be capable of measuring supersonic speeds through Mach 3.0 to an accuracy of 1% of indication, and should not be subject to deterioration in accuracy due to accumulation of ice or atmospheric electrostatic conditions. Physical dimensions and weight should be the minimum possible.

Special Devices

Three-Dimensional Display. A three-dimensional device that would display the trajectory of a missile by a quick visual means relative to time and space. This display would appear on a stand as the missile is fired. The path would be a permanent record such as a spider leaves.

Temperature-Sensing Device. Reliable satisfactory temperature sensing device that has an ultra-short time-lag and that will not burn out at 2000°F within a reasonable time.

Visibility Meter. Report is required of methods that can be made the subject of further research to develop a meter for measuring visibility at any angle without requiring a specific known sighting target. Any physical phenomena may be employed providing the resulting data can be equated to visibility indices.

Wind-Measuring Equipment. Determine the feasibility of developing an instrument for the measurement of surface wind speed and direction. This instrument is intended primarily for arctic and sub-arctic operation where icing and high winds preclude normal operation of standard anemometers and wind vanes. The equipment is to have no external moving parts and the external head must have small mass to minimize ice and frost formation, and to permit easy purging by hot air or electrical elements. Considerations may include investigation of multi-opening pitot static systems.

Vertical Sensing Element or Indicator. A sensing element or indicator attached to an object, giving its true angle in the vertical plane and not being affected by the angular position of the object around any axis within $\pm 20^{\circ}$ in the vertical plane. Desired accuracy is 0.10°. The device should give average values at small oscillations of the object up to a frequency of 50cy. Maximum dimensions: 1.50" cube. This device will be used as a true pitch-and-roll indicator for wind tunnel model testing.

New Tracking Methods. Development of a tracking method to determine the position of a test vehicle in space with extreme accuracy, with respect to a known reference coordinate system. The motion of the vehicle is to be also determined. The system should not be limited by weather and visibility. Available systems are of optical and electronic characteristics. The first is limited by requirement of illumination and slowness in obtaining data in useable form. The second is limited in accuracy of data.

Internal Data Collection System. A new method is required for making accurate measurement of physical phenomena within a test vehicle—to be determined under extreme condi-

Ideas for
Design

tions not suitable for human occupation. These phenomena are acceleration, altitude, pressure, temperature, mechanical stress, electrical and radiation measurements, shaft positions, etc. Measurements are to be made and transmitted instantaneously or with the least possible delay and recorded in useable form or introduced into a computer for further evaluation. Possible techniques include digitalization of data directly after pickup by the sensing element. Other steps involve investigation of noise inherent in electromechanical systems, stability studies and application of high-speed computers for data conversion. Use is made of radio telemetry, television and inboard recording systems. These systems are deficient in speed and accuracy and the data is not presented in useable form.

Materials

Frequency Sensitive Magnetic Materials. Frequency sensitive magnetic materials that would increase permeability with increased frequency for use in chokes.

Conductor Material. Conductor material that would maintain essentially the same temperature coefficient over wide ranges of temperature from -65°C to $+535^{\circ}\text{C}$.

Insulation Material. There is interest in new ideas for the following types of insulation material: (1) Insulation material having a dielectric constant of one over a wide temperature range from -65°C to $+535^{\circ}\text{C}$. (2) Insulation material that would be machinable over a wide temperature range from -65°C to $+535^{\circ}\text{C}$. (3) Insulation material that has good heat conduction properties to conduct heat to a heat sink. (4) Insulation material for wire that can be worked easily and will have a good dielectric coefficient at -65°C to $+535^{\circ}\text{C}$.

Liquid Magnetic Core. Liquid magnetic material for core materials in the audio frequency range.

Dielectric Material. A material is desired that has the following characteristics: (1) Good thermal conductivity (one calorie per second per square cm) (2) Good insulation (10 ohms/cm) (3) A high dielectric constant (five).

Permanent Anti-Static Coating. Precipitation static properties of many plastics indicate the need for a permanent transparent anti-static coating or fiber that can be applied to the external surfaces after fabrication to control this objectionable static property.

Methods

Thermo-Generator. Improve techniques by which chemical or thermal energy may be converted into electrical energy, to provide considerably greater efficiency than that of present thermo-electric generators. The procedure desired should be suitable for incorporation into a simple device that can be made sufficiently rugged for field use. Electrical output should be obtainable at 6, 12, or 24v, with a capacity up to 100w.

Wireless Power Transmission. The development of a technique whereby an appreciable amount of power (1000w) may be transmitted without the use of cables up to a distance of 50 miles, and in addition, techniques for accepting this power at the receiving end in a usable form.

IDENTICAL AMPLIFIERS IN NEW PRECISION CATHODE-RAY OSCILLOGRAPH

THE DU MONT TYPE 340



- Identical, sensitive X- and Y-amplifiers
- Amplifier response dc to 100 kc
- All potentials regulated for stability
- Hard-tube linear sweeps with beam gate
- Mono-accelerator cathode-ray tube for distortionless presentation

Yes, and also precision, simple operation, ruggedness, reliability, ease of maintenance all characterize the *new* Du Mont Type 340 which can well take its place as the oscilloscope for those who require the *best* for their important studies.

Identical amplifiers, unexcelled in other commercial instruments, make the Type 340 a powerful tool for measuring electrical phase or mechanical resonance. Controls can be adjusted for less than 1° relative phase shift between

amplifiers below 100 kc. Distortion in amplifiers and sweeps is negligible. D-C stability sets new standards. Shifts in level are scarcely observable, even over long periods of operation. The Type 340 truly fits the needs of the discriminating engineer and scientist.

For further information on the Type 340 write to: Technical Sales Department, Allen B. Du Mont Laboratories, Inc., 760 Bloomfield Avenue, Clifton, New Jersey.

In less than a year you have seen a complete new line of precision instruments by Du Mont typified by:

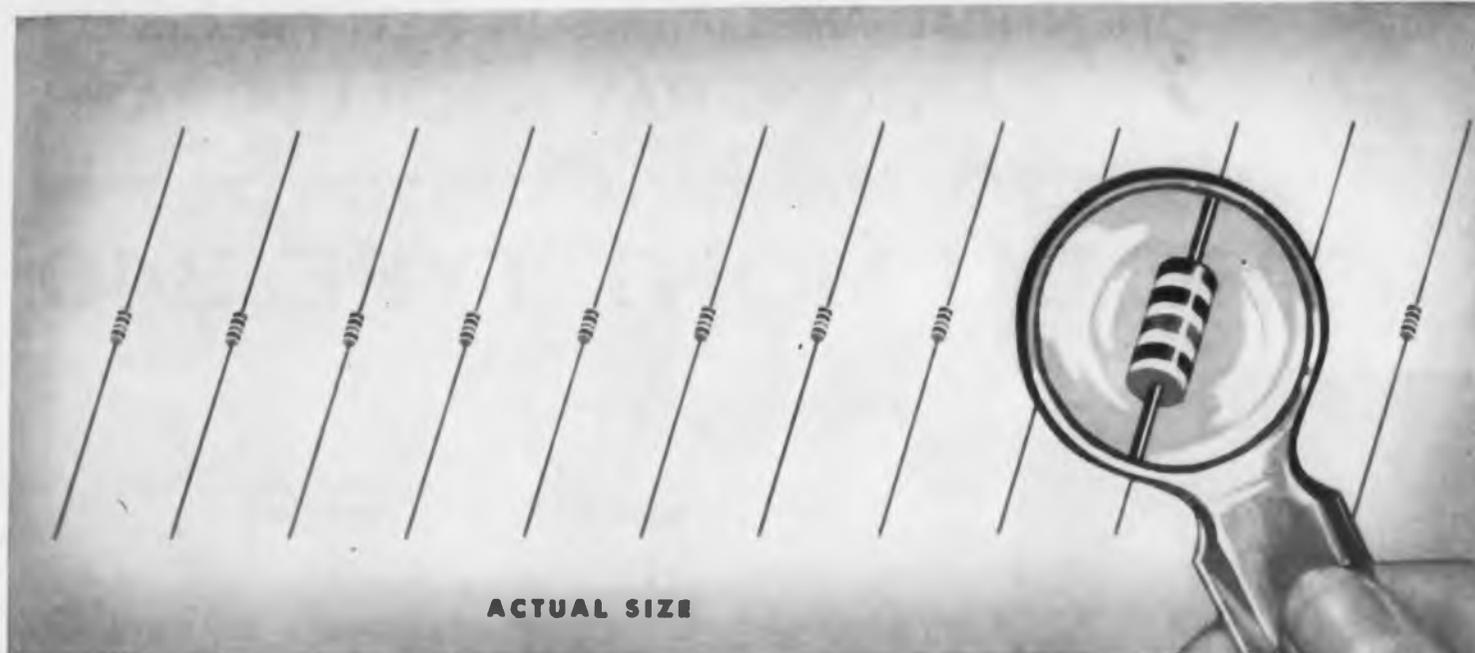
Type 336 CRO dc to more than 20 mc, high brightness
Type 329 CRO dc to 10 mc, high voltage
Type 327 CRO dc to 5 mc, precision calibration
Type 324 CRO microvolt sensitivity, dc to 300 kc
Type 330 universal electronic switch: dc to 15 mc
Type 300 precision time calibrator

And now the Type 340 with identical amplifiers, dc to 100 kc — PRICE \$335.00

TECHNICAL SALES DEPARTMENT
ALLEN B. DU MONT LABORATORIES, INC.,
760 BLOOMFIELD AVE., CLIFTON, N. J.

DU MONT

SEE THE DU MONT EXHIBIT AT IRE SHOW BOOTHS 264-266-268
CIRCLE ED-53 ON READER-SERVICE CARD FOR MORE INFORMATION



ACTUAL SIZE

Type TR "tiny" resistors shown in natural size—One unit is magnified to show color-code bands

NEW! TINY ALLEN-BRADLEY FIXED RESISTORS

Type TR—Length—0.140 in. Diameter—0.067 in.
1/10th Watt—In all RETMA values and tolerances.

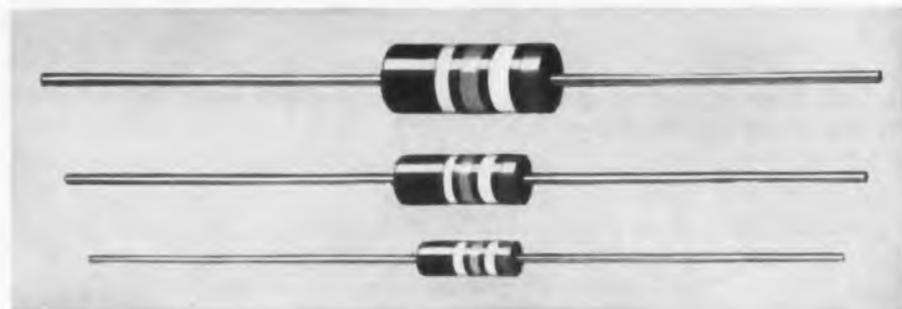
For electronic applications, where small size is a major consideration, the new Allen-Bradley Type TR "tiny" resistors are the ideal answer. While these 1/10th watt, miniaturized resistors are extremely small in size, they are a QUALITY product in construction and performance.

Because of their low noise level, they are especially suited for hearing aids and compact, portable receivers.

Type TR resistors have an insulating coating which affords a conservative insulation strength of 200 volts DC for continuous operation. These tiny resistors can be supplied in all standard RETMA, JAN-R-11A, and MIL-R-11A resistance values from 10.0 ohms to 22.0 megohms, inclusive in 5%, 10%, and 20% tolerances. If you build miniaturized electronic equipment, take advantage of Allen-Bradley Type TR QUALITY resistors.



The Sign of
QUALITY



Allen-Bradley Types HB (2-watt), GB (1-watt), and EB (1/2-watt) solid molded fixed resistors are shown actual size in the above illustration.

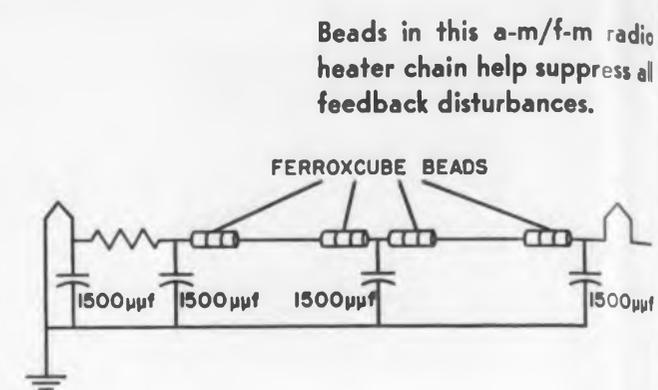
See Allen-Bradley exhibit at IRE Engineering Show — Booth 794

Allen-Bradley Co., 1344 S. Second St., Milwaukee 4, Wis. • In Canada—Allen-Bradley Canada Limited, Galt, Ont.

ALLEN-BRADLEY

RADIO, ELECTRONIC AND TELEVISION COMPONENTS

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



Beads in this a-m/f-m radio heater chain help suppress all feedback disturbances.

Shielding Beads

UNWANTED high-frequency feedback can be drastically attenuated simply by threading ferrite beads on the offending supply leads. The high permeability of the ferrite material substantially increases the lead's inductance, and h-f choke action is simulated. In addition, i-f, h-f, and pulse oscillations are dampened due to high losses within the bead at frequencies above 0.5Mc.

This interesting application of ferrites overcomes some of the disadvantages of other methods of preventing unwanted feedback to the input stages. For example, parasitic resonances which might be caused by a decoupling capacitor or series-inductance choke are not likely to occur with beads because ohmic damping is present.

A practical example of the use of the beads produced by Ferroxcube Corp. of America, Saugerties, N. Y., is found in the heater chain of an a-m/f-m receiver. The decoupling network consists of three sections, an R-C section (the resistance being needed in any event to complete the total resistance of the heater chain) and two beaded sections. The beaded sections consist of three beads on both ends of a piece of hook-up wire and a 1500mmfd capacitor to ground. All feedback disturbances from the filament leads are suppressed. Long leads which might pick up disturbing i-f signals can be decoupled in a similar manner.

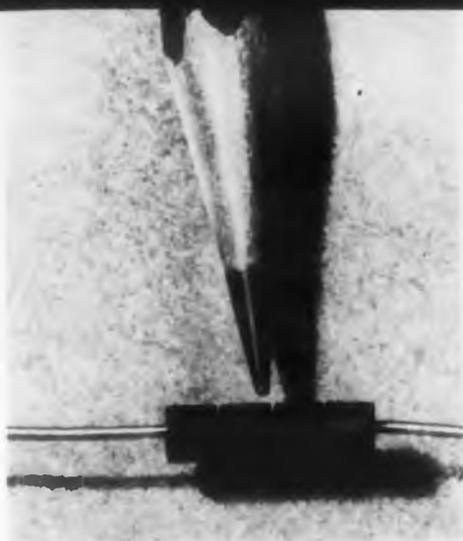
Typical increases in inductance and damping resistance for a single bead on 0.040" diam hook-up wire are shown in the accompanying graph. If more than one bead is used, inductance and resistance will increase proportionally. For more data on these beads, turn to the Reader's Service Card and circle ED-55. This product will be on display at the Radio Engineering Show, Booth 340.

$\Delta L(\mu H)$

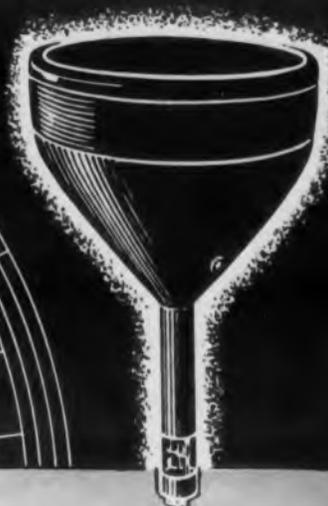
0.15

0.1

0.05



Radar Tubes by Du Mont

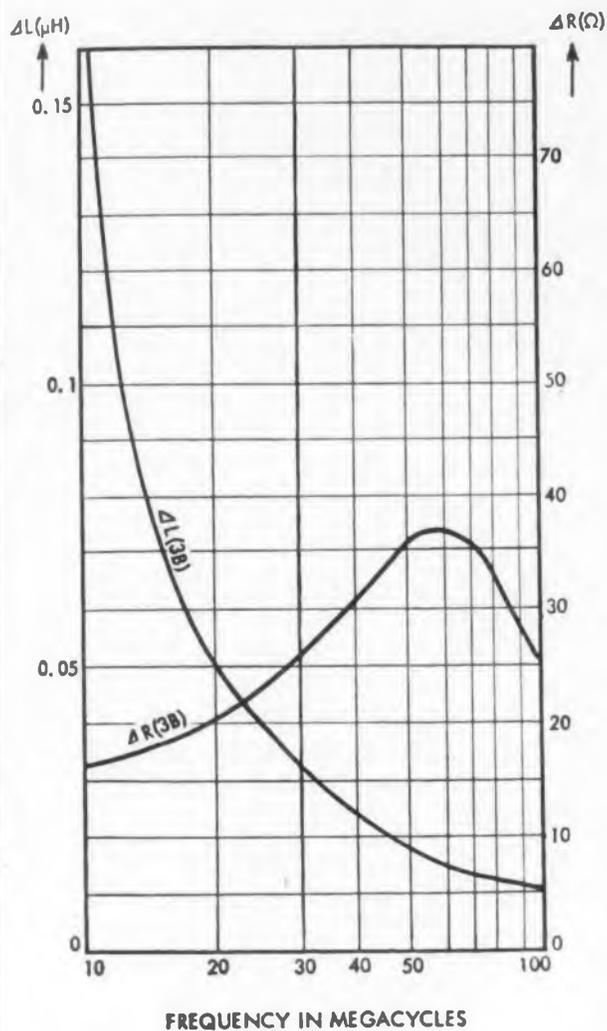


Now — Du Mont, whose brand has long been the hallmark of superior quality, reliability and performance, offers the most complete line of high-resolution cathode-ray tubes for radar. Below, in tabular form is listed a cross-section of types. However, the full story cannot be told here.

All tubes can be furnished with P7, P14, P19 or P21 screens. Other screens are available where special requirements must be met. Screens can be metallized on any tube, and metallization is recommended for operation above approximately 5000 volts, to provide optimum screen stability and to increase light output.

Du Mont facilities are set up to work closely with you. We are prepared to build, to your specifications, tubes which exactly match your needs in any size up to 30-inches in diameter.

For complete specifications on these or any Du Mont cathode-ray tubes, or for information on Du Mont special tubes, write to Technical Sales Department at address below.



Change in inductance and resistance as a function of frequency for a single 3B-type bead threaded on a piece of bare hook-up wire 0.040" in diameter.



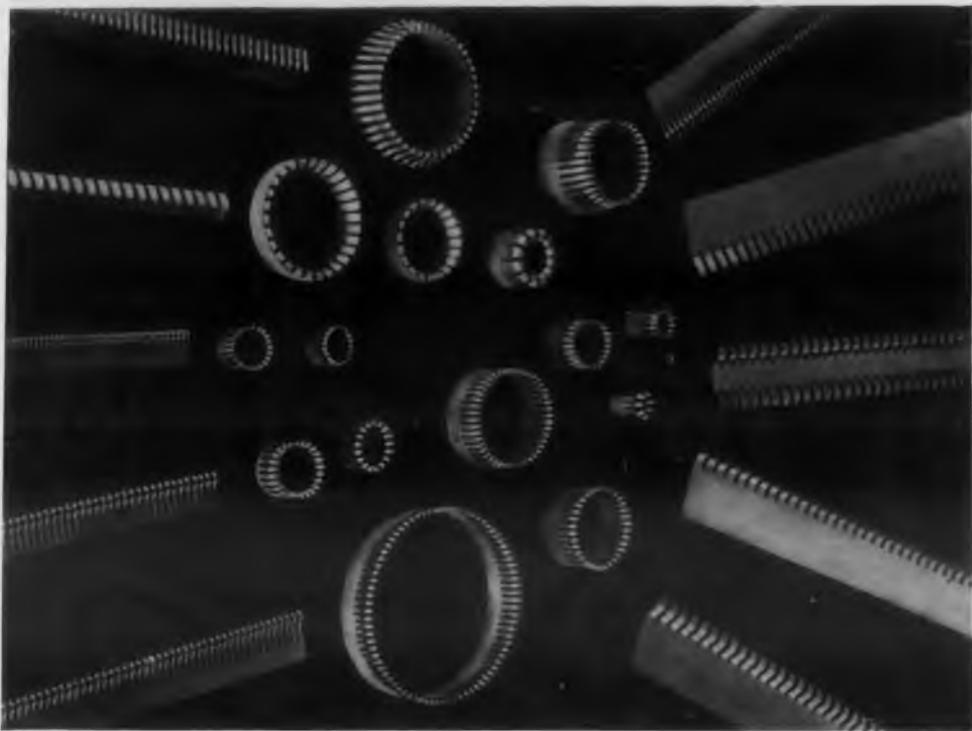
Typical Radar Tubes Available From Du Mont (Not a Complete Listing)

TUBE TYPE	LENGTH (INCHES)	TYPICAL ANODE VOLTS	NO. LINES IN USEFUL DIAM.	TYPICAL LINE WIDTH (INCHES)
ELECTROSTATIC FOCUS				
5AHP—	11%	7,000	550	0.008
7ABP—	13%	7,000	650	0.009
10UP—	17%	10,000	900	0.01
10WP—	16%	10,000	650	0.014
Magnetic Deflection				
12ABP—	18%	10,000	700	0.016
B1116P— (Rectangular)	23%	16,000	700	0.02
MAGNETIC FOCUS				
B1125P—	7 (seated)	8,000	450	0.01
5FP-A	11%	5,000	450	0.01
7BP—	13%	7,000	550	0.01
10KP—	17%	9,000	650	0.015
12DP-A	19%	7,000	550	0.018
12SP—	18%	9,000	625	0.018
ELECTROSTATIC FOCUS				
Electrostatic Deflection				
K1233P—	18	8,000	400	0.015
K1137P— (Dual Beam)	24%	7,500	725	0.015
K1187P—	22%	10,000	625	0.017

DU MONT

TECHNICAL SALES DEPARTMENT
ALLEN B. DU MONT LABORATORIES, INC.
760 BLOOMFIELD AVENUE, CLIFTON, NEW JERSEY

SEE THE DU MONT EXHIBIT AT IRE SHOW BOOTHS 264-266-268
CIRCLE ED-56 ON READER-SERVICE CARD FOR MORE INFORMATION



How to CUT Development Time And Costs

Exclusive I-S Services for Electronic Design Engineers

Product development costs frequently become excessive—both in time and dollars. This can be critical in a fast-moving industry like electronics, where today's preliminary drawing is on tomorrow's production-line. Hastily-conceived short-cuts are not the answer. Essential prototype-testing should not be by-passed—production standards should not be down-graded to compensate for development overhead. Many leading manufacturers have found I-S service of value in overcoming these ever-present headaches confronting the design engineer.

Put these I-S services to work for you, now . . .



1. I-S ENGINEERS' MICRO-WAVE KIT

The new enlarged kit contains 15 circular contact rings and 10 finger contact strips, 12"-16" long. All jig-hardened beryllium copper, cleaned for soldering. Used for tuning slides, tube sockets, grounding and bonding components. Available from stock, order by catalog number 97-270.

2. I-S SHORT-RUN SERVICE

For pilot runs and regular small-production on beryllium copper springs—instead of costly "special orders". Checks your design against production tolerances—assures prototype reliability—speeds transition to full production.

3. I-S CONTIPS

Beryllium copper contact strips and rings (spherical radii) with localized deposit of silver for high-frequency applications where mechanical or electrical wear is a problem. Retains peak spring performance, ideal for miniaturization.

4. I-S ENGINEERING

I-S' specialized abilities in manufacturing problem springs and electronic components are available to your designers. This usually results in substantial cost reduction.

5. I-S EXCLUSIVE PRODUCTION TECHNIQUES

Exclusive I-S methods and patented equipment can produce a better spring or contact . . . faster, at lower cost—and usually to a higher performance than specified.

6. I-S NEW CATALOG No. 9

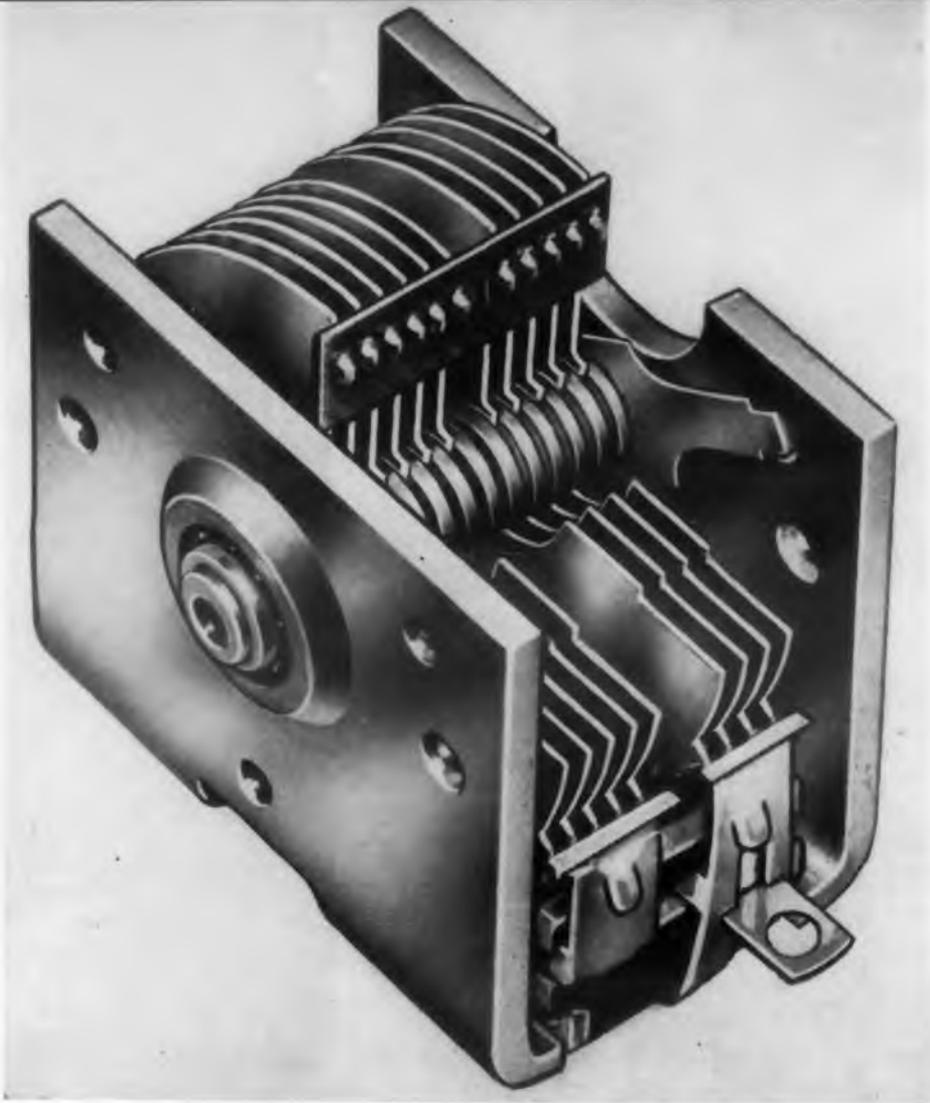
Our latest Catalog is in Sweet's Product Design file—but we'll be glad to send you an additional copy for your own personal file, if you desire.

Instrument Specialties Co. Inc.

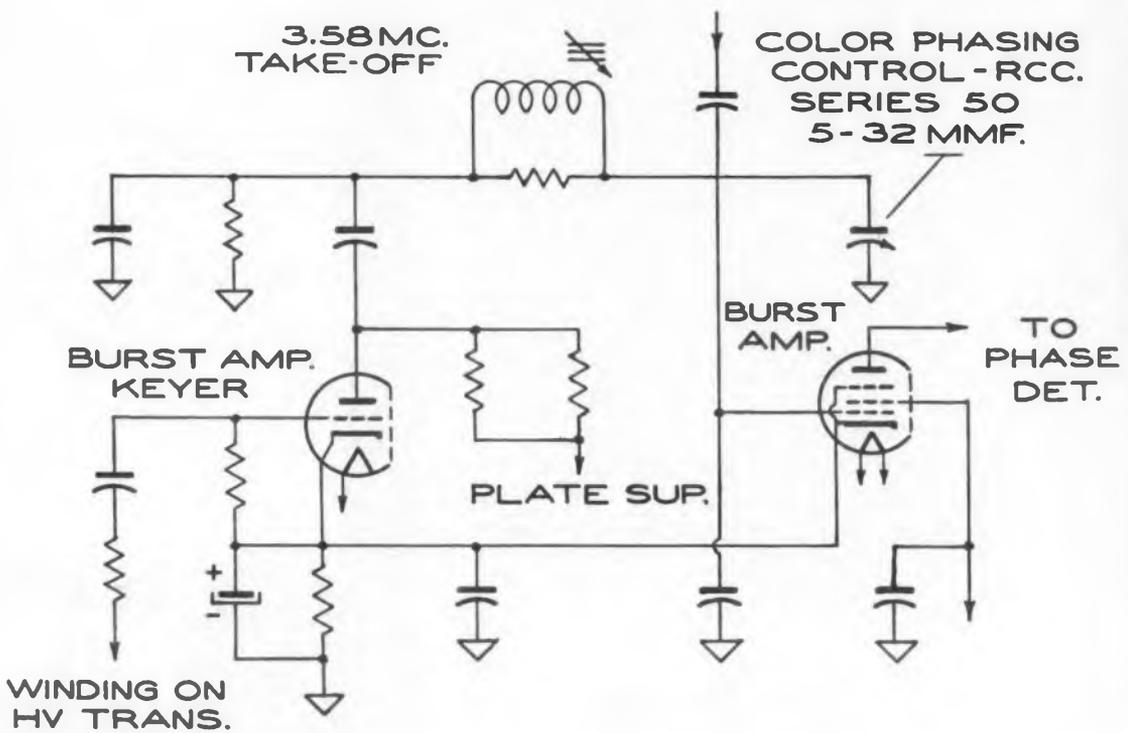
270-C BERGEN BOULEVARD
LITTLE FALLS, NEW JERSEY

Telephone Little Falls 4-0280

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



BURST TAKE-OFF FROM
1ST. VIDEO AMP. PLATE



M

stabil
unit i
ceiver

Mo
withi
the f
1-5/1
a typ
num
has a
oscill
78.2r

Co
other
man
3, N
of e
stab
phas
som
This
mic
T
For
turn
Thi
nee

Sta
po:
50
wit

Small Variable Capacitor

MINIATURIZATION of this variable capacitor was accomplished without sacrificing stability or calibration accuracy. The compact unit is especially suitable for transistor radio receivers.

Model 51, illustrated here, contains two sections within a depth of 15/16". The end plate size of the formed aluminum frame is 1-3/8" wide by 1-5/16" high. Up to 20 plates are available. In a typical superhet receiver application, the total number of plates is divided so that the r-f section has a maximum capacitance of 123.1mmf and the oscillator section a maximum capacitance of 78.2mmf.

Control of color phasing in TV receivers is another application of the small variable capacitor manufactured by Radio Condenser Co., Camden 3, N. J. Their low cost makes them desirable, but of equal, or more, importance is the high order of stability that can be achieved. Since the color phasing control requires only a range of 25mmf, some plates can be removed to increase the spacing. This increased spacing decreases susceptibility to microphonics as well as improving stability.

The model 50 is 1/4" deeper than the Model 51. For more information about these variable capacitors, turn to the Reader's Service Card and circle **ED-58**. *This product will be on display at the Radio Engineering Show, Booth 780.*

Stable TV color phasing is possible by using Model 50 capacitor as control with some plates removed.



Yours for the asking... up-to-date listing of New Instruments by **DU MONT**

We have been adding so rapidly to our new line of high-precision instruments, that we know any Du Mont catalog you may have is obsolete. A new 8-page quick-reference catalog that outlines in greater detail the new Du Mont line of high precision instruments is just off the press.

Get your copy now by writing to us at the address below.

Meanwhile, here is a brief review of these great new instruments, together with some of their more important characteristics.

TYPE	BANDWIDTH	SWEEP RANGE	SENSITIVITY	RECORDABLE WRITING RATE	APPLICATIONS
323	DC to 30% down at 10 MC	1 sec to 0.1 usec per major division	0.2 to 400 volts full scale	2.8 in./usec	Medium voltage, wide band, high-precision, quantitative oscillograph
324	DC to 30% down at 300 KC	1 sec/inch to 1 usec/inch	0.004 to 400 volts full scale	2.8 in./usec	Very high sensitivity (1.33 millivolt/inch) in the low frequency range
327	DC to 30% down at 5 MC	1 sec/inch to 1 usec/inch	.5 to 500 volts full scale	2.8 in./usec	Modest cost, highly linear, precision measurements at medium high frequencies
329	DC to 30% down at 10 MC	1 sec to 0.1 usec/major division	.2 to 400 volts full scale	35 in./usec	High precision, high accelerating potential for the ultimate in high-frequency measurements
340	DC to 30% down at 100 KC	2 to 30,000 cps	25 mv/in p-p	—	Identical X and Y amplifiers with negligible phase shift
341	DC to 30% down at 600 KC	2 to 30,000 cps	125 mv/in p-p	—	Identical X and Y amplifiers with negligible phase shift to 1 megacycle
336	DC to 30% down at 18 MC	1 sec to 0.1 usec/major division	.5 v/major division	35 in./usec	Superior instrument for advanced, precision high frequency measurements

ACCESSORY INSTRUMENTS

And don't forget these new accessory instruments, any of which may be used with any cathode-ray oscillograph.

TYPE	APPLICATIONS
300	Crystal-controlled time calibration pulses for use as accurate and dependable time-marker standard
325	TV line selector for converting any cathode-ray oscillograph into a video signal monitor
330	Electronic switch converts any single channel cathode-ray oscillograph to dual-channel or any a-c coupled oscillograph to d-c operation
332	Differential transformer control is complete unit for differential transformer operation
335	Strain gage control for use with any commercial strain-gage

TECHNICAL SALES DEPARTMENT, ALLEN B. DU MONT LABORATORIES, INC., 760 Bloomfield Ave., Clifton, New Jersey
SEE THE DU MONT EXHIBIT AT IRE SHOW BOOTHS 264-266-268

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

1 to 5 ratio your quality insurance

- 21 INSPECTORS to each 100 production workers—a 1 to 5 ratio.
- ALL units thoroughly inspected on exacting custom equipment.
- UNIQUE inspection procedure for each application.

EXTREME MANUFACTURING ACCURACY

- EVERY gear cut with an AA hob and rolled against a master.
- EVERY final grind on every shaft run through a Sheffield comparator set by "jo" blocks.
- EVERY bearing bore checked with an air gauge and XX plug gauge.

A wide variety of rotating electrical components for electronic and airborne applications . . . designed and produced to your specifications. Send your requirements to OSTER design engineers. Write for "The Oster Story of Quality" today.



John Oster

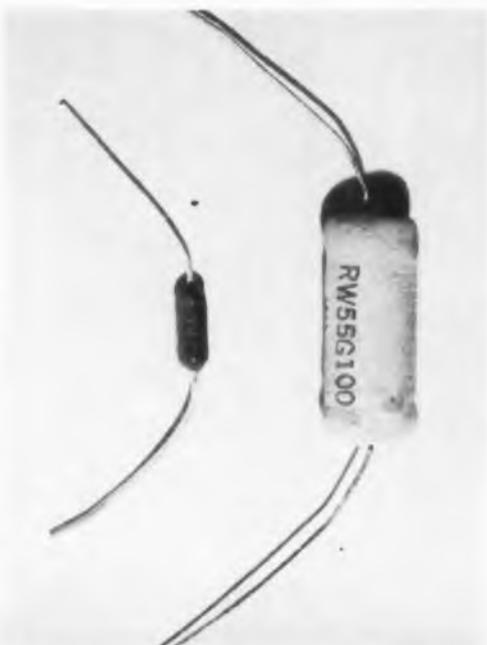
MANUFACTURING CO.
AVIONIC DIVISION
RACINE, WISCONSIN

Your Rotating Equipment Specialist

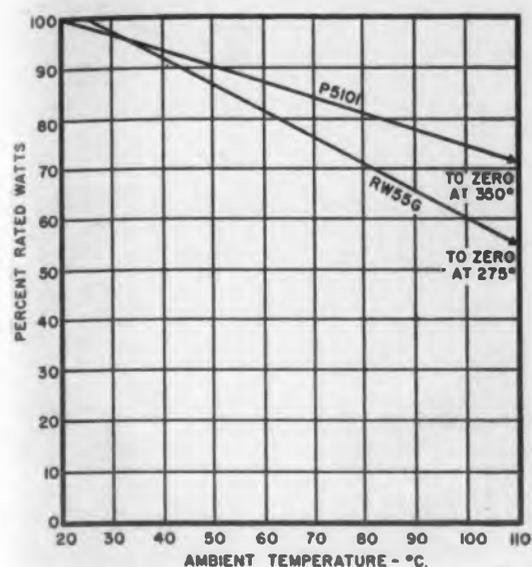
Oster



Midget Power Resistors



Midget power resistor dwarfed by standard size.



Resistor derating graph shows percentage of rated dissipation at 110° C. Note maximum operating temperature of 350° C for Painton resistor.

OVER five watts dissipation from a size no larger than the ordinary 1/2w carbon resistor makes these midget wire-wound resistors ideal for airborne or other portable equipment applications where space and weight requirements are stringent.

The accompanying illustration compares the small-sized (15/32"), 5.5-w type P5101 with a typical JAN type RW55G. The P5101, and others in this series, have a better derating characteristic than RW55G types. (See graph.) The Painton & Co.'s imported resistor also features hard-to-match stability characteristics.

The retrace characteristic of the resistor is exceptional. This factor, plus a high mutual matching characteristic, enables separate groups of resistors of various values and frame sizes to track together with extreme accuracy. The resistors can be used in summing networks and in any instrumentation, control, or analog computer applications requiring matched operation. Axial leads make the resistor suitable for dip soldering or mounting against a metal plate.

The manufacturer uses very fine wire (0.0006" diam.) to achieve both a smaller physical size and a higher resistance value than that of standard RW55 types. The high thermal conductivity of the special form on which the wire is wound also contributes to the resistor's miniature size.

Internal connections are welded for permanency and stability. The vitreous enamel glaze forms a hermetic seal. The resistor operates with no "hot spots" or measureable temperature gradient. British Electronics Sales Co., Inc., 23-03 45th Road, Long Island City, is the USA representative for Painton & Co., Ltd., the manufacturer. For further information about the complete line of resistors, turn to the Reader's Service Card and circle ED-141.

New! \$\$-Saver deluxe!



HERMETICALLY-SEALED
GENERAL-PURPOSE RELAY

TYPE FC-6 (U.S.A. Standard)

Withstands 0 to 2,000
cycles vibration to 30G

Withstands up to 60 G shock without
contact opening, 2,000 ft.-lbs. with-
out contact transfer or damage.

Designed to exceed MIL-R-5757B and
to meet MIL-R-25018 (USAF) and
MS24115 (USAF) specifications.

Available for both 85°C and 125°C
ambient Nominal coil voltage 26.5
volts DC.

...and priced materially
lower than existing relays in its
class!

Far superior in performance and durability to pre-
vious types, the new Dunco FC-6 hermetically-
sealed general-purpose relay is priced materially
lower.

Designed from a background of 5 years experi-
ence with the Dunco 220XFX100, the FC-6 offers far
greater simplicity in its moving parts; easier con-
struction and adjustment; extreme rigidity for high
vibration and shock; high contact pressures; low
contact bounce; plenty of contact over-travel; and
complete absence of internal gaseous materials
which might cause contact unreliability.

Vibration resistance of 0 to 2,000 cycles up to
30 G's is attained . . . a heretofore unheard of per-
formance for relays of this class.

Throughout, the Dunco FC-6 incorporates safety
factors that make it ideally suited for difficult appli-
cations, even in low-energy circuits.

Write, wire or 'phone for Dunco FC-6 Relay Data
Bulletin L2406 giving complete specifications.

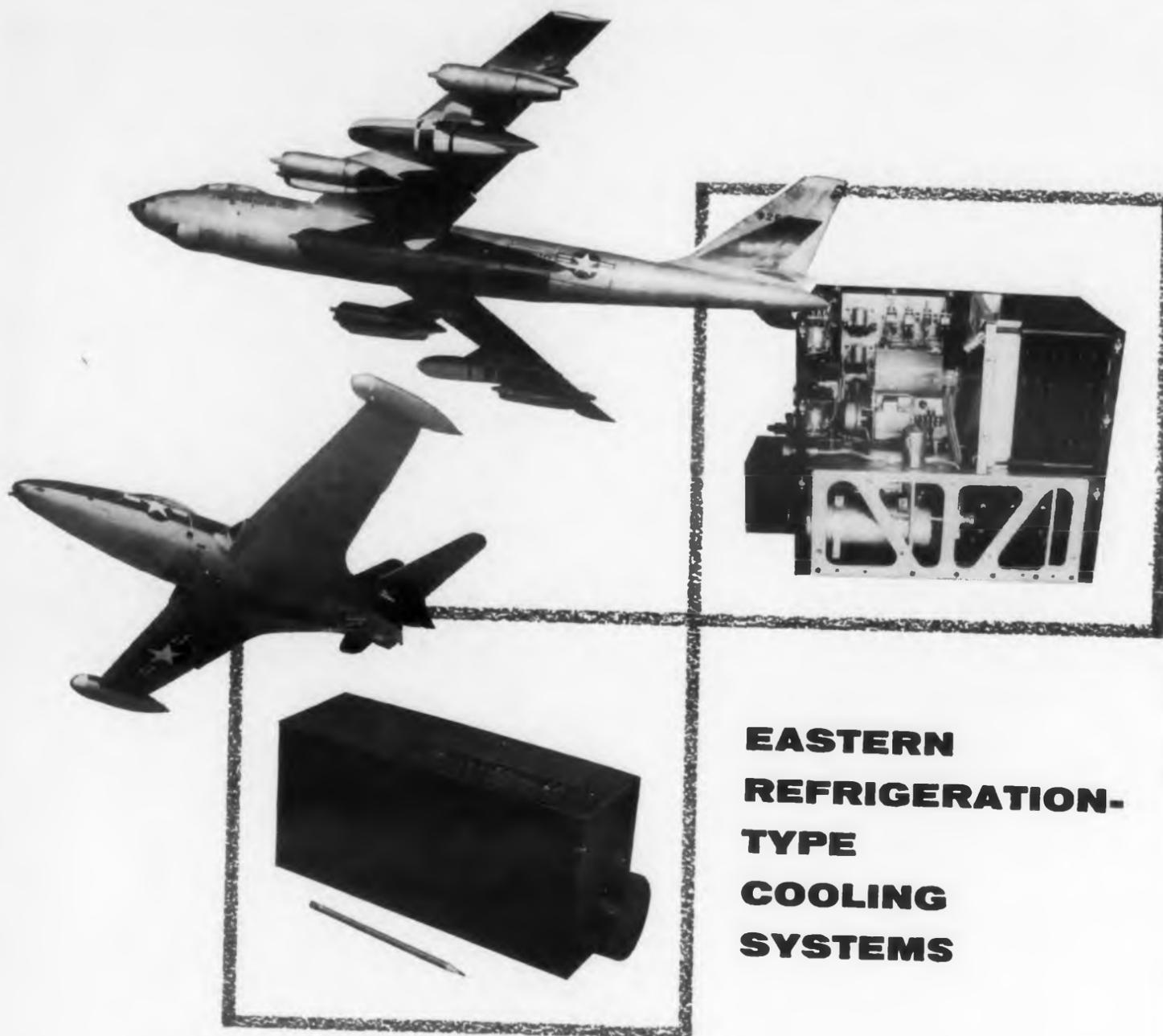
STRUTHERS-DUNN

FC-6 RELAY TYPES

STRUTHERS-DUNN, INCORPORATED, Pitman, N. J.

SALES ENGINEERING OFFICES IN: ATLANTA • BALTIMORE • BOSTON • BUFFALO • CHARLOTTE • CHICAGO
CINCINNATI • CLEVELAND • DALLAS • DETROIT • KANSAS CITY • LOS ANGELES • MINNEAPOLIS • MONTREAL
NEW ORLEANS • NEW YORK • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE • SYRACUSE • TORONTO

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



**EASTERN
REFRIGERATION-
TYPE
COOLING
SYSTEMS**

... maintain a predetermined temperature range in electronic equipment

SPECIFICATIONS:

Operate up to 70,000 feet.
Ambients up to 185°F.
Units from 100 to 6,000 watts capacity.
Operating range from below 0°F. to 100°F.
Pressurized evaporators available with units.
Explosion-proof systems complete in one container for many applications.
Normal aircraft power sources can be used.

Complete Refrigeration Cooling Systems using various gases and liquids as cooling media in closed-cycle operation, are Eastern specialties. Within the conditions shown at the left, these compact airborne units can be supplied complete with one heat exchanger, or with several exchangers in different locations as a centralized compressor unit.

Eastern welcomes inquiries regarding custom made or adapted units. They meet appropriate government specifications and can solve your specific cooling problems.

Write for data on Eastern's Cooling Unit line, included in Eastern Aviation Catalog No. 330. Related Pressurization Equipment and Hydraulic Products are also described in this catalog.

EASTERN



INDUSTRIES, INC.

100 SKIFF STREET, HAMDEN 14, CONN.

CIRCLE ED-60 ON READER-SERVICE CARD FOR MORE INFORMATION

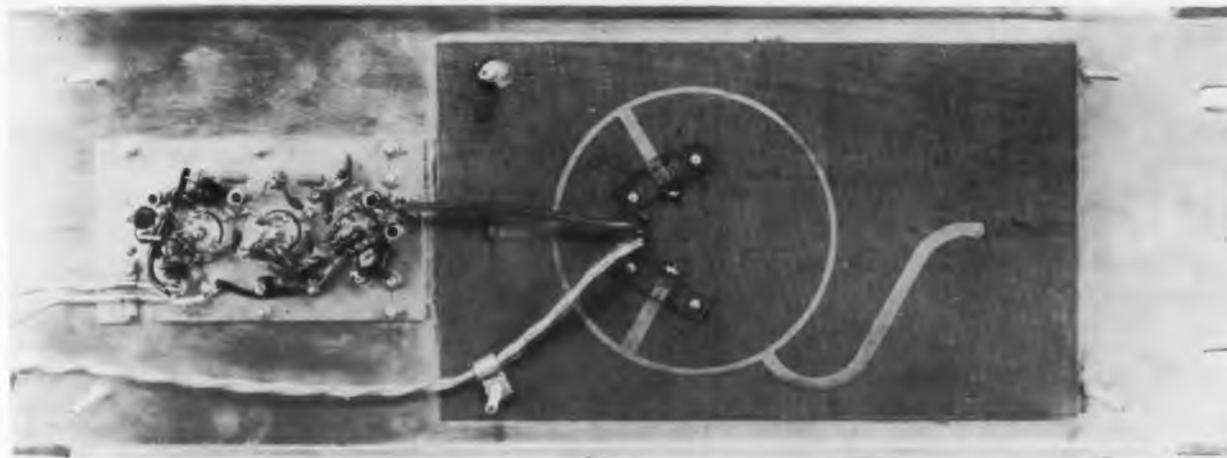
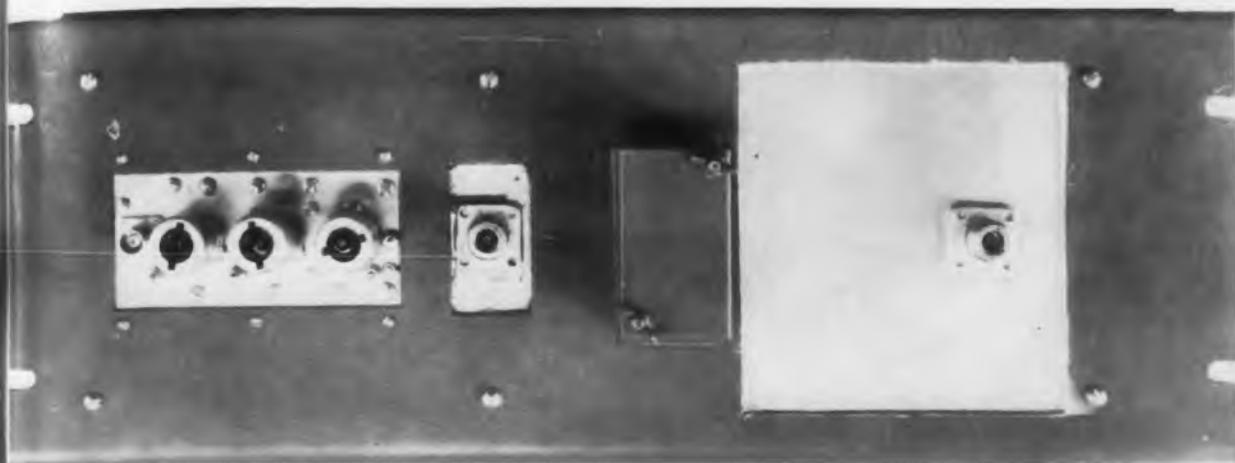
**Microstrip
Microwave
Receiver**

PRINTED circuitry in the r-f head considerably reduces the size of this microwave receiver. The entire mixer circuit is based on a "Microstrip" hybrid ring which feeds balanced crystal mixers. The superheterodyne receiver illustrated was designed to operate in the band of 890 to 940Mc.

The frequency of the receiver can be varied simply by substituting an alternate r-f head which has a printed circuit hybrid ring designed specifically for the frequency to be covered. In the model shown, manufactured by the Federal Telecommunications Laboratories Div. of International Telephone & Telegraph Corp., the entire Microstrip chassis comprising the

See us
at the
I.R.E.
SHOW
Booth
#633





By utilizing the single-conductor-and-ground-plane transmission system (microstrip), conventional "plumbing" is discarded. Bottom view shows strip conductor and dielectric medium.

balanced crystals, a straight and reverse type 1N21-B and 1N21-BR respectively, and the transformer which feeds the i-f amplifier, is replaced. The chassis includes antenna and local oscillator connectors and leads for connecting to the i-f amplifier and the crystal-current meter circuit. Looking at the rear view, the curved strip to the lower right of the ring is the LO input, the short straight strip to the left is the antenna input, and the two strips going from the ring toward the center are the leads to the crystals. The much narrower matching stubs can also be seen.

A local oscillator input of 900Mc establishes the i-f frequency from the mixer at 60Mc. The i-f amplifier which is the re-

maining part of the receiver located on the relay-rack mounting chassis, consists of three cascaded 6AK5s. The r-f power required from the local oscillator is 1/2mw. Antenna VSWR averages 1.2 in the 890-940Mc band. The noise figure is approximately 11db at the center frequency and does not vary appreciably over the entire range of the receiver. The design engineers report that the hybrid ring could be reduced in size 3 or 4 times by using a base with a dielectric constant in the order of 10-20. For more information about this Microstrip receiver, turn to the Reader's Service Card and circle **ED-61**. *This product will be on display at the Radio Engineering Show, Booth 877-893.*

miniaturizing your antenna

PROBLEMS

Whether it is miniaturizing an airborne antenna down to fighting weight, or designing new ground based waveguide systems . . . Airtron's complete antenna facilities . . . including research, design, testing and mass production of precision components . . . can substantially reduce the time and expense between concept and reality.



Airtron offers you "standard" antenna plumbing . . . or will engineer a new design to fit your antenna application, and deliver it complete from flexible waveguide input to feed horn. Whatever your need, you'll get components that meet your every requirement for high power broadband operation, low VSWR, pattern accuracy, as well as special mechanical characteristics.

For full details on Airtron's microwave antenna facilities and their application to your antenna problems, write or call today.

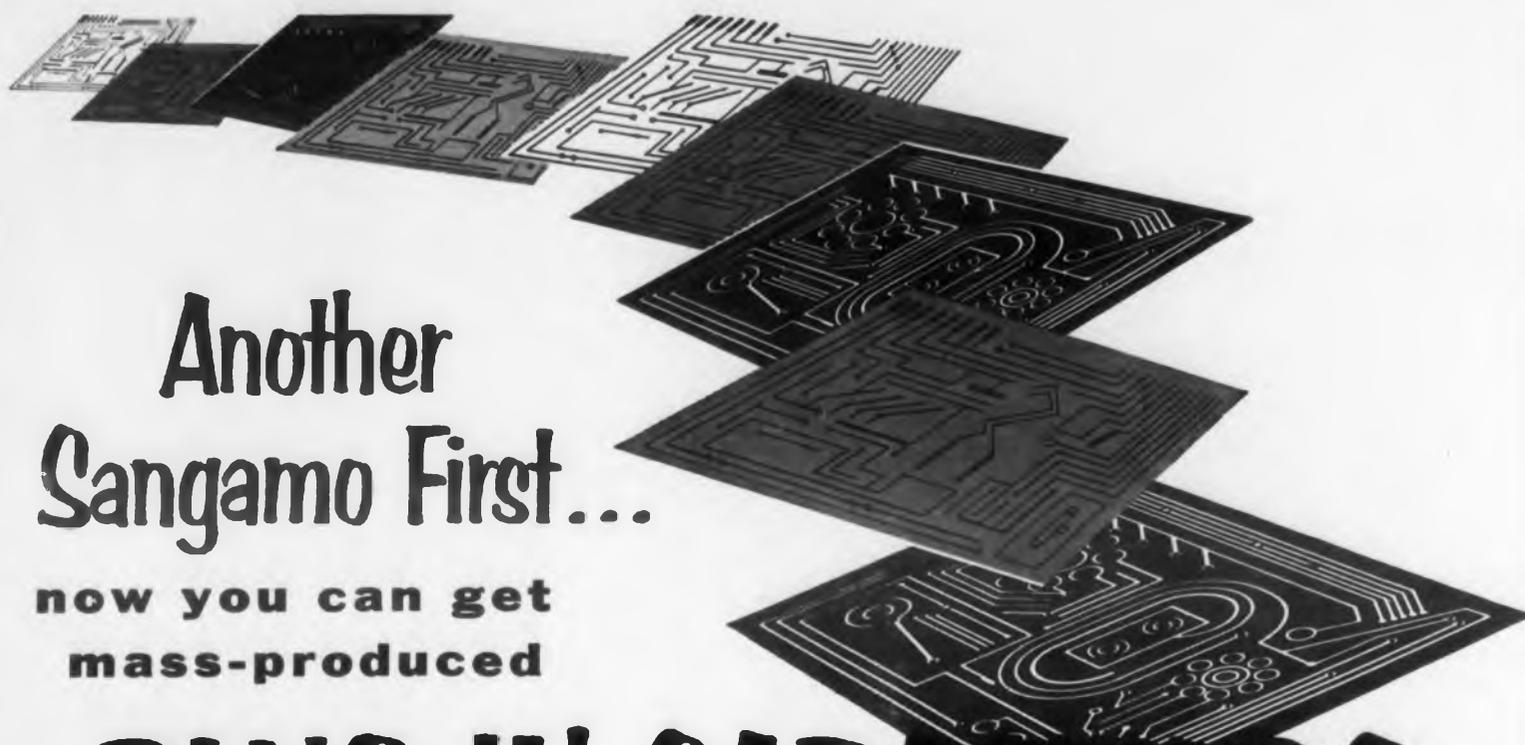
Airtron inc.

1121 W. Elizabeth Ave.
LINDEN, NEW JERSEY
Linden 3-1000

Branch Offices:

Albuquerque
Chicago
Dallas
Dayton
Kansas City
Los Angeles
San Francisco
Seattle
London

VISIT OUR BOOTH #373 AT THE I.R.E. SHOW
CIRCLE ED-62 ON READER-SERVICE CARD FOR MORE INFORMATION



Another Sangamo First...

now you can get mass-produced

PLUG-IN CAPACITORS

for printed circuitry applications

Sangamo now offers you production quantities of plug-in paper tubular and dry electrolytic capacitors for use in your automated pro-

duction of under-chassis assemblies. These Sangamo plug-in capacitors are designed specifically for use in printed circuit applications.



PLUG-IN TUBULAR PAPER CAPACITORS

These plug-in paper tubulars incorporate all the internal design features of the famous Sangamo Telechief. They come in a molded bakelite case with a moisture resistant end fill, and leads cut and properly spaced to fit. They are available in a range of popular sizes for almost any application.

PLUG-IN ELECTROLYTICS

Leads will not contaminate solder pots during the printed circuitry dipping process...heat created when leads are soldered will not injure Sangamo plug-ins because terminals are designed so that the unit stands off from the circuit board...this "stand-off" feature also permits the designer to run additional circuits under the capacitor.

Write for complete information.



One-Piece Miniature Tube Shields

TELESCOPING over its integral base for tube removal or insertion, this shield cannot become misplaced or inadvertently forgotten. By enclosing the socket inside the shield base practically all radiation from u-h-f tubes is eliminated. Because of its one-piece construction, the shield section never becomes a loose part and there is no hazard of accidentally shorting exposed wiring to the chassis or metal cabinets.

Miniature tubes are easily inserted or removed simply by collapsing the shield down over the shield base. Slight upward pressure locks the shield in position covering the tube.

If u-h-f radiation is not a problem, the CapTivated Mini-Shield, manufactured by the Staver Company, 41-51 N. Saxon Ave., Bay Shore, N. Y., for top chassis mounting is ideal. The shield base fits present standard mounting rivet holes. All wafer and molded sockets for under-chassis mounting, as well as above chassis molded sockets without saddles can be used.

For u-h-f applications, the shield containing its own enclosed socket should be used. The base of this shield-socket combination protrudes through a chassis hole and is secured to the under side by roll-flaring the base. This provides a complete metal-to-metal seal. Practically all radiation is eliminated. In addition, the tube is supported by pressure fingers inside the shield which help dampen vibrations. For more information regarding the applications of these tube shields, turn to the Reader's Service Card and circle **ED-64**.



SANGAMO ELECTRIC COMPANY

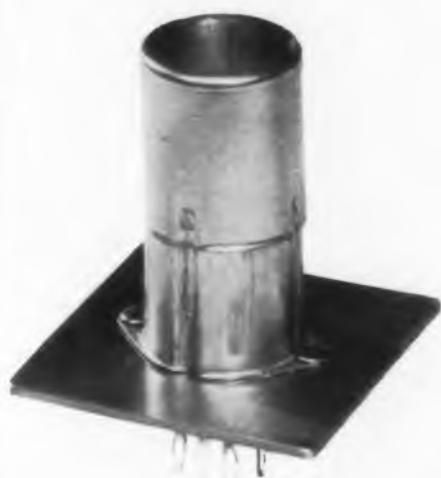
MARION, ILLINOIS

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

SC55-1



Shield is collapsed over base for tube removal.



Top-chassis mounting type, above, and u-h-f socket-shield type, right, to be roll-flared to chassis.



SLOGAN for SERVICE
custom-made by **ESC***

DELAY LINES • FILTER NETWORKS
PULSE TRANSFORMERS
DECADE DELAY LINES

*Custom-Made by ESC signifies your specifications have been met with the precision and skill born of years of experience in the production of all types of video delay lines! ESC Delay Lines, custom-made or from our large selection of stock models, all meet MIL specifications and assure you maximum efficiency in a minimum of space.

Our Representatives Are At Your Service

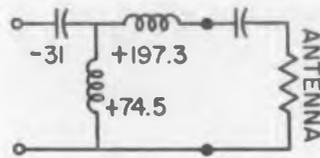
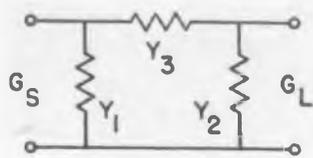
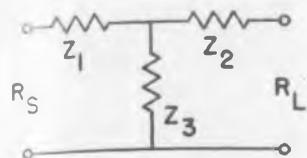
EDWARD F. AYMOND COMPANY Dallas 19, Texas Logan 5233 Tulsa, Oklahoma Oklahoma 7-9617	A. L. LIVERA & ASSOC. Madison, N. J. Madison 6-3220 St. Albans, N. Y. St 6-9686 Lansdowne, Pa.
WALTER J. BRAUER & ASSOC. Cleveland 7, Ohio	MAGNUSON & ASSOC. Chicago 41, Ill. Kildare 5-4426
COMPONENT SALES CORP. Hartsdale, New York Scarsdale 5-1050	WM. M. MEILY CO. Fort Wayne, Ind.
	WEIGHTMAN & ASSOC. Burbank, Calif.

Write for Our Delay Line Brochure

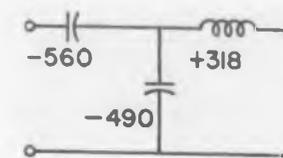
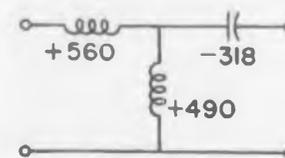
See Us In Booth 684
I.R.E. Show
Kingsbridge
Armory
Bronx, N. Y.

ESC CORPORATION
534 BERGEN BLVD., PALISADES PARK, NEW YORK

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



Sample Problem A



Sample Problem B

Basic Relationships

$$Z_3 = [R_s R_L]^{1/2} / j \sin \theta$$

$$Y_3 = [G_s G_L]^{1/2} / j \sin \theta$$

$$Z_1 = \frac{R_s}{j \tan \theta} - Z_3$$

$$Y_1 = \frac{G_s}{j \tan \theta} - Y_3$$

$$Z_2 = \frac{L}{j \tan \theta} - Z_3$$

$$Y_2 = \frac{G_L}{j \tan \theta} - Y_3$$

GRAPHICAL solutions for τ and π reactive matching networks are readily obtained by means of the chart and scale shown on these pages. Such networks are employed to match a resistance load to a resistance source impedance for maximum power transfer at one frequency. The design of such matching networks is normally given in the form of τ or π networks.

These two network forms can be altered into the balanced H or O networks. In special cases the τ or π can be reduced to the L network.

The three element values are determined from the values of the source and load impedance (or admittance) and the phase shift (θ) through the matching network. If the network could be constructed of pure reactance elements, there would be no power loss. The above three equations for the π network are developed by an application of the dual principle* and are expressed in admittance units (mhos or μ mhos).

The element values will be pure reactance (or susceptance) as indicated by the equations. The phase shift θ must be restricted to the range from -180° to $+180^\circ$.

The graphical solution of these equations entails following different types of calculations:

1. The geometric mean value of R_s and R_L must be found. If these two values are located upon a log scale, the geometric mean is found at the point equidistant between R_s and R_L .
2. The mean value of R_s and R_L must be divided by $\sin \theta$.
3. The values of R_s and R_L must be divided by $\tan \theta$.

Operating the Chart and Scale

The scale must always be placed so that it is parallel with the horizontal lines of the chart.

1. The scale is adjusted so that the values of R_s and R_L lie on the two lines marked 2 and 3. The geometric mean of their values is found on the scale at the index line 1.
2. The scale is adjusted so this geometric mean value

Match a 75-ohm co-axial cable to an antenna having $55 - j240$ ohms of capacitance reactance.

1. Find the mean of 75 and 55 as 64.5 ohms.
2. Select $\theta \pm 60^\circ$. Find $Z_3 = +74.5$ ohms reactance.
3. Read 43.5 from curve B. $Z_1 = 43.5 - 74.5 = -31$ ohms reactance.
4. Read 31.8 from curve B. $Z_2 = 31.8 - 74.5 = -42.7$ ohms reactance.

Modify the Z_2 branch to absorb the reactance of the load. $240 - 42.7 = 197.3$.

$$Z_2' = Z_2 - X_L = (-42.7) - (-240) = +197.3 \text{ ohms}$$

($R_M = [R_s R_L]^{1/2}$) lies on the index line and the scale is set on the value of θ desired. The value of Z_3 is read on the scale from curve A. The sign (+ or -) is selected.

3. The scale is adjusted so the value of R_s lies on the index line and the scale is set to the same value of θ . The value on the scale at curve B is recorded. The value of Z_3 found in step 2 above is subtracted from this value and the result is the value of Z_1 that faces the source R_s element.

4. The scale is adjusted so the value of R_L lies on the index line and the scale is set to the same value of θ . The value on the scale at curve B is recorded. The value of Z_3 is subtracted from this value and the result is the value of Z_2 that faces the load R_L element.

The choice of θ is controlled by the following notes:

1. The sign (+ or -) determines the type of element required for Z_3 in the τ network or Y_3 in the π . If θ is +, then Z_3 is a capacitor and Y_3 is an inductor. If θ is -, then Z_3 is an inductor and Y_3 is a capacitor.
2. The τ or π networks may be reduced to L networks if that particular value of θ is selected that makes one of the elements ($Z_1, Z_2, Y_1,$ or Y_2) have the value of zero. The chart will locate the particular value of θ in this manner:

Place the smaller factor of R_s or R_L on curve B. Keep the scale parallel to the chart and adjust it until the geometric mean R_M lies on curve A. This scale is now at the particular value of θ that gives a L network.

The π network is designed in the same manner as the τ network except that the values must be expressed in admittance units (mhos or μ mhos). The element values are then given in the same admittance units.

Matching networks often are required to match between source and loads that are not pure resistance. This chart will solve these problems in the manner outlined below:

1. Express the source and load by their resistance and reactance components for the τ or by their con-

ductance and susceptance components for the π networks. Design the basic τ (or π) network using only the resistance (or conductance) components of the source and load.

2. Modify the series arms of the basic τ (or the shunt arms of the basic π) network so as to absorb the reactance (or susceptance) components of the source and load. The modified elements will have the element value of the basic network less the value of the reactance (or susceptance) that it faces. Strict attention must be given to the proper signs (+ or -) associated with these elements.

The scale and chart may be used as a simple slide-rule in finding the inverse of any value when converting from ohms to mhos or from mhos to ohms. The scale is inverted and located over the normalized scale figures at the bottom of the chart. The ends of the scale must meet the edges of the chart. If a value is located upon the scale, the inverse value is found on the chart on the normalized scale figures. The decimal point is not given by this operation just as the decimal point is not found on a slide-rule.

For pure resistance source or load values, $R = 1/G$: where R is in ohms and G is in mhos.

For complex source or load values, $Z = R + jX$ and $Y = G + jB$; and R is not equal to $1/G$ and X is not equal to $1/B$, but $Z = 1/Y$: where $R, X,$ and Z are in ohms, and $G, B,$ and Y are in mhos.

For pure resistance source or load values, $R = 1/G$: where R is in ohms and G is in mhos.

For complex source or load values, $Z = R + jX$ and $Y = G + jB$; and R is not equal to $1/G$ and X is not equal to $1/B$, but $Z = 1/Y$: where $R, X,$ and Z are in ohms, and $G, B,$ and Y are in mhos.

$$Y = 1/Z = \frac{1}{R + jX} = \frac{R - jX}{R^2 + X^2} = \frac{R}{R^2 + X^2} - j \left(\frac{X}{R^2 + X^2} \right) = G_{\text{eq}} + jB_{\text{eq}}$$

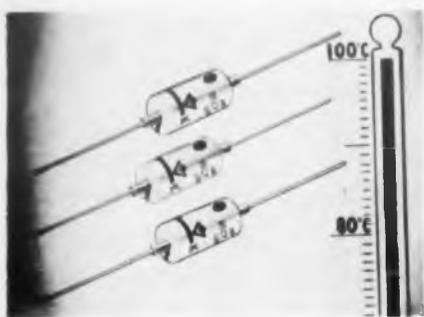
$$Z = 1/Y = \frac{1}{G + jB} = \frac{G - jB}{G^2 + B^2} = \frac{G}{G^2 + B^2} - j \left(\frac{B}{G^2 + B^2} \right) = R_{\text{eq}} + jX_{\text{eq}}$$

Reference

*Communication Engineering, W. L. Everitt, Mc-Graw-Hill Book Co., 2nd Edition, 1937, pp. 277-280.

New Products..

Germanium Diodes For 100°C Operation



Three high-temperature germanium diodes, for operation over an ambient temperature range from -60° to $+100^{\circ}\text{C}$, have been added to this firm's "Red Dot" Series. All

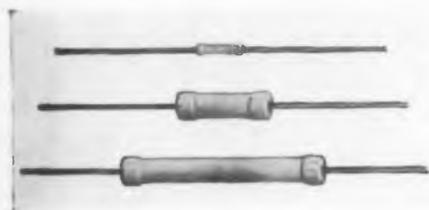
three types are rated and tested at 25°C and at temperatures above 75°C . They are RETMA registered as Types 1N265, 1N266, and 1N267.

Typifying the diodes' high temperature characteristics are the ratings of the 1N267 at 85°C : 4.0ma (min) at +1v, 0.040ma (Max) at -10v , 20v d-c maximum allowable inverse voltage.

Designed for clip-in or solder-in application, these diodes measure 0.230" diam x 0.470" long. All are supplied with No. 22 tinned copper 1" (min) pigtail leads. International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif. *This product will be on display at Radio Engineering Show, Booth 730.*

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

Metal Film Resistors In Tolerances to $\pm 1\%$



"Noblette" Metal Film Resistors, with axial leads, are now available in 1/2w, 1w, and 2w ratings. Resistance ranges are 1

ohm to 1 megohm in the 1/2w unit; 1 ohm to 5 megohms in the 1w unit, and 2 ohms to 10 megohms in the 2w unit. Tolerances available are $\pm 1\%$, $\pm 2\%$, and $\pm 5\%$. Continental Carbon, Inc., Dept. ED, 13900 Lorain Ave., Cleveland 11, Ohio. *This product will be on display at Radio Engineering Show, Booth 456.*

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

Delay Line In 30% Smaller Version



This 200 μsec delay line, No. 4D59, is available with more than a 30% reduction in volume, measuring 5-27/32" x 2-11/32" x 2-15/16" (approximately 40 cu in). New and old versions are shown at left and right, respectively.

Electrical specifications include: total delay of 200 $\mu\text{sec} \pm 1\%$; rise time of 4.4 μsec ; impedance of 1000 ohms; and attenuation of 3.0db. Electronic Computer Div., Underwood Corp., Dept. ED, 35-10 36th Ave., Long Island City 6, N. Y. *This product will be on display at the Radio Engineering Show, Booth 801.*

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

Capacitors

In Ranges from 0.0005-1.0mfd



"Illini Ste-Tie" Type ITC Capacitors are designed for high insulation resistance, low

power factor, and long-life performance at high temperatures. Their non-inductively wound foil assemblies are oil impregnated and hermetically sealed in steatite cases. They are overload tested and have a standard tolerance of $\pm 20\%$. Thermoset end seals will not soften or flow with soldering or at any conceivable operating temperature.

The capacitors are available in ranges from 0.0005-mfd to 1.0mfd and in 200, 400, 600, and 1600wvdc ratings. Tinned copper leads of 2" minimum length make for easy soldering. Illinois Condenser Co., Dept. ED, 1616 N. Throop St., Chicago 22, Ill. *This product will be on display at the Radio Engineering Show, Booth 422.*

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

Oscilloscope Low-Cost Laboratory Type Unit



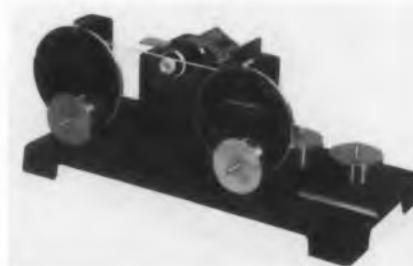
The Type 340 cathode-ray oscilloscope features identical X and Y amplifiers extending from d-c to 100kc, and a hard tube sweep circuit with beam gate ranging from 2cy to 30,000cy. The unit has the ability to select the horizontal center of expansion so that a selected detail of the signal may be expanded up to

five times without losing the reference. On the Y axis, the signal may be expanded up to three times full scale and positioned over the full range without distortion.

An internal regulating transformer provides nearly complete freedom from line-voltage change. Another feature is the use of a single etched-wiring board for essentially all of the circuitry, providing a clean, accessible layout. Allen B. DuMont Laboratories, Dept. ED, Clifton, N. J. *This product will be on display at the Radio Engineering Show, Booth 264-268.*

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

Dynamometer For 0.1 to 15 oz-in Range



The Model 10-B dynamometer will provide an accurate and convenient means of loading and measuring the torque delivered by small instrument and servo

motors. The break-away torque of potentiometers and gear trains may also be measured.

An accuracy of better than $\pm 3\%$ may be obtained on any torque reading between 0.1 in-oz and 15 in-oz. The instrument will operate at any speed where the power developed is 20w or less. Bischof Die & Engraving Co., Dept. ED, 1405 16th St., Racine, Wis.

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

ELECTRONIC DESIGN • March 1955

Test Oscil
deviation
The outpu
by the FO
east trans
The out
open circ
put (appl
form dist
above 100
ties for c
means of
modificati
range to
54 Kinke
will be o
Booth 30.

CIRCLE ED-72



Heinema
silicone
iron cor
tube ext
the mag
gized. T
thus co
tuated
valve c
setting

Relay
240v a
Co., De
produc
Show.

CIRCLE ED-73

ELECTR

□ Test Oscillator

Controlled by Push-Buttons



Any of 19 different pre-selected frequencies in the range from 20cy to 20kc may be selected by push-button controls on the Model TO-100A

Test Oscillator. A deviation dial permits calibrated deviation from the center frequencies up to $\pm 10\%$. The output frequencies include those recommended by the FCC for distortion measurements on broadcast transmitters.

The output amplitude is calibrated from 1v to 25v open circuit across 600 ohms. A low impedance output (approximately 18 ohms) is also included. Waveform distortion at 18mw output is less than 0.25% above 100cy and less than 0.5% below 100cy. Facilities for calibrating an unknown external signal by means of a zero beat indicator are provided. Factory modifications can be made to extend the frequency range to 100kc. Teletronics Laboratory, Dept. ED, 54 Kinkel St., Westbury, L. I., N. Y. This product will be on display at the Radio Engineering Show, Booth 302.

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

□ Time Delay Relay

Utilizes Silicone Fluid



The Type A "Silie-O-Netic" Relay is available with standard timings from 1/4sec to 120sec. Variable flux operation, caused by the changing relationship of a solenoid coil and its core, produces highly definitive contact action.

The relay utilizes the Heinemann hydraulic-magnetic principle, in which a silicone fluid is the basis of time delay. A movable iron core, hermetically sealed in a non-magnetic metal tube extending through a solenoid coil, is drawn into the magnetic field resulting when the coil is energized. The silicone fluid slows the rate of core travel, thus controlling the response time. Contacts are actuated as the core touches the pole piece, and check valve construction within the core allows faster re-setting of the relay.

Relays are furnished with coil ratings from 24v to 240v a-c, and 6v to 125v d-c. Heinemann Electric Co., Dept. ED, 449 Plum St., Trenton 2, N. J. This product will be on display at the Radio Engineering Show, Booth 365.

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

ELECTRONIC DESIGN • March 1955

PERKIN

New!! Compact!!

28 VOLTS @ 100 AMPERES $\pm 1/2\%$ REGULATION

SPECIFICATIONS

DC OUTPUT: 24-32 Volts at 100 amperes

AC INPUT: 230 or 460V. $\pm 10\%$, 3 phase, 60 cycles

RIPPLE: 1% rms

VOLTAGE REGULATION: $\pm 1/2\%$: (a) from no load to full load; (b) from 24-32 Volts DC; (c) for 230 (or 460) Volts $\pm 10\%$

RESPONSE TIME: 0.2 seconds WEIGHT: 250 lbs.

DIMENSION: 25" long x 15" deep x 15" high

Price: \$1,149.00, including meters & cabinets

PROMPT DELIVERY



MODEL MR532-15

5 to 32 VOLTS @ 15 AMPS (CONT.) IMMEDIATE DELIVERY!!!

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

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

RESPONSE: 0.2 seconds

METERS: 4 1/2" Rectangular AM and VM—2% Accuracy

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

MOUNTING: Cabinet or 19" Rack Panel

FINISH: Baked Grey Wrinkle

WEIGHT: 150 lbs.

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

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

Write for Bulletin MA154.
Also write (on company letterhead) for Free Subscription to technical periodical "PERKIN," Power Supply Bulletin.



Rectifier Specialists Since 1932

345 KANSAS ST. • EL SEGUNDO, CALIFORNIA

TUBELESS!!! MAGNETIC AMPLIFIER REGULATED DC POWER SUPPLIES



Model MR2432-100X

24 to 32 volts @ 100 amps



MODEL M60VMC

0 to 32 VOLTS @ 25 AMPS (CONT.) IMMEDIATE DELIVERY!!!

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

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

A.C. INPUT: 115 Volts, Single Phase, 60 cps

FINISH: Baked Grey Wrinkle

WEIGHT: 130 lbs.

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

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

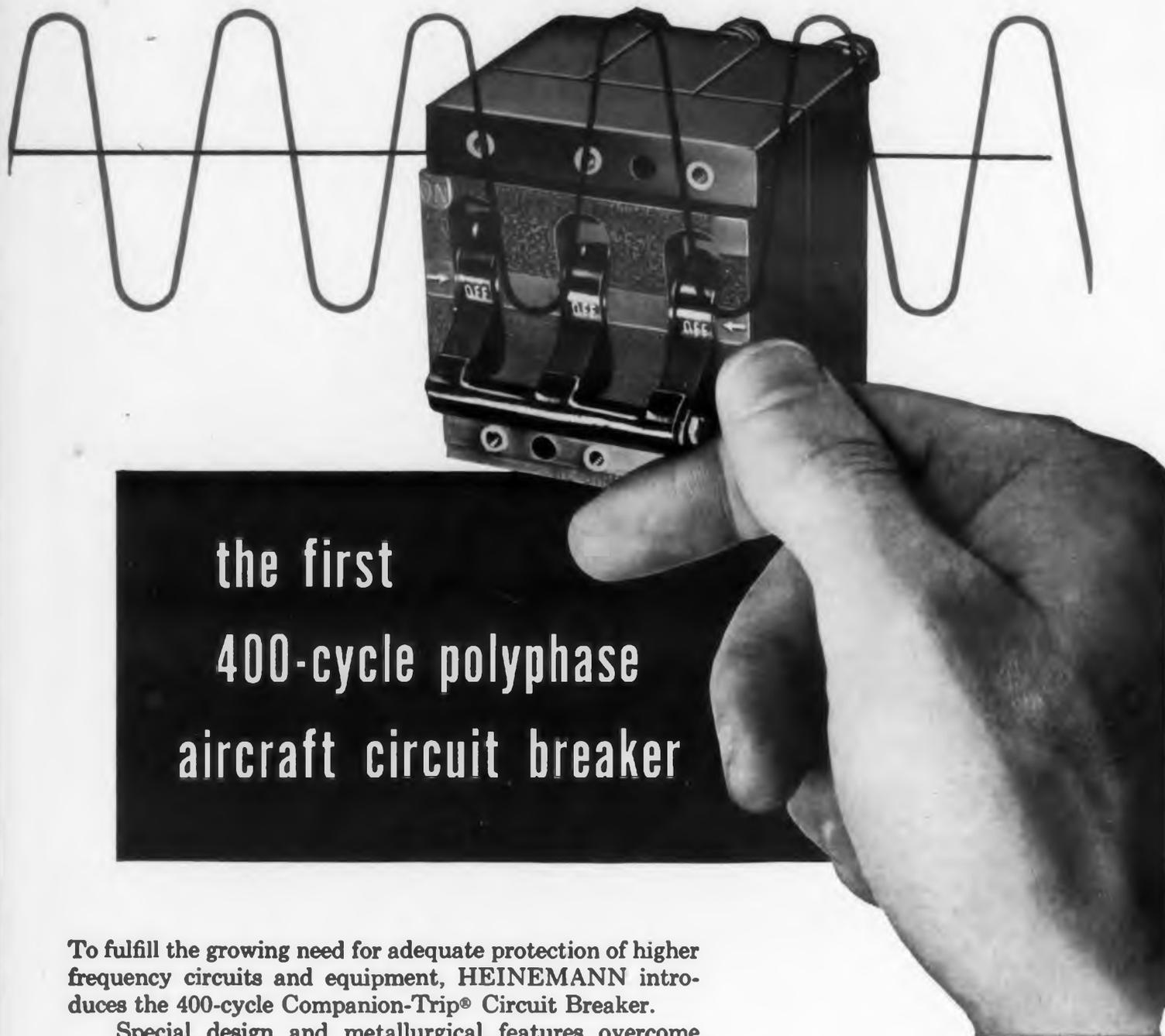
Price \$439 w/o cabinet, \$474 w/cabinet

PERKIN ENGINEERING CORP.

PHONE: ORegon 8-7215

Visit our booth No. 13 at Kingsbridge Palace, Nat'l IRE Convention—March 21-24

ANNOUNCING...



the first 400-cycle polyphase aircraft circuit breaker

To fulfill the growing need for adequate protection of higher frequency circuits and equipment, HEINEMANN introduces the 400-cycle Companion-Trip® Circuit Breaker.

Special design and metallurgical features overcome previous limitations, and Companion-Trip—a new principle—provides complete phase isolation.

The new aircraft type circuit breaker is hydraulic-magnetic, of course. Current carrying capacity and set tripping points are completely unaffected by ambient temperature.

Moreover, a selection of time delay response curves permits overload protection to be fitted to the precise requirements of your equipment.

For complete information, request Bulletin T-3301.

HEINEMANN
Circuit Breakers



HEINEMANN ELECTRIC COMPANY
97 Plum Street • Trenton 2, New Jersey

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

□ Audio Amplifier With Only 0.005% Distortion



Extremely low distortion is achieved in the Model UF-101 Power Amplifier by incorporating 80db of negative feedback. Rated harmonic and in-

termodulation distortion is less than 0.005% at 50w output. The frequency response is flat ± 0.5 db from 0.5cy to 30kc.

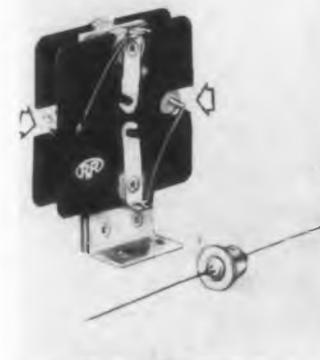
Excellent transient response is maintained at all output impedances from 2-450 ohms by switching the feedback to the output transformer secondary winding being used. The d-c on the input stage heater maintains noise 110db below full output.

Plug in electrolytic capacitors and ruggedized output tubes are featured. The controls include an input impedance and low frequency cut-off selector, a gain potentiometer calibrated in decibels, an output impedance selector switch, and a high-low gain switch. The 80db of negative feedback is employed in a main loop around four stages and the output transformer secondary. At high frequencies, multiple feedback paths are used to improve the stability, particularly under overload conditions.

This amplifier is designed to fill the need for a lower distortion laboratory signal source and is particularly useful in the development and testing of audio frequency equipment. Krohn-Hite Instrument Co., Dept. ED, 580 Massachusetts Ave., Cambridge 39, Mass. *This product will be on display at the Radio Engineering Show, Booth 201.*

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

□ Silicon Alloy Junction Rectifiers Miniature Power Type



These silicon alloy junction rectifiers feature long life and reliable operation, small size, low forward drop, excellent regulation, high efficiency, and extraordinarily high ratings for their size. Forward currents such as 1ampere with low forward voltage drop are typical. They have extremely low reverse leakage, and operate at

temperatures up to 200°. Radio Receptor Co., Inc., Dept. ED, 251 W. 19th St., New York 11, N. Y. *This product will be on display at the Radio Engineering Show, Booth 511-513.*

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

ELECTRONIC DESIGN • March 1955

Medium-Mu Twin Triode

9 Pin Miniature



The 6CG7 is a 9-pin miniature version of the popular 6SN7-GT intended for use particularly as a t-v deflection oscillator, phase inverter, multivibrator, synchronizing separator and amplifier, or resistance-coupled amplifier. This type is designed with a 600-milliamperere heater having a controlled warm-up time to insure dependable performance. Design features of the 6CG7 include a structure which permits cool operation of the grids with the result that emission from them is minimized. The structure also incorporates an internal shield which provides effective shielding between the triode units to prevent electrical coupling between them. Tube Div., Dept. ED, Radio Corp. of America, Harrison, N. J. This product will be on display at the Radio Engineering Show, Booth 151-155.

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

Differential Transformer

For Measurement and Indication

This rotary variable differential transformer is particularly useful in the continuous measurement and remote indication of the angular position of rudders, control surfaces of aircraft, valves, and similar equipment. A small compact device, it provides a voltage whose magnitude varies linearly with change in the angular position of its shaft.



The unit is similar to a linear variable differential transformer, but has a suitably-shaped ferromagnetic cam as its core. This cam is affixed to the shaft, which is ball-bearing mounted, and varies the relative coupling between the primary and the two halves of the secondary as the shaft is rotated.

Primary excitation requires 3v to 6v, single phase a-c in the medium audio frequency range of 400cy to 8kc. The normal sensitivity is 0.004v per degree at 2000cy (with an input of 5v). Accuracy is $\pm 1\%$ over the range of $\pm 40^\circ$, and $\pm 3\%$ over $\pm 60^\circ$. The input vs output characteristic is symmetrical about the null point. Schaevitz Engineering, Dept. ED, Camden 1, N. J.

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

ELECTRONIC DESIGN • March 1955

TYPE 310 OSCILLOSCOPE SERIAL

It's New!
and this is its
ACTUAL SIZE.

DC to 4 mc
23½ lbs.
\$595

VERTICAL AMP. VOLTS/DIV.

1 .5 CALIBRATED
2 .2
5 .1
10 .05 AC ONLY
20 .02
50 .01 INPUT

AC DC

VERTICAL POSITION

HORIZONTAL POSITION

FOCUS

INTENSITY

SCALE ILLUM.

TRIG. INPUT

TIME/DIV.

M SEC. 1 500 200 100
2 50
5 20
10 10
20 5
50 2
CALIBRATED
SEC. .1 .2 .5 1 2

TIME BASE

AC INT. DC
EXT. AUTO. LINE

TRIGGER

MAG. X5 X1

HORIZ. INPUT

STABILITY TRIG. LEVEL

CALIBRATOR

VOLTS PEAK TO PEAK

.5 1 2 5
.2 10
.1 20
.05 50 CAL. OUT
OFF 100

NON-CALIBRATED

TEKTRONIX, INC.,
PORTLAND, OREGON, U.S.A.

DIMENSIONS 6¼" X 10" X 17"

See it... Try it... at the 1955 IRE Show.. Booth 129

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

A SNAP FOR WIRING BOARD ASSEMBLIES

NEW Sprague Type 28D Push-Lok* Electrolytic Capacitors Give Fast, Fool-Proof Mounting

HERE'S THE BEST APPROACH yet to electrolytic capacitors for printed wiring board assemblies.

It's Sprague's new Type 28D Push-Lok Electrolytic. Just insert the connecting lugs through the slots in the wiring board, and the capacitor is held securely in place until the chassis is ready for dip soldering . . . so securely that solder gaps are eliminated. Spring action of the Push-Lok lugs is strong enough to hold relatively heavy capacitors in place, even when the board is carried sideways, or upside-down on a conveyor. Tab connections are always in close contact with the printed conductors. Yet, unlike other designs, no secondary operations are required for this fast and secure mounting.

Other advantages include:

Fool-Proof Positioning—A Push-Lok can only be inserted the right way. A wide index terminal is provided in the mounting ring to index the assembly on the chassis or other surface if desired.

The Ability to Print Wiring Boards on Both Sides—Shoulders on the Push-Lok lugs plus additional prongs keep the capacitors clear of the chassis.

Safety—Circular shield conforms with suggestions of Underwriters' Laboratories, Inc. Tools cannot be inserted easily between the bottom of the capacitor and the chassis.

FOR COMPLETE INFORMATION on these new Type 28D Push-Lok electrolytic capacitors, write for Engineering Bulletin to Sprague Electric Co., 000 Marshall Street, North Adams, Massachusetts.

*Push-Lok is a Trademark of the Sprague Electric Company



Sprague, on request, will provide you with complete application engineering service for optimum results in the use of electrolytic capacitors.

SPRAGUE

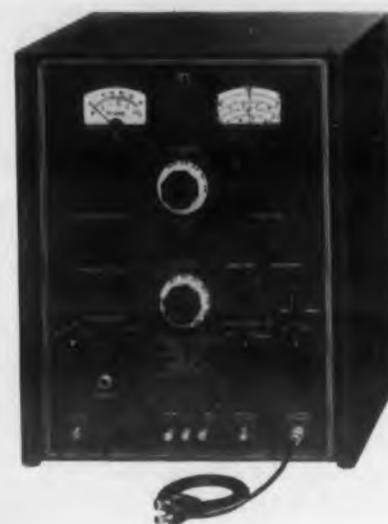
WORLD'S LARGEST CAPACITOR MANUFACTURER

Export for the Americas: Sprague Electric International Ltd., North Adams, Mass. CABLE: SPREXINT

SEE US AT THE I.R.E. SHOW—247-249 INSTRUMENTS AVENUE
CIRCLE ED-83 ON READER-SERVICE CARD FOR MORE INFORMATION

Signal Source

With 4.5-120Mc Range



The Sweep Signal Generator, Type 240-A, is a multi-purpose precise signal source. It can be used as a single frequency source, an amplitude modulated signal generator, a sweep frequency signal generator with frequency deviation variable over a wide range, and a sweep frequency

signal generator with frequency identifying marks. Arrangements have been included for calibrating the single frequency output against internal crystal-controlled frequencies.

The frequency range is 4.5Mc to 120Mc, continuously tunable in five ranges with an accuracy of $\pm 1\%$. The calibrated r-f output voltage is continuously variable from 1.0mv to 30,000mv by use of an external 20db attenuator (Type 509-A). Amplitude modulation at 30% from a 1000cy internal oscillator is available. Boonton Radio Corp., Dept. ED, Boonton, N. J. This item will be on display at the Radio Engineering Show, Booth 225-227.

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

Power Supply

Rugged, Constant-Current Type



Designed and built to withstand rugged treatment, the Model CC-503-B constant current d-c power supply provides a wide range of current suitable for a variety of uses. Output

current ranges from 0 to 500ma in five steps, with vernier control of 100ma between steps. The voltage across the load may vary from 100v to 250v, depending on load resistance.

Regulation of the supply is 0.3% for 10v line variation, 0.03% for load change. The unit is designed to operate in temperatures ranging from -50° to $+130^{\circ}$ F. It is built for standard rack panel mounting. Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena, Calif.

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

CIRCLE ED-81 ON READER-SERVICE CARD

ELECTRONIC DESIGN • March 1955

NEW G-E LIGHTHOUSE TRIODE OPERATES UP TO 4000 MC!

For military and industrial CW and pulsed power applications!



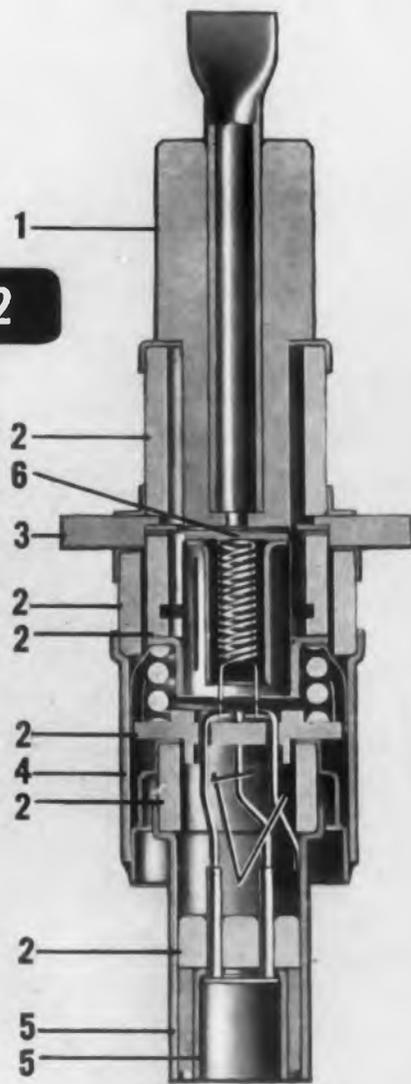
GL-6442

Shown actual size. Height (max) only 2 39/64". Diameter (max) only 39/64" exclusive of grid flange.

- Operates safely CCS up to 175 C seal temperature.
- Shock-tested to 400 G.
- Sturdy grid flange permits rigid mounting.
- Ceramic construction resists heat, adds strength.
- Co-planar design gives high electrical efficiency.
- Silver-plated terminals with large areas assure low-loss circuit contacts.

On display, General Electric exhibit at I. R. E. Show, March 21st to 24th!

GENERAL ELECTRIC



1. PLATE TERMINAL has exceptionally large area, for good electrical conduction and proper cooling. Extra length is a plus in the case of many tuning mechanisms. Surface is silver-plated—as are all GL-6442 terminals—for high conductivity.

2. CERAMIC INSULATORS at all points are high-strength with low dielectric loss. They withstand higher temperatures than glass. All vacuum seals are brazed metal-and-ceramic, to resist vibration and shocks.

3. GRID TERMINAL is designed with maximum rigidity, so that it may seat positively and clamp firmly to the external circuit.

4. CATHODE TERMINAL is electrically insulated from the heater terminals. This permits use of a simpler circuit.

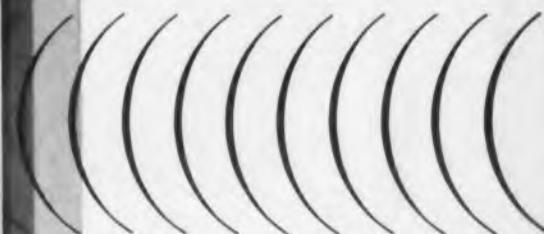
5. HEATER TERMINALS are sturdy cylindrical shells, permitting use of simple and substantial cavity-type contacts. No polarized socket is required!

6. PARALLEL-PLANE PLATE, GRID, AND CATHODE give (a) higher-frequency operation, (b) greater efficiency in respect to transit time and inductance losses, (c) better resistance to shocks and vibration.

Developer of
ers, and
control,
the field
and data
systems.

Important new programs are under way in the Radar Research and Development Division for the development of ground radar and data processing networks. In these projects, Hughes engineers are drawing on their extensive experience in the successful development of radar fire control systems and airborne computers.

The data gathering for these ground networks will be performed by very high power radar using advanced high-speed scanning techniques developed by Hughes under sponsorship of the U. S. Navy. The processing, transmission, and correlation of the great mass of data involved will be handled by large-scale digital systems. This equipment must be designed to meet stringent tactical requirements for reliability and maintainability.



of the types of work included:

TRANSISTOR CIRCUITS
DIGITAL CIRCUITS
MAGNETIC DRUM AND
CORE MEMORIES
LOGICAL DESIGN
PROGRAMMING
ADVANCED RADAR TECHNIQUES

*Engineers
and Physicists*

Application of the techniques, special knowledges and individual talents indicated here is creating positions at all levels in the Ground Systems Department. Engineers and physicists with experience in the fields listed, or those with exceptional ability in these directions, are invited to consider joining our Staff.

Scientific
and
Engineering
Staff

HUGHES

RESEARCH
AND DEVELOPMENT
LABORATORIES

Culver City, Los Angeles County,
California

APPLICATIONS AND RATINGS . . .

RECOMMENDED APPLICATIONS, NEW GL-6442 TRIODE

	R-f power amplifier and oscillator, Class C telegraphy:	Plate-modulated r-f power amplifier and oscillator, Class C telephony:	Plate-pulsed r-f power amplifier and oscillator, Class C telegraphy:	Frequency multiplier, Class C (inquire about ratings for this service):
BEACONS	Yes	---	Yes	Yes
COMMUNICATIONS	Yes	Yes	---	Yes
LOW-POWER RADAR	Yes	---	Yes	Yes
MICROWAVE RELAYS	Yes	Yes	Yes	Yes
NAVIGATION	Yes	Yes	Yes	Yes
SPECIAL TEST EQUIPMENT	Yes	Yes	Yes	Yes
TELEMETERING	Yes	Yes	Yes	---

MAXIMUM RATINGS AND TYPICAL OPERATION

MAX RATINGS, ABSOLUTE VALUES		TYPICAL OPERATION	
As r-f power amplifier and oscillator, Class C telegraphy, to approx 2500 mc: CCS D-c plate voltage 350 v D-c plate current 35 ma D-c grid current 15 ma Plate power input 12 w Plate dissipation 8 w Peak heater-cathode voltage: heater negative to cathode 90 v heater positive to cathode 90 v		As plate-pulsed oscillator at 3500 mc: Duty factor 0.001 Peak positive-pulse plate-supply voltage 3,000 v Peak negative-pulse grid-bias voltage 75 v Peak current from pulse supply 2.5 amp D-c plate current 2.5 ma Useful power output at peak of pulse, approx 2 kw Pulse duration 1 microsecond Pulse repetition rate 1,000 pulse per second Heater voltage 6 v	
As plate-modulated r-f power amplifier and oscillator, Class C telephony, to approx 2500 mc: CCS D-c plate voltage 275 v D-c plate current 35 ma D-c grid current 15 ma Plate power input 9.5 w Plate dissipation 6 w		As plate-pulsed r-f power amplifier and oscillator, Class C telegraphy, to approx 4000 mc: Peak positive-pulse plate-supply voltage 3,000 v Peak negative-pulse grid-bias voltage 100 v Peak plate current from pulse supply 2.5 amp Peak rectified grid current 1.25 amp D-c plate current 0.0025 amp D-c grid current 0.00125 amp Plate dissipation 7.5 w Pulse duration 2 microseconds Cathode heating time 60 seconds (min) Peak heater-cathode voltage: heater negative to cathode 90 v heater positive to cathode 90 v	

For further information, phone or write the G-E tube regional office nearest you, listed below.
Tube Department, General Electric Company, Schenectady 5, New York.

General Electric Company
 Tube Department
 200 Main Avenue, Clifton, N. J.
 Telephone: GRegory 3-6387
 (For direct connection in N. Y. C.
 dial Wlscosin 7-4065, 6, 7, 8)

General Electric Company
 Tube Department
 3800 North Milwaukee Avenue
 Chicago 41, Illinois
 Telephone: SPring 7-1600

General Electric Company
 Tube Department
 11840 West Olympic Boulevard
 Los Angeles 64, California
 Telephones: BRadshaw 2-8566
 ARizona 9-7765

Progress Is Our Most Important Product

GENERAL  ELECTRIC

162-1B2

Ultrasonic Drill Cuts to Accuracy of 0.0005"



The Model U 600 ultrasonic drill is valuable for such operations as cutting, shaping, grinding, and finishing. It is particularly useful for drilling hard materials as glass, tungsten carbide, sapphire, ceramic, and hardened steel within a tolerance of 0.0005".

Employing a Glennite ceramic transducer, the drill avoids any heating or deformation of the work piece, while tool wear is reduced to a minute fraction of the cutting penetration. The drill achieves a high degree of mechanical driving energy at an unusually reduced power and cost; maximum power required is only 35w, and the generator supplied is completely contained in a cabinet 9" x 9" x 6". The entire unit, including drill and generator, is completely portable and weighs only 15 lb. Vibro-Ceramics Corp., Dept. ED, Metuchen, N. J. *This product will be on display at the Radio Engineering Show, Booth 850.*

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

TV Amplifiers For Closed-Circuit Applications



"Master-line" amplifiers and accessories are designed for closed-circuit TV signal distribution and master systems for reception of commercial program material. The amplifiers shown provide more than 37db gain over the entire vhf band. Frequency response is flat within $\pm 1/2$ db over any 6Mc channel, and ± 1 db over either high or low vhf band. Constant output levels can be maintained with an auxiliary unit. Spliceless cable tap-offs provide signals to multiple sets in branch lines, with 17db isolation.

Directional couplers, matching transformers, frequency duplexers, attenuators, and radiation shield housings fill out the line of accessories to make a flexible and economical type of TV distribution system for any purpose. Blonder-Tongue Laboratories, Inc., Dept. ED, 526-536 North Ave., Westfield, N. J. *This product will be on display at the Radio Engineering Show, Booth 614.*

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

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

Drill

0005"

Model U 600 ultra-drill is valuable for operations as cutting, grinding, and polishing. It is particularly for drilling such as glass, tungsten sapphire, ceramics, hardened steel, to a tolerance of

transducer, the drill of the work surface a minute fraction of an inch. The drill achieves a high accuracy at an unusually low power required is applied is completely portable. The entire unit, completely portable Grammes Corp., Dept. 1000. It will be on display at Booth 850.

FOR MORE INFORMATION

ERS

Applications



Accessories are for television and master TV aerial programming. More than 37db gain frequency response is flat channel, and within bandwidth. Constant output with an auxiliary AGC provide signals to TV station.

transformers, frequency and radiation-proof accessories to make a complete TV distribution system. Under-Tongue Laboratories, 100 North Ave., Westfield, Mass. Display at the Radio

FOR MORE INFORMATION

CARD FOR MORE DATA



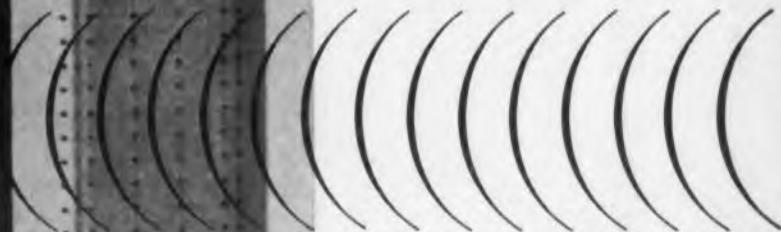
Hughes, pioneer developer of airborne digital computers, and leader in radar fire control, now enters the field of ground radar and data processing systems.

Visit the
HUGHES EXHIBITS
Booths 753 • 755 • 757
I.R.E.
NATIONAL CONVENTION
and
RADIO ENGINEERING SHOW
New York City, March 21, 22, 23, 24
Headquarters, Waldorf-Astoria Hotel
Exhibits, Kingsbridge Armory

**SCANNING
A NEW
HORIZON**



Shown here is a new magnetic drum memory for the Hughes airborne digital computer. Many of the techniques it employs will be used in the ground radar data processing systems.



Here are some of the types of work included:

- TRANSISTOR CIRCUITS
- DIGITAL CIRCUITS
- MAGNETIC DRUM AND CORE MEMORIES
- LOGICAL DESIGN
- PROGRAMMING
- ADVANCED RADAR TECHNIQUES

*Engineers
and Physicists*

Application of the techniques, special knowledges and individual talents indicated here is creating positions at all levels in the Ground Systems Department. Engineers and physicists with experience in the fields listed, or those with exceptional ability in these directions, are invited to consider joining our Staff.

*Scientific
and
Engineering
Staff*

HUGHES
RESEARCH
AND DEVELOPMENT
LABORATORIES

*Culver City, Los Angeles County,
California*



"MICROVAL" PACKAGE

Regulated Klystron
Power Supply

Tube Mount
and Pad

Slotted Section
and Probe

Standing Wave Amplifier

FXR Type Z816A
Regulated Klystron Power Supply
Beam: 300 to 500 V. up to 65 MA.
Reflector: 0 to 600 V.
Metered voltages and beam current.
Modulation: Square wave and sawtooth
(sync. and external modulation jacks)

FXR Type X763A Tube Mount
Mounts 2K25 Klystron (Tube incl.)
Built-in 15 DB variable waveguide attenuator
Frequency Range: 8,500 to 9,600 MC/S

FXR Type X105A Slotted Section
Friction Drive
CM vernier scale
Special narrow tapered slot
Precision broached waveguide (1" x 1/2")
Built-in fixed-tuned probe with
radiation suppression
Frequency Range: 8,200 to 12,400 MC/S
1N23B Crystal supplied

FXR Type B810A Standing Wave Amplifier
Standard FXR Precision Component
VSWR Ranges: 1 to 3, 3 to 10, 10 to 30,
30 to 100
Modulation Range: Wide band 300 to 4,000 CPS
Narrow band 1,000 ± 50 CPS
Metered Bolometer Bias: 3.5 to 9 MA.
Separate output jack (from cathode follower)
Calibrated Meter Scale: VSWR, DB, MA.

Other information available upon request.

COMPLETE BASIC EQUIPMENT
For measurements in the "X" band frequency range.

MICROWAVE VALUE is packed into this FXR engineered package of companion instruments . . . made for each other, and priced right for budget minded schools and industry. The versatile Power Supply and Modulator unit drives the Klystron. The variable Buffer Attenuator controls power into the Slotted Section, where a sensitive fixed tuned Crystal Detector supplies the signal to a Standing Wave Amplifier. You get one well-integrated package for all purposes, and all these fine value-packed test instruments for one low price. Individual instruments are also available separately. Be sure to see them at the show. Delivery from stock.



See the complete line of
FXR PRECISION MICROWAVE TEST EQUIPMENT
at the I.R.E. Show
Kingsbridge Armory, March 21-24
BOOTH No. 375

Write today
for Complete Catalog



Electronics & X-Ray Division

F-R MACHINE WORKS, Inc.

26-12 BOROUGH PLACE, WOODSIDE 77, N. Y. • ASTORIA 8-2800

PRECISION MICROWAVE
TEST EQUIPMENT

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

Pressure Sensitive Label
Adheres to Oily Surfaces

This combination oil and heat-resistant pressure-sensitive label resists oil penetration . . . and also adheres firmly to oily and greasy surfaces. It is extremely heat-resistant. Avery Adhesive Label Corp., Dept. ED, 1616 S. California Ave., Monrovia, Calif. This product will be on display at the Radio Engineering Show, Booth 389-391.

CIRCLE ED-91 ON READER-SERVICE CARD

Magnetic Tapes

Two With Polyester Backing

Three new magnetic tapes with various advantages are now available. "Scotch" brand magnetic tapes No. 111 and "High Output" No. 120 are now available on high-strength polyester backing as well as on conventional acetate backing. Designated No. 111 AM and No. 120 AM, respectively, the two new tapes are identical in magnetic characteristics with their acetate base counterparts.

Key feature of "Extra-Play" 190 tape is a new, high-potency oxide coating only half as thick as standard coatings, but with equivalent magnetic properties. It has a new, thinner backing of tough cellulose acetate. Although about 30% thinner than conventional acetate tape, it is nearly 80% as strong—more than adequate for use on all recorders. Minnesota Mining & Mfg. Co., Dept. ED, 900 Fauquier St., St. Paul 6, Minn.

CIRCLE ED-92 ON READER-SERVICE CARD

Laminate

Easily Punched Cold

A new punching-grade phenolic laminate that provides exceptional cold punching qualities at a lower cost is known as "Textolite Grade 11561". The material can be punched cold to 1/8" and sheared cold to 3/32". Laminated & Insulating Products Div., General Electric Co. Dept. ED, Coshocton, Ohio.

CIRCLE ED-93 ON READER-SERVICE CARD

America's most complete line

Carter ROTARY POWER SUPPLIES

ROTARY POWER IS BEST

The "clap-clap" of "Old Bess" gave Grandma's buggy ride more vibration than the smooth Rotary Power of today's modern automobiles. ROTARY POWER is best for mobile radio, too . . . and for all DC to AC conversion . . . smoother . . . more dependable.



DC TO AC CONVERTERS



For operating tape recorders, dictating machines, amplifiers and other 110-volt radio-audio devices from DC or storage batteries. Used by broadcast studios, program producers, executives, salesmen and other "field workers".

DUO-VOLT GENEMOTORS

The preferred power supply for 2-way mobile radio installations. Operates from either 6 or 12-volt batteries. Carter Genemotors are standard equipment in leading makes of auto, aircraft, railroad, utility and marine communications.



CHANGE-A-VOLT DYNAMOTORS

Operates 6-volt mobile radio sets from 12-volt automobile batteries . . . also from 24, 32 and 64-volt battery power. One of many Carter Dynamotor models. Made by the world's largest, exclusive manufacturer of rotary power supplies.



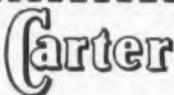
BE SAFE . . . BE SURE . . . BE SATISFIED

AC can be produced by reversing the flow of DC, like throwing a switch 120 times a second. But ROTARY converters actually generate AC voltage from an alternator, same as utility stations. That is why ROTARY power is such clean AC, so dependable . . . essential for hash-free operation of recorders from DC power.



MAIL COUPON for illustrated bulletin with complete mechanical and electrical specifications and performance charts. Carter Motor Co., Chicago 47.

CARTER MOTOR CO.
2664 N. Mablewood Ave.
Chicago 47, Illinois



Please send illustrated literature containing complete information on Carter "Custom" Converters and Dynamotor Power Supplies

NAME

Address

City State

CIRCLE ED-95 ON READER-SERVICE CARD

R-F Capacitors

Made of Glass and Foil Layers



Different in physical form from capacitors previously available for r-f operation, these medium-power transmitting capacitors take advantage of the properties of glass as a dielectric. Formed of alternate layers of glass and foil, they have heavy terminal lugs which are used for both electrical connection and mechanical mounting. Small in size and weight, they are well suited for airborne equipment. They also have characteristics which recommend them for use in power amplifiers, low-power transmitters, low-power oscillators, and television transmitters.

Available in types CY60, CY65, and CY70, the capacitors electrically replace mica capacitor types CM45 to CY70. In most cases, the equivalent ratings in glass capacitors occupy less volume than their mica counterparts while giving equal or superior service. Temperature coefficient is 140ppm/°C over the temperature range of +25° to +85°C. Capacitance drift is usually of the same order of magnitude as the error of measurement and does not exceed 0.1% +0.1mmfd.

The capacitors will be available with voltage ratings to 6000 peak working volts and power ratings to 7.8kva at 1Mc. Corning Glass Works, Dept. ED, Corning, N. Y. *This product will be on display at the Radio Engineering Show, Booth 397.*

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

Thyratron

For Close Control of Motor Speeds



The NL-730, a 3.2amp d-c thyratron, utilizes gas and mercury-vapor for long life, quick starting, and wide temperature limits. It is especially designed for motor speed control and regulated rectifier applications.

Ratings of the unit include: filament voltage, 2.5v; filament current, 12amp; peak inverse and forward voltage, 1500v; anode current, 3.2amp; peak anode current, 40amp; anode current averaging time, 5sec; and filament heating time, 30sec. National Electronics, Inc., Dept. ED, Geneva, Ill.

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

DIELECTRIC TESTING AT

PERMAGEL TAPE CORPORATION



WITH *Industrial Instruments*: HIGH-VOLTAGE BREAKDOWN TESTER

To assure uniformly high-quality of their product, the Permagel Tape Corporation, manufacturers of industrial type tapes, employ an Industrial Instruments high-voltage breakdown tester. Samples of the company's products are constantly being checked for dielectric characteristics in a safe, accurate method with this instrument.

The Industrial Instruments high-voltage breakdown tester has found countless applications in laboratories, factories, and research centers. It provides a means of controlled measurement of dielectrics, with a wide voltage range available. The particular model pictured at the Permagel Tape Corporation is rated at 50,000v.-2KVA.

As with all Industrial Instruments products, operation of the high-voltage breakdown tester may be done with either technical, or non-technical personnel. A wide variety of standard test jigs are available, while special jigs can be designed to fit your needs as to mechanical, electrical, temperature, and humidity requirements,

SEND FOR YOUR COPY OF THE INDUSTRIAL
INSTRUMENTS ELECTRIC TEST EQUIPMENT
CATALOG . . .



Industrial Instruments

89 COMMERCE ROAD, CEDAR GROVE, N. J.

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

WHEN YOU SPECIFY . . . **MAGNETIC SHIELDS**

SPECIFY . . .

MAGNETICS inc.

*Performance -
Guaranteed*

HERE'S WHY . . .

Shielding is a vital element in circuit design, and the Magnetics, Inc. "Performance-Guarantee" on your shields is your assurance that they have been designed and manufactured to meet *your* performance specifications. You then know, whether your shields have been made from Mumetal, A.E.M. 4750, or from any other commercially available magnetic or non-magnetic material selected to meet your needs, they will make money for you on the assembly line by eliminating waste.

You also know that these Performance-Guaranteed Magnetic Shields cost no more—indeed, despite the fact that you have a guarantee of performance, they are sold at prices standard in the industry. Let our Engineering Department design your shields and production engineer to your cost requirements . . . one more important Magnetics, Inc. service to our customers.

How Do You Like Your Shields? . . .

Painted, lacquered . . . or unfinished? Painted . . . to match any equipment shade you select? From *any* commercially available material to meet your performance and cost needs? That's exactly how they're furnished by Magnetics, Inc. . . . to meet *your* specifications.

WANT THE COMPLETE STORY?

Write us . . . on your company letterhead . . . we'll be delighted to answer your questions. No obligation, of course. . . .

MAGNETICS inc.

DEPT. ED-14, BUTLER, PENNSYLVANIA

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

Transistor Tester

Performs "Go No-Go" Tests



The Model TT-11A Transistor Tester checks NPN, PNP, junction, and point contact transistors, diodes, and other semiconductor devices on a direct-reading "Go, No-Go" basis, and is not obso-

leted by new transistor types. Both static and dynamic tests are performed by means of a bridge comparison circuit, and results are independent of voltage and temperature variations.

The tests performed by this instrument (which are accomplished by simply depressing lever switches) include forward emitter-base and reverse collector-base characteristics, amplification, and oscillation comparisons with respect to a reference transistor. Quantitative values can also be obtained by substituting equivalent circuits for the reference transistor.

The unit includes an internal d-c power supply for transistor biases of 0.10ma for emitter current, and 0-10/100ma for collector voltage. Electronic Research Associates, Inc., Dept. ED, 67 E. Centre St., Nutley, N. J. *This product will be on display at the Radio Engineering Show, Booth 216.*

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

Quartz Crystals

For 16-100kc Range

Two quartz crystals, available from this firm, conform to MIL-C-3098A specifications, as well as aviation and industrial requirements. Each unit is ultrasonically cleaned and hermetically sealed.



Crystal CR-38/U has a frequency range of 16-100kc; load capacity of 20mmfd; frequency tolerance of $\pm 0.012\%$; and a temperature range of -40° to $+70^{\circ}$ C. The holder is IIC-13/U. Recommended drive level is 0.1mw.

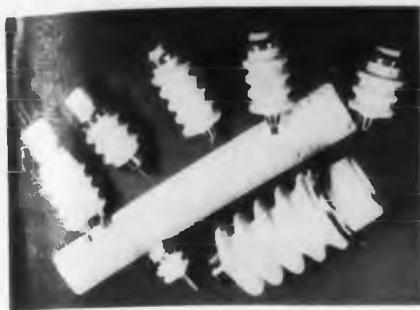
The other crystal, the CR-50/I, is the same as the CR-38/U, with the exception of the load capacity. Cryco, Inc., Dept. ED, 1138 Mission St., South Pasadena, Calif.

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

ELECTRONIC DESIGN • March 1955

□ Ceramic Terminals

Leak-proof



A number of electrical terminals have been developed by this firm, consisting of metal parts bonded to ceramic insulators, using high temperature bonding

alloys as the bonding medium. These terminals are hermetically sealed, have excellent properties of strength, thermal shock resistance, electrical characteristics, and ability to be used at high temperatures. Insulation material is normally of the high alumina type. For most applications, the metal used is an alloy steel of thermal expansion properties similar to the ceramic and such as to induce compressive stresses. The bond alloy is usually the silver-copper eutectic, with a melting point of 776°C. The process of sealing is such as to produce a molecular bond to the ceramic.

The terminals are leak-tight as tested by the mass spectrometer, the type H halogen leak detector, and by life tests carried out over extended periods of time. Operating pressures in service have been as high as 2500psi, and the terminals can be used at temperatures up to 350°C, or higher. Resistance to thermal shock is extremely high. Terminals have been plunged alternately in liquid at -55° and +225°C for many cycles without bond rupture. A variety of methods are open to the user for permanently attaching the terminals to equipment. Ceramaseal Co., Dept. ED, Box 25, New Lebanon Center, N. Y. *These Components will be on display at the Radio Engineering Show, Booth 630.*

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

□ Coaxial Relay

Hermetically Sealed Miniature



This moving coil relay incorporates the advantages of the Marion "Coaxial Mechanisms." Sensitive, rugged and reliable, the "Coaxial Relay" is a hermetically sealed, miniature unit mounted on a standard 7-pin tube base. It weighs 1-1/2 oz, and measures 13/16" x 1-9/16" high x 1-13/16" overall. Marion Electrical Instrument Co., Dept. ED, Manchester, N. H. *This product will be on display at the*

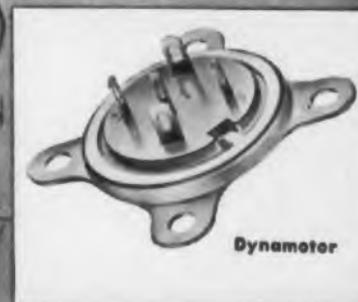
Radio Engineering Show, Booth 556.

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

Let Sylvania make your tube socket "doodling" come to life!

DESIGNERS find quick, economical solutions to tube socket problems by taking their special designs to Sylvania. (More often than not they're in doodle form.) We can do the same for you. If you need something new in a socket, go ahead and doodle it. Sylvania will translate it into three dimensions and supply you with engineering samples.

Sylvania has produced millions of sockets in over 150 varieties to fit every description. Most of these were developed to fill a specific product or production need. Now, many are standard items and may offer an even quicker solution to your current requirements.



Use this handy coupon to write for Sylvania's Electronic Components catalog.

SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC., 1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg., St. Catherine Street, Montreal, P. Q.

LIGHTING • RADIO • ELECTRONICS
TELEVISION • ATOMIC ENERGY

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

Dept. C22S
SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
Please send catalog of Sylvania
Electronic Components.

Name _____
Company _____
Address _____
City _____ Zone _____ State _____

INDUSTRIAL POCKETSCOPE

by

Waterman

MODEL S-11-A

**DC-COUPLED
WORK-HORSE OF
INDUSTRY**

Size:
11" x 5" x 7"
8 3/4 Pounds



ANOTHER EXAMPLE OF *Waterman* PIONEERING...

The INDUSTRIAL POCKETSCOPE, model S-11-A, has become America's most popular DC coupled oscilloscope because of its small size, light weight, and unique flexibility. This compact instrument has identical vertical and horizontal amplifiers which permit the observation of low frequency repetitive phenomena, while simultaneously eliminating undesirable trace bounce. Each amplifier sensitivity is 0.1 Volt rms/inch. The frequency responses are likewise identical, within -2 db from DC to 200 KC. Their total undistorted outputs permit effective trace expansion of twice the screen diameter. The internal sweep generator is continuously variable from 3 cycles to 50 KC and can be synchronized from positive going signals. Return trace blanking is optional. Intensity modulation is accomplished by connecting either directly to the grid of the three-inch cathode ray tube or thru an amplifier having a gain of approximately 10 and a flat response to 500 KC. Direct intensity modulation threshold voltage is approximately 1 volt rms. Additional provisions for direct access to all the deflection plates, the second anode, and the amplifier output terminals extend the usefulness of the S-11-A many fold.

WATERMAN PRODUCTS CO., INC.

PHILADELPHIA 25, PA.
CABLE ADDRESS: POKESCOPE

WATERMAN PRODUCTS INCLUDE

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



WATERMAN PRODUCTS

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

Terminal Block Sections Easily Added

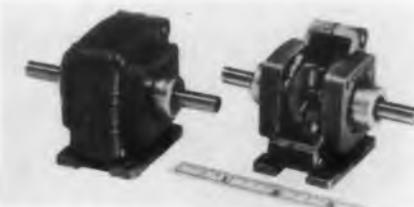


"Pres-SURE-blocks" allow any number of circuit sections to be securely assembled into a compact 70amp, 750v sectional terminal block. One-piece ruggedness of assembled circuit sections is achieved through three integrally molded serrated pins which locate and secure each circuit section by a mating with corresponding holes in the adjoining circuit section. The pins permit limitless circuit sections to be assembled without accessory fastening hardware or loose-fitting sections.

Three contact types are available for stripped or terminal ended wire, with a range of No. 18 through No. 4 wire. Snap-in marking strips do not require fastening hardware. The blocks are supplied in various MIL-P-14 molding materials. Buchanan Electrical Products Corp., Dept. ED, 225 Route 22, Hillside, N. J. This product will be on display at the Radio Engineering Show, Booth 608.

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

Speed Reducer With Anti-Backlash Feature



same weight as the standard "Bantam" units.

Anti-backlash results from two parallel gear trains that are spring loaded against each other; backlash is continuously taken up, whether running or not. The torsion spring is wound to give an anti-backlash torque of 2 lb-in in either direction. Where maximum output is not needed, spring torsion may be reduced to permit lower input torques.

The units are suited to flow controls, computers, timers, oscillographs, and similar equipment. They may be obtained in any of 600 standard ratios. Gears are hobbled, 48 pitch, and hardened to provide smooth operation and long life. Anti-friction bearings are used throughout. Metron Instrument Co., Dept. ED, 432 Lincoln St., Denver 3, Colo.

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

there's a

BETTER WAY...



use **BIRTCHEK
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 99 1/2% 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 3-55

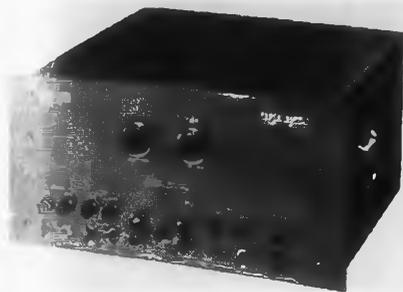
The BIRTCHEK CORPORATION
4371 Valley Blvd. Los Angeles 32, California

CIRCLE ED-110 ON READER-SERVICE CARD

ELECTRONIC DESIGN • March 1955

Power Supply

For Tube and Transistor Circuits



The Model 450 D Voltage Regulated Power Supply features two identical regulated d-c outputs which may be used separately or in series, and one unregulated

filament supply. Excellent regulation, low ripple content and low output impedance distinguish the two d-c outputs; each is continuously variable from 0-150v and delivers from 0-75ma. Output voltage variation is less than 0.1v for both line fluctuations from 105-125v and load variations from minimum to maximum current. The ripple voltage is less than 3mv. For series operation of the d-c outputs, the output voltage range is 0-300v; the output current is 0-75ma.

Panel height of the supply is 8-3/4", width 19", depth 17". It is designed for relay rack mounting or bench use. Carrying handles are provided. Kepeo Laboratories, Dept. ED, 131-38 Sanford Ave., Flushing 55, N. Y. *This product will be on display at the Radio Engineering Show, Booths 342-344.*

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

Dummy Load

High Absorption in Small Size

The "VHP" (very high power) dummy load is for use wherever extremely high microwave power is used. It is applicable in laboratory, field, and production testing. It provides a high absorption despite light weight and small size.



No cooling fins are needed in this unit, even at the full peak power rating encountered in rigid waveguides. In addition, the lossy material is specially designed to present a minimum reflection coefficient, while permitting only negligible absorption of moisture. All-aluminum construction and black enamel finish help reduce weight and resist heat. All models are available with either choke or cover flanges. Bogart Manufacturing Corp., Dept. ED, 315 Siegel St., Brooklyn, N. Y. *This product will be on display at the Radio Engineering Show, Booth 379.*

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

SILICONDUCTORS*

TRADE-MARK



ENLARGED FIVE TIMES
ACTUAL SIZE

Proven

**IN
29 RANGES**

MAXIMUM REVERSE
WORKING VOLTAGE

*SILICON JUNCTION DIODES

(Licensed by Western Electric Co., Inc.)

TYPES	e_b max	V
IN138A	18	
IN137A	36	
IN200	6.8	
TQ	TO	
IN222	470	
A3B	3.3	
A4B	3.9	
A5B	4.7	
A6B	5.6	

National
SEMICONDUCTOR PRODUCTS

DIVISION OF NATIONAL FABRICATED PRODUCTS, INC.

930 PITNER AVENUE
EVANSTON, ILLINOIS
DAVIS 8-0800

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

DOW CORNING
CORPORATION

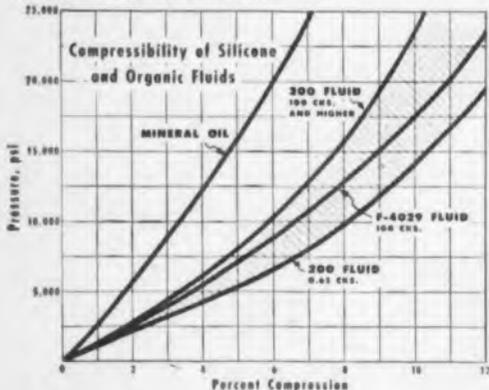
Silicone News

FOR DESIGN ENGINEERS

DESIGNERS USE SILICONE FLUIDS FOR MORE EFFICIENT SPRINGING

Dow Corning silicone fluids have always been noted for their thermal stability and their remarkably flat viscosity-temperature slopes. They have, therefore, been widely used as damping media in such devices as dashpots, overload relays and torsional vibration dampers for crankshafts.

More recently, designers have found that certain silicone fluids, Dow Corning F-4029 and some Dow Corning 200 Fluids, also have high compressibility. Using these fluids, engineers have produced liquid springs and shock absorbers with the same capacity as much larger and heavier metal coil springs. Testing indicates these highly compact liquid springs retain a high order of efficiency even under constant recycling at milli-second intervals.



As shown in the graph, both Dow Corning F-4029 and the Dow Corning 200 Fluids are more compressible than the mineral oil commonly used in liquid springs. At 20,000 psi, F-4029 has a compressibility of 10.8% which is mid-way between that of Dow Corning 200 Fluids of the same and of lower viscosity grades. While it lacks the compressibility of the lower viscosity 200 Fluids, Dow Corning F-4029 is less volatile and has a lower viscosity-temperature coefficient. **No. 29**

New 1955 Reference Guide to Dow Corning silicone products gives in 8 pages a brief but comprehensive summary of the properties and applications for the silicone products that are most widely used. Products are indexed by type of application. With increasing effort devoted to product improvement and cost reduction, such a reference guide to this remarkably stable group of engineering materials becomes increasingly important to design engineers. **No. 30**

ATLANTA • CHICAGO • CLEVELAND • DALLAS • DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D. C. (Silver Spring, Md.)
Canada: Dow Corning Silicones Ltd., Toronto; England: Midland Silicones Ltd., London; France: St. Gobain, Paris

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



Buyers Specify Silicone Insulation for Greater Safety in Transformers

Safety conscious plant planners are swinging to silicone insulated, nitrogen-filled transformers for greater protection against fires and explosions. New evidence of this growing trend is the order for over three hundred 30 KVA, 3 phase, dry-type units recently received by Moloney Electric Company of St. Louis. Designed for lighting and small motor service, these transformers are completely insulated with silicone materials to withstand abnormally high ambient or overload temperatures. **No. 31**

Silicone Resin Makes Wire-wound Resistors More Moistureproof



The Tru-Ohm Division of the Model Engineering and Manufacturing Co., of Chicago, has improved its line of wire-wound resistors by using a silicone-based cement that is much more resistant to moisture than the silicate-type cements previously used.

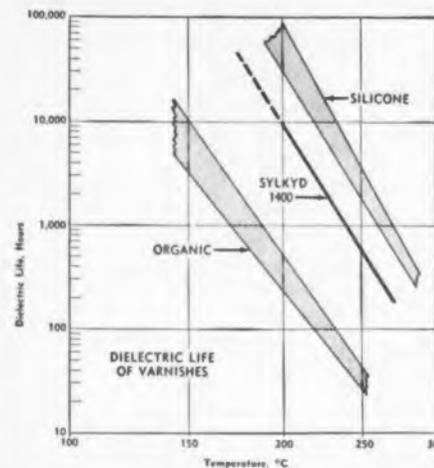
They make this cement by blending Dow Corning 996 silicone varnish with appropriate inorganic fillers. The material builds up well on the resistance wire and seals the element into the casing. It is set by air drying for 3 hours and then baking for 3 hours at 450 F.

Tru-Ohm produces the new resistors in 10, 15, 20 and 25 watt ratings for top-of-chassis mounting, and in 5, 7 and 10 watt ratings for axial leads. **No. 32**

New Silicone Varnish Improves Performance of Class B Machines

Sylkyd* 1400, a new modified silicone dipping and impregnating varnish, makes possible the production of more durable, more reliable Class B electrical equipment. Highly resistant to heat, it also has excellent bond strength and outstanding resistance to moisture, oil and degreasing solvents.

Accelerated life testing in our motor test laboratory indicates that the insulating life expectancy of Sylkyd 1400 at a hottest spot temperature of 130 C is 25 to 50 times that of Class B varnishes. As shown in the graph, the dielectric life of this new varnish approaches that of straight silicone (Class H) varnishes.



Sylkyd 1400 appears to be particularly useful on railroad traction motors and other heavy duty equipment subject to heavy overloads and periodic cleaning. Costwise, it is less expensive than Class B varnishes when the extra life and reliability are taken into consideration. **No. 33**

U.S. PAT. OFF.

Design Edition 7

DOW CORNING CORPORATION - Dept. 4703
Midland, Michigan

Please send me more data on numbers:

29 30 31 32 33

NAME _____

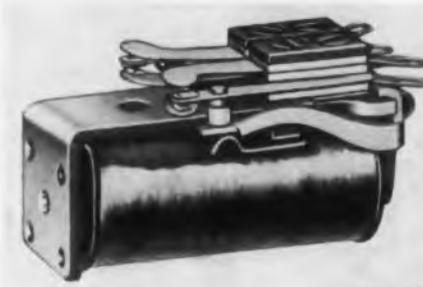
TITLE _____

COMPANY _____

STREET _____

CITY _____ ZONE _____ STATE _____

Telephone Relay With 15mv/Pole Sensitivity



The "SQ Series" coil telephone relay is available in 1amp to 5amp contact ratings, and in contact combinations from spst to 6pdt. The unit offers a maximum

sensitivity of 15mw per pole in the dpdt combination. This is an optimum combination, withstanding 10g vibration from 10cy to 500cy. When power is increased to 40mw per pole, vibration resistance rises to 30g. Sensitivity and vibration resistance decrease as additional contact combinations are added with the same amount of power.

No organic insulation is used in this high-temperature relay. The unit is insulated with silicone glass, Kel-F, or Teflon tubing. Movable blades are actuated by ceramic bumpers, with nylon or linen-base Bakelite optional. An extremely rugged relay, it withstands the Signal Corps tumbling tests and shock for mechanical damage in excess of 200g with operating characteristics unimpaired. Contact ratings show a life expectancy of 300,000cycles minimum at 1amp inductive loads, or 1,000,000cycles minimum at 1amp non-inductive loads. In continuous rated duty under low vibration and shock, the minimum operational power is 0.005w per pole; for 10g vibration and 30g shock, the minimum power is 0.015w per pole. Dimensions of the open-type "SQ" are 1" x 3/4" x 1-9/16". Units are available in a sealed container, solder-terminal, or plug-in type measuring 1" x 1" x 2". Advance Electric & Relay Co., Dept. ED, 2435 N. Naomi St., Burbank, Calif. This product will be on display at the Radio Engineering Show, Booth 759.

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

Bellows Non-Magnetic Monel



This non-magnetic Monel bellows provides the high-temperature non-corrosive advantages of Monel for electrical and electronic equipment where stray magnetic fields are a problem. Made of Type 326 Monel, it is especially use-

ful for tunable cavity applications, such as magnetrons and vacuum variable capacitors. It also offers superior performance at high temperatures and in corrosive atmospheres. Units are available in a variety of sizes. Clifford Manufacturing Co., Division of Standard-Thomson Corp., Dept. ED, Waltham, 54, Mass.

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

ELECTRONIC DESIGN • March 1955

□ Beta Gage

Uses Cesium-137 Source



The Light Materials Beta Gage uses a Cesium-137 source, the first gage to utilize this radioactive material. It has lower energy beta rays and a half-life of 33 years, much longer than the approximately two-year source used in older gages. Because low energy beta rays are emitted by the source, much thinner materials can be successfully gaged. The electronic circuitry in the detector head and console incorporates many new features.

Because the gage essentially weighs a small section of a moving sheet, without contact and regardless of sheet speed, it provides a means for controlling sheet process materials with high accuracy. As long as the density of the material remains constant, results can be presented in terms of thickness. Tracerlab, Inc., Dept. ED, 130 High St., Boston 10, Mass. *This product will be on display at the Radio Engineering Show, Booth 317.*

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

□ Resistor

Plug-In Fuse Type



These dual-purpose plug-in fuses and resistors known as Fuzohms are low-cost units to protect critical and expensive electronic equipment, particularly in TV sets.

These resistors will repeatedly withstand high-surge currents without damage, but will fuse when surge becomes dangerous to expensive components.

An example is the series 4FYG-001, part no. CM-14282, a 7.5 ohm resistor normally carrying 1amp and withstanding surge currents of 1.75amp. This resistor is designed to fuse at 2.3amp in less than 30sec. Clarostat Mfg. Co., Inc., Dept. ED, Dover, N. H. *This product will be on display at the Radio Engineering Show, Booth 725-727.*

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

ELECTRONIC DESIGN • March 1955

NUMBER 1 OF A SERIES

THE IMAGINATION FOR RESEARCH + THE SKILL FOR PRODUCTION

INTEGRATED ELECTRONICS

...welded into one close knit organization of integrated responsibility. From the first step in research to the first production unit, the same engineering group is responsible for both design and development. This integrated operation eliminates diversion between early development and final responsibility for maximum production design. One group of specialists with one goal... the solution to your problem.

For the past ten years Hoffman Laboratories has been successfully solving advanced design and production problems in electronics and electro-mechanics. In almost every case it has been necessary to reach beyond the routine of development... to develop special test and analytic equipment... to formulate unique research procedures.

Hoffman Laboratories has never undertaken a development project that has not gone into production.

Write the Sales Department for your free copy of "Report From Hoffman Laboratories."



Interior view of Sound Chamber. Hoffman Laboratories has one of the West's largest and best equipped Environmental Test Laboratories.

Hoffman

LABORATORIES, INC.

A SUBSIDIARY OF HOFFMAN ELECTRONICS CORPORATION

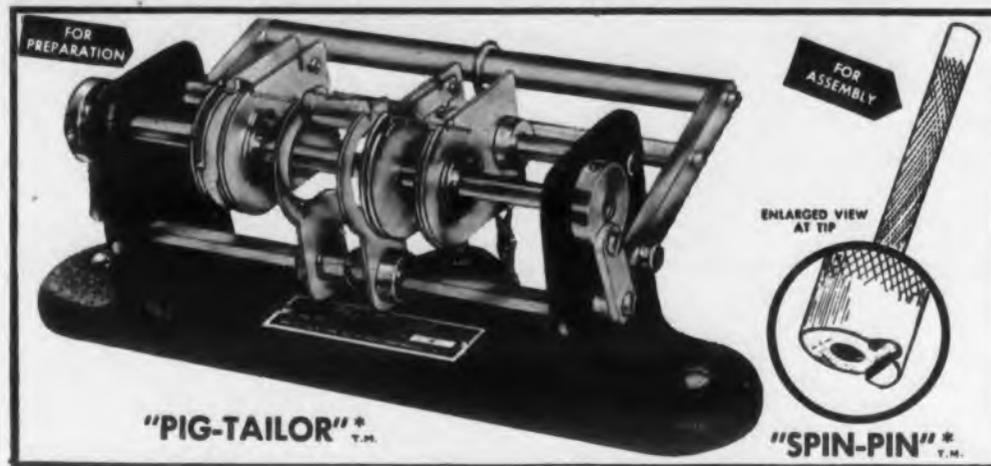
Navigational Gear
Missile Guidance &
Control Systems
Radar
Noise Reduction
Countermeasures (ECM)
Computers
Communications
Terminal Equipment
Transistor Application

Challenging opportunities for outstanding engineers. Write Director of Engineering, Hoffman Laboratories, Inc. 3761 S. Hill Street, Los Angeles 7, California.

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

"PIG-TAILORING"

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



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

PIG-TAILORING provides:

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

PIG-TAILORING eliminates:

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

* PATENT PENDING

Write for illustrated, descriptive text on "PIG-TAILORING" to Dept. ED 3-P

BRUNO-NEW YORK INDUSTRIES CORPORATION

DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT

460 WEST 34th STREET

NEW YORK 1, N. Y.



Broadband RF Power Meters

THE CHOICE OF ALL ARMED SERVICES FOR MICROWAVE POWER MEASUREMENTS

POWER: PULSE and CW — $5\mu W$ to 5W average

FREQUENCY: 20MC — 10,000MC

ACCURACY: 5% Absolute at all ranges, frequencies, temperatures

- INDICATIONS: Direct Reading
- CALIBRATION: Compensates for All Variables
- R-F COMPONENTS: 3, 6, 10 and 20db Attenuators, Bolometer Mount and Elements, R-F Cable
- BOLOMETER: Broadband, High Overload Capacity
- PLUMBING: $\frac{3}{8}$ " and $\frac{1}{8}$ " 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 3-M

Bruno - New York Industries Corporation

DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT

460 WEST 34th STREET

NEW YORK 1, N. Y.



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

Reflectometer Systems

For 8.2-10.0kMc Range



This reflectometer system, when measuring small reflections, has an accuracy that is comparable to that obtained with slotted section techniques, and may be used with sufficient speed to allow investigation of reflection coefficients over a wide frequency range in a few seconds' time. The equipment is now available to form reflectometer systems for the 8.2kMc to 10.0kMc range.

The system consists basically of the "hp" Model 670HM Swept Frequency Oscillator, connected to the device under test through two precision directional couplers which, in turn, feed samples of the incident and reflected voltages to separate detectors. The outputs of these detectors are applied to the "hp" Model 416A Ratio Meter, which automatically measures and displays the magnitude of the ratio of reflected to incident voltages, i.e., the magnitude of the reflection coefficient of the system being measured.

When a visual presentation of the measured reflection coefficient is desired, it may be obtained by connecting the output of the Ratio Meter to a de-oscilloscope which has a long-persistence screen. Hewlett-Packard Co., Dept. ED, 275 Page Mill Rd., Palo Alto, Calif. This product will be on display at the Radio Engineering Show, Booth 248-250.

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

Transformers

Made from Standard Molds



Nine standard molds for open-type Class II Transformers have been added to this firm's "Clipper" Series line. These standard molds make it possible to design a large variety of open-type transformers which will meet MIL-T-27 specifications

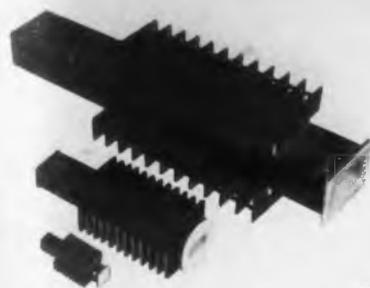
and operate up to 150°C. Use of standard mold sizes makes prototypes available for fast delivery without expensive mold charges. Sterling Transformer Corp., Dept. ED, 297 North 7th St., Brooklyn 11, N. Y. This product will be on display at the Radio Engineering Show, Booth 99.

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

ELECTRONIC DESIGN • March 1955

□ Waveguide Terminations

Handle High Power



These waveguide terminations are an improved design capable of handling extremely high power without deteriorating under high temperatures. The loads are designed for

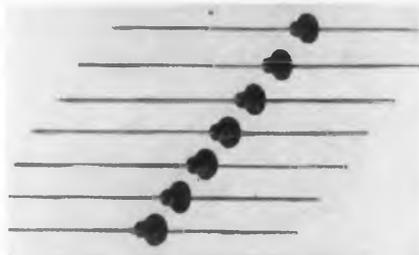
operation over the entire waveguide band with an average vswr of approximately 1.05. Seven models cover the frequency range of 1120Mc to 1700Mc and 2600Mc to 18,000Mc. Each model covers a complete waveguide band.

Typical average power ratings are 3500w at S band and over 500w at X band. Peak power ratings exceed the standard rated values for straight waveguide. All models may be pressurized for still higher power levels. The Narda Corp., Dept. ED, 66 Main St., Minneola, L. I., N. Y. *This product will be on display at the Radio Engineering Show, Booth 378.*

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

□ Silicon Rectifier

Has High Efficiency



This rectifier has an efficiency of approximately 99 per cent and has the ability to operate in extremely high ambient temperatures. It is small

in size, occupying about one-eighth of a cubic inch, light in weight, about 0.1 ounce, of all-welded construction, and it is hermetically sealed. It will function under the most severe environmental conditions.

The new unit's high efficiency is due to the low voltage drop and infinitesimal reverse leakage current (as low as 10^{-10} amps).

The silicone power rectifier has performed continuously without deterioration at temperatures up to 200°C. Repeated cycling from -40°C to +125°C shows no appreciable effect. They are rated from 100 to 500ma. The maximum forward drop at full rating is less than two volts, rectification ratios run as high as 10^8 . The forward voltage drops average 1.5v at 200ma. The new rectifier also possesses practically flat Zener characteristics, making it extremely useful as a voltage reference. Bogue Electric Mfg. Co., Dept. ED, 52 Iowa Ave., Paterson 3, N. J. *This product will be on display at the Radio Engineering Show, Booth 109-111.*

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

... here's new might for miniatures

Dur-Mica DM15

WORLD'S SMALLEST MICA CAPACITOR



El-Menco

THE FIRST MINIATURE DIPPED MICA CAPACITORS WITH PARALLEL LEADS.

IDEAL FOR PRINTED CIRCUITS — Meets all Humidity, Temperature and Electrical Requirements of MIL-C-5 Specifications. El Menco's Dur-Mica DM15 establishes a "new dimension" in capacitor performance with ranges from 1 to 390 mmf. at 500vDCw and 1 to 510 mmf. at 300vDCw. A new, tougher phenolic casing provides temperature co-efficient and stability equal to or better than characteristic F. in all but the lowest capacity values... efficient operation at temperatures as high as 125°C. El Menco's Dur-Mica DM15 can be used in a variety of transistor circuits and other miniature electronic equipment in military and civilian applications. Sells for Less than the famous El Menco CM-15 — Provides Economy of Size with Maximum Performance and Widest Application.

(Shown Actual Size)

NOW! ALSO AVAILABLE
EL Menco Dur-Mica DM20
1 to 3900 mmf. at 500vDCw —
1 to 5100 mmf. at 300vDCw.

TEST EL Menco "Dur-Micas" FOR YOURSELF!

Write for free samples and catalog on your firm's letterhead.

THE ELECTRO MOTIVE MFG. CO., INC.

WILLIMANTIC

CONNECTICUT

molded mica · mica trimmer
tubular paper · ceramic

Jobbers and distributors write to Arco Electronics, Inc., 103 Lafayette St., New York, N. Y.

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

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

FRAHM REED RELAYS ▶

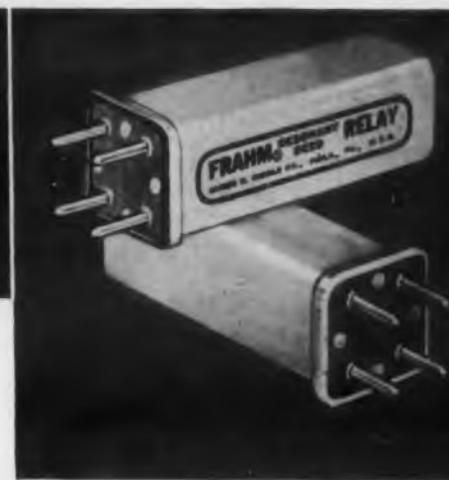
◀ FRAHM OSCILLATORS



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

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

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



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

JAMES G. BIDDLE CO.

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

1316 ARCH STREET
PHILADELPHIA 7, PA.

James G. Biddle Co.
1316 Arch St., Phila. 7, Pa.

Gentlemen:
Please send me Bulletin 33-ED —
Frahm Relays
 Bulletins 34-10-ED —Frahm
Oscillators

NAME

JOB FUNCTION

COMPANY

ADDRESS

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

CUT IRON CORE COSTS

with Stackpole "PREFERRED TYPES"



Made to well-known Stackpole quality standards, these new "EE" Cores are available only in commonly needed grades and sizes. They're ready for delivery from stock . . . at low prices . . . and without the usual set-up charge for custom-engineered cores.

Mechanical specifications conform to the latest MPA recommendations. Electrical standards fully meet 8 out of 10 requirements of radio, TV, and communications equipment. Write, wire, or 'phone for details.

Electronic Components Division

STACKPOLE CARBON COMPANY
St. Marys, Pa.

STACKPOLE

CIRCLE ED-131 ON READER-SERVICE CARD FOR MORE INFORMATION

Controllable Inductors Operate Up to 1Mc



These "Increductor" controllable inductors, designated as the LP series, operate on the principle of saturable reactors but use a direct current to control the inductance of a signal winding suitable for use in high frequency circuits. The series has been developed in response to the increasing demand for more uniform performance characteristics in the supersonic frequency range. A

reduction of more than 5:1 in distributed capacity of the signal winding results from a new yoke configuration.

The units are designed for operation up to 1Mc and are particularly suitable for use in variable frequency filters and traps, tunable oscillators and amplifiers, remote modulator or level control, and expander-compressor circuits.

The 47LP1 unit requires about 20ma d-c for full inductance change. A lower impedance unit, the 47LP2, is particularly suitable for rapid sweep applications and provides full inductance change with 100ma d-c. Maximum variation of the d-c control current produces a change of 200:1 in the inductance of the signal winding. C.G.S. Laboratories, Dept. ED, 391 Ludlow St., Stamford, Conn. This product will be on display at the Radio Engineering Show, Booth 666-668.

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

Slip-Ring Assembly Widely Applicable Shelf Item



This standard "off-the-shelf" slip-ring and brush assembly is designed to meet a wide variety of applications for rotating electromechanical

devices. From two to 10 circuits can be obtained in one assembly, and two or more assemblies of 10 each can be stacked together to achieve a greater number of circuits.

Currents up to 20amp and extremely low noise levels make the assemblies useful for a great variety of applications, including strain gages, telemetering, radar test equipment, and controls. D. E. Makepeace Co., Dept. ED, Attleboro, Mass. This product will be on display at Radio Engineering Show, Booth 403.

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

ELECTRONIC DESIGN • March 1955

PROBLEM: Selenium rectifiers plus control transformers for direct current power in industrial applications.

WHY 

BUY

SPECIALS?



You don't have to go to the inconvenience, expense and delay of ordering special transformers for use with selenium rectifiers in industrial control applications.

MERIT

has a complete line of standard transformers specifically for this application.

MERIT

The line will cover better than 90% of your applications. Request

MERIT

form #55 and form #6353A for full information.

MERIT

is the only supplier with a complete line of transformers, coils, yokes and chokes for all radio, TV, communication, sound and industrial applications.



MERIT COIL & TRANSFORMER CORP.
4427 N. Clark Street
Chicago 40, Illinois

CIRCLE ED-134 ON READER-SERVICE CARD

Lighthouse Tube
Peak Output of 2kw at 3500Mc



This miniaturized lighthouse tube, the GL-6442, is a 2-5/8" long metal-and-ceramic tube of new design that permits pulsed power applications up to 4000Mc. Peak power output at 3500Mc is 2.0kw.

The mechanical structure features an exceptionally strong grid flange for rigid mountings, which together with the use of ceramic and coplanar design permits the tube to offer greater resistance to shock and vibration than conventionally-constructed lighthouse tubes. The tube is shock-tested to 400G, and operates safely in continuous commercial service up to 175°C seal temperature. Large-area silver-plated terminals assure low-loss contacts.

The tube is designed for beacons, low-power radar, microwave relays, navigation, special test equipment, and telemetering. Tube Dept., General Electric Co., Rm. ED, Schenectady 5, N. Y. *This product will be on display at the Radio Engineering Show, Booth 174-196.*

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

Digital Voltmeter
Has Three-Digit Counter

The Digital Voltmeter, Model 615 replaces the deflection needle and multiple scales found on conventional voltmeters with a revolving three-digit counter. This affords direct readings of voltage, current or resistance without the necessity for interpolation or the possibility of errors caused by parallax or reading of the wrong scale. The dial is also equipped with illuminated, automatic decimal point and polarity sign as further aids to quick, accurate readings.



Sensitivity ranges for the Model 615 are from one millivolt to 1,000v and from 1000 ohms to ten megohm, with an accuracy rating of 1% (on d-c and ohms, 2% on a-c). Hycan Mfg. Co., Dept. ED, 2961 East Colorado St., Pasadena 8, Calif. *This product will be on display at the Radio Engineering Show, Booth 735.*

Sensitivity ranges for the Model 615 are from one millivolt to 1,000v and from 1000 ohms to ten megohm, with an accuracy rating of 1% (on d-c and ohms, 2% on a-c). Hycan Mfg. Co., Dept. ED, 2961 East Colorado St., Pasadena 8, Calif. *This product will be on display at the Radio Engineering Show, Booth 735.*

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

for your product
 whether it **PLAYS** or **COMPUTES**



RF TRANSISTORS



RADIO APPLICATION

Raytheon RF Transistors create a whole new concept of portable radio convenience, performance and economy — portable radios that run for 500 hours on ordinary, low cost universally available flashlight batteries, and that *really* out-perform most tube portables.

	CK760	CK761	CK762
Gain in db at 455 Kc.	32	33	33
Gain in db at 2000 Kc.	18	20	22

COMPUTER APPLICATION

Raytheon RF Transistors combine high alpha cutoff, fast rise time, the desired dissipation and voltage ratings and excellent base current amplification. They mark a milestone in computer development, design and progress.

	CK760	CK761	CK762
Rise time (μ secs)	0.05	0.04	0.02
Decay time (μ secs)	0.06	0.05	0.03

(measured in circuit which will be supplied on request)

	CK760	CK761	CK762
Alpha frequency cutoff (megacycles)	5	10	20
Collector capacitance ($\mu\mu$ fd)	15	15	15
Extrinsic base resistance (max. ohms)	125	125	125

**There are more — several times more
 RAYTHEON TRANSISTORS
 in use than all other makes combined**



RAYTHEON MANUFACTURING COMPANY
 Semiconductor Division — Home Office: 55 Chapel St., Newton 58, Mass. 02459
 For application information write to: Home Office: 4935 West Fullerton Avenue, Chicago 39, Illinois, NA 3773
 589 Fifth Avenue, New York 17, New York, Plaza 9 3970 • 622 South La Brea Ave., Los Angeles 36, California, WE 8-2831
 RAYTHEON MAKES ALL THESE
 RELIABLE SUBMINIATURE AND MINIATURE TUBES - SEMICONDUCTOR DIODES AND TRANSISTORS - NUCLEONIC TUBES - MICROWAVE TUBES - RECEIVING AND PICTURE TUBES

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

BELL SYSTEM'S NEWEST TELEPHONE DEVELOPMENTS

use **RAYTHEON** filamentary subminiature tubes



TELEPHONE ANSWERING. When you aren't there, the automatic telephone answering set takes over, delivers previously dictated message in your voice, records caller's reply and plays it back to you at your convenience.

"HANDS-FREE" TALKING.

Telephone set base has a built-in microphone—you talk without picking up handset. Tiny desk speaker amplifies the distant voice so that several persons in a group can listen to the conversation. For privacy, you lift the receiver, automatically shutting off the microphone and speaker. Small amplifier, not visible in the picture, furnishes power.

The Bell System's new telephone answering set and new telephone for "hands-free" and conference use naturally require tubes of the utmost reliability. Raytheon Filamentary Subminiature Tubes qualified only after undergoing a long series of exacting tests by both Bell and Raytheon.

Low microphonics, low power requirements, high efficiency, long life and, above all, supreme reliability characterize the Raytheon Tubes in these newest telephone developments.

It will pay you to find out what Raytheon Filamentary Subminiatures can do to better the performance, convenience and economy of your electronic equipment.



RAYTHEON FLAT PRESS Subminiature Tubes are the tubes with the SEAL OF RELIABILITY—the longer glass to metal seal that gives you these important advantages:

Glass heated only once—no button, low glass strain, no lead burning

Reentrant seal eliminates breakage from short bends

Leads completely tinned right to glass

Flat press with in-line leads for easier socketing, easier wiring, adaptability to printed circuits

Reliable, long-lived Raytheon Subminiature Tubes in these Bell equipments, illustrated above, were tested for dependable, trouble-free service over long periods.



RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division—Home Office, 55 Chapel St., Newton 38, Mass. 02459
 For application information write or call the Home Office or: 4935 West Fullerton Avenue, Chicago 39, Illinois, National 2-2770
 339 Fifth Avenue, New York 17, New York, Plaza 9-3900 • 622 South La Brea Ave., Los Angeles 36, California, WEster 8-2851
 RAYTHEON MAKES ALL THESE

RELIABLE SUBMINIATURE AND MINIATURE TUBES - SEMICONDUCTOR DIODES AND TRANSISTORS - NUCLEONIC TUBES - MICROWAVE TUBES - RECEIVING AND PICTURE TUBES

CIRCLE ED-143 ON READER-SERVICE CARD FOR MORE INFORMATION

☐ Magnetic Amplifiers Ultra-Fast Types



Developed for use in control systems where a high gain amplifier and fast response is required, the speed of response of this amplifier has been made independent of the number of stages of amplification. This has

made possible the present 3-stage amplifier in which the input and output phase occur during the same half cycle of the power supply. Reduction of the series major loop lag permits the use of more negative feedback in the inner loop, resulting in improved stability.

Specifications of the Ultra-Fast Magnetic Amplifier, Model 504-1 are: power gain, 50,000; a-c power output, 15w phase reversible with a-c input; d-c power output, 15w, polarity reversible with d-c input; power supply, 115v, 60cy $\pm 10\%$. Total time lag is 0.0083-secs. Load impedance is 800 ohms and input impedance is 15,000 ohms. Weight: 10 lbs. Dimensions: 6" x 5" x 10-1/2". Librascope, Inc., Dept. ED, 808 Western Ave., Glendale, Calif. *This item will be on display at the Radio Engineering Show, Booth 156.*

CIRCLE ED-149 ON READER-SERVICE CARD FOR MORE INFORMATION

Encapsulated Toroids

Accurate to 0.1%



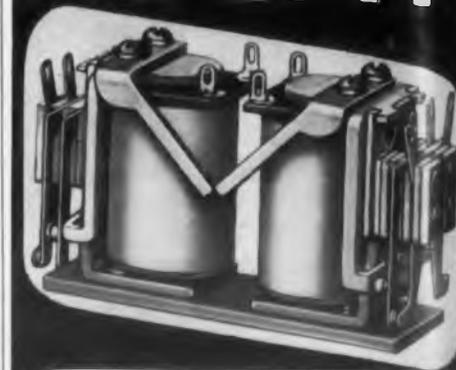
This line of encapsulated toroids are low in cost and provide high accuracy and stability. The outstanding feature of the units is a

molding technique which permits relief of mounting strains to permit absolute physical and electrical uniformity. Guaranteed accuracies as great as 0.1% are available where required. Hermetic sealing is employed, meeting MIL-T-27 requirements.

Toroids with threaded or oversize hole mountings, are available wound on standard or temperature stabilized cores with permeabilities of 125, 60, 26, or 14. Available on special order are coils tapped to customer's specification for use in oscillator circuits and similar applications. Dietz Design and Manufacturing Co., Dept. ED, Grandview, Mo.

CIRCLE ED-151 ON READER-SERVICE CARD FOR MORE INFORMATION

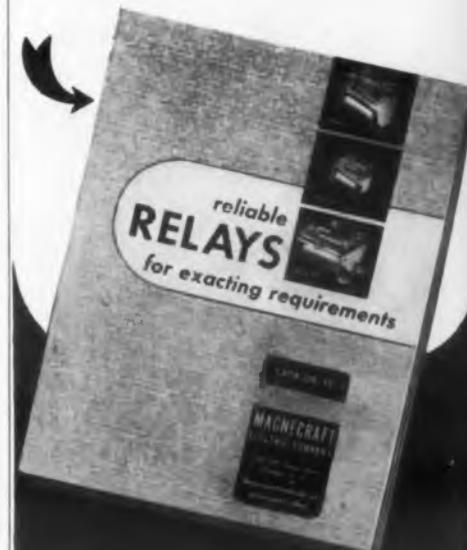
New Miniature LATCH-IN RELAY



featuring

- Reliability of the popular Magnecraft Class 11 D.C. Relay.
- Latching levers of alloy steel, heat treated and hard chrome plated.
- Electrical or manual reset.
- Wide range of contact ratings.
- Widely varied contact combinations.
- D.C. operation; 6 to 115V.
- Small size—Approximate overall length, 2 3/8"; width, 1"; height, 1 1/8".

Send for Catalog describing the new LATCH-IN RELAY, also Class 33, Class 11 and Class 22 Relays for A.C. or D.C., open, plug-in, dustproof, hermetically sealed and many special models.



MAGNECRAFT ELECTRIC CO
3350D W. Grand Ave. Chicago 51, Ill

CIRCLE ED-151 ON READER-SERVICE CARD

ELECTRONIC DESIGN • March 1955



A company
organized
to provide
**microwave
tube service**

to the
electronics
industry...

Roger White
**ELECTRON
DEVICES
INC.**

specializing in
the design and
production of
**traveling
wave tubes
backward wave
oscillators
microwave gas
control tubes**

We have facilities for development, model shopping and production. You are invited to bring your microwave tube problems to us. Write today for informative 6 page Bulletin A-20 "MICROWAVE GAS TUBES."

ROUTE 17 & ERIE R.R.
RAMSEY, NEW JERSEY
Telephone
RAMsey 9-1660

CIRCLE ED-152 ON READER-SERVICE CARD

I-F Amplifiers In Four Standard Models



The Series M-200 I-F Amplifier now includes four standard models, with band centers of 30, 23.5, 30, and 60Mc, and bandwidths of 2Mc (3db), 2Mc (3db), 10Mc (3db), and 10Mc (1db), respectively. Maximum gain is greater than 100db on the first two units, and 90db on the second two.

Input vswr is less than 1.3, and input and output impedance is 50 ohms on all four units. The first two units are available with 1.5db noise figure. The maximum output powers available are 0.1w for the first two, and 0.04w for the others.

These standard models each consist of eight 6AK5 tubes. They are 15" long x 3" high (including tubes) x 1-3/8" wide. Input power for the first three units is 140v d-c at 70ma, 6.3v a-c at 1.4amp. The last unit takes 120v d-c at 70ma. Instruments for Industries, Inc., Dept. ED, 150 Glen Cove Rd., Mineola, N. Y. *This product will be on display at the Radio Engineering Show, Booth 711.*

CIRCLE ED-153 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse-Forming Network Requires Little Mounting Space



The Model No. 21-19 decade pulse-forming network requires only 2-1/2" x 1-1/2" of front panel space. It provides pulse formations from 0.25 μ sec to 2.0 μ sec wide by means of

three miniature toggle switches. The circuit is arranged to provide a residual pulse width of 0.025- μ sec at all times.

Other features of this compact delay network include an impedance of 200 ohms $\pm 10\%$, with a 35% maximum attenuation for 2.0 μ sec delay of the reflected pulse. Each delay network is potted in epoxy resin and enclosed in a hermetically sealed case. The entire assembly is further enclosed in a dust-proof case, and is finished in accordance with MIL-T-945A Salt Spray and Humidity Conditions. Glass compression-type terminals are provided for connections. ESC Corp., Dept. ED, 534 Bergen Blvd., Palisades Park, N. J.

CIRCLE ED-154 ON READER-SERVICE CARD FOR MORE INFORMATION

SUPERIOR
ELECTRICAL
RATINGS

SPECIALLY SELECTED
FOR
SPECIAL SERVICES

EXTENDED
TEMPERATURE
RATINGS
50 C to +150 C

HERMETICALLY
SEALED

NEW
SMALL SIZE



YOU
GET
THESE

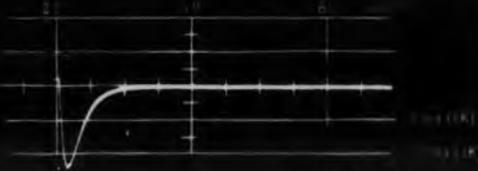
5

IMPORTANT ADVANTAGES

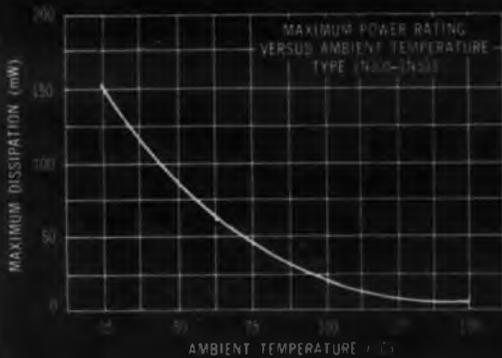
when you specify these



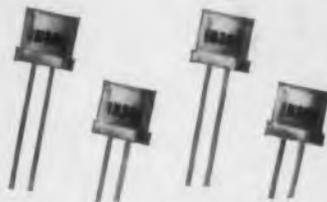
SILICON DIODES



Oscillogram of reverse transient response of 1N301 at 100°C when switched from 30 ma forward current to — with 100 V. Note less than 3 μsecs recovery to full back resistance.



Charted here are some of the performance characteristics and features of four of these Silicon Diodes. Other characteristics can be supplied to your requirements. Other Raytheon Silicon, Gold Bonded Germanium and Point Contact Germanium Diodes are available. Complete data is yours for the asking.



DIODES SHOWN ACTUAL SIZE

Type	RATINGS AT 25°C AMBIENT					RATINGS AT 100°C AMBIENT			
	Minimum Forward Current @ +1.0 volt (mA)	Maximum Continuous Reverse Voltage (Volts)	Minimum Zener Voltage (@ 100μA) Volts	Maximum Reverse Current @ -10V (μA)	Maximum Average Dissipation (mW)	Maximum Average Forward Current (mA)	Maximum Reverse Current @ -10V (μA)	Maximum Average Dissipation (mW)	Maximum Average Forward Current (mA)
1N300 (CK735)	8.0	12	15	0.001	150	40	0.01	20	15
1N301 (CK736)	5.0	60	70	0.01	150	35	0.2	20	12
1N303 (CK738)	3.0	115	125	0.01	150	30	0.2	20	10
1N302 (CK737)	1.0	215	225	0.01	150	25	0.2	20	8



RAYTHEON MANUFACTURING COMPANY

Severance Drive - Home Office, 35 Depot St., Newton 33, Mass. 02459-4730

For complete information write to our New York Office at 2945 West 34th Avenue, Chicago 19, Illinois 60629-2270

RAYTHEON MAKES ALL THESE

RELIABLE SUBMINIATURE AND MINIATURE TUBES - SEMICONDUCTOR DIODES AND TRANSISTORS - NUCLEONIC TUBES - MICROWAVE TUBES - RECEIVING AND PICTURE TUBES

CIRCLE ED-155 ON READER-SERVICE CARD FOR MORE INFORMATION

SIE

MODEL C-6

RESISTANCE METER



for

- ★ RESEARCH
- ★ DESIGN
- ★ PRODUCTION
- ★ ACCEPTANCE TESTS

3

UNIQUE FEATURES
enable the C-6 to meet all requirements

1. Three test voltages:
 - 1½ volts — for low resistance ranges
 - 50 volts — for low-voltage capacitor leakage measurements
 - 500 volts — to meet MIL specs on insulation tests
2. Complete coverage, from zero ohms to 10,000,000 megohms, without auxiliary equipment.
3. Pre-settable "Charge Adjust" control and "Quick Charge" button for rapid Go, No-Go capacitor leakage tests.

ACCURATE • VERSATILE • RELIABLE •

available from stock

SIE

\$200. f.o.b. Houston

SOUTHWESTERN INDUSTRIAL ELECTRONICS CO.
P. O. Box 13058 2831 Post Oak Rd.
Houston, Texas

SEND FOR FREE LITERATURE.
REPRESENTATIVES THROUGHOUT THE WORLD.

CIRCLE ED-156 ON READER-SERVICE CARD FOR MORE INFORMATION

Impedance Bridge

With High Accuracy, Wide Range



Model 250-DA is an accurate wide-range impedance bridge designed for the measurement of resistance, capacitance, inductance, dissipation factors, and storage factors. It operates directly from an a-c power line. A carefully stabilized capacitance standard unit is included that is adjusted to better than $\pm 0.15\%$ of its nominal value.

The bridge uses a resistance-capacitance type oscillator with plug-in frequency selection networks for any fixed frequency between 100 cy and 10,000cy; this frequency is adjusted to within $\pm 1\%$.

Operating limits for this bridge are 0.1 milliohm to 12 megohms in eight ranges, 0.1 mmfd to 1200mfd in seven ranges, 0.1 μ h to 1200h in seven ranges, 0.001 to 1.0 for dissipation factor, and 0.02 to 1000 for storage factor. High accuracies are possible because of 11,000 graduations on the "slide wire" dial. Weight is 20 lb, and dimensions are 9" x 10-1/2" x 10-1/2" (approx). Electro-Measurements, Inc., Dept. ED, 4312 S. E. Stark St., Portland 15, Ore. *This product will be on display at the Radio Engineering Show, Booth 212.*

CIRCLE ED-157 ON READER-SERVICE CARD FOR MORE INFORMATION

Auto-Transformers

Permit Fast Voltage Ratio Selection



Two new versions of the "Standard Ratio Transformer" (a-c voltage divider) are available. Both models permit rapid selection of accurate voltage ratios by means of rotary switches. Five decade switches, followed by a single-turn potentiometer, provide continuous resolution and readout of better than six significant figures. Ratio value is indicated as direct decimal reading. Every switch position displays its corresponding digit through a dust-proof window.

The PT-4 has a frequency range of 30-1,000cy. The PT-5 frequency range is 50-10,000cy; the latter unit is available with convenient handle either for carrying or reading in table position. Gertsch Products, Inc., Dept. ED, 11846 Mississippi Ave., Los Angeles 25, Calif. *This product will be on display at the Radio Engineering Show, Booth 204.*

CIRCLE ED-158 ON READER-SERVICE CARD FOR MORE INFORMATION

THE KENYON TWINS



M LINE

Meets All MIL-T-27 Requirements

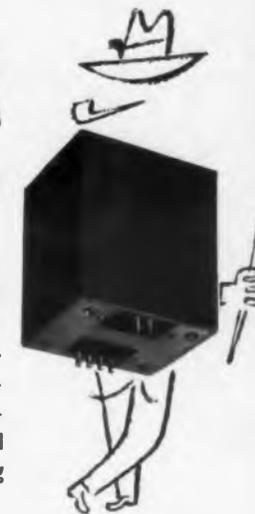
Completely hermetically sealed to meet MIL-T-27 specifications. Military Standard types are included. Catalog Listing M L



C LINE

Meets All Commercial Requirements

A complete line to MIL electrical specifications, housed in conventional cases. Satisfactory performance at substantial savings. Catalog Listing C L



HOUSED IN CASES WITH STANDARD MIL-T-27 DIMENSIONS... BOTH LINES CARRY THE USUAL KENYON GUARANTEE

The new Kenyon Military and Commercial Lines feature the very latest practice, using the best class "A" wire and insulation now available, and the latest types of core material, to obtain minimum size at reasonable cost... Cases are identical to the requirements in the MIL-T-27 specifications. Full rating information and schematic is furnished in the form of a stencil on each case... Special units with other ratings and the same or similar cases are available on short delivery, in any quantity. Write for catalog. Your inquiry will receive prompt attention.



Kenyon
TRANSFORMER CO., INC.

840 Barry Street, New York 59, N. Y.

See us at Booth 541—I.R.E. Show

CIRCLE ED-159 ON READER-SERVICE CARD

ELECTRONIC DESIGN • March 1955

Binary-Decimal Converter

Provides Both Display and Control



The Binary-Decimal Converter is an electronic instrument which converts binary numbers to decimal numbers. It provides an in-line visual display, as well as control for machine storage of the decimal numbers.

Binary input is accepted in the form of contact closures for each binary number in the range from 2^0 to 2^{13} . Accuracy is ± 1 decimal digit with a maximum conversion time of 1 sec. Further versatility is provided through the addition of a scale factor control, which enables the operator to multiply the decimal conversion by a constant.

Size of the instrument is 7" x 19" x 16", and it is rack mounted. Electro Instruments, Dept. ED, 3796 Rosecrans St., San Diego 10, Calif. *This product will be on display at the Radio Engineering Show, Booth 234-236.*

CIRCLE ED-207 ON READER-SERVICE CARD FOR MORE INFORMATION

Have you returned your subscription renewal and qualification form?

See Page 100

Panel Meter

Sealed Version



The Model 455 is a ruggedized and sealed 4-1/2" outside diam panel mounting meter conforming to mounting specifications of MIL-M-6A. It is designed to withstand shock, vibration, and other environmental requirements of MIL-M-10304 (Sig C).

Ranges are 20 μ amp to 50amps a-c or d-c; 0-5mv d-c and 0-25mv a-c to 0-500v a-c or d-c. Dial diameter is about 3-1/2" with a 95° arc length. Barrell diameter is 3-23/32"; depth is 1-5/8". Projection in front of panel is less than 3/8". Assembly Products, Inc., Dept. ED, Chesterland, Ohio. *This product will be on display at the Radio Engineering Show, Booth 311.*

CIRCLE ED-208 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

VIBRATION ISOLATION FOR HIGH FIDELITY



**LORD Bonded
Tube-Form Joint
For Microphone Heads**

"Vibration Isolation" has helped solve the increasing problem of mechanical vibrations in high fidelity reproduction of sound.

For years, sound engineers have been plagued by mechanical vibrations caused by movement of grips, dollies and other studio equipment. And the progressive development of the high fidelity microphone has increased the importance of eliminating the adverse effects of these disturbances.

Faced with this problem, design engineers of a leading manufacturer of microphones and related electronic equipment consulted with LORD engineers. LORD's 30 years of experience and knowledge in vibration control resulted in a bonded tube-form joint of live rubber which effectively isolated mechanical vibrations from the microphone head.

"Vibration Isolation" is the answer to only one of the many problems presented to and solved by LORD engineers. If you are interested in producing tape recorders, microphones and other types of reproduction equipment, LORD engineers are ready to consult with you. Let them help you produce equipment of the most exacting professional standards with LORD rubber bonded products.



DESIGNERS AND PRODUCERS OF BONDED RUBBER PRODUCTS

SINCE 1924

CIRCLE ED-209 ON READER-SERVICE CARD FOR MORE INFORMATION

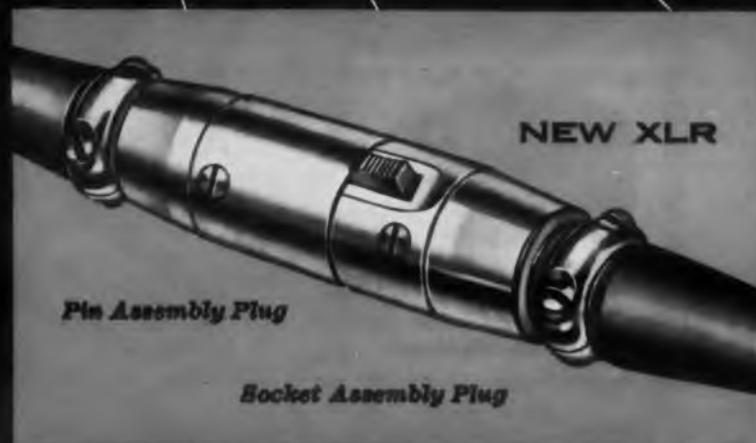
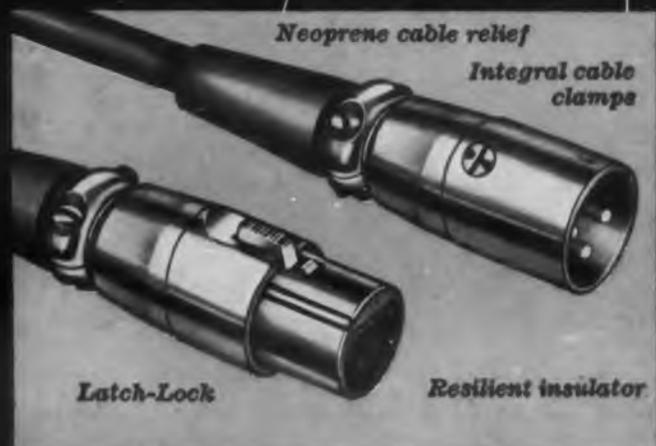
QUIET QUIET QUIET QUIET

XLR is the designation of Cannon's all new audio cord connector... the most modern addition to the long line of distinguished Cannon Connectors featured on all top-quality microphones. It's really quiet, too!

New resilient insulator and specialized construction of socket contact assembly protects against disagreeable mechanical interference... noise problems encountered with many other type connectors when their cables are moved, pulled or subjected to shock.

Features streamline design, bright nickel finish, integral cable clamp, neoprene cable relief, and the time-tested Latch-Lock that Cannon pioneered on the first audio connectors. Available with three 15-amp. or four 10-amp. contacts. Available in panel receptacle type, providing same continuous characteristics.

Available from distributors everywhere, or from the factory in production quantities.



first in connectors

CANNON PLUGS

CANNON ELECTRIC COMPANY
3209 Humboldt St.,
Los Angeles 31, California

Please refer to Dept. 143

Factories in Los Angeles; East Haven; Toronto, Canada; London, England. Representatives in all principal cities. Distributors everywhere.

Epoxy Laminates

For Waterproof Printed Circuits

Laminates particularly suited for printed circuit bases use epoxy resins. One type, known as "Epoglas" is reinforced with glass cloth; a second type, "Epolon", uses "Orlon". These epoxy resins feature a very low moisture absorption factor.

Copper sheets are bonded to laminates directly, without using adhesives. The Orlon-reinforced laminate can be formed to shapes other than flat. The laminates machine easily. Epoxy base laminates are resistant. They come in a wide variety of thicknesses, clad and unclad. Industrial Laminate Div., Dept. ED, Plastilight, Inc., Box 214, Stamford, Conn.

CIRCLE ED-196 ON READER-SERVICE CARD

Metallized Ceramics

Take Hard and Soft Solders

This company has developed a single metallic coating for its refractory ceramic bodies (either glazed or bisque). The coating permits both hard and soft solders to be applied to form vacuum-tight joints with metal parts or other non-metallic refractories. Previously it had not been possible to provide non-refractory bodies with one coat of metal to which both classes of solders would bond. Frenchtown Porcelain Co., Dept. ED, 74 Muirhead Ave., Trenton, N. J.

CIRCLE ED-197 ON READER-SERVICE CARD

Resins

Make Foam Structures

A series of expansible resins for silicone foam structures are now available in the form of "ready-mix" powders. Containing pre-measured proportions of resin, filler, blowing agent and catalyst, the mixes melt, foam and cure by themselves when heated. No further mixing or processing is required. Density can be controlled from 8 to 18lb per cu ft by varying the expansion temperatures. Dow Corning Corp., Dept. ED, Midland, Mich.

CIRCLE ED-198 ON READER-SERVICE CARD

◀ CIRCLE ED-199 ON READER-SERVICE CARD

Coated Materials

Reduced Water Absorption

New plastic coatings which improve physical and electrical characteristics of structural and electrical fiber boards are being applied to chemical- and fiber combination specialty materials and impact phenolics. The coatings, made of such plastics as epoxies, vinyls and alkyds, increase the physical and dielectric strength of the materials by reducing water absorption and moisture penetration. The coated material is also better able to withstand flexing. Coating materials are available in sheets 60" wide, coated one or two sides, with no limitations on thickness. The coating results in a high-gloss finish and can be applied in various colors. Rogers Corp., Dept. ED, Rogers, Conn.

CIRCLE ED-200 ON READER-SERVICE CARD

Polystyrene Capacitors

Used Up To 85°C

Polystyrene as a dielectric in such standard capacitor designs as cardboard-case tubulars, metal-cased bath-tubs, and miniature metal-can tubulars, is available from this firm.

Such capacitors are used in computing devices, tuned circuits demanding high Q standards, capacitance bridges, timing circuits, laboratory standards, and circuits requiring low dielectric absorption. Units are available with polystyrene dielectric for operation up to 85°C. Aerovox Corp., Dept. ED, New Bedford, Mass.

CIRCLE ED-201 ON READER-SERVICE CARD

Silicone Rubber Gum

Has Low-Shrinkage

Designated as SE-30, this new gum is being used in compounds to produce parts requiring close tolerances. Because the shrinkage of the material is extremely low, molds and dies designed for organic rubber may often be used with compounds made from SE-30 silicone rubber gum. General Electric Co., Dept. ED, Pittsfield, Mass.

CIRCLE ED-202 ON READER-SERVICE CARD

CIRCLE ED-203 ON READER-SERVICE CARD >

Specify . . .

ALSiMAG[®] pressed ceramics

For Volume Production

The most complete automatic press facilities in the industry. Small tablet presses, high-speed rotaries, huge hydraulics. Every imaginable machine for efficient production of simple or intricate ceramics in any quantity. Open dies for many designs.

For Superior Quality

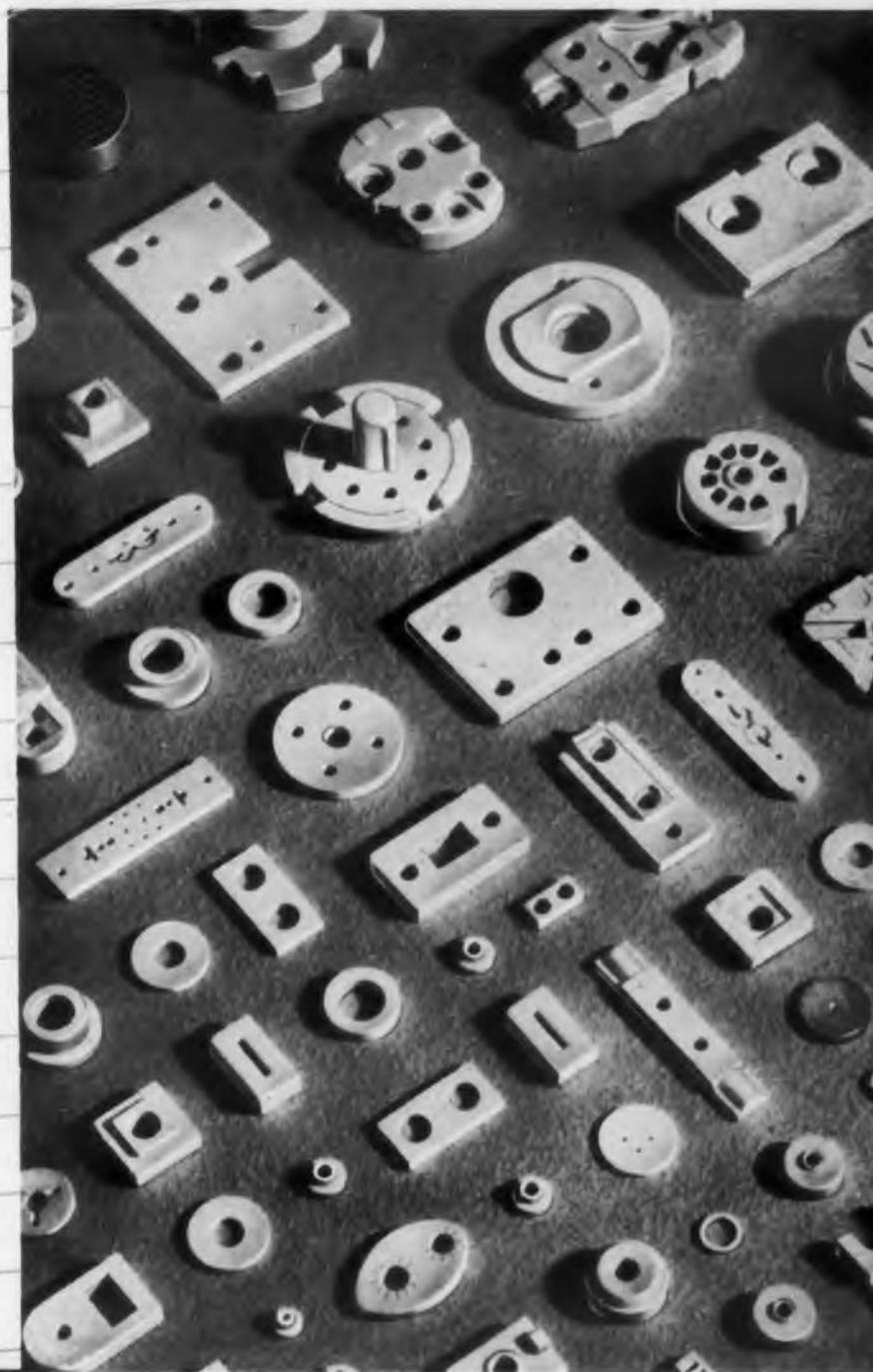
No other source offers as wide a selection of versatile ceramic materials. Careful matching with requirements. Many special characteristic compositions developed for unusual applications. Latest gauging and testing equipment. Quality Control at every production step. Experienced personnel . . . unequaled "know how" in handling variables, gained from over 54 years of technical ceramic manufacture.

For Greatest Economy

Proven production methods . . . the right equipment for economical manufacture . . . thoroughly trained operators . . . all combined to give you the best possible ceramics at the lowest possible cost.

For Important "Extras"

When you specify ALSiMag, you receive many "extra" benefits. Redesign service . . . to insure the best possible design for economical manufacture and outstanding performance. Alert production staffs, constantly searching for improved equipment, improved methods. Engineering assistance from men of wide experience, competent to advise on problems in many fields. Continuous Research to anticipate your needs and solve your problems.



**SEND YOUR BLUEPRINT,
SKETCH OR SAMPLE. LET US PROVE WHAT
ALSiMAG CAN DO FOR YOU !**

**Visit our Booth at the IRE Show,
124 Television Avenue**

54TH YEAR OF CERAMIC LEADERSHIP

AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENNESSEE

A SUBSIDIARY OF MINNESOTA MINING
AND MANUFACTURING COMPANY

Branch offices in these cities (see your local telephone directory): Cambridge, Mass. • Chicago, Ill. • Cleveland, Ohio • Dallas-Houston, Texas • Indianapolis, Ind. • Los Angeles, Calif. • Newark, N. J. • Philadelphia-Pittsburgh, Pa. • St. Louis, Mo. • South San Francisco, Calif. • Syracuse, N. Y. • Tulsa, Okla.
Canada: Irvington Varnish & Insulator Div., Minnesota Mining & Mfg. of Canada, Ltd., 1390 Burlington Street East, Hamilton, Ontario, Phone Liberty 4-5735.



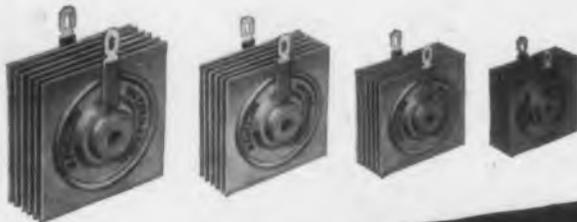
INTERNATIONAL

Selenium Rectifiers

the WIDEST RANGE in the INDUSTRY



INTERNATIONAL
industrial power rectifiers



INTERNATIONAL
tv and radio miniature rectifiers



INTERNATIONAL
high voltage cartridge rectifiers



INTERNATIONAL
RECTIFIER CORPORATION

EL SEGUNDO, CALIFORNIA • OREGON 8-6281
NEW YORK: 501 MADISON AVENUE • PLAZA 3-4942
CHICAGO: 205 W. WACKER DR. • FRANKLIN 2-3889

World's Largest Supplier of Quality Industrial Rectifiers

CIRCLE ED-220 ON READER-SERVICE CARD FOR MORE INFORMATION

Size 11 Synchro
Low Cost Corrosion Resistant



Designated the R900 Series, these Size 11 synchros are low cost units available for all functions, including transmitters, control transformers, receivers, resolvers, and differentials. Torque receivers with hollow shafts for coaxial mounting in certain indicator applications

are available. Dimensionally and electrically interchangeable with this firm's present R200 series, the new units are made for rigid environmental conditions.

The stator of these units is integrally bonded with the housing, preventing null shifts when rotating or clamping in a mount. All materials have similar thermal coefficients of expansion. Corrosion resistant materials are used, and non-metallic materials are fungus inert.

Accuracy is 10' maximum deviation spread from electrical zero. Size is 1.062" diam x 1.45/64" long. Weight is 4 oz. Units are available with leads or terminals, single or double-ended shafts, and 26v or 115v excitation, high or low impedance. Kearfott Co., Inc., Dept. ED, 1378 Main Ave., Clifton, N. J. *This product will be on display at the Radio Engineering Show, Booth 152.*

CIRCLE ED-221 ON READER-SERVICE CARD FOR MORE INFORMATION

Curve Tracer
Analyzes Transistors



The Model TA-3A Transistor Analyzer, a transistor family curve tracer, displays on an oscilloscope the R_{12} , R_{22} , and I_{12} families in the grounded base connection, and the

R_{22} family in the grounded emitter connection. Either N, P, NPN, or PNP transistors can be tested.

Collector current power supply has a peak rating of 100ma at 100v, enabling the instrument to be used for testing power transistors as well as conventional transistors. Polyphase Instrument Co., Dept. ED, Bryn Mawr, Pa. *This product will be on display at the Radio Engineering Show, Booth 767.*

CIRCLE ED-222 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955



**LOOKS LIKE
REAL METAL!**



GOMAR
**METALLIZED
THERMOPLASTIC
SHEETINGS**
for Vacuum Forming

CUTS COSTS...

because it
eliminates metal-plating
of plastic

Make trim, frames, grilles, trademark plaques and other decorative parts with this amazing, tough plastic that retains its gleaming, metallic finish indefinitely. Light-fast, color-fast... will not crack or craze, peel or chip. Butyrate for deep-draw vacuum forming, acetate for shallow forming and flat uses. In gold, silver, steel, aluminum, bronze, copper and metallic reds, blues, yellows, greens.

SEND FOR FREE COLOR CHART
AND LITERATURE.

GOMAR

MANUFACTURING COMPANY

79 Paris St., Newark 5, N. J., MArket 3-1967

CIRCLE ED-223 ON READER-SERVICE CARD

ELECTRONIC DESIGN • March 1955

Laminated Plastic

Makes Flexible, Non-Breakable Panels



"Gravoflex" is a flexible laminated plastic especially suited for use as instrument panels, for electronic equipment. "Gravoflex" is 27%

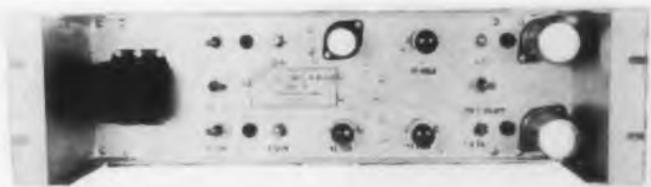
lighter than laminated phenolic and 62% lighter than aluminum. At the same time it is shatter-proof (will not break or chip); it can be bent to any angle or form, to follow the shape of any instrument housing; it has a fine, grained, leather-like and scratch-resistant surface which does not need any further finishing; and it is laminated in layers of two contrasting colors. The latter feature permits engraving through the top layer to reach a surface of another color for permanent lettering on a contrasting background.

This plastic is easily machined, cut, nailed, riveted, etc. It can be cold bent or, when heated, formed into intricate shapes. The photo shows it cold bent around a fuel pipe and simply stapled together. It is offered in thicknesses of 1/32", 1/16", or 1/8". Hermes Plastics, Inc., Dept. ED, 13-19 University Pl., New York 3, N. Y. *This product will be on display at the Radio Engineering Show, Booth 468.*

CIRCLE ED-224 ON READER-SERVICE CARD FOR MORE INFORMATION

Amplifier-Mixer

For Color Television



Though designed for the amplification, mixing, and distribution of color and monochrome TV signals, the Model V-1A Video Distribution Amplifier and Mixer may also be used in non-television applications where flat amplitude frequency response and time-delay characteristics to 10Mc are desired.

The unit handles two inputs and provides one output for each input. Either the inputs or the outputs, or both, may be combined by front panel switches. The latter method provides 75 ohm sending impedance.

Amplitude characteristics is flat to 10Mc, and 3db down at 13Mc. The envelope delay characteristic is especially suited for the strict requirements of color TV, and is essentially flat from 200kc to 10Mc. The unit occupies 5-1/4" of height in a standard 19" rack cabinet. Foto-Video Laboratories, Inc., Dept. ED, P. O. Box 296, Clifton, N. J.

CIRCLE ED-225 ON READER-SERVICE CARD FOR MORE INFORMATION

PULSE ACCOUNTING

There are entirely too many pulses batting around lately that we don't get paid for. A good many of them go by so fast we can't find them,

let alone reform and

charge for them,

but there are still a goodish number of slow pokes

which neatly sidestep our keying relays.¹

We are now gunning for these.

To be doubly sure of catching them gainfully,

we propose to collect them in tin boxes

with the quantity marked right on top.

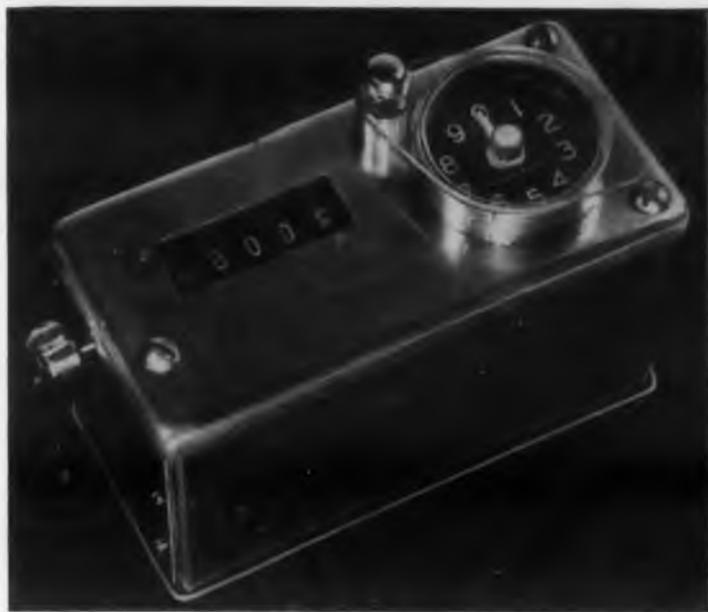


The Sigma Cyclonome Pulse Counter consists of a special 6 figure Veeder-Root register driven by a completely novel stepping motor* with but one moving part which rotates in ball bearings and drives the counter through a Nylon worm. Starting and stopping is accomplished magnetically each half cycle. Counting rate is nearly 8000 per minute (0 to 130 pulses per second) at an accuracy of

$\pm 1/2$ count, and, depending on the user's choice, the device will accept either DC pulses down to 3 milliseconds wide (50% on-time minimum at 130 pulses per second) or AC cycles with a minimum half-cycle of 3 milliseconds.

Average power required varies with frequency, from 1/2 watt (AC input) at 20 cps to 12 watts (DC input) at 130 pulses per second.

This device will advantageously replace the slow decade and mechanical registers in computers and electronic counters, as it has a life of at least 500,000,000 counts, and is adaptable to production and process counting. By special arrangement with the Fisher-Pierce Company, specialists in photoelectric devices, we can provide photoelectric sensing equipment to drive the Sigma Cyclonome Counter.



**ELECTRICALLY DRIVEN COUNTER
8,000 COUNTS PER MINUTE**

The Sigma Cyclonome motor (separately available) has attractive features as a stepping motor. There are no reciprocating parts to wear or clatter; torque output is about 1.3 inch-ounces and stepping speed is 260 half-steps (20 per revolution) per second. Size, about 1-3/8" x 1-7/8" x 2-1/2". Another model with twice the torque (same speed) is 1-7/8" x 1-7/8" x 2-1/2". Caution: the inertia of driven devices must be reckoned with and we will be glad to work out the details on samples thereof.

Price and application information are available.

¹ A new complete catalog of Sigma Sensitive Relays is available if specifically requested.

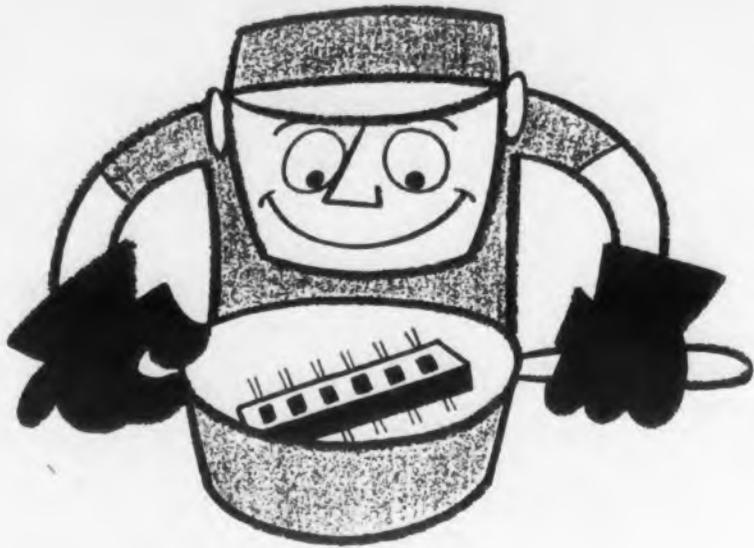
*Patent Applied For.

SIGMA

SIGMA INSTRUMENTS, INC.

91 Pearl Street, So. Braintree, Boston 85, Mass.

CIRCLE ED-226 ON READER-SERVICE CARD FOR MORE INFORMATION



Resistors that went to pot

Here's a trick question so easy you'll probably think we're stupid for asking it. The fact is, it's one of those questions with only one answer; so we know nobody will get it wrong. Ready?

"Which can you pick up faster—a hundred beans in a bag or a hundred loose beans?"

See what we mean?

Change the word *beans* to *resistors*, and the word *bag* to *pot*, and you'd wonder why it took a bunch of smart electronics engineers so long to find the answer.

Well, I-T-E isn't one to look a customer in the mouth. So when a leading manufacturer asked us how he could cut his resistor costs and assembly time, we replied (so fast he was still holding his empty hands wide apart in the air), "Pot them, of course."

Then, to relieve his embarrassment, we explained, "We mean you take those resistors you're now putting into your equipment one at a time, and bury them in blocks of resin with just the leads sticking out. That keeps moisture out, protects them from damage, and makes sure they're always in the right order. No matter how late the poor little working girl has been out the night before, she's always sure of getting the right size resistors into the set."

For the sake of brevity here, we won't harangue about all the money this idea saved in greater efficiency, quicker assembly, fewer rejects, and all that.

Potting these resistors for this customer was an idea I-T-E supplied as a regular part of its service to customers. We're not out of ideas—not by a long shot. And we've got several thousand miles of resistor wire just waiting for your order. Write for the new 6-page Bulletin R-5501. I-T-E Circuit Breaker Company, Resistor Division, 19th & Hamilton Sts., Phila. 30, Pa.



I-T-E CIRCUIT BREAKER COMPANY
Resistor Division

CIRCLE ED-212 ON READER-SERVICE CARD FOR MORE INFORMATION

□ Dial

Keeps Count of Turns Made



The SR Series "Duo-dial", a turns-counting dial originally designed for use with the AJ series "Helipot", is equally useful with any rotating component having a 1/8" diam shaft. The unit has a weight of 1/2 oz and a diameter of only 1-5/32". It consists of two coaxial

dials. The inner dial counts hundredths of each turn; the outer counts completed turns up to 10. When used with a 10-turn component, it gives a direct percentage reading. A polished aluminum finish with black-filled numerals and divisions is available from stock. Other colors and finishes can be furnished on special order. Helipot Corp., Dept. ED, 916 Meridian Ave., South Pasadena, Calif. *This product will be on display at the Radio Engineering Show, Booth 756-758.*

CIRCLE ED-213 ON READER-SERVICE CARD FOR MORE INFORMATION

□ Fractional-Hp Motors

In Skeleton and Clutch-Gear Types



This line of "Molon" skeleton type and clutch-gear type fractional-horsepower motors features high starting torque, simplified mounting, and low cost. The skeleton type motors are shaded two-pole, types available in sizes from 1/500hp to 1/25hp with operating speeds of 2100rpm to 3500rpm.

Voltage range is 6v to 220v a-c, 50cy or 60cy. Maximum torque is 14 in-oz running and 10 in-oz starting. Shaft sizes are up to 13/64" diam. Stack sizes are 5/16" to 2". Thrust bearings are available. The units operate in position, and have lifetime lubrication.

The clutch-gear types feature compact size and a fast disengagement time of approximately 25millisec. They are available in all speeds from 4rpm to 328rpm. At 25rpm, torque is 100 in-oz on continuous duty. Single or double output shifts, are available in sizes from 3/16" to 5/16" diam. Gears are nylon or metal. Comar Electric Co., Dept. ED, 3349 Addison St., Chicago 18, Ill. *This product will be on display at the Radio Engineering Show, Booth 314.*

CIRCLE ED-214 ON READER-SERVICE CARD FOR MORE INFORMATION



'dag' Colloidal Graphite improves CRT performance



Coat inside walls of CRTs with a dispersion of 'dag' Colloidal Graphite in de-ionized water to retard secondary emission and adsorb gases. The resulting film also acts as an electrical conductor and a ray-focusing material.

A 'dag' dispersion in lacquer, sprayed onto exterior tube surfaces, dries in one to two minutes and produces a smooth, black, adherent, conductive coating on any type of glass. Once thoroughly dried, the film is resistant to removal by water.

You'll find a surprising number of ways to use 'dag' dispersions described in our free booklet on 'dag' Colloidal Graphite for electronics and electrical applications. Write for Bulletin No. 433-X12.

Dispersions of molybdenum disulfide are available in various carriers. We are also equipped to do custom dispersing of solids in a wide variety of carriers.

ACHESON COLLOIDS COMPANY

PORT HURON, MICHIGAN

...also ACHESON COLLOIDS LTD.
LONDON, ENGLAND



CIRCLE ED-215 ON READER-SERVICE CARD

ELECTRONIC DESIGN • March 1955

Power Supply

With 0.1% Stability



Model 323 is a highly compact 200-325v, 300ma, regulated d-c power supply. Panel height is 8-3/4", and depth behind panel is 9-1/4". Stability is better than 0.1% for line or load variations, ripple less than 1.0mv, and transient response less than 150 μ sec.

Designed for reliability under continuous service conditions, the unit features "Reliable" type tubes, oil-filled capacitors, boro-carbon resistors, "Helipot" voltage control, 40 $^\circ$ rise transformers, and Weston meters. It is also available without meters. Power Designs, Inc., Dept. ED, 119-22 Atlantic Ave., Richmond Hill 19, N. Y. *This product will be on display at the Radio Engineering Show, Booth 338.*

CIRCLE ED-216 ON READER-SERVICE CARD FOR MORE INFORMATION

Have you returned your subscription renewal and qualification form?

See Page 100

Coupling

Bellows Type



Type No. T1 Precision Bellows Coupling is designed to join shafts of the same or different diameters. It is used where only low torque operation is required. The stainless-steel

bellows action of the unit permits a reasonable degree of angularity and misalignment.

The coupling is designed for three basic shaft sizes: 1/8", 3/16", and 1/4". It has stainless-steel set screws for holding, and sub-drill holes for fixed pinning, as desired. As many as six different shaft-to-shaft combinations are immediately available from stock, with special designs on request. PIC Design Corp., Dept. ED, 160 Atlantic Ave., Lynbrook, L. I., N. Y.

CIRCLE ED-217 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW...FROM **Transitron**

SILICON JUNCTION DIODES WITH SUPERIOR FORWARD CONDUCTANCE

- Operation up to 150 $^\circ$ C
- Low Inverse Current
- Sharp Zener Break
- Hermetic Sealing

Transitron silicon junction diodes are specifically designed to meet exacting high temperature requirements. Combining high forward conductance with very high inverse resistance, they provide improved circuit performance in many applications. Reliability is assured through welded hermetic sealing.

SPECIFICATIONS AND RATINGS

TYPE	Forward Current at +1.0 Volt (ma)	Inverse Current at Specified Voltage (μ a)		Maximum Reverse Working Voltage (volts)
		at 25 $^\circ$ C	at 125 $^\circ$ C	
1N137A	3	.03 at 20V	—	36
1N138A	5	.01 at 10V	—	18
1N137B	20	.03 at 20V	5 at 20V	36
1N138B	40	.01 at 10V	2 at 10V	18
1N350	20	.03 at 60V	5 at 60V	70
1N351	8	.03 at 100V	5 at 100V	120
1N352	5	.05 at 150V	10 at 150V	170
1N353	3	.10 at 200V	20 at 200V	225
1N354	1	.10 at 300V	20 at 300V	325

Types 1N200 through 1N222 as well as special types, including Zener regulators, are also available. Your inquiries are invited.

VISIT BOOTH 580 AT THE I.R.E. SHOW, MARCH 21-24

Transitron
electronic corporation
melrose 76, massachusetts



Glass Diodes



Silicon Diodes



Germanium Diodes



Transistors



Silicon Rectifiers

CIRCLE ED-218 ON READER-SERVICE CARD FOR MORE INFORMATION



ACTUAL SIZE

SEND FOR BULLETIN TE1322

Tape Recorders

For Airborne Use

Model 807 and 814 are seven-track and fourteen-track (respectively) magnetic tape recorders designed especially for airborne use. The tape transport, amplifier, and power and bias supply units are housed separately. Ampex Corp., Dept. ED, 934 Charter St., Redwood City, Calif. *This product will be on display at the Radio Engineering Show, Booth 206-208.*

CIRCLE ED-338 ON READER-SERVICE CARD

Epoxy Laminate

Glass Fabric Base

A laminated glass fabric base Epoxy resin laminate possessing very high mechanical strength, and particularly high tensile and flexural strengths is available for electronic applications. The insulation has low moisture absorption, good dielectric strength, both perpendicular and parallel to laminations and good insulation resistance. Copper clad bases are available for printed circuits. Continental-Diamond Fibre Co., Dept. ED, Newark, Del. *This product will be on display at the Radio Engineering Show, Booth 665-667.*

CIRCLE ED-339 ON READER-SERVICE CARD

Precision Resistors

Metal-film Type

Metalohm precision metal film resistors offer stability at high ambient temperatures, combined with a low and uniform temperature coefficient. The resistors exceed specification MIL-R-10509A requirements. Drawn-on end caps withstand 25 pound pull test. Litton Industries, Dept. ED, 336 N. Foothill Rd., Beverly Hills, Calif. *This product will be on display at Radio Engineering Show, Booth 708.*

CIRCLE ED-340 ON READER-SERVICE CARD

CIRCLE ED-341 READER-SERVICE CARD ➤

NOW...
FROM **Transitron**



**Silicon
POWER
Rectifiers
for 125°C
Operation**

Transitron

electronic corporation
melrose 76, massachusetts

600
500
400
300
200
100
0
FORWARD CURRENT (MILLIAMPERES)

- Reliability at High Temperatures
- High Power Handling Ability
- Negligible Leakage Current
- No Forward Aging
- High Conductance
- Miniature Size
- Hermetic Sealing

Transitron's silicon rectifiers meet the long felt need for reliable and efficient power rectification at high temperatures.

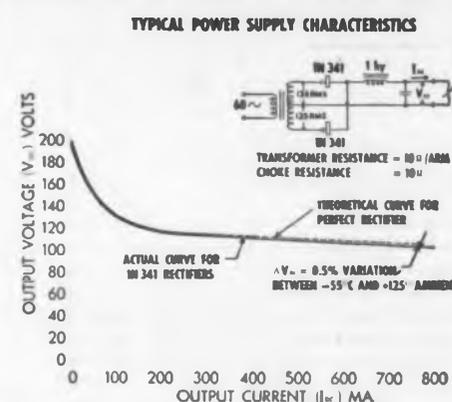
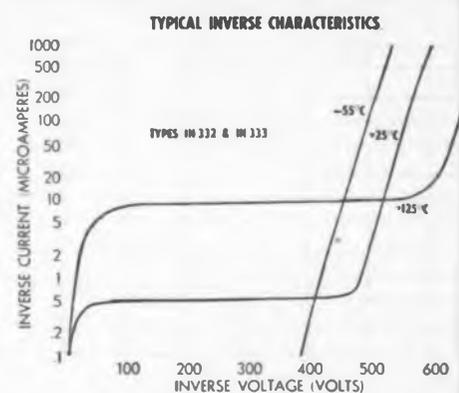
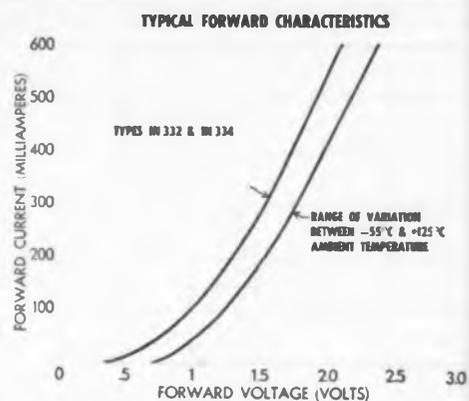
Overcoming the basic limitations of selenium, germanium, and the vacuum tube, they provide trouble-free operation over wide ambient temperature ranges.

These rugged rectifiers offer major savings in both size and weight in any high temperature application.

VISIT BOOTH 580 AT THE
I.R.E. SHOW, MARCH 21-24



SEND FOR
BULLETIN
TE1321



SPECIFICATIONS AND RATINGS AT 125°C

POWER SUPPLY TYPES					MAGNETIC AMPLIFIER TYPES				
TYPE	Peak Recurrent Inverse Voltage (volts)	Maximum Average Forward Current (ma)	Maximum* Average Forward Voltage (volts)	Maximum* Average Inverse Current (ma)	TYPE	Peak Recurrent Inverse Voltage (volts)	Maximum Average Forward Current (ma)	Maximum* Average Forward Voltage (volts)	Maximum* Average Inverse Current (ma)
1N341	400	400	3.0	.5	1N332	400	400	1.5	.10
1N342	400	200	3.0	.5	1N333	400	200	3.0	.10
1N343	300	400	3.0	.5	1N334	300	400	1.5	.10
1N344	300	200	3.0	.5	1N335	300	200	3.0	.10
1N345	200	400	2.5	.5	1N336	200	400	1.3	.05
1N346	200	200	2.5	.5	1N337	200	200	2.5	.05
1N347	100	1000	1.0	.5	1N338	100	1000	1.0	.10
1N348	100	400	2.5	.5	1N339	100	400	1.3	.05
1N349	100	200	1.0	.5	1N340	100	200	2.5	.05

Special silicon rectifiers, or combinations, are available to meet specific requirements. Your inquiries are invited.

*Averaged over one cycle for full wave choke input circuit with Rectifier operating at full rated forward current.

Picture Tubes

Color and Monochrome

A new monochrome aluminized twenty-one inch cathode ray picture tube which features a reduced neck diameter and a lower power requirement for beam deflection has been added to this company's "Phototron" line. Also available is a Tri-Gun, rectangular all glass, aluminized, twenty-two inch, color cathode ray picture tube which has just been developed. Thomas Electronics, Inc., Dept. ED, 118 Ninth St., Passaic, N. J. *These products will be on display at the Radio Engineering Show, Booth 773-775.*

CIRCLE ED-342 ON READER-SERVICE CARD

Cathodes

Special Nickel Alloy

Cathodes made of special nickel alloys are available in four grades A-30, A-31, A-32, and P-50. Several are tungsten bearing grades which offer high strength properties to resist shock and vibration and are used in ruggedized military vacuum tubes.

Cathodes in round, oval, elliptical and rectangular shapes, either welded and drawn or mechanically locked, are available. Superior Tube Co., Dept. ED, Norristown, Pa. *These products will be on display at the Radio Engineering Show, Booth 825.*

CIRCLE ED-343 ON READER-SERVICE CARD

Lacing Tapes

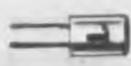
Nylon or Braided Glass

"Gudelace-II" is a braided nylon lacing tape with a rubber covering which adheres to all types of covered wire. Gudebrod Bros. Silk Co., Inc., Electronic Division, Dept. ED, 225 West 34th St., N. Y. 1, N. Y. *This product will be on display at the Radio Engineering Show, Booth 734.*

CIRCLE ED-344 ON READER-SERVICE CARD



Glass Diodes



Silicon Diodes



Germanium Diodes



Transistors



Silicon Rectifiers

T

◀ CIRCLE ED-341 READER-SERVICE CARD

THIS CARD IS YOUR **FREE SUBSCRIPTION**
TO **ELECTRONIC DESIGN**

By now you have received the Annual Subscription Renewal and Qualification Form from ELECTRONIC DESIGN.

Do not clip facsimile card below.

HAYDEN PUBLISHING COMPANY, INC.
19 EAST 62ND STREET, NEW YORK 21, NEW YORK

Fill out entire form
in order to qualify
for renewal.

ANNUAL SUBSCRIPTION RENEWAL AND QUALIFICATION FORM

This entitles qualified readers to one year free subscription to Electronic Design.

- Continue sending **ELECTRONIC DESIGN** monthly, without charge.
(This in no way obligates me or my company)
- Stencil shown below is OK Change Stencil as noted

JOHN DOE, DESIGN ENGINEER
HAYDEN ELECTRONIC MFG CORP
19 EAST 62ND ST
NEW YORK 21, NEW YORK

- Check One
Industry Classification
- Audio, Communication, Radar, Radio and TV Mfrs.
 - Instruments, Control, Test Equipment Mfrs.
 - Analyzers, Computers, Business Machine Mfrs.
 - Aircraft, Aircraft Accessories, Guided Missile Mfrs.
 - Component Parts, Sub-Assembly Mfrs.
 - Material Mfrs.
 - Atomic Energy
 - Independent Labs., Research Organizations, Consultants
 - U. S. Government
 -

In order to continue receiving ELECTRONIC DESIGN free of charge for the next year, fill out the card as indicated and mail.

In accordance with the regulations of The Business Publications Audit of Circulation, Inc. (formerly Controlled Circulation Audit, Inc.), it is necessary for each reader of ELECTRONIC DESIGN to requalify for subscription.

Our definition of recipient qualification: Qualified recipients are those who are engaged in design and development engineering of manufactured products by all United States companies manufacturing electronically actuated or controlled devices, component parts, and basic materials incorporated into electronic devices; and those employed by independent laboratories and government agencies engaged in electronic development.

ELECTRONIC DESIGN

Hayden Publishing Company, Inc.
19 E. 62nd St., New York 21, N. Y.

TO BE ASSURED YOU WILL
RECEIVE EVERY COPY OF
ELECTRONIC DESIGN, SEND
IN YOUR SUBSCRIPTION RE-
NEWAL AND QUALIFICATION
FORM WITHOUT DELAY.

Coaxial Triodes
For 5-10kw Equipment



The ML-6420 and ML-6421 coaxial-terminal triodes are intended for industrial and broadcast equipment having 5-10-

kw power outputs. As replacements for type 5666 and 5667, respectively, the units provide improved performance ratings, safety margins, and strength.

New thoriated-tungsten filaments greatly reduce power requirements, while offering life increases to 100%. Plate and grid current ratings are increased by better than 10%; terminal inductances are low; and high transconductance characteristics assure stable operation, low grid drive, and high plate efficiency.

ML-6420 uses a water jacket and is rated for 20kw input, 12.5kw anode dissipation. ML-6421 employs an aluminum radiator to reduce weight to 13 lb, as against 40 lb for the conventional type; it is rated for 20kw input, 10kw anode dissipation. Full ratings on both tubes are to 30Mc; reduced ratings to 90Mc. Machlett Laboratories, Dept. ED, Springdale, Conn. *This product will be on display at the Radio Engineering Show, Booth 567-569.*

CIRCLE ED-312 ON READER-SERVICE CARD FOR MORE INFORMATION

Locknut
Gives Positive Metal Contact



This locknut is a single solid metal piece, with a slotted cone shape on one end and a splined cylinder on the other. It is designed to be inserted in a countersunk hole: the nut is partially or completely seated in material and is held in position by force-fitted splines. After a bolt is inserted, locking action is effected by the pressure of the sector threads forced against the bolt by the interference of the countersinks. Locking action is unaffected by high temperatures.

The unit is available in all metals and in all standard thread specifications. Pre-positioning of the nut permits blind assembly. The design requires no wrenching on the nut end, and the nut remains in place keeping locking action after bolt is removed.

The nut threads remain free-spinning until the bolt is locked. The design gives a flush mount, and can be used as a threaded insert to replace stripped threads. Allmetal Screw Products Co., Inc., Dept. ED, 821 Stewart Ave., Garden City, L. I., N. Y.

CIRCLE ED-313 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

NEV
ISOT

These Magne
the first units
developed by
intended for
becomes mor
ISOTRANS no
250, 500, 100



Input voltage
Output
Regulation a
Load co
Time c

Model MVR1
Model MVR3
Model MVR6
Model MVR1

Se
me

SC
SORENSEN
CIRCLE ED-3

Pro
ff

B
Spee

ANTI
F

are rea

When yo
speed re
do the
using ru
compon

• 2 lb.-i
• Speed
• Quick
Banta

W
for da
10 an
d

DISTR

CIRCLE E

ELECT

NEW NEW NEW
ISOTRANS by SORENSEN
 (Magnetic Voltage Regulators)

These Magnetic Voltage Regulators, or regulating transformers, are the first units in a comprehensive line of equipment of this type being developed by Sorensen. Known as ISOTRANS, they are primarily intended for incorporation into other equipment, where performance becomes more effective when incoming line voltage is stabilized. ISOTRANS now available with capacities of 15, 30, 60, 120 VA. 250, 500, 1000 VA units are in design.



ELECTRICAL SPECIFICATIONS

Input voltage range 95-130 VAC, 10, 60 cycles.
 Output range 115 VAC, RMS, 10.
 Regulation accuracy $\pm 0.5\%$ against line changes.
 Load conditions $\pm 0.5\%$ against line at any given load from 0 to full.
 Time constant From 2 to 6 cycles for line changes.

MECHANICAL SPECIFICATIONS

Model MVR15 Length 6 1/2", Width 2 1/2", Height 3 1/2"
 Model MVR30 Length 6 1/2", Width 2 1/2", Height 3 1/2"
 Model MVR60 Length 8 1/2", Width 3 1/2", Height 4 1/4"
 Model MVR120 Length 9 1/2", Width 3 1/2", Height 4 1/4"

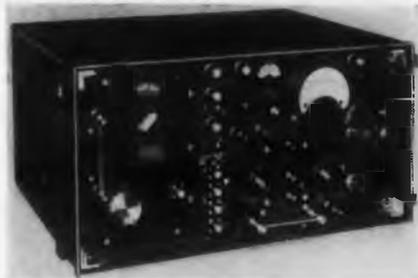
Send for Catalog MVR1, which gives full information on the magnetic voltage regulator line.

SORENSEN

SORENSEN & CO., INC., 375 FAIRFIELD AVE., STAMFORD, CONN.
 CIRCLE ED-314 ON READER-SERVICE CARD FOR MORE INFORMATION

Low-Frequency Tuner

For Field Intensity Meter



A low-frequency tuning unit, covering the 150ke to 20Me range, has been developed for the Noise and Field Intensity Meter, Model NF-105.

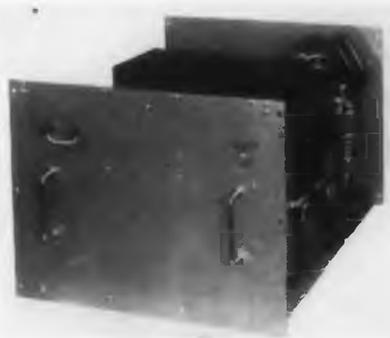
This tuning unit now makes it possible to conduct measurements of r-f interference and field intensity over the entire 150ke to 1000Me range with the NF-105.

The wide frequency range is obtained by use of four separate tuning units. The new tuner employs one stage of tuned r-f amplification. It utilizes a six-band turret arrangement for frequency range switching. An impulse generator furnishes the calibrating voltage. Empire Devices Products Corp., Dept. ED, 38-15 Bell Blvd., Bayside, L. I., N. Y. This product will be on display at the Radio Engineering Show, Booth 252.

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

Power Supply

For Digital Computer Uses



This regulated power supply is specifically intended for digital computer applications. The circuitry is adaptable up to 25kw of power at voltage levels consistent with computer re-

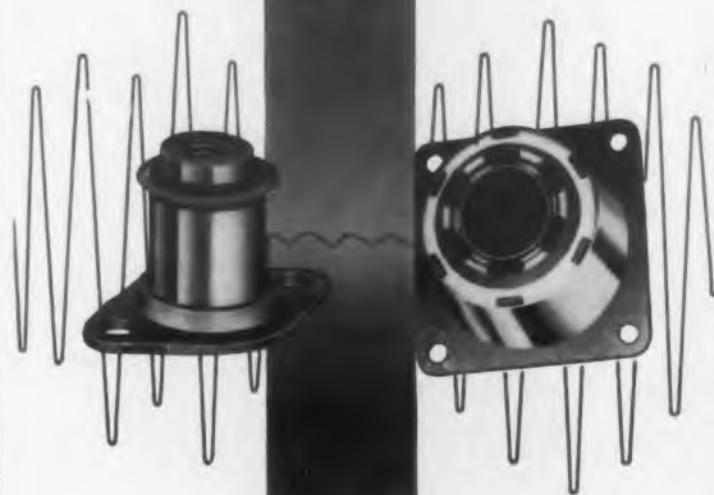
quirements. Units are constructed with rugged, long lasting, magnetic components and conservatively rated selenium rectifiers.

The following general specifications are typical: line voltage, 115v or 220/440v, single phase, 220/440v, three-phase; d-c output: adjustable to $\pm 5\%$ of nominal value; accuracy, $\pm 0.5\%$ from 10% load to full load, with $\pm 10\%$ change in line voltage and $\pm 5\%$ change in line frequency; ripple, 0.5% rms of d-c output voltage; speed of response, 0.17sec, 10% load to full load.

Multiple outputs are available to the above specifications with individual voltage adjustments. The power supplies can be provided for assembly in standard relay racks to facilitate computer wiring. Mag-Electric Products, Inc., Dept. ED, 12822 Yukon Ave., Mawthorne, Calif.

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

SILENTBLOC
 simply smothers
VIBRATION



Silentbloc rubber-in-metal mounts soak up sound and vibration through a unique deflection principal. It works equally well in shielding delicate equipment or protecting larger apparatus from the damaging effects of vibration.

There is practically no limit to the working life of Silentbloc. Units will stand unbelievable stresses for many years with no measurable fatigue.

For complete information on Silentbloc motion control products write to The General Tire & Rubber Company, Industrial Products Division, Dept. I-2, Wabash, Indiana.

"From Plans to Products in Plastics and Rubber"

These are General Tire Industrial Products
 now serving Industry

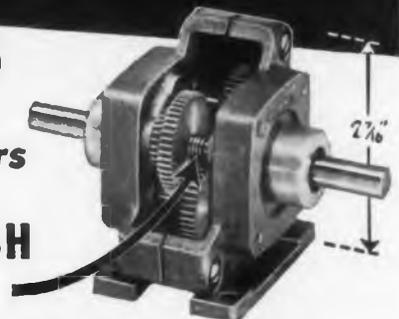
Silentbloc vibration and shock mountings • Silentbloc bushings • Silentbloc bearings • Oil & hydraulic seals • Bonded to metal rubber parts • Hydraulic brake parts • Metal stampings • Extruded & molded rubber • Extruded plastic • Polyester glass laminates • Sponge rubber • Glass run channel • Vibrex® fasteners



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

Pre-fab SPEED REDUCERS

Metron
Bantam
 Speed Reducers
 with
ANTI-BACKLASH
FEATURE



are ready-to-go in your product

When you need small but powerful speed reducers, a Metron Bantam will do the job. Save design time by using rugged pre-fab Bantams as components.

- 2 lb.-in. output torque
- Speeds up to 10,000 RPM input
- Quick delivery—1 or 1000 Bantams

Write for data sheet 10 and 11 for details



A Section—
 29 ratios up
 to 44 to 1



B Section—
 129 ratios up
 to 1936 to 1

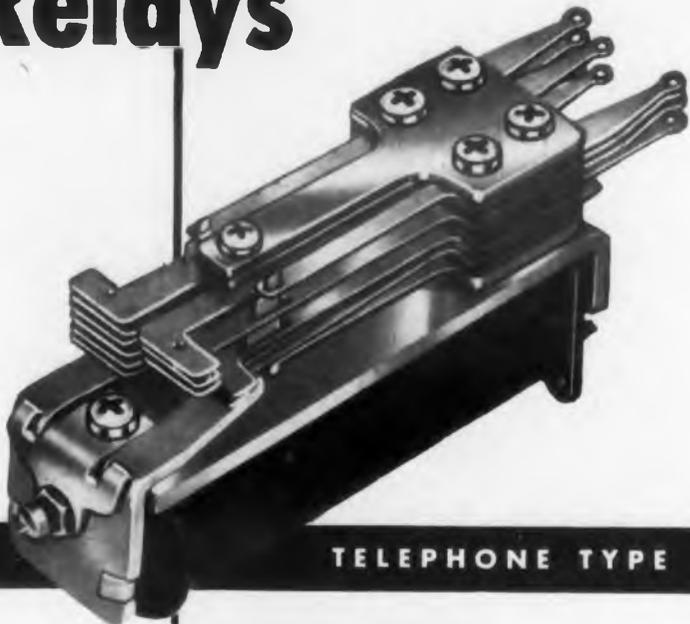


C Section—
 484 ratios up
 to 85184 to 1

Metron INSTRUMENT COMPANY
 450 Lincoln St., Denver 3, Colo.
 DISTRICT OFFICES • NEW YORK • CHICAGO • LOS ANGELES

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

Kellogg Provides Custom Assembled Relays



TELEPHONE TYPE

- GENERAL PURPOSE
- AT STOCK PRICES
- 1710 STOCK CONTACT SPRING COMBINATIONS
- 100 STOCK COILS AVAILABLE
- LIFE EXPECTANCY — over 50 million operations
- PRECIOUS METAL CONTACTS — Palladium or gold alloy
- DELIVERY — 20 to 45 days

A Famous Name in Communications Now Solving Problems in the Control Industry

KELLOGG

Industrial Sales Department

KELLOGG SWITCHBOARD AND SUPPLY COMPANY

A Division of International Telephone and Telegraph Corporation
Sales Offices: 68 West Monroe Street, Chicago 3, Illinois

KELLOGG SWITCHBOARD AND SUPPLY COMPANY
79 West Monroe Street, Chicago 3, Illinois

Please have representative call.

Please send detailed relay information.

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

CIRCLE ED-180 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistor Batteries

Made for Longer Service



This company's multiple-cell miniature transistor batteries employ a construction especially suited to the long service requirements of transistors. They maintain a uniform sustained

voltage during long periods of operation under low drains.

The batteries are effectively protected by being individually hermetically sealed in plicofilm (rubber-hydrochloride); and, after being positively connected in series, groups of cells are again sealed in a specially formed coating of plastic, paper, and impervious wax. Inner cell connections are made using a newly developed "Silver Wax" in which the current is carried by silver. The batteries are further protected by final assembly in aluminum and plastic containers. Burgess Battery Co., Dept. ED, Freeport, Ill. This product will be on display at the Radio Engineering Show, Booth 762.

CIRCLE ED-181 ON READER-SERVICE CARD FOR MORE INFORMATION

Counter Chronograph

Measures Time Intervals

The Model 800 series 0.1microsecond counter chronographs measure the elapsed time interval between two electrical signals in 0.1microsecond steps to a total time interval that can be as long as 100,000 sec. These units are particularly useful in testing radar and sonar systems performing velocity, acceleration, and detonation time measurements, in ballistics and missile work, and in testing fast pulse responses.

A temperature-controlled 10Mc crystal oscillator serves as a time base accurate to one part in a million. The time base is fed through a gate to a series of decade counters of which the input decade is capable of being operated above 10Mc. A binary counter system converted by switching diode gates to a 1-2-4-8 decade system without the use of feedback results in a highly reliable high-speed decade system. The time interval is indicated in direct digital form in units of a tenth of a microsecond, one digit per decade. The gating accuracy is 0.1microsec. and hence time intervals as long as 1/20 of a second are accurate to a 0.1microsec. Longer time intervals are accurate to one part in a million ± 0.1 microsec. The long time accuracy can be made much better (1 part in ten million) by providing calibration with station WWV. Epic Co., Dept. ED, 42-19 27th St., L. I. C., N. Y.

CIRCLE ED-182 ON READER-SERVICE CARD FOR MORE INFORMATION

MECHANICAL INTEGRATORS

from FORD INSTRUMENT

for extreme accuracy in computing and variable speed applications



- STANDARD INTEGRATOR in 2½" and 5" disk diameter

FOR EARLY DELIVERY

- and a variety of SPECIALS, such as component and tangent integrators.

Ford Instrument's standard mechanical integrators utilize the Company's two-ball and disk low-friction design. Supplied with a patented ball roller tilt device which minimizes ball slip for all carriage positions, these integrators are high precision units for a wide variety of computing and variable speed drive applications.

FREE — Fully illustrated data bulletin gives specifications and performance information. Please address Dept. ED



47



FORD INSTRUMENT COMPANY

Division of The Sperry Corporation
31-10 Thomson Ave.
Long Island City 1, N. Y.

Ford Instrument's standard components



Rate Generators



Differentials



Servo Motors



Telesyn Resolvers



Integrators



Telesyn Synchros

CIRCLE ED-183 ON READER-SERVICE CARD

□ Rate Gyro

Develops 1,500,000gm-cm²/sec



Model 36128 is a high-performance, small-sized Rate Gyro, suitable for use in aircraft and missile control, or telemetering. A rugged, fluid-damped instrument, it is enclosed in a hermetically

sealed, oil-filled case. The gyro is maintained at a uniform temperature by means of internal thermostatically controlled heating elements to make possible constant damping ratio over a wide ambient temperature range. The fluid-filled case cushions the inner assembly to provide exceptional operation under conditions of severe vibration and shock.

The rotor of the gyro develops an angular momentum of 1,500,000gm-cm²/sec (inertia ratio of 0.006sec). High output level is obtained from a precious-metal potentiometer pick-off, the output of which is proportional to rate of rotation.

The Gyro weighs less than 1-1/2 lb and measures 2.0" x 2.68" long. It is also available with induction potentiometer output (Model 36628). G. M. Giannini & Co., Dept. ED, 918 East Green St., Pasadena 1, Calif. *This product will be on display at the Radio Engineering Show, Booths 117 and 119.*

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

□ Mica Capacitors

Sealed by Dip Coating



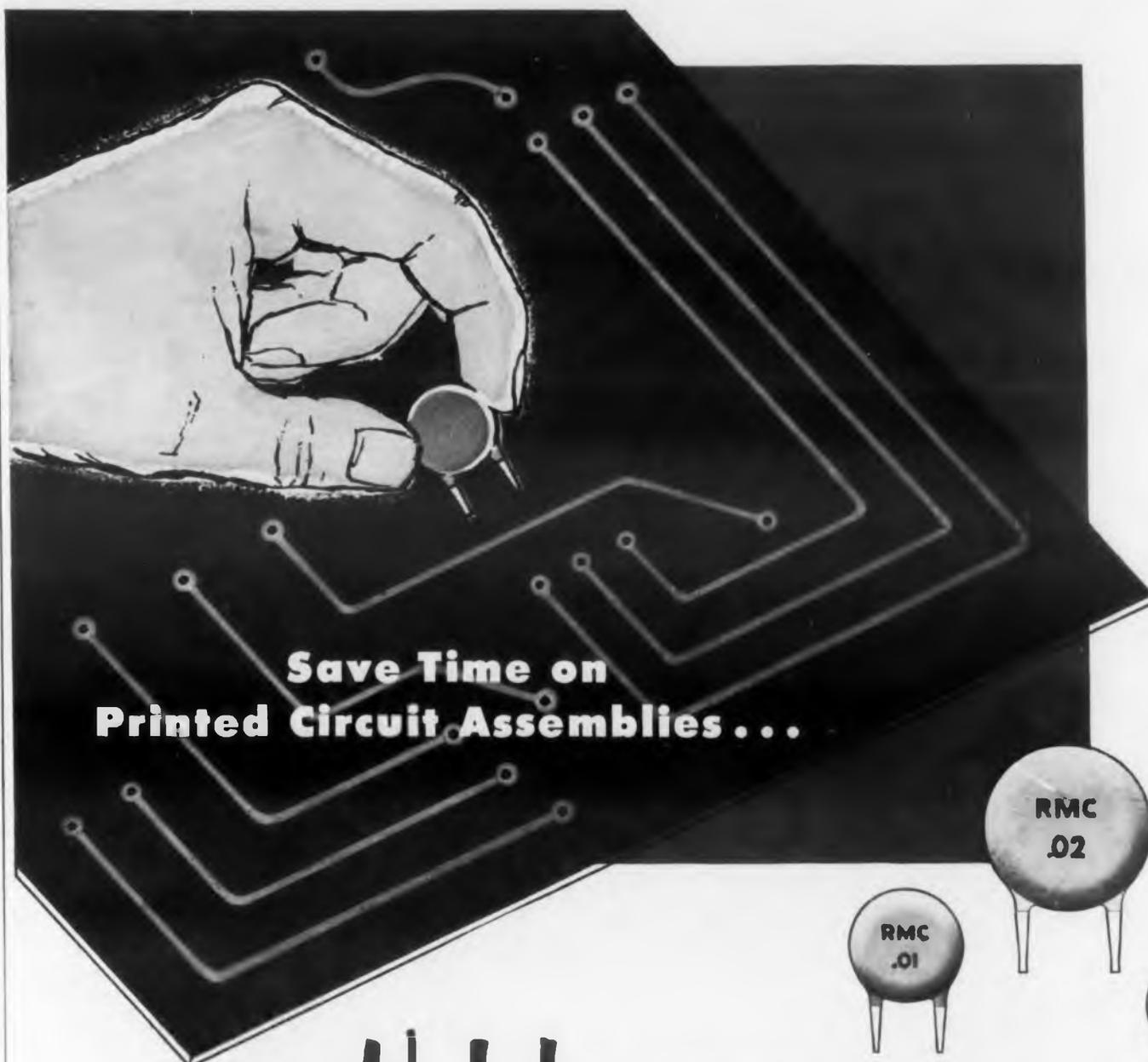
"Micap" capacitors are encapsulated and hermetically sealed by a dip-coating method rather than the usual compression-molding procedure. They are smaller in size than molded types, and are generally

lower in cost. Radial wire leads make them easy to use in subminiature assemblies.

"Micap" Style MQ has a capacitance range of 5-330 mmfd, rated at 500v d-c, with nominal dimensions of 1/16" x 1/4" x 5/32". Style MO has a capacitance range of 220-1000mmfd, rated at 500v d-c, with nominal dimensions of 19/32" x 13/32" x 3/16". Micamold Radio Corp., Dept. ED, 1087 Flushing Ave., Brooklyn 17, N. Y. *These components will be on display at the Radio Engineering Show, Booth 466.*

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

ELECTRONIC DESIGN • March 1955



Save Time on
Printed Circuit Assemblies...

RMC Wedg-Loc DISCAPS

RMC "Wedg-Loc" DISCAPS are designed specifically to cut assembly time on all types of electronic equipment using printed circuits.

The exclusive wedge design of the leads on these new type DISCAPS locks them firmly in place on printed circuits... eliminates their falling out during production line operations... insures a uniform connection with a minimum amount of solder.

Available in capacities between 2 MMF and 20,000 MMF in temperature compensating, by-pass and stable capacity types, "Wedg-Loc" DISCAPS will provide worthwhile economies on printed circuit assembly. Suggested hole size for "Wedg-Loc" DISCAPS is a .062 square hole.

BOOTH 518, Components Ave., I.R.E. Show

DISCAP
CERAMIC
CAPACITORS



RADIO MATERIALS CORPORATION

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

FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

Two RMC Plants Devoted Exclusively to Ceramic Capacitors

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

star performer in

GOOLOR

TV...

Midland CRYSTALS

Whatever your crystal need,
conventional or highly
specialized. When it has to be
exactly right, contact

Midland **MANUFACTURING COMPANY, INC.**
3155 Fiberglas Road • Kansas City, Kansas

Midland's part in color television is frequency control to the most critical standards of accuracy, stability and uniformity. We supplied many of the first crystals used in color TV and pioneered in the development of frequency control circuits. As the sets multiply, we're geared to the increasing demand.

Midland makes crystals by the millions for frequency control in land, sea, and air communications. Makes them to ANY specifications, but ONE standard of quality. Be sure you get it.

WORLD'S LARGEST PRODUCER OF QUARTZ CRYSTALS

CIRCLE ED-164 ON READER-SERVICE CARD FOR MORE INFORMATION

Flip-Flop Low-Weight Plug-In Unit



The Z-91000 is a medium-speed bistable multivibrator circuit designed for use in counting frequency division, switching, and time selection applications. Making use of etched circuitry, the unit was designed to provide a low-cost, light-weight, plug-in device. The output of one Z-91000 may be directly coupled into another without the use of amplifiers. The unit is wired so it can be used

for linear, binary, or feedback counting applications.

Size is 3-1/2" high x 2-3/4" wide x 1-1/8" thick; weight is only 1-1/2 oz. The unit uses a 1/16" phenolic etched circuit board. It plugs into a standard 15-contact printed circuit connector. It uses a 5963 tube with a tube holddown and is designed to operate in the range of 0 to 100kc. It requires 200v d-c at 3.5ma, and a filament of either 6.3v or 12.6v. Other units to customer specifications are available. EECO Production Co., Dept. ED, 827 South Vermont Ave., Los Angeles 5, Calif.

CIRCLE ED-165 ON READER-SERVICE CARD FOR MORE INFORMATION

□ Tube Holder

For Subminiature Ovals



The Oval Subminiature Tube Holder takes oval-shaped subminiature filament-type tubes and holds them without twisting and consequent danger to the leads. The oval holder cross-section

is on a concave base, which adds to the holders rigidity when mounted.

The unit allows easy clip-in, clip-out insertion and removal of subminiature tubes for maximum mounting convenience. It is made of SAE 1065 annealed carbon steel; cadmium plated per QQ-P-416 Class B Type II Iridite No. 4; and able to withstand minimum 50hr salt spray test per AN-QQ-S-91. Atlas E-E Corp., Dept. ED, Bedford Airport, Bedford, Mass. This product will be on display at the Radio Engineering Show, Booth 745.

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

ELECTRONIC DESIGN • March 1955

Fixed-Stylus Recorders
Have 210 Channels on 5" Paper



The R-1021-1 Miniature Fixed Stylus Recorder provides 210 channels of On-Off information recorded on a 5" wide "Teledeltos" chart. It is particularly adaptable to events or sequence recording requirements, and can be used as a high-speed digital recording system. A direct-writing instrument, it offers continuously variable chart speeds.

Quantitized inputs in either unidigital or digital form appear on the electro-sensitive chart as visible traces which may be reduced manually by operating personnel or automatically by machine. The recording medium provides a dry, permanent record which requires no processing and is not affected by light, fungus, or atmospheric temperature changes. Size of the unit is 9-1/2" x 7-1/2" x 8", and weight is 15 lb. Power input is 115v 60cy. Chart speed is variable from 1/4 ips to 5 ips, with a magazine capacity of 100'. Also available is another version, the R-1021-D Flight Recorder. Radiation, Inc., Dept. ED, Melbourne, Fla. *This product will be on display at the Radio Engineering Show, Booth 10.*

CIRCLE ED-167 ON READER-SERVICE CARD FOR MORE INFORMATION

A-C Motors

60cy or 400cy Miniatures



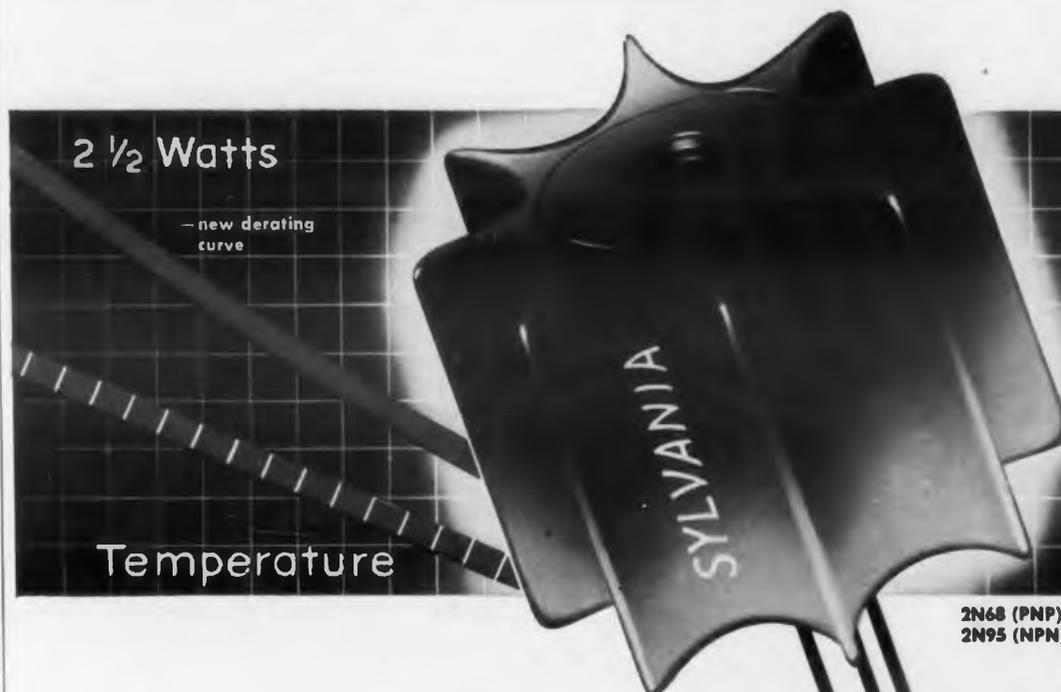
Type SC sub-miniature motors are available in either 400cy or 60cy varieties. They are intended for applications where size, weight, and high performance

are the governing factors. Diameter is 1-1/16". They meet military environmental specifications.

The motors can be wound for single phase, 2 phase or 3 phase power and furnished as induction or hysteresis types. Characteristics can be readily modified to cover a wide range of application requirements. Motors can also be furnished with concentric spur-gear reducers. Globe Industries, Inc., Dept. ED, 1784 Stanley Ave., Dayton, Ohio. *This product will be on display at the Radio Engineering Show, Booth 612.*

CIRCLE ED-168 ON READER-SERVICE CARD FOR MORE INFORMATION

Sylvania Power Transistors...



...now with **increased ratings**

dissipate 2½ watts in free air,
have low thermal inertia

New Sylvania design developments achieve low thermal inertia and increased ratings in the Sylvania Power Transistors 2N68 and 2N95. Dissipation of 2½ watts in free air reflects a full watt increase over previous ratings. Power dissipation up to 5 watts is possible with an external heat sink.

With Sylvania's new design heat is conducted quickly away from active elements. Resulting low thermal inertia improves performance stability over a wider range of operating temperatures. Operated as a Class A amplifier the 2N68 or 2N95 provides a minimum power gain of 20 db.

"Another reason why it pays to specify Sylvania"

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.

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

SYLVANIA

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY
CIRCLE ED-169 ON READER-SERVICE CARD FOR MORE INFORMATION

Sylvania Transistors
— for military, industrial, and commercial applications. Available in commercial quantities.

High-Gain, Low Frequency—
2N35 (NPN)—2N34 (PNP)—
low to medium
power—use as a
high-gain audio
amplifier—gains
up to 40 in ground-
ed emitter circuit.



High-Power, Low Frequency—
2N68 (PNP)—2N95 (NPN) in-
creased power ratings—use for
high current, low voltage appli-
cations (6-24 volts power
supplies).

High Frequency—2N94 (NPN)
—2N94A (NPN)—high alpha
(over 0.95)—low base resistance
and collector capacitance—typi-
cally 1500 ohms uufd—gains up
to 40 db.

Also available
in commercial quantities

Silicon Junction Diodes—1N137A
—1N138A and allied types—
high back resistance at high
operating temperatures.

Silicon Point-Contact Diodes—
1N193, 1N194, 1N195, 1N196—
specifically de-
signed for comput-
er and high tem-
perature genera-
purpose applica-
tions. Excellent
transient response
(0.1 u sec.)



For your semiconductor require-
ments, check Sylvania first. Use
this convenient form to indicate
your interests and address it to
Department C20R.

Dept. C22R
Sylvania Electric Products Inc.
1740 Broadway, New York 19, N. Y.
Gentlemen: Please forward additional in-
formation on the items checked below:

Transistors	Silicon Diodes
<input type="checkbox"/> High Power	<input type="checkbox"/> Point Contact
<input type="checkbox"/> High Gain	<input type="checkbox"/> Junction
<input type="checkbox"/> High Frequency	

Name _____

Address _____

City _____

Zone _____ State _____

6738... First again in the field of tube miniaturization, Bomac developed a new type TR tube designated the 6378. Designed specifically for airborne radar equipment, the 6378 is a miniaturized version of the 1B24A (another Bomac first), 1B60 and the 1B24. Size was cut in half, and weight was reduced by one fifth with no sacrifice in performance or efficiency.



BL-25... The BL-25 TR tube, designed and developed by Bomac, was the first cell-type tube system — engineered to withstand high power levels and maintain recovery time over a long period of life. The BL-25, although originally designed for a specific piece of equipment, has proven its versatility in various applications within the industry.



1N23D... Bomac was the first to manufacture the 1N23D silicon diode. System designers, for the first time, could obtain a diode with greatly increased sensitivity and superior electrical characteristics in relation to existing types.



BL-87... Now, Bomac is first again to introduce a new concept in complete duplexer operation. For the first time in S-band, a complete duplexer is offered to the industry. The BL-87 is a dual TR tube, complete with perfectly matched hybrids to assure maximum efficiency and long life. Systems designers can now be assured of reliable duplexer operation because Bomac's hybrids are designed specifically for their dual TR tubes. Bomac is first again in design and development of microwave tubes.

BL-58... Bomac was the first to develop shutter tubes and integral TR-shutter combinations for continuous crystal protection. The BL-58 was the first integral TR-shutter combination developed by Bomac. With integral TR-shutter operation, bulky waveguide shutters could be eliminated at considerable savings in size and weight. This tube has now been superseded by improved models.

BL-509... Bomac's BL-509 was the first complete duplexer offered in one compact unit. Combining a Bomac dual TR tube having integral shutters with two perfectly matched hybrid junctions in a single unit, the BL-509 provides duplexer operation and continuous crystal protection in one package. Light weight and compact, the BL-509 assures superior electrical performance and mechanical simplicity.



BOMAC DUAL TR DUPLEXERS			
Tube	Frequency (MC)	Tube	Frequency (MC)
6334	8490-9578	BL71	8500-9600
(BL-27)		BL78	8490-9578
BL29	9325-9425	BL87	2700-2900
BL35	15000-17000	BL507	8490-9578
BL47	9325-9425	BL600	8490-9578
BL60	5400-5900		

Bomac Laboratories, Inc.

GAS SWITCHING TUBES - DIODES - HYDROGEN
THYRATRONS - DUPLEXERS - MAGNETRONS
MODULATORS - CAVITIES

Silicone Gum

Applies to Various Fillers

Identified as "400 Gum," this polymer can be compounded with a wide range of fillers and vulcanizing agents to produce silicone rubbers suitable for a variety of applications. Clear, uniform, and nontoxic, the gum is a dimethyl silicone gum of high molecular weight and extremely high viscosity. It is stable in storage and requires no preliminary breakdown. Williams plasticity is 45 mils; specific gravity at 25°C is 0.98.

Heating a blend of this gum and certain vulcanizing agents converts the mixture to a cross-linked, resilient mass. The selection of inorganic fillers and additives, however, determines to a large extent the physical properties of the finished elastomer. Dow Corning Corp., Dept. ED, 592 Saginaw Rd., Midland, Mich.

CIRCLE ED-156 ON READER-SERVICE CARD

Feed-Through Terminals

Use High-Insulation Glass

A new type of glass having high performance characteristics is now being used in hermetically sealed electrical feed-through terminals. Designated as V-24, the glass is available in all standard models and electrodes (pins) made by this company. In laboratory tests, the glass is rated at 100,000 megohms insulation resistance at 150°C. It is extremely resistant to thermal and mechanical shock, and has a characteristic green color.

In conjunction with the new glass, a new alloy pin has also been developed that is extremely corrosion resistant. The seal is leak-proof. Fusite Corp., Dept. ED, 660 Fernview Ave., Cincinnati 13, Ohio.

CIRCLE ED-157 ON READER-SERVICE CARD

Metallized Ceramics

Production Facilities Available

This firm does printing of conductive silver on ceramic objects to specification. Ceramet Co., Dept. ED, 5905 Broadway, N. Y. 63, N. Y.

CIRCLE ED-158 ON READER-SERVICE CARD

◀ CIRCLE ED-159 ON READER-SERVICE CARD

Testing Facilities

Many Instruments Available

This firm runs qualification and production tests of electrical and mechanical products for government and industry. Equipment includes a vibration table of 1250 lb force output, 2 to 2000ey per sec; an altitude chamber for testing at extremely high and low ambient temperatures; an explosion-proof chamber with capacity from sea level to 40,000' altitude; a sand and dust chamber; and other precision machines for making shock, endurance and acceleration tests as well as humidity and salt spray, sunshine and radio noise interference tests. Testing, Inc., Dept. ED, 5051 W. Jefferson Blvd., Los Angeles 16, Calif.

CIRCLE ED-160 ON READER-SERVICE CARD

Insulating Lacquer

Has High Adhesion

Designated A-11, this air-dry acrylic coating finds wide application in the electrical-electronic fields as a binder, a sealant, and as an adhesive. Supplied in colors as well as clear, it is also used for color coding such units as ceramic capacitors, which are subject to high operating temperatures. For most uses the compound is applied by brushing or dipping. Insl-X Sales Co., Dept. ED, 26 Rittenhouse Pl., Ardmore, Pa.

CIRCLE ED-161 ON READER-SERVICE CARD

Curing Agent

For High-Temperature Resistance

Heat-resistant epoxy castings, laminates, adhesives, and structural members that retain their physical properties up to 150°C are obtained with Curing Agent 105. It is available in a liquid form. No premelting or preheating of catalyst or resin is necessary. Castings prepared with this curing agent exhibit excellent electrical properties up to the heat distortion point. Aries Laboratories, Inc., Dept. ED, 270 Park Ave., New York 17, N. Y.

CIRCLE ED-162 ON READER-SERVICE CARD

CIRCLE ED-163 ON READER-SERVICE CARD ➤

Warden, Inc. is advertising



Better for you



*Pyramid will now
be listed in
Photofact folders.*

Pyramid has joined the select group of manufacturers who participate in this most valuable of all service aids to make available to you an immediate cross reference between the set manufacturer's part and the part number of the exact Pyramid equivalent.

You will find Pyramid capacitors as original components in sets bearing such famous brand names as

RCA • GE • CBS • Arvin • DuMont • Zenith • Raytheon • Emerson
Motorola • Sylvania • Packard-Bell • Hallicrafters • Westinghouse • Hoffman
and at leading parts distributors everywhere.



▶ PYRAMID ELECTRIC CO., 1445 Hudson Boulevard, North Bergen, N. J.

□ Bridge

For Checking Low Resistances



The Model 604 Low Resistance Bridge provides a means for rapidly and easily checking low resistances (10-10,000 ohms) to a high degree of accuracy ($\pm 0.25\%$). Three ranges for full-scale resistance values are selectable by a front panel switch.

In operation, the unknown resistance is connected to the appropriate terminals, the range switch set, a key depressed and a "Helipot" turned to obtain a null indication on the zero-center galvanometer. The value of the unknown is then read directly from the "Helipot" dial setting and multiplied by the appropriate factor of ten.

The dial-lock on the "Helipot" also enables the operator to pre-select, and lock into place, a resistance value for rapid checking of tolerances or comparisons without fear of inadvertently bumping the dial off its setting. Shasta Div., Beckman Instruments, Inc., Dept. ED, 1432 Nevin Ave., Richmond, Calif. *This product will be on display at the Radio Engineering Show, Booth 750.*

CIRCLE ED-333 ON READER'S SERVICE CARD FOR MORE DATA

□ Color TV Test Equipment

Complete Series



A complete line of test equipment for color TV engineers is available for rack mounting. Units available include a Color End Coder, a Color Synchronizing Delay Unit, a Color Sub-Carrier Generator, a Color Burst Keying Generator, a Color Bar Chart Generator, a Color Vectorimeter, a Color Staircase Generator, and an Envelope Delay Corrector. The user can select one or all of these test equipments to suit his particular needs. Philco Corp., Government and Industrial Div., Dept. ED, Philadelphia 44, Pa.

These products will be on display at the Radio Engineering Show, Booth 489-493,

CIRCLE ED-334 ON READER'S SERVICE CARD FOR MORE DATA

108

NEW SYMBOL FOR SEMICONDUCTOR LEADERSHIP



now...from Pacific
Semiconductors

new designs

new techniques

new performance

Back of Pacific Semiconductors' new diode design is a fresh approach based on experience... over 145 man-years professional experience in the field of semiconductor electronics. Starting where others have left off, these pioneers in one of the decade's most promising electronic fields have developed a series of truly *new* semiconductor devices uniquely suited to the demands of today's airborne and computer circuitry.

Experienced personnel and a thorough, continuing research and development program are your assurance of the most advanced design, combined with *proven* performance at levels heretofore unobtainable. Pioneering at PSI is not mere guesswork; it is based on thorough knowledge of each product and of the conditions under which that product is used. In the months and years to come, look to PSI... Pacific Semiconductors, Inc. ... for your requirements of gold bonded germanium diodes, silicon junction diodes and other important semiconductor devices. Inquiries are invited for both standard units and for the special characteristics constantly called for by advances in electronic design.



High-purity silicon crystals are drawn in PSI's high frequency induction furnaces.



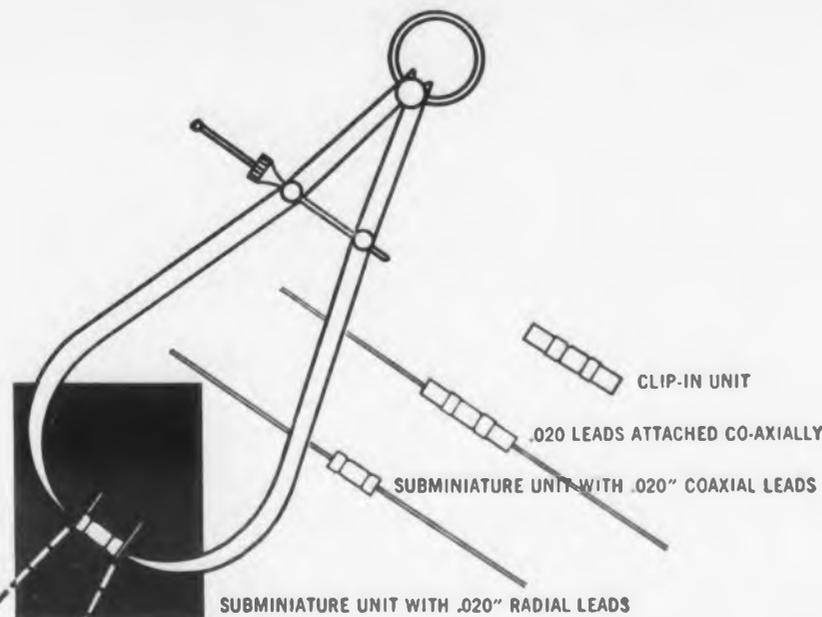
X-ray diffraction orients crystals prior to slicing wafer for silicon junction diodes.

CIRCLE ED-335 ON READER-SERVICE CARD FOR MORE INFORMATION

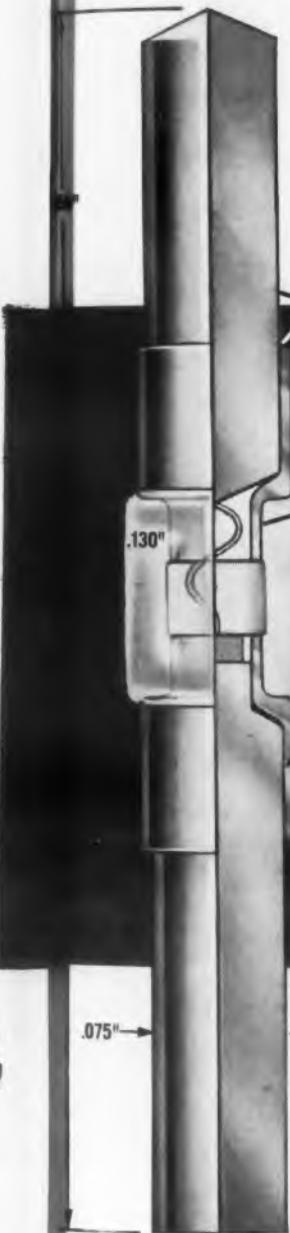
NOW AVAILABLE

**GERMANIUM GOLD BONDED DIODES
SILICON JUNCTION DIODES**

*the new PSI diode package...
designed around user requirements*



PSI's revolutionary new package, with advantages not found in any other commercially available diodes, was designed only after an exhaustive survey of user requirements. Space limitations, environmental demands, even assembly procedures became factors in the final design. The result: diodes with demonstrably superior performance, greater versatility, top all-around utility.



1

2

3

***CHECK THESE BENEFITS...**

1. VERSATILE LEAD ARRANGEMENT... for maximum adaptability, diodes may be obtained in a variety of configurations.

2. GLASS-TO-METAL SEAL... for positive moisture resistance, PSI uses a true fusion seal.

3. WELDED CONSTRUCTION... for greater strength and freedom from contamination; no low melting point solders are used.

and your net benefit from all these features...

**NEW STANDARDS OF
RELIABILITY AND STABILITY**

(Pat. Pending)

Typical PSI Gold Bonded Diode Characteristics @ 25°C

Forward Current @ 1v (ma)	Inverse Current (μa)	Inverse Working Voltage (volts)
100	100 (-20v)	35
35	10 (-50v)	80
15	25 (-50v) 200 (-200v)	220

Typical PSI Silicon Junction Diode Characteristics

E _s /E _t (volts)	Forward Current @ 1v (ma)	Back Current	
		at 25°C	at 150°C
30/29	80	.01μa (-15v)	5μa (-15v)
55/53	40	.01μa (-30v)	5μa (-30v)
150/145	15	.01μa (-75v)	5μa (-75v)
300/290	5	.01μa (-150v)	5μa (-150v)

a: The saturation voltage (E_s) is measured at 500μa; the transition voltage (E_t) is measured at 20μa.

b: Recovery time: after switching from 5ma forward current to -40v for all these types, back resistance reaches or exceeds 50K in 1μsec.

For complete product specifications, address inquiries to Dept. S-4



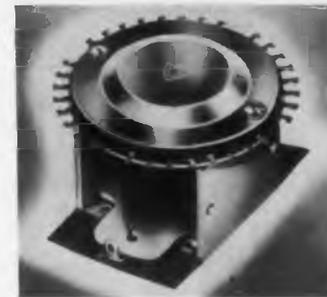
PACIFIC SEMICONDUCTORS, INC.

10451 WEST JEFFERSON BOULEVARD
CULVER CITY, CALIFORNIA

CIRCLE ED-335 ON READER-SERVICE CARD FOR MORE INFORMATION

D-C Relay

5 oz Unit With 32 Poles



Originally designed as a "group" relay, the Series 805 d-c relay is capable of simultaneously connecting together 32 electrical circuits. Individual contact blades are molded in thermosetting phenolic for maximum strength, durability, and heat resistance. All contacting members are completely enclosed in an aluminum cover, making the unit virtually dust proof. The unit weighs slightly less than 5 oz. Guardian Electric Manufacturing Co., Dept. ED, Chicago 12, Ill. This product will be on display at the Radio Engineering Show, Booths 582-584.

CIRCLE ED-336 ON READER'S SERVICE CARD FOR MORE DATA

Decade Counter

Plug-in Types from 20-100Kc



This miniaturized electronic decade counter uses the EIT decade scaler tube and weighs only 11oz with tubes in place. Four types are available: 20kc, 40kc and 100kc scalers, and an output stage scaler operating at 10cy which can be used to feed a mechanical counter. The

40kc and 100kc types can be furnished with or without an input shaper circuit.

The counters employ plug-in construction, using an Alden 20-pin plug for quick installation and removal. All types now available measure 1-3/4" x 3-1/4" x 3-3/4", exclusive of tubes. One miniature tube is used in addition to the EIT scaler tube, and, when an input shaper circuit is included, a second miniature tube is employed. Ransom Research, Dept. ED, P. O. Box 383, San Pedro, Calif.

CIRCLE ED-337 ON READER'S SERVICE CARD FOR MORE DATA

**Have you returned your subscription
renewal and qualification form?**

See Page 100

Spotlight

E-I

hermetically-sealed terminations and miniature closures*

● **MULTIPLE TERMINATIONS** — Featuring cushioned glass construction. Lead wire ends are tin dipped for easy soldering.

● **SEALED TERMINATIONS** — Provide shock resistance and feature cushioned glass construction. Preferred types and special designs.

● **OCTAL HEADERS** — Employ a new principle of hermetic sealing. Solid metal shells afford maximum rigidity and mechanical strength.

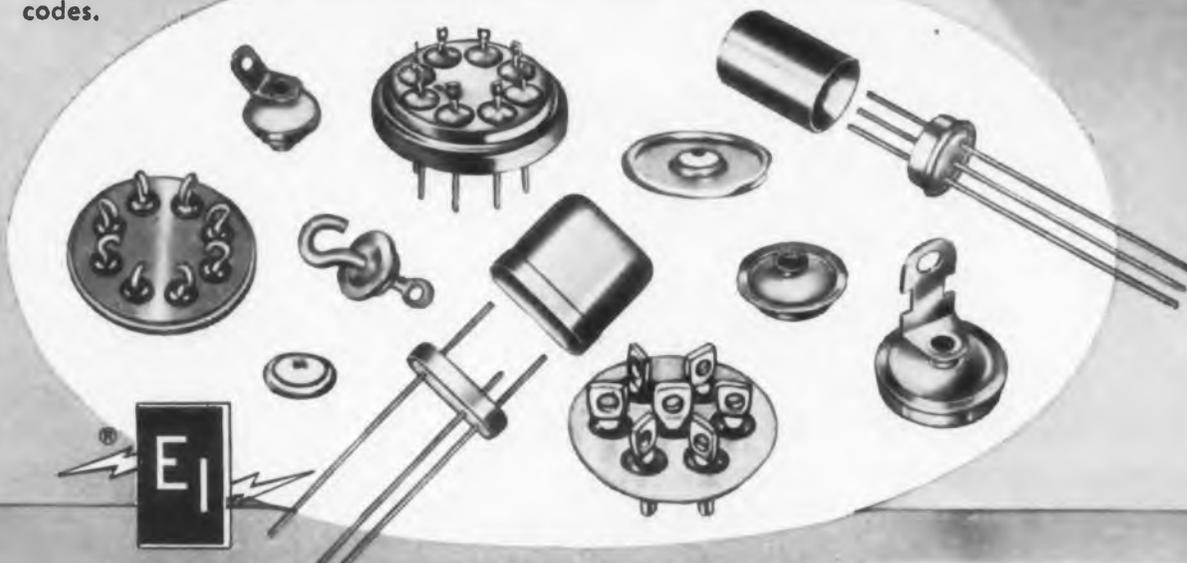
● **E-I END SEALS** — Completely strain-free. Provide a permanent hermetic seal. For condensers, resistors and other tubular-type components. Available in many standard types.

● **COMPRESSION TYPE HEADERS** — Super rugged, practically indestructible and absolutely rigid. Exclusive E-I process affords increased resistance to shock and vibration.

● **LUG-TYPE, LEAD-THRU INSULATORS** — Compression sealed, super rugged. For applications requiring voltage ratings from 2000 to 4000 (rms.) — transformers, "bath-tub" condensers, etc.

● **MINIATURE CLOSURES** — For transistors and other components requiring hermetic sealing. Square, rectangular and round cases. Supplied in E-I standard types or custom designs to specifications.

● **COLOR-CODED TERMINALS** — Featuring glass inserts with permanent coloring in the glass. All types offered in standard, easily-identified RMA color codes.



ELECTRICAL INDUSTRIES

44 SUMMER AVENUE, NEWARK 4, NEW JERSEY

DIVISION OF AMPEREX ELECTRONIC CORP.

AT THE I. R. E. SHOW.
BOOTHS #650, 652
CIRCUITS AVENUE
Kingsbridge Armory
New York City
March 21-24, 1955

Long-Playing Tape

Base Is 50% Thinner

A long-playing magnetic recording tape called "Plus 50," will play 50% longer than standard tape since each reel will hold 50% more tape. The five-inch reel, which holds 600' of standard tape, will hold 900' of the new tape, and the seven-inch reel will hold 1800' of +50 tape compared to 1200' of standard tape. The new tape will also be available in 10-1/2", 3600' hubs and reels and 3", 225' reels.

The base is 50% thinner than standard acetate-base tape, but is stronger because it is made of "Mylar" polyester film. Reeves Soundcraft Corp., Dept. ED, 10 East 52nd St., New York, N. Y.

CIRCLE ED-260 ON READER-SERVICE CARD

Glass-Reinforced Plastics

Custom-Molded

This firm makes high-pressure compression and transfer-molded parts of glass-reinforced plastics to specification. High-pressure molding, a relatively recent development, extends the application of glass-reinforced plastics to parts incorporating varying section thickness, complex details and multiple inserts requiring flow of material around the inserts. American Hard Rubber Co., Dept. ED, 93 Worth St., New York 13, N. Y.

CIRCLE ED-261 ON READER-SERVICE CARD

Nameplates

For Unpainted Equipment

Pre-masked "Metal-Cals", suitable for application to unpainted surfaces, are completely masked to allow painting of an article after the trademark or label is applied, thus building up the paint around the edge of the trademark and making it an integral part of the item to which it is affixed. The masking is easily stripped off the thin, anodized, etched aluminum nameplates after painting. Metal-Cals, both masked and unmasked, are available in a wide range of colors and come with a highly reflective or a matte finish. Free samples are available. C&H Supply Co., Dept. ED, Inglewood, Calif.

CIRCLE ED-262 ON READER-SERVICE CARD

◀ CIRCLE ED-263 ON READER-SERVICE CARD

*PATENT PENDING
ALL RIGHTS RESERVED

AVAILABLE IN A
WIDE RANGE OF
STANDARD TYPES TO
ECONOMICALLY MEET
SPECIAL REQUIREMENTS!

Economical E-I standardized hermetically-sealed terminations and miniature closures are available to meet almost any electronic application. Samples and recommendations on your particular needs will be supplied promptly on receipt of your data. Call or write for complete E-I catalogs, today!



Paste Solder

For Sweat Soldering

"SweTite" Paste Solder for sweat soldering and tinning has applications in the construction of micro-wave plumbing and large tubes. The paste consists of a blend of 50/50 powdered solder and an active flux. For most applications, cleaning is unnecessary. The paste is applied with brush or cloth, the parts fitted together, and heat applied. After heating, the small amount of flux residue can be removed by wiping with a damp cloth. Alpha Metals, Inc., Dept. ED, 56 Water St., Jersey City 4, N. J.

CIRCLE ED-264 ON READER-SERVICE CARD

Potting Compound

Fast Setting

Named "Em-ed-it" this potting compound was especially formulated to solve the problems encountered in encapsulating delicate electronic components for the armed forces. It is fast setting . . . and requires less expensive molds. Besides supplying the material, this firm offers a complete service for embedment of electronic components and assemblies as well as the manufacture of rods from 1/4" diam up. Electronic Plastics Corp., Dept ED, 130th St. & 90th Ave., Queens 18, N. Y.

CIRCLE ED-265 ON READER-SERVICE CARD

Insulation

Self-Extinguishing

A new flame retardant, self-extinguishing electrical insulation laminate, known as "RepcO GOC" Grade, retains its self-extinguishing properties even after a test exposure of 90 days to a heat of 275°F. In addition to the self-extinguishing property, the new laminate has good arc resistance, low water absorption, high dielectric strength, a low dielectric constant, high surface and volume resistivity, high insulation resistance, and low loss and dissipation factors. The laminate is also available in a variety of thicknesses and sizes. Russell Reinforced Plastics Corp., Dept. ED, 1 S. 12th St., Lindenhurst, N. Y.

CIRCLE ED-266 ON READER-SERVICE CARD

CIRCLE ED-267 ON READER-SERVICE CARD >

Now!

Improved 100%



U. S. Navy Photo

with the new PHILCO 1N263 Crystal Diode



FEATURES

- Superior detection ability.
- Greatly improved noise figure over previous types.
- Reversible for use in balanced mixer circuits.
- 20° higher range in ambient operating temperatures.
- Controlled processing . . . rigid testing assures uniform diode characteristics . . .

The greatest mixer crystal advance in over 15 years! Philco's intensive program to reduce noise in radar front ends brings you this new "X" band diode, the 1N263. Now the noise figure is improved 2 to 3 db over the performance of ordinary crystals . . . equivalent in over-all performance to a power increase of 100%.

The 1N263 is a hermetically sealed point-contact germanium diode, designed to withstand environmental testing far beyond present military specifications. Maximum ambient operating temperatures have been increased 20° C over present mixer diode ratings to reach 90° C.

This new Philco diode will, with minor circuit modifications, operate in present radar systems. It is the only diode that can be reversed for use in either side of a balanced circuit.

Now in production and available. For complete information write Philco Dept. ED.



PHILCO CORPORATION

ANY TYPE

ANY SIZE

Electron



Electron ASSURES YOU QUALITY MANUFACTURE

- High temperature operation
- High insulation resistance
- Low series resistance
- AC and/or DC types
- Minimum sizes

- Solid or liquid impregnants — including our new Epicon epoxy resin. Hermetically sealed or wrapped and filled for potting application.

ELECTRON PRODUCTS, INC.

CIRCLE ED-170 ON READER-SERVICE CARD FOR MORE INFORMATION

Analog Computers For Design, Development, Control



"EASE" (Electric Analog Simulation Equipment) can be used for: systems design, providing fast problem set-up and computer operation; systems development, by simulating part or all of a system for performance prediction; and for system control, providing amplifiers,

servo-multipliers, servo-resolvers, and other precision components for use in the system itself.

Featured in this equipment are two new components, the Model 1032 Receptacle Control, and the Model 1048 D-C Amplifier. The former features centralized pushbutton control of problem solution, coefficient setting, and monitoring. It can handle 50 amplifiers, 16 multipliers, 102 pots, and 10 diodes, and has 126 blank contacts for other equipment, 40 interconnections for a second computer.

The d-c amplifier is a compact plug-in type featuring low drift (less than $100\mu\text{v}$ referred to summing junction), greater than 2×10^8 gain, less than 0.1 ohm output impedance, excellent frequency range, and high power output with large voltage range. Berkeley Div., Beckman Instruments, Inc., Dept. ED, 2200 Wright Ave., Richmond, Calif. *This product will be on display at Radio Engineering Show, Booth 752.*

CIRCLE ED-171 ON READER-SERVICE CARD FOR MORE INFORMATION

Blower

Miniature High Pressure Type



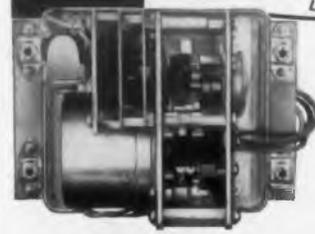
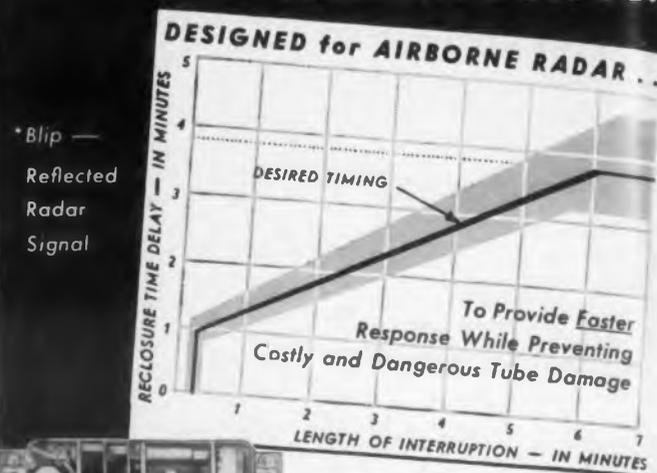
The Model R Type 201 high-pressure miniature blower was specially designed for cooling a gyrator in a pressurized waveguide system. It is part of a new line of Model R single-stage radial blowers with high pressure-to-volume ratios.

The unit moves 7cfm against 6" WC. It operates either on single or three-phase, 400cy power. Total

weight is less than 2 lb. Rotron Manufacturing Co., Dept. ED, Woodstock, N. Y. *This product will be on display at the Radio Engineering Show, Booth 581.*

CIRCLE ED-172 ON READER-SERVICE CARD FOR MORE INFORMATION

There'd be no "blip"* without power control by the **A.W. HAYDON CO.**



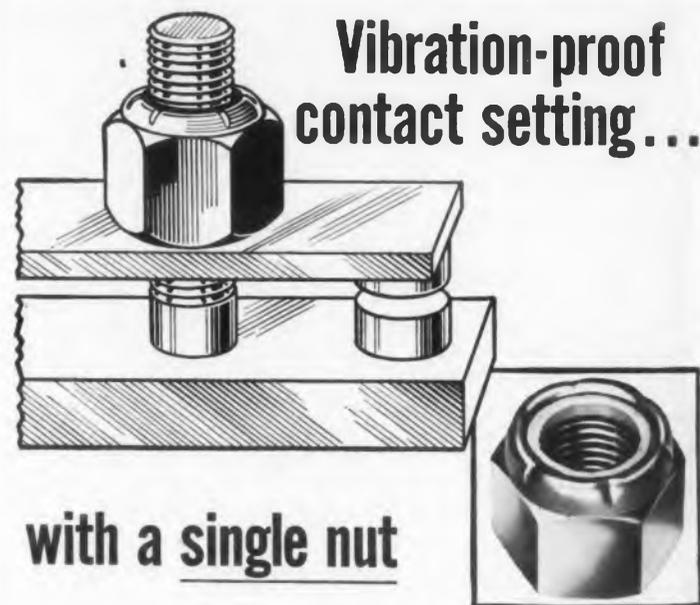
**double
delayed reset
time delay relay**

This Time Delay Relay is used to delay application of plate power to vacuum tubes until filaments reach operating temperature. It provides maximum reset rate with minimum "time-out". — Eliminates danger of costly tube damage. — Provides faster response. Send for information about this Time Delay Relay and other special cost-saving timing devices.

WHEN TIMING POSES A PROBLEM CONSULT



CIRCLE ED-173 ON READER-SERVICE CARD FOR MORE INFORMATION



with a single nut

Easily wrenched on to an exact setting, the one-piece, self-locking Elastic Stop® nut won't shake loose. The red elastic locking collar grips the stud threads tightly . . . maintains a precision adjustment without any secondary locking devices. Usable over and over again. Many types available in miniature sizes for electronic and instrument assemblies—hex nuts as small as .109 across flats!

For information and help with electronic fastener problems, write Dept. N70-357.



**ELASTIC STOP NUT CORPORATION
OF AMERICA**

2330 Vauxhall Road, Union, N. J.

DESIGN HEADQUARTERS FOR SELF-LOCKING FASTENERS
CIRCLE ED-174 ON READER-SERVICE CARD FOR MORE INFORMATION

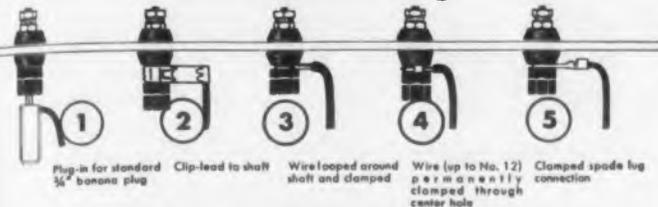
ELECTRONIC DESIGN • March 1955

Why Superior 5-WAY Binding Posts are No. 1 Choice
with Equipment Makers Exhibiting at the 1955 Radio Engineering Show

It is the same reason that 5-WAY Binding Posts are the first choice among all makers of electrical and electronic equipment. These binding posts help the manufacturer design and deliver a better product — both in performance and appearance. They give the maker and the user more for his money.

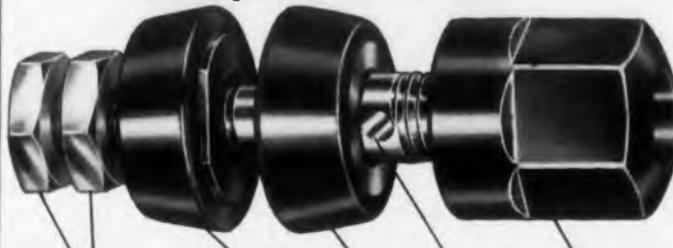
Send for Bulletin BP652 giving full details on 5-WAY Binding Posts.

New Flexibility



1 Plug-in for standard 5/16" banana plug
2 Clip-lead to shaft
3 Wire looped around shaft and clamped
4 Wire (up to No. 12) permanently clamped through center hole
5 Clamped spade lug connection

Rugged Construction Complete Insulation



Twin hexagonal 10x32 brass nuts
Sliding panel-mounted insulator. Flatted insert for locking to panel.
Panel insulator over brass cone frozen to shaft. Flatted insert for locking to panel.
Hole in center shaft for wire up to size No. 12.
Hex flange nut with brass cap nut with stud.

The SUPERIOR ELECTRIC Company
1703 Reynolds Avenue, Bristol, Conn.

CIRCLE ED-175 ON READER-SERVICE CARD FOR MORE INFORMATION

New Complete Lab Coil Kit
Boon to "Designing" Engineers

THIS KIT TYPE X2060 answers a long-felt need among working design engineers and laboratory technicians.

Kit includes 10 coils on LS-6 ceramic coil forms, type C, all slug tuned with silicone fibreglas collars, all with necessary mounting hardware. They cover a range of from 2 Microhenries to 800 Microhenries, with slight overlap in each range in the scale.

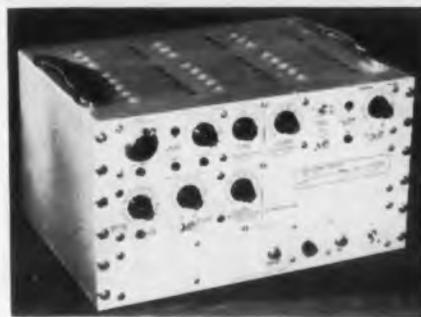
Inside top cover has chart of listed coil data such as inductance range, wire size, number of turns, Q value, etc. Coils are color-coded for easy use or ordering. No design engineer or developer of prototypes or pilot models should be without this handy C.T.C. Coil Kit. Send for your kit today . . . only \$7.95 F.O.B., Cambridge, net 30.

On any of your component problems, let C.T.C.'s consulting engineers help you, without charge. Just write Cambridge Thermionic Corporation, 457 Concord Avenue, Cambridge 38, Massachusetts.

CIRCLE ED-176 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

Time Delay Generator
With 20 μ sec to 10sec Range



The Model 1310A "Long Time Delay Generator" provides accurately controlled and continuously variable time delays over a very wide range (20 μ sec to 10sec), with excellent stability, accuracy, and jitter characteristics. It is designed for use in pulse width and spacing measurements, control of gating circuits, geophysical and biological studies, and other timing applications.

Delay is covered in five decade ranges and controlled by a 10-turn potentiometer. Long-term accuracy is 1% of full scale for each range (0.5% with standard modification available), and jitter is 0.01%. Blocking oscillator pulses at the reference and delay termination are 0.5 μ sec wide, with an amplitude of at least 45v.

Positive and negative variable width pulses (10 μ sec to 100,000 μ sec in four decade ranges) are also available at the reference and delay points, variable in amplitude to 25v maximum. In addition, a positive or negative pulse, variable in width from 20 μ sec to 10sec, is available. Electro-Pulse, Inc., Dept. ED, 11811 Major St., Culver City Calif. *This product will be on display at Radio Engineering Show, Booth 221.*

Circle ED-177 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply
A Variable Frequency Source



The VFS-250 Variable Frequency Power Supply is a compact, self-contained, semi-portable source of 45cy to 2000cy with available output up to 300va. High flexibility of voltage; frequency, and power output makes this frequency changer suitable for three main categories of use: (1) testing airborne electronic and electrical systems, synchro equipment, servo amplifiers, transformers, inductors, and export equipment; (2) powering choppers, vibrators, vibrator shakers, and magnetic amplifiers; and (3) controlling synchronous motors and processing equipment. Vectron, Inc., Dept. ED, 380 Main St., Waltham 54, Mass. *This product will be on display at the Radio Engineering Show, Booth 381-383.*

Circle ED-178 ON READER-SERVICE CARD FOR MORE INFORMATION

Are you up to date on Latches?

LOOK BETTER
MAKE YOUR PRODUCT WORK BETTER
SELL BETTER



H-4600

HARTWELL
DESIGN WITH **FLUSH**
LATCHES

They improve appearance (fasten flush) . . . safer (no projections) . . . save weight (stainless corrosion resistant or cold rolled steel, cadmium plated) . . . add speed (trigger-action) . . . save production time (eliminate time-consuming machining operations) . . . they fit your needs (available for over 300 combinations of door and frame thicknesses) . . . fast installations.

Better use these HARTWELL FLUSH LATCH advantages to your advantage—make your products easier and less costly to manufacture. Add product features which your customers will appreciate.

◀ *New Catalog illustrates and gives full details of complete line.*

Send illustrated new Catalog

NAME _____
COMPANY _____
ADDRESS _____
CITY _____

CIRCLE ED-179 ON READER-SERVICE CARD FOR MORE INFORMATION

IBM
TRADE-MARK

news

FOR ENGINEERS

MARCH'S BIG CAREER OPPORTUNITIES

DEVELOPMENT ENGINEERING*

Digital computer component development—design of components and functional units of accounting and data processing machines—transistors and transistorized units—special electron tubes—counters—magnetic core, drum, tape, and ferro-electric storage devices. ALSO fine openings in digital computer circuit design, electro-mechanical development and systems planning and analysis.

"I'VE GROWN WITH IBM"

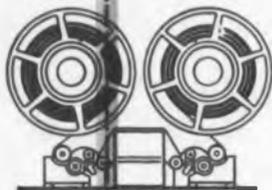
says Wallace D. Bolton,
Development Engineer at
the Endicott Laboratories

"The way IBM is growing certainly offers a young engineer the opportunity to move ahead—and in work that's interesting," says Wally. "Since I joined IBM in July of '50, right after getting my BS/EE from the University of Pennsylvania, I've been closely associated with a new development in the field of high-speed printing. Now, I'm in charge of the research phase of this program. And in just about every other area around me, I've seen opportunities opening up all the time for other young engineers."



IBM MAGNETIC TAPE DEVELOPED BY ADVANCED ENGINEERING

The great data processing machines produced by IBM employ the latest advances in processing and data storage. Among these is oxide-coated acetate tape used to record information in the form of magnetized spots. Tape units for either reading or writing operate at a rate of 15,000 characters per second.



The density of recording is 200 characters per inch, permitting permanent files of data to be compressed onto a 10½-inch diameter reel holding 2,400 feet of tape. A single reel can contain over 50,000 grouped records of 100 characters each.

Your replies, of course, will be held in strictest confidence.

INTERNATIONAL BUSINESS MACHINES CORPORATION

MANUFACTURING ENGINEERING*

Design and development of electronic test equipment for digital computer production testing—circuit design—systems planning and analysis—test planning. ALSO excellent openings in functional and acceptance testing—test equipment installation and maintenance—automation engineering—manufacturing research.

***Required**—a degree in E.E., M.E., or Physics, or equivalent experience.

Desirable—experience in any of the following fields: digital and analog computers, including airborne types, radar, TV, communications equipment, relay circuitry, automation, servo-mechanisms, instrumentation, or data handling systems.

APPLIED MATHEMATICS**

IBM seeks a special kind of mathematician and will pay well for his abilities. You'll work as a special representative of IBM's Applied Science Division as a top-level consultant to business executives and scientists. Employment assignment can probably be made in almost any major U.S. city you choose.

****Required:** major or graduate degree in Mathematics, Physics, or Engineering with Applied Mathematics equivalent. Desirable, but not required, experience in teaching Applied Mathematics and use of automatic computing equipment.

For information on these career opportunities

WRITE,

giving details of education and experience, to:

William M. Hoyt, IBM, Dept. 686 (9)
590 Madison Ave., New York 22, N. Y.

World's Leading
Producer of
Electronic
Accounting
Machines
and Computers

JOIN YOUR FRIENDS AT

IBM

THEY'LL TELL YOU
IT'S A GREAT PLACE TO WORK.

CIRCLE ED-204 ON READER-SERVICE CARD FOR MORE INFORMATION

Rate Generator

Has 0.05% Linearity to 4000rpm



This High Precision Rate Generator is designed to supply a voltage output that is proportional to the speed at which it is driven. Having a linearity of 0.05% up to 4000rpm, the unit may be used

in circuits where the output potential from the generator is fed back into the circuit to prevent oscillation, or in anticipatory circuits.

The unit is of particular value in applications where environmental conditions dictate the need for a corrosion-resistant unit. It consists of a two-phase stator, a copper-alloy cup-type rotor, compensating windings, and temperature-compensating network. It is supplied with an external resistor (shown at left in illustration) calibrated to match the rate generator with which it is packaged. Eclipse-Pioneer Div., Bendix Aviation Corp., Dept. ED, Teterboro, N. J. This product will be on display at the Radio Engineering Show, Booth 128-140.

CIRCLE ED-205 ON READER-SERVICE CARD FOR MORE INFORMATION

VTVM

Has Logarithmic Movement



The Model 207A VTVM utilizes a logarithmic meter movement which provides the user with a logarithmic voltage scale and a linear db scale. The accuracy of the log scale therefore is not affected by the position of the pointer, as is the case with instruments which state accuracies as a "percent of full scale".

Another feature is a scale division which provides an effective scale length of 7-1/2".

Meter ranges are 0.001v to 100v full scale (by factors of 10); calibrated rms value of sine-wave, 0.003v to 300v (by factors of 10). Db ranges are -60db to +50db in steps of 10db. Frequency range is 20cy to 2Mc. Accuracy is 3% to 100ke and 5% to 2Mc, at any point on the scale. Shasta Div., Beckman Instruments, Inc., Dept. ED, P. O. Box 296, Sta. A, Richmond, Calif. This product will be on display at the Radio Engineering Show, Booth 750.

CIRCLE ED-206 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

NEW lightweight model!
CANOGA Wobbulator

SWEPT FREQUENCY SIGNAL GENERATOR with OSCILLOSCOPE



Model 7105

Used in Radar, Communication and Television Applications

- Manufacturing
- Servicing
- Testing

Of receiving equipment including Video, RF, IF, and distributed amplifiers.

FREQUENCY RANGE... 2.0 to 1000 mcs. Continuous single knob tuning with calibrated dial.

FREQUENCY SWEEP... Any bandwidth of 100 mcs. or smaller.

AMPLITUDE VARIATION... Less than 0.01 db/mc.

OUTPUT VOLTAGE... 0.1 volts across 50 ohm resistive load.

ATTENUATOR... The output level is continuously adjustable by means of a wave guide beyond cut-off attenuator calibrated in 1 db divisions.

DISPLAY... 5" CRT.

SENSITIVITY... Detector for built-in amplifier and CRT presentation has a sensitivity approx. 60 db below 0.1 volt; gain and bandwidth measurements can be accomplished on circuits having a loss as great as 60 db.

POWER SUPPLY... Self-contained, all DC voltages regulated. Input 105-125 volts, 50-400 cps, approx. 100 watts.

SIZE... 12" x 13" x 17".

WEIGHT... Approx. 50 lbs.

Write today for complete detailed information

CANOGA CORPORATION

Radar Systems, Antennas, Receivers, Test Equipment

5953 SEPULVEDA BLVD.
 VAN NUYS, CALIFORNIA

CIRCLE ED-184 ON READER-SERVICE CARD

Time Delay Relay

In 1% Accuracies

A line of precision adjustable time delay relays is offered in 2.2" diam aluminum housings only 4-1/4" long. A large calibrated dial with a positive detent makes rapid and accurate adjustment easy.



Accuracy is 1%, and one model adjustable from 2-30sec, is calibrated in 0.2sec increments. Calibrations are on the perimeter of the dial. Weight is about 1-1/4 lb. The unit, which is for use on 24-29v d-c, features the 5600 Series Chronometrically Governed Motor. Control current is low.

Standard electrical connection is to screw terminals, but solder type can also be supplied. A flange is provided for panel mounting with the dial on the front of the panel. The design meets the requirements of military applications. A. W. Haydon Co., Dept. Ed, Waterbury, Conn. *This product will be on display at the Radio Engineering Show, Booths 570-572.*

CIRCLE ED-185 ON READER-SERVICE CARD FOR MORE INFORMATION

Double-Ridge Waveguide

Covers Both C and X-Band



This flexible double-ridge waveguide, Type ARA-136, is for use with C-band or X-band radar systems. It is designed to provide the solution to difficult interconnections in double-

ridge waveguide systems where vibration or mechanical alignment tolerances are involved. The flexible sections are easily installed or disconnected, using ridge waveguide quick disconnects.

At 5400Mc (C-band), the flexible ridge waveguide has a maximum vswr of 1.08, maximum attenuation of 0.10db/ft, and power capacity at atmospheric pressure of 500kw. The corresponding values for operation at 9300Mc (X-band) are 1.10, 0.10db/ft, and 400kw. The guides are supplied with any combination of gasket or mating r-f and pressure flange. Airtron, Inc., Dept. ED, Linden, N. J. *This product will be on display at the Radio Engineering Show, Booth 373.*

CIRCLE ED-186 ON READER-SERVICE CARD FOR MORE INFORMATION

from KDKA to RADAR!
join the company that creates history in electronics!

now... you can CREATE with the WESTINGHOUSE electronics division

It's a long way from KDKA... the world's first radio broadcasting station... to radar, the backbone of America's air defense. It's a long way from the vacuum tube to the transistor.

To the men who have played vital roles in these developments... electronics has been a challenge. To you... it is an opportunity. It is the opportunity to create history in electronics, just as other engineers have done at Westinghouse.

Top-level design and development positions are now open. If you can fill one of these exciting openings... you will find unlimited creative opportunity. You will be well-compensated for your efforts... both in income and benefits, and in the satisfaction of contributing to America's superiority in ground and shipborne radar; fire-control, communications and missile guidance systems.

openings exist for:

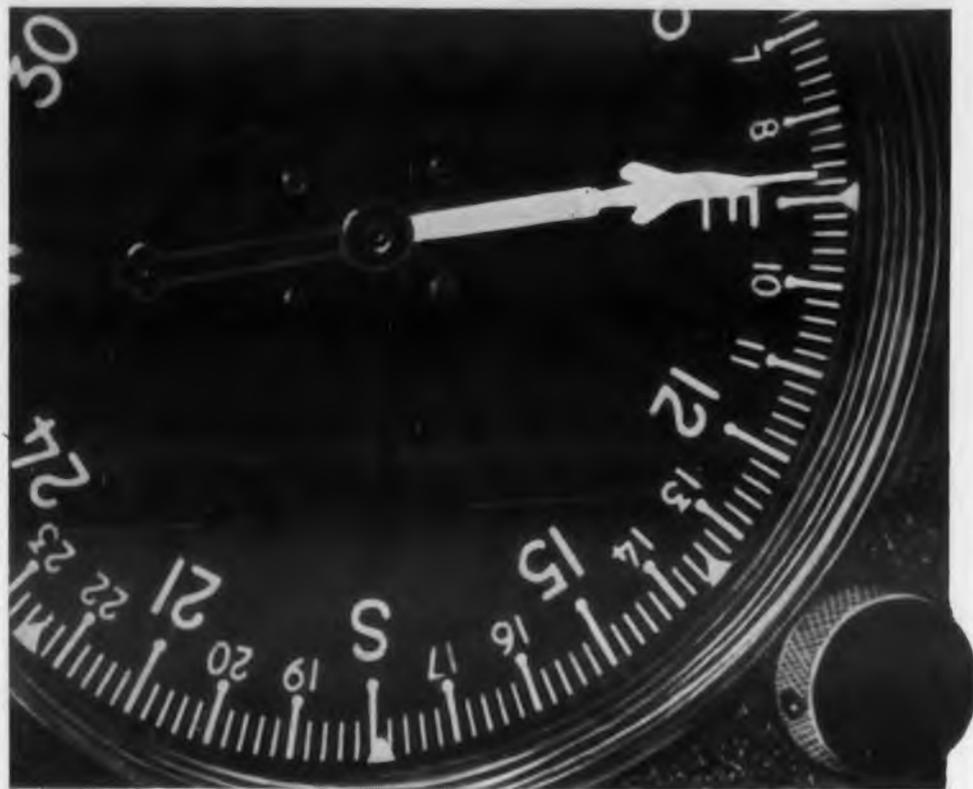
Circuit Engineers
 Radar Systems (Indicator) Engineers
 Antenna Waveguide Engineers
 Transformer Magentics Engineers
 Digital Analog Tracking Specialists
 Technical Writers

act now!
 See us at the I.R.E. show
 or
 Send letter outlining education
 and experience to —

R. M. Swisher, Jr.
 Employment Supervisor, Dept. 106
 WESTINGHOUSE ELECTRIC CORP.
 2519 Wilkens Avenue
 Baltimore 3, Maryland

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

CIRCLE ED-187 ON READER-SERVICE CARD FOR MORE INFORMATION



Both the Counter and the Dial Indicator are shown full size.



WHICH IS READ WITH GREATER ACCURACY?

The Kearfott Counter shown can be read with the same ease and accuracy as a dial indicator 143 inches in diameter.

Ball Bearings and precision hardened steel parts used in Kearfott Counters permit their high speed rotation for long periods of time. Kearfott Counters are capable of being driven at 1800 RPM. Precision parts also contribute to precise positioning and precise reading.

STANDARD KEARFOTT TYPES

ANGLE COUNTERS: Odometer indication of shaft position, fully reversible operation returning to 0° at end of count. Either 0°-359.9° in 1/10 or 0°-359° in 1/2° increments as desired. Maximum speed 1800 RPM.

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 Counters and other components of interest to you.

DECIMAL COUNTERS: High speed decimal count from 0-9999 and return to 0 in 1/2 increments. Maximum speed 1800 RPM. One revolution of shaft equals 10 units.

LONGITUDE COUNTERS: For east-west longitude indication in degrees and minutes in 1/2 minute increments. Mask transfers hemispheric indication at 0° and 179°59'. Maximum speed 1800 RPM.

LATITUDE COUNTERS: Indicates N 89°59' to S 89°59'. For same direction of input the mask transfers hemispheric indication and reverses reading at 00 degrees 00 minutes. Maximum speed 1800 RPM.

Variations of these Standard Types are available for special purposes.

KEARFOTT DISPLAY AT THE NATIONAL I. R. E. SHOW, KINGSBRIDGE ARMORY, NEW YORK, BOOTH 152.



A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

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

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

CIRCLE ED-188 ON READER-SERVICE CARD FOR MORE INFORMATION

Decades In Resistance, Capacitance Series



A wide range of panel-mounted resistance decades and capacitance decades is available for use by laboratories, or manufacturers building their own test equipment. Of standard RETMA relay rack dimensions, the new rack-mounted instruments are identical electrically to the standard cabinet decades manufactured by this firm.

The resistance decades feature non-inductive windings, self-cleaning switches, and direct resistance reading from calibrated dials. Units are available having total resistances ranging from 0.9 ohm to 999,000 ohm. Accuracy is from 0.25% for the 0.9 ohm unit to 0.1% for the 999,000 ohm unit.

The capacitance decades give progressive adjustments in 0.01mfd or 0.0001mfd and feature low zero capacity (approximately 35mmfd). Units are available having total capacitances ranging from 0.111 mfd to 11.1mfd. Industrial Instruments, Inc., Dept. ED, 89 Commerce Rd., Cedar Grove, N. J. *These products will be on display at the Radio Engineering Show, Booth 637.*

CIRCLE ED-189 ON READER-SERVICE CARD FOR MORE INFORMATION

Signal Generator

Covers 32kc to 70Mc Range



The Model 552 Standard R-F Signal Generator covers the frequency range from 32kc to 70Mc in seven ranges. Signals from less than 1mv to the high voltage requirements of bridge

measurements may be obtained with this unit.

Circuitry consists of an r-f oscillator, modulating amplifier, vtvm, attenuator, 400cy oscillator, and power supply. The r-f carrier may be modulated from the oscillator or from an external source.

The unit features minimum leakage and stray fields, easy-to-read precisely-graduated frequency dial, low cable standing wave errors, sturdy construction, light weight and portability. Clough-Brengle Co., Dept. ED, 6014 Broadway, Chicago 40, Ill. *This product will be on display at the Radio Engineering Show, Booth 290.*

CIRCLE ED-190 ON READER-SERVICE CARD FOR MORE INFORMATION

Genisco's New GOH Accelerometer withstands vibrational accelerations of 15 G's up to 2000 cps



PHYSICAL DIMENSIONS	
OVERALL HEIGHT	3 1/4"
OVERALL WIDTH	3 1/4"
OVERALL DEPTH	3 3/4"
WEIGHT	38 OUNCES
Hermetically sealed	

This newest Genisco Accelerometer is a rugged, oiled-damped, potentiometer-type instrument designed to operate in the most severe missile and aircraft vibrational environment. For example, in a recent production test the GOH performed satisfactorily after vibrational environment of 15 G's up to 2000 cps. As further proof of its ruggedness, the GOH will withstand 40-G shocks of 5 millisecond duration on the sensitive axis, and steady-state accelerations of 30 G's on the non-sensitive axes and 10 G's on the sensitive axis without damage.

HEATING ELEMENT AVAILABLE—A thermostat-controlled, internal heater may be installed in the GOH to keep operating characteristics constant between -50° F. and +160° F. However, thermostat operation is limited to 60,000 feet or less, 95% relative humidity at 160° F., and a vibrational environment of 10 G's up to 500 cps.

SPECIFICATIONS

- Ranges:** ±1 G to ±3 G's inclusive.
- Natural Frequencies:** 7 cps to 12 cps.
- Nominal Damping:** 0.65 of critical at 75° F. Values between 0.4 to 1 set if desired.
- Resistance:** 14000 ohms (±5%); center tap at 0 G-point. Other resistances also supplied.
- Potentiometer Voltage:** Up to 60 volts.
- Resolution:** One part in 300 for standard potentiometer.
- Noise Levels:** Less than 10 mv at 0.1 ma brush contact.
- Linearity:** Within 1% of full scale from best straight line through calibration points.

Complete technical data on the GOH and other Genisco Accelerometers and Pressure Transducers is available from Genisco, Incorporated, 2233 Federal Avenue, Los Angeles 64, California. Write for your copy today.

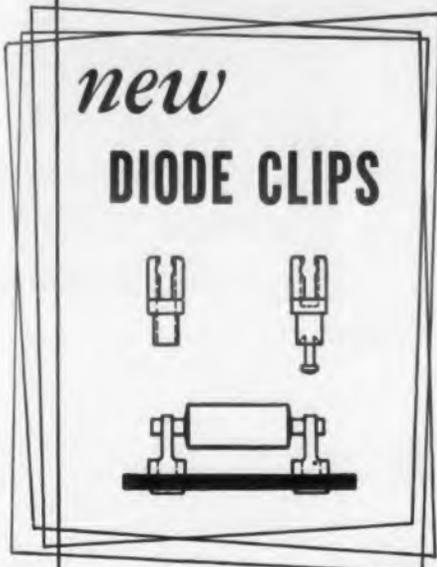
RELIABILITY FIRST



CIRCLE ED-191 ON READER-SERVICE CARD



a name to remember
in electronic hardware



An efficient, new way of holding crystal diodes. Three types available. Model #9000 for front panel mounting. Model #X9000 for front panel mounting with a blind hole for dip solder application. Model #9020 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.



Write for free catalog



LERCRO division of
LYNN-DEATRICK, INC.
501 South Varney Street
Post Office Box 69
BURBANK VICTORIA 8-5556

CIRCLE ED-192 ON READER-SERVICE CARD

Adjustable-Speed Drive

Uses Tachometer Feedback



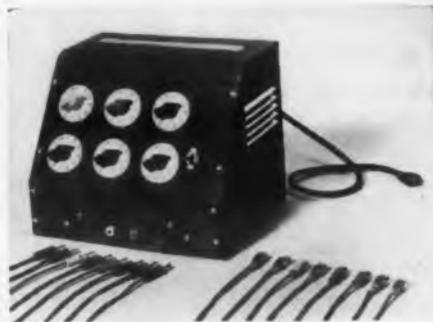
These drives use a tachometer feedback signal to hold speed within desired setting, eliminating critical phasing circuits or adjustments, and at the same time providing close speed-load regulation. Both 1/4hp and 1/2hp Models are available from stock with a choice of either 1800rpm or 3600rpm as the base motor speed. Both motors supply constant torque over a 30:1 speed range.

An epoxy resin fully encapsulates all resistors, capacitors, etc., within a single plug-in assembly. A screwdriver is the only tool necessary to replace any part. By remote mounting of the small d-c tachometer, it is possible to maintain constant linear or peripheral speed of such equipment as rewinders and inspection tables. Servo-Tek Products Co., Inc., Dept. ED, 1086 Goffle Rd., Hawthorne, N. J. *This product will be on display at the Radio Engineering Show, Booth 816.*

CIRCLE ED-193 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Unit

For Charting Applications



The electronic "Power Unit" provides current for use with electrically responsive facsimile charting papers that are used in this manufacturer's line of chart-moving equipment. Also, any ink writing instrument and many pointer or indicating instruments can be converted easily to use the instantaneous facsimile charting paper with this power unit.

Six independent grid-controlled d-c circuits are provided with a novel and effective color coding. Each circuit has a contrasting color that appears in four places: the control knob, the jack, and the plug, as well as on the test clip on the 4' cords. The unit operates from 120v a-c to give a maximum of 15ma d-c. Operating voltage is 150v; open circuit is 350v. Gorrell & Gorrell, Dept. ED, Hawthorth, N. J.

CIRCLE ED-194 ON READER-SERVICE CARD FOR MORE INFORMATION

precision instruments by DeJUR

SERIES BC-200-E
(Extended Terminal Board)



BC-200
(Typical Cross-Section)

Linear and non-linear function Ball Bearing Potentiometers

- External phasing
- Starting torque: 0.5 oz. in. max.
- Backlash: 0.05° max.
- Logarithmic, sine-cosine and other functions
- Multiple, adjustable taps
- Unitized design for universal coupling
- Precision machined aluminum housing
- Servo or single hole mounting

Our engineering department can supply prototypes quickly to meet unusual design specifications for tests and approval. Write for complete technical literature. No obligation.

DeJUR

Electronic Sales Division

DeJUR-Amsco Corporation

45-01 Northern Blvd., Long Island City 1, N. Y.

- **Fully enclosed precision ganging types**
- **Standard and power types**
- **High resolution precision types**

"You're always sure with DeJUR potentiometers"

See us at Booth 200, "Production Road," Radio Engineering Show
CIRCLE ED-195 ON READER-SERVICE CARD FOR MORE INFORMATION



You save money ON SMALL PRECISION PARTS

With almost 90 years of precision metal-working experience, Torrington has developed many automatic machines and techniques to produce small precision parts in quantities, large or small, at real savings to you.

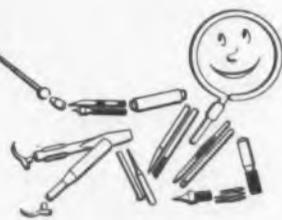
This experience and equipment enables us to give you temper, hardness, finish and tolerances exactly to your specifications—*faster, better and for less* than you could produce them yourself. Why not send a sample part or blueprint for our quotation. Ask for our Condensed Catalog which shows the many types of parts we can make economically.

THE TORRINGTON COMPANY
Specialties Division
37 Field Street, Torrington, Conn.



TORRINGTON SPECIAL METAL PARTS

Makers of
Torrington
Needle Bearings



CIRCLE ED-249 ON READER-SERVICE CARD FOR MORE INFORMATION

118

Connectors

Save Space by Side Mounting



The countersunk side mounting hole and narrow width of Series "JF" connectors permit exceptionally flat mounting, minimizing connector protrusion when installed on equipment. The design helps solve circuit terminal problems in apparatus where space is limited, or where unusual design prohibits conventional connector mounting.

Contacts are rated 5amp, use No. 20 A.W.G. wire, and are precision machined and gold plated over silver for low contact resistance, prevention of corrosion, and ease of soldering. Mineral-filled melamine bodies provide high dielectric strength and are resistance. Available with either two or four contacts, the reversed pin and socket assembly provides positive polarization. Connector dimensions are 7/16" high x 1-1/32" maximum overall engaged length x 1/8" wide (2-contact type) and 1/4" wide (4-contact type).

Minimum voltage breakdown at sea level is 2250v d-c; at 60,000' altitude, 700v d-c. Weight of the two-contact connector is 0.03 oz; four-contact connector, 0.06 oz. Winchester Electronics, Inc., Dept. F, Norwalk, Conn. *This product will be on display at the Radio Engineering Show, Booth 628.*

CIRCLE ED-250 ON READER-SERVICE CARD FOR MORE INFORMATION

Clips

Hold Fuses, Resistors Under Shock



A wide selection of Navy type fuse and resistor clips, that provide positive locking for extreme conditions of shock and vibration, is available. Consisting of silver-plated, phosphor-bronze clasps and passivated, stainless-steel springs, they have an ejector feature which makes resistor and fuse changing an easy matter.

The units are available in three ferrule diameter sizes, three different lug lengths, and can be obtained with ejector or non-ejector springs. They are exceptionally rugged in their construction. Designed for positive locking under the severest circumstances, they meet the requirements of Navy specification 16E4 (Ships), 16E7 (Ships), and MIL-E-16400. Raytheon Mfg. Co., Dept. ED, 90 Willow St., Waltham, Mass.

CIRCLE ED-251 ON READER-SERVICE CARD FOR MORE INFORMATION

Good products
deserve good
components



Comar
components help
good products
perform better

If you use relays, solenoids, coils, transformers, or switches, in your product, your best source is Comar. Custom-manufactured to your specs, Comar components provide maximum efficiency and dependability at low cost. Send for full details now!



VISIT
BOOTH
314
I. R. E.
SHOW

RELAYS • SOLENOIDS • COILS • TRANSFORMERS • SWITCHES • HERMETIC SEALING
CIRCLE ED-252 ON READER-SERVICE CARD FOR MORE INFORMATION



Need a relay for AUTOMATION controls?

Whether it's for automation, traffic, elevator or instrument control, Ward Leonard's Bulletin 110 relays provide the millions of trouble-free operations required.

Our mechanical design, quality-controlled manufacturing methods and materials, and ample safety factors (both electrical and mechanical) insure this exceptionally long life.

Write today for Relay Bulletin 110. Ward Leonard Electric Co. 77 South St., Mount Vernon, N.Y.

4.11

WARD LEONARD ELECTRIC CO.

Result-Engineered Controls Since 1892

RHEOSTATS • RESISTORS • MOTOR CONTROLS • CHROMASTER



CIRCLE ED-253 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

specify standard

FLEXLOC
SELF-LOCKING
CLINCH NUTS



These one-piece, all-metal locknuts simplify blind mounting because the hollow shanks serve as guides or positioners for screws or bolts during assembly. And since they become an integral part of the material in which they are clinched, FLEXLOCs are particularly useful where equipment must be taken apart and reassembled or where the nuts are difficult to reach. Stocked by authorized industrial distributors in #4 to 1/4" in a full range of standard shank lengths. Write for literature and samples of locknuts. STANDARD PRESSED STEEL CO., Jenkintown 12, Pa.

FLEXLOC LOCKNUT DIVISION

SPS
JENKINTOWN PENNSYLVANIA

CIRCLE ED-254 ON READER-SERVICE CARD FOR MORE INFORMATION

Write today for your free
copy of this Technical Paper.

ask for data file

307

Accuracy of Potentiometer Linearity Measurements

BY ROBERT McDONALD & IRVING HOGAN
Research and Development Division
Helipot Corporation

Reprinted from TELE-TECH & ELECTRONIC INDUSTRIES

386

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

CIRCLE ED-255 ON READER-SERVICE CARD FOR MORE INFORMATION

Signal Generator 10-500Mc Range



The TF.801B Signal Generator, with a frequency range of 10Mc to 500Mc, has an output range of 0.1 μ v to 2v and incorporates a piston attenuator.

The unit is designed for long tube life, and has a "Hi-Lo" switch which reduces oscillator drive at normal outputs.

Features also include: a timed output stage; low FM; a contactless turret which avoids r-f contact troubles; and an adjustable incremental dial which permits small, measured changes of frequency. Marconi Instruments, Ltd., Dept. ED, 23-25 Beaver St., New York 4, N. Y. This product will be on display at the Radio Engineering Show, Booth 260-262.

CIRCLE ED-256 ON READER-SERVICE CARD FOR MORE INFORMATION

Coil Windings Encased in Epoxy Resins



Molded from the new epoxy resins, these electrical coils are impervious to water, oils, dust, acids, alkali solutions, and water-base hydraulic fluids. They are completely en-

cased in the thermosetting resin by incorporating a core tube fabricated from the same resin as is used in the encapsulating process. This offers a complete homogeneous bond on all external surfaces and eliminates material separation during thermal cycling. To hermetically seal leads, a chemical bond is made between the polyvinylchloride lead wire and the "Luxolene" resin.

Coil windings are currently being molded in green, black, red, and blue colors. Insulating materials are recognized by Underwriters' Laboratories as for general purpose applications 105°C class A requirements. A very low shrinkage factor assures accurate dimensional stability. The high dielectric value of 1800v/-mil enables high voltage applications to be miniaturized by reducing bulky insulation materials. All coils must withstand a 200 megohm leakage test. Free sample available. Deluxe Coils, Dept. ED, 1300 First St., Wabash, Ind.

CIRCLE ED-257 ON READER-SERVICE CARD FOR MORE INFORMATION



FAST DELIVERY



AMRECON
ALL-PURPOSE RELAYS

SEVERAL TYPES
AVAILABLE FROM STOCK

AMRECON can give exceptional delivery on many all-purpose relays. These include a wide variety of contact arrangements and coil voltages. In addition, reasonable quantities of several of the most popular types may be shipped from stock. Get the right relay sooner from AMRECON.

WRITE FOR
FREE CATALOG AND
DESCRIPTIVE BULLETIN R-10



**AMERICAN
RELAY & CONTROLS, Inc.**

3643 Howard St., Skokie, Illinois
(Suburb of Chicago)

A Subsidiary of **OHMITE** MANUFACTURING COMPANY

CIRCLE ED-258 ON READER-SERVICE CARD FOR MORE INFORMATION

SILVER

FOR ELECTRICAL AND ELECTRONIC USES...

- Fine silver (wire & strip)
- Silver contact alloys
- Silver anodes and grain for plating
- Silver powders
- Silver flakes and paints
- Silver brazing alloys
- Special electronic solders
- Silver sintered metals
- Solder-flushed silver alloys
- Silver chloride and oxide
- Special silver alloys to your requirements



SILVER—because of its superior electrical conductivity, its equally superior thermal conductivity, its excellent resistance to corrosion and its ready workability—is used in many different forms on a wide variety of applications in the electrical and electronic industries.

As a leading fabricator of silver and its alloys, Handy & Harman has developed silver in many forms to meet the industries' needs.

The list above is typical of the silver products readily available for your use. In addition, we are equipped to produce special silver alloys to meet special requirements. Our engineering and research departments are always ready to cooperate in solving your particular problems.

Write us if you want information about the uses of silver and its alloys.



HANDY & HARMAN

General Offices: 82 Fulton St., New York 38, N. Y.

OFFICES and PLANTS: Bridgeport, Conn.; Providence, R. I.; Chicago, Ill.; Cleveland, Ohio; Detroit, Mich.; Los Angeles, Calif.; Toronto, Canada; Montreal, Canada

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

Insulation Test Set Non-Destructive Type



The Model 3 Corona Test Set is designed to facilitate non-destructive testing of the insulation on electrical equipment. This is accomplished by the detection of electric discharges that may result when

an a-c test voltage applied to such equipment exceeds a critical value. In many types of electrical equipment, the absence of discharges at the operating voltage level is sufficient assurance that the insulation is in good condition at the time of test. This is particularly true of dry type organic insulations. This method of testing has been used successfully on cables, transformers, capacitors, terminations, and to some extent on motors and generators.

The Model 3 set includes a pickup network, operated in air and corona free to at least 30kv. Also included is a detector unit, a suitable cabinet rack, two 10' leads for connecting to the pickup network and a power input cord 50' long for the detector. James G. Biddle Co., Dept. ED, 1316 Arch St., Philadelphia 7, Pa. *This product will be on display at the Radio Engineering Show, Booth 714.*

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

Insulated Terminal For 400°F Aircraft Use



The "Thermolug" is a compression-installed, insulated terminal designed for high ambient temperature operation in aircraft, or in any area of the aircraft where temperatures approach 400°F, such as fire alarm systems. Constructed of one-piece, high-strength, pure copper, it is nickel-plated and insulated with crystal-clear tubing extruded from special high-impact and temperature-resistant fluorocarbon polymer. Moisture pick-up of the insulation is nil, and its resistance to most oils and chemicals is excellent.

The "Thermolug" meets all the requirements of MIL-T-7928A. The transparency of the insulation permits easy inspection of the installation, and longitudinal color striping promotes rapid size identification. The terminals are available in sizes RM-22 through RM-2, per Military Specification MIL-W-7139A. Burndy Engineering Co., Inc., Dept. ED, Norwalk, Conn.

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

PRINTED CIRCUITS

can simplify your design . . .
speed output . . . cut costs

Eliminate wires! With Du Pont Conductive Coatings, you can print circuits for capacitors and couplings; for static shielding to replace foils and cans; for resistors and solder seals. Streamline your designs in television sets and radios, electronic equipment, meters and switchboards.

Coatings are easily applied by spray, brush, dip or stencil on metals or non-conductors. Fit right into high-speed assembly-line operation. Save you money. For up-to-date, descriptive bulletin write to: E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Department, Wilmington 98, Delaware.

DU PONT
CONDUCTIVE COATINGS
—Best for printed circuits!

DU PONT
BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

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

FREE

the most widely used
Electronic Supply Guide

ALLIED'S

COMPLETE 308-PAGE
1955 CATALOG

Send for it

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

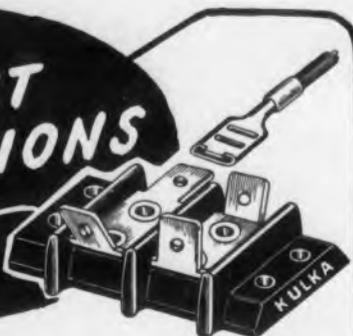
Simplify and speed all your electronic supply purchases. Order from the world's largest stocks of electron tubes (all types), test instruments, audio equipment, electronic parts (transformers, capacitors, controls, etc.). Our expert industrial supply service saves you time, effort and money. Send today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

One complete dependable source for everything in electronics

ALLIED RADIO
100 N. Western Ave., Dept. 69-C-5
Chicago 80, Illinois

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

Make
**INSTANT
CONNECTIONS**
without
Screws



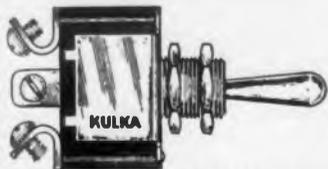
Use "KLIPTITE"
TERMINAL BLOCKS
(Molded, Barrier-type)
with **ANGLED TABS** Made
for AMP, Self-locking Wire
Terminals.

Tabbs are plated brass
and come eyeletted to
block, or separately. Tab
combinations in various
angles, or flat, for single
or multiple connections.
Several sizes and number
terminals.



**SINGLE & DOUBLE POLE
ELECTRONIC SWITCHES**

Other terminal blocks
available in approved
materials range from
subminiature (shown) to
jumbo (90 amps),



Toggle handle, aircraft
type. Bakelite housing.
With screw terminals, or
solder lugs. DC, or AC
up to 1600 cycles. One-
hole mounting.

KULKA ELECTRIC MFG. CO., Inc.

Manufacturers of Electrical Wiring Devices
MOUNT VERNON, N. Y.

SEE OUR EXHIBIT BOOTH #425, I.R.E. SHOW

CIRCLE ED-325 ON READER-SERVICE CARD FOR MORE INFORMATION

DATA SHEET

FAIRCHILD PRECISION
POTENTIOMETERS

3" diam.

Type 743
For linear
and nonlinear
functions

Type 753
For
sine-cosine
functions

These Fairchild potentiometers have all-metal-case construction providing high electrical and mechanical stability. The Type 753 provides a sine-cosine function in resistance ranges of 2K to 45K/quadrant, with standard conformity of $\pm 0.5\%$ peak to peak. The Type 743 can be furnished with either a round mandrel or flat card type resistance element to obtain linear or nonlinear functions, in resistance range of 1,000 to 250,000 ohms. Standard linearity is $\pm 0.25\%$.

SAMPLES AVAILABLE ON ORDER

These units show how Fairchild can help you solve all your precision potentiometer problems. For more information write Fairchild Camera and Instrument Corporation, Potentiometer Division, Dept. 140-61N, 225 Park Ave., Hicksville, L. I., N. Y.

CIRCLE ED-326 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

Magnetic Tape Heads
For Multi-Track Record/Reproduce



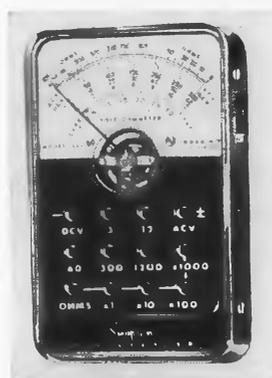
These heads, for multi-track recording and playback, are designed to meet stringent requirements of data and instrumentation. They are completely encapsulated in thermosetting plastic and are impervious to environmental conditions commonly encountered in field equipment.

Complete shielding practically eliminates cross-talk between tracks, and manufacturing techniques guarantee precision gap alignment in each multi-track head. The latter assures proper operation of wow and flutter compensation in FM carrier recording and precise phasing and timing uniformity among the various signal track. Standard gap width is 0.25mils, with the same head used for recording and reproducing.

Various head stacks can be obtained ranging from 7 to 10 tracks per inch with complete shielding, up to 20 tracks per inch when resultant lack of shielding is not detrimental. Head stacks can be furnished with any desired spacing to make tapes which are interchangeable with those made on equipment of other manufacturers. Binaural heads with complete shielding are available. The head impedance may be large or small depending on the application. The Davies Laboratories, Inc., Dept. ED, 4705 Queensbury Rd., Riverdale, Md. *This product will be on display at the Radio Engineering Show, Booth 222.*

CIRCLE ED-327 ON READER-SERVICE CARD FOR MORE INFORMATION

Volt-Ohmmeter
Is Shirt-Pocket Size



The "Midgetester" Model 355 measures only 2-3/4" x 4-1/2" x 1", but has 14 measurement ranges—five for a-c voltages from 0-3v to 0-1200v; five for d-c voltages (same ranges); and four for d-c resistances from 0-10,000 ohms to 0-10 megohms. It has a sensitivity of 10,000 ohms/v on both a-c and d-c.

Leads are partially threaded; a slight turn keeps them from falling out. An ohms zero-adjust thumb wheel is recessed on the right-hand side. Accuracy is 3% on d-c, 5% on a-c, and within 3° of arc from absolute value of resistance being measured. Simpson Electric Co., Dept. ED, 5200 W. Kinzie St., Chicago 44, Ill. *This product will be on display at Radio Engineering Show, Booth 448.*

CIRCLE ED-328 ON READER-SERVICE CARD FOR MORE INFORMATION

Behind the line



...nearly 22 acres of
plant facilities

If you look behind the Fafnir Line of Instrument Ball Bearings, you'll discover advantages that appeal to many instrument manufacturers... the cooperation of a large, modernly-equipped product research and development department... capacity to produce extra large quantities of instrument bearings... experience of more than 40 years in producing many types and sizes of bearings... conveniently located branch offices... plus the Fafnir "attitude and aptitude", a way of looking at bearing problems from the designer's viewpoint and the ability to come up with the *right* bearing for the job.

It may *pay you well* to switch to Fafnir Instrument Bearings. To find out what specific advantages Fafnir can offer you, call in a Fafnir Engineer. The Fafnir Bearing Company, New Britain, Conn.



Fafnir ball bearings for instruments are available in ABEC classes 1, 3, 5, and 7—thus giving you a wider choice for your specific needs.

FAFNIR
BALL BEARINGS

MOST COMPLETE  LINE IN AMERICA

CIRCLE ED-329 ON READER-SERVICE CARD FOR MORE INFORMATION

In a
HURRY?
order **GTC**
Custom-Specified
TRANSFORMERS



NOW ... through a unique method ... "GTC" manufacturers' representatives are prepared to give you on-the-spot answers on delivery time, price and other pertinent details ... to accurately order to your particular electrical and mechanical requirements ... yet, to provide delivery practically from stock.

Visit
Booth 359
at the **1955**
I.R.E. Show



"GTC" calls it "Custom-specified." Prototype transformers are illustrated in detail to:

✓ eliminate time-consuming liaison between your engineers and ours

✓ reduce time for processing orders because sample submission is usually unnecessary

✓ realize cost economies through application of mass production techniques to limited quantities

✓ simplify and assure more accurate specifying of your requirements

Write today for the "GTC" representative in your area ... he'll be glad to call upon you at your convenience and show you how to save time and money on your transformers.

Our new and complete catalog is just off the press ... write for your copy.

**GENERAL
TRANSFORMER COMPANY**

serving industry since 1928
18240 Harwood Avenue,
Homewood, Illinois
(Suburb of Chicago)



CIRCLE ED-268 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Electrolytics
Uses Tantalum



The type 102D electrolytic tubular capacitor uses tantalum as the anode and is ideal for low voltage applications, where small size, superior and stable electrical characteristics are required. Use

of tantalum, the most stable of all anodic film-forming materials, provides exceptional stability of performance. The capacitor exhibits no shelf aging under long periods of test.

Of particular interest to the designer of military and industrial electronic equipment is the small capacitance drop-off at extremely low temperatures; the extremely low leakage current, and the low power factor of Type 102D Capacitors over an operating temperature range of -55 to $+85^{\circ}\text{C}$. Sprague Electric Co., Dept. ED, 347 Marshall Street, North Adams, Mass. *This product will be on display at the Radio Engineering Show, Booth 247-249.*

CIRCLE ED-269 ON READER-SERVICE CARD FOR MORE INFORMATION

High Potential Tester
Automatic Type



This instrument automatically tests, in sequence, the dielectric strength between any ten conductors and indicates the location of breakdown when it occurs. The test interval can be accurately controlled up to 120 seconds,

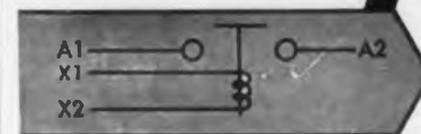
and the applied voltage is continuously variable up to 2000v rms. A dual scale, hand calibrated meter insures accurate setting of the test voltage. High sensitivity to breakdown is made possible by employing a specially designed relay in series with the high voltage circuit.

The instrument can be used for rapid testing of slip rings, commutators, cable connectors, synchros, transformers, and similar devices. The unit can be used to automatically indicate changes as experimental or environmental conditions are altered. Industrial Test Equipment Co., Dept. ED, 55 E. 11th St., New York 3, N. Y. *This product will be on display at the Radio Engineering Show, Booth 309.*

CIRCLE ED-270 ON READER-SERVICE CARD FOR MORE INFORMATION

Better Performance...

**WITH THIS NEW
HERMETICALLY
SEALED
RELAY**



No. A-53-110

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

CHARACTERISTICS

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

RELAY
DIVISION

Brochure and specifications
available upon request.

Electrical Products CORP.

1100 North Main Street, Los Angeles 12, California

CIRCLE ED-271 ON READER-SERVICE CARD FOR MORE INFORMATION

Every User
of

**SOLDERING
LUGS
•
TERMINALS
•
SMALL
STAMPINGS**



**CAN PROFIT through MALCO'S
Low Cost, Quantity Production**

We manufacture a complete line of standard and custom-made solder and solderless lugs, terminals, corona rings, and small stampings for radio, television, industrial and military electrical/electronic use.

Precision tooling and rigid quality control insures tolerances to your most critical specifications. High production techniques, plus over 1000 different standard parts permit prompt delivery at lowest possible unit cost.

Let us know your requirements.
Request our new 38-page
convenient reference catalog.



Malco TOOL and MANUFACTURING CO.
4027 W. LAKE ST., CHICAGO 24, ILLINOIS

CIRCLE ED-272 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

For knots that tie easier—faster—tighter
and will not slip!



Fungus-Proof

NYLON Flat Braided TAPES and NYLON Lacing CORDS

TAPES Specially developed in wax finish,
wax-free and resin-coated finish.

CORDS Comply with ALL Construction and
Finish requirements of Gov. Spec.
Jan-T-713 and Jan-T-152.

The greater strength of these Tapes and Cords mean minimum breakage—minimum rejects—easier tying. Their special construction prevents knot slippage. Lacing actually tightens itself after knot is made.

Write for **FREE SAMPLES** and prices

Visit us at the I.R.E. Show—Booth #888

The Heminway & Bartlett Mfg. Co., ELECTRONICS DIVISION, 500 5th Ave., N.Y. 36.
Sales Offices: Chicago, Philadelphia, Boston, St. Louis, Cincinnati, Dallas,
San Francisco, Los Angeles, Detroit, Charlotte, N. C., Gloversville, N. Y.,
Lynchburg, Va. Foreign Agent: Turner, Halsey Co., Inc., 40 Worth St., N. Y.

CIRCLE ED-273 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW

Type USM

ACTUAL SIZE

SUB-MINIATURE UNIMAX® SWITCH

for easy wiring
in miniaturized apparatus.

- Sturdy, standard flat terminals are widely spaced for rapid wiring and easy soldering.
- Case size 25/32" x 23/64" x 1/4".
- Long life.
- In plain or leaf-actuator styles.
- Rated 5 amps. at 125/250 volts a-c, or 2 amps. at 30 volts d-c; SPDT.

Write for data sheet.

UNIMAX

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

CIRCLE ED-274 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

Rotary Switch

Has Highly Adaptable Construction



The "12000 Series" precision, oval ceramic switches are designed to combine the adaptability of radio-type switches with the heavy-duty construction of instrument-type switches. They

make use of standardized parts, which permits moderate costs, even with custom units.

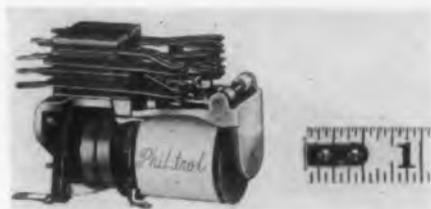
Available in shorting types with either 20° or 30° indexing, or in non-shorting types with 40° or 60° indexing, the switches may be assembled with up to three poles per deck and with up to 10 decks per switch. All types are available with this firm's extremely positive star-wheel detent mechanism and adjustable stops.

Low contact resistance (0.0025 ohm) is achieved through the use of 1/4" diam silver contact, silver collector rings, and silver wiper arm contacts. Nominal rating is 1amp, 110v 60cy. At lower currents, or where current is not broken, the switches will handle up to 2500v 60cy; or at lower voltages, currents up to 40amp. Shallcross Mfg. Co., Dept. ED, Collingdale, Pa. *This product will be on display at the Radio Engineering Show, Booth 559-561.*

CIRCLE ED-275 ON READER-SERVICE CARD FOR MORE INFORMATION

Relay

With Self-Contained Rectifier



The "Phil-Trol" Type 8AC Relay has its own self-contained rectifier, thereby eliminating exterior wiring and requiring less

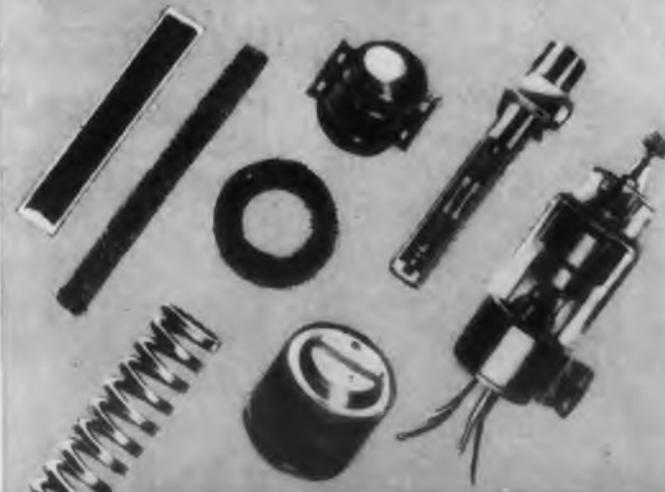
space. The rectifier occupies only a fraction of an inch of space adjacent to the coil. One section of the rectifier is for half-wave control, while the other section shunts the coil to prevent a-c vibration.

The coil rating is 115v, 60cy to 400cy. Power is 0.022amp at 130v and 20°C. The relay can operate 4 Form C up to 55°C. In military applications where operation is necessary at 85°C, the relay can be used continuously for approximately 10,000 hours while limited to 2 Form C.

The relay can be supplied in hermetically sealed enclosures for commercial, military, and aircraft use. Phillips Control Corp., Dept. ED, Joliet, Ill. *This product will be on display at the Radio Engineering Show, Booth 687.*

CIRCLE ED-276 ON READER-SERVICE CARD FOR MORE INFORMATION

FOR RELIABILITY AND LONG LIFE IN
ELECTRONIC COMPONENTS . . .



Use
**NICKEL and
NICKEL ALLOY**
Wire and Strip

Electron tubes, lamp leads, interference shielding, magnetostrictive components, thermostat parts, fine wire springs, and hundreds of other electronic applications rely on Nickel and Nickel Alloy Wire and Strip for dependable performance and long service life. Good electrical properties, high mechanical strength, excellent resistance to high temperatures and corrosion are the properties that make the Nickel group of metals a must in electronic design. We can supply you with wire and strip in Nickel, Monel, Inconel, Nickel Irons, Incoloy and special processed Gas-Free Nickel and Gas-Free Nickel-Iron Wire for your electronic applications.

Nickel-clad and Inconel-clad copper wire are also available for applications requiring high electrical conductivity plus outstanding resistance to high temperatures. Send today for free 40-page Nickel Handbook.



Ask about our
**High-Emissivity
Aluminum-clad Steel Strip.**

ALLOY METAL WIRE DIVISION

HKP

H. K. PORTER COMPANY, INC.
Prospect Park, Pennsylvania

CIRCLE ED-277 ON READER-SERVICE CARD FOR MORE INFORMATION

To observe
Ku Band
Radar
Performance!

FEATURES:

Signal Generator:
CW, Square Wave, FM or
pulse mod fr, 15.5 to 17.0
Kmc.

Power Monitor:
Measures Signal power 15
to 17.5 Kmc. Accuracy ± 2
db full range.

Maximum Average Power:
1 watt, 25° C and 60% rela
tive humidity.

Wavemeter:
15.0 to 17.5 Kmc. accurate
to 0.03% at 25° C temps.

Spectrum Analyzer:
15.5 to 17.0 Kmc displayed
on 3" CRT

Size: 17" x 10 1/2" x 13"

Weight: 45 lbs.

KEARFOTT'S NEW FOUR-FUNCTION PACKAGED K_U BAND TEST SET

MODEL W-509



Available
in K_U, C, and X Bands

Portable-modular — complete

Tests signal strength, spectra, power and frequency from a single chassis unit. One warm-up period, one switch to activate signal generator, power monitor, wavemeter and spectrum analyzer.

Also analyzes bandwidth characteristics, and supplies square wave modulated signal for use in standing wave measurements. Each test unit mounted on separate plug-in sub-chassis for maintenance ease. Special plug-in test units can be ordered. Combination package means lower first cost than separate units.

Kearfott K_U Band Microwave Components

Bends, twists, T's, loads, attenuators, crystal mount and many other K_U Band microwave components are available at Kearfott. Silver-plated brass or aluminum to rigid specifications. Special assemblies such as rotary joints, etc., may be designed in this band. Kearfott Microwave Equipment also now available in all standard bands. Custom items to your blueprints or ours. Send today for information on Kearfott Microwave Equipment.

See Our Booth
I-R-E SHOW
Brooklyn

Kearfott COMPANY, INC.
LITTLE FALLS, NEW JERSEY
WESTERN MANUFACTURING DIVISION
14844 OXNARD ST. • VAN NUYS, CALIF.

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

SALES OFFICES

EASTERN OFFICE:
1378 Main Ave.
Clifton, N.J.

SOUTH CENTRAL OFFICE:
6115 Denton Drive
Dallas, Texas

MIDWEST OFFICE:
188 W. Randolph St.
Chicago, Ill.

WESTERN AREA OFFICE:
253 Vinado Ave.
Pasadena, Calif.

CIRCLE ED-298 ON READER-SERVICE CARD FOR MORE INFORMATION

Chassis Slides

Hold up to 100 lb



Chassis slides, Type H-5798, are inexpensive units designed to fit most standard relay racks. Although light in weight, they will hold up to 100 lb without distortion.

Features include roller action without lubrication,

and split-second tilting for easy access to bottom of chassis. The slides are also provided with a tilt-lock mechanism to securely hold the chassis when tilted for checking the circuit or for needed repairs. The chassis itself may be quickly demounted by removing two locking pins.

Slides are manufactured in accordance with MIL-E-16400 (Ships) and are supplied with steel rails, bronze rollers, stainless-steel pins, and nylon bushings. Weight of the slides and associated hardware is 6 lb. Radio Frequency Laboratories, Inc., Dept. ED, Powerville Rd., Boonton, N. J. This product will be on display at the Radio Engineering Show, Booth 823.

CIRCLE ED-299 ON READER-SERVICE CARD FOR MORE INFORMATION

Aircraft Hinge

Requires No Skin Cutout



Designated Type H84 and H85, this hinge design permits attachment of any small access cover or door to the exterior skin of aircraft. A major feature is that skin cutout is not required for installation. The unit requires only 0.450" maximum depth dimension below the skin surface for

necessary installation clearance.

The hinge gives 145° rotation of door panels. It is fastened to door and structure with rivets or by spot welding, and is adaptable for pressure-sealed doors. It is completely hidden from the exterior.

Lengths from 2" to 6", in increments of 1", are offered. The unit is available to suit a variety of frame and door thickness in standard sheet metal gages, and is fabricated either from Type 302 stainless steel or 24-ST aluminum alloy. Both models are available with or without spring loading. Hartwell Aviation Supply Co., Dept. ED, 9035 Venice Blvd., Los Angeles 34, Calif.

CIRCLE ED-300 ON READER-SERVICE CARD FOR MORE INFORMATION



Veco Thermistors also are sensitive to temperature!

These versatile sensing elements are resistors with a high negative temperature coefficient of resistance — temperature goes up — resistance goes down. This characteristic makes thermistors useful components in electronic circuits as temperature compensators, surge suppressors, voltage regulators, automatic gain controls, etc.

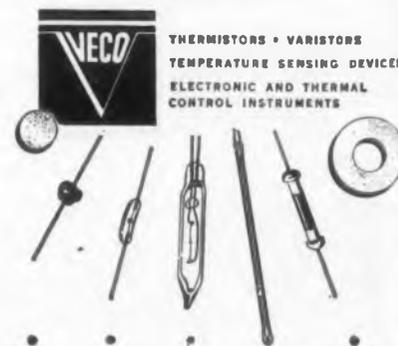
They are used also as sensing elements in high speed thermometry and temperature control for which they are available in a multiplicity of forms such as small beads, rods, discs, washers, glass, plastic or metal probes, or even embedded in the tips of hypodermic needles! Because of their extremely small size, they assist in miniaturization.

To find out how "VECO" thermistors can improve your products, write for free information. New M-168 kit of 6 thermistors and 1 varistor with suggested circuitry. \$5.00 postpaid, or available at electronics parts wholesalers.

SEE US AT THE I. R. E.
SHOW BOOTH 657-659

Victory Engineering Corporation

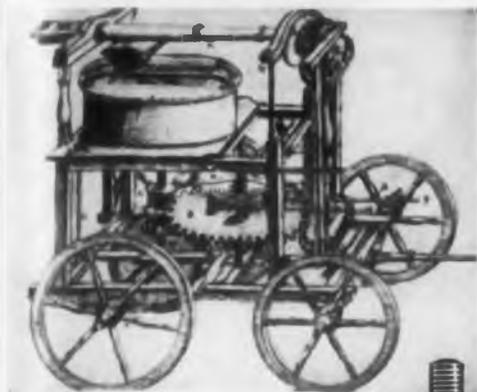
102 Iorio Court, Union, New Jersey
Tel. MUrdock 8-7150



CIRCLE ED-301 ON READER-SERVICE CARD

ELECTRONIC DESIGN • March 1955

17th century PENCIL SHARPENER?



Well, whatever it is, complex as it appears, this drawing is not nearly as complex as the engineering drawings of today. The need for drafting precision has increased steadily over the years.

To keep pace with this need, Staedtler has made constant improvement in pencil design and manufacture ever since the first Staedtler pencils were produced in Nurnberg, Germany, in 1662 — about the time the above drawing was made.

Today, the Mars-Lumograph is America's finest imported drawing pencil. In the clutch pencil field, the combination of the new 1001 Mars Technico push-button lead holder and 1904 Mars-Lumograph imported drawing leads insures your having the very best.

The 2886 Mars-Lumograph drawing pencil gives you precise thickness and the blackness of line needed for crisper, cleaner prints. Perfectly graded in 19 degrees—EXEXB to 9H. \$1.50 per dozen—less in quantity.

The 1001 Technico Mars-Lumograph push-button lead holder costs no more than ordinary holders, has a noiseless, smooth-working, low-friction clutch mechanism, lightweight wood construction with perfect balance and, built into the push-button cap, a unique lead sharpener. \$1.50 each—less in quantity.

1904 Mars-Lumograph Imported Drawing Leads are so opaque that inking-in is not necessary. Leads are ribbed for firm clutch grip and each has a metal cap which prevents sliding from holder. Available in 18 degrees—EXB to 9H. \$1.20 per dozen—less in quantity.



J.S. STAEDTLER, INC.

41 DICAROLIS COURT

HACKENSACK, NEW JERSEY

CIRCLE ED-302 ON READER-SERVICE CARD



□ Terminals

Threaded Hermetic Seals



A line of hermetically sealed terminals for tubular components is now available from this firm. Designed for use on capacitors and similar components, the terminals

feature threaded barrels. Three standard types are available: flared tubing types, lug types, and grooved flange types.

The seals withstand pressure changes, shock, and vibration. No special skill is required to apply the seal, and assembly is rapid, as all metal parts are tin dipped for easy soldering. In addition to standard types, special constructions and diameters can be supplied. Electrical Industries, Dept. ED, 44 Summer Ave., Newark 4, N. J. *These components will be on display at the Radio Engineering Show, Booth 650-652.*

CIRCLE ED-303 ON READER-SERVICE CARD FOR MORE INFORMATION

Automatic Timer

Has 2sec to 2-week Cycle



This automatic timer and cycle control sensing device provides a compact, dependable, and inexpensive unit with wide application: (1) for timed quantity measurements in production processing of liquids or solids; (2) for coin-operated vending machines; and (3) for sequential production operation.

This new equipment fills an important need in preventing the delivery of articles as long as a normally pulsed circuit is closed continuously.

The cycle of operation may be set to meet any specific requirement: 2sec or 2 weeks. As a result, this unit can control almost any automatic electrical equipment, with the further advantage of eliminating relays and certain circuits heretofore required.

The device controls a given cycle from beginning to end. In the event of any interruption, the normal cycle is completed and the machine shuts off to prevent loss of material or revenue. After the interruption is cleared, the device automatically resets the cycle for normal operation. Johnson Fare Box Co., Dept. ED, 4619 N. Ravenswood Ave., Chicago 40, Ill.

CIRCLE ED-304 ON READER-SERVICE CARD FOR MORE INFORMATION

BIG NEWS...IN SEALED

THERMOSTATS!

G-V's Series C8 is Undamaged By 150 G Shock, Vibration up to 2000 Cycles, Exposure to -100°F. and +300°F.

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.

Available in Numerous Convenient Mounting Forms

WRITE...

for Bulletin with complete technical and application data.



G-V

G-V CONTROLS INC.

18 Hollywood Plaza • East Orange, N. J.



CIRCLE ED-305 ON READER-SERVICE CARD FOR MORE INFORMATION

TO THE FINE ENGINEERING MIND SEEKING THE CHALLENGING PROJECTS IN



ELECTRONIC DESIGN

ELECTRONIC DESIGN ENGINEERS looking for the advanced problems in guided missile systems design are offered unusual career opportunities working on expanded, long-range programs within the Convair Engineering Department. These opportunities include work of a research and development nature in the fields of system engineering, circuit design and analysis, mechanical design and electronics packaging, electronics test and evaluation, and reliability and parts control. Experience in the entire radio frequency spectrum is applicable. Particularly applicable is experience in both electro-mechanical and all electronic servos, magnetic amplifiers, receivers, data transmission systems, digital techniques, sub-miniaturization, and data accumulation systems.

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. 1003

CONVAIR

A Division of General Dynamics Corporation

3302 PACIFIC HIGHWAY

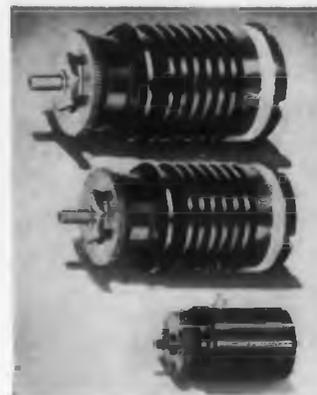
SAN DIEGO, CALIFORNIA

SMOG-FREE SAN DIEGO, lovely, sunny city on the coast of Southern California, offers you and your family a wonderful, new way of life... a way of life judged by most as the Nation's finest for climate, natural beauty and easy (indoor-outdoor) living. Housing is plentiful and reasonable.

□ Magnetic Clutches

For Servo, Instrumentation Systems

A line of three high-speed precision magnetic clutches is available for use in all types of electronic and electro-mechanical control systems, computers and servomechanisms, as well as tape and film drive units and numerous other commercial applications. The smallest unit is especially designed for aircraft and missile applications.



The clutches are the friction disc type. Sizes range from the 1/4" diam miniature to the 2-1/2" diam high torque unit. Torque ratings are available from 20 in-oz to 125 in-oz. Response time of the three models ranges from 0.005sec to 0.025sec, depending on torque requirements. The stationary d-c coils are available in 12v, 24v, 48v, 80v, and 175v.

The two smaller units may be supplied with the output brake to ground when de-energized, if desired. All models feature concentric input and output shafts on the same end, which makes them ideal for mounting on gear trains alongside other electrical components such as motors and synchros. The shaft arrangement makes them easy to service and permits economy of space. Ball bearings are used throughout to insure minimum friction. Instrument Components, Inc., Div. of Belock Instrument Corp., Dept. ED, 14-34 112th St., College Point, N. Y. *These components will be on display at the Radio Engineering Show, Booth 7.*

CIRCLE ED-229 ON READER-SERVICE CARD FOR MORE INFORMATION

□ Time-Delay Relay

Thermal Type



The commercial type "G" series snap-action thermal time-delay relay is provided in a 9-pin miniature glass envelope. These relays feature snap-action spdt contacts, time delays preset from 5sec up, and ambient temperature operation from -60° to +80°C. They are available in 6.3v, 26.5v and 115v a-c or d-c heater ratings.

Other features are small size, lightweight, low operating temperatures, operation in any position,

high contact rating, consistent time, and long life. Elly Electronics Corp., Dept. ED, 22-02 Raphael St., Fair Lawn, N. J. *This product will be on display at the Radio Engineering Show, Booth 890.*

CIRCLE ED-230 ON READER-SERVICE CARD FOR MORE INFORMATION

where
stability is a must...

TIC

**PRECISION
TRIMMER POTENTIOMETERS**
small..compact..precise
Engineered to the high standards of TIC Quality... a familiar standard of comparison. Environmental tested for MIL-E-5272A. TIC's Trimmer Potentiometers may be used as adjustable resistors or voltage dividers.

for

- Adjusting scale factors of functions basically derived by other potentiometers
- Pinpointing circuit values of voltage, current, or resistance
- Balancing adjustments
- Critical magnetic or electric bias
- Padding or fixed reference circuits
- Establishing critical threshold voltages
- Fixed gain adjustments
- Compensation for variable parameters

RV 7/8" MINIATURE
TRIMMER



- 7/8" diameter, threaded bushing mounting, aluminum cup construction
- Dissipation: 2.0 watts at 25°C
- Resistance values: 50 ohms to 15K
- Temperature range: -55°C to +80°C



RV 1/2" SUBMINIATURE
TRIMMER

- 1/2" diameter, threaded bushing mounting, stainless steel case
- Dissipation: 1.5 watts at 25°C
- Resistance values: 50 ohms to 15K
- Temperature Range: -55°C to +80°C

RFT SUBMINIATURE
METFILM TRIMMER



- 13/32" x .400 x 1 21/64", rectangular case, 2 screw eyelet mount, 25 turn lead screw adjustment
- Size permits stacking 7 per square inch
- Infinite resolution
- Dissipation: 0.5 watts at 40°C
- Resistance values: 50 ohms to 25K
- Temperature range: -55°C to +125°C



RVH1 HIGH TEM-
PERATURE TRIMMER

- 1" diameter, threaded bushing mounting, aluminum cup construction
- Dissipation: 2 Watts at 25°C, 0.5w at +130°C
- Resistance values: 100 ohms to 5K
- Temperature range: -55°C to +145°C

For further information regarding your trimmer requirements, TIC invites your inquiries.

TECHNOLOGY INSTRUMENT CORP.

555 Main Street, Acton, Mass.

P.O. Box 3941, North Hollywood, Calif.

See Booth 226-228 Instruments Ave., IRE Show

CIRCLE ED-231 ON READER-SERVICE CARD

ELECTRONIC DESIGN • March 1955

ElectroData
Corporation announces

DataReader

Model 546

A transport unit for high speed searching, reading and recording of data on magnetic tape.



Applications
Include:

High-Speed
Computing

Data
Processing

Automatic
Control

Telemetry

PERFORMANCE:

RAPID START—STOP—REVERSE—from stop to full speed in 6 milliseconds.

HIGH TAPE SPEED—optional speed of 30, 40, 50, 60 or 75 in/sec.

TWO-DIRECTION SEARCH—either direction, automatically at full speed.

REMOTE OPERATION—forward, reverse, stop, rewind and selection of reading and writing.

VACUUM CONTROL—smooth vacuum column servo-action control.

END OF TAPE SENSING—stops automatically at either end of tape.

RAPID REWIND—2400 ft. of 1/2" or 3/4" tape in 3 minutes.

FOR FURTHER INFORMATION WRITE

ElectroData Corporation
Component Sales Division
717 No. Lake St., Pasadena 6, Calif.

ElectroData

An Affiliate of
CONSOLIDATED ENGINEERING CORPORATION
OF PASADENA, CALIFORNIA

ElectroData Corporation maintains a nationwide sales and service organization.

CIRCLE ED-232 ON READER-SERVICE CARD

☐ Microwave Kit

Aids Development



The "Engineer's Microwave Kit" is especially designed for use by product and development engineers and model makers. It contains 15 circular rings of various diameters, and 10 finger contact strips of varied contours, all made from beryllium copper and

jig-hardened for uniform elastic properties.

The items in the kit are especially useful for the development of tuning slides, tube cavities, and grounding or bonding applications. Instrument Specialties Co., Inc., Dept. ED, Little Falls, N. J. *This product will be on display at the Radio Engineering Show, Booth 867.*

CIRCLE ED-233 ON READER-SERVICE CARD FOR MORE INFORMATION

☐ Signal Generator

Provides Sine and Square Waves



The Model E-300 Sine-Square Wave Signal Generator, covering the audio-video range, provides accurate sine and square-wave signals for direct performance testing of high fidelity audio amplifiers, TV audio ampli-

fiers, carrier current systems, and other wide-range instruments and equipment.

For variable-frequency sine-waves, the unit provides continuous coverage from 20cy to 200kc in four bands. For variable frequency square wave analyzing of audio amplifiers, wide-range amplifiers, etc., it gives 20cy through 20,000cy in three bands. There are also four fixed, high-frequency square waves for analysis of video and other wide-band amplifiers up to 20Mc band-width: 50ke, 100ke, 250ke, and 500ke steps. Accuracy is $\pm 2\%$ from 50cy to 200ke; $\pm 1\%$ from 20cy to 50cy. Distortion is less than 1% from 20cy through 20ke. The 20ke square-wave rise time is 0.5sec.

The instrument is provided in a portable steel case, 10-1/2" x 12" x 6". It is complete with tubes, coaxial output cable, and operating manual. Precision Apparatus Co., Inc., Dept. ED, 92-97 Horace Harding Blvd., Elmhurst, L. I., N. Y. *This product will be on display at the Radio Engineering Show, Booth 438.*

CIRCLE ED-234 ON READER-SERVICE CARD FOR MORE INFORMATION

for direct measurement
of electrical, mechanical
or optical events



new SMALL
SIZE!

new!
DS-6100-T
FREQUENCY COUNTER

New Low Cost!
New Light Weight!

A compact precision frequency counter designed for direct measurement of any electrical, mechanical or optical phenomena which can be converted into a varying voltage. Reads out in direct digital form requiring no interpolation or reference to curves or tables. The all new DS-6100-T is ideal for use by skilled or unskilled personnel. Price \$700.00

EXCLUSIVE FEATURES

at no extra cost...

TEN CYCLE GATE
increases accuracy of period measurement

MULTI-SAMPLING
manually scans the unknown frequency for any multiple of the time base for greater accuracy

BATCH COUNTING

NEW, IMPROVED SENSITIVITY

EXCELLENT LOW FREQUENCY ACCURACY

The new DS-6100-T has an accuracy of ± 10 microseconds over the frequency range of 1 to 10,000 events per second. In addition, frequencies of 10,000 to 100,000 events per second can be measured with an accuracy of ± 1 count ± 1 part in 100,000 (one part in 1,000,000 with crystal oven).

SPECIFICATIONS

FREQUENCY MEASUREMENT

- Frequency Range—10-100,000 cycles per second
- Input Sensitivity—
0.1 volt RMS: 20-100,000 cps
0.25 volt RMS: 10-20 cps
- Accuracy— ± 1 count \pm stability
- Time Base—1 second (0.1 and 10 seconds optional)
- Read-Out—Cycles per second:
Five digits

PERIOD MEASUREMENT

- Frequency Range—1-10,000 cycles per second
- Input Sensitivity—0.1 volt RMS
- Accuracy— ± 10 microseconds
- Gate Time—1 and 10 cycles of unknown frequency. May be increased by multi-sampling (only below 5 cycles per second).
- Read-Out—Tens of microseconds

GENERAL

- Stability—1 part in 100,000 (1 part in 1,000,000 with crystal oven)
- Display Time—Automatic; continuously variable from 1 to 10 seconds. Manual; until reset
- Input Impedance—0.5 meg., 0.05 mf
- Power Requirements—117 volts $\pm 10\%$, 50-60 cycles (50-400 cycles optional); 150 watts
- Dimensions—14 $\frac{1}{4}$ " wide x 7 $\frac{1}{2}$ " high x 13 $\frac{1}{2}$ " deep
- Weight—28 lbs. net (approximately)

VISIT US IN
BOOTH 39 - IRE Show
Kingsbridge Palace, N.Y.C.

THE *Detection* CORP.

*Trade Mark

COMPUTER-MEASUREMENTS DIVISION

5528 Vineland, North Hollywood, Calif. Dept. 76-E

TECHNICAL REPRESENTATIVES:

NEW ENGLAND
Electronics Associates, Inc.
Stamford, Conn.—ST. 4-7300

ILLINOIS, INDIANA, SO. WISCONSIN
Warren B. Cozzens
Evanston, Ill.—DA. 8-4800

NEW YORK & NO. NEW JERSEY
Gerard C. Leeds Company
Great Neck, N.Y.—HU. 2-7784

SO. NEW JERSEY & EAST PENNSYLVANIA
Louis A. Garten & Associates
Montclair, N.J.—MO. 3-0257

MARYLAND, D.C., VIRGINIA, NO. CAR., TENN.
S. S. Lee Associates
Washington, D.C.—EM. 2-8626

Branch:
Baltimore 28, Md.—AR. 3742

OHIO, SO. MICH., W. VIR., W. PA.
Michael J. Cudahy
Chicago 40, Ill.—BU. 4-5858

WASH., ORE., W. IDAHO & MONTANA
Testco
Seattle 8, Wash.—MO. 4895

CALIFORNIA, ARIZONA, NEVADA
Koesler Sales Co.
Los Angeles 38, Calif.—YO. 6271
Branch: San Francisco 18, Calif. JO. 7-0522

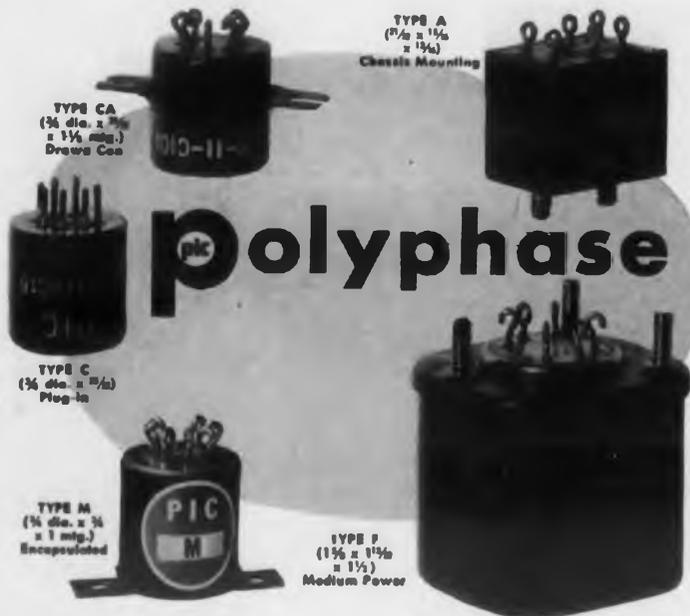
MINN., NO. WIS., NO. MICH., NO. & SO. DAK.
Industrial Representatives Co.
Minneapolis 16, Minn.—WE. 9-9019

COLORADO, WYO., E. IDAHO, UTAH, NEBR.
Allen I. Williams Co.
Denver 4, Colo.—MA. 3-0343

NEW MEXICO & EL PASO COUNTY, TEXAS
Allen I. Williams Co.
Albuquerque, N. Mex.—AL. 3-9632

CANADA
Electromechanical Products
St. Thomas, Ontario—
St. Thomas 5094-W
EXPORT
Frazar and Hansen, Ltd.
San Francisco, Calif.—EX. 2-5112

CIRCLE ED-235 ON READER-SERVICE CARD FOR MORE INFORMATION



FERRITE PULSE TRANSFORMERS

- WITH—short rise time and flat top pulses.
- FOR—blocking oscillator, impedance matching, or isolation applications.
- AT—low or medium average power.
- IN—plug-in or chassis mounting, hermetically sealed or encapsulated units.

MIL-T-27 or COMMERCIAL

POLYPHASE INSTRUMENT CO.
BRYN MAWR, PENNSYLVANIA

CIRCLE ED-345 ON READER-SERVICE CARD FOR MORE INFORMATION



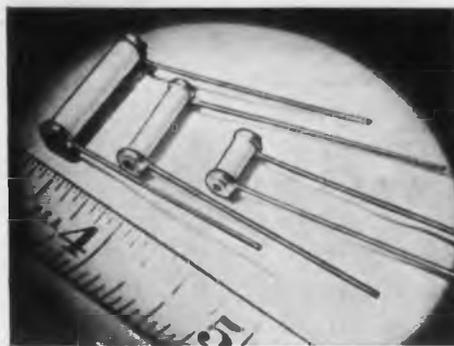
CASE and COVER PRODUCED for BENDIX by the ZERO METHOD of DEEP DRAWING at a 66% SAVING

Many of America's finest instruments are now housed in precision drawn aluminum cases by Zero. Why? Check costs and quality on the Zero Method of deep drawing—and you'll understand.

For custom or stock (over 900 standard sizes) precision, seamless, deep drawn boxes—call on Zero. Write for our latest catalog.

ZERO MANUFACTURING COMPANY
ZERO BUILDING, BURBANK 53, CALIF.
CIRCLE ED-346 ON READER-SERVICE CARD FOR MORE INFORMATION

Ceramic Capacitors Temperature-Compensating Types



Type CNP ceramic capacitors provide close temperature-coefficient tolerances. A unique manufacturing process insures uniformity of temperature coefficient

and consequently the capacitors can be supplied in close temperature-coefficient limits without individual TC testing.

Type CNP units are available in a non-insulated tubular style with radial leads and a clear non-hygroscopic plastic coating. They meet the performance requirements of MIL-C-11015A, JAN-C-20A, and RETMA REC-107-A specifications. Hi-Q Div., Aerovox Corp., Dept. ED, Olean, N. Y. *This product will be on display at the Radio Engineering Show, Booth 548-552.*

CIRCLE ED-347 ON READER-SERVICE CARD FOR MORE INFORMATION

Template

Aid in Laying Out Printed Circuits



This plastic template facilitates drafting of components for printed circuitry. It is pocket-sized, measuring 4" x 8", and is satin-

finished to clearly indicate markings, scales, and stencils.

A variety of stencil die cuts provides for accurate resistor spacings, standard component spacings, and plug-in tab spacings, as well as 7- and 9-pin molded and wafer socket layouts and terminal pads from 1/8" to 1/4". A current-carrying-capacity chart is included, and scale divisions are located on two edges. Photocircuits Corp., Dept. ED, Glen Cove, N. Y. *This product will be on display at the Radio Engineering Show, Booth 661-663.*

CIRCLE ED-348 ON READER-SERVICE CARD FOR MORE INFORMATION

Correction

The typical reading given for the Time-Data Printer (*ED, January, 1955, p. 90*) manufactured by Clary Multiplier Corp., San Gabriel, Calif., omitted two digits in the time of day column and did not show the complete data identification symbol. The reading should have been: P11:08.11 J418.9.

FASTER, MORE ACCURATE INSPECTION WITH FLASH-O-LENS Illuminate Magnifiers



In industrial inspection departments, on production lines, in foundries and laboratories, wherever close visual inspection is important, FLASH-O-LENS gets the job done better, faster. FLASH-O-LENS spots minute defects by spotlighting the area it magnifies.

Battery models, powered by standard flashlight cells, and AC-DC plug-in models are available with 5, 7, 20 or 40 power precision lenses to meet a wide range of inspection needs. Prices start from \$10.95.

WRITE TODAY
for literature showing
applications, types, prices.

E. W. PIKE & COMPANY, Inc.
492 NORTH AVENUE ELIZABETH 3, N. J.
CIRCLE ED-349 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW HIGH STABILITY PACKAGE WITH 100kc AND 1000kc CRYSTALS



The
**BLILEY TCO-2L
TEMPERATURE
CONTROLLED OVEN**
(75°C) WITH TYPE
BH6A CRYSTAL AT
1000kc AND TYPE
BH9A CRYSTAL AT
100kc

PHANTOM
VIEW

This compact temperature controlled package provides a high stability reference source at both 100kc and 1000kc. Recommended for general laboratory use and the precision calibration of signal generators or other test instrumentation.

**Bliley
CRYSTALS**

BLILEY ELECTRIC CO.
UNION STATION BLDG. • ERIE, PA.

CIRCLE ED-350 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

WRITE, WIRE
or PHONE FOR
YOUR CATALOG
TODAY



- Class 3 Screws
- Dowel & Taper Pins
- AN Drilled Fillister Heads
- Binding Heads #0/#1/#2
- Screws Machine Products
- Piano Hinges

BOLTS & CAP SCREWS
SOCKET, SET & CAP
NUTS, WASHERS
MACHINE SCREWS
SHEET METAL SCREWS
WOOD SCREWS
PIPE FITTINGS

Star Stainless
screws have CLEAN,
BRIGHT AND SHINY HEADS

STAR STAINLESS SCREW CO.

Telephone: Little Falls 4-2300

663 Union Blvd. • Paterson 2, N. J.

Direct New York Telephone: Wisconsin 7-9041

CIRCLE ED-351 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-352 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

D-C VTVM

Panel Unit Accurate to 3%



The Model F D-C Vacuum Tube Voltmeter is a miniaturized panel - mounting version of a laboratory instrument. It consists of a standard 4" x 4-1/4" rectangular meter, with a small housing that extends approximately 3"

from the rear of the meter movement. Complete amplifier and power supply circuits are contained within the housing, and four terminals are available for d-c signal input for 115v 60cy power input.

The face of the instrument contains two controls: a miniature switch for removing the input signal, plus a miniature pot for setting the zero level. An additional pot is available at the rear for adjusting calibration. Having an accuracy of 3% and an input impedance of 10 megohms, the voltmeter is available in single-scale sensitivities ranging from 1v to 300v. Multiple scale operations can be readily tailored to meet exact equipment requirements, either at the factory or by the user. Trio Laboratories, Inc., Dept. ED, 3293 Seaford Ave., Wantagh, N. Y. *This product will be on display at the Radio Engineering Show, Booth 862.*

CIRCLE ED-353 ON READER-SERVICE CARD FOR MORE INFORMATION

Dual Test Set

Measure Voltage Breakdown or Resistance



The Megohm-meter and High Potential Test Set measures breakdown voltage and resistance without damage to the component being tested. When a short occurs, current is automatically re-

duced to a safe level. Continuously variable tests for leakage can be made readily. Voltage range is 0-3000v a-c. Resistance ranges are 1-4 million megohms at 200v d-c and 2.5-10 million megohms at 500v d-c. General Hermetic Sealing Corp., Dept. ED, 99 E. Hawthorne Ave., Valley Stream, N. Y. *This product will be on display at the Radio Engineering Show, Booth 803.*

CIRCLE ED-354 ON READER-SERVICE CARD FOR MORE INFORMATION

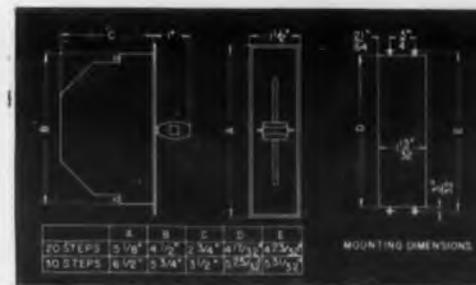
the most important vertical attenuator development in

17 years!



Here is a completely NEW design for straight-line finger-tip attenuator operation . . . the result of 17 years of TECH LAB experience. A new* linkage system does away with guide rods, completely eliminating backlash or stickiness, reducing wear and lengthening life. Narrow construction permits as many as ten mixers on one 19" panel. Available in plug-in or fixed-panel designs, with new floating switch blades and better adjustment of spring tension. Completely shielded and dust proof.

*patents applied for



specifications:

Range: Standard units have 30 steps at 1.5 db or 20 steps at 2 db...31 or 22 contacts.

Circuits: Ladder, "T" or potentiometer.

Impedance: 30 to 600 ohms for ladders; 250,000 ohms for potentiometers

Write for complete data

Visit us at the I. R. E. Show, Booth 656, Circuit Ave.

TECH LABORATORIES, INC.

PALISADES PARK, NEW JERSEY

CIRCLE ED-355 ON READER-SERVICE CARD FOR MORE INFORMATION

KEEP UP TO DATE WITH THIS FREE IDEA SERVICE....



KOILED KORDS* APPLICATION REPORTS GIVE CASE HISTORIES OF SUCCESSFUL USES OF RETRACTILE CORDS.

Let us send you a file-full of ideas at no cost to you, and we will see that you get future Application Reports as issued. Write today.

KOILED KORDS are used on Electronic Instruments, Cameras, Dictating Machines, Air Conditioners, Industrial Balancers, Automotive Checking Devices, Portable Tools, Hydraulic Lift Jacks, Hoists, Telephones, An Infinite Number of Machine Tools, Trouble Lamps, Railway Sewing Machines

**IN FACT KOILED KORDS, RETRACTILE CORDS,
HAVE THOUSANDS OF USES
IN COMMUNICATIONS — ON ELECTRICAL
MACHINES THAT MOVE — IN THE HOME**

See for yourself through KOILED KORDS Application Reports how versatile KOILED KORDS can be. You, too, may find them the answer to a problem.

© 1954

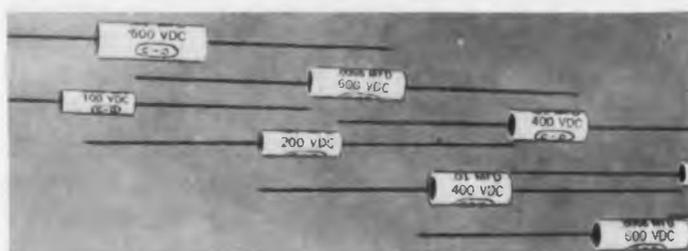
Koiled Kords

INCORPORATED

Box K, New Haven 14, Connecticut
In Canada: R. D. Fleck & Co., Ltd., Oshawa, Ont.
*KOILED KORDS is the trademark of Koiled Kords, Inc.

CIRCLE ED-236 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitors Have Wide Temperature Ranges



STT Midget "Budroc" steatite-cased paper tubular capacitors are miniaturized versions of this company's regular "Budroc" line. The new units range in size from 7/32" diam x 11/16" long, to 3/8" diam x 1-1/8" long.

Capacitors in the line which are rated up to 400v d-c are impregnated in "HT" compound and have an operating temperature range from -40° to +90°C; while those rated at 600v d-c are impregnated in "Vikane" and have an operating temperature from -55° to +100°C. Standard tolerance is ±20%, with other tolerances on special order. Cornell-Dubilier Electric Corp., Dept. ED, South Plainfield, N. J. *These components will be on display at the Radio Engineering Show, Booth 294-296.*

CIRCLE ED-237 ON READER-SERVICE CARD FOR MORE INFORMATION

Soldering Unit

For Precise and Sensitive Parts



The Model 23 "Localized Heating Soldering Unit" is recommended for parts that need to be soldered very carefully, such as printed circuits, germanium diodes,

and transistors. It features instant heat (up to 1250°F); a precision timer mechanism; adjustable heat control (25w to 1000w); low-current consumption (1/4amp stand by, 6amp at full load); special electrode tips (solder will not adhere); and resistance-type soldering.

The unit has a timer mechanism (0-60sec) which controls duration of heat within a split second. By merely stepping on a footswitch, the current will pass into the power unit and start the timer mechanism. The unit prevents overheating and warping, and it eliminates "cold joints", because both the timer mechanism and heat controller are set, and each and every cycle will stay the same in heat and time. A variety of accessories is available. Vemaline Products Co., Dept. ED, P. O. Box 222, Hawthorne, N. J.

CIRCLE ED-238 ON READER-SERVICE CARD FOR MORE INFORMATION

Want MAXIMUM Performance in MINIMUM SPACE and WEIGHT?



Among the wide variety of Standard Phil-Trol Relays you will find many designed to solve your "special" problems . . . like the types 4BQA and 4BQA POWER shown above. While both are small, compact, lightweight units, each is designed to perform its job best.

These are but two of the many unusual Phil-Trol designed relays that will help you solve the "tough" application problems as well as the simpler ones . . . and with security in knowing you will always have dependable performance. Send for a new Phil-Trol Catalog — today!

Phil-trol

is the Registered Trade Mark of
PHILLIPS CONTROL CORP., DEPT. ED, JOLIET, ILLINOIS
A Thor Corporation Subsidiary—Offices in All Principal Cities

CIRCLE ED-239 ON READER-SERVICE CARD FOR MORE INFORMATION



NEW!

VACUUM-TUBE VOLTMETER

DC: 0.02 to 500 Volts
AC: 0 to 1500 Volts

With a single zero adjustment for all five ranges, increased accuracy, greater convenience in use, and G-R reliability, the improved Type 1803-B VT Voltmeter is an even more useful meter than its predecessor, the popular "A" model.

With a new d-c range of 0.02 to 500 volts, in addition to the 0.1 to 150 volt range, extended to 1,500 with a permanently attached multiplier, this voltmeter becomes as valuable for everyday laboratory use as are the more elaborate models available at much greater cost.

Without correction, measurements are possible to 120 Mc with maximum frequency error of 10%. The resonant frequency is 410 Mc.

Type 1803-B Vacuum-Tube Voltmeter: \$180.00.

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Massachusetts, U. S. A.

90 West St. NEW YORK 6 8055 13th St., Silver Spring, Md. WASHINGTON, D. C.
920 South Michigan Ave. CHICAGO 5 1000 North Seward St. LOS ANGELES 38

CIRCLE ED-240 ON READER-SERVICE CARD FOR MORE INFORMATION

**NEED A GOOD SOURCE FOR TERMINALS?
WE MAKE All Sizes, All Kinds!**



SMALLEST TO LARGEST — Hermaseal manufactures Sealed Terminals in an extremely wide range of sizes, for very low or very high voltage, with tubular electrodes for high current-carrying capacity — and with solid electrodes for moderate current requirements.

COMPLETE ASSEMBLIES — We have facilities for soldering terminals to your transformer covers — evacuating and pressure filling enclosures.

NEW CATALOG — Just off the press, a new catalog with descriptions and specifications for most of Hermaseal's stock sizes and designs. Write for your copy today!



THE HERMASEAL CO., Inc.
Elkhart 45, Indiana

CIRCLE ED-241 ON READER-SERVICE CARD FOR MORE INFORMATION

Erie-Chemelec **TEFLON**
Insulated **ELECTRONIC COMPONENTS**



Illustrated above are ERIE TEFLON and KEL-F seven and nine pin Miniature Tube Sockets, which meet all RETMA and JAN Specifications and below the spaghetti which comes in five sizes and three colors. The Erie-Chemelec Teflon line also includes Stand-Off and Feed-Thru Insulators; Crystal Sockets; and nine, fifteen and eighteen pin Connectors.

Write for catalog, price list and the name of your nearest stocking Erie-Chemelec Electronic Parts Distributor.

TEFLON SPAGHETTI



ERIE ELECTRONICS DISTRIBUTOR DIVISION
ERIE RESISTOR CORPORATION
Main Offices ERIE, PA.
Factories ERIE, PA. • LONDON, ENGLAND • TRENTON, ONTARIO

CIRCLE ED-242 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

Power Supply

Magnet-Amplifier Regulated



The Model No. MR2432-200 tubeless magnetic-amplifier-regulated power supply is rated 24-32v at 200amp continuous. The unit has a regulation accuracy of 1% (a) from 0-200amp, (b) for the d-c voltage range of 24-32, (c) for a-c input voltage range of 208/230/-460v $\pm 10\%$. The ripple is 1% rms maximum; response time is 0.2sec; and the unit is designed for 3-phase, 60cy a-c input.

Dimensions are 22" wide x 18" deep x 67" high, and approximate weight is 440 lb. Overload protection is in the form of a magnetic starter with thermal overload also provided. This unit has found wide application for centralized laboratory power supply, stationary engine starting, and atomic energy and missile testing application. Perkin Engineering Corp., Dept. ED, 345 Kansas St., El Segundo, Calif. This product will be on display at the Radio Engineering Show, Booth 13.

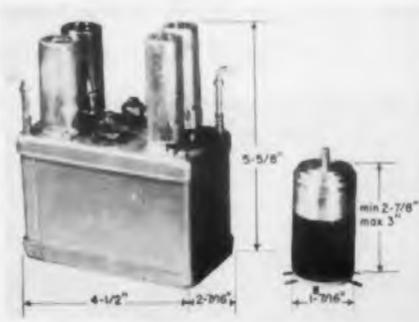
Dimensions are 22" wide x 18" deep x 67" high, and approximate weight is 440 lb. Overload protection is in the form of a magnetic starter with thermal overload also provided. This unit has found wide application for centralized laboratory power supply, stationary engine starting, and atomic energy and missile testing application. Perkin Engineering Corp., Dept. ED, 345 Kansas St., El Segundo, Calif. This product will be on display at the Radio Engineering Show, Booth 13.

CIRCLE ED-243 ON READER-SERVICE CARD FOR MORE INFORMATION

Servo System

In One Package

This complete packaged precision servo system includes amplifier, motor, and gear train. The amplifier is equipped with screwdriver adjustments to peak the system to a wide variety of load conditions.



The system is engineered for minimum space requirements, maximum ease of adjustment, and plug-in adaptability. Applications include synchro data transmission systems, follow-up systems, laboratory and industrial instrumentation, simulators, computers, fire control equipment, automatic systems, etc.

Two versions are offered, one for 60cy and the other for 400cy. Power output of each is 1.5w. Input impedance is 1 megohm. An adjustable error rate is provided for damping. Loop gain on the 60cy system is adjustable to 0.014 in-oz/mv error times the gear ratio; on the 400cy system it is adjustable to 0.015 in-oz/mv error times the gear ratio. Typical damped natural frequencies are 12cy and 40cy, respectively. Feedback Controls, Inc., Dept. ED, 1332-34 N. Henry St., Alexandria, Va.

CIRCLE ED-244 ON READER-SERVICE CARD FOR MORE INFORMATION

Announcing 2 New

Completely Different

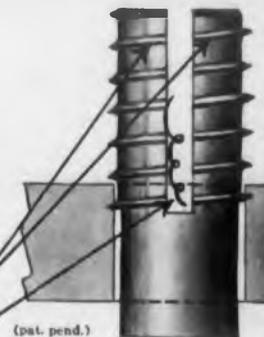
SETKO SET SCREWS

Set Screw & Mfg. Co. presents for the first time, two of the most revolutionary set screw developments—entirely new and different but fully proven and backed by Setko's 20 year, billion set screw experience!

NEW SELF-TAPPING SET SCREWS

Save taps, save time, save on production cost!
2 Cutting Edges

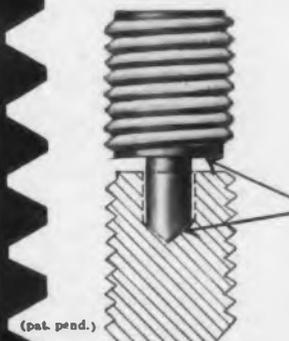
Cutting thread extends only around top or slotted section, cuts on both sides of hole; chips are gathered in slot instead of accumulating below. Self-aligning, self-tapping, self-locking! "Pulls itself in" Can be supplied with any type set screw point. In full range, including the smaller sizes. Write for new illustrated, descriptive bulletin.



(pat. pend.)

NEW PIVOT-LOK SET SCREWS

For jobs using two screws for security purposes, or where vibration is a factor. Pivot on top screw acts as a bearing. Pivot avoids friction between the two screws and prevents damage to the lower socket. Pivot screw can be furnished with any type of self-locking thread such as Zip-Grip, Off-Set, etc. Provides most positive holding action, but both screws easily removed when desired. Send for new illustrated bulletin giving full data.



(pat. pend.)

Also

SELF-TAPPING FASTENERS

Now Available in Smaller Sizes — as small as # 2 x 1/2



(pat. pend.)

This is actual size of self-tapping screw being furnished to leading manufacturer

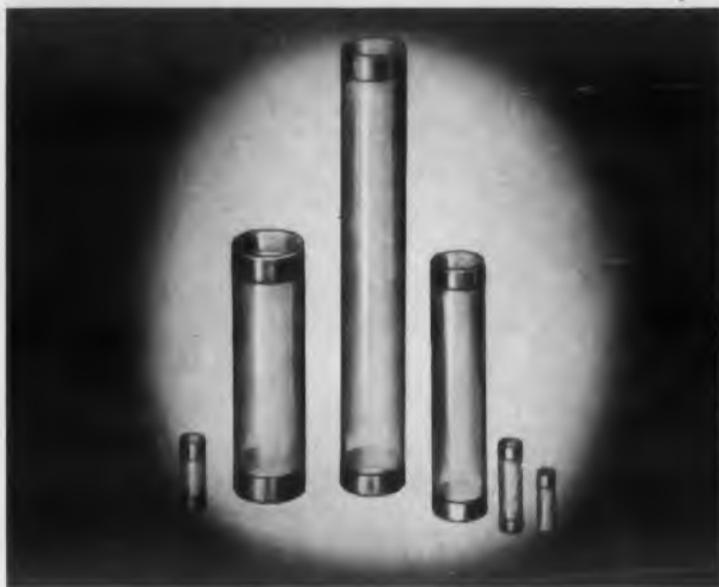
A self-tapping fastening screw for difficult applications. Also has self-aligning feature. Especially suitable for soft metals and plastics but will also work in steel. Write for complete list of sizes.

Set Screw & Mfg. Co.

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

We specialize in Solving Puzzling Set Screw Problems.

CIRCLE ED-245 ON READER-SERVICE CARD FOR MORE INFORMATION



Corning Metallized Glass Enclosures like these are used for hermetically sealing rectifiers, resistors and capacitors.

How to protect delicate components from moisture, mold, dirt, thermal shock

You've got to safeguard delicate components so they can stand up under rough and tumble operating conditions.

Encapsulate sensitive components in rugged Corning Metallized Glass Tubes and you give them stamina they otherwise lack.

You protect them in a hermetic seal from moisture. You keep out dust and dirt. You prevent moulds and fungi from settling on them.

When assembled with metal end caps, Corning Metallized Glass Enclosures can take sudden temperature changes—from as much as 275° C. to ice water. And they are not affected by atmospheric changes.

The protection of metallized glass enclosures is permanent. Bond strength for metallizing used on enclosure tubes has been measured at 1500 to 2000 pounds per square inch. Because the glass is transparent, you can see inside the tubes to check the conditions of components. The electrical characteristics of the glass are excellent.

You can get metallized glass enclosures in a variety of sizes. We'll be happy to send you a descriptive catalog sheet telling you more about them. Or, if you have some specific problems metallized glass enclosures might help you solve, we'll be pleased to work with you. Write, wire or phone us.



Corning means research in Glass

CORNING GLASS WORKS, 39-3 Crystal St., Corning, N. Y.
New Products Division

Please send me descriptive catalog sheet on Corning Metallized Glass Enclosures.

Name Title

Address

Company

City Zone State

CIRCLE ED-368 ON READER-SERVICE CARD FOR MORE INFORMATION

Microwave Noise Source Covers 26.5 to 40 Kilomegacycles



The GNW-Q18 Microwave Noise Source covers the frequency range from 26.5 to 40.0 kilomegacycles. With this addition, the line of waveguide-mounted gas tube noise sources offered by this company extends

from 2600 to 40,000 megacycles. The GNW-Q18 is mounted in a RG-96/U waveguide and is fitted with UG-381/U flanges. The single 3-terminal connector on the noise source operates off the standard GPS-1A Noise Source Power Supply.

The GNW-Q18 features a noise figure of 18db. The gas tube noise source is specially processed to insure maximum reliability, reproducibility, and life. Roger White Electron Devices, Inc., Dept. ED, 12 West Island Road, Ramsey, N. J. *This product will be on display at the Radio Engineering Show, Booth 80.*

CIRCLE ED-369 ON READER-SERVICE CARD FOR MORE INFORMATION

Three-Inch Oscilloscope Rack Mounting



Identified as the Model 385R, this scope has d-c amplifiers for excellent square wave response. Frequency range for the vertical amplifier covers d-c to 4Mc, 3db down; the horizontal amplifier covers d-c to 500kc, 3db down; and the sweep circuit oscillator covers 3cy to 50kc.

The input impedance of the vertical amplifier is 2.2 megohms at 25mmf, and that for the horizontal amplifier is the same. The vertical and horizontal amplifiers both have a deflection sensitivity of .075 rms volts per inch. The instrument mounts in a standard relay rack. The Hickok Electrical Instrument Co., Dept. ED, 10525 Dupont Ave., Cleveland 8, Ohio. *This product will be on display at the Radio Engineering Show, Booth 458-460.*

CIRCLE ED-370 ON READER-SERVICE CARD FOR MORE INFORMATION

INSTRUMENT and CONTROL KNOBS at Interesting Prices!—no Tooling



See us for "best buys" in standard parts



Parts of hard-finish thermosetting plastic
Readily available—often in stock



Many more models than illustrated—most in complete size ranges



Send for complete catalog

KURZ-KASCH, INC.

Standard Parts Division
1422 S. Broadway, Dayton 1, Ohio

CIRCLE ED-371 ON READER-SERVICE CARD FOR MORE INFORMATION

new design possibilities!
new production economy!

GRC

GRC INJECTION MOLDING TECHNIQUES OFFER WIDE FLEXIBILITY AT IMPORTANT SAVINGS!

Gries tiny thermoplastic parts meet simple or intricate specifications precisely, uniformly, and economically. We mold all thermoplastics! Nylon, Kel-F, acetates, polystyrene, polyethylene, etc. Quantities of 25,000 to millions.

SMALL PLASTIC PARTS



NYLON A SPECIALTY
Gries' unique special molding facilities make the most of nylon's unique advantages—at the least cost!



AUTOMATIC INSERT MOLDING Exclusive facilities for individual or continuous inserts; finished parts produced automatically—without manual labor of any kind!



Write today for samples and informative bulletins; send prints for quotations.

MAXIMUM SIZE: .025 oz.-1" long
NO MINIMUM SIZE

GRIES REPRODUCER CORP.

World's Foremost Producer of Small Die Castings
40 Second St., New Rochelle, N.Y., New Rochelle 3-8600

CIRCLE ED-372 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

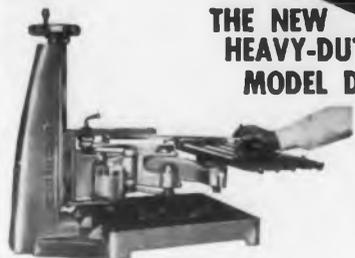
unique in design —
rugged in construction

GREEN PANTOGRAPH ENGRAVERS

THE FAMOUS
MODEL 106

THE NEW
HEAVY-DUTY
MODEL D-2

The three-dimensional bench Model 106 cuts costs — engraves, routs, models and profiles, giving you expert results even by unskilled workers.



The Model D-2 two dimensional heavy-duty Pantograph is a precision machine with a multitude of new features. Open on three sides, it permits complete freedom for engraving, milling, profiling large panels (up to 30" in diameter) or bulky pieces. Single, micrometer adjustment controls vertical depth of cut, automatically adjusting copy table with pantograph. Range of reduction ratios from 2-to-1 to infinity! Vertical range over 10 inches!

For complete information, write to

GREEN INSTRUMENT COMPANY
361 Putnam Ave. Cambridge, Mass.

CIRCLE ED-373 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW!

BRUSH DIGITAL COUNTER

higher performance
... lower cost!



This new Digital Counter is the first designed for 150-volt operation—one-half the voltage, one-fourth the power required for conventional counters. The result is less heat—greater reliability. Data can be presented visually on neon or drum-dial readouts, or electrically in four-line code or analog stair step. Write for information on the "Countess"—lowest cost precision counter available. Brush Electronics Company, Dept. J-3A, 3405 Perkins Avenue, Cleveland 14, Ohio.

BRUSH ELECTRONICS COMPANY

INDUSTRIAL AND RESEARCH INSTRUMENTS
PIEZOELECTRIC MATERIALS • ACOUSTIC DEVICES
MAGNETIC RECORDING EQUIPMENT AND COMPONENTS

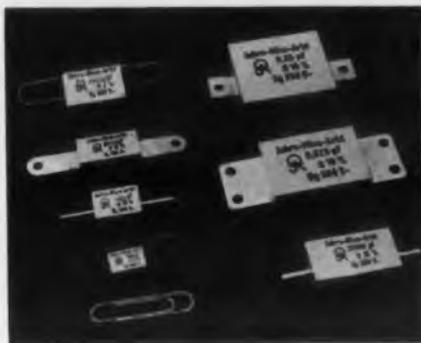


Division of
Clevite Corporation

CIRCLE ED-374 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

Silver-Mica Capacitors In Wide Ranges of Values



Providing a wide range of values and voltage ratings, "Jahre" silvermica capacitors are intended for demanding applications in test equipment, computers, radio transmitters, receivers, and other

electronic equipment. Three grades are offered: the "Mica Block" series, for temperatures from -10° to $+60^{\circ}\text{C}$, at relative humidities to 80%; the "Mica Trop" series for temperatures from -20° to $+70^{\circ}\text{C}$, 100% relative humidity; and the "Mica Arkt" series, for temperatures from -55° to $+85^{\circ}\text{C}$, at 100% relative humidity.

Four lead styles are available, depending on the case size: flat wire, cylindrical wire, lug, and strap terminals. The latter two are particularly suited to v-h-f applications, and are silvered for low loss. Dielectric loss factor is held to less than 1×10^{-3} , through sheet-by-sheet inspection of raw mica.

Capacitances from 5mmfd to 0.25mfd are available in voltage ratings from 125v to 3000v d-c. Since working voltages are only one-third the test voltages, stability and long life are guaranteed. Tolerances available are $\pm 20\%$ to $\pm 1\%$.

The capacitors employ a construction which virtually eliminates failure due to silver migration. "Trop" and "Arkt" series are encapsulated; and the latter meets JAN-C-5 requirements. Arka Imports, Dept. ED, 904 San Pasqual St., Pasadena 5, Calif.

CIRCLE ED-375 ON READER-SERVICE CARD FOR MORE INFORMATION

Voltmeter

Tests Transistor Batteries



This small pocket type voltmeter is suitable for testing batteries used in transistor type devices such as hearing aids, etc. The instrument is supplied with a nickel plated case, one positive stationary test prod and a negative flexible lead with probe attached. The current drain is in the order of 11-12ma at 7v. Shurite Meters, Dept. ED, 61 Hamilton Street, New Haven 8, Conn. *This item will be on display at the Radio Engineering Show, Booth 205.*

CIRCLE ED-376 ON READER-SERVICE CARD FOR MORE INFORMATION

to your specifications
...for quick delivery

You tell our engineers your needs, and Thermador's Electronics Plant goes into immediate operation. Complete, unsurpassed facilities and precision craftsmanship manufacture transformers that meet your most exacting requirements.

Your completed transformers are subjected to extreme environmental conditions; tested under critical loads. Thermador transformers with-

Precision-designed Thermador Transformers

stand the severest testing—will exceed any MIL requirements or exacting specifications. Thermador certifies your transformers without delay.

We work from your specifications to develop a transformer for your application, chassis or performance standards... one or a thousand. Delivery is quick. Tell us what you need. Call us today. Request literature from: Electronic Division, Thermador Electrical Manufacturing Company, 2000 South Camfield Avenue, Los Angeles 22, Calif. PARKVIEW 8-2105



THERMADOR

Electronic Division



SEVEN LEAGUES AHEAD

3-919

CIRCLE ED-377 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW!

Easy Dependable Direct Measurements of Transistor Characteristics

MODEL GPI



with the Baird Associates

Transistor Test Set

AT ANY FREQUENCY 100 cps to 1 megacycle

FEATURING

- NPN and PNP
- GROUNDED BASE and GROUNDED EMITTER
- HYBRID COEFFICIENTS h_{11} h_{12} h_{21} h_{22}
- ALPHA CUT-OFF

- ★ PRECISION for the transistor laboratory
- ★ VERSATILITY for the circuit designer
- ★ SPEED for the production line

- JUNCTION and POINT CONTACT
- COLLECTOR SATURATION CURRENT I_{co}
- T-NETWORK COEFFICIENTS r_e r_b r_o a β
- COLLECTOR CAPACITANCE

The Baird Associates Model GPI Transistor Test Set is a versatile precision instrument designed to analyze transistors at any frequency from 100 cps to 1 mc in terms of well-known standard parameters. The transistor coefficients thus obtained enable the circuit designer to predict the performance of amplifiers in the AUDIO, INTERMEDIATE and LOW RADIO FREQUENCY ranges.

PLEASE REQUEST TECH. CIRC. RDS11

Baird Associates, Inc.

33 UNIVERSITY ROAD
CAMBRIDGE 38, MASSACHUSETTS



CIRCLE ED-357 ON READER-SERVICE CARD FOR MORE INFORMATION

134

Crystal Sweep Calibrator

With $\pm 0.01\%$ Accurate Spacing



The Model 238-1A Crystal Sweep Calibrator was developed for the purpose of oscilloscope time base calibration. Its many applications include: sweep time calibration,

marker generator use, counter and computer calibrator use, and frequency measurement. The unit produces narrow pulses spaced at intervals of 1, 10, 100, 1000, and 10,000 μ sec. Pulse spacing is accurate to $\pm 0.01\%$ and is controlled by two precision crystals. Pulse spacing is selected by a five-position front panel switch. Output pulse widths of 0.1 μ sec or 1 μ sec are provided; selection of the proper pulse widths is made by means of a panel switch.

Pulse outputs are positive and are preset by internal adjustments for each range to a level of 3.0v. Output impedance is 93 ohms. Accurate output frequencies of 1Mc, 100kc, 10kc, 1kc, and 100cy are provided at the various pulse-spacing settings, by use of reciprocal scales. The unit is completely self-contained and operates on 115v a-c, 50-420cy. Power consumption is 50w. Built to military standards, it measures only 11" x 5-1/4" x 5-1/4"; weight is only 8 lb. Loral Electronics Corp., Dept. ED, 794 E. 140th St., New York 54, N. Y. This product will be on display at the Radio Engineering Show, Booth 821.

CIRCLE ED-358 ON READER-SERVICE CARD FOR MORE INFORMATION

Wedge Clamps

Give Full Circle Grip



These cushioned clamps feature one-piece built-in wedges. Designated MS-21919, the clamps enable full circle grip with even, positive pressure upon the entire circumference of conduit or line. The wedge is an integral part of the cushion and cannot be dislodged.

The units permit rapid installation and prevention of shape distortion. They are available in a range of sizes from stock, in general-purpose, fuel-resistant, and high-temperature rubbers. Bare clamps are made of dural or steel. Universal Metal Products, Inc., Dept. ED, Bassett, Calif.

CIRCLE ED-359 ON READER-SERVICE CARD FOR MORE INFORMATION



SEE THE FULL LINE OF
G-M PRECISION

Servo Motors

DISPLAYED AND DEMONSTRATED IN

BOOTH 61

Institute of Radio Engineers
1955 National Convention • March 21-24
Kingsbridge Palace • New York City

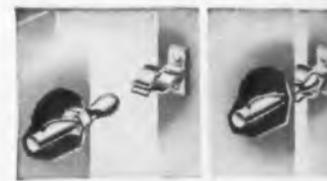


LABORATORIES • INC.

4284 NO. KNOX AVENUE • CHICAGO 41, ILLINOIS

CIRCLE ED-360 ON READER-SERVICE CARD FOR MORE INFORMATION

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



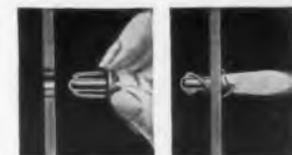
It's a Cabinet Door Strike... Simple to install; eliminates welding and cuts assembly cost. Any head can be designed without affecting fastening principle.



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



It's a 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 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

SIMMONS FASTENER CORP., 1763 North Broadway, Albany 1, N. Y.
CIRCLE ED-361 ON READER-SERVICE CARD FOR MORE INFORMATION

QUICK-LOCK • SPRING-LOCK
ROTO-LOCK

ELECTRONIC DESIGN • March 1955

Partners... YOU AND YOUR
NO. 50 POCKET PAL



\$1.00 AT YOUR LOCAL DEALER
CATALOGUE NO. 49 AVAILABLE UPON REQUEST

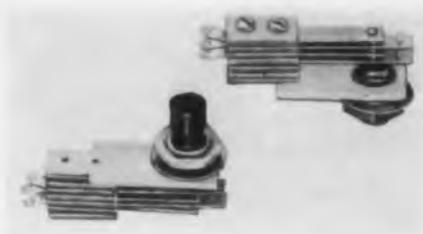
030 MATTE FINISH MATHEMATICAL QUALITY DOUBLE-CURED PLASTIC
ALL HOLES SMOOTH-MILLED TO ENGRAVING MACHINE ACCURACY
ONE OF MORE THAN 30 RAPIDESIGN TIME-SAVER TEMPLATES— ALL
OF WHICH ARE BETTER MADE, MORE USEFUL AND LESSER PRICED.

RAPIDESIGN INC.

P. O. BOX 592 GLENDALE, CALIF.

CIRCLE ED-362 ON READER-SERVICE CARD FOR MORE INFORMATION

Flat-Frame Switches
In Seven Standard Circuits



Through utilization of a smaller spring design, which has resulted in the reduction of the entire physical size of the switch, this manufacturer has developed a new line of flat-frame "NF-Switches". The rugged flat frame is readily adaptable to any stack or "pile-up" of contact springs, providing a simple, direct-acting, small, push-button switch.

Through modification and combinations of contact springs, these switches can be made to meet most requirements. Contacts are fine silver for minimum contact resistance, rated at 3amp 120v a-c, non-inductive load. They also can be made with welded cross-bar palladium contacts for low level circuits. Seven standard circuits are available: single make, single break; single break-make spdt; two makes; two breaks; two break-makes dpdt; three break-makes 3 pdt (3 Form C). Switchcraft, Inc., Dept. ED, 1328 N. Halsted St., Chicago 22, Ill. *These components will be on display at the Radio Engineering Show, Booth 435.*

CIRCLE ED-364 ON READER-SERVICE CARD FOR MORE INFORMATION

A New Role
for the
**ELECTRONIC
ENGINEER**

*Pioneering in
Automatic Control*

The automation of industrial processes, the elimination of tedious paper work, the safeguarding of human lives and creative energy through split-second sensing, thinking and deciding machines that act with intelligence and discretion are part of the second industrial revolution that is changing the life and work patterns of us all.

ECA's engineers are creating the automatic industrial controls, the electronic business machines, the digital and analog computers that are bringing this revolution into focus day by day. Until they can design a machine that can do it better, these engineers are encouraged to bend their best thoughts to this work in an atmosphere that allows for professional freedom, where there are open channels for the propagation of new ideas, where work executed with imagination is remembered, where there is opportunity to grow in the profession.

As one of the leaders in this change, ECA is daily stretching out into new fields and enlarging its interest in old ones. Nevertheless, the corporation rests on a sound base of well-established commercial products, which provide the ECA engineer with stability, and assure him of compensation on a high industrial pay scale.

There are now a few positions open for electronic engineers with a good theoretical background and a few years' experience. Address all inquiries to: Mr. W. F. Davis, Dept. 506



**ELECTRONICS
CORPORATION
OF AMERICA**

77 Broadway Cambridge 42, Mass.

CIRCLE ED-366 ON READER-SERVICE CARD FOR MORE INFORMATION



**Miniature,
Hermetically Sealed, Aircraft Type Relays**

Have a New, Wider Range of Performance Characteristics

If you need a small, light 4 PTD or DPDT relay to operate consistently under extremely critical or downright adverse conditions, chances are your requirements can be readily met by one of the multitude of variations possible with the basic "Diamond H" Series R relay. Originally designed to meet all requirements of USAF Spec. MIL-R-5757B, they far surpass many. For example: Various brackets of vibration resistance from 10 to 2,000 cps, plus temperature ranges from -55° to $+200^{\circ}$ C., coil resistances from 1 to 50,000 ohms, contact capacities from 350 V., D.C., 400 MA, to 10 A. at 30 V., D.C. (20 A. for reduced life). Also reliable in signal circuits. Operating time (24 V. models) 10 ms. or less; dropout less than 3 ms. Dielectric strength 450 to 1,250 V., RMS. Insulation resistance 1,000 megohms at room temperature (100 at 200° C.). Operational shock resistance 30, 40 or over 50 "G". Mechanical shock resistance to 1,000 "G". Single or two independent coils, either or both of which will operate unit. All standard mounting arrangements.

Call on "Diamond H" engineers to work with you in developing a variation to meet your specific needs.

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

CIRCLE ED-363 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

Panel Meters

Pass Extremely Rugged Tests



The Model 163 line of 1-1/2" Ruggedized Miniature Panel Meters, designed to meet MIL-M-10304 (Sig. C.), is available in ranges of 0-100amp d-c, 0-1ma d-c, and 0-10mv d-c.

The units pass rigid moisture resistance, water tightness, thermal shock, tumbling, salt spray, and high shock tests, and operate over a temperature range from -55° to $+85^{\circ}$ C. In the high shock tests, the meter is attached to a steel anvil plate which is struck by a 400 pound hammer giving a blow of 2,000 foot pounds.

The meter has a dielectric strength of 1500v rms, is magnetically shielded, and has combination solder lug and stud terminals. Both the lance type pointer and the three cardinal points of the scale are self-luminous. Initial accuracy is within $\pm 3\%$ of full scale deflection. Weight is only 4.2 oz. International Instruments, Inc., Dept. ED, New Haven, Conn. *This product will be on display at the Radio Engineering Show, Booth 763.*

CIRCLE ED-365 ON READER-SERVICE CARD FOR MORE INFORMATION

What's Your Counting Problem?



Instantaneous Mechanical
Reset Type

SODECO Electric Impulse Counters meet a wide range of needs.

You can "count" on finding an answer to your counting problem in the Sodeco line. For in the Sodeco line are electric impulse counters with speeds up to 25 impulses/second. Rugged and accurate, they are available with instantaneous mechanical reset, electric reset, and no reset. Extremely compact, they require less space than most counters, and are suitable for flush mounting. The low power requirements of these counters permit their use in electronic circuits.

A new Sodeco feature allows counters to be "teamed", so that when a certain predetermined point has been reached, the first counter automatically activates a second counter—keeping an accurate count of process cycles.

Write today for our counter bulletins file—we're sure we have the answer to your counting problem.

LANDIS & GYR, Inc.

45 WEST 45TH STREET

NEW YORK 36, N. Y.

CIRCLE ED-392 ON READER-SERVICE CARD FOR MORE INFORMATION

Stop Corrosion with

RHODIUM PLATING

New uses for Rhodium Plating are constantly being found by electronic design engineers where hard, corrosion resistant electrical contact surfaces are required.

RHODIUM PLATE offers these advantages:

- assures low and stable contact resistance
- allows higher pressures to be used in sliding contacts
- not affected by atmospheric changes
- oxide-free contacts eliminate partial rectification and unwanted signals
- provides low noise level for moving contacts
- extremely long-wearing

These properties are particularly well-suited to electrical and electronic applications. RHODIUM plate affords excellent protection against atmospheric corrosion for printed circuits and permits incorporation of sliding contacts as part of the circuit.

Write for Free, detailed booklet on RHODIUM PLATING.

BAKER PRECIOUS METALS
A COMPANY, INC.

113 ASTOR STREET, NEWARK 5, NEW JERSEY
NEW YORK • SAN FRANCISCO • CHICAGO • LOS ANGELES

CIRCLE ED-393 ON READER-SERVICE CARD FOR MORE INFORMATION

D-C Decade Amplifier Drift Less Than 10 μ v



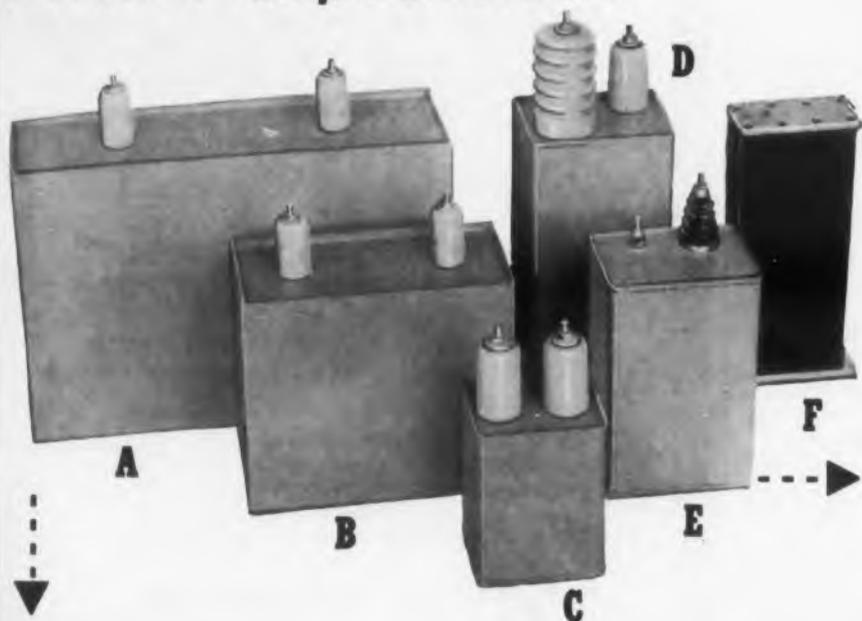
The D-C Decade Amplifier contains a high-gain, wide-band, direct-coupled amplifier operated with negative feedback and frequency corrective networks to

provide uniform response from d-c through 100kc in step-controlled gains of 0, 20, 30, and 40db. The use of chopper-stabilized amplifier circuitry produces essentially drift-free operation (less than 10 μ v).

The amplifier has many uses in electronics: recorder or oscilloscope preamplification, strain gage applications, servo system design and testing, geophysical and medical electronics, computer analysis and synthesis, and as a general-purpose precision laboratory amplifier. Input impedance is 100,000 ohms; output voltage range is ± 35 v; output current range is ± 20 ma into 1500 ohms; and input is 115v, 60cy, single phase, 150w. Dimensions are 17-1/8" x 8-15/16" x 12-3/4" deep. Kay Lab, Dept. ED, 1090 Morena Blvd., San Diego 10, Calif. *This product will be on display at the Radio Engineering Show, Booth 261-263.*

CIRCLE ED-395 ON READER-SERVICE CARD FOR MORE INFORMATION

Plastic Capacitors'...



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

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



Plastic Capacitors, Inc.

2511 W. MOFFAT STREET, CHICAGO 47, ILLINOIS

CIRCLE ED-394 ON READER-SERVICE CARD FOR MORE INFORMATION

HIGH VOLTAGE CAPACITORS

for DC filter applications

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

Our specially designed facilities guarantee faster delivery.

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

Panel Instruments Core-Magnet Type



Core-magnet, self-shielded panel instruments in a 3-1/2" size are identified as the 1301 Line. These instruments are available for d-c or as a-rectifier type instruments in both round and rectangular shapes.

The Cormag mechanism affords shielding from external magnetic fields and thus eliminates any interference effect when instruments are mounted close together. They also can be mounted on magnetic or nonmagnetic panels interchangeably without need for special adjustment.

Basic accuracy for the 1301 d-c instruments is within $\pm 2\%$ of full-scale range; and $\pm 3\%$ for the a-c rectifier types. Weston Electrical Instrument Corp., Dept. ED, 614 Frelinghuysen Ave., Newark 5, N. J. *This product will be on display at the Radio Engineering Show, Booth 533-535.*

CIRCLE ED-396 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

DONNER analog computer

\$995

Model 30 with 30-3 problem board as illustrated.
f.o.b. Berkeley, Calif.



This versatile and compact Donner Model 30 is the first electronic computer specifically designed as a personal tool of the engineer, mathematician and scientist. It offers the speed and accuracy of electronic computation with slide rule operating simplicity wherever differential equations are used.

Write for Booklet No. 302 on the Model 30 and its applications.

DONNER SCIENTIFIC COMPANY

2829 SEVENTH STREET • BERKELEY 10, CALIFORNIA

CIRCLE ED-397 ON READER-SERVICE CARD FOR MORE INFORMATION

VERSATILE "12,000 SERIES"

Ceramic Switches



MEET "CUSTOM" SPECS AT LOW COST

Avoid the delay and cost of "specials" when ordering quality switches for prototypes or quantity production of instruments, control systems and assemblies.

Thousands of "12,000 Series" Switches to meet virtually any requirement are quickly assembled from basic stock parts. All types have solid silver contacts and collector rings, low-loss steatite decks, and silver-plated beryllium-copper wiper springs for uniformly low contact resistance and exceptional durability.

For complete data, write for Bulletin L-32.

SHALLCROSS MFG. CO., 526 Pusey Ave., Collingdale, Pa.

CONDENSED SPECIFICATIONS

ACTION—shorting or non-shorting
POLES—1, 2, or 3 per deck
DECKS—up to 10
DETENT—optional
SHAFT—completely isolated
CONTACT RESISTANCE—0.0025 ohm
RATINGS—nominal—1a., 110v., 60 cy.
de-rated current—2500v., 60 cy.
de-rated voltage—40 amperes

Shallcross

See us at the I.R.E. SHOW—559 and 561 Components Avenue

CIRCLE ED-398 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

□ Swept Frequency Generator

20 to 200 Cycles



Known as Model 200K, this Swept Frequency Generator provides an instantaneous and continuous visual display of frequency response of a device under test.

Model 200K Generator produces a constant amplitude output voltage, continuously varying in frequency, and covers a frequency range from 20cy to 200cy, or any increment of this range. Continuous frequency variations are produced by the modulation of a voltage controlled oscillator with internally generated sawtooth, triangular, or square wave forms at any rate between 0.5cy and 50cy. Provision is made for external modulation. A frequency marker is provided and can be set for any frequency within the range of the instrument. Marker accuracy is $\pm 0.1\%$. The unit can be mounted in a standard 19" relay rack, and requires 12-1/4" panel space. Electromec, Inc., Dept. ED, 3200 N. San Fernando Blvd., Burbank, Calif. *This product will be on display at the Radio Engineering Show, Booth 35.*

CIRCLE ED-399 ON READER-SERVICE CARD FOR MORE INFORMATION

□ Variable Resistors

For Color TV Control



This complete line of variable resistors for all color TV applications includes 3/4" diam "dime size" to 2-1/2" diam controls with wattages from 0.2w to 4w. Control types are carbon and wire-wound, with and without attached switch. Mountings are conventional bushing, twist ear, and snap-in bracket for printed circuits.

Terminal styles available are for conventional soldering, printed circuits, and wire wrap. An endless combination of tandems with both single and dual-shafts is possible. The entire 45 Series 15/16" diam line is also available, including 90 Series special 1w military resistance elements with exceptional stability. Also, an entire 35 Series 1-1/8" diam line is available, with 95 Series special 2w military resistance elements. Chicago Telephone Supply Corp., Dept. ED, Elkhart, Ind. *This product will be on display at Radio Engineering Show, Booth 450.*

CIRCLE ED-400 ON READER-SERVICE CARD FOR MORE INFORMATION

The Sign of precision engineered
TRANSFORMERS

for greater **DEPENDABILITY**

QUALITY CONSTRUCTION



AUDIO - POWER PULSE

TRANSFORMERS & INDUCTORS
High Temperature-Miniaturized Encapsulated Units.

SEE US AT
THE IRE SHOW
KINGSBRIDGE PALACE
Booth #31

INDUSTRIAL TRANSFORMER Corporation
GOULDSBORO PENNSYLVANIA

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

NEW MODEL 1145 SIDE INDICATOR

**MAXIMUM READABILITY
SPECIAL BI-LEVEL SCALE
MINIMUM SIZE, WEIGHT**

Compare with Conventional 4 1/2" Round Meters —

- 1/3 THE PANEL AREA . . . only 5.5 sq. inches compared with 16.4 sq. inches.
- SCALE LENGTH . . . 2.7 inches.
- LESS WEIGHT . . . only 10 ounces.
- COMPARABLE ACCURACY . . . $\pm 2\%$ of full scale deflection.



and . . . horizontal or vertical mounting . . . self-contained with front external zero adjuster . . . dustproof black plastic case with clear lucite cover.

SEE THEM AT BOOTH 763, I.R.E. SHOW IN NEW YORK

Write FOR ENGINEERING DATA SHEETS ON:

1 1/2" Ruggedized Meters; 1" and 1 1/2" Panel Meters; 1 1/2" VU, DB and Illuminated Meters; Miniature Multi-testers and Side Indicators.

international instruments, inc.

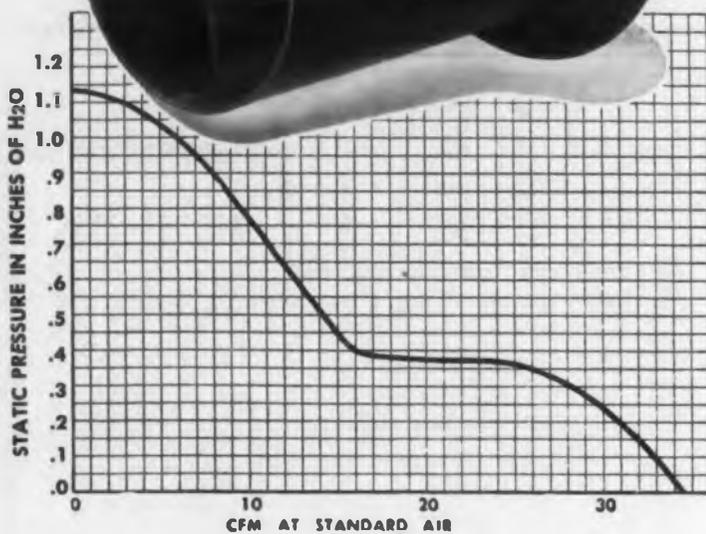
P.O. Box 2954, New Haven 15, Conn.



CIRCLE ED-402 ON READER-SERVICE CARD FOR MORE INFORMATION

High CFM
even with
High SP STATIC PRESSURE

EAD
miniature
**TUBE AXIAL
BLOWERS**



For efficient, spot cooling of electronic equipment, for air change in small equipment-filled boxes, it's EAD's miniature tube axial blowers, driven by EAD's new one-inch diameter motor. These light weight, long life units have no brushes . . . no arcing . . . no radio interference. They meet applicable MIL specifications for aircraft use.

Modifications or new designs expertly engineered to meet specific needs. Write for detailed information.

EASTERN AIR DEVICES, INC.

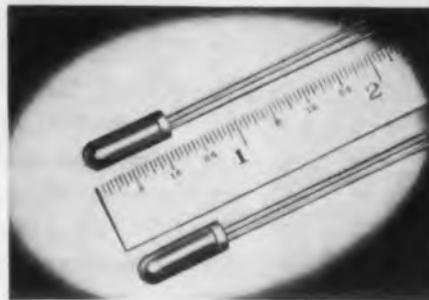
SOLVING SPECIAL PROBLEMS IS ROUTINE AT EAD



391 CENTRAL AVE., DOVER, NEW HAMPSHIRE

See us at Booth #655, Circuit Ave., Radio Engineer Show
CIRCLE ED-381 ON READER-SERVICE CARD FOR MORE INFORMATION

Junction Transistors
In Four Styles



Four "p-n-p" Junction Transistors, types *OC70*, *OC71*, *O80C*, and *O81C*, have been added to this firm's line. The *OC70* has a grounded emitter current gain from 20 to 40,

while *OC71* had a gain of 30 to 75. Both transistors have average noise figures of only 10db and are particularly suited to hearing aids and other portable circuits. They are excellent for low-level audio applications, dissipating 6mw at 45°C.

The units are "all-glass" with true fusion seals. The seal prevents the penetration of contaminants and moisture into the transistor, which could cause increase in leakage currents with corresponding reduction in life and gain.

The *O80C* and *O81C* are metal-cased transistors having the standard "Jetec" base and dimensions. The metal casing allows a higher collector voltage and a dissipation of 50mw at 45°C. Otherwise the electrical characteristics are the same as for the *OC70* and *OC71*, respectively. Amperex Electronic Corp., Dept. ED, 230 Duffy Ave., Hicksville, N. Y. *These components will be on display at the Radio Engineering Show, Booth 273-275.*

CIRCLE ED-382 ON READER-SERVICE CARD FOR MORE INFORMATION

Lead Holder

Propels Flat Ribbon Inserts



This flat propelling lead holder, the "Alvin Constructor", is specially designed for precise work. The flat

ribbon lead inserts, which are only 0.016" thick and 0.047" wide, never require sharpening. Drawings, clothing, and hands always remain clean.

Extremely accurate work can be done, because there is a firm guide edge for straight edges and triangles. The holder can be used for block printing as well as regular writing.

Made of hard rubber, the holder is durable and light. For instant recognition of the different grades of lead hardness, the top of each holder is stamped. "Paramount-Constant" flat ribbon lead inserts are offered for holders in HB, H, 2H, and 4H. Alvin & Co., Dept. ED, Windsor, Conn.

CIRCLE ED-383 ON READER-SERVICE CARD FOR MORE INFORMATION

**COMPRESSION
TERMINALS
and
LINKS**



All types, all sizes quickly, easily installed with wide variety of matched tooling

All sizes of solderless lugs and links for all conductors and all applications in manufacturing and plant wiring can be rapidly, economically installed by means of Burndy tooling, coordinated with specific manufacturing methods and production requirements.

Burndy Hylugs and Hylinks are of one-piece, pure copper construction, so they can be indented on any side of the barrel and they can't split. There are no intermediate contact surfaces — current is carried by the entire cross-section. Plated to resist corrosion. Listed by Underwriters' for #22 through 2000 Mcm.

Intimate high-pressure contact between conductor and connector is assured by Burndy matched installation tools. Manual, hydraulic, and pneumatic tools are designed for portable, on-the-job use and for production bench operation.

For complete details and catalogs, write
BURNDY ENGINEERING CO., INC.
600 Richards Ave., Norwalk, Connecticut.

CIRCLE ED-384 ON READER-SERVICE CARD FOR MORE INFORMATION

Try Them Free!
KEPS
TESTING SAMPLES

See how this amazing new Shake-proof fastening saves assembly time and assures vibration protection. A **SHAKEPROOF®** Lock Washer of the right size and type is pre-assembled on each nut . . . only one unit to handle . . . the lock washer can't drop off . . . every nut is certain to be locked tight.

SEND FOR YOUR FREE KIT OF KEPS TESTING SAMPLES TODAY!

SHAKEPROOF
"Fastening Headquarters"

Division of Illinois Tool Works
St. Charles Road, Elgin, Illinois

CIRCLE ED-385 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

For HIGHEST ELECTRICAL
& MECHANICAL Efficiency!

New

JONES 2400 SERIES PLUGS & SOCKETS

Improving Socket Contacts. Four individual flexing surfaces. Positive contact over practically their entire length.

Both Plug and Socket Contacts mounted in recessed pockets greatly increasing leakage distance. INCREASING VOLTAGE RATING. Plug and Socket Contacts cadmium plated. Add to appearance of your equipment. Interchangeable with Jones 400 Series.

Ask for Catalog 20, Complete line Jones Plugs, Sockets, Terminal Strips.



P-2406-CCT
Plug—with cable
clamp in top.
S-2406-SB
Socket with shallow
bracket for flush
mounting.



SEE NEW DEVELOP-
MENTS AT THE
I.R.E. SHOW—
Booth 394-396

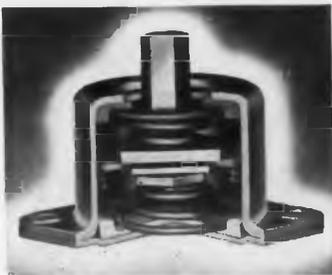
HOWARD B. JONES DIVISION
CINCH MANUFACTURING CORPORATION
CHICAGO 24, ILLINOIS
SUBSIDIARY OF UNITED-CARR FASTENER CORP.

CIRCLE ED-386 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW BARRY ALL-ANGL VIBRATION MOUNT

Works in Any Position — Has High Damping

Satisfying the need for a vibration isolator that protects the mounted equipment regardless of the position in which it is supported, the new Barry ALL-ANGL mount permits equipment to be mounted upside down, vertically on firewall or bulkhead, or at any odd angle. Damping is exceptionally high in all directions; transmissibility at resonance is less than 3.



The ALL-ANGL mount above has a standard one-inch cup to mount on 1-13/32" centers, and is interchangeable with other miniature BARRYMOUNT® isolators. Weighing less than one ounce, it handles loads up to 3 pounds.

This isolator answers the tough vibration-protection problems — permits design for easiest installation and best utilization. Let us show you what it will do for you at the New York I. R. E. Show.

The Barry Corporation, 775 Pleasant Street,
Watertown 72, Massachusetts

CIRCLE ED-387 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

Capacitors

With Improved Stability



The stability of capacitors which use polystyrene as the dielectric has been increased appreciably by a production technique developed by this firm. The technique involves a

series of heating and aging cycles which have a marked effect on the stability of the film.

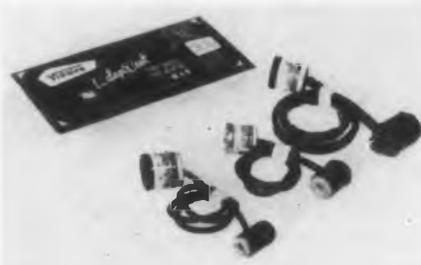
The polystyrene capacitors made by the firm now have a room temperature capacity drift of less than 0.1% over a temperature range of -80° to $+75^{\circ}\text{C}$. Temperature coefficient is less than 1.5% overall capacity change in a temperature range of -60° to $+85^{\circ}\text{C}$; formerly the temperature coefficient over this range was about 2%.

The two lines of polystyrene dielectric capacitors manufactured by the firm are represented by the five units illustrated. The three capacitors in the cans represent the "Plasticon" PAC line of 22 capacitors ranging from 0.1mfd at 1000v d-c to 25mfd at 100v d-c. The two tubular capacitors represent the 22 capacitors catalogued in the "Glassmike" PAG line; these range from 0.001mfd at 1000v d-c to 1mfd at 100v d-c. Condenser Products Co., Div. of New Haven Clock and Watch Co., Dept. ED, 140 Hamilton St., New Haven, Conn. *These components will be on display at the Radio Engineering Show, Booth 423.*

CIRCLE ED-388 ON READER-SERVICE CARD FOR MORE INFORMATION

Kit

Adapts Tube Sockets for Testing



has test points clearly numbered for easy identification.

Extension leads 20" long reach hidden tube sockets in chassis, making it unnecessary to remove chassis from the cabinets when testing socket voltages. The kit is intended for use with any voltmeter and is supplied in a clear plastic case. Vidair Electronics Manufacturing Corp., Dept. ED, Lynbrook, N. Y.

CIRCLE ED-389 ON READER-SERVICE CARD FOR MORE INFORMATION

marion
advancement
in instrument
design

new
COAXIAL*
relay



Actual Size
Weight 1.5 oz.

Very
sensitive,
rugged, reliable.
Hermetically sealed.
Engineering data for your
application on request.

*Trademark for the basic Marion moving
coil mechanism. Patents Pending.

Marion electrical instrument co.
417 Canal St., Manchester, N. H., U. S. A.

Manufacturers of Ruggedized and "Regular"
Panel Instruments and Related Products.

copyright 1955 M.E.I. Co.

marion meters

CIRCLE ED-390 ON READER-SERVICE CARD FOR MORE INFORMATION



"Standard
Units"

"From
Stock"

48 STANDARD UNITS

Now available . . . with more to come

- Standard Components . . . from stock.
- Standard Quality . . . to meet all usual precision requirements.
- Standard Prices . . . from our published price list.
- Standard Specifications

Sizes: 7/8", 1 1/16", 2" diameters Rotation: 320° and 350°
Linearity: from 1/4% Bearings: Sleeve and ball
Overall Resistances: 10 to 100,000 ohms in 16 values
for each diameter
Temperature Coefficients of Resistance Wire:
0.0002 parts per °C
Starting Torque: from 1 inch-ounce

Send for
bulletin
and
price list
TODAY



VECTRON, inc.

Precision Components Section
380 MAIN STREET
WALTHAM 54 • MASSACHUSETTS

CIRCLE ED-391 ON READER-SERVICE CARD FOR MORE INFORMATION

Stycast® 2340 M

Casting Resin for Electronic Embedments

Flexible - Tough and rubbery

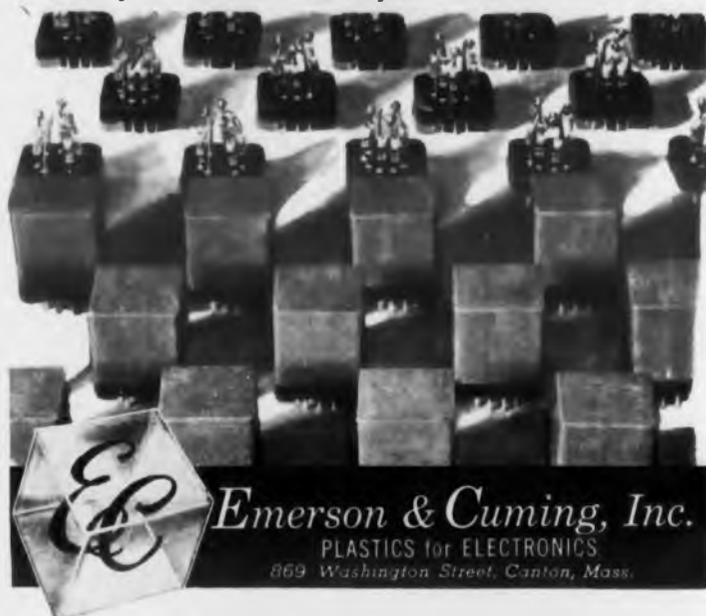
High Impact Strength

Excellent Adhesion - to metals, ceramics, plastics, etc.

Wide Temperature Range - -100° F to +400° F

Easy to Use - Two component System. Long Pot Life

Write for detailed information and Specifications on Stycast 2340 M and other Stycast Plastics for Electronics



Emerson & Cuming, Inc.
PLASTICS for ELECTRONICS
869 Washington Street, Canton, Mass.

CIRCLE ED-428 ON READER-SERVICE CARD FOR MORE INFORMATION

FOR MAGNETIC RECORDING



Brush heads

give perfect time-phase accuracy

This Brush multi-channel magnetic head (Model BK-1500 series) features precision gap alignment. When you use tape recorders incorporating these heads, you can record data on one machine, and play back on another—with all signals remaining in perfect time-phase relationship. As many as 14 tracks can be recorded on a single tape 1 3/4 inches wide.

Brush produces a complete line of magnetic recording heads, with models available for all existing applications. For complete information, write Brush Electronics Company, Dept. J-8, 3405 Perkins Avenue, Cleveland 14, Ohio.

BRUSH ELECTRONICS COMPANY

INDUSTRIAL AND RESEARCH INSTRUMENTS
PIEZOELECTRIC MATERIALS • ACOUSTIC DEVICES
MAGNETIC RECORDING EQUIPMENT AND COMPONENTS



Division of
Clevite Corporation

CIRCLE ED-429 ON READER-SERVICE CARD FOR MORE INFORMATION

Toggle Switch

Handles 5amp, Two Circuits



The Type T-2104 Toggle Switch measures only 1-5/6" long x 15/32" diam. It uses the same patented cam-roller snap-action mechanism found in the larger switches

this firm makes for military aircraft. This mechanism makes it impossible to "tease" the switch on or off contact.

Contacts, shorting bar, and terminals are of heavy silver overlay on a copper base. The anodized aluminum housing protects the switch mechanism from dust and moisture. The compact cylindrical construction allows several switches to be grouped in very small space.

The contact arrangement "makes" contact with two separate circuits in alternate positions of the toggle. For conventional spdt operation, a jumper can be added between contacts. The extremely fast contact make-break and thorough wiping action allow the switch to be rated for currents up to 5amp inductive, or 10amp resistive. Hetherington, Inc., Dept. ED, Sharon Hill, Pa. *This product will be on display at the Radio Engineering Show, Booth 330.*

CIRCLE ED-430 ON READER-SERVICE CARD FOR MORE INFORMATION

Multi-Band Frequency Multiplier

80-10 Meter Range



Designated Model 504C Multi-Band Frequency Multiplier, the unit makes transmission on any band available at the flip of a switch. It covers the 80 through 10 meter bands with a nominal power output

of 25 watts from its 807 amplifier stage through its flexible pi-network output circuit. No tuning is required and the unit comes equipped with four 6AQ5's which make up its multiplier string. An external VFO or crystal oscillator (80 meter fundamental) is required, as is a suitable power supply.

The unit measures 8" x 7" x 9-1/2". Barker & Williamson, Inc., Dept. ED, 237 Fairfield Ave., Upper Darby, Pa. *This product will be on display at the Radio Engineering Show, Booth 202.*

CIRCLE ED-431 ON READER-SERVICE CARD FOR MORE INFORMATION

METER-RELAYS

For Sensitive and Accurate Control

RANGES:

0/20 Ua. to 0/50 A.
0/5 Mv. to 0/500 V.



Model 261-C Range 0/200 DC
Microamperes. Price \$33.00

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, 2 1/2, 3 1/4 and 4 1/2 inches (all rectangular). Two ruggedized and sealed models, 2 1/2 and 3 1/2 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.

BOOTH 311, I.R.E. SHOW, MARCH 21-24

CIRCLE ED-432 ON READER-SERVICE CARD FOR MORE INFORMATION



vernistat... The Revolutionary New Precision Variable-Ratio Transformer

Analogue Computers? Servos? Control Systems? The Vernistat is a completely new type of voltage divider that combines low output impedance with an inherently high resolution and linearity not ordinarily attainable by precision potentiometers.

The Vernistat consists of a tapped auto-transformer which provides the basic division of voltage into several discrete levels. These levels are selected and further sub-divided by a continuous interpolating potentiometer that moves between 31 transformer taps.

Because of its unique operating principles, electrical rotation is held to close tolerances eliminating the need for trim resistors. In many applications there is no need for impedance matching amplifiers.

Specifications of the standard model Vernistat are shown below. Other versions are under development to meet specific end uses.

What are your requirements for this unique precision voltage divider?

SPECIFICATIONS

Linearity Tolerance better than ±.05%	Frequency	50-3000 cps	
Output Impedance	130 ohms (max.)	Max. Output Current	50 ma
	Minimum Voltage Increment	better than .01%	

Other models including a miniaturized 400 cps version will soon be available.

vernistat division Perkin-Elmer Corporation, Norwalk, Conn.
CIRCLE ED-433 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

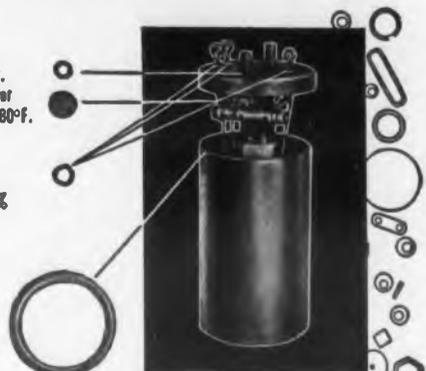
3 Soldering Operations in 1 Easy as ABC

with KESTER "SOLDERFORMS"

A Solder screws and stud to can cover.
"Solderform" Disc & Rings 5% Silver
—95% Lead Alloy. Melting Point 680°F.

B Solder glass terminals to cover.
"Solderform" Rings 63% Tin—37%
Lead Alloy. Melting Point 361°F.

C Hermetically seal cover on can.
"Solderform" Ring 28.5%
Bismuth—28.5% Tin—43%
Lead Alloy. Softening Point 250°F.



Here's a typical example of a rough resistance soldering job involving progressively lower melting temperatures. Kester "Solderforms" made sure this high precision oscillator coil came through every test successfully.

WRITE TODAY for free "Solderform" samples and literature.

KESTER

SOLDER COMPANY

4266 Wrightwood Avenue • Chicago 39, Illinois
Newark 5, New Jersey • Brentford, Canada

CIRCLE ED-434 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW FREE CATALOG

FOR

- Designers
- Purchasing Agents
- Engineers
- Superintendents
- Managers

FREDDY FEDERAL
will rush your copy today!



Costs, materials, and procedures graphically illustrated. New catalog tells where and how you can save money using Short Run Stampings. Also design tips to reduce stamping costs.

Write for your copy of catalog 201 today.

CIRCLE ED-435 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

Test Cabinets

For Humidity-Temperature Testing



The "Weather-Lab", a simplified line of humidity-temperature test cabinets for use in the above-freezing range, is available in standards 20 cu ft and 30 cu ft sizes for simulation of most conditions between +35° and +200°F, and between 20% and 95%

humidity. The design is suitable for testing products for conformance to above-freezing JAN, MIL, and other government environmental specifications. It can also be used to study the effects of climate on mold and fungus growth.

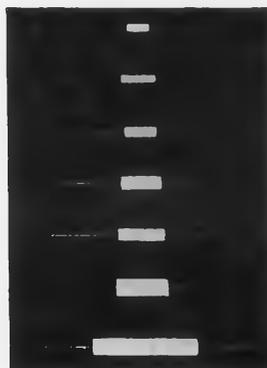
All cooling, heating, humidifying, dehumidifying, and air-moving equipment is located within an enclosed portion of the test space. The hermetically-sealed refrigeration condensing unit is located within an enclosed compartment beneath the test chamber.

The basic unit is equipped with an exterior-mounted control panel with adjustable wet and dry bulb thermostats. Optional cam-operated program controllers provide programming of the wet and dry bulb functions on a predetermined time cycle.

Both the interior and the exterior of the "Weather-Lab" are of polished stainless steel construction. Low density glass wool insulation provided minimum thermal "drag" during periods of temperature change. Hudson Bay Div., Refrigeration Systems, Inc., Dept. ED, 646 W. Washington Blvd., Chicago 6, Ill.

CIRCLE ED-436 ON READER-SERVICE CARD FOR MORE INFORMATION

Deposited Carbon Resistors In Hermetically Sealed Line



Two new sizes have been added to this company's line of hermetically sealed, deposited carbon resistors. With these additions, DC 1/8 HC (1/4w) and DC 1/2 EHC (1/2w), the line covers a range from 1/4w to 3w.

The resistors are especially recommended for applications where high temperature, radical temperature changes, or high humidity are factors. They also are valuable for applications where mechanical or chemical protection is needed. Electra Mfg. Co., Dept. ED, 2537 Madison Ave., Kansas City, Mo. This product will be on display at the Radio Engineering Show, Booth 477.

CIRCLE ED-437 ON READER-SERVICE CARD FOR MORE INFORMATION

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-438 ON READER-SERVICE CARD FOR MORE INFORMATION

MORE DESIGN FREEDOM

accurate motion

transfer
without
complicated
gearing...

SIERRA MINIATURE MECHANICAL
CHAIN AND SPROCKETS...

Provide precise, positive motion transfer through several planes simultaneously with no cable slippage...no complicated gearing. Unlimited center-to-center selection for miniature and sub-miniature assemblies in servo systems, gyro systems, special cameras, electronic equipment, and small precision instruments. Less weight, cost, maintenance—wider tolerances. Designed to operate around minimum 7-tooth sprocket with root diameter of .250 inches. Chain pitch .1475 inches; Weight .45 oz. per lineal ft. Material: stainless steel, or other materials, including non-magnetic beryllium copper.

NEW CATALOG



Contains useful application data, specifications, tables on chain pitch and sprocket sizes, suggestions for calculating center-to-center distance. Write for yours today.

123 E. Montecito Avenue,
Sierra Madre, California

Sierra
ENGINEERING CO.

T. M. REG.

CIRCLE ED-439 ON READER-SERVICE CARD FOR MORE INFORMATION



Something in Common

No single tool...
not even
a hairpin...
works best
for all applications.
This is
true of
diodes, too.

The Hughes line of semiconductor devices is multiplying swiftly. It comprises several different categories and numbers more than two hundred separate RETMA, JAN, and special diode types. This means that you can now spell out requirements for a diode in terms of your particular circuit application. And it means that one or more types in the extensive Hughes line will most probably match those requirements with *just the right* characteristics.

Greater selectivity is one of the results of the vigorous and continuing Hughes program of research and devel-

opment—a program aimed directly at satisfying anticipated industrial and military requirements. At the same time, your assurance of better quality and thorough dependability in *all* Hughes semiconductors is maintained. So, when you need diodes with High Temperature . . . High Forward Conductance . . . Computer Type . . . High Back Resistance . . . JAN-Approved . . . General Purpose, or other special characteristics, be sure to ask about Hughes Diodes. The chances are that you will find just the one you want.

At the IRE Show

We will be displaying samples of our famous GERMANIUM POINT-CONTACT DIODES, as well as the new GOLD JUNCTION and SILICON JUNCTION series. You will want to inspect the operating demonstration of light beam voice transmission system, with circuitry featuring our latest types of NPN fused junction transistors and photocells. So come in to Booths 753-5-7 and pay us a visit. You will be most cordially welcome.

Hughes

SEMICONDUCTOR SALES DEPARTMENT

Aircraft Company, Culver City, Calif.



New York Syracuse
Philadelphia Chicago

ALL SUBMINIATURE DIODES MADE BY HUGHES ARE FUSION-SEALED IN A ONE-PIECE MOISTURE-PROOF GLASS BODY. ACTUAL DIMENSIONS, DIODE GLASS BODY: 0.265-INCH LONG, BY 0.105-INCH DIAMETER, MAXIMUM.

CIRCLE ED-440 ON READER-SERVICE CARD FOR MORE INFORMATION

Grommet

Easily Locks Wire to Panels



With only simple assembly motions, and with little or no tooling, a "Moorhead Roll-Lock" Grommet will lock a wire, rod, or tube into the housing of an electrical

device, the instrument panel of an airplane, or similar support. In assembly, the grommet is pushed through a hole in the panel. Then the wire (or rod or tube) is pushed through the grommet head for at least 6" as illustrated. When the wire is pulled back, the grommet locks in position.

The grommet also can serve a secondary purpose as a seal. Specific types of these grommets have held hydrostatic pressures of 225psi. Sealing can be against water, air, gases, moisture, chemicals, oils, solvents or dusts. Outboard or over-hung loads, such as lamps, switches, or small assemblies of any kind, can be supported by the grommets. Assembly can be controlled to permit precise positioning. Disassembly can be made easy; or, with a different design of grommet, disassembly can be made impossible unless the grommet is destroyed.

All grommets of this type of inherently shock absorbing, vibration dampening, and silencing. With appropriate changes in design, the hole in the supporting member of the assembly can be clean, flanged, extruded, or recessed. The grommets also can serve as shock mounts or "feet" for instruments and portable devices. Spencer Rubber Products Co., Dept. ED, Manchester, Conn.

CIRCLE ED-441 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse System Package

For Airborne Use



These pulse systems are reduced in size and weight for use in light-weight radar systems. The design includes incorporation of pulse switching relays, de-spiking circuits, and Bifilar

pulse transformers if magnetron circuits require them. Aircraft-Marine Products, Inc., Dept. ED, 2100 Paxton Street, Harrisburg, Pa. *This product will be on display at the Radio Engineering Show, Booth 770.*

CIRCLE ED-442 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

REGULATED POWER SUPPLY



with **0.001%
REGULATION**

- 0-500 Volts 0-200 MA
- 0.001% REGULATION
- 0.01 ohms IMPEDANCE
- 0.1 millivolts RIPPLE
- 0.003% STABILIZATION

Model **UHR-220**

The Krohn-Hite Model UHR-220 is a compact (7½" wide x 10" high) Power Supply for applications requiring ultra-high regulation, extremely low ripple and unusual stabilization under severe input line voltage transients.

The ultra-high regulation applies over the entire operating range. Full rated maximum current can be drawn at any output voltage from 105 to 125 volt line.

The internal impedance is less than 0.01 ohms for low frequencies and d-c and less than 0.1 ohm for frequencies as high as 100 k-c.

A 0-150 volt, 0-5 ma, bias supply with 0.05% stabilization and 0.002% ripple is available in addition to two 6.3 volt unregulated a-c outputs of 5A capacity.

PRICE \$350.00

For Further Details Write

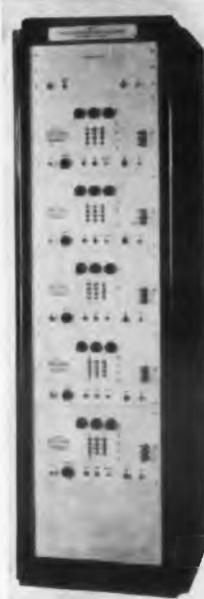
KROHN-HITE INSTRUMENT COMPANY,

DEPT. ED,
Cambridge 39, Mass.

CIRCLE ED-443 ON READER-SERVICE CARD FOR MORE INFORMATION

Interval Generator

For Series of Preset Delays



The Model 3157 Multiple-Sequence Megacycle Preset Interval Generator provides a convenient means of generating a series of preset time delays adjustable in increments of 1μsec. Typical applications include multiple-sequence control of high-speed camera systems and radiographic units for use in firing ranges and destructive testing facilities.

The system includes a 1Mc crystal-controlled master oscillator feeding one or more present counters that are capable of producing an output pulse any desired number of counts (microseconds) after application of a start pulse. Each counter is set to the desired number

of microseconds (up to 999) by means of front panel selector switches. For sequential intervals or extended delays, the output of one counter may be used to start another.

Provisions are made for using the equipment as a multiple-channel-interval timer. Pulses defining an interval are used to open and close an electronic gate that causes 1μsec-spaced pulses to be counted during the unknown interval. Direct indication in microseconds is by means of neon lamps, arranged in binary-coded decimal form.

The model illustrated has five separate timing channels. More or less channels can be provided. Potter Instruments Co., Inc., Dept. ED, 115 Cutter Mill Rd., Great Neck, N. Y.

CIRCLE ED-445 ON READER-SERVICE CARD FOR MORE INFORMATION

Terminal

Provides Hermetic Seal



This rivet-type, hermetic seal bushing meets MIL-T-27 specifications and conforms to

the MIL-T-27 Twist Test. It is designed to provide a terminal which will not develop cracks or leaks and which will save space for capacitor manufacturers. Insulation resistance at 45% relative humidity at sea level is over 500,000 megohms.

The terminal can be supplied and installed at a low price, and is available in five standard styles. It can be modified to meet the customer requirements. Heldor Manufacturing Corp., Dept. ED, 238 Lewis St., Paterson, N. J. This product will be on display at the Radio Engineering Show, Booth 863.

CIRCLE ED-446 ON READER-SERVICE CARD FOR MORE INFORMATION

APPLICATIONS UNLIMITED

A new, informative 16-page booklet just published by The Beryllium Corporation, world's largest producer of beryllium copper.

- Contains nearly 40 case histories
- Pictures galore
- Shows how Beryllco beryllium copper has solved many troublesome design and engineering problems

A free copy of this invaluable booklet is yours for the asking.



FILL IN

THE COUPON
AND MAIL IT
TODAY!

THE BERYLLIUM CORPORATION
DEPT. S-C, READING 24, PA.

Please send me a copy of "Applications Unlimited" at once.

Name Occupation

Company

Street

City

Zone State

CIRCLE ED-447 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:

±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):

¼" dia. x ½" long.

Resistance range: 1.0 ohm

-0.35 meg.

Send for Bulletin H for complete description on other physical sizes and wattage ranges.

HYCOR
Company, Inc.

11423 Vanowen St., North Hollywood 4, Calif.

CIRCLE ED-448 ON READER-SERVICE CARD FOR MORE INFORMATION

FOR THE DIFFICULT TIME DELAY JOBS

- Hermetically sealed
- Miniature construction
- Light Weight
- Accurate timing over wide temperature range
- Long term repeatability
- Withstands extreme shock and vibration

SEND FOR COMPLETE DETAILS

BRANSON
Corp.

BOONTON, NEW JERSEY

CIRCLE ED-444 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW! 1955
MICROTRAN
TRANSFORMER CATALOG!
 LISTS HUNDREDS OF MINIATURE
 TRANSFORMERS AVAILABLE
 AS STOCK ITEMS!

Miniaturizing? Don't gamble!
 Use these field-tested and
 proven MIL-T-27 type designs.

- No sampling expense — no wasted time!
- Eliminate redesign of production equipment!
- Used in guided missiles, airborne equipment, servos, transistor amplifiers, high temperature applications, and many, many other applications.

Immediate delivery at key industrial distributors!
Write — right away — for the brand new 1955 Microtran Catalog! Gives detailed information about available stock items: Hermetically Sealed, Molded, Encapsulated, Cased.

microtran co. 84-11 Blvd., Rockaway Beach, N.Y.



CIRCLE ED-416 ON READER-SERVICE CARD FOR MORE INFORMATION

★ **A Motor for**
LOW SPEED OPERATION



If you are now manufacturing a product or developing a product where you need motion at slow speed, here is the motor for you. Hundreds of thousands now in use on cooking appliances, vending, coin operated, amusement, and advertising displays.

These AC gear motors are precision built and are being manufactured in volume for immediate delivery. For further information, send the requirements of your application to us. Special motors are built to meet your new product needs. Write today for data sheet.

MOTORESEARCH COMPANY
 1600 JUNCTION AVENUE
 RACINE, WISCONSIN
 Designers and Manufacturers of
SPECIAL INDUCTION MOTORS

★ CIRCLE ED-417 ON READER-SERVICE CARD FOR MORE INFORMATION

Relay

In Flexible Armature Design



The Series 23 Relay is equipped with a flexible armature and adjustable contacts. The first feature makes the relay ideal for a-c as well as d-c use; the second provides for an easy readjustment after the unit has been placed in service.

The relay is a highly sensitive unit (30mv) which exhibits excellent high speed keying characteristics and weighs less than 2 oz. Coil resistances up to 5000 ohms are available with a maximum continuous coil dissipation of 1w. Adjustable spdt contacts are rated at 1amp 110v d-c. It is suited for such applications as a plate circuit relay; for a-c or battery operated remote control units; and any control apparatus where space, economy, and current drain are the chief design factors.

Additional features available for special applications include coil resistances up to 13,000 ohms, 11-18mw adjustment, insulated mounting, varnish-impregnated coils, dust cover or hermetic sealing, contacts rated at 2amp, 110v, a-c, high drop out, and tropicalization. Kurman Electric Co., Dept. ED, 35-18 37th St., Long Island City 1, N. Y.

CIRCLE ED-418 ON READER-SERVICE CARD FOR MORE INFORMATION

Amplifier

For Differential Transformers



Static, transient, or higher frequency oscillatory physical phenomena, including force, pressure, stress, strain acceleration, and displacement, can be studied and accurately measured using the Model 400 Differential Transformer Amplifier in conjunction with available differential transformer transducers. The unit includes a carrier oscillator, demodulator, and all circuits necessary to provide an output suitable for display or photographing on a cathode ray oscillograph. Low impedance output for galvanometer oscillographs is optionally available.

Featured are stable calibration, overall linearity exceeding 1%, and flat frequency response from zero to 1000cy within 1/2db. Transducer core displacements as small as 0.0001" can be measured. Daytronic Corp., Dept. ED, 216 S. Main St., Dayton 2, Ohio.

Featured are stable calibration, overall linearity exceeding 1%, and flat frequency response from zero to 1000cy within 1/2db. Transducer core displacements as small as 0.0001" can be measured. Daytronic Corp., Dept. ED, 216 S. Main St., Dayton 2, Ohio.

CIRCLE ED-419 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW!

over 15 million
Microdot coax
combinations

Microdot cuts design time by multiplying possibilities... with the world's smallest, lightest microminiature coax connectors and cables. See the unique Microdot line at the IRE Show, Booth 679, Kingsbridge Armory, N. Y., March 21-24, or write today for applications data.



MICRODOT
 1826 FREMONT AVENUE
 SO. PASADENA - CALIF.

CIRCLE ED-420 ON READER-SERVICE CARD FOR MORE INFORMATION

MICRODOT
data
example
70 OHM

CABLES

- Z₀
70 ohms
- C
21 mmf/ft
- Δ (400 mc)
.17 db/ft
- V
70% (Teflon)
- T
up to 400° F

CONNECTORS

- "S"
Screw Series
- "QC"
Quick Connect
- "P"
Pressurized

Available:

- Plugs, Jacks, Receptacles, BNC Adapters, Feed-throughs and special designs.

CURTIS
TERMINAL BLOCKS
 for
EVERY PURPOSE
 in Factory Assembled
 and Kit Form
SEE THEM
BOOTH 644
 Radio Engineering Show
 Kingsbridge Armory
 Bronx, New York
 March 21-24

CURTIS DEVELOPMENT & MFG. CO.
 3236 North 33rd Street, Milwaukee 16, Wisconsin

CIRCLE ED-421 ON READER-SERVICE CARD FOR MORE INFORMATION

RESINITE CORPORATION

invites you to visit
BOOTH No. 791*

AT THE
Radio Engineering Show

**1955 IRE
NATIONAL CONVENTION**
New York City... March 21-24

Kingsbridge Armory,
Airborne Avenue



The coil form with the highest resistivity of any resinated product. Custom fabrication to your exact specification assures correct dimensions to within the most critical tolerances.

We will furnish—without charge—a pilot production run of custom-made embossed forms to fit your particular application.

**RESINITE
CORPORATION**

Get full information on Use of Threaded Tubes, Threaded Iron Cores VS. Torque Control.

Sales Representatives in:

New England: Framingham, Mass., Framingham 7091	Philadelphia: Philadelphia, Pa., Chestnut Hill 8-0282
New York, New Jersey: Jersey City, New Jersey, Journal Square 4-3574	Northern Ohio, Western Pennsylvania: Cleveland, Ohio, Atlantic 1-1060
Upstate New York: Syracuse, N.Y., Syracuse 76-8056	Indiana, Southern Ohio: Logansport, Indiana, Logansport 2555
Maryland: Baltimore, Maryland, Plaza 2-3211	Missouri, Southern Illinois, Iowa: St. Louis, Missouri, Sterling 2318
Canada: Montreal, Quebec, Canada, Walnut 2715	California: Pasadena, California, Sycamore 8-3919

PRECISION PAPER TUBE COMPANY
2035C W. CHARLESTON ST. • CHICAGO 47, ILLINOIS

CIRCLE ED-422 ON READER-SERVICE CARD FOR MORE INFORMATION

Standardized CORD SETS Ready for Your APPLICATION

Cords manufactures a complete line of U.L. approved cord sets for any application. Through their extensive standardization, Cords Ltd. can reduce both your engineering and inventory costs . . . and at the same time furnish quality cord sets at a competitive price. Sales offices in principal cities.

Write Cords today for free catalog outlining complete specifications of standard cord sets . . . or for Bulletin C442 on new 3 conductor U.L. approved cord sets.

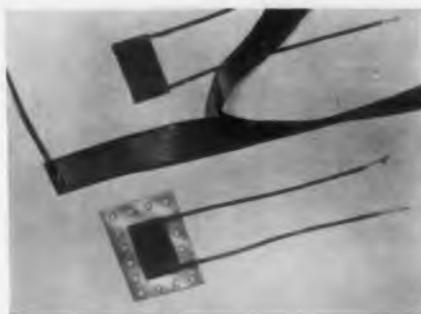
CORDS LIMITED

DIVISION ESSEX WIRE CORPORATION
121 DODGE STREET, DEKALB, ILLINOIS

CIRCLE ED-423 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

Heating Elements In Flexible Strips and Blankets



These electric heating elements have a wide variety of uses, such as maintaining temperature in electronic and electrical apparatus. In form, they are flexible blankets or

strips, as illustrated. For ease of mounting or for the purpose of reducing flexibility, they are also offered with a perforated stainless steel backing.

The thinness (0.100" or less) and flexibility of the elements allow installation at the place of need. Light weight is often a factor in their selection, as is their ability to operate under pressure in excess of 100psi. The insulation used is silicone rubber and fiberglass cloth. The assembly can withstand continuous operation at temperatures in excess of 450°F.

Offered as pre-engineered standard elements, they are available in great size and variety from 1" x 1-1/2" overall to 24" x 42". Resistance variation is infinite throughout a wide range; tolerance is $\pm 7\%$. Electro-Flex Heat, Inc., Dept. E-2, 516 Asylum St., Hartford 5, Conn.

CIRCLE ED-424 ON READER-SERVICE CARD FOR MORE INFORMATION

Picture Tube 17" 90° Deflection Type



This improved 17" bulb design permits 90° deflection. It provides a weight reduction of 5-1/2 pounds, with a resulting overall length reduction of about 3", compared to previous 17" models.

Two new tube types (17ATP4 and 17ATP4-A), are available. Both are electrostatic-focus, directly-viewed picture tubes of rectangular glass construction, with a nominal screen diagonal of 17"; both tubes have external conductive coatings. The 17ATP4-A has an aluminized screen for increased picture brightness. Westinghouse Electronic Tube Div., Dept. T-215, Box 284, Elmira, N. Y.

CIRCLE ED-425 ON READER-SERVICE CARD FOR MORE INFORMATION

STRIP WIRE . . .

✓ **FASTER**
✓ **CLEANER**
✓ **WITHOUT
CRUSHING!**

WITH THE

Speedex

**AUTOMATIC
WIRE STRIPPER**

Now . . . save at least 90% of your wire stripping time. New Speedex Automatic Wire Stripper strips both solid and stranded wire. Heavy duty for shop or production use. "Delayed return action" prevents crushing. Range of models for every requirement. See your distributor or write direct for information.

Model 766-B

Net Price
\$4.95
(\$8.25 list)



Wood Specialty MANUFACTURING CO.

DIVISION OF GENERAL CEMENT MFG. CO.

928 Taylor Avenue

Rockford, Illinois

CIRCLE ED-426 ON READER-SERVICE CARD FOR MORE INFORMATION

FREE
Subscription
to
*Applied
Magnetics*



You should receive *Applied Magnetics* if you're interested in, or responsible for, the design or development of products using permanent magnets.

Some of the practical material discussed in recent issues of this bi-monthly publication include (1) How Magnets Help Solve Your Measurement Problems, (2) Nuclear Resonance—Giant Magnets in Research, (3) Will the Permanent Magnet Replace the Mechanical Latch? For your free subscription, write to *Applied Magnetics*, Dept. M-3, of:

**THE INDIANA
STEEL PRODUCTS COMPANY
VALPARAISO, INDIANA**

**INDIANA
PERMANENT
MAGNETS**

World's Largest Manufacturer of Permanent Magnets

CIRCLE ED-427 ON READER-SERVICE CARD FOR MORE INFORMATION

SEALED

TWIST-PRONG ELECTROLYTICS

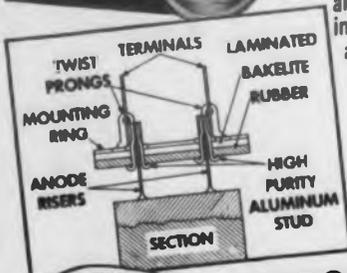
Capacitors

New cover design for twist-prong electrolytics embodies several highly desirable features . . .

All-in-one phenolic disk and sealing rubber. Greater basic strength than with usual separate layers of phenolic and rubber. Lead connection through stud to terminal, for excellent moisture seal. Design flexibility allows greater size and shape variation of terminals. No internal contact between dissimilar metals. Interchangeable with other types—but superior in performance.

Literature . . .

Sent on request. Let us collaborate on your capacitor requirements—with the most complete line available today—and let us quote.



AEROVOX CORPORATION

AEROVOX CORPORATION
New Bedford, Mass.

In Canada: AEROVOX CANADA LTD., Hamilton, Ont.

CIRCLE ED-404 ON READER-SERVICE CARD FOR MORE INFORMATION

HEYCO NYLON STRAIN RELIEF BUSHINGS CUT PRODUCTION COSTS AND IMPROVE PRODUCT QUALITY



1—SLIP OVER WIRE
2—SNAP INTO HOLE

Approved

With Heycos it's no longer necessary to tie wire knots or use insulating grommets. Product life is increased and product appearance is greatly enhanced.

HEYMAN MANUFACTURING COMPANY
Kenilworth 16 New Jersey



Send wire sizes for free samples and specifications.

CIRCLE ED-405 ON READER-SERVICE CARD FOR MORE INFORMATION

Bridge

Rapidly Compares Inductances



The Type 1870 Incremental Inductance Comparison Bridge is designed for rapid testing of transformers and chokes under actual operating conditions. The use of 4" easy-to-read meters and

a minimum number of operating controls assures rapid and reliable operation.

The instrument consists of a variable 0 to 500ma d-c supply, a 60cy 0 to 135v a-c supply, a comparison circuit, and a vacuum-tube voltmeter. A jack is incorporated for connecting an external oscillator to supply other test frequencies. Inductances of 25mh to 25hy can be compared on a deviation range of $\pm 20\%$ with an accuracy of $\pm 1\%$, and deviation of $\pm 50\%$ with an accuracy of $\pm 5\%$.

All controls and power supplies are contained in one unit. The instrument operates from a 100-125v, 50-60cy line. Freed Transformer Co., Inc., Dept. ED, 1715 Weirfield St., Brooklyn 27, N. Y. *This product will be on display at the Radio Engineering Show, Booth 522-524.*

CIRCLE ED-406 ON READER-SERVICE CARD FOR MORE INFORMATION

Steel Slides

Aid Equipment Maintenance



Two sizes of heavy-duty telescoping steel slides, precision fabricated of sheet metal, have been developed to facilitate movement of fixed objects or materials from "in-

use" to "storage" positions within aircraft compartments. Important economies in weight and space result from these close-tolerance stampings, which are designed to replace extruded types.

The slides, available as counterpart pairs, are presently manufactured in two sizes: the larger pair, No. A-40346-2, is 24" long with an 18" telescoping travel, and supports a 150 lb to 250 lb load when extended. The smaller pair, No. A-40208-2, operating from a spring-action trigger, carries a 75 lb to 150 lb load when extended. Universal Metal Products Inc., Dept. ED, Alhambra, Calif.

CIRCLE ED-407 ON READER-SERVICE CARD FOR MORE INFORMATION

PHALCOM Weather Resistant Communication Cables provide Year Round Dependability for...

—Motorola—Microwave—

This is the cable . . . Motorola and Phalo engineers collaborated on its design and manufacture.

The cable had to be tough . . . had to perform in tough weather and in rough terrain, 24 hours a day.

These Motorola Microwave Cables, (14 and 24 conductors) connect DC and AC voltages from remotely located control panels and power supplies to outdoor equipment in outdoor housing.

Here is a classic example of Phalo's ability to develop that special cable for that special communication application!

PHALCOM Cables!

Send for complete Phalo catalog

PHALO PLASTICS CORPORATION

25-1 FOSTER ST., WORCHESTER, MASS.

Insulated Wire and Cables—Cord Set Assemblies

CIRCLE ED-408 ON READER-SERVICE CARD FOR MORE INFORMATION

P GRIEVE-HENDRY PORTABLE ELECTRIC OVENS...

Standard Models
For Every
Special Need!



Model CR-1
10 cu. ft. capacity—30" wide x 25"
deep x 24" high. Removable shelves
and drip pan. **\$89.50**

Chicago

Portable. Costs less than 5c per hour to operate. Adjustable temperature control to 225° F. Fan driven forced air circulation. Uniform temperature throughout. Plugs into any 110V wall outlet—no special wiring required.

Can be used in a group or bank.
Use them on the production line
—save handling—hauling.

Other standard models with
temperature ranges to 1000° F.
available. Write for literature.

GRIEVE-HENDRY CO., INC.

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

CIRCLE ED-409 ON READER-SERVICE CARD FOR MORE INFORMATION

save with standard



UNBRAKO

BUTTON HEAD SOCKET SCREWS

BUTTON HEAD FEATURES

designed for applications where countersinking is not practicable
heat treated alloy steel for strength

low head height for streamlining designs

accurate hex sockets for nonslip drive and freedom from marred heads or mutilated work

fully formed threads—Class 3 fit

Save time and money by using standard UNBRAKO Button Head Socket Screws. Stocked in standard sizes—#8 through 5/8"—by your authorized UNBRAKO industrial distributor. Ask him for Bulletin 856. Or write STANDARD PRESSED STEEL Co., Jenkintown 12, Pa.

UNBRAKO SOCKET SCREW DIVISION

SPS

JENKINTOWN PENNSYLVANIA

CIRCLE ED-410 ON READER-SERVICE CARD FOR MORE INFORMATION



SIMPLIFY CIRCUIT TRIMMING with BOURNS sub-miniature TRIMPOTS

- Resolution: As low as 0.25%
- Power Rating: 0.25 watt at 100° F.
- Weight: Only 0.1 oz.

One of many applications when space is at a premium

BOURNS TRIMPOT is a 25 turn, fully adjustable wire-wound potentiometer, designed and manufactured exclusively by BOURNS LABORATORIES. This rugged, precision instrument, developed expressly for trimming or balancing electrical circuits in miniaturized equipment, is accepted as a standard component by aircraft and missile manufacturers and major industrial organizations.

Accurate electrical adjustments are easily made by turning the exposed slotted shaft with a screw driver. Self-locking feature of the shaft eliminates awkward lock-nuts. Electrical settings are securely maintained during vibration of 20 G's up to 2,000 cps or sustained acceleration of 100 G's. BOURNS TRIMPOTS may be mounted individually or in stacked assemblies with two standard screws through the body eyelets. Immediate delivery is available in standard resistance values from 10 ohms to 20,000 ohms. BOURNS TRIMPOTS can also be furnished with various modifications including dual outputs, special resistances and extended shafts.

BOURNS also manufactures precision potentiometers to measure Linear Motion; Gage, Absolute, and Differential Pressure and Acceleration.

BOURNS LABORATORIES
6135 MAGNOLIA AVENUE, RIVERSIDE, CALIFORNIA
3 L. PATENTS PENDING Technical Bulletin on Request, Dept. 232

CIRCLE ED-411 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

□ Voltmeter

In Kit or Wired Form



The Model 249 Peak-to-Peak VT-VM is offered either in kit or factory-wired form, and is supplied with the dual-purpose a-c/d-c "Uni-Probe".

A half-turn of

the tip of this probe selects either a-c or d-c ohms.

The Model 249 features a stable push-pull triode bridge circuit, with accuracy unaffected by line voltage variations. Among others, it reads peak-to-peak voltages of complex and sine waveforms from 0-4v to 0-4200v; rms voltage of sine waves and d-c voltages from 0-1.5v to 0-1500v (to 30kv with the high voltage probe); and resistance from 0-100 megohms. Accuracy is $\pm 3\%$ or better.

Seven non-skip ranges on every function assure a uniform 3:1 scale ratio between adjacent ranges for extreme wide-range accuracy. The unit provides for center-scale zero adjustment for TV/FM alignment, and for calibration from outside the cabinet. Its 7-1/2" meter, electronically protected against burn-out, provides extra convenience and legibility. Electronic Instruments Corp., Dept. ED, 84 Withers St., Brooklyn 11, N. Y. This product will be on display at the Radio Engineering Show, Booth 209-211.

CIRCLE ED-412 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse Transformers

Toroidal Miniatures



The GM Series toroidal steel core pulse transformers produce rectangular pulses with durations, when operated in this firm's standard blocking oscillator circuit, of 0.05, 0.1, 0.2, 0.5, 1 and 2 μ sec. Available with two or three windings, they are epoxy resin impregnated and encapsulated, and they are impervious to moisture.

The transformers feature 1:1 turns ratio, small size (3/8" x 3/8" x 2-3/8" overall), light weight (1/2gr to 2gr, depending on type), extremely fast rise time (better than 0.005 μ sec for the 0.1 μ sec unit), and clear identification of leads. They are tested at 2000v rms and will withstand repeated thermal shock cycles from -70° to $+135^\circ$ C. They surpass MIL-T-27, Grade 1, Class A test specifications. The Gudeman Co. of California, Inc., Dept. ED, 9200 Exposition Blvd., Los Angeles 34, Calif.

CIRCLE ED-413 ON READER-SERVICE CARD FOR MORE INFORMATION

Does that new design call for a special transformer?

... One that's special in coil design or frequency response? Is insulation a problem? or weight? or size?

You may find the answer in our design department, staffed by engineers who are experienced not only in transformer design but also in the communications systems. They approach your problem with a knowledge of your over-all circuit requirements, and design a transformer that meets *all* your needs *exactly*.

And when the transformer has been proved, we have streamlined facilities to produce it in the quantity you need.

When you have a transformer problem, call on



Dept. ED-3, Caledonia, N. Y.

CIRCLE ED-414 ON READER-SERVICE CARD FOR MORE INFORMATION

FORM-FLEX
TRANSFORMERS



See How FORM-FLEX Saves!
CUTS WEIGHT 40%—BULK BY 30%

... gives Absolute Transformer Protection at Lower Cost.

Pioneering the development of encapsulation in transformer manufacture has brought Aircraft Transformer a high degree of proficiency in the production of hermetically sealed high and low temp. transformers that far exceed the requirements of MIL-T-27, Grade 1.

If you are faced with weight, space or cost limitations in your components, we invite you to explore the possibilities of our advanced methods. Our engineers and production people will gladly consult with you.

Write for complete data on transformer encapsulation with neoprene and other materials.

AIRCRAFT TRANSFORMER CORPORATION

Manufacturers of Inductive Equipment
Long Branch New Jersey

CIRCLE ED-415 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature . . .

Carbide Guide

458

A 24-page publication, "Selection of Carboly Grades and Suggested Speeds", has been issued as a supplement to section 3 of Carboly tool manual GT-191. The booklet includes data for determining efficient cutting speeds for machining steel, cast iron, and nonferrous materials, calculating machine horsepower, determining carbide grades by characteristics, selecting rake and relief angles of carbide tools, and reference tables covering speed and grade suggestions for cutting various materials. The supplement also includes latest speed and feed data on the new grades 350 and 370 carbides. Carboly Dept., General Electric Co., P. O. Box 237, Roosevelt Park Annex, Detroit 32, Mich.

Retaining Rings

459

An 8-page supplement, Supplement No. 1, contains revisions, corrections, additions, and new product developments to retaining ring catalog No. RR9-52. Two pages in the supplement are devoted to engineering data and specifications covering the use of two internal rings and two external rings in deeper grooves than those specified in the catalog. Waldes-Kohinoor, Inc., 47-16 Austel Pl., Long Island City 1, N. Y.

Transformer Catalog

460

This 20-page catalog should simplify custom-specifying of transformers for design engineers. The new catalog illustrates prototypes covering the complete range of transformer applications to make it easier and simpler to specify accurately electrical and mechanical requirements. General Transformer Co., 18240 Harwood Ave., Homewood, Ill.

Wire Cutting

461

Sixteen models of wire straightening and cutting machines for wire from 0.012" to 0.75" are described in Bulletin No. 55-1. Typical models are illustrated. A chart facilitates selection of the proper machine to meet production requirements. Lewis Machine Co., Dept. 6H, 3441 E. 76th St., Cleveland 27, Ohio.

Rack, Panel Connectors

462

A 64-page engineering bulletin provides technical information on DP rack, panel/chassis types, plus the RTC, all rack, panel/chassis designs. The bulletin contains a new descriptive index; detailed, illustrated parts; exploded views; contact detail; data summaries; comparative shell sizes; mounting area information; wire and assembly data. Complete dimensional figures and insert arrangements are given on all types. Cannon Electric Co., Advertising Dept., 420 W. Ave. 33, Los Angeles 31, Calif.

Wirewound Resistors

463

Engineering Bulletin No. L-35 describes and lists 0.10 to 2w AKRA-OHM ceramic-bobbin precision wirewound resistors from 0.1 ohm to 1000 megohms, 75 to 2000v. Resistors are offered in radial or axial lead, radial or axial lug, or bracket type mountings for almost any size and mounting requirements. Five resistance wire alloys are used, depending on required temperature coefficient, stability, and tolerance. Shallcross Mfg. Co., Collingdale, Pa.

Electronic Components

464

This company's line of standard electronic components is described and illustrated in a 56-page catalog. Among the components listed are fixed and variable resistors, line and slide switches, capacitors, powdered iron and ferromagnetic cores, and molded coil forms. Specifications and dimensional drawings are provided. Electronic Components Div., Stackpole Carbon Co., St. Marys, Pa.

Insulating Materials

465

A newly revised and enlarged 32-page catalog has descriptive information, photographs, prices, and ordering data on electrical insulating materials. A table of contents and an alphabetical product index are guides to cords and twines, woven tapes, tubings and sleeving, mica plates, slot wedges, varnishes, solvents, filling compound, slot insulation, pressure-sensitive tapes, Class H silicone insulating materials, etc. Insulation Mfg. Corp., Publications Dept., 565 W. Washington Blvd., Chicago 6, Ill.

Wire & Cable

466

A new illustrated bulletin (No. SW-1) on shielded wires and cable for microphone and sound system use describes the company's new microphone cables with semi-conducting textile shield as well as the conventional types with braided copper shield. Speech input and sound system cables with enamel-textile insulation and polyvinyl chloride insulated signal wires are also listed. Whitney Blake Co., 100 Pershing St., New Haven 14, Conn.

Bobbin-Resistor Winders

467

A new specification sheet illustrates and fully describes Models 212-AM and 212-AML bobbin-resistor winders. Complete data includes dimensions, weights, types of windings accommodated, maximum traverse for any single winding, maximum OD of coils wound, maximum distance between winding centers, wire sizes handled, tension devices available, gears, winding speeds, set-up time, and other features. Geo. Stevens Mfg. Co., Inc., Pulaski Rd. at Peterson, Chicago 30, Ill.

Speaker Enclosures

468

This 8-page brochure discussed the advantages and disadvantages of the many types of enclosures for high fidelity loudspeakers. Frequency response curves which may be expected from different cabinet types are reproduced to illustrate the characteristics of different enclosure designs. The literature also contains complete information for the design and construction of a bass reflex enclosure and detailed drawings for the construction of a corner enclosure. Altec Lansing Corp., 161 Sixth Ave., New York 13, N. Y.

Industrial TV Housings

469

Catalog No. E. 55 describes two special housings developed for use with industrial TV equipment. Features and specifications for the explosion-proof housing and for the weatherproof housing are included in the catalog sheet. Radio Corp. of America, Engineering Products Div., Building 15-1, Camden 2, N. J.

New kind of catalog

Complete facts on cathodes, anodes, grid cups — their characteristics, uses, variety



For the first time, Superior Tube Company's complete line of cathodes and other vacuum tube components appears in a single catalog. Properties of the new CATHALOYS,* plus 19 other alloys, fully covered. A detailed reference for vacuum tube designers on cathode materials, types of cathodes, and fabricated tubular parts. Write for free copy. Superior Tube Company, 2050 Germantown Ave., Norristown, Pa.

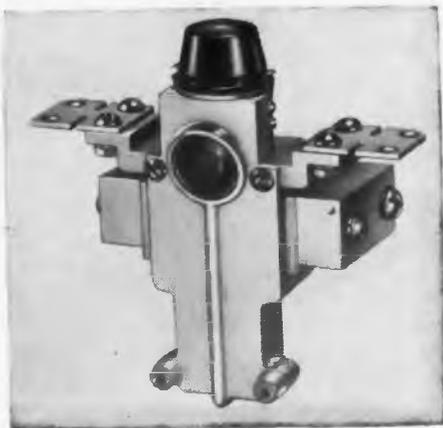
Superior Tube

The big name in small tubing

All analyses .010" to 5/8" O.D. Certain analyses in light walls up to 2 1/2" O.D.
CIRCLE ED-470 ON READER-SERVICE CARD FOR MORE INFORMATION

D. C. GALVANOMETERS— Feature Adaptability

These taut-suspension moving-coil galvanometers feature adaptability through balanced electrical design. Their unusually high sensitivity (0.01 microamp. per mm.) is in balance with maximum ruggedness, making them stand up well under the severest use as components of industrial apparatus. The galvanometers



as sensitive current and voltage measuring instruments because of their concentric pole piece construction and the use of stable Alnico magnets.

Complete specifications for pointer and mirror type galvanometers are given in a new 4-page illustrated catalog containing all electrical and dimensional specifications.

G-M LABORATORIES INC.
4342 N. Knox Ave., Chicago 41, Ill.

CIRCLE ED-471 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistor Catalog 472

A technical data sheet has been issued on this company's line of diffused p-n-p junction transistors. The sheet illustrates the double sealing process—encapsulated in plastic and hermetically sealed in a can. It also includes absolute maximum transistor ratings and characteristics. General Transistor Corp., 95-18 Sutphin Blvd., Jamaica 35, N. Y.

Magnetic Tape 473

The seven questions recording engineers have asked most often about "Scotch" brand "Extra Play" magnetic tape No. 190 are answered in this 8-page booklet. Discussed in the booklet are such points as playing time, tape strength, reel sizes, recorder settings and performance characteristics. Minnesota Mining and Mfg. Co., 900 Fauquier St., St. Paul 6, Minn.

Using Gears 474

A 4-color brochure describes "Geartronics", an approach to solving gear problems conceived by this firm. This bulletin touches upon the application of true precision gears used under conditions of exceedingly high speeds or extreme temperatures. Actual design cases are used as illustrations. Technical Products Co., Inc., Powder Mill Rd., W. Concord, Mass.

Tubes 475

This indexed catalog contains diagrams and charts of this firm's line of tubes. Information is included on tetrodes, pentodes, triodes, klystrons, rectifiers, vacuum capacitors, vacuum pumps and gages, switches, sockets, and heat-dissipating connectors. Eitel-McCullough, Inc., 198 San Mateo Ave., San Bruno, Calif.

Radioisotope Instruments 476

A 28-page catalog of radiation instruments describes scintillation counters, scalers, and their corresponding electronic equipments, as well as a variety of radioactivity counting accessories. Each instrument is illustrated and specifications given. NRD Instrument Co., 6429 Etzel Ave., St. Louis 14, Mo.

Power Supply News 477

A new technical periodical, "Perkin Power Supply Bulletin", will include technical characteristics and articles concerning the latest advances in the field of magnetic amplifiers and power supplies. Subscriptions are available gratis. Perkin Electric Corp., 345 Kansas St., El Segundo, Calif.

SEE THE LATEST IN
Electronics
EQUIPMENT



FREE

Send for

Newark's 1955 Catalog

Here are the latest releases in tubes, transformers, capacitors, test instruments and everything in electronics parts and equipment. See also the newest developments in Radio, TV and High Fidelity.

NEWARK
ELECTRIC COMPANY

Dept. ED-3, 223 W. Madison, Chicago 6, Ill.

CIRCLE ED-479 ON READER-SERVICE CARD FOR MORE INFORMATION

compact CRYSTAL TEMPERATURE CONTROL

with the NEW
VALPEY VCO-2
CRYSTAL
OVEN

The Valpey type VCO-2 Oven is a very compact temperature controlled housing for two standard mounted crystal units. Oven occupies approximately the space of a single vacuum tube.

The base of the oven contains two 2-pin sockets to receive JAN-HC-6/U, JAN-HC-13/U or Valpey Model VR-6 crystal units, and supports the four watt heater element and its thermostat.

The one-piece, heavy anodized aluminum cover threads onto the base to simplify changing crystals. Base plugs into standard octal socket.

Operating temperature: 75°C
±1° from -10°C to
+70°C.
Operating power: 4 watts,
6.3, 12.6 or 28 volts, AC
or DC.
(Higher wattage available
on special order)
Weight: 57.5 grams, exclu-
sive of crystals.
Connection brought out for
pilot lamp.
Isolated crystal connections.



Write for
Bulletin 2-55.



VALPEY Crystal CORPORATION

1242 Highland Street
Holliston, Mass.

Craftsmanship in Crystals since 1931

CIRCLE ED-478 ON READER-SERVICE CARD FOR MORE INFORMATION

WINCHESTER ELECTRONICS, INC.

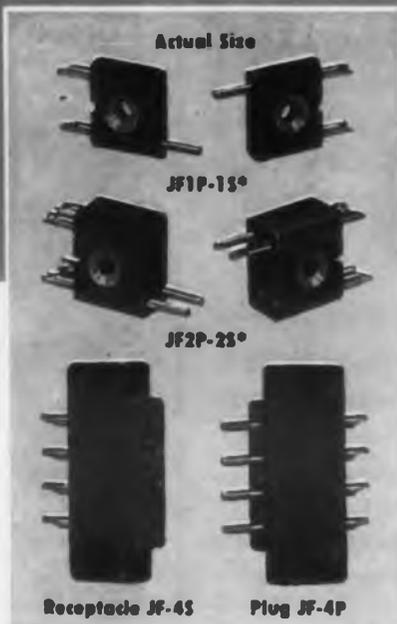
MINIATURE SIDE MOUNTING PRECISION Series "JF" CONNECTORS ...use minimum space

• Exceptionally flat mounting (with countersunk side holes)—to achieve maximum space economy in miniaturized equipment—is one of the principal features of Winchester Electronics' "Series JF" Connectors. Additionally, extreme light weight... and high dielectric strength and arc resistance... enable engineers and designers to realize weight savings and higher operating voltages when these units are incorporated in airborne and portable apparatus. MONO-BLOC† construction to eliminate internal creepage paths and to reduce dust and moisture pockets, and precision machined contacts, gold plated over silver, are the "plus" values that have established Winchester Electronics Connector quality as highest in the industry.

New Designs . . . New Applications
On Display at the Radio Engineering Show
Booth 628, Circuits Avenue

WINCHESTER ELECTRONICS, Inc. PRODUCTS
and DESIGNS ARE AVAILABLE ONLY
FROM WINCHESTER ELECTRONICS, Inc.

West Coast Branch: 1729 Wilshire Blvd., Santa Monica, California



*CODE NUMBER FOR INDIVIDUAL UNITS:
TO BE USED IN PAIRS. †TRADE MARK

**WINCHESTER
ELECTRONICS**
INCORPORATED

NORWALK, CONNECTICUT

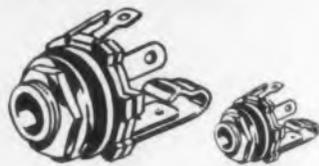
CIRCLE ED-480 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW! "TINI-PLUGS" and "TINI-JAX" BY SWITCHCRAFT INC.

FOR MINIATURE
RADIOS, TAPE
RECORDERS, ETC.

COMPARATIVE SIZE

Incorporating
the features of
"Littel-Jax" and
"Littel-Plugs"
that have
made them the
preferred
components of
Design Engineers.



• "LITTEL-
PLUG"

• "TINI-
PLUG"

• "LITTEL-
JAX"

• "TINI-
JAX"

- High grade insulation through-out; one piece tip rod staked into tip terminal to insure tightness; terminals and body of plug interlock eliminating any shifting; available in black and red Tenite handles and shielded handles.

Switchcraft design eliminates probability of electrical shorts or change in adjustment; mating plug held firmly; springs of special alloy of nickel silver insure maximum spring life.

SWITCHCRAFT
INC.

1312 N. Halsted St.
Chicago 22, Ill.
Canadian representative
Atlas Radio Corp., Ltd.
560 King St. W., Toronto 2B, Canada
Phone: Waverly 4761

Write for details
See these and other NEW products
at Booth No. 435
RADIO ENGINEERING SHOW
Kingsbridge Armory
New York, N. Y.
MARCH 21-24

CIRCLE ED-481 ON READER-SERVICE CARD FOR MORE INFORMATION

Plug-In Components

482

A 32-page illustrated bulletin, No. 81554, presents circuit drawings and specifications on 29 different plug-in units. A number of typical applications are also presented to illustrate their uses. The plug-in units include linear and pulse amplifiers, cathode followers, diodes, flip-flops, gates, a multivibrator, oscillator, phantastrons, power supplies, squaring circuits, and other units. Eeco Production Co., 827 Vermont Ave., Los Angeles 5, Calif.

Adhesives

483

Typical starting formulations, properties, and methods of application of liquid polymer/liquid epoxy resin adhesives are described in a 16-page booklet. Features of the adhesives include shear strengths as high as 2500psi with room temperature cures and as high as 4500psi with elevated temperature cures. They are suitable for bonding aluminum, steel, copper, tin, zinc, wood, glass, ceramics, plastics, leather, and rubber, among other materials. Thiokol Chemical Corp., 780 N. Clinton Ave., Trenton 7, N. J.

Insulation Testers

484

This 24-page edition of Bulletin No. 21-20 contains information and application data on two new high range "Megger" resistor-operated insulation resistance testers. Many data on uses, operation, construction features, characteristics, ranges, and accessories are provided, as are numerous illustrations. James G. Biddle Co., 1310 Arch St., Philadelphia 7, Pa.

Maintenance Facilities

485

Facilities for servicing, repairing, and reconditioning electronic devices in the midwest area are described in this brochure. Chicago Electronics Laboratories, 1214 W. Madison St., Chicago 7, Ill.

Stamping

486

This company's method of stamping products for precision parts in short runs is described in a brochure. Diagrams illustrate tooling. Quality Stamping Products, 5322 Bragg Rd., Cleveland 27, Ohio.

electronic

engineers

applied

physicists

wanted to work in basic research and development for commercial and military applications.

You will find unusual opportunities for rapid advancement and professional growth as part of a team of recognized scientists and engineers.

Positions at all levels available for work in:

- Advance pulse circuits
- Digital system testing
- Magnetic core techniques
- Data conversion systems
- Electronic packaging
- Logical design
- Semi-conductor circuits
- Materials research

For personal interview, send resume to

MAGNAVOX RESEARCH LABORATORIES*
2255 South Carmelina Avenue, Los Angeles 64, Calif.

* A DIVISION OF THE MAGNAVOX COMPANY

CIRCLE ED-487 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

Modul

The ' in 4-pag compact circuitry, "statche and au have sp enclosu tailed s include Fernan

Labor

A 12 line of laborat ses the chanica vides compar "Dupl trols a Moder 11 Fir

ELEC

484 Modular Circuit Structures 488

The "Strip Turret System", described in 4-page Bulletin No. 54A, provides ultra-compact deck type mounting units for circuitry, with "clip-in" terminals and "stitched" wiring, all with dip-soldering and automation possibilities. The units have special cases which provide plug-in enclosures with snap-open side panels. Detailed specifications, dimensions, etc., are included. Vector Electronic Co., 3352 San Fernando Rd., Los Angeles 65, Calif.

Compass System 490

A gyro-stabilized magnetic compass system for airborne applications is fully described in this 8-page 2-color brochure. Known as the "MC-101" system, it utilizes magnetic amplifiers, modular construction, and numerous other advantageous design features. Data on power requirements, installation, detailed specifications, and a block diagram of the system are included. Collins Radio Co., Cedar Rapids, Iowa.

485 Laboratory Ovens 489

A 12-page catalog (No. II) describes a line of gravity and mechanical convection laboratory ovens and sterilizers. It discusses the relative merits of gravity and mechanical (forced draft) air flow, and provides information about units in the company's oven line. "Multiplex" and "Duplex" close-tolerance temperature controls are also discussed and illustrated. Modern Laboratory Equipment Co., 1809-11 First Ave., New York 28, N. Y.

Rubber Hardness 491

This 2-page data sheet has a conversion table for latex foam rubbers, sponge rubbers, and rubber-like plastic sponge for the various scales of the American Society for Testing Materials, Rubber Manufacturers Association, Scott and Shore A scales, and the "Pandux" scale. It also describes and illustrates the "Pandux" foam and sponge rubber hardness tester, which provides a fast, accurate method for checking the resilient qualities of soft rubbers. Pacific Transducer Corp., 11836 W. Pico Blvd., Los Angeles 64, Calif.



"Trimming" resistance elements on printed circuits



Cutting fragile crystals into accurate cylinders



Cutting spiral grooves on film-type resistors

See it at the IRE SHOW

The "Airbrasive" Unit will be demonstrated at the Show. Bring your parts and try it out on them.

BOOTH 707 • Airborne Ave.



For those
"problem"
cutting jobs
on hard, brittle
materials

S. White INDUSTRIAL "AIRBRASIVE" UNIT

With the "Airbrasive" Unit you can cut, shape, drill or etch wafer-thin sections of hard, brittle materials without danger of shattering, chipping or crazing. And you can also remove deposited surface coatings safely and accurately. Successful applications include work on printed circuits, carbon film resistors and parts made of germanium, glass, ceramics and crystalline materials.

We'll be glad to test the process on your sample parts or give you a demonstration at our New York or California Office. Write or call today.

BULLETIN 5411 has full details. Send for a copy. Address Dept. 10.



A-3

THE **S. White** INDUSTRIAL DIVISION
DENTAL MFG. CO.



10 East 40th Street
New York 16, N.Y.

Western District Office • Times Building, Long Beach, California

CIRCLE ED-492 ON READER-SERVICE CARD FOR MORE INFORMATION

See us
at



RADAR ROAD &
ELECTRONICS AVE.

Microwave
Assemblies,
Radar Components,
and Precision
Instruments . . .
manufactured to
your Blueprints
and Specifications.

BOOTH No. 426
Radio Engineering Show
MARCH 21-24, 1955
Kingsbridge Armory
New York City

N.R.K. MFG. & ENGINEERING CO.

4601 WEST ADDISON STREET • CHICAGO 41, ILL. • SPing 7-2970

West Coast Representatives TUBERGEN ASSOCIATES 2232 W. 11th St., Los Angeles 6, Calif.

CIRCLE ED-493 ON READER-SERVICE CARD FOR MORE INFORMATION

*the only practical gold plating
process for electronic use!*



Bright Gold Process



NOW . . . all the advantages of gold plating for precision components without the common faults of ordinary gold. Here is the first real advance in industrial gold plating. Components that require surface or sliding contacts can be gold plated to any desired thickness without altering the finish or contour of the basic metal.

SEL-REX gold produces mirror-like deposits regardless of thickness . . . without scratch brushing or buffing. Its exceptional hardness resists abrasion, wear and galling . . . affords far greater corrosion protection. Less gold is required to secure minimum specified thickness, yet has unusually good "throwing power" to plate interior surfaces and deep recesses without the need for auxiliary anodes.

No special equipment is required for plating with SEL-REX BRIGHT GOLD for either barrel or still plating operations. The SEL-REX BRIGHT GOLD BATH operates at room temperature and is simple to maintain. Solution is stable. Packaged in 1, 5 and 10-ounce bottles.

Send for impartial comparative test chart between conventional and SEL-REX BRIGHT GOLD.

SEL-REX PRECIOUS METALS, INC.
Dept. ED-3, 229 Main St., Belleville 9, N.J.

Send FREE literature and comparative chart specifications on SEL-REX BRIGHT GOLD PROCESS.

Name

Company

Address

CityZone...State.....

CIRCLE ED-494 ON READER-SERVICE CARD FOR MORE INFORMATION

AMPHENOL

"AN"
CONNECTORS
for POTTING



Potting is the modern method of moisture-proofing AN connectors—and also the most effective. Briefly defined, Potting is the injection of a synthetic rubber sealant around the wired terminals on the back of a connector; the sealant is contained and shaped by a mold form which may be removed in 24 hours after the sealant has set.

What are the advantages of Potting and why does AMPHENOL consider it to be the most effective moisture-proofing process?

1. A moisture-proofing process which provides the most secure protection.
2. The sealant permanently remains in position on the connector, protecting all wiring, and all of the back terminals, from moisture damage.
3. The sealant is a thick, tough and elastic layer of the type commonly known as epoxy resin and hardener.
4. The sealant is applied in a controlled manner by a special potting machine.

AMPHENOL

AMPHENOL TELEPHONE CORPORATION

1000 CENTRE STREET, PITTSBURGH, PA.



Welding Aluminum

496

This "Welding Aluminum Sheet", reprinted from *Linde Tips*, describes a simple and useful method of preheating aluminum work pieces and suggests procedures to control preheat temperatures. Tempil Corp., 132 W. 22nd St., New York 11, N. Y.

Regohms

497

This 8-page bulletin illustrated all sizes of Regohms and gives type designations and dimensions for sizes 1 and 3. Also given are dimensions for standard sockets and chassis. Electric Regulator Corp., Norwalk, Conn.

Voltmeters

498

A 4-page illustrated bulletin describes d-c and a-c expanded scale panel voltmeters available from this firm. The d-c meters are a new line which complements the already existing line of a-c expanded scale voltmeters for panel mounting. Tables are given for base voltages, scales, and accuracy. Arga Div., Beckman Instruments, Inc., 220 Pasadena Ave., S. Pasadena, Calif.

Autotransformers

499

Bulletin No. N discusses Variac autotransformers with Duratrak contact surfaces. Dimensional drawings, specification charts, and graphs of operating characteristics are included. General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Motors and Blowers

500

Shaded pole motors and blowers are described in this 16-page catalog. Detailed drawings with performance curves are provided for the standard models. Charts show dimensions and performance. Fasco Industries, Inc., North Union at Augusta, Rochester 2, N. Y.

Silicones

501

The 1955 Reference Guide lists 23 new silicones as well as the 100-odd mentioned in the previous issue. Individual products are listed by application. The guide contains many tables, graphs, and photos. Comparable data on various silicone products and the organic materials they displace are also given. Dow Corning Corp., Midland, Mich.

Magnet

This 8-page bulletin describes a company's line of photographic enlargers, list, and electronic equipment. 206 E. 3rd St., New York 10, N. Y.

Pneum

A 2-page bulletin describes performance curves for rotating machinery and these mechanical problems. 206 E. 3rd St., New York 10, N. Y.

Precis

A 32-page bulletin describes and discusses the use of curved surfaces in precision engineering. Pressed

PRECISION
and **ACCURACY**
in both
MARKING and
FABRICATION

The United States Radium Corporation is experienced in marking by ALL methods, not just one. This enables us to recommend a marking best adapted to the type of part. These methods comprise photographic reproduction, screening, an improved offset process, etching, engraving, and lithography.

USRC is equally experienced in the fabrication and marking of metals or plastics—for direct reading, edge- or back-lighted, or window type parts.

Accuracy in marking is impossible unless the blank parts are equally accurate. This company has the facilities for very accurate fabrication for all types of parts and for the manufacture of complete dial and indicator assemblies. This accuracy is obtainable in USRC-furnished components.

Inquiries invited — address Dept. ED-3.



UNITED STATES RADIUM CORPORATION

Eastern Sales Office—535 Pearl St., New York 7, N.Y.
Western Sales Office—5420 Vineland Ave., N. Hollywood, Cal.
Plants and Laboratories at—Bloomsburg, Pa., Whippany, N.J.
Bernardsville, N. J., North Hollywood, Cal.

CIRCLE ED-502 ON READER-SERVICE CARD FOR MORE INFORMATION

◀ CIRCLE ED-495 ON READER-SERVICE CARD

499

Magnetic Clutches

503

This 8-page brochure describes this company's line of miniature magnetic clutches. Photographs, drawings, features, specifications, data on ordering information, price list, and generalized applications are given. Electronic Mfg. Engineers Co., 2410 Beacon Ave., Seattle 44, Wash.

500

Pneumatic Riveting

504

A 2-color brochure covers the design, performance, and markets of the Airflex rotating-impact method of pneumatic riveting and dimpling. Also included is how these machines meet modern fabricating problems. Lemert Engineering Co., Inc., 206 E. Jefferson, Plymouth, Ind.

501

Precision Plating

505

A 32-page, picture-and-text booklet describes this company's plating facilities and discusses the history as well as some of the technical aspects of plating. A series of curves and graphs illustrate requirements for precision plating. Standard Pressed Steel Co., Box 202, Jenkintown, Pa.

Nickel Alloys

506

Nickel alloys for electronic, industrial, and consumer products are illustrated and described in this 38-page catalog. Characteristics of various types are listed and charts of chemical compositions and mechanical properties are included. Alloy Metal Wire Div., H. K. Porter Co., Inc., Prospect Park, Pa.

Microprocessed Springs

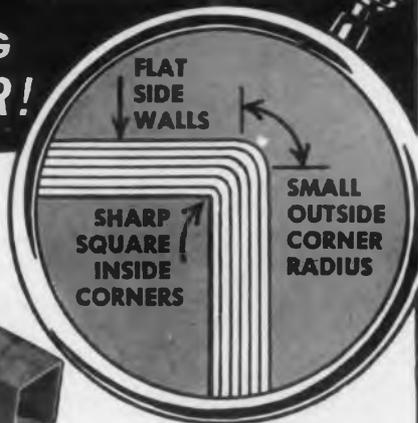
507

Catalog No. 9 describes microprocessed beryllium copper springs, showing a variety of custom made compression coil and flat springs, for a wide range of industrial applications. Technical and design data are included. Instrument Specialties Co., Inc., Dept. 271, Little Falls, N. J.

Threaded End Seals

508

A 2-color data sheet describes compression-type, threaded end seals for tubular components. Dimensional drawings are shown and various types are illustrated. Electrical Industries, Div. of Ampere Electronic Corp., 44 Summer Ave., Newark 4, N. J.

NEW "PARAFORMED" PAPER TUBES**MAKE YOUR COIL WINDING EASIER! FASTER! BETTER!****SPIRAL WOUND
NOT DIE FORMED****ANY SIZE—SQUARE OR RECTANGULAR**

Entirely new technique in tube making developed and perfected by PARAMOUNT now for the first time solves many coil winding problems, *yet costs you no more!* Hi-Dielectric. Hi-Strength. Kraft, Fish Paper, Acetate, Red Rope or any combination wound on automatic machines. Produced from stock arbors or special sizes engineered for you.

Write on Company letterhead for Stock Arbor List of over 2000 sizes

- No sharp outside edges to cut wire
- Has full rigidity and physical strength
- Permits winding coils to closer tolerances
- No need for wedges to tighten wire
- Allows faster stacking of wound coils

PARAMOUNT PAPER TUBE CORP.**608 LAFAYETTE STREET, FORT WAYNE 2, INDIANA***Manufacturers of Paper Tubing for the Electrical Industry Since 1931*

CIRCLE ED-509 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE ED-510 ON READER-SERVICE CARD ➤



actual size
illustrations

AMPHENOL
 SUB*Minax*
 RF
 CONNECTORS

The new miniature Subminax RF connectors are so small that the entire line of connectors can easily fit into the palm of your hand! Available in 50 ohm and 75 ohm impedances, Subminax connectors offer full size RF efficiency and rugged construction in a miniature design.

They come both male and female and include a wide variety of plug, jack, panel, and bulkhead styles. They are available in aluminum, stainless steel, and brass. For more information, contact your AMP distributor or AMP Sales Office.

AMPHENOL

AMPHENOL CORPORATION
 300 Main Street
 Littleton, Colorado 80120
 Telephone (303) 741-4000



VICTOREEN ELECTRONIC COMPONENTS

HI-MEG RESISTORS



For applications requiring extreme stability and accuracy. Elements are vacuum sealed in glass envelopes and aged for lasting stability.

SPECIFICATIONS

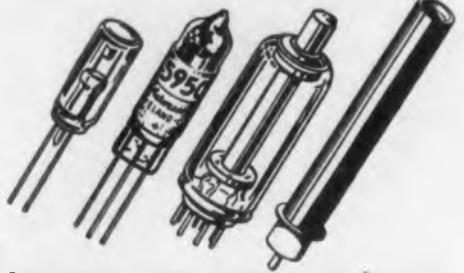
- *Resistance R.T.M.A. Values 10^6 to 10^{12} ohms
- **Tolerance from Specified Value $\pm 10\%$
- Temperature Coefficient $-0.15\%/^{\circ}\text{C}$
- Voltage Coefficient $-0.03\%/V$
- Maximum Voltage 1000 V
- *Higher Values to Order
- **Also available within $\pm 5\%$ or $\pm 2\%$ of specified value up to 5×10^{12} ohms.

VICTOREEN CARBON DEPOSITED RESISTORS



Carbon deposited resistors are sealed in glass and filled with inert gas. For applications where long term accuracy and stability are required. Impervious to mechanical damage, humidity, deviations of pressures, fumes, etc. Capable of operating up to voltages of 15 KV or wattages up to 10 watts. Available in 2 - 5 - 10% tolerances. Temperature coefficient averages 0.0005 to 0.0008 with voltage coefficient almost nil.

VOLTAGE REGULATOR TUBES



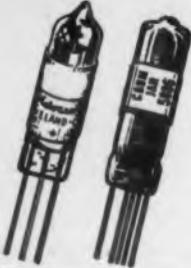
Low-current voltage regulator tubes for stabilizing a wide range of battery-operated R. F. or vibrator high voltage power supplies, voltage reference, voltage limiting, coupling in D. C. amplifiers, and other voltage limiting requirements.

Voltage regulator tubes for operating 18 KV, 20 KV, 25 KV and 27 KV, designed for regulation and protection of the kinescope in color and monochrome TV are available in quantity. Regulators will be made on special orders for any operating point between 50 and 30,000 volts.

GENERAL SPECIFICATIONS

- Many standard voltages: 50 to 30,000 volts (nominal)
- D. C. starting voltage: About 5% above nominal
- D. C. regulated voltage tol. from nominal: Varies ± 2.0 to $\pm 5.0\%$
- Voltage regulation: $\pm 1.5\%$
- Maximum rating regulation current: Varies 100 to 1000 μA (except glow tubes to 2.5 MA)

SUBMINIATURE ELECTROMETER AND D.C. AMPLIFIER TUBES



The type 5800 tetrode and the type 5886 pentode are 10 mil filament power subminiature tubes designed specifically for electrometer applications where low grid current is an exact design consideration.

The type 5803 is a low filament power subminiature triode designed for electrometer applications where high transconductance is desired.

The type 5828 is a conventional low filament power triode.

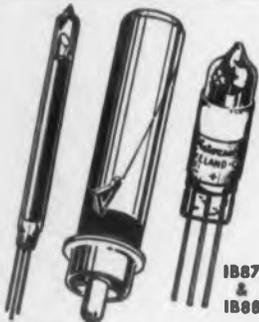
Other subminiature types include the 5799 high vacuum half wave rectifier and the VX-10 thermal time delay relay.

SPECIFICATIONS

TUBE TYPE	DESIGNATION	TYPICAL SERVICE	PLATE VOLTS (volts)	ACCEL. GRID VOLTS (volts)	CONTROL GRID VOLTS (volts)	PLATE CUR-RENT (μA)	CONTROL GRID CURRENT (amps)	Mu	Gm** (μmhos)
*5800	Tetrode	Electrometer	+4.5	+3.4	3.0	12	3×10^{-15}	1	15
*5886	Pentode	Electrometer	+12	+4.5	2.0	6	3×10^{-15}	—	14
*5886	(Connected) Triode	Electrometer	+10.5	—	3.0	200	2×10^{-13}	2	160
*5828	Triode	D.C. Amplifier	+45	—	-1.0	250	10^{-9}	17.5	450
*5803	Triode	Electrometer	+7.5	—	-1.7	100	2×10^{-14}	2.0	150

*Filament 1.25 volts at 10ma. *JAN tubes available except for 5828.
**Higher Gm may be obtained at the expense of high ic by operating at higher Ib.

VICTOREEN COUNTER TUBES



Victoreen Counter tubes are self-quenching geiger tubes designed to cover the general field of beta, gamma, X-ray and cosmic ray measurements. Some meet the needs of laboratory reliability and accuracy, others are adapted to the more rugged requirements of portable operations. A convenient socket, our part No. 380-26, is available for probe or chassis mounting of the 1B85 and 6306 tubes.

SPECIFICATIONS

TUBE TYPE	DESCRIPTION	OPERATING VOLTAGE (volts)	THRESHOLD VOLTAGE (volts)	PLATEAU LENGTH (volts)	PLATEAU SLOPE PER 100 V (%-100V)	ACTIVE LENGTH (inches)	WALL (mg-cm ²)	LIFE (counts)	TYPE BASE
1B85	Beta-Gamma Aluminum Wall	900	800	200	3	2.75	30	10^9	Coaxial A1-A2
1B86	Gamma Ray Glass Wall	300	280	60	10	2.5	200	5×10^7	Tinned Leads
1B87	Gamma Ray Glass Wall	900	850	100	10%/50v	0.5	200	10^8	Tinned Leads
1B88	Gamma Ray Glass Wall	300	275	50	30%/50v	0.5	200	5×10^7	Tinned Leads
6306	Beta-Gamma Bismuth Lined Aluminum Wall	900	800	150	5	2.75	30	10^8	Coaxial A1-A2

Consult our engineering staff on applications of these components



The Victoreen Instrument Co.

COMPONENTS DIVISION: 3811 Perkins Ave., Cleveland 14, Ohio

CIRCLE ED-511 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscilloscopes

512

A 14-page bulletin describes and illustrates this firm's type 531 and 535 cathode-ray oscilloscopes. Sweep patterns for the various types are shown and vacuum tube complements and other technical data are given. Tektronix, Inc., P. O. Box 831, Portland 7, Oreg.

Tape Recorder Directory

513

Magnetic tape recorders made by various companies are illustrated and described in this 20-page catalog. Frequency response, technical data, and price are given for each item. Data on tape recording accessories are included also. Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y.

Potentiometers

514

A set of three bulletins describes this firm's line of single-turn, multiple-turn, and rectilinear potentiometers, respectively. Dimensional drawings are provided for each type and technical data is given. General Scientific Corp., 12017 Vost St., N. Hollywood, Calif.

Miniature Relay

515

A hermetically sealed, miniature relay, primarily applied in military and civilian aircraft, is described in this 4-page brochure (No. GEA-6213). The brochure explains the features, performance, and specifications of the small relay and includes dimensional drawings. General Electric Co., Schenectady 5, N. Y.

Analog Computers

516

This technical bulletin describes this firm's Model 30 analog computer. Complete specifications and a description of the computer and its applications are included. Photographs show wiring and various views of the computer. Donner Scientific Co., 2829 Seventh St., Berkeley 10, Calif.

Solenoids

517

This bulletin gives data on intermittent duty and continuous duty solenoids. Operating data, power requirements, resistance values, and dimensional drawings are provided. Guardian Electric Mfg. Co., 1621 W. Walnut St., Chicago 12, Ill.

X-Y PLOTTER AND RECORDER



**RECORDS
TWO INDEPENDENT
VARIABLES FROM
ANALOG OR DIGITAL
INPUTS**

A compact, desk-size unit designed for general purpose graphic recording from analog or digital inputs with standard Librascope converters or special modifications engineered to customer requirements. Unique pen travel, fast and dependable. Full chart visibility allowing curve generation to be observed at all times. Write for detailed catalog information.

Mechanical and electrical analog computers, digital computers, input-output devices and components.

Computers and Controls

LIBRASCOPE

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION
1607 FLOWER ST., GLENDALE, CALIF.

LIBRASCOPE INCORPORATED

CIRCLE ED-518 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

Magn
Spec
grades
given i
temper
proper
Crows
Draft
This
interes
signers
of vacu
ases,
tube ex
way T
Angelo
Rub
Mole
truded
buying
tions,
ances,
vided.
dustri

ELEC

Magnetic Cores 519

Specifications and data on standard grades Ferramic "Q" magnetic cores are given in this 4-page brochure. Charts show temperature, frequency, and magnetic properties. General Ceramics Corp., 21 Crows Mill Rd., Keasbey, N. J.

Drafting Templates 520

This literature on templates should be of interest to electronic engineers and designers. Vinyl plastic templates for layout of vacuum tube sockets, capacitor twist-lock bases, rotary selector switches, and vacuum tube envelope outlines are described. E-Z Way Templates, 2242 S. Colby Ave., W. Los Angeles 64, Calif.

Rubber Buying Guide 521

Molded and extruded rubber and extruded plastics are covered in a 16-page buying guide. Specifications, terms, definitions, performance characteristics, tolerances, and tables of properties are provided. General Tire & Rubber Co., Industrial Products Div., Wabash, Ind.

Commutator Motors 522

A 22-page plastic-bound brochure offers a quick reference to the electrical and physical characteristics of this firm's full line of commutator motors, as well as governor units. It includes sections on field-, shunt-, and universal-wound motors, as well as permanent magnet and separately excited types. In addition, performance curves, dimensional drawings, and specifications are given for each type listed. Electric Indicator Co., Inc., Springdale, Conn.

Time Delay Relay 523

The Model NEH "Agastat" time delay with a double-throw auxiliary switch which will allow push-button operation, or instant or delayed contacts after deenergization, is described in 2-page, 2-color Bulletin No. SR-6. The publication also gives dimensions, mounting arrangements, terminal arrangements, and wiring diagrams for each type. AGA Div., Elastic Stop Nut Corp. of America, 1027 Newark Ave., Elizabeth, N. J.

"AMERICAN 40" (pat. pending)
Lindgren
SHIELDED ENCLOSURES

THE FINEST SCREEN ROOMS ON THE MARKET TODAY
At the Lowest Prices!

IMPROVED "AMERICAN 40" FEATURES:

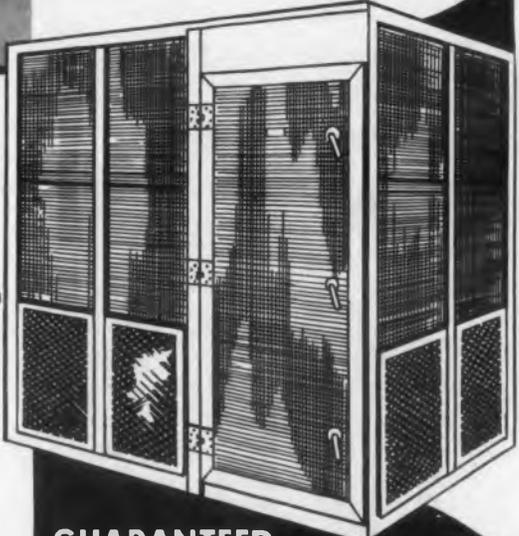
- New extra-strong floor — cross beams every 12".
- 1" plywood flooring — covered with 1/8" linoleum.
- New pat. pend. door — completely leak-proof.
- New pat. pend. air intake — no leaks.
- New pat. pend. service door — slides inside screen panels.
- All rooms have expanded metal protection on outside
- THE BEST NAMES IN AMERICAN INDUSTRY USE LINDGREN PORTABLE, TRUE DOUBLE SHIELDED SCREEN ROOMS.
- (Names of companies supplied on request.)

Meets U. S. Gov't performance specifications

ERIK A. Lindgren & ASSOCIATES
Established 1939
4515-17 N. Ravenswood Ave., Dept. ED3, Chicago 40, Ill. SUNnyside 4-0710

GUARANTEED HIGHEST ATTENUATION RATINGS
146 DB-Copper
128 DB-Bronze

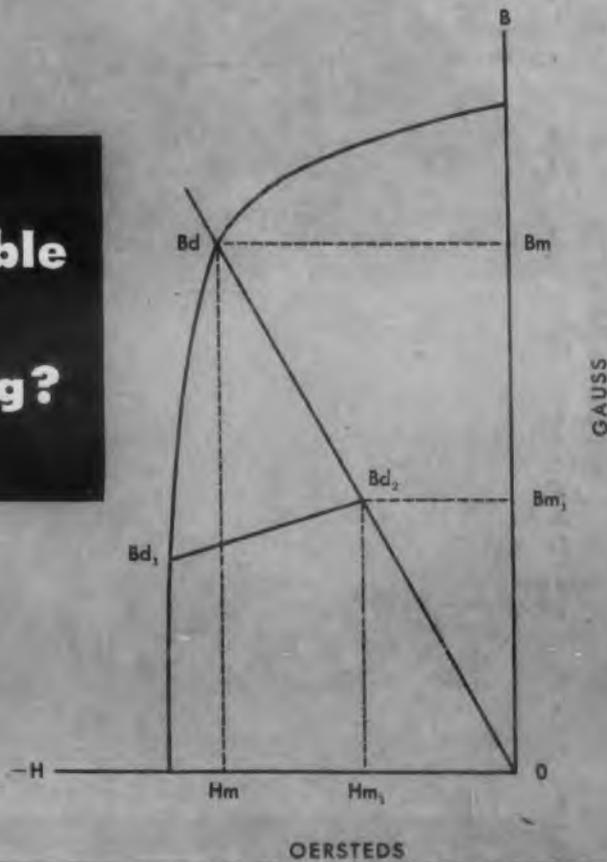
WRITE FOR ILLUSTRATED BOOK
Contains specs., performance charts



CIRCLE ED-524 ON READER-SERVICE CARD FOR MORE INFORMATION

Analysis of a basic magnet problem:

**Why assemble
before
magnetizing?**



A closed circuit magnet exists when the magnet is magnetized in its assembly of soft iron or other magnetic materials and is not removed later. Normally, there is a specified air gap. The chart illustrates the demagnetization curve for Alnico permanent magnet material.

To illustrate the advantage of magnetizing the complete circuit after assembly, let's use an example: The magnet  is to be assembled with pole pieces . If the magnet is charged *before* assembly, it will operate at point Bd_1 on the curve. When the poles are placed on this saturated magnet , it will move up a minor hysteresis loop to point Bd_2 , resulting in Bm_1 flux density. How-

ever, if the entire circuit is magnetized *after* assembly, it will operate at point Bd with Bm flux density, or a 100% increase in flux density in this example. The percentage of increase is a function of the gap length and area.

This is a very brief explanation of a basic design problem. For a detailed discussion of this and other design considerations, we suggest our Design Bulletin #151. *The Thomas & Skinner research and engineering staffs are at your disposal . . . write today for engineering assistance in the design of your magnetic applications.*



T&S at I.R.E. Show
Computer Ave.
Booth 304

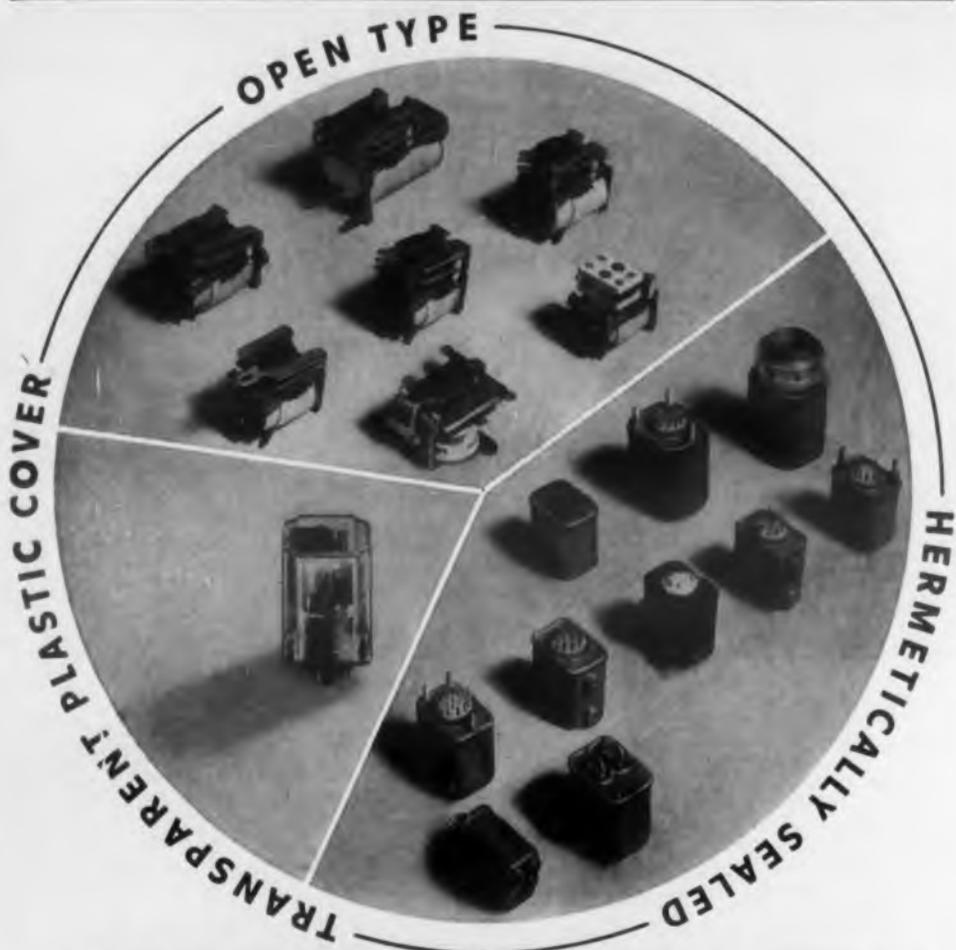
SPECIALISTS IN MAGNETIC MATERIALS . . .

Permanent Magnets  Laminations  and Wound Cores 



THOMAS & SKINNER Steel Products Company, Inc.

CIRCLE ED-525 ON READER-SERVICE CARD FOR MORE INFORMATION



R-B-M Relays

**FOR EVERY ELECTRONIC
APPLICATION**

Meeting Commercial and Government Requirements

OPEN TYPE. Circuit switching—power and dynamotor loads—plate circuit—low capacitance.

HERMETICALLY SEALED. Stud or bushing mounting—solder or plug-in headers—circuit switching—power—low loss applications.

TRANSPARENT PLASTIC COVER. Most R-B-M relays now available in low cost transparent plastic cover.

OTHER PRODUCTS: Motor starting relays and overload protectors for refrigeration, appliance and general purpose motors. Industrial contactors and across-the-line starters. NEMA size 1 and smaller. Low cost general purpose relays. Low voltage D.C. manual and magnetic devices.

Visit Booths 617-619 Kingsbridge Armory

I.R.E. Convention

New York City, March 21-24

R-B-M DIVISION
ESSEX WIRE CORPORATION
Logansport, Indiana

*Controls for Electronic,
Refrigeration, In-
dustrial, Appliance,
Communication and
Automotive Industries*



CIRCLE ED-526 ON READER-SERVICE CARD FOR MORE INFORMATION

Engineering Facilities

527

The engineering, testing, and production facilities of this firm are covered in an 8-page brochure, "Electronic Advancement". Also shown is a variety of products this firm has produced, including coaxial switches, electronic and magnetic amplifiers, sensing switches, slot antennas, control junction boxes, wavemeters, power supplies, and other precision products. Electronics Div., Thompson Products Inc., Cleveland 3, Ohio.

Bobbin Cores

528

Bulletin No. BC-102 describes in 4 pages a standard line of tape-wound bobbin cores. It explains how these ultra-thin tape cores with very rectangular hysteresis loops under pulse conditions are used in industry, and gives specification details covering dimensions of both bobbin cores and tapes. The procedures for testing cores are described and illustrated with the aid of wave form diagrams. Magnetics, Inc., Box 230, Butler, Pa.

Grommets

529

A 16-page brochure in file folder form lists many sizes and types of grommets. The line includes the complete Air Force-Navy Standard AN931 grommet series: 34 basic sizes, each size available with 1/16", 1/8", 3/16", and 1/4" groove widths, and the 34 sizes in the web type with 1/16" groove width. In addition, there are many special sizes, all of which can be furnished from industrial compounds. Goshen Rubber Co., Inc., Goshen, Ind.

Power Supply

530

A 49-lb wide range (0-500v d-c at 0-200-ma) portable power supply is illustrated and described in a 4-page bulletin (54-4). Measuring only 13" x 8-3/4" x 14-1/2" deep, the unit has many laboratory and field applications. Detailed data are provided on specifications and features. Also included is a list of other power supplies available from this firm, along with their specifications. Lambda Electronics Corp., 103-02 Northern Blvd., Corona 68, N. Y.

for all applications requiring exceptionally high insulation resistance and unusual stability at high temperature

**HOPKINS
"HY-THERM"**
New sub-miniature high temperature
CAPACITORS

Hermetically sealed and metal encased, new HY-THERM capacitors have been designed to meet or exceed military requirements (Mil-C-25A). Example: At 125°C the minimum insulation resistance is 20 megohm-microfarads and maximum insulation resistance is 500 megohms. Available in all standard values and tolerances. Variety of mounting and circuit combinations. Special units designed to meet individual requirements.

Have a special problem?
Write, wire or phone for
details, TODAY!



Catalog available

2082 Lincoln Ave., Altadena, Calif.,
SYcamore 8-1185 • Offices in
WASHINGTON, D.C. and DETROIT

CIRCLE ED-531 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

Lamps

A table of performance lamps for is given in brochure from 75 house F. Bloomfield

Cleaning

Precision subject the wet page be applicat profitable Equipm Mishaw

Insulation

Bulletin A1SiMa insulator electric treated. T-8 nur kee Blv

ELECT

Lamps

532

A tabulation of application and performance data for reflector and projector lamps for use in laboratory photography is given in leaflet No. CE-954. The brochure gives data on spot and floor lamps from 75 to 500w. Lamp Div., Westinghouse Electric Corp., Watsessing Center, Bloomfield, N. J.

Teflon Rods

535

A 4-page folder on Teflon rods describes the physical properties of the two grades of Teflon available in rod form to fabricators of finished Teflon parts. The folder points out typical uses for the rods and gives complete price and size information. Garlock Packing Co., 250 Main St., Palmyra, N. Y.

Cleaning and Finishing

533

Precision cleaning and finishing is the subject of this new brochure. Dealing with the wet abrasive blasting process, the 18-page booklet presents 40 frequently met applications in which this process can be profitably used. American Wheelabrator & Equipment Corp., 1750 S. Byrkit St., Mishawaka, Ind.

Insulating Rosin Flux

536

This 4-page 2-color bulletin describes fluxes, rosin core solder, fluxcote, and flux removers. Graphs give anti-corrosive characteristics and insulation resistance. London Chemical Co., Melrose Park Plant, 1535 N. 31st St., Melrose Park, Ill.

Insulators

534

Bulletin No. 546 describes this firm's AlSiMag L-5 high-frequency electrical insulators. A chart shows mechanical and electrical properties and each style is illustrated. The catalog is arranged in JAN-T-8 numbers. American Lava Corp., Cherokee Blvd. & Mfrs. Rd., Chattanooga 5, Tenn.

O-Ring Catalog

537

Catalog No. AD-148, describing this firm's line of O-rings, gives complete design information, recommended pressures, and available materials for both dynamic and static applications. It also contains a complete list of standard stocked sizes. Garlock Packing Co., 250 Main St., Palmyra, N. Y.



How can YOU use this simple, rugged SNAPSLIDE FASTENER?

This positive, quick-action fastener was originally developed to hold airborne equipment with security—even under severe stress and shock of carrier-based aircraft operations—and yet permit equipment replacement in a matter of seconds.

A wide variety of industrial uses has been found for the fastener. Perhaps you can use it profitably. It requires no tools; thumb and finger fasten and release. Even with repeated use no adjustments are necessary. Available in two sizes, with parts to match different thicknesses of mounting plates.

Write for details.

Dependable Airborne Electronic Equipment Since 1928

AIRCRAFT RADIO CORPORATION
BOONTON, NEW JERSEY



CIRCLE ED-538 ON READER-SERVICE CARD FOR MORE INFORMATION

for precision measurement of phase relationship



Designing an accurate, reliable computer necessitates locating troublesome quadrature voltages. With the Link 201 Phase Comparator, determination of phase shifts in reference and circuit transformers is accomplished simply and easily.

Phase relationships of in-phase and out-of-phase voltages, at the commonly used carrier frequencies of 60 and 400 cycles may be precision-measured with an accuracy of 1/10 to 1/3 milliradian.

The Link 201 operates from the Link Model 204 Power Supply—and with an a.c. VTVM forms a compact complete system.

The Link 201 Phase Comparator



design features

Functionally grouped controls for quick operation.

Fast hook-up binding posts to accommodate banana plug, spade, lug, phone tip, or tip and lug combination terminal attachments as well as wires.

Compact and light weight—overall dimensions: 10" x 12 $\frac{3}{4}$ " x 13 $\frac{3}{4}$ ".
Weight: 22 pounds.

Null-type adjustment with a fine vernier control for determining phase relationships. Readings in the form of null voltage are shown on a VTVM.

Write our Commercial Products Department for complete data.



LINK AVIATION, INC.
BINGHAMTON—NEW YORK

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

Manufacturers of the world-famous Link Trainers and Simulators • servo mechanisms • simulator instruments • computer components • gear boxes • friction overdrive clutches • ratio volt-meters • phase angle meters • precision potentiometers • and other special electronic devices

CIRCLE ED-539 ON READER-SERVICE CARD FOR MORE INFORMATION



PHOTOGRAPH ANY SCOPE PATTERN

with the

FAIRCHILD

Oscillo-Record Camera

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

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

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

For more information, write *Fairchild Camera and Instrument Corporation, 88-06 Van Wyck Expressway, Jamaica, N. Y., Department 120-21N3.*

FAIRCHILD

OSCILLOSCOPE RECORDING CAMERAS

CIRCLE ED-540 ON READER-SERVICE CARD FOR MORE INFORMATION

Cooling Nomograms 541

"Hi-Altitude Nomograms" an 8-page data book (No. 20201-1), offers the design engineer a short-cut to calculating volumes and weights of cooling air required in diverse airborne applications. It contains many graphs and nomograms with text giving examples pertaining to typical practical cases. These examples are split into two categories, for laminar and turbulent flow. Rotron Mfg. Co., Woodstock, N. Y.

Noise Meters, Attenuators 542

This 6-page 2-color bulletin covers a variety of equipment, including noise and intensity meters, step and u-h-f attenuators, broad band crystal mixers, u-h-f impulse generators, and noise and distortion analyzers. Full engineering data and illustrations are provided on all these units, as well as application information. Empire Devices Products Corp., 38-15 Bell Blvd., Bayside 61, N. Y.

Soluble Precious Metals 543

Soluble precious metals available for electroplating are listed, along with information on precious metal electroplating with scientific accuracy, in this price list. The list is in the form of a card folded to convenient pocket size, imprinted on heavy stock to permit constant reference. Varied gold, rhodium, and palladium solutions that are widely used on contact faces are covered. Technic, Inc., Providence 1, R. I.

Plastic Glass 544

This 24-page, 2-color brochure, "Plexiglas Molding Powder Product Design", has many valuable sections, including: optical design, decorative affects, methods of attaching "Plexiglas", designing for practical molding, and products performance. Typical products and parts molded from this material are listed in another section. Rohm and Haas Co., Washington Square, Philadelphia 5, Pa.

DELAY LINES

Designed for you!

- ★ VERY COMPACT
- ★ CHOICE OF MOUNTINGS
- ★ TUBULAR OR PACKAGE
- ★ ECONOMICALLY PRICED



All Technitrol Delay Lines are continuously wound for minimum pulse distortion . . .
are covered and impregnated to protect the winding . . .
are extremely stable with temperature and environmental variations.

Write for complete
information. Send
your specifications.

NEW—TYPE DD:
VERY WIDE BAND PASS

TECHNITROL
ENGINEERING COMPANY
2751 N. 4th St., Philadelphia 33, Pa.

CIRCLE ED-545 ON READER-SERVICE CARD FOR MORE INFORMATION

Electrometers

546

This 12-page catalog describes vacuum-tube electrometers and accessories. Designed in part as a manual for engineers and scientists, the catalog includes introductory data on electrometer characteristics, circuit discussions, and equipment photographs. Seventeen connection diagrams show how the instruments are used. Keithley Instruments, 3836 Carnegie Ave., Cleveland 15, Ohio.

Temperature Cabinets

548

This 4-page bulletin features three types of temperature cabinets for cold and heat requirements with temperature ranges from -200°F to $+300^{\circ}\text{F}$. A table of specifications and a discussion of features and applications are included. Trop-Artic Temperature Products, Dept. B-393, 627 S. Mulberry St., Muncie, Ind.

High-Speed Relay

547

Information on a high-speed relay "with a memory" is contained in a 4-page publication, No. GEA-6212. It describes the function and operation of this hermetically sealed, high-speed, polarized unit, which is designed for electronic applications. In addition to information on various applications, the bulletin provides data on ratings, specifications, and dimensions. General Electric Co., Schenectady 5, N. Y.

Repeat Cycle Timers

549

Complete information on a new line of miniature hermetically-sealed Repeat Cycle Timers is provided in 2-page Bulletin No. RC200. Included are data on cycling time, timing accuracy, detailed characteristics, and determination of timing tolerances. A. W. Haydon Co., 230 Elm St., Waterbury, Conn.

Have you returned your subscription renewal and qualification form?

See Page 100



First Use of High Shock
Multiform Glass Wafer Stem

NEW

TAYLOR 6044 Xenon Thyatron

The new Taylor 6044 is an inert gas grid controlled rectifier designed especially for motor control circuits where short deionization time is required. The tube will also serve on applications requiring high peak current carrying capacity such as timing control.

This tube is designed for negative grid control characteristics. Extremely reliable performance will be provided by the 6044 even where heavy shock and vibrational conditions are encountered. Utilizing a design where the electrical contacts and mechanical supports are provided by the same set of connections, the 6044 can be fastened to the mounting panel by captive screws on the tube terminals. This feature gives extreme rigidity and eliminates tube sockets for simplified mounting.

**WRITE FOR LITERATURE ON FULL
XENON TUBE LINE**

Taylor

HEAVY CUSTOM BUILT DUTY

Tubes

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

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

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

CIRCLE ED-550 ON READER-SERVICE CARD FOR MORE INFORMATION

*It takes more than
parts to make an*

ARGA RESOLVER



15 size 23 size
Uncompensated
Resistor compensated
Feedback winding compensated

maximum error ▶

Grade 1 — .05%

Grade 2 — .10%

Grade 3 — .20%

**Null voltage less than
1 millivolt per volt**

**Built to military
specifications**

Write for data file, 3-11



Arga

division

BECKMAN INSTRUMENTS, INC.

220 PASADENA AVE., SOUTH PASADENA, CALIFORNIA

CIRCLE ED-551 ON READER-SERVICE CARD FOR MORE INFORMATION

HUBBELL

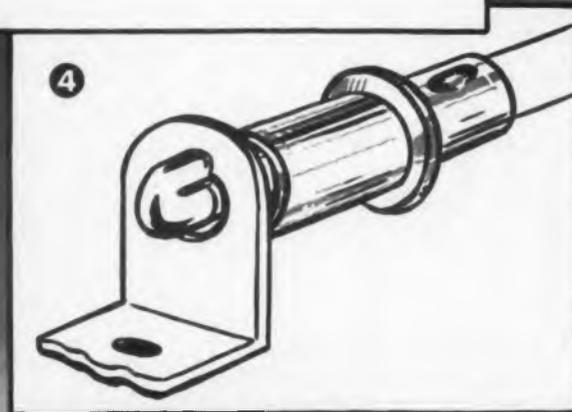
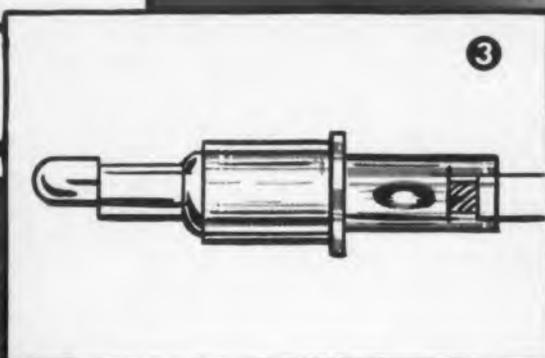
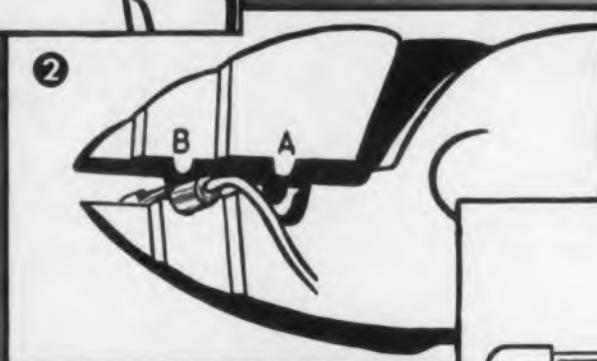
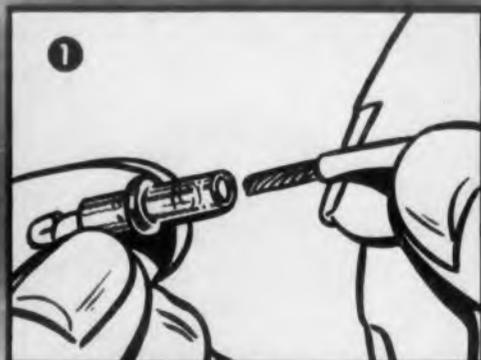


Interlock

NEW Automatic Locking — Quick Disconnect **INSULATED** Interlock Plugs

Fast Crimp Wiring for #22 to #18 Wire

1. Strip wire $\frac{1}{4}$ " (diameter of wire insulation not to exceed .075). Insert wire through Nylon Insulation into plug barrel.
2. Crimp with *Interlock Crimping Pliers*. (Cat. No. 120Y91)
3. Male plug (Cat. No. 480B10) is now fully insulated and ready for a multiplicity of electrical or electronic applications.
4. Plug locks securely, automatically in any *Interlock Type "B"* Jack.



The unique locking features of all *Interlock* Plugs assure a permanent low resistance contact, vibration-proof connection every time. The contact parts themselves form the locking mechanism, making an electrical breakdown impossible while plug is locked. Constant coil spring pressure on contact points adjusts automatically for changes in temperature or pressure.

Interlock Plugs are easily adaptable for use wherever a positive, vibration-proof connection is required. Our Development Laboratory will cooperate with your engineers to adapt *Interlock* for your specific applications.



SEE BOOTH #406 AT
THE IRE SHOW

HARVEY HUBBELL, Inc.

Interlock Division, Department 2, 1000
1000

For Further Information, Write Dept. A:

CIRCLE ED-552 ON READER-SERVICE CARD FOR MORE INFORMATION

Permanent-Magnet Motor

553

Details on type PM-36 permanent magnet motors are given in bulletin PM36-954. This publication includes full dimensional details on the 20w, 6000rpm unit. Specification data are tabulated and performance curves given to cover relationships between torque output and input current, rpm, output watts, and efficiency. Dalmotor Co., 1326 Clay St., Santa Clara, Calif.

Microwave Assemblies

554

Catalog No. 5-200 discusses various microwave assemblies. Among the components described and illustrated are low output mixers and preamplifiers, antenna dipoles, r-f line sections, duplexers, directional couplers, antenna horns, rotary joints, signal mixers, tunable cavities, and antenna reflectors. Equipment Marketing Div., Raytheon Mfg. Co., 138 River St., Waltham 54, Mass.

Instrumentation Facilities

555

Extensive facilities for research, development, and design of instrumentation for aircraft and guided missiles are described in a new publication. The 16-page, 2-color brochure discusses the company's research, design, materials engineering, model shop, and test engineering facilities. An illustrated account shows the course of a typical project from inception to delivery of completed equipment. Avien, Inc., 58-15 Northern Blvd., Woodside 77, N. Y.

Surface Finishing

556

Suggestions for the solution of micro-finishing problems involving lapping, honing, grinding, etc., are offered in this 4-page brochure. The brochure illustrates examples of what can be accomplished in producing high-precision exactness. Surface Finishes, Inc., 114 Official Rd., Addison, Ill.

Megohmmeter

557

Type 1862-B megohmmeter provides two test voltages, 50 and 500v, for measuring high resistances. Various applications of the megohmmeter are illustrated and six schematic diagrams are provided in the 4-page bulletin. General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Correction

On p. 80 in the February, 1955 issue of ED, typical tube noise for the Raytheon CK6533 should read: between $100\mu\text{v}$ and $200\mu\text{v}$.

Wattage

A fully straight entire ra 2-color l developn company controlli but also oven op ham Sts

Compl

No. 1 report c ing field studyin plane a analyze which i The an repeate bers in 531 Ma

Test E

Two square ator. feature Co., 10

Selen

An scribes seleniu sizes o put ra cuts. circuit ings a N Ch

Mini

A r new l design sheet drawi showi 2954, ELEC

Wattage Control**558**

A fully automatic proportional wattage control for straight line temperature control throughout the entire range of an oven is described in this 8-page, 2-color brochure. The brochure also gives a brief development history of this new method and how this company's engineering staff looked at the problem of controlling wattage not only as a control function, but also as a matter pertaining to element design and oven operation. Blue M Electric Co., 138th & Chatham Sts., Blue Island, Ill.

Complex Plane Analyzer**559**

No. 14 of the series "Laboratory Reports" is a report on antenna design calculations for determining field patterns, synthesizing antenna arrays and studying pattern behavior by use of the complex plane analyzer. Applications of the complex plane analyzer to other engineering design calculations which involve complex numbers also are described. The analyzer was developed specifically to handle repeated multiplication and division of complex numbers in vector form. Technology Instrument Corp., 531 Main St., Acton, Mass.

Test Equipment**560**

Two technical data sheets describe model 710 sine-square wave generator and model 755 noise generator. Each instrument is illustrated and special features are discussed. Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland 8, Ohio.

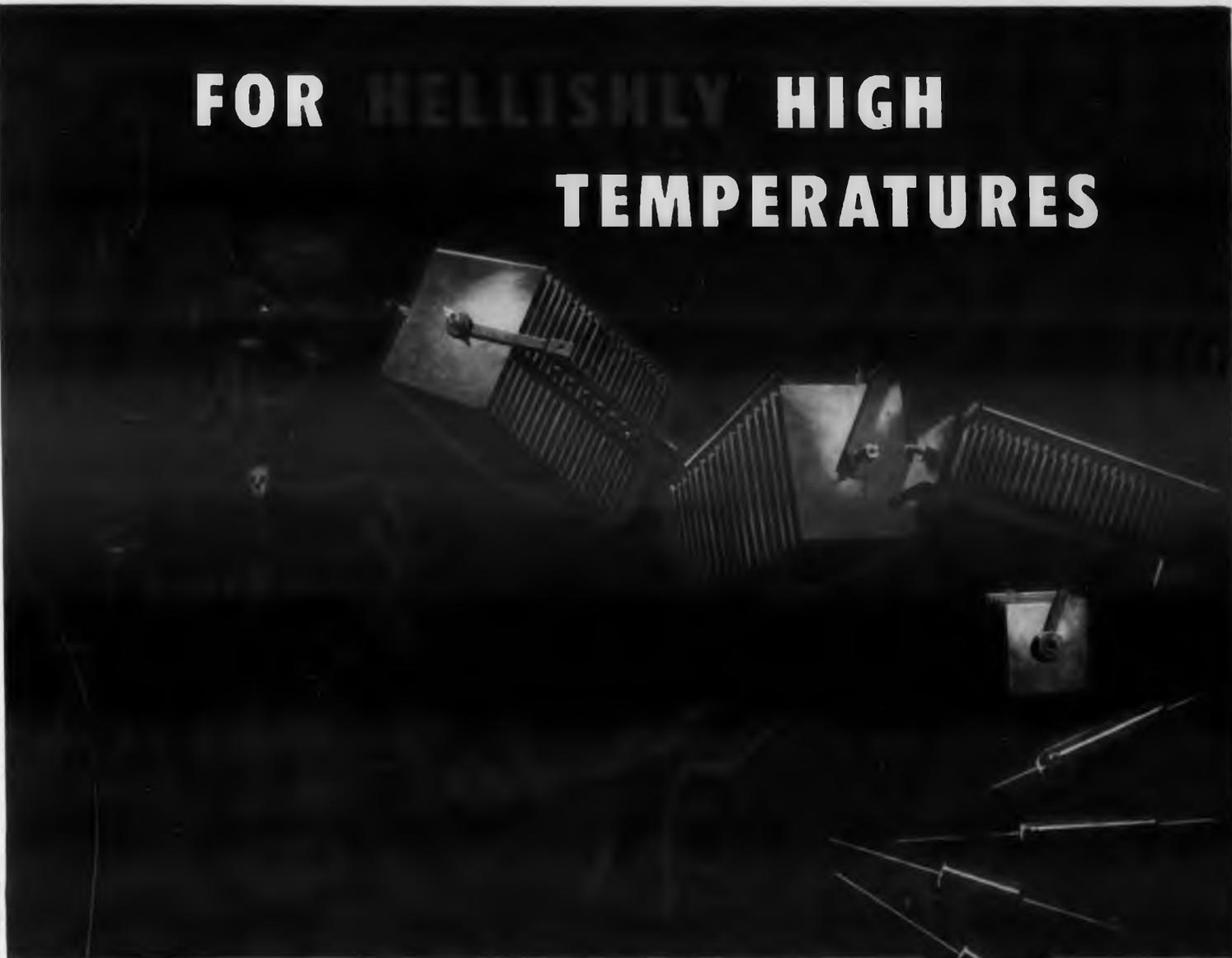
Selenium Rectifiers**561**

An engineering information folder, No. 6.401, describes this company's line of high temperature selenium rectifiers. The bulletin lists 86 types and sizes of high-temperature rectifier cells, their d-c output ratings in various single-phase and 3-phase circuits. Life and aging characteristics, voltage drop, circuit formulae and constants, and protective coatings are also discussed. Fansteel Metallurgical Corp., N. Chicago, Ill.

Miniature Panel Meters**562**

A new engineering data sheet describes this firm's new line of 1-1/2" ruggedized miniature panel meters designed to meet specification MIL-M-10304. The data sheet lists the standard ranges, and dimensional drawings and photographs of the instrument are shown. International Instruments, Inc., P. O. Box 2954, New Haven 15, Conn.

FOR HELLSHLY HIGH TEMPERATURES



Rectifiers now available for continuous operation at 150°C

"Hellishly High" is used in a comparative sense, of course. But the fact remains: Bradley's SS series of high-vacuum processed Selenium Rectifiers was developed to *perform as rated* at ambient temperatures of 150° C.

Life tests have passed 4200 hours at 150° C without any indication of cell deterioration. The units undergoing tests comprise four Bradley SS series R-cells, experimentally rated at 13 volts,

operating with an a-c input of 52 volts under a resistive load of 50 milliamperes. Available cell sizes range from 3/16" diameter to 5" x 6" plates.

Our representative will be glad to discuss the application of Bradley High Temperature Rectifiers to your application. Curves showing test results are available upon request. Please write for them.

SEE US AT I.R.E. NATIONAL CONVENTION BOOTH #722

VACUUM-PROCESSED — FOR PERFORMANCE AS RATED
Manufacturers of Metallic Rectifiers and Photoelectric Cells

BRADLEY LABORATORIES, INC. • 174 Columbus Ave., New Haven 11, Connecticut

CIRCLE ED-563 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW PRECISION INSTRUMENT OF HIGHEST ACCURACY...

currently meeting the demanding requirements of telemetry, computing, data reduction, automatic testing, plus many other instrumentation applications.



AUTOMATIC DIGITAL DC VOLTMETERS

The Model DV51B—a precision instrument combining in one convenient package all requirements for automatically measuring voltages rapidly and accurately. Offering these outstanding advantages:

- Direct-reading, five-digit, in-line display of DC voltages from ± 00.001 to ± 999.99
- Accuracy to within 0.01% above 10 volts and to ± 1 millivolt below 10 volts
- One-second average reading time
- Completely automatic polarity indication and range switching
- Calibration, switching circuits and bridge resistors sealed in special housing for temperature stability and dust prevention
- Rugged unitized construction with highest quality components for utmost reliability
- Dependability attested by aircraft, industrial and government laboratories
- Machine-recording output for automatic operation printers, electric typewriters, IBM punch equipment (optional)

SPECIFICATIONS. Input impedance: 11 megohms. Calibration: 10 internally-mounted certified standard cells. Size: 7x19x16 in. (rack and panel mounting). Color: instrument grey. Weight: 35 pounds. Power: 115 v., 60 cps ac, 50 w. Price: \$3590.

OPTIONAL DESIGN. Electro-Instruments offers six standard digital voltmeters for precision laboratory and production measurements. To meet specific requirements, optional design features including special voltage ranges, higher speeds, automatic ranging, automatic machine read-out and remote read-out may be selected.

For complete literature and specifications, write Dept. 10

ELECTRO- INSTRUMENTS

3796 ROSECRANS STREET
SAN DIEGO 10, CALIF.

ENGINEERING FIELD REPRESENTATIVES THROUGHOUT THE UNITED STATES

CIRCLE ED-564 ON READER-SERVICE CARD FOR MORE INFORMATION

Chassis Machinery 565

A 12-page bulletin (No. 74-B) describes a new air actuated adjustable bar folder, along with this company's complete line of hand-and foot-operated folders and brakes. Operating data and specification tables are accompanied by illustrations of machines, as well as examples of sheet metal work produced. Niagara Machine & Tool Works, 683 Northland Ave., Buffalo 11, N. Y.

Tubeless Power Supplies 566

This bulletin covers additions to this firm's line of tubeless regulated power supplies. Units illustrated and described include a combined d-c/a-c medium voltage supply; portable, variable low-voltage high-current d-c/a-c supply; dual transistor supply. Electronic Research Associates, Inc., 67-69 E. Center St., Nutley, N. J.

Plastic Packaging 567

"Butyrate Peelable Plastic Packaging" and its ability to protect metal parts against corrosion, impact, and abrasion are discussed in a 12-page booklet. Eastman Chemical Products, Inc., Kingsport, Tenn.

Precision Instrument Parts 568

This company's complete inventory of precision parts and components is illustrated in a 64-page catalog. Dimensions, tolerances, and prices are provided for such items as precision shafts, gears, collars, couplings, differentials, and bread-board equipment. PIC Design Corp., 160 Atlantic Ave., Lynbrook, L. I., N. Y.

Potentiometer Linearities 569

To aid in the selection of the type of linearity which the application of a potentiometer demands, this 4-page bulletin defines the four different types of linearities—-independent, zero-based, terminal, and index-point. Clarostat Mfg. Co., Inc., Dover, N. H.

Illuminated Magnifier 570

The Flash-O-Lens, a precision magnifier with built-in illumination, is described in this brochure. A small electric bulb is mounted in the handle of the magnifier to spotlight the magnified field of vision. Various models are illustrated and their uses outlined. E. W. Pike & Co., 492 North Ave., Elizabeth 3, N. J.

For Generation of Pulse Voltages -

CHATHAM MODEL 5C22 HYDROGEN THYRATRON

3 electrode
zero bias
thyatron
with peak
power
handling
capacity
to 2.6
megawatts



HEATER VOLTAGE: 6.3v
HEATER CURRENT: 10.6a
ANODE VOLT. DROP: 150v(pk)

For complete information on this and other Chatham Hydrogen Thyratrons, call, write or wire today. Years of specialized experience insures uniformly high performance.

**CHATHAM
ELECTRONICS**

Division
of Cera
Corporation



LIVINGSTON, NEW JERSEY

MAXIMUM RATINGS—Absolute Values	
Maximum Peak Anode Voltage	
Inverse	16 Kilovolts
Forward	16 Kilovolts
Minimum Peak Anode Voltage	
Inverse	800 Volts
Forward	4500 Volts
Maximum Cathode Current	
Peak	325 Amperes
Average	200 Milliampères
Averaging Time	1 Cycle
Minimum D.C. Anode Voltage	4500 Volts
Maximum Operating Frequency (Note 1)	1000 cps
Minimum Peak Trigger Voltage	200 Volts
Maximum Peak Trigger Voltage	600 Volts
Maximum Heating Factor (Note 2)	3.2×10^4
Maximum Current Rate of Rise	1500 Amps μ s
Maximum Anode Delay Time	1 μ s
Maximum Time Jitter	0.02 μ s
Ambient Temperature	+90 to 50°C

NOTE 1: This is not necessarily the upper operating frequency limit but represents the highest repetition rate for present life test requirements.

NOTE 2: Heating factor is the product (peak x amp x sec).

Visit us at the I.R.E. SHOW!
474, 476, 478 Electronic Ave.

CIRCLE ED-571 ON READER-SERVICE CARD FOR MORE INFORMATION

Production Facilities 572

A 2-color, 16-page brochure describes facilities available for subcontract manufacturing. In addition to describing the manufacturing plant and equipment, the publication discusses supporting services. Avien, Inc., 5815 Northern Blvd., Woodside 77, N. Y.

Tube Insulators 573

This 4-page, 3-color bulletin (No. 549) covers internal insulators for electron tubes. These insulators are available in lava and synthetic ceramics, and are available in strong, thin, intricate shapes as the result of a newly developed process. Detailed data on properties of the insulators are provided. American Lava Corp., Chattanooga 5, Tenn.

Ball Mounts 574

Bulletin No. 543 shows how the use of ball mounts provides inexpensive vibration and noise isolation for light loads. Dept. BM, Barry Corp., 1000 Pleasant St., Watertown, Mass.

Unilines 575

Two technical data sheets describe Unilines which feature a new mechanical construction that makes them suitable for use in applications where severe intermittent or continuous vibration and shock occur. Cascade Research Corp., 53 Victory Lane, Los Gatos, Calif.

Shelving Folder 576

A 2-color, 4-page folder points out in photographs, cartoons, and text the outstanding features of this company's Hallowell adjustable steel shelving. Standard Pressed Steel Co., Box 202, Jenkintown, Pa.

Colloidal Graphite 577

Bulletin No. 427, "Colloidal Graphite as a Parting Compound", discusses the use of "dag" colloidal graphite dispersions. Specific "dag" dispersions for many industrial uses and techniques of application are presented. Acheson Colloids Co., Div. of Acheson Industries, 4618 Washington Ave., Port Huron, Mich.

*this is what
a good
COLOR TV
TRANSFORMER
looks like*



● Nothing takes the place of an Acme Electric power transformer to provide the proper performance, long life and minimum of service expense in color TV as well as monochrome receivers. As cooperating pioneers in the development of transformer components for television applications, Acme Electric has accumulated valuable experience which may benefit you.

ACME ELECTRIC CORPORATION

903 WATER STREET

CUBA, N. Y.

West Coast Engineering Laboratories: 1375 W. Jefferson Blvd. • Los Angeles, Calif.
In Canada: ACME ELECTRIC CORP. LTD. • 50 Northline Rd. • Toronto, Ontario

Acme  **Electric**
TRANSFORMERS

CIRCLE ED-578 ON READER-SERVICE CARD FOR MORE INFORMATION

► Automatic Measurement

of Direct Current Voltages from

00.001 to 999.99 volts

► Accuracy within 0.01%

of Measured Voltage

► Five Decimal Digits

Clearly Display Measured Voltage



NON-LINEAR SYSTEMS'

DIGITAL VOLTMETER

MODEL 519

A self-balancing *digital* potentiometer that averages 40 readings per minute, clearly presented in an easy-to-read, in-line numerical display of five illuminated digits. Polarity and decimal point automatically indicated; no range switching required. One simple adjustment calibrates instrument to internal standard cell. Maximum error less than 0.01% of measured voltage or 00.001 volts, whichever is greater. Range of 00.001 to 999.99 volts. Full price: \$4,000.*

Accessories available for remote readouts and for automatically printing, typing, or punching permanent records. Two, three, and four digit instruments also available.

For complete specifications and full information concerning specific applications, write Dept. 2A

NON-LINEAR
SYSTEMS
INC.

*Published price is net,
f.o.b. Del Mar, Calif.
Factory-direct sales.

DEL MAR, CALIFORNIA

CIRCLE ED-579 ON READER-SERVICE CARD FOR MORE INFORMATION

High Efficiency

low noise *

A new line of Rotron
MODEL R blowers fills the gap
between squirrel-cage and multistage blowers.



ALL SIZES

2" TO 10" IMPELLER DIAMETERS

1/100 TO 5 HP • 50-60-400 CPS

MODEL R, radial-wheel, centrifugal blowers cover

the pressure-to volume range in which squirrel-cage type blowers
become inefficient, bulky and noisy. The new **MODEL R** now offers

the designer a line of blowers of superior performance
specifically tailored for electronic and instrument applications.



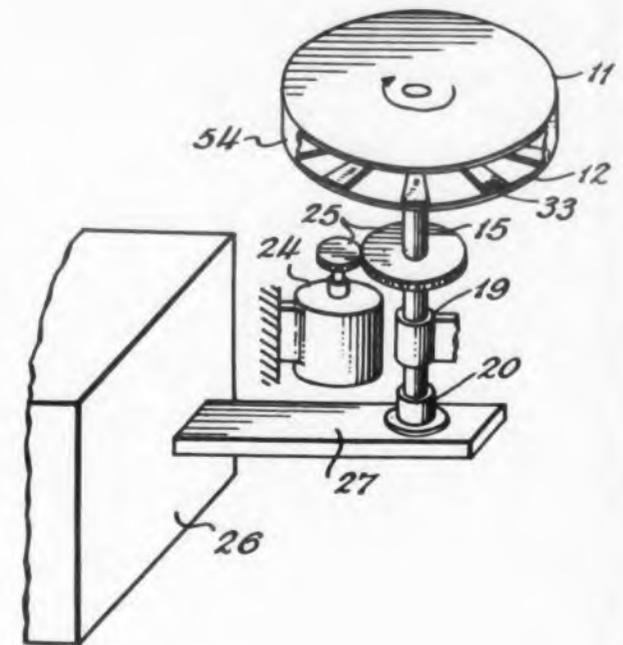
ROTRON

MANUFACTURING CO., INC.

7 SCHOONMAKER LANE • WOODSTOCK • NEW YORK
CIRCLE ED-580 ON READER-SERVICE CARD FOR MORE INFORMATION

Patents . . . By John Montstream

Fig. 1. The scalloped
limaçon pattern anten-
na is mounted verti-
cally on outer conduc-
tor 15 of a coaxial line
and rotated by motor 24
through gears 25.



Scalloped Limaçon Pattern Antenna . . .
Patent No. 2,677,766, George B. Litchford
(Assigned to Sperry Corp., New York,
N. Y.).

The antenna is designed particularly for an omni-azimuth guidance system of high directional accuracy as described in Patent No. 2,564,703, granted to George B. Litchford and Joseph Lyman. Although the antenna has special applicability, it does teach some new principles of antenna construction by which a signal of scalloped outline is produced. The antenna of the earlier patent used two spaced conductive discs with a scalloped peripheral outline. Because of its form, this antenna is difficult to enclose for protection against the weather.

The new antenna also includes a pair of spaced conductive discs with circle peripheries. Only the lower disc 12 is shown in Fig. 2, which is a sectional view in order to illustrate the pertinent details. The antenna is rotated by a motor which turns a tubular coaxial transmission line (15) upon which the discs are mounted. The scalloped or generally limaçon outline of the signal radiated by the antenna is secured by

providing spaced outwardly directed fingers or spokes (33) of dielectric material at the periphery of one or both discs. The illustration shows the fingers on the upper face of disc 12, which are located between the discs. The fingers shown extend from a central hub (30), although they may be individual parts of wedge-shaped form at the disc periphery. Ultra-high-frequency energy is supplied to a centrally located radiator (35) between the conducting discs. This radiator consists of three arcuate dipoles (37, 38, and 39). The central conductor (17) of the coaxial line is connected with each dipole by wires 41, 42, and 43, respectively. A shorting bar (46) between conductor 42 and radial bar 47 of dipole 38 causes the radiation pattern to become somewhat eccentric.

The scalloped form of the radiation pattern from the antenna is brought about by the dielectric fingers (33) which produce a phase difference in the radiated energy because of a difference in the dielectric constant at different angles around radiator 35. In other words a ray of energy "A" at or over a finger 33, where the effective dielectric constant is large, has a lower phase velocity than a ray of energy "B" radiated at a point where the effective

dielectric constant is smaller. The phase difference between the two components varies directly as the thickness of dielectric fingers 33 and inversely with respect to the spacing between the parallel discs of the antenna. The spacing between the discs is of the order of one wave length of the operating frequency and the thickness of

the dielectric fingers is about 3/8" for operation at a frequency in the neighborhood of 5000Mc. The dimensions of the other antenna elements are also given in the patent. The antenna is readily protected against the weather by an enclosure such as a fiberglass strip (54, Fig. 1) around the edges of the discs.

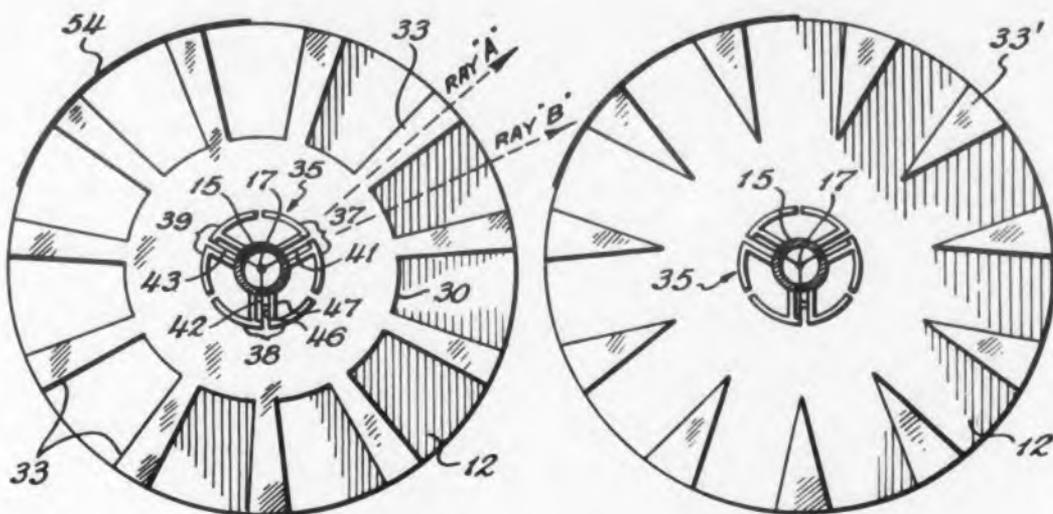


Fig. 2. The top (left) and bottom faces of disc 12.

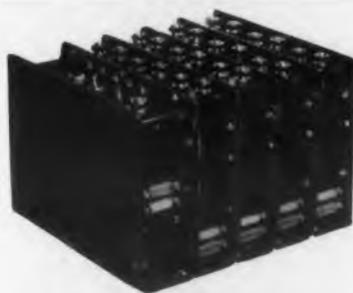
THE LAST WORD IN AIRBORNE TELEMTRY

Universal Mounting Assembly for simplified system planning and installation

The UNERAC (Universal Electronic Regulator, Amplifier and Calibrator) is a self-contained junction box for all elements of the transmitter system. It supplies or distributes all power, signal, calibration and transducer instrumentation voltages. Provides for transmitter deviation control, stepping relay circuits for 3 or 5 point calibration, and manual calibration.

The Universal Mount Section has mounting facilities for three RREP-type plug-in oscillators, plus necessary distribution and supply circuitry. Each building block section is constructed so that power is fed to the entire assembly, each section taking only that power required for its own oscillators and transducers.

Write for Technical Bulletin.



UNIVERSAL MOUNTING ASSEMBLY



TYPE 1401A UNERAC



TYPE 1402A UNIVERSAL MOUNT



RAYMOND ROSEN ENGINEERING PRODUCTS, INC.
32nd & Walnut Streets • Philadelphia 4, Penna.
15166 Ventura Boulevard • Sherman Oaks, California

CIRCLE ED-581 ON READER-SERVICE CARD FOR MORE INFORMATION

Amerac's latest . . .

C&D "S" BAND WAVEMETER



Amerac has now produced a new, inexpensive "S" Band Wavemeter. The model C&D covers the frequency range from 1800 MC to 3800 MC.

— FEATURES —

- Rugged, metal case, attractively finished in gray baked enamel.
- Micrometer extends outside instrument, for easy reading.
- Highly sensitive indication of resonance.
- Sensitivity control for setting sensitivity of indicating instrument.
- Rugged components give long, accurate, trouble-free service.
- Precision cavity assembly for accurate repeatable readings.
- Anti-backlash device to give further accuracy.
- Silver-plated parts are Rhodium flashed to minimize corrosion.

— SPECIFICATIONS —

Accuracy (at 3260 MC/S)..... $\pm 1/2$ MC.
Loaded Q.....Approximately 1000
Ruggedized 50 microampere indicating instrument.
RF detector.....Selected type 1N21-B silicon diode.
Input connections.....2 type N jacks
Output connections (video).....UHF jack
Overall size...8" long, 7 $3/4$ " wide, 2 $1/4$ " deep.
Weight.....2 $1/2$ lbs.

PRICE—\$225.00



Amerac, Incorporated

116 TOPSFIELD ROAD
WENHAM, MASSACHUSETTS

CIRCLE ED-582 ON READER-SERVICE CARD FOR MORE INFORMATION

RHEEM INSTRUMENTATION FOR OUTSTANDING QUALITY



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

RHEEM instrumentation units are:

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

... Designed to fulfill the demands of missile and aircraft 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.

RHEEM SUBMINIATURE INSTRUMENTATION AMPLIFIER

Model REL-12

SPECIFICATIONS

Size..... 7/8" x 2-5/16" x 4-3/8"
Weight..... 7 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
Output Impedance..... Less than 100 ohms
Load..... 33,000 ohms minimum
Will maintain a constant output with 8+ 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 R. F. POWER MINIATURE AMPLIFIER

Model REL-09

SPECIFICATIONS

Size..... 4.90 x 3.37 x 2"
Weight..... 16 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..... 1.4 watts minimum
Plate..... 250 V dc @ 90 ma
Filaments..... 12.6 V @ 0.41 amp
or 6.3 V @ 0.82 amp
Bias..... None Required

RHEEM SUBMINIATURE VOLTAGE REGULATOR

Model REL-11

SPECIFICATIONS

Size..... 1-3/4" x 2-5/16" x 4-3/8"
Weight..... 14 ounces
Output Voltage..... Any nominal voltage from 130 to 235 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

YOU CAN RELY ON...

For equipment display see...
I.R.E. National Convention
and Radio Show—Mar. 21-24
Booth 87

Kingsbridge Palace, New York, New York.



CIRCLE ED-583 ON READER-SERVICE CARD FOR MORE INFORMATION

Two-Terminal Sine Wave Oscillator . . .
Patent No. 2,675,474. Everett Eberhard
(Assigned to Radio Corporation of America,
New York, N. Y.)

The uses of transistors are gradually broadening as inventors extend their investigations of this new electronic device. The use of transistor in an oscillator circuit has been treated already. However, such circuits use an external feed back path. The inventor of the oscillator circuit shown in Fig. 3 makes use of the negative resistance of a transistor that occurs under limited operating conditions of the device.

The circuit illustrated is one embodiment of the circuit of the invention in which the transistor (12) has the usual transistor emitter 13, collector 14, and base 15 electrodes. Each of the emitter, collector and base electrodes has a resistor (26, 24, and 23, respectively) of about 10,000 ohms connected to it. The emitter circuit includes a source (17) of forward potential, and the collector circuit includes a source (16) of reverse potential. This much of the circuit is conventional, and the function and operation of the component parts is well

known. By inserting a series resonant circuit (41, 42) between the collector electrode and ground, or shunting the collector resistor 24 and potential source 16, the circuit will oscillate when the bias potential upon the emitter electrode is of the proper value. It has been found also that the frequency of oscillation is a function of the emitter and collector potential. The circuit will oscillate too if the series resonant circuit is connected between the emitter electrode and ground and also if connected between the emitter and collector electrodes. In another pending patent application, the inventor describes an oscillator with the resonant circuit forming a part of the base circuit.

The circuit is interesting from another aspect. By fixing the value of resistance of resistor 26 and the potential of the emitter electrode at level 61 shown in Fig. 4, the circuit is quiescent. By applying a positive trigger pulse on the input terminals (63), the potential on the emitter is raised to a point where it is between the vertical lines 0 and 60, in which region, the circuit oscillates and it continues to oscillate for the duration of the pulse.

After
its qu
obtain
either
to the
value

Machlett ML-2C39A

High Transconductance, UHF Planar Triode



Machlett Laboratories offers the designer a 2C39A* UHF planar triode whose transconductance is held between 20,000—28,000 micromhos.

Maximum input ratings include: Plate voltage, 1000 volts; average cathode current, 125 mA. Filament voltage is 6.3 volts, nominal.

Average strength of the ML-2C39A is over 400% greater than *any other* 2C39A, as measured in torque and pry tests. Exception stability and uniformity is assured in operation up to 2,500 Mc and beyond.

Construction features include: Uniquely processed mesh grid to assure greater frequency stability with maximum grid dissipation; silver plating for optimum conductivity; thick cross-section kovar seals for strength; one-piece finned aluminum radiator for 100 watt plate dissipation.

Used in hundreds of military and commercial UHF communications transmitters, the ML-2C39A gives superior, trouble-free service.

* Manufactured to JAN specifications.

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

CIRCLE ED-584 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • March 1955

ELEC

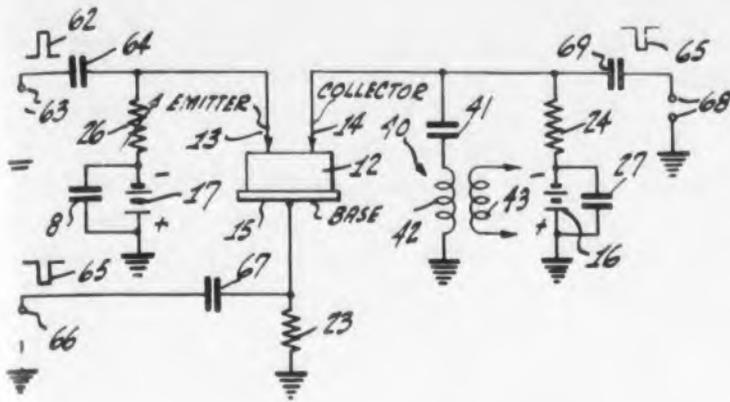
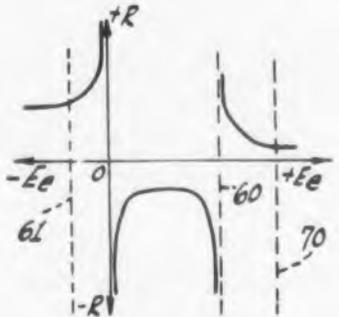


Fig. 3. Circuit for the two-terminal transistor sine wave oscillator.

Fig. 4. This plot of emitter voltage vs. the value of resistance inserted in its circuit helps to explain the oscillation action.



After the pulse dies the circuit returns to its quiescent state. The same result may be obtained by applying a negative pulse to either the base electrode terminals 66 or to the collector electrode or by varying the value of the emitter resistance. The latter

may be done by replacing resistor 26 with a device such as a vacuum tube or transistor. The circuit may be used also for frequency modulation. With other circuit modifications described in the patent, it may be used as a harmonic generator.

a highly stable
 dual power supply



DRESSEN-BARNES
Model D3-300D

You get two high-voltage output ranges—each widely useful... each independent of the other—on one compact chassis. Appearance of the unit meets highest laboratory standards. All components are de-rated for long, trouble-free service life. Write for literature on Model D3-300D.

Output Voltages:

1. 0-300 V.D.C. continuously variable without switching... current 300 MA. max. load.
2. 0-300 V.D.C. continuously variable without switching... current 150 MA. max. load.
3. DC variable bias: 0-150 volts @ 5 MA. max. load (regulated by VR tube).
4. AC unregulated 0-10 V.A.C. @ 10 amps. max. load (variable with Powerstat control).

Regulation:

1. For line voltage 115 V.A.C. \pm 10%, the output voltage change is .15%.
2. D.C. regulated high voltage: less than 30 MV. change N.L. to F.L.

Ripple — both high voltage outputs less than 500 microvolts RMS.

Grounding — both pos. or neg. of either high voltage outputs may be grounded.



dressen-barnes
DRESSEN-BARNES CORP., 250-A N. Vinedo Ave., Pasadena 8, Calif.

CIRCLE ED-585 ON READER-SERVICE CARD FOR MORE INFORMATION

To Wind Coils of "INVISIBLE WIRE"

(or other minute
precision operations)



At the Hathaway Instrument Company, tiny galvanometer coils are wound with wire so fine that it is almost invisible to the unaided eye. Ingenious tooling and use of an AO Stereoscopic Microscope assure fast, precise workmanship.

These unique AO Microscopes provide two complete optical systems (one for each eye) to enhance the perception of depth and to provide *three-dimensional* reality plus an exceptionally wide field of view. Unlike ordinary microscopes, objects and movements are *not* inverted. Instead they appear in their natural directions. Because AO Stereoscopic Microscopes are unequalled for fabrication, assembly, inspection of minute precision parts, they are widely used in electronics, metal working, food and many other industries.

Let AO Stereoscopic Microscopes help you achieve high precision at low cost. Mail coupon below.

You NEED



Stereoscopic Microscopes

American Optical

 INSTRUMENT DIVISION
BUFFALO 15, NEW YORK

American Optical Company
Dept. J 178
Instrument Division
Buffalo 15, New York

Gentlemen:

Please send me further information on AO Stereoscopic Microscopes.

Signed

Organization

Address

City..... Zone..... State.....

CIRCLE ED-457 ON READER-SERVICE CARD FOR MORE INFORMATION

serving **ELECTRONICS**

with Custom Quality **SHEET METAL PRODUCTS**

See Us At
I.R.E. SHOW
 354 Microwave Ave.



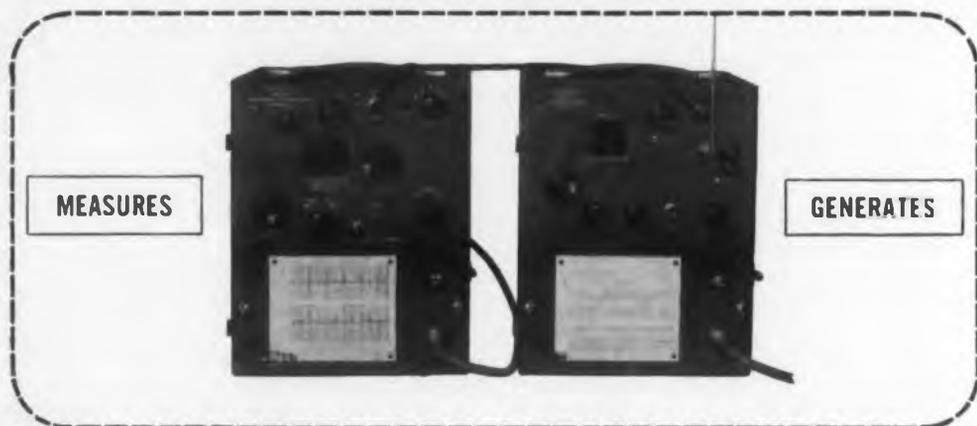
Complete sheet metal fabricating services—*plus*. This plus is the 50 years experience and our versatile staff, plant, equipment, tools and dies which show up in your job as R & T quality. Short runs or quantity production, we can assist in design and build it with utmost economy. Or, if you prefer, submit your blueprints or specifications.

• Aluminum Spot Welding • Heliarc Aluminum Welding

THE RIESTER & THESMACHER COMPANY
 1526 W. 25th ST. • CHerry 1-0154 • CLEVELAND, OHIO

CIRCLE ED-586 ON READER-SERVICE CARD FOR MORE INFORMATION

Now... Complete Frequency Coverage 50 kc. to 1000 mc.



MODEL FM-3 Frequency Meter
 20 to 1000 mc.

The Gertsch FM-3 VHF frequency meter is the standard of the industry. Measures and generates 20 to 1000 mc. with accuracy and stability of $\pm .001\%$. Compact, portable model. Battery, AC, or battery/AC operation available.

MODEL FM-5 Frequency Divider
 50 kc. to 20 mc.

The NEW companion to the already established FM-3. When driven by a VHF frequency meter, measures 50 kc. to 20 mc. and generates 200 kc. to 20 mc. Continuous coverage. Contributes NO error. Same accuracy and stability as FM-3. Battery, AC, or battery/AC models available.

For complete information and specifications contact your nearest Gertsch representative or

= GERTSCH =

GERTSCH PRODUCTS, INC.
 11846 Mississippi Avenue
 Los Angeles 25, California

CIRCLE ED-587 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistor Oscillator . . . Patent No. 2,681,996. R. L. Wallace. (Assigned to Bell Telephone Laboratories, New York, N. Y.)

In the May, 1954, issue of *ELECTRONIC DESIGN* (p. 74) a patent disclosure was discussed which pointed out that, when a transistor was substituted for a vacuum tube in an amplifier circuit without some essential change in the circuit, the results secured were well below expectations. The earlier patent disclosed that a transistor very closely approximates the dual counterpart of a triode tube both quantitatively and qualitatively. It also showed that when an amplifying circuit was designed utilizing dual theory then a transistor used in that circuit gave excellent results. Briefly the dual relationship may be illustrated generally by such parameters as voltage, resistance, and inductance, the dual counterpart of which are the parameters, current, conductance, and capacitance, respectively. That the relationship between a triode and a transistor is a dual one is further shown by a comparison of the current, voltage characteristic curves of a tri-

ode with the voltage, current characteristic curves of a transistor. The series of characteristic curves for the two devices are very similar.

The patent sets forth circuits and circuit theory in the design of dual counterpart circuits for different known vacuum-tube oscillator circuits. The circuit and applicable equations of the triode oscillator circuit of Fig. 5 has as one of the dual counterpart transistor circuits, the circuit and equations of Fig. 6. The circuits are schematic circuit diagrams of bridge stabilized oscillators showing the signal frequency portions only. In the transistor circuit of Fig. 6, the center tap of the transistor $L_{1,5}$ is connected with the base electrode. One end of the transformer is connected with the emitter electrode and the other end is connected with the collector electrode. The stabilizing resistor $R_{1,1}$ of the triode circuit has a negative temperature coefficient resistor R' as its dual counterpart in the transistor circuit. The tuned circuit $L_{1,4}, C_{1,4}$ of the triode circuit has as its dual counterpart a series resonant tuned circuit L', C' .

The three dual circuit diagrams of Fig. 5, Fig. 6, and Fig. 7 are connected in series. The second circuit diagram of Fig. 6 is connected in series with the first circuit diagram of Fig. 6.

**Portable...
Versatile...
Temperature
Test Chamber**

For ambient temperature tests in the LABORATORY or on the PRODUCTION LINE, the Model TC-2 Temperature Test Chamber is ideal. Interchangeable extra test trays may be ordered to eliminate loading delays in continuous production tests, or for convenience in special test work.

Range: -65° to $+350^{\circ}$ F.
Heater: Electric strip heater
Coolant: Dry ice, 15 lbs. capacity
Control: Adjustable thermostat & selectable heat inputs
Load Capacity: 600 cubic inches of test materials
Power: 115V, 5 amp. 50-60 cycle
Overall Size: 48" x 16½" x 12"
Weight: 62½ lbs.



**MODEL TC-2
TEMPERATURE
TEST CHAMBER**

\$550.00
F.O.B. LOS ANGELES

**STATHAM
DEVELOPMENT
CORPORATION**

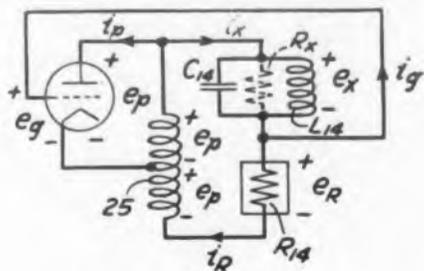
12411 W. Olympic Blvd.
Los Angeles 64, Calif.

CIRCLE ED-588 ON READER-SERVICE CARD FOR MORE INFORMATION

The patent describes and illustrates three other oscillator circuits that are also dual counterparts of the triode circuit of Fig. 5. The tuned circuit may be connected between the midpoint of the inductance L_{15} and the collector electrode, as in Fig. 6, or in the first alternate circuit it is connected with the emitter electrode. A second alternate circuit connects the tuned

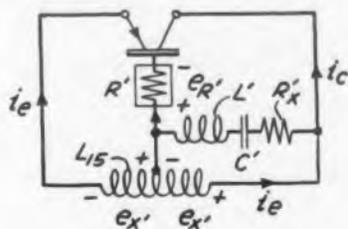
circuit between the emitter and collector electrodes but with different values for the circuit elements. A third alternate circuit is somewhat more complex and connects the series tuned circuit between the midpoint of the transformer and the base electrode. The patent gives a mathematic analysis of the manner in which the values of the dual circuit elements are secured.

Fig. 5. The triode oscillator circuit.



$$\begin{aligned} -i_p &= i_R + i_x \\ -i_g &= i_R - i_x \\ -e_p &= -\frac{1}{2}e_R - \frac{1}{2}e_x \\ -e_g &= e_x - e_p \\ &= -\frac{1}{2}e_R + \frac{1}{2}e_x \end{aligned}$$

Fig. 6. The transistor circuit analyzed to show its relation to the triode.



$$\begin{aligned} e_c &= e_{R'} + e_{x'} \\ e_e &= e_{R'} - e_{x'} \\ i_c &= -\frac{1}{2}i_{R'} - \frac{1}{2}i_{x'} \\ i_e &= i_{x'} + i_c \\ &= -\frac{1}{2}i_{R'} + \frac{1}{2}i_{x'} \end{aligned}$$

a complete line of relays



SUPER RUGGED
Vibration 10 G's - 500 cps
MIL R 5757B

SUB-MINIATURE
1/2 cu. in. - 1/2 oz.

HIGH CONTACT RATINGS
5 amp., 24VDC, 115 VAC
RESISTIVE

EARLY DELIVERIES

SENSITIVE
from .020 Watts

HI-TEMPERATURE
- 65° to 200° C.

FAST OPERATING
TIME DELAY

HERMETICALLY SEALED

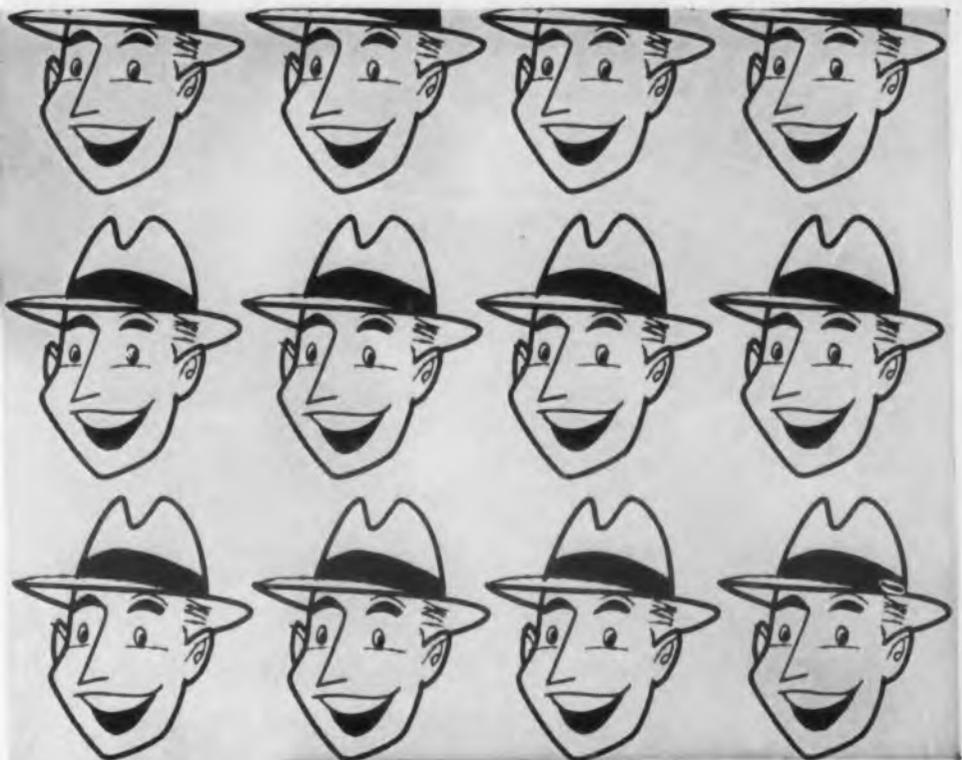
ALL TO MIL R 5757B SPECIFICATIONS

Manufacturer's of High Precision Sub-Miniature Electro-Mechanical Devices.

ELGIN-NEOMATIC, INC.

A SUBSIDIARY OF ELGIN NATIONAL WATCH COMPANY
9010 BELLANCA AVE. • LOS ANGELES 45, CALIF. • OR 8-3814

CIRCLE ED-589 ON READER-SERVICE CARD FOR MORE INFORMATION



How Users* Feel

ABOUT OUR PRECISION

SYNCHROS

Users of E-P Precision Synchros enjoy the happy combination of extreme dependability, high accuracy and low cost. All result from our more than twenty years' experience in this specialized field.

As the number one manufacturer of precision synchros, we suggest . . . with (we hope) pardonable pride . . . that we can supply the most efficient answer to *your* synchro requirements, too.

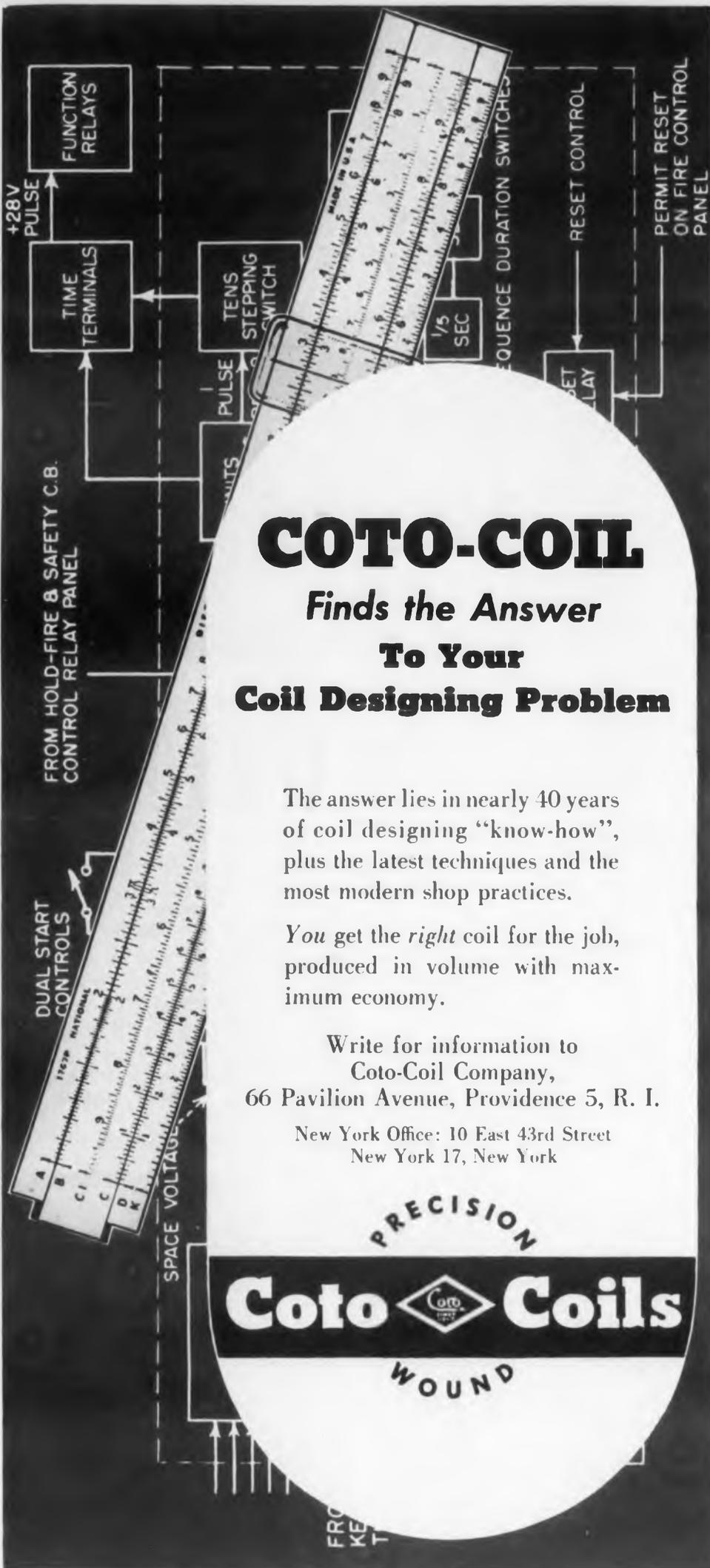
Write, wire or call us for information on standard and special types . . . prices . . . and deliveries. ECLIPSE-PIONEER DIVISION, BENDIX AVIATION CORPORATION, TETERBORO, N. J.

***AND WE HAVE MORE OF THEM THAN ANYONE ELSE**



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

CIRCLE ED-590 ON READER-SERVICE CARD FOR MORE INFORMATION



COTO-COIL

Finds the Answer

To Your

Coil Designing Problem

The answer lies in nearly 40 years of coil designing "know-how", plus the latest techniques and the most modern shop practices.

You get the *right* coil for the job, produced in volume with maximum economy.

Write for information to
Coto-Coil Company,
66 Pavilion Avenue, Providence 5, R. I.

New York Office: 10 East 43rd Street
New York 17, New York

PRECISION

Coto  **Coils**

WOUND

CIRCLE ED-591 ON READER-SERVICE CARD FOR MORE INFORMATION

Books . . .

The Electronic Musical Instrument Manual . . . By Alan Douglas, second edition, 221 pages. Pitman Publishing Corp., 2 W. 45th St., New York, N. Y. \$6.00

Many more electronic designers are concerned with the reproduction rather than the production of sound electronically, yet a considerable portion of the art deals with the latter. This volume contains practically all that a designer needs to know to design an electronic musical instrument. In addition, many commercially available electronic instruments are discussed and illustrated. The complete circuits of the Hammond "Solovox" and the "Novachord" organ are given on fold-outs.

The work is actually a second edition.

The growing number of electronic musical instruments, despite the competition of other electronic devices for the consumer's time, has forced the author to bring out a revised edition only five years after the first version.

The theory of tone production has advanced little in the past five years, so that little new material has been added to the first few chapters on design. Some new material has been added to the last chapter on "Experimental Methods".

Among the devices discussed is the German "Welte" organ, which employs a printed-circuit wheel similar to a code wheel to produce the various tones. The glass-base wheel, which has various waveforms printed on it, spins between a light

AMONG THE
Engineering Opportunities
at the
Ramo-Wooldridge Corporation

The Ramo-Wooldridge Corporation, Los Angeles, affiliate of Thompson Products, because of a large contractual backlog must undertake a rapid expansion of its research and development programs in the fields of guided missiles and other advanced electronic systems.

Immediate openings are available for:

**ELECTRO-MECHANICAL
ENGINEER**

Experienced in the analysis and design of precision mechanical and electro-mechanical components for airborne electronic systems.

PROCESS ENGINEER

Experienced in the selection and application of manufacturing processes and materials required in the fabrication of miniaturized airborne electronic equipment.

Applicants must be U. S. citizens. Please submit a complete résumé of qualifications and experience to:

The Ramo-Wooldridge Corporation

Dept. ED, 8820 Bellanca Avenue, Los Angeles 45, California

source and a photoelectric pick-up. A system of producing square waves from two sawtooth waves is also described.

Since pianos and conventional pipe organs are hardly likely to drop in cost, the increased quality and lowered cost of many electronic components should bring more of these electronic instruments within the reach of the consumer.

Introduction to Nuclear Engineering . . .

By Raymond L. Murray, 418 pages. Prentice-Hall, Inc., 70 Fifth Ave., New York, N. Y. \$9.35.

An important future market for electronic instruments and control devices will be generated by the widespread use of radioactive materials. This volume can help acquaint the electronic designer with the problems of those engineers working with radioactive materials.

Chapter 16, "Detectors and Control Instruments", is of direct interest to the electronic designer, but many of the other chapters provide valuable information. Some of these chapters are entitled "Reactor Start-up and Operation", "Radiation

Hazards", and "Nuclear Propulsion of Aircraft, Submarines, and Rockets".

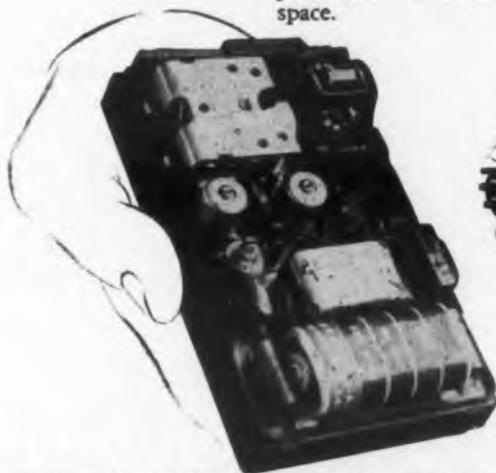
There are three appendices. One lists all the libraries where Atomic Energy Commission unclassified reports are deposited. The author is Professor of Physics at North Carolina State College of Agriculture and Engineering, where the Raleigh Research Reactor is located.

Cook Technical Review . . . 113 pages, paper-bound. Cook Electric Co., 2700 Southport Ave., Chicago 14, Ill. \$1.00.

This book contains reprints of seven useful articles, written by members of the Cook Research Laboratories, dealing with the design of servomechanisms. The articles are entitled: "Analog Computers for Servo Problems", "Electromechanical Lead Networks for A. C. Servomechanisms", "Stabilizing Servomechanisms", "Nonlinear Techniques for Improving Servo Performance", "Multiple Mode Operation of Servomechanisms", "The Application of Nonlinear Techniques to Servomechanisms", and "Design Considerations of a Saturating Servomechanism".

PROBLEM:

High-performance components — minimum space.



Regency TR1 radio.

SOLUTION BY VOKAR:

Vo-Tron Subminiature Components—smallest ever mass-produced!

The design problems you face in working with transistors, printed circuits, automation, can also be solved with the use of Vo-Tron Subminiature Components.

455kc and 262kc IF Transformers—Oscillator Coils—Ferrite Antennas and other Vo-Tron Components are now available.

Wire or write for samples and technical details.

Vo-Tron Division

VOKAR CORPORATION
Dexter 1, Michigan

CIRCLE ED-593 ON READER-SERVICE CARD FOR MORE INFORMATION

For **Versatility!**



Pacific VERTICAL GYROS



From design to final application, Pacific Vertical Gyros give maximum versatility. Different case configuration provides the one best suited for your own particular needs... for either aircraft or missile installation... for telemetering or control systems... for use where small space and light weight are vital.

Torque motors are capable of extremely high precessing rates, and can be cut out by external switching. Gyro erection to gravitational, vertical or case axes, with erection over a full 60° from any direction... angle indication $\pm 85^\circ$ in pitch - 360° in roll. Furnished with precision potentiometers and improved design mercury switches for vertical reference.



Pacific RATE GYROS

Simple and rugged in design, Pacific Rate Gyros provide exceptional dynamic performance. An entirely new, unique motor and wheel design gives higher natural frequency for any rate range. Small size and light weight... write for full details!

New—catalog sheets with drawings and full specifications on Pacific Gyros. Write for free copies today!



Pacific SCIENTIFIC CO.

LOS ANGELES • SAN FRANCISCO • SEATTLE • ARLINGTON, TEXAS

REPRESENTATIVES:

Aero Engineering Co
Atlanta, Ga • Baltimore, Md.
Indianapolis, Ind • Mineola, L.I., N.Y.
Columbus, Ohio • St. Louis, Mo
GARRETT MFG CORP. Toronto, Canada
In England: TELEFLEX PROD., LTD
In France: SARMA - St. Vallier

PACIFIC SCIENTIFIC COMPANY

1424 Grande Vista Avenue
Los Angeles 23, California

Please send me data on:

- Pacific Gyros Potentiometers
 Accelerometers

NAME _____

FIRM _____

STREET _____

CITY _____ STATE _____

CIRCLE ED-594 ON READER-SERVICE CARD FOR MORE INFORMATION



TRANSFORMERS for...

RADIO • TELEVISION • MILITARY • SPECIAL APPLICATIONS

RADIO & TV



PLATE TRANSFORMERS
 MODULATION TRANSFORMERS
 REACTORS
 FILAMENT TRANSFORMERS
 UNITIZED RECTIFIERS
 PULSE TRANSFORMERS
 CHARGING REACTORS
 OIL, ASKAREL
 DRY TYPE, (CLASS A, B & H)

PER { MIL-T-27 }
RETMA } SPEC.

RADIO & TV



MILITARY



SPECIAL APPLICATIONS



MILITARY



Moloney quality, backed by 58 years of transformer experience, is designed and built into each unit.

This engineering background and experience enables Moloney to produce transformers that offer the maximum in reliability, endurance and efficiency at a minimum of size and weight.

Write for Specialty Transformer Bulletin ST 3505.

MESS-8

MOLONEY ELECTRIC COMPANY

SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES: ST. LOUIS, MO., TORONTO, ONT., CANADA



CIRCLE ED-595 ON READER-SERVICE CARD FOR MORE INFORMATION

Abstracts of the Literature on Semiconducting and Luminescent Materials and Their Applications: 1953 issue . . . Compiled by Battelle Memorial Institute, 169 pages, John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. \$5.00.

The library of every electronic design laboratory that deals with semiconductors or tubes incorporating luminescent materials should include this volume. It includes abstracts of articles dealing with these materials published during 1953 in more than 50 periodicals from all over the world. Although many articles deal with subjects of little pertinence to designers, such as extraction and purification, there is much of interest to the circuit designer and many articles of great interest to designers of semiconductor devices or tubes incorporating luminescent materials.

Among the materials discussed are: germanium; silicon; carbon and diamond; boron, gray tin, antimony, and phosphorus; selenium and tellurium; antimonides and other intermetallics; borides, carbides, nitrides, and silicides; oxides, sulphides, halides, and others. Among the articles discussed in the section on semiconductor theory are ones on galvanomagnetic effects, noise, and electron statistics and thermodynamics.

A subject and author index are included. This work was sponsored by the Electrochemical Society.

The Radio Amateur's Handbook . . . 32nd edition, 768 pages. American Radio Relay League, West Hartford 7, Conn. \$3.00

The latest edition of this famous work includes much of value to the electronic designer. Of special interest is the section on vacuum tube and semiconductor types. All RETMA tube base diagrams are given along with electrical characteristics. The earlier chapters on electrical fundamentals and basic circuitry could be used for review purposes.

Television Factbook: Spring, 1955 edition . . . 428 pages. Television Digest, Wyatt Building, Washington 5, D. C. \$4.00

The 20th semi-annual edition of the *Television Factbook* contains much of interest to the electronic designer, although the work was not prepared for his use. A list of all receiving tube and picture tube manufacturers is given along with the complete text of the FCC color television standards. The manufacturers of TV receivers, tuners, and u-h-f converters is also included.

Other valuable information includes a list of private and Government electronics research laboratories and statistics on TV receiver sales. Most of the book is devoted to lists of existing TV stations and their ownership.

Acheson
 Acme Ele
 Aerovox
 Aircraft R
 Aircraft-N
 Aircraft T
 Airtron
 Allen-Brad
 Allied Ra
 Alloy Me
 Amerac.
 American
 American
 American
 American
 Arga Div
 Arnold E
 Assembly
 Astron C
 Automati
 Baird Ass
 Bakelite
 Baker &
 Barry Co
 Bead Ch
 Bendix A
 Berkeley,
 Beryllium
 Biddle, J
 Bircher C
 Bliley Ele
 Bogue Ele
 Bomac L
 Bourns L
 Bradley I
 Branson
 Bruno-Ne
 Brush Ele
 Burndy E
 Burnell &
 Caledoni
 Cambrid
 Cannon
 Canoga
 Carborun
 Carter N
 Centralal
 Chatham
 Collins F
 Comar E
 Convaire
 Corning
 Coto-Col
 Curtis D
 Daven C
 DeJur A
 Detectro
 Doelcam
 Donner
 Dow Cor
 Driver-H
 Dessen-I
 DuMont
 Du Pont
 E. S. C.
 Eastern
 Eastern
 Eastern f
 Eitel-Me
 Elastic S
 Electrica
 Electra
 ElectroD
 Electro-I
 Electron
 Electro-M
 Electron
 Electron
 Elgin N
 Emerson
 Erie Res

Advertising Index

March 1955

Advertiser	Page
Acheson Colloids Co.	96
Acme Electric Corp.	163
Aerovox Corp.	146
Aircraft Radio Corp.	157
Aircraft-Marine Products, Inc.	16
Aircraft Transformer Corp.	147
Airtron	65
Allen-Bradley Co.	58
Allied Radio Corp.	120
Alloy Metal Wire, Div. of H. K. Porter Co.	123
Amerac, Inc.	165
American Lava Corp.	93
American Optical Co., Instrument Div.	167
American Phenolic Corp.	152, 153
American Relay & Controls, Inc.	119
Arga Div., Beckman Instruments, Inc.	159
Arnold Engineering Co., The	49
Assembly Products, Inc.	140
Astron Corp.	31
Automatic Electric Co.	173
Baird Associates	134
Bakelite Co., Div. of Union Carbide & Carbon	6
Baker & Co.	136
Barry Corp., The	139
Bead Chain Mfg. Co.	29
Bendix Aviation Corp.	169
Berkeley, Div. of Beckman Instrument	30
Beryllium Corp., The	143
Biddle, James G. Co.	85
Birtcher Corp.	80
Bliley Electric Co.	128
Bogue Electric Co.	48
Bomac Laboratories, Inc.	106
Bourns Laboratories	147
Bradley Laboratories, Inc.	161
Branson Corp.	143
Bruno-New York Industries Corp.	84
Brush Electronics Co.	133, 140
Burndy Engineering Co., Inc.	138
Burnell & Co., Inc.	11
Caledonia Electronics & Transformer Corp.	147
Cambridge Thermionic Corp.	113
Cannon Electric Co.	92
Canoga Corporation	115
Carborundum Co., The	19
Carter Motor Co.	77
Centralab, Div. of Globe Union	45
Chatham Electronics Corp.	162
Collins Radio Corp.	20
Comar Electric Co.	118
Convair, Div. of General Dynamics	126
Corning Glass Works	132
Coto-Coil Co.	170
Curtis Development & Mfg. Co.	144
Daven Co., The	4
DeJur Amsco Corp.	117
Detectron Corp., The	127
Doelcam Corp.	42
Donner Scientific Co.	137
Dow Corning Corp.	82
Driver-Harris Co.	14
Dressen-Barnes Corp.	167
DuMont, Allen B. Laboratories	55, 57, 59, 61
Du Pont, E. I., de Nemours & Co.	10, 120
E. S. C. Corp.	67
Eastern Air Devices	138
Eastern Industries, Inc.	64
Eastern Precision Resistor Corp.	37
Eitel-McCullough, Inc.	44
Elastic Stop Nut Corp.	112
Electrical Industries	110
Electrical Products Corp.	122
ElectroData Corp.	127
Electro-Instruments	162
Electromec, Inc.	35
Electro-Motive Mfg. Co.	85
Electronics Corp. of America	135
Electron Products	112
Elgin Neomatic, Inc.	169
Emerson & Cuming, Inc.	140
Erie Resistor Corp.	131



Class Z relay—super-miniature, costs less

"exactly large enough"

Automatic Electric's Class Z relay exactly fits many applications where relays of *extremely* small size cannot match its service and operating characteristics. Take these typical cases:

Machine tool manufacturer—needed a relay that was *small*, but carried a good-sized contact load.

Computer manufacturer—needed an *inexpensive* relay with large bearing surfaces for long life.

For airborne equipment—maker needed a compact relay capable of withstanding shock, vibration, and extreme temperatures.

All three selected Automatic Electric Class Z relays—and all three are highly pleased!

Surprisingly low cost.

You'll find, as many manufacturers have, that the Class Z—made to Automatic Electric's usual standards of high quality—actually costs less than most so-called "cheap" relays! Here's a relay you can consider for *all* your relay applications!

Write for recommendations, prices and delivery schedules. Delivery is prompt. Automatic Electric Sales Corporation, 1033 West Van Buren Street, Chicago 7, Illinois. In Canada: Automatic Electric Sales (Canada) Ltd., Toronto. *Offices in principal cities.*

S P E C I F I C A T I O N S

Standard Types—ZQA (quick-acting), ZSO (slow-operating), ZSR (slow-releasing), ZSA (slow-acting), and ZFA (for a-c operation).

Operating Voltage—Series ZQA and ZSA, up to 135 volts, dc; Series ZSO and ZSR, up to 115 volts, dc; Series ZFA, up to 115 volts, ac.

Contact Spring Capacity—Series ZQA, ZFA, and ZSO, 13 springs; Series ZSA and ZSR, 6 springs.

Contacts—Normally single. Load-carrying capacity, 150 watts.

Dimensions—Overall length, 2½"; height, 1½" to 2¾"; width, 1¼" for single pile-ups, 1½" for double pile-ups.

Net weight—4.6 oz.

Can be plug-mounted—ask for Circular 1804

RELAYS

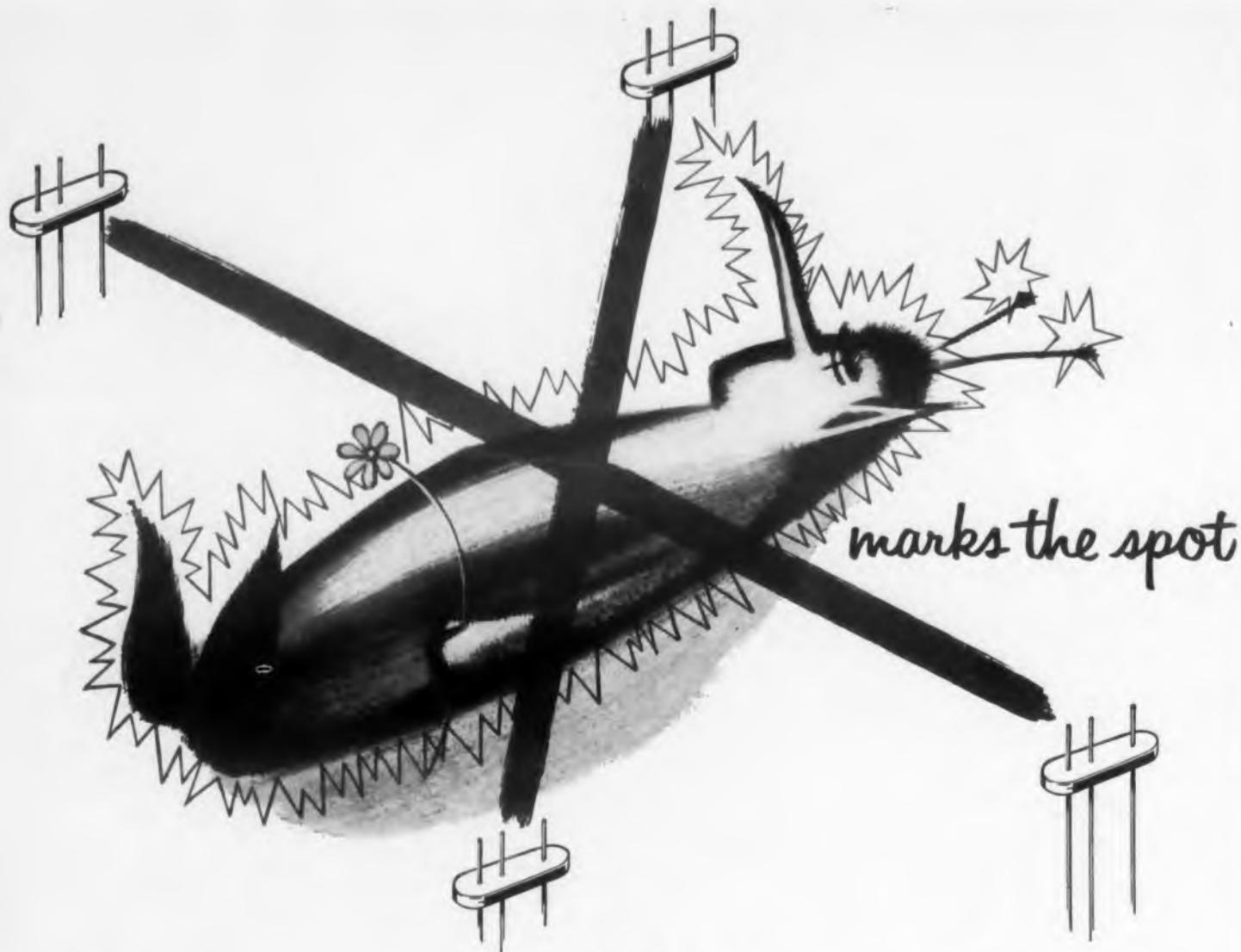
SWITCHES

PRODUCTS OF THE INDUSTRIAL DEPARTMENT OF

AUTOMATIC ELECTRIC

CHICAGO

CIRCLE ED-596 ON READER-SERVICE CARD FOR MORE INFORMATION



... That's Where Hermetic Kills Sputter "Bugs" in Transistor Housing Bases—

We have used *all glass* in the internally exposed area of our No. 1619 Transistor Base. This all-glass construction prevents contamination of a transistor wafer when closure is made after mounting. Had we left this area as *metal*... your "buttoning-up" operation would float solder and flux right in under the wafer. When this occurs, the possibility of contamination or degradation of the wafer is raised, and with results that are difficult to predict.

Hermetic's specialist-engineers can help you avoid trouble in all your hermetic sealing problems. Why not draw upon their knowledge and skill?... it covers the full range of matched glass or VAC-TITE* hermetic sealing for the most advanced components.

Write us about your problem, and for your copy of our latest addition to the "Encyclopedia Hermetica." You'll find it most complete and up-to-date.

*Vac-Tite is Hermetic's new vacuum-proof, compression construction glass-to-metal seal.



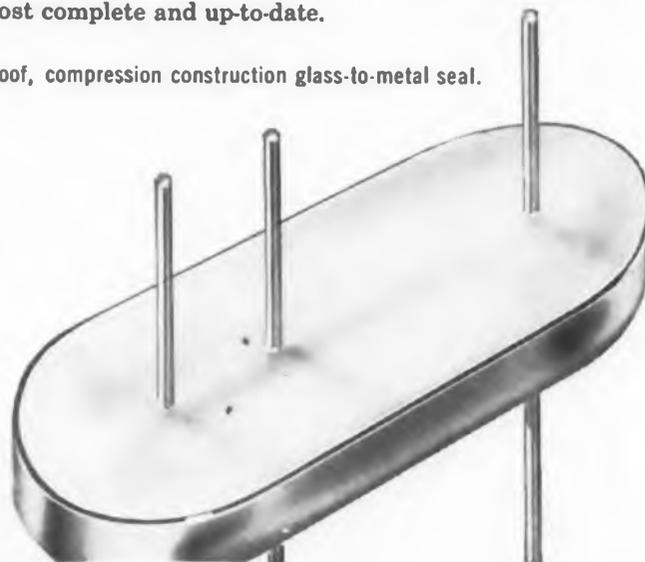
Hermetic Seal Products Company

39 South 6th Street,
Newark 7, New Jersey

Visit us at the IRE Show—
199 Broadcast Way

FIRST AND FOREMOST IN MINIATURIZATION

CIRCLE ED-597 ON READER-SERVICE CARD FOR MORE INFORMATION



Advertiser

Essex Wire Corp., Cords Ltd. Div.	121
Essex Wire Corp., R.B.M. Div.	121
FR Machine Works, Inc.	121
The Fafnir Bearing Co.	121
Fairchild Camera & Instrument Corp.	121, 158
Federal Tool & Mfg. Co.	141
Ford Instrument Co.	102
Freed Transformer Co.	2
G-M Laboratories, Inc.	134, 149
G-V Controls, Inc.	125
General Cement Mfg. Co., Wood Specialty Mfg. Co. Div.	145
General Electric Co., Apparatus Sales	22
General Electric Co., Apparatus Sales	51
General Electric Co., Electronics Div.	12
General Electric Co., Tube Dept.	7
General Radio Co.	130
General Tire & Rubber Co.	10
General Transformer Co.	
Genisco, Inc.	
Gertsch Products, Inc.	16
Gomar Manufacturing Co.	95
Green Instrument Co.	133
Gries Reproducer Corp.	132
Grieve-Hendry Co., Inc.	146
Gudeman Co., The	8
Handy & Harman	120
Hart Manufacturing Co.	135
Hartwell Company	113
Haydon, A. W., Co.	112
Heinemann Electric Co.	72
Helipot Corp.	119
Heminway & Bartlett Mfg. Co.	123
Hermaseal Co., Inc.	131
Hermetic Seal Products Co.	174
Heyman Manufacturing Co.	146
Hoffman Laboratories, Inc.	83
Hopkins Engineering Co.	156
Harvey Hubbell, Inc.	160
Hughes Aircraft Co.	142
Hughes Research & Development Labs.	75
Hycor Co., Inc.	143
I-T-E Circuit Breaker Co.	
Indiana Steel Products Co.	
Industrial Instruments, Inc.	
Industrial Transformer Corp.	137
Instrument Specialties	60
International Business Machine Corp.	114
International Instruments, Inc.	137
International Rectifier Corp.	94
International Resistance Co.	175
Jones, Howard B. Div. of Cinch Mfg. Corp.	139
Kearfott Co., Inc.	116
Kearfott Co., Inc., Western Mfg. Div.	124
Kellogg, M. W. Co.	9
Kellogg Switchboard & Supply Co.	102
Kenyon Transformer Co.	90
Kepco Laboratories	40
Kester Solder Co.	141
Koiled Kords, Inc.	130
Krohn-Hite Instrument Co.	143
Kulka Electric Mfg. Co.	121
Kurz-Kasch, Inc.	132
Landis & Gyr, Inc.	134
Lerco, Div. of Lynn-Deatrick, Inc.	117
Librascope, Inc.	154
Lindgren, Erik A., & Associates	152
Link Aviation, Inc.	157
Lord Manufacturing Co.	91
Machlett Laboratories	166
Magnavox Research Laboratories	150
Magnecraft Electric Co.	88
Magnetics, Inc.	78
Malco Tool & Mfg. Co.	122
Marion Electrical Instrument Co.	139
Merit Coil & Transformer Corp.	87
Metron Instrument Co.	101
Microdot Div. of Felts Corp.	144
Micro Switch, Div. of Minneapolis-Honeywell	47
Microtran Co.	144
Midland Manufacturing Co.	104
Moloney Electric Co.	172
Motoresearch Co.	144
NRK Manufacturing & Engineering Co.	151
National Semi-conductor Prod.	81

Newark Electric Co.	149
New Jersey Electronics Corp.	21
New Linear Systems, Inc.	163
Norris Thermador Corp.	133
Oster, John, Mfg. Co.	62
Pacific Scientific	171
Pacific Semiconductors, Inc.	108
Paramount Paper Tube Corp.	153
Perkin-Elmer Corp., Vernistat Div.	140
Perkin Engineering Corp.	71
Photo Plastics Corp.	146
Philco Corp.	111
Phillips Control Corp.	130
Pike W., & Co.	128
Plastic Capacitors	136
Polyphase Instrument Co.	128
Potter Instrument Co.	3
Pyramd Electric Co.	107
Radio Condenser Co.	28
Radio Corp. of America, Tube Div.	176
Radio Materials Corp.	103
Ramo-Wooldredge Corp.	170
RapiDesign, Inc.	135
Raymond Rosen Engineering Products, Inc.	165
Raytheon Mfg. Co.	87, 88, 89
Resinite Corp., Div. of Precision Paper Tube Co.	145
Rheem Manufacturing Co.	166
Richardson Co., The	39
Riester & Thesmacher Co., The	168
Robinson Aviation, Inc.	15
Rotron Manufacturing Co.	164
Sangamo Electric Co.	66
Sel-Rex Precious Metals, Inc.	151
Servomechanisms	33
Set Screw & Mfg. Co.	131
Shakeproof, Div. of Illinois Tool Works	138
Shallcross Manufacturing Co.	137
Sierra Engineering Co.	141
Sigma Instrument, Inc.	95
Simmons Fastener Corp.	134
Sorenson & Co., Inc.	101
Southwestern Industrial Electronics Co.	90
Spague Electric Co.	74
Stackpole Carbon Co.	86
Staedtler, J. S., Inc.	125
Standard Pressed Steel Co.	119, 147
Star Stainless Screw Co.	129
Statham Development Corp.	168
Staver Company, Inc.	36
Stevens-Arnold, Inc.	129
Struthers Dunn, Inc.	63
Superior Electric Co.	113
Superior Tube Co.	149
Switchcraft, Inc.	150
Sylvania Electric Products, Inc., Electronic Div.	105
Sylvania Electric Products, Inc., Parts Div.	79
Sylvania Electric Products, Inc., Tungsten & Chemical Div.	54
Synthane Corp.	18
Taylor Tubes, Inc.	159
Tech Laboratories, Inc.	129
Technitrol Engineering Co.	158
Technology Instrument Corp.	126
Tektronix, Inc.	73
Thomas & Skinner Steel Products Co., Inc.	155
Tibbets Laboratories, Inc.	141
Torrington Co., The	118
Transitron Electronic Corp.	97, 98
Unimax, Div. of W. L. Maxon Corp.	123
Union Electronics Corp.	27
Union Gaskets Gasket Co.	46
U. S. Radium Corp.	152
Valley Crystal Corp.	149
Vaco, Inc.	139
Victory Engineering Corp.	124
Victoreen Instrument Co.	154
Vye Corp.	171
Ward Leonard Electric Co.	118
Waterman Products Co.	80
Westinghouse Electric Corp.	115
White, Roger, Electron Devices, Inc.	89
White, S. S., Industrial Div.	151
Winchester Electronics, Inc.	150
Zero Mfg. Co.	128

NOW

a new wire wound potentiometer

The mechanical and electrical features of Type 2W Rheostat-Potentiometer are designed for current and future electronic circuits. This modern, 2 watt unit offers maximum application adaptability plus typical IRC superior performance. Electrical operation is improved by one-piece center terminal and collector ring, and direct contact between collector ring and contactor. Advanced mechanical design anchors winding securely to strip, locks element into position, and assures accurate location of terminals.

IMPROVED DESIGN FEATURES

▶ **Better Heat Dissipation**

▶ **Greater Dust Protection**

▶ **Increased Mechanical Rotation**

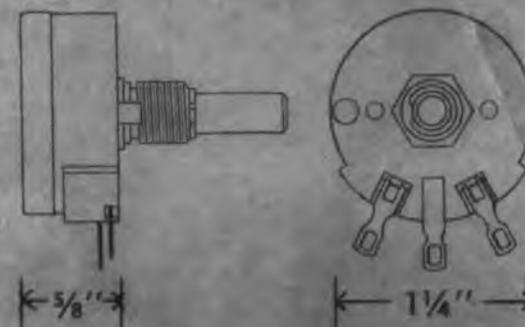
▶ **Increased Electrical Rotation**

▶ **More Resistance Values**

▶ **Double and Single Taps Available**



Equivalent To JAN-R-19
Style RA20 Specification



New IRC Design
Smaller and More Compact



2 Watt Power Rating Based On 60°C. Rise
Above 40°C. Ambient

SEND COUPON FOR DATA BULLETIN

Voltmeter Multipliers • Baron & Deposited Carbon Precistors • Insulated Composition Resistors • Power Resistors • Controls and Potentiometers • Low Wattage Wire Wounds • Germanium Diodes

Wherever the Circuit Says

IRC

Precision Wire Wounds • Ultra HF and Hi-Voltage Resistors • Low Value Capacitors • Selenium Rectifiers • Insulated Chokes • Hermetic Sealing Terminals

INTERNATIONAL RESISTANCE CO.

Dept. 263, 401 N. Broad Street, Philadelphia 8, Pa.
In Canada: International Resistance Co., Ltd., Toronto, Licensee

Send Bulletin describing Type 2W Potentiometers:

Name _____

Title _____

Company _____

Address _____

City _____ State _____

CIRCLE ED-598 ON READER-SERVICE CARD FOR MORE INFORMATION

KEEP AHEAD WITH YOUR EQUIPMENT DESIGNS

RCA UNF "PENCIL" TYPES
... for superior efficiency
in UHF communications.



RCA PREMIUM TYPES
... for added reliability
in industrial and
military environments.



RCA COMPUTER TYPES
... for dependable,
uninterrupted use in
computer applications.

RCA LOW-NOISE TYPES
... for low-noise
operation in critical
audio applications.



**CIRCLE ED-599
READER - SERVICE
CARD FOR MORE
INFORMATION**

RCA "SPECIAL REDS"
... for exceptional uniformity,
stability, dependability, and
minimum life of 10,000 hours.



RCA VR's and THYRATRONS
... for stability and dependability
in control circuits.

... Choose RCA Industrial Receiving- Type Tubes

To help get your share of the enormous market potential in the expanding industrial and communications fields, RCA research and manufacturing facilities bring you this important family of industrial receiving-type tubes. The line offers you a wide latitude in designing "industrial type" circuits—and, of course, offers you the famous RCA standard of performance.

See the array of RCA Tubes, Semiconductor Devices, Components, and Test Equipment ... at the IRE Show—Booths 151 to 155



RADIO CORPORATION of AMERICA
ELECTRON TUBES
HARRISON, N.J.

Postmaster: Form 3579 Requested

HAYDEN PUBLISHING COMPANY, INC.
19 East 62nd Street, New York 21, N. Y.

ELECTRONIC
design