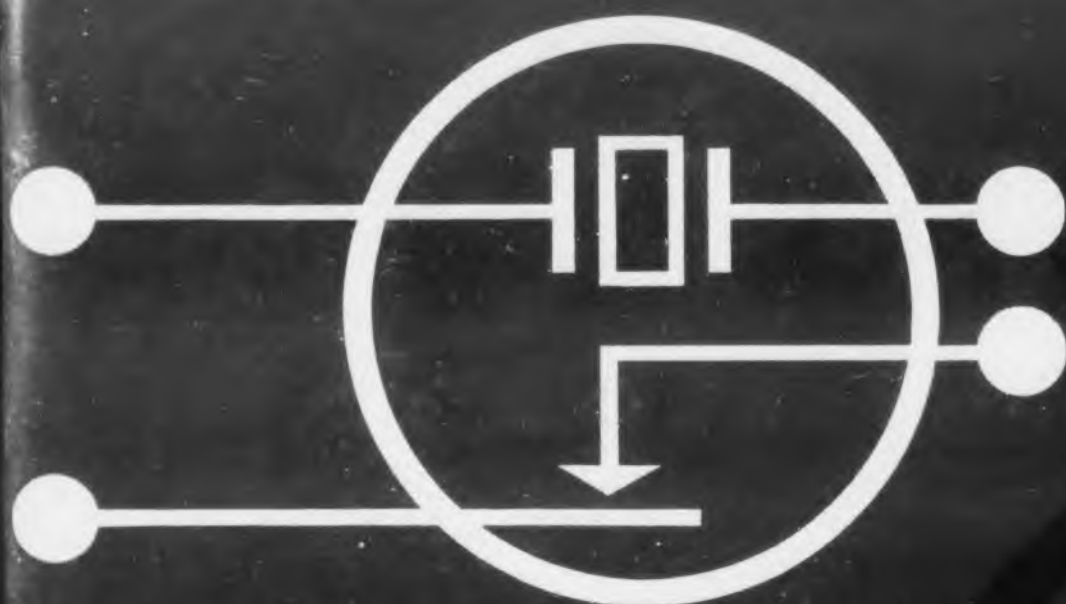


DEC 30 1956

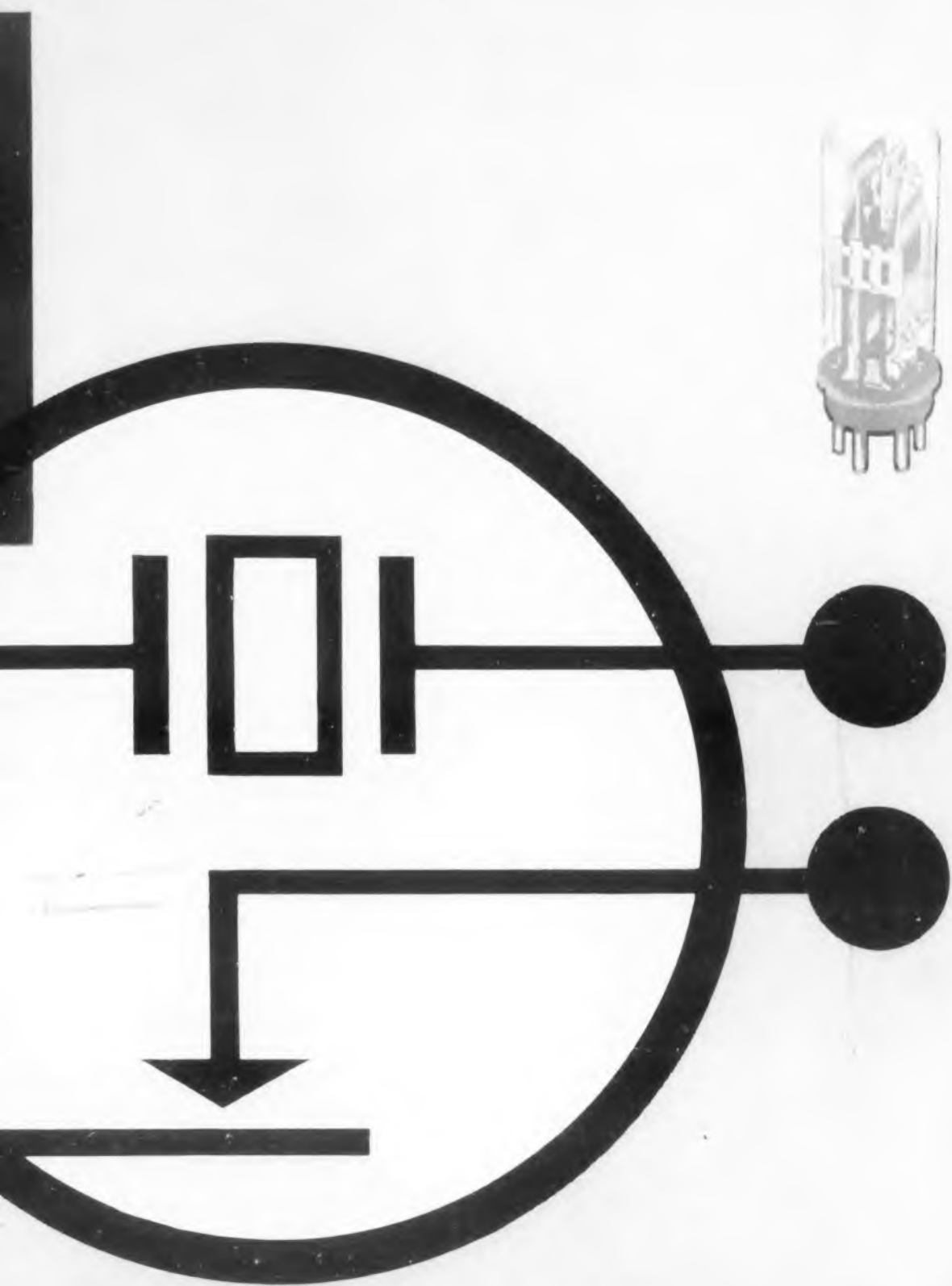
ELECT

D



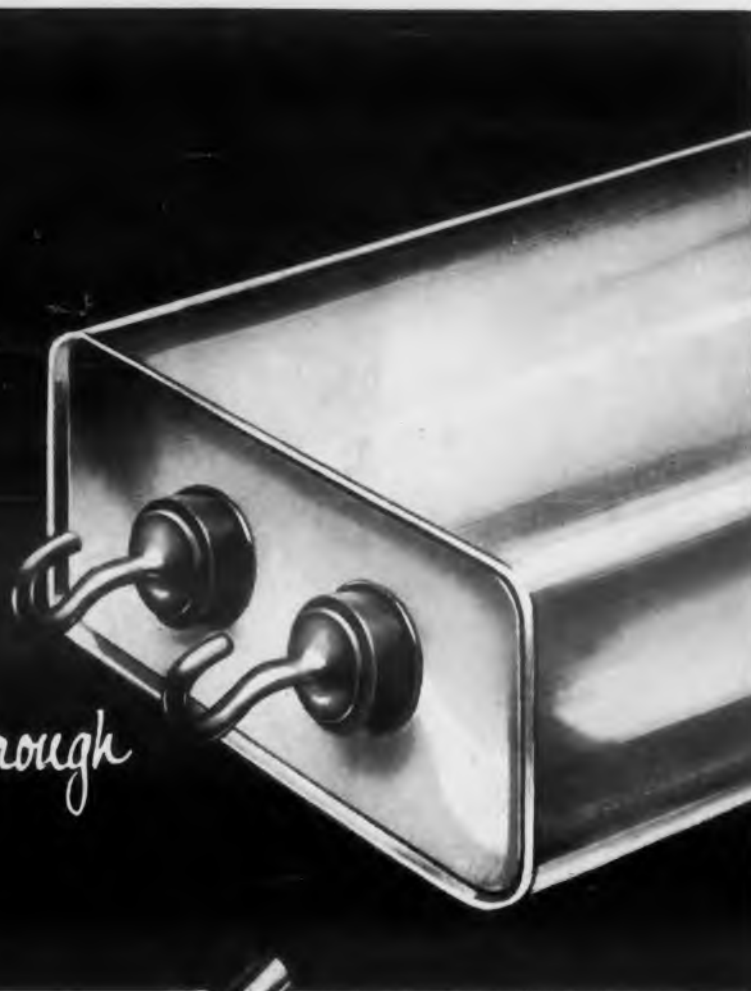
RONIC ESIGN

DECEMBER 15, 1956



IRC® Hermetic Sealing Terminals

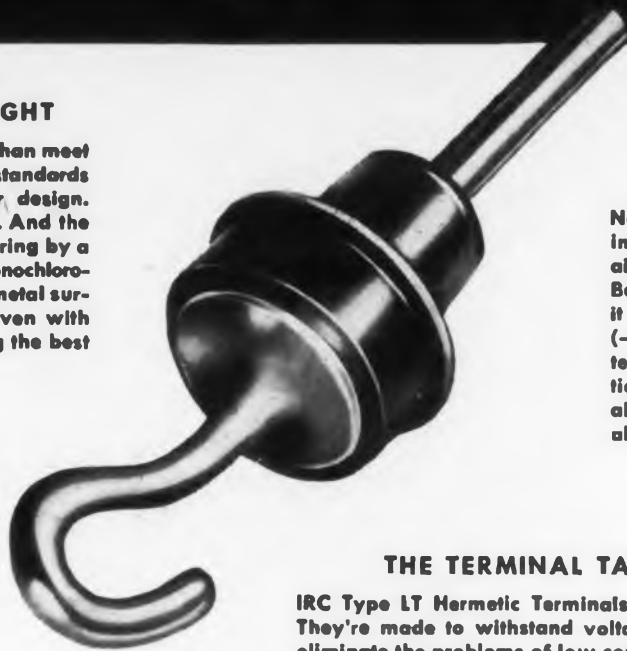
Only the signal ever gets through



THE SEAL STARTS AIR-TIGHT

IRC Type LT Hermetic Terminals more than meet military requirements and commercial standards because of their inherently superior design. First of all, they are a solder seal type. And the terminals are separated from the seal ring by a specially-compounded plastic (polymonochlorotrifluoroethylene) which is bonded to metal surfaces by an exclusive IRC process. Even with rough handling, you're sure of getting the best possible seal from the start.

Type LT
HERMETIC SEALING
TERMINALS
1, 2, 3 & 5 KILOVOLT SIZES
6 LEAD TYPES



THE SEAL STAYS AIR-TIGHT

Not only is the special plastic body a superior insulating material, but it also keeps the seal air-tight under demanding service conditions. Because of its high resistance to thermal shock, it withstands higher operating temperatures (-70°C. to +150°C. continuous or +190°C. intermittent). Furthermore, its zero water absorption eliminates the effects of high humidity. It is also chemically inert to organic solvents, acids, alkalies, oils, fumes, and other atmospheres.

THE TERMINAL TAKES HEAVY LOADING

IRC Type LT Hermetic Terminals give superior electrical performance. They're made to withstand voltages as high as 5,000 volts and they eliminate the problems of low corona breakdown voltage and excessive electrolysis under high DC voltage. Available in a choice of leads—phosphor bronze, copper, and brass.

Insulated Composition Resistors •
Deposited and Boron Carbon
Precistors • Power Resistors •
Voltmeter Multipliers • Ultra HF
and Hi-Voltage Resistors.

Low Wattage Wire Wounds •
Resistance Strips and Discs •
Selenium Rectifiers and Diodes
• Hermetic Sealing Terminals •
Insulated Chokes • Precision Wire
Wounds • Potentiometers.

Wherever the Circuit Says



INTERNATIONAL RESISTANCE CO.

Dept. 267, 401 N. Broad St., Phila. 8, Pa.

In Canada: International Resistance Co., Ltd., Toronto, Licensee

Send me Hermetic Terminal Bulletin LT-1.

NAME

COMPANY

ADDRESS

CITY STATE

CIRCLE 1 ON READER-SERVICE CARD FOR MORE INFORMATION

Staff

Editor Edward E. Grozda

Managing Editor (Acting) J. A. Lippke

Associate Editors E. T. Ebersol, Jr.
L. D. Shergalis
E. Burger

Assistant Editors S. Dresner
P. J. Lahey
D. S. Viebig

Washington Editor H. H. Rosen
National Press Bldg.
1346 F St., NW
Washington, D.C.
STerling 3-8912

West Coast Editor H. C. Jordan
5720 Wilshire Blvd.
Los Angeles, Calif.
WEbster 5-5158

Contributing Editors S. H. Hubelbank
J. M. Monstream
J. G. Adashko
R. D. Thornton
A. Jorysz

Editorial Assistants G. A. Schwartz
B. Parrish
F. Muehleck
M. S. Buckley

Art Director S. Sussman
Asst. Art Director R. A. Schulze

Production Manager E. D. Fava
Asst. Production Manager M. W. Baron
Business Manager P. L. Canfield
Circulation Manager S. Buffinton
Reader Service L. R. Wendt

Co-Publishers

T. Richard Gascoigne
James S. Mulholland, Jr.

Advertising Representatives

New York: Owen A. Kean
19 E. 62nd St.
TEmpleton 8-1940
Lawrence Conover
Bryce Gray, Jr.
Robert W. Gascoigne

Chicago: Thomas P. Kavooras
664 N. Michigan Ave.
SUperior 7-8054
Berry Conner, Jr.
Nelson Joliffe

Los Angeles: Robert E. Ahrensdorf
5720 Wilshire Blvd.
WEbster 8-3881
Earl W. Wilken
John Quillman

Subscription 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 subscription without charge provided you send us the following information on your company's letter head: your name and title; your company's name, address, and main product. Electronic, research, development, project, electrical, and chief engineers are typical qualifying titles. If you have a design responsibility not indicated by your title, describe those responsibilities. Job changes require requalification.

Subscription rate for non-qualified subscribers—\$12.00 for 1 year only.

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

ELECTRONIC DESIGN

Contents

Vol. 5, No. 24

December 15, 1956

Electrostrictive Relay (Cover)	24
Editorial	4
Engineering Review	5
Washington Report	14
Features	
Designing Transistor D-C Amplifiers, J. W. Stanton	20
Advances in RF Calorimetric Power Measurement, S. Freedman	26
Bold Meter Redesign	30
E and I Regulation With Non-Linear Resistors, G. J. Hegedus	32
Close Tolerance Snap-Action Thermostat	34
Determining Optimum Temperature Compensation, R. Kozinsky	36
Semi-Annual Index of Articles	38
Hot Solvent Sprayer	46
Russian Translations	
Positive Current Feedback in Audio Amplifiers, J. G. Adashko	116
What The Russians Are Writing	120
Abstracts	
High-Q Resonators—Equivalent Circuit Constants	126
British Epoxide Resins	128
Voltage-Drop Compensators for DC Microammeters	130
Departments	
Meetings	16
New Products	48
Production Products	96
New Literature	100
Patents	108
Books	114
Report Briefs	132
Standards & Specs	134
Advertisers' Index	137



ELECTRONIC DESIGN is published semi-monthly by Hayden Publishing Company, Inc., 19 E. 62nd Street, New York 21, N. Y., T. Richard Gascoigne, President; James S. Mulholland, Jr., Vice-President & Treasurer and David B. Landis, Secretary. Printed at Hildreth Press, Bristol, Conn. Acceptance under section 34.64 P. L. & R. authorized. Copyrighted 1956 Hayden Publishing Company, Inc. 30,000 Copies this issue.



G-V quality at half the cost!

There are many thermal time delay applications for which the high cost of hermetic sealing is unnecessary, but where long life and complete reliability are vital. The new G-V Red Dot is made for these jobs. At half the cost of the well known G-V Hermetically Sealed Thermal Relays you get —

- *Rugged, welded stainless steel operating mechanism for reliable operation*
- *Stainless steel encased heater for long life*
- *Dust tight metal shell for protection against damage or tampering*

RED ● DOT THERMAL TIMING RELAYS



At half the cost you get G-V's ruggedness, reliability, and long life for an extra 1000 hours over other light, fragile thermal time delay relays.

G-V Red Dot Relays are available from stock for delays of 2 seconds to 5 minutes with heater voltages from 6.3 to 120 volts.

Request publication 130 for complete data and prices.



G-V CONTROLS INC.

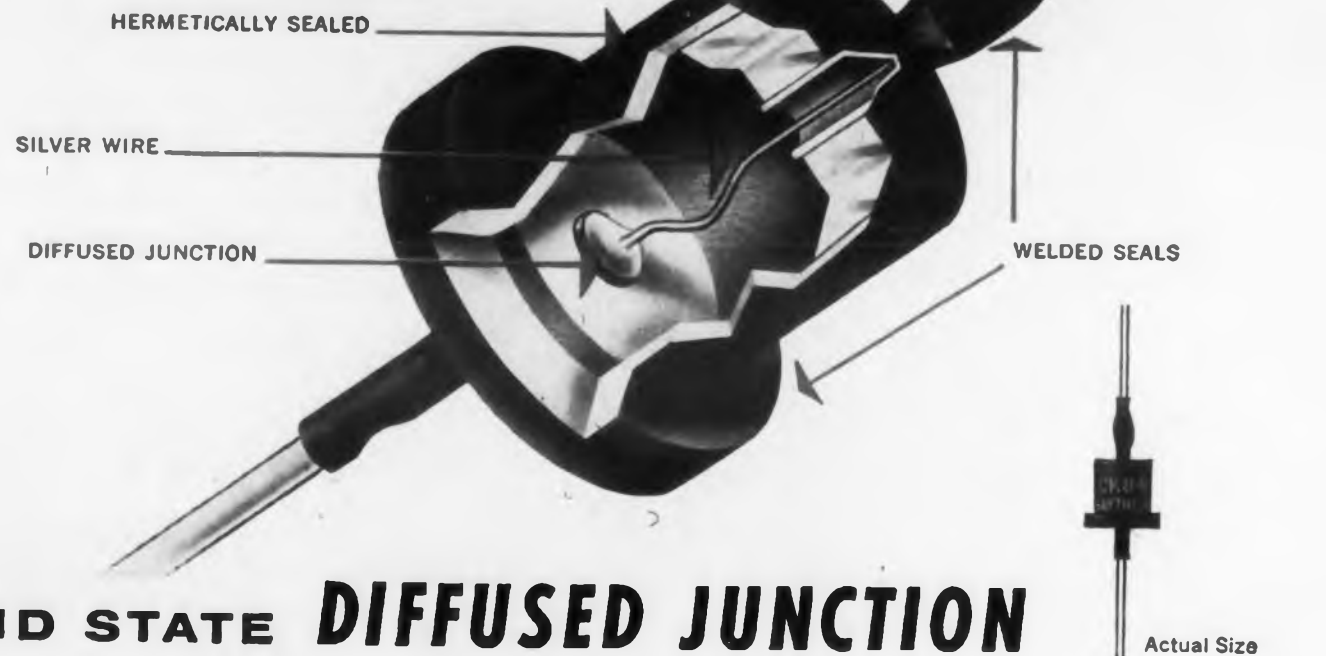
225 Industrial Plaza, San Diego, Calif.

CIRCLE 2 ON READER-SERVICE CARD FOR MORE INFORMATION

another

RAYTHEON

first!



SOLID STATE *DIFFUSED JUNCTION* SILICON RECTIFIERS now in QUANTITY PRODUCTION

Uniform Characteristics — Uniformly High Quality

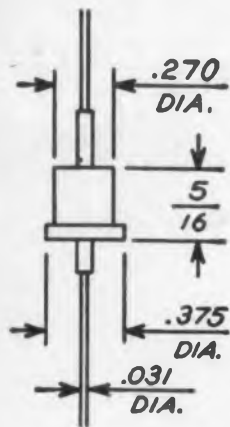
The Solid State Diffusion Process involves the formation of a junction by diffusing suitable gaseous materials into silicon at high temperatures. This process offers many advantages including:

1. Exact control of junction penetration.
2. Precise junction gradient for specific rectifier applications.
3. Flat junctions for uniformity and control of characteristics.

Operating Temperatures — minus 65°C to plus 150°C

Storage Temperature — up to 170°C

Hermetically Sealed — Welded



AVERAGE CHARACTERISTICS

Type	Peak Inverse Volts*	Forward Current** milliamperes		Forward Volts*** at 350 mA 100°C	Reverse Current*** (max.) mA at rms volts 100°C
		100°C	150°C		
CK840	100	350	100	0.75	0.2 at 70
CK841	200	350	100	0.75	0.2 at 140
CK842	300	350	100	0.75	0.2 at 210
CK843	400	350	100	0.75	0.2 at 280
CK844	500	350	100	0.75	0.2 at 350
CK845	600	350	100	0.75	0.2 at 420

*PIV ratings apply from -65°C to +150°C

**Into inductive or resistive load

***Averaged over one complete cycle



SEMICONDUCTOR DIVISION

Silicon and Germanium Diodes and Transistors • Silicon Power Rectifiers

NEWTON, MASS.: 150 California St. • DEcatur 2-7177
NEW YORK: 589 Fifth Ave. • PLaza 9-3900
CHICAGO: 9501 Grand Ave., Franklin Park • TUxedo 9-5400
LOS ANGELES: 5236 Santa Monica Blvd. • NOrmandy 5-4221

CIRCLE 3 ON READER-SERVICE CARD FOR MORE INFORMATION

Editorial

Sub-Subminiaturization Data Needed

The day when an electronic design engineer merely assembles some standard parts into a new combination of standard circuits for standard production is just about "out the window."

Many recent design efforts have been dictated by a new requirement—miniaturization. Most electronic engineers have gulped twice and then taken the new requirements in stride (almost). Then, came the demand to design for "subminiaturization." This was more difficult but only "took a little longer." The most recent demand, though, is next to "impossible." It is "sub-subminiaturization."

It is "impossible" because no one understands how it is done in practice. We refer to those relays, coils, transformers, diodes, batteries, etc., which almost require a jewelers glass to see. Have any of you tried winding a coil with wire too fine to see with the naked eye? Only the watch makers can handle it; and they hold all the secrets.

It seems now that only watch makers will be able to make such parts in the foreseeable future. The trouble, however, is not the production of the parts—it is in design. Designers have no concept of the problems encountered and thus can't design for sub-subminiature assembly. Up-to-now the watch-makers have been taking existing designs and re-designing them for the process. This is obviously wasted effort and places some serious limitations on what can be built in this fashion.

There is little communication between the designer faced with the problem of satisfying a functional requirement and the watch maker who is the only one capable of producing the design to fit available space. The answer lies in educating the electronic engineer on the materials, techniques, testing standards, inspection, etc. of sub-subminiaturization. But how?

Graduate schools don't offer such courses. Experience on the job won't help. Neither will conventions—at present. Those few who have "sub-subminiaturization" knowledge have to write some books, some magazine articles, give some demonstrations, conduct some plant tours—in spite of security problems. We need the knowledge *now*. We are desperate if we are going to extend our frontiers!—E.T.E.

Engineering Review

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



Automated X-Ray Test

A machine, which automatically inspects the explosive charge in each artillery rocket as it comes off the production line, and automatically marks any that have defects in them, is completing engineering tests at the Cornhusker Ordnance Plant, Grand Island, Nebraska.

Newly made rockets are transported on a conveyor to a circular inspection platform. In the center of this platform is a conventional 250,000 v X-ray machine, which sends X-ray beams fanning out to the six "inspection stations" located around the rim of the platform. The "eyes" of the "Robot X-Ray Inspector" are cadmium selenide crystals that are sensitive to X-rays. When they are "excited" by receiving X-Rays, they unleash the flow of large quantities of electrical current.

At each station, the X-ray beam strikes the rocket in a different place. If the rocket's explosive charge is sound and uniform, it permits the passage of only a normal amount of X-ray beam and the rocket passes on, approved, to the next station. If it is defective, the X-ray beam passing through the rocket "excites" the crystal into action, and it releases an electrical current that feeds back to a digital computer. The digital computer quickly evaluates the amount of X-ray beam passing through the rocket. If the defect is serious enough the computer sends out an electrical signal that

causes a mechanical arm to mark the place where the defect is located.

The General Electric device can be readily adapted to future machines that will automatically inspect many other types of ammunition.

CAA Prepares for Jet Traffic

An expanding coast-to-coast traffic control network of more than 70 civil and military radar installations are being set up to track the civil and military jets in the higher altitudes, and the conventional aircraft traffic using the lower altitudes. The network will give controllers a picture of aircraft from 15,000 to 70,000 feet in virtually all the U.S. airspace, and of aircraft at lower altitudes on densely traveled routes.

Included in this network will be 23 long range radars, designed and constructed by Raytheon Manufacturing Co., Waltham, Mass. Each radar uses a giant 40-foot antenna, and effectively covers more than 125,000 square miles of area. A single set will be able to feed up to 15 different monitor screens simultaneously (see photo), so that each controller on duty in a CAA center can have a picture of traffic movement.

At present, with the exception of the radar-equipped New York and Washington centers, CAA controllers depend on position reports radioed in by pilots en route. CAA also has radar for surveillance around 34 airports, which will continue to serve approaching and departing traffic within a range up to 30 miles.

The ability of the new radars to detect and track aircraft in rain and other bad weather—which frequently causes excessive "clutter," or visual interference, on the radar viewing scope—is an important advantage of the equipment. This benefit is obtained through the flexibility of the system which permits the operator to select either linear or circular polarization of the radar signal, depending upon weather conditions.



Radar operators scan skies on long-range radars, which track aircraft up to 200 miles away. Shown on scope are air lanes connecting cities. Planes appear as light spots or pips. Electronically-projected map overlay on scope enables operator to instantly pinpoint a plane's position.

Under Secretary of Commerce for Transportation Louis S. Rothschild called the Raytheon contract for \$9,000,000 "another giant step in preparation of the Federal Airways for the jet age. By 1959, civil jet transports will be in operation, and the government intends to be ready with a system of traffic control that will insure safe separation and expeditious movement."

Almost \$30,000,000 has been obligated for new air navigation and traffic control facilities during the fiscal year which began July 1. A total of \$75,000,000 was appropriated for the purpose.

ICB M

to be guided by **UNIVAC**



New applications are continually being found for Remington Rand Univac electronic computing systems. They are playing a vital and versatile role in scientific research, business, industry, communications and transportation. Now Univac is engaged in the design and development of a guidance system for the Air Force's Intercontinental Ballistics Missile—a system which will guide such missiles as the "Atlas" and the "Titan."

Univac offers engineers and technicians opportunities in virtually every field of professional interest. The diversity of its operations means stability and continued growth for Univac—and for members of the Univac team. Univac offers you interesting assignments, excellent opportunities and starting salaries that are among the highest in the field. Say: "I'm with Univac." Investigate the following permanent positions.

Send complete resumé to

Remington Rand Univac

DIVISION OF SPERRY RAND CORPORATION
J. N. WOODBURY
Dept. SD-3

1902 W. MINNEHAHA AVE., ST. PAUL W4, MINNESOTA



IMMEDIATE
OPENINGS FOR:

ELECTRONIC
DESIGN
ENGINEERS

• • •

ELECTRO-
MECHANICAL
DESIGN
ENGINEERS

• • •

FIELD
LOCATION
TECHNICIANS

• • •

MATHEMATICIANS

• • •

PHYSICISTS

German Taught On TV

A foreign language is being taught through the medium of video at the Pennsylvania State University.

The course chosen for the experiment this fall is introductory German for technical students and it is believed to be the first foreign language course taught over university-operated closed circuit television anywhere in the country.

One hour of the three-hour course is being televised each week and the remaining two hours are being taught in the conventional manner. Dr. Philip Shelley, professor and head of the German department, is teaching the televised portion.

Educational television continues to expand at Penn State with 4709 students receiving some part of their instruction via closed circuit television. Thirty sections of 13 courses are being televised this semester under the direction of 19 instructors. There are 52 hours a week of televised classes. Eleven additional classrooms have been wired for television use, making the total 18 and raising classroom capacity from 450 to 800 students.

Automation Costs Less Than Girls

It's easier and cheaper to switch girls from model to model in some of Motorola's receiver assembly lines than it is to switch automated assembly. The volatility of the receiver market makes changes in chassis frequent. Motorola reports assembly girls can be put to work assembling a new model merely by changing components in containers placed at arm's length. Moreover, automation tools are a capital investment while employees are an expense investment, thus offering a tax advantage over automation.

Japan Exports Radios to US

Japan exported 41,000 radio receivers to the United States in September of this year. This one month quantity is more than the entire amount exported in 1955. Shipments in the first nine months of the year totaled 102,000 sets. Total production for the same period in Japan was 2,005,000 sets.

◀ CIRCLE 4 ON READER-SERVICE CARD

56 Patents Released For Public Use

The Atomic Energy Commission has released 56 government owned patents to the public. The Commission will grant non-exclusive, royalty-free licenses on the listed patents, as part of its program to make non-secret technological information available for use by industry.

Patents of special interest to the electronic industry are as follows:

No. 2,749,520, Directional Coupling Means for Transmission Lines

No. 2,750,500, Linear Pulse Integrator

No. 2,750,520, Electrostatic Measuring Device

No. 2,751,344, Electropolisher

No. 2,751,662, Method of Making an Electronic Grid

No. 2,751,780, Leakage Testing Apparatus

No. 2,752,508, Counting Rate Meter

No. 2,755,441, Counting Rate Meter

No. 2,756,930, Computing Device

No. 2,759,175, Leak Detector for Pipe Joint

No. 2,760,064, Pulse Analyzer

No. 2,760,158, Method and Apparatus for Measuring Electrical Current

No. 2,761,063, Electrostatic Memory System

Applicants for licenses should apply to the Chief, Patent Branch, Office of the General Counsel, U.S. Atomic Energy Commission, Washington 25, D.C., identifying the subject matter by patent numbers and title. Copies of the patents are available at the U.S. Patent Office.

TV Relays Stock Quotations

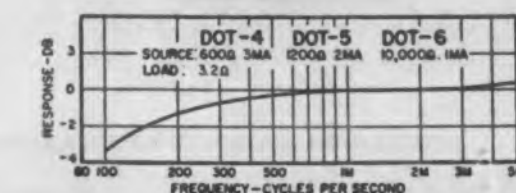
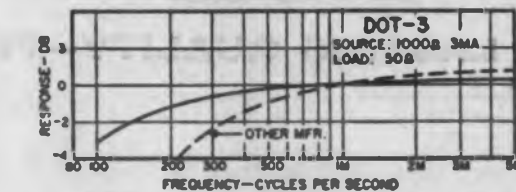
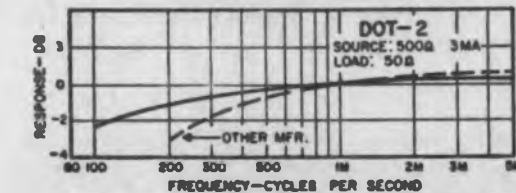
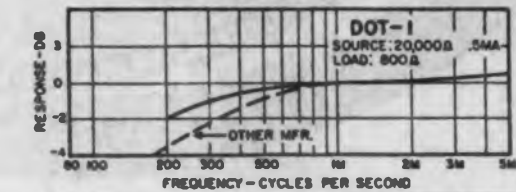
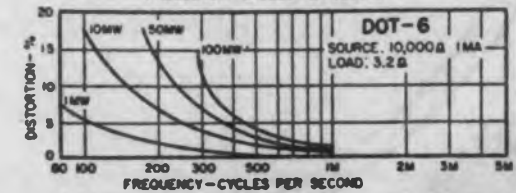
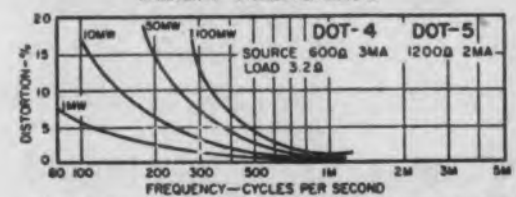
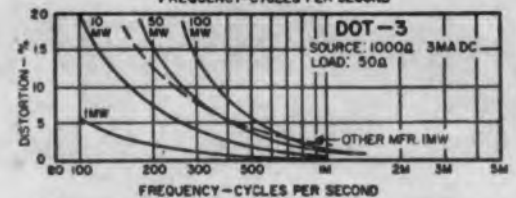
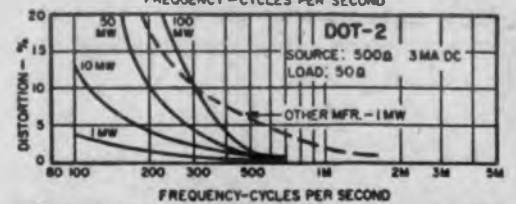
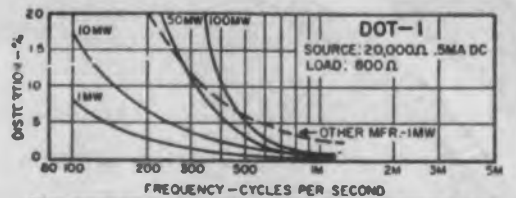
A London brokerage house is using closed circuit TV to bring board quotations directly to its customers and brokers at the firm. It is reported to be the first time that a brokerage firm has employed TV to transmit Exchange News. The TV camera, set in the firm's box at the Exchange, can cover the entire board at once. The 200 prices changing every few minutes, can show at a glance general trends in stocks and shares. The method helps eliminate delays and errors sometimes occurring over phone reports.

CIRCLE 5 ON READER-SERVICE CARD ➤



TYPICAL DOT PERFORMANCE CURVES

Power curves based on setting output power at 1 KC, then maintaining same input level over frequency range.



*DOT units have been designed for transistor applications only . . . not for vacuum tube service **Pats. Pending

DOTS

Mini-Douglas Transformer

REVOLUTIONARY TRANSISTOR TRANSFORMERS

unequaled power handling capacity and reliability

Conventional miniaturized transistor transformers have inherently poor electrical characteristics, perform with insufficient reliability and are woefully inadequate for many applications. The radical design of the new UTC DOT transistor transformers provides unprecedented power handling capacity and reliability, coupled with extremely small size. Twenty-two stock types cover virtually every transistor application. Special types can be made to order.

High Power Rating . . . up to 100 times greater.

DOT-1 has 5% distortion at 100 mw, other mfr. 6% at 1 mw.

Excellent Response . . . twice as good at low end.

DOT-3 is down 1 db at 200 cycles, other mfr. is down 4 db.

Low Distortion . . . reduced 80%.

DOT-1 shows 3% distortion where other mfr. shows 20%.

High Efficiency . . . up to 30% better.

DOT-1 has 850 ohm pri. resistance, 125 ohm sec.; other mfr. approx. 1200 and 200.

Moisture Proof . . . processed to hermetic specs.

DOT units are hermetic sealed compared to other mfr. open structures.

Rugged . . . completely cased.

DOT units can withstand all mechanical stresses.

Anchored leads . . . will withstand 10 pound pull test.

Lead strain completely isolated from coil winding.

Printed Circuit Use . . . plastic insulated leads at one end.

Other variations available.

1.3X ACTUAL SIZE



DOT CASE

Diameter 5/16"

Length 1 3/32"

Weight 1/10 oz.

Type No.	Application	Level Mw.	Pri. Imp.	D.C. Ma.‡ In Pri.	Pri. Res.	Sec. Imp.
DOT-1	Interstage	50	20,000 30,000	.5 .5	850	800 1200
DOT-2	Output	100	500 600	3 3	60	50 60
DOT-3	Output	100	1000 1200	3 3	115	50 60
DOT-4	Output	100	600	3	60	3.2
DOT-5	Output	100	1200	2	115	3.2
DOT-6	Output	100	10,000	1	1000	3.2
DOT-7	Input	25	200,000	0	8500	1000
DOT-8	Reactor 3.5 Mys. @ 2 Ma. DC				630	
DOT-9	Output or driver	100	10,000 12,500	1 1	930	500 600
DOT-10	Driver	100	10,000 12,500	1 1	930	1200 1500
DOT-11	Driver	100	10,000 12,500	1 1	930	2000 2500
DOT-12	Single or PP output	500	150 CT 200 CT	10 10	11	12 16
DOT-13	Single or PP output	500	300 CT 400 CT	7 7	20	12 16
DOT-14	Single or PP output	500	600 CT 800 CT	5 5	43	12 16
DOT-15	Single or PP output	500	800 CT 1070 CT	4 4	51	12 16
DOT-16	Single or PP output	500	1000 CT 1330 CT	3.5 3.5	71	12 16
DOT-17	Single or PP output	500	1500 CT 2000 CT	3 3	108	12 16
DOT-18	Single or PP output	500	7500 CT 10,000 CT	1 1	505	12 16
DOT-19	Output to line	500	300 CT	7	19	600
DOT-20	Output or matching to line	500	500 CT	5.5	31	600
DOT-21	Output to line	500	900 CT	4	53	600
DOT-22	Output to line	500	1500 CT	3	86	600

‡DCMA shown is for single ended usage (under 5% distortion—100MW—1KC) . . . for push pull, DCMA can take any balanced value taken by .5W transistors (under 5% distortion—500MW—1KC)

UNITED TRANSFORMER CO.

150 Varick Street, New York 13, N. Y. • EXPORT DIVISION: 13 E. 40th St., New York 16, N. Y.

CABLES: "ARLAB"

NACA Exhibits At Langley Labs

The National Advisory Committee for Aeronautics exhibited four-stage rockets zooming 200 miles above the earth, supersonic air jets hotter than a blast furnace, aircraft with wings only inches thick and light gas guns capable of 13,000 mph speeds. The occasion was the 1956 Triennial Inspection at the Langley Laboratory.

A four-stage rocket-propelled research missile was fired from a site at the NACA Pilotless Aircraft Research Station at Wallops Island, off the Eastern Shore of Virginia. It attained a speed of Mach 10.4 or 6864 mph. The topmost stage went over a million feet above the launching site.

Data obtained from flights such as these is going into the storehouse of information from which will evolve the "flight of the satellite." This missile, to be launched in July 1957 as part of the International Geophysical Year, is expected to attain a height of 300 miles and a speed of 18,000 miles per hour.

NACA's "hot jet" combustion products tunnel can produce speeds of 4750 mph and provide temperatures above 4100 degrees to simulate high speed and high altitude flight.

A special light gas gun capable of speeds to Mach 20 is located at NACA's Ames Laboratory. A small magnesium model fired in this device at 11,000 mph for a brief period became hot enough to ignite the metal model.

NACA's flight research planes are past the concepts of the X-2 and into the X-1B and X-1E. The wing of the latter plane has a thickness only 4% of its chord. Under construction by North American Aviation is the X-15, designed to fly faster and higher than man has ever ventured.



PHELPS DODGE SODEREZE®

CUTS



FIRST FOR LASTING QUALITY—FROM MINE TO MARKET!

CIRCLE 6 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • December 15, 1956

TENDS STRIPPING, CLEANING— SOLDERING COSTS!

Sodereze—Phelps Dodge's isocyanate-type* magnet wire—provides:

1. *Low temperature* soldering—no damage to copper conductor.
2. A balance of physical, chemical and electrical properties permitting replacement of existing film wires.
3. Resistance to heat and solvent shock for safer wax or varnish treatment.
4. Excellent resistance to alcohol and most solvents.

Phelps Dodge Sodereze was designed to keep pace with industry's growing need for magnet wires that handle easily, reduce over-all costs and fit a variety of exacting design requirements.

The versatility of Sodereze not only permits its use wherever solderable wires are required, but allows replacement of conventional film wires.

* Isocyanates, when combined with other resins, form Polyurethanes that can be balanced in properties to give the maximum in performance as a magnet wire insulation. Several years of research have been spent on Phelps Dodge Sodereze to accomplish this result. A patent application covering Phelps Dodge isocyanate-type magnet wire has been filed.

*Any time magnet wire is your problem,
consult Phelps Dodge for the quickest, easiest answer!*



PHELPS DODGE COPPER PRODUCTS
CORPORATION

INCA MANUFACTURING DIVISION
FORT WAYNE, INDIANA

CIRCLE 6 ON READER-SERVICE CARD FOR MORE INFORMATION



Aircraft Position Fix System

Operating in the 100 kc, low frequency range, a fully developed navigation and potential air traffic control system is available for use in this country. This Bendix-Decca System of Bendix Pacific Div., 11600 Sherman Way, North Hollywood, Calif., operates by transmissions from a master station and three slave stations. Aircraft position is recorded and displayed graphically, automatically and instantly on a chart for the pilot-navigator through the medium of a moving ink stylus. Accuracy of better than 25 yds at distances up to 50 mi from the transmitting stations is possible.

Meteorological Research

A balloon air train carrying 14 radiosondes was launched in a recent international radiosonde comparison test in Switzerland to determine vital weather data collected from upper atmosphere.

The first of its kind in meteorological research, the train rose to an altitude of approximately thirteen miles. Each of the fourteen radiosondes took separate temperatures, pressure and humidity readings and radioed the information to ground stations. Variations between data received from each system was the subject under study.

Thirteen nations participated in the experiment sponsored by the World Meteorological Organization, a United Nations agency. Results are expected to improve weather forecasts on a world-wide scale.

Nuclear Powered Aircraft Carrier

A contract for the design and manufacture of reactor compartment components for an atomic powered aircraft carrier has been awarded to the Westinghouse Electric Corp., Pittsburgh, Pa. Estimated cost of the contract is \$13,157,000.

The nuclear propulsion plant for the aircraft carrier is being developed by the Atomic Energy Commission in cooperation with the Department of the Navy.

The aircraft carrier, which will be propelled by eight pressurized water type nuclear reactors, is being requested by the Navy in the FY 1958 Shipbuilding Program.

save panel space with **LAMBDA** d.c. power supplies

NEW COM-PAK* SERIES

*trademark

200-400-800 MA SERIES 0-200, 125-325 and 325-525 D.C. VOLTAGE RANGES



COM-PAK MODELS RANGES AND PRICES

Model ¹	Output Voltage ²	Output Current ³	Base Price ¹
C-280	0-200 VDC	0-200 MA	184.50
C-281	125-325 VDC	0-200 MA	159.50
C-282	325-525 VDC	0-200 MA	169.50
C-480	0-200 VDC	0-400 MA	259.50
C-481	125-325 VDC	0-400 MA	244.50
C-482	325-525 VDC	0-400 MA	259.50
C-880	0-200 VDC	0-800 MA	340.00
C-881	125-325 VDC	0-800 MA	315.00
C-882	325-525 VDC	0-800 MA	360.00

¹For metered models add suffix "M" to model and add \$30 to base price. (For example C-281M, \$189.50.)

DC OUTPUT (regulated for line and load):

Voltage Refer to chart above.

²Voltage range for any given model is completely covered in four continuously variable bands.

Current Refer to chart above.

³Current rating applies over entire voltage range.

Regulation (line) Better than 0.15% or 0.3 Volt (whichever is greater). For input variations from 105-125 VAC.

Regulation (load) Better than 0.25% or 0.5 Volt (whichever is greater). For load variations from 0 to full load.

Transient Response (line) Output voltage is constant within regulation specifications for step-function line voltage change of plus (+) 10 volts or minus (-) 10 volts rms within the limits of 105-125 VAC.

Transient Response

(load) Output voltage is constant within regulation specifications for step-function load change from 0 to full load or full load to 0.

Internal Impedance

C-200 Series Less than 6 ohms.
C-400 Series Less than 3 ohms.
C-800 Series Less than 1.5 ohms.

Ripple and Noise Less than 3 millivolts rms.

Polarity Either positive or negative may be grounded.

AMBIENT TEMPERATURE

AND DUTY CYCLE Continuous duty at full load up to 50°C (122°F) ambient.

AC OUTPUT

(unregulated) 6.5 VAC (at 115 VAC Input).⁴
C-200 Series 10 AMP.
C-400 Series 15 AMP.
C-800 Series 20 AMP.

⁴Allows for voltage drop in connecting leads. Isolated and ungrounded.

AC INPUT 105-125 VAC, 50-400 CPS

OVERLOAD PROTECTION:

External Overload

Protection AC and DC fuses, front panel, with built-in blown-fuse indicators.

Internal Failure

Protection Fuse, rear of chassis.

CONTROLS:

DC Output Controls Band-switches and screw-driver adjusting vernier-control, rear of chassis.

AC and DC Switches Front panel.

Prices and specifications effective November 1956, subject to change without notice.

GERMANIUM RECTIFIERS† TRANSIENT-FREE OUTPUT · HERMETICALLY SEALED TRANSFORMERS

These new and compact power supplies occupy a minimum of space, deliver maximum performance. They are without qualification the finest power supplies in Lambda's long experience.

The 400 and 800 MA series include new, more efficient longer lasting germanium rectifiers. All Com-Pak models are constructed with hermetically sealed transformers and chokes. Completely

† except in 200 MA series

protected from moisture, they can be depended on for long trouble-free service.

These new Lambda power supplies represent a major advance in thermal and mechanical design, and in outstanding performance. Send in your first order now for priority in handling.

SEND FOR NEW CATALOG. Complete specifications for all Lambda Power Supplies.



LAMBDA
Electronics Corp.

The First Name in Power Supplies

11-11 131ST STREET,
COLLEGE POINT 56, N. Y.

Cable Address: Lambdatron, New York

Satellite Guidance System

Inertial guidance systems for the Project Vanguard rockets have recently been completed by the Minneapolis-Honeywell Regulator Co.

Three hermetic integrating gyros will be calibrated to a "memorized" heading reference in the three axes of flight—roll, pitch, and yaw. The super-sensitive gyros have their rotors and gimbals mounted in a special fluid, insuring virtually frictionless operation. Signals from the gyros eventually control the engine thrust chambers mounted on gimbal joints, which will control pitch and yaw. Separate off-and-on jets on the sides of the rocket will control roll.

If sloshing fuel, engine irregularity, or air forces tend to incorrectly rotate the rocket, the gyros will sense it and the servomechanism will compensate for it. The programming device will be coordinated with the pitch gyro to send the rocket into the proper elliptical trajectory around the earth.

Higher Strength Permanent Magnet

A permanent magnet having an energy of 11,000,000 gauss-oersteds was announced at the second annual conference on Magnetism and Magnetic Materials in Boston. This is more than twice the approximate 5,000,000 gauss-oersteds maximum obtainable in the past. The implications are obvious in that it will mean smaller magnets, increasing the applications enormously. N. V. Phillips Gloeilampenfabrieken, Eindhoven, the Netherlands, accomplished this feat by using the single-crystal Alnico technique.

Tubes for 300 C Operation

Hard-glass electron tubes able to withstand 300 C temperatures have been developed by the Sylvania Electric Co. The new group of tubes was designed for use in instrumentations requiring high temperature ratings. According to the Industrial Resources Division of Sylvania, the new group will eventually replace all low temperature tubes. These high temperature tubes should result in reduced cost through greater reliability.

◀ CIRCLE 7 ON READER-SERVICE CARD

Computer Rental

Analog computation is now within the financial reach of all industry in the West Coast area. Electronic Associates, Inc. have opened a computation center at 1500 East Imperial Highway, El Segundo, Calif. which has analogue computers available on an hourly rental basis. Rental charges for computation service range from \$45 to \$90.

Nuclear Research Center

This country's first privately owned Nuclear Research Center has been completed at Battelle Institute in Columbus, Ohio. The announcement made by Dr. Clyde Williams, president and director of Battelle, followed initial "start-up" of the Institute's one-million watt research reactor.

The center will make available to industry all facilities for the peacetime study of nuclear energy. It can contact industry at any time for nuclear research with government security restrictions.

Lower Cost Crystals

A crystal pulling furnace, capable of doubling normal crystal output, with no sacrifice of quality has been developed by the U. S. Dynamics Corp., Boston, Mass. This increase in production should result in lower cost germanium and silicon crystals. The dual crystal pulling unit consists of two resistances or induction-heated pulling furnaces with duplicate sets of raising, lowering, and rotating mechanisms.

Grant For Foreign Translation Study

The National Science Foundation has granted the Special Libraries Association \$20,350 to support the Scientific Translation Center at Chicago's John Crerar Library. Russian translations, now in the Library of Congress, will be transferred to the Center and all papers will be available for photocopying or borrowing.

**COMING JANUARY 1st
DESIGN '57
Yearly Feature Issue of ED**

CIRCLE 8 ON READER-SERVICE CARD >

E-I

COM TER



● **MULTIPLE HEADERS**



● **SINGLE LEAD TERMINALS**



● **PLUG-IN CONNECTORS**



● **COMPONENT END SEALS**



● **TRANSISTOR CLOSURES**



● **CUSTOM TERMINATIONS**

COMPRESSION MINIATURES*

Hermetically Sealed miniature, sub-miniature or standard E-I terminals are specified for performance *plus* in military and commercial service. These dependable compression seals perform successfully under the most gruelling conditions . . . offer maximum immunity to shock, vibration and wide variations of temperature and pressures. Check your sealed terminal requirements with E-I—recommendations will be made on your specific applications without obligation.



**ELECTRICAL
INDUSTRIES**

44 SUMMER AVENUE, NEWARK 4, N.J.

FIRST silicon transistors meeting NAVY SPECS



For *reliability* under *extreme* conditions . . . design with TI's military silicon transistors . . . built to give you high gain in small signal applications at temperatures up to 150°C. Made to the stringent requirements of MIL-T-19112A (SHIPS) and MIL-T-19502 (SHIPS), these welded case, grown junction devices furnish the tremendous savings in weight, space and power you expect from transistorization . . . *plus* close parameter control

that permits you to design your circuits with confidence.

All 19 Texas Instruments silicon transistor types have proved themselves in military use. First and largest producer of silicon transistors, TI is the country's major supplier of high temperature transistors to industry for use in military and commercial equipment.

degradation rate tests for TI's USN-2N117 and USN-2N118 silicon transistors

test	condition	duration	end point at 25°C
lead fatigue	three 90-degree arcs	—	no broken leads
vibration	100 to 1000 cps at 10 G	3 cycles, each x, y, and z plane	$I_{CO} = 2\mu A$ maximum at 5V $h_{ob} = 2\mu mhos$ maximum $h_{fb} = -0.88$ minimum for 2N117 $h_{fb} = -0.94$ minimum for 2N118
vibration fatigue	60 cps at 10 G	32 hours, each x, y, and z plane	
shock	40 G, 11 milliseconds	3 shocks, each x, y, and z plane	
temperature cycle	-55°C to +150°C	10 cycles	
moisture resistance	MIL-STD-202	240 hours	
life, intermittent operation	$P_c = 150$ mW, $V_c = 30$ V	1000 hours, accumulated operating time	
life, storage	150° C, ambient	1000 hours	
salt spray	MIL-STD-202	50 hours	no mechanical defects interfering with operation

**LOOK TO TI FOR: SILICON HF, MEDIUM POWER, POWER, AND SMALL SIGNAL TRANSISTORS
SILICON DIODES AND RECTIFIERS • GERMANIUM VHF, POWER, RADIO, AND GENERAL PURPOSE TRANSISTORS**

**pioneer producer of
silicon transistors**



**TEXAS INSTRUMENTS
INCORPORATED**
6000 LEMMON AVENUE DALLAS 9, TEXAS

CIRCLE 9 ON READER-SERVICE CARD FOR MORE INFORMATION



Clockworks ? ?

The balance wheel has been replaced by the atom in the world's most accurate clock developed by the National Co., Malden, Mass. The Atomichron tells time by tuning in on the characteristic frequency of the cesium atom in a vacuum tube. An ordinary clock dial may be attached to tell time with an accuracy of one second in 3000 years.

Radar on the Delaware River

A radar system which would guide ships through the tortuous channels of the Delaware River during fog is being investigated by the City of Philadelphia. The 90-mile stretch from Cape Henlopen to the city has a long history of shipwrecks.

A preliminary survey indicates the need for six radar antenna sites, at an estimated cost of \$1 million. The city has expressed a willingness to pick up the \$140,000 tab for one station, but hopes the federal government will undertake the remainder of the project. Shipping interests are being asked to support the city in seeking federal funds.

2.5 Billion on 1957 Construction

During 1957 the American Telephone and Telegraph Co. plans to spend two and one half billion dollars on new construction. According to Frederick R. Kappel, President of the Bell System, we can look forward to a communication system that will do anything people could ask from it. A new radio relay system using existing towers that will be capable of carrying up to 14,000 conversations is one of the advancements that will soon become a reality.

Other developments forecasted include wave guide transmission that will enable the simultaneous sending of 400,000 telephone conversation and electronic switching centers that will automatically place calls without dialing. The first test of automatic call placing will be in Morris, Ill. in 1959.

Simplified Drafting

Simplified drafting is one of the tools which industry can use in its effort to make a profit while producing more and better goods at competitive prices. According to Arthur H. Rau, General Electric consultant on drafting, new approaches must be sought and old methods of drafting improved to meet the challenge in today's highly competitive era.

He suggested that drafting, stripped of its frills yet surrendering nothing in either clarity of presentation or accuracy of dimension, is the new standard for the measurement of drafting values. A simplified drawing, he pointed out, is one in which the complex details that are obscuring its message are omitted. It is a functional drawing where every line, legend and every view is drawn with a purpose, and where fussy, or superfluous elaboration is not obscuring the real purpose of the drawing.

Extra views, unnecessary lines, repetition, conventional representation instead of symbolism are but a few glaring examples of "work-that-should-never-have-been-done," he said.

Atomic Sentinel

On constant alert against sneak A- or H-Bomb attacks on vital underground installations is a new warning system developed by the Army Signal Corps Engineering Laboratories, Fort Monmouth, N.J. Detectors triggered by nuclear explosion, heat blast, gamma rays or poison gas are set atop towers around the installation.

The detectors will not act on high explosive or thunderstorm false alarms. In the event of attack they instantly sound warning horns, turn off gas lines, close blast doors, start ventilation systems and take other protective measures. The protection system is being installed at important defense points, including key Air Force headquarters, and will be available for Civil Defense and industrial plants.



THIS IS OUR
50 Year
ANNIVERSARY
STACKPOLE
FOUNDED 1904

STACKPOLE CARBON CO.
ST. MARYS, PA.
Our Order No. 4217243
Cust. Part No. 735.600
For Ed. Sullivan's Lab. Equip.
Attention of
Date 5/11/56
SAMPLE IS FOR
All Mech. & Elec. Spec.
Mechanical Only
Electrical Only

Lab Samples from STACKPOLE

QUALITY- CONTROLLED COMPONENTS

FIXED RESISTORS
VARIABLE RESISTORS
SPECIAL RESISTORS
POWDERED IRON CORES
CERAMAG®
FERROMAGNETIC CORES
MOLDED COIL FORMS
FIXED COMPOSITION
CAPACITORS
TUBE ANODES
CARBON DISCS
(Voltage Regulators)
LINE SWITCHES
SLIDE and ROTARY-
ACTION SWITCHES

... assure accurate engineering plus efficient production

Laboratory samples of Stackpole components are exactly what samples should be—true and accurate reflections of the product when made in quantities and bought for use on your production line.

Stackpole was one of the earliest pioneers in strict statistical quality control. This, plus many unique manufacturing techniques and facilities evolved over years of carbon, graphite and metal powder product specialization, means that the sample you get from Stackpole matches your specifications to the fullest possible extent.

Equally important, and regardless of size, shape or quantity, each production unit is a "twin" of the sample on which your engineering and production calculations were based.

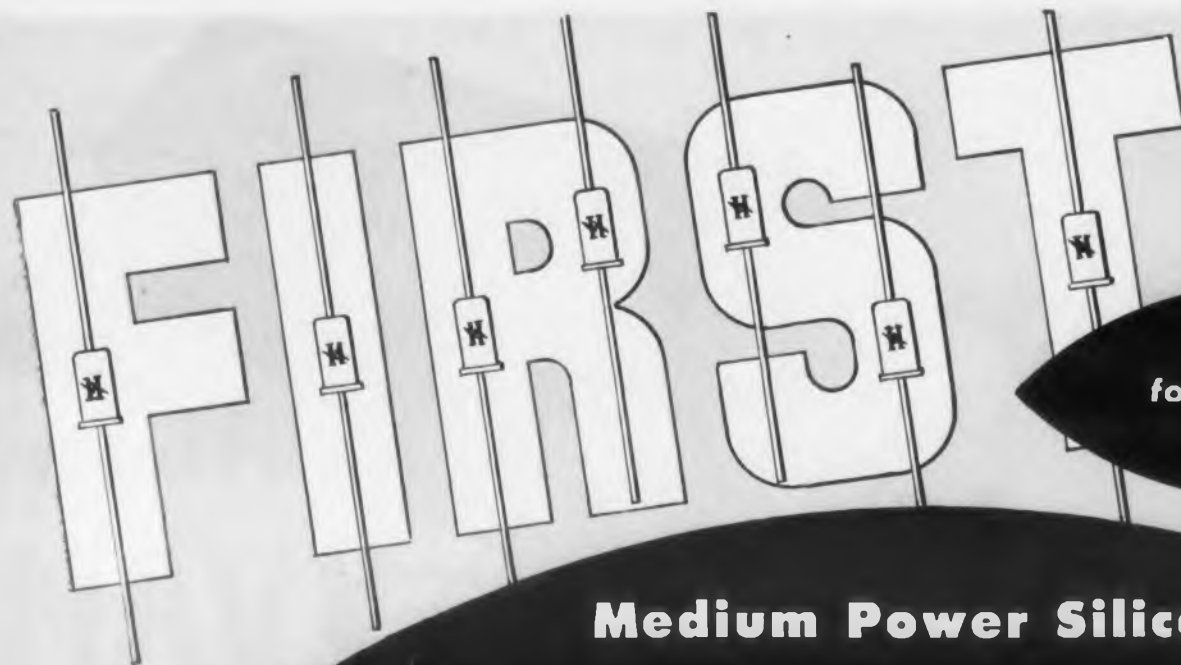
Write for Engineering Data Bulletin on any type. Samples to quantity users on receipt of full information.

Electronic Components Division

STACKPOLE CARBON COMPANY

St. Marys, Pa.

CIRCLE 10 ON READER-SERVICE CARD FOR MORE INFORMATION



Available
for Immediate
Delivery!

Medium Power Silicon DIFFUSED Junction Rectifiers

with High Forward Conduction Independent of Reverse Voltage Ratings . . .

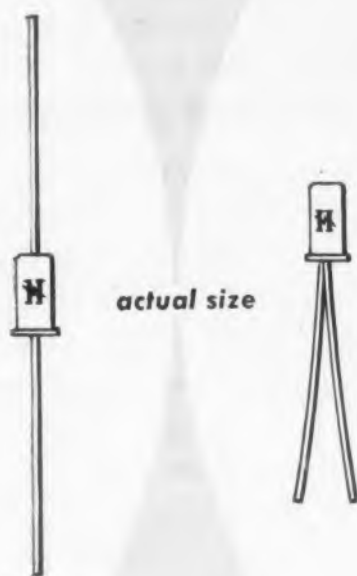
for all applications

including those involving

AUTOMATION

These medium power silicon *diffused* junction rectifiers are designed for heavy forward conduction without the necessity of using an external heat sink.

Two types are provided to allow a choice of mounting: a two wire single ended type identical in size and physically interchangeable in mounting systems developed for the widely used IN200 series of alloy junction diodes; and an axial lead type* for automation, printed circuit board or terminal board assemblies. Both types have exceptionally good stability, are highly efficient (approximately 99%) and can operate in ambients ranging from -65°C to $+175^{\circ}\text{C}$.



Type	Max. Recurrent Inverse Working Voltage — V_b (Volts)	Min. Zener (breakdown) Voltage — E_z (Volts) (Note 1)	Max. RMS Voltage (Volts)	25°C Ambient Max. Avg. Forward Current — I_o (Milliamps.)	Max. Avg. Forward Voltage at $I_o = 500$ mA (Volts)	125°C Ambient Max. Avg. Forward Current (Milliamps.)
HMP1 HMP1A*	50	70	35	500	1	250
HMP2 HMP2A*	100	125	70	500	1	250
HMP3 HMP3A*	200	250	140	500	1	250
HMP4 HMP4A*	300	375	210	500	1	200
HMP5 HMP5A*	400	500	280	500	1	200

Note 1 — Measured at a reverse current (I_z) of 0.1 mA
 Note 2 — Derate to 0 forward current at 175°C Ambient
 Note 3 — Cathode is electrically connected to the case
 * — Axial lead types

We invite
your inquiry



Hoffman Semiconductor Division
of
Hoffman Electronics Corporation

930 Pitner Avenue, Evanston, Illinois

MANUFACTURERS OF: silicon junction diodes • zener reference elements • high power rectifiers • solar cells

formerly
National Semiconductor Products

CIRCLE 11 ON READER-SERVICE CARD FOR MORE INFORMATION

Washington Report

Herbert H. Rosen

FCC Actions

The Federal Communications Commission this month notified the electronic industries that it wants to learn the facts on service allocations above 890 mc, both present and future demands. The possibility exists for a change in rules "consistent with microwave and other development and future use and requirements by various fixed and mobile services. A hearing will be held early in 1957, but the FCC would like to have comments filed before January 7, 1957. The Commission is also questioning the need for the establishment of a system of priorities. Also involved will be decisions on shared vs. exclusive use; common carrier vs. private systems; interconnection requirements for land mobile, ISM and navigation; broad band vs. narrow band; and establishment of common engineering standards for all point-to-point microwave equipment.

Low-power radiation rules are also up for revision. Comments will have been received by December 7 on proposed amendments to part 15 of the FCC rules governing "Incidental and Restricted Radiation Devices to curb radiation from Low Power Communications Devices." The purpose of the revision is to protect radio stations from interference from devices such as wireless microphones, phonographs, oscillators, radio-controlled garage door openers, and various types of radio-controlled toys.

One part of the rule changes limits the field strength of low power devices operating at frequencies up to 27.12 mc. These limitations are substantially the same as those affecting devices below 1600 kc, which were proposed by the Commission in April 1954.

In general, the Commission would allow power devices to operate on the designated frequencies provided the size of the antenna or the power input to the final RF stage or both, meet specified requirements. A label on the device attesting to its ability to comply will be acceptable to the Commission.

Military Security

The Department of Defense is undergoing a thorough investigation of its practices of classifying

technical information and scientific personnel. One inquiry has recently been completed by the Coolidge Committee, set up by Secretary Wilson to look into the department's operations. A second study is being made by the Moss Committee, a subcommittee of the House Government Operations Committee.

The Coolidge Committee findings point up two major areas of laxity: overclassification and deliberate unauthorized disclosures. The Department of Defense is accused of putting documents not in the interest of national security under Top Secret, Secret, or Confidential classification when there is not need for it. The committee recommendations, which numbered 28, suggested, among many other things, the establishment of a single authority to govern the classifying system. Also, that fewer people be given the power to assign classification ratings.

Esprit d'Corps, interservice rivalry, and overzealousness were judged the cause of "leaking" technical information to the newspapers and to the technical press. However, the Coolidge Committee recommended strong disciplinary action for discovered offenders. Industry was also cited for its part in unauthorized disclosures. Those firms responsible for "leaks" face loss of clearance rating and, possibly loss of their contracts.

The Congressional Moss Committee believes that the whole security system needs changing. Eminent scientists and some top industrialists who have been caught up in the morass of red tape have supplied the committee with ammunition for bringing about a change.

The committee's contention is that it should be easier for scientists to exchange basic information without requiring them to exchange security credentials in the presence of a security officer. Also, the Committee is interested in finding out why clearance by one military department is not acceptable in another department. The objection here is that an engineer transfers from Navy to Army, his clearance cannot also be transferred. Rather, the individual must wait 30 to 90 days before he can securely be placed on the job.

This inquiry by the Moss Committee has been going on since early this year. Twenty-five intermediate reports have been filed (the last was 300 pages long). A survey of all Government Agency information policies has been made and compiled into a 500-page tome. Much evidence has been collected and this session of Congress might see some kind of recommendation come out that will loosen and widen present security regulations.

At the present time however Rep. Moss has cancelled all hearings until after January. He has accused Assistant Secretary of Defense Ross of refusing to cooperate with the Committee—but promised that this "will not stop them from doing its job."

AMP's Creative
Approach
TO BETTER WIRING

Order out of Chaos

For today's intricate circuitry, AMP's "Taper Technique"—with or without programming boards—makes possible the greatest number of orderly connections in the smallest space.

See your nearest AMP representative
or write the General Office.

AMP's Automatic Crimping Machine produces up to 4,000 finished Taper terminations per hour.

AMP INCORPORATED

GENERAL OFFICE: HARRISBURG, PA.

Wholly Owned Subsidiaries:

Aircraft-Marine Products of Canada Ltd., Toronto, Canada
Aircraft-Marine Products (G.B.) Ltd., London, England
Societe AMP de France, Le Pre St. Gervais, Seine, France
AMP-Holland N.V.'s-Hertogenbosch, Holland

Japanese Distributor:

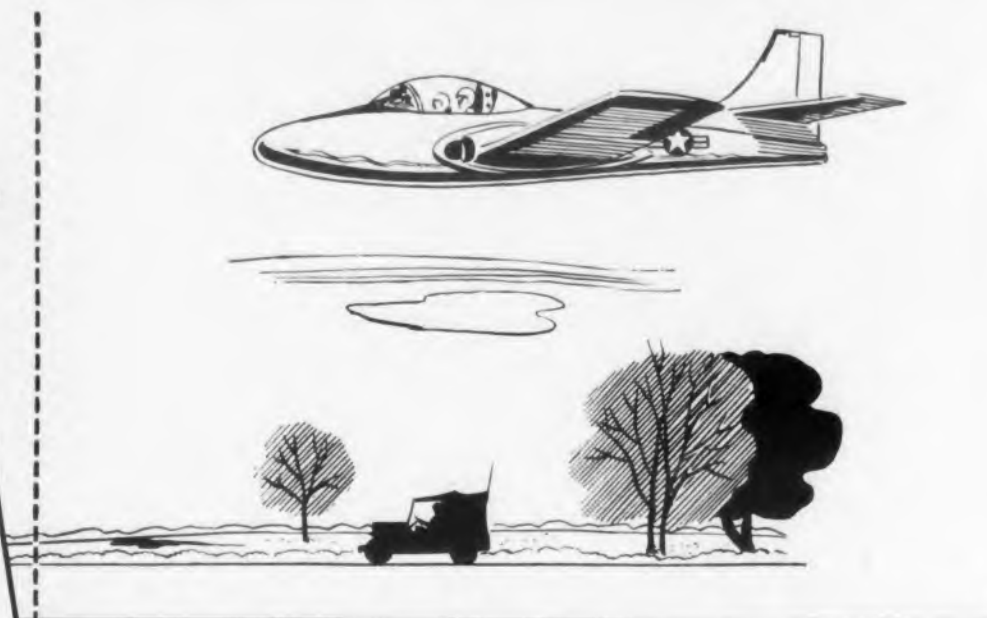
Oriental Terminal Products Co., Ltd., Tokyo, Japan

Photo courtesy of National Advisory Committee for Aeronautics

CIRCLE 12 ON READER-SERVICE CARD FOR MORE INFORMATION

Winco dynamotors qualify

for Signal Corps Reduced Inspection Plan



MEMO
TO: Dynamotor Users—
We ran this advertisement in June, 1955, Now—
18 months later—
Wincharger still is
the only Dynamotor
Manufacturer qualified
under the Signal Corps
Reduced Inspection
Quality Assurance Plan!

WINCO®

Power for the nation's
mobile communications

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

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

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

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

WINCHARGER CORPORATION

Sioux City 2, Iowa
Subsidiary of Zenith Radio Corporation

CIRCLE 13 ON READER-SERVICE CARD FOR MORE INFORMATION

Meetings

Dec. 19-20: RETMA Symposium on Applied Reliability.

Bovard Hall, University of Southern California, Los Angeles, Calif. Sessions on Mechanical Reliability, Information Feedback, Component Evaluation Usage will be presented. "Failure Feedback—Is It Effective" is highlight of the meeting. Registration in advance is \$3.00. Further information received from RETMA Engineering Office, Room 650, 11 West 42nd St., New York 36, N. Y.

Dec. 26-27: American Association For the Advancement of Science.

Statler Hotel, New York, N. Y. General theme of program on the Aids for Environmental Control. Various discussions will be held. For further information contact the American Association for the Advancement of Science, 1515 Massachusetts Ave., N.W., Washington 5, D. C.

Jan. 9-11, 1957: Symposium on Communication Theory and Antenna Design.

Boston University, Boston, Mass. Sponsored by the Air Force Cambridge Research Center and Boston University. For information, contact Miss Alice Cahill, Air Force Cambridge Research Center, Air Research and Development Command, Laurence G. Hanscom Field, Bedford, Mass.

Jan. 14-15, 1957: Third National Symposium on Reliability and Quality Control in Electronics.

Hotel Statler, Washington, D. C., Sessions to be included are: System Reliability Analysis, Commercial Electronics Reliability, Reliability of Component Parts, and Quality Control in Production. Sponsored jointly by the IRE Professional Group on Reliability and Quality Control, the American Society for Quality Control, the American Institute of Electrical Engineers, and RETMA. For information, write to IRE, 1 E. 79th St., New York 21, N. Y.

Jan. 16-18: Society of Plastics Engineers, Inc., Thirteenth Annual Technical Conference.

Sheraton-Jefferson Hotel, St. Louis, Mo. Sixty-eight advanced technical papers will be presented. For further information contact Jas. R. Davidson, Executive Secretary, Society of Plastics Engineers, Inc., Suite 116-18, 34 East Putnam Ave., Greenwich Conn.

Jan. 21-25: Annual AIEE Winter General Meeting
Hotel Statler, Sheraton McAlpin New York, N.Y. Speaker will be F. R. Kappel, president of AT&T. The entire field of electrical engineering will be the subject of the meeting. For further information contact the American Institute of Electrical Engineers, 33 W. 39th St., New York, N.Y.

Jan. 23-25, 1957: Very Low Frequency Symposium.
NBS Boulder Laboratories, Boulder, Colo. Co-sponsored by the Denver-Boulder chapter of the IRE PGAP and the Boulder Laboratories, National Bureau of Standards. The program is titled "Theoretical and Experimental Results in the Propagation and Radiation of Very-Low-Frequency Electromagnetic Waves (less than about 100 kc)." Authors are being requested to submit summaries for appraisal as soon as possible to Dr. J. R. Wait, Chairman, Denver-Boulder PGAP Chapter, National Bureau of Standards, Boulder, Colo. For further information, contact U. S. Dept. of Commerce, NBS, Boulder Laboratories, Boulder, Colo.

February 5-7: Twelfth Reinforced Plastics Division Conference.

Edgewater Beach Hotel, Chicago, Ill. Latest developments in both technical and practical aspects of reinforced plastics. Subject matter will range from reports on research and testing to product design to production methods to marketing techniques. A complete program, listing papers and speakers, registration forms for the three day Conference and hotel reservation blanks will be available after December 26. Those interested should write now to The Society of the Plastics Industry, Inc., 250 Park Ave., New York 17, N. Y.

Feb. 7: Annual Symposium of the New York Section of the ISA.

Garden City Hotel, Garden City, N. Y. Short papers on "Practical Accuracy of Measurement" will be presented followed by a discussion. Afternoon session will be on "Data Handling." For further information contact G. Newberg, Publicity Chairman, Fairchild Engine Division, Fairchild Engine & Airplane Corp., Deer Park, L. I., N. Y.

Feb. 7: Operations Research Symposium.

University Museum Lecture Hall, University of Pennsylvania. Sponsored jointly by the Professional Group on Engineering Management of the Philadelphia Section of IRE and the Society of Industrial and Applied Mathematics. Major theme will be Mathematical Models in Management Decision Making. Contact Haydn Ringer, 1303 Highland Ave., Palmyra, N. J.

*A good product... made even better
... with plastics parts by G.E.*



Coil form and mount used in two-way radio, molded by G.E.'s Plastics Department to exacting tolerances. Note how metal inserts are molded right into the mount — threaded afterwards to insure clean contacts.

LOOKING FOR PRECISION-MOLDED PLASTICS PARTS? Perhaps this example from General Electric's Plastics Department will help you. Molded for the G-E two-way radio, this coil form and mount require exacting tolerances, since they determine the accuracy with which other components fit into the assembly. In addition, they must resist arcs and high heat. G-E Plastics Department engineers selected a mineral-filled phenolic with good dimensional stability and excellent dielectric strength. They then molded the parts to the exact dimensions required, assuring quick, accurate assembly. Metal in-

serts were molded in, threaded afterwards, to insure clean contacts.

Where can YOU use plastics parts by G.E. to make a good product even better? If you are contemplating a new product, or are looking for a way to improve a present one, keep plastics in mind! As one of the world's foremost custom-molders, General Electric has helped scores of manufacturers improve product performance and appearance, realize important cost savings. G.E.'s custom-molding service will be happy to help you in engineering and developing your products—through plastics.

Write today on your company letterhead for a free copy of "The G-E Plastics Story," containing stimulating case histories of how customers profit through plastics. Just write: Plastics Department, General Electric Company, Section 6X6A2, Decatur, Ill.



Progress Is Our Most Important Product

GENERAL ELECTRIC

CIRCLE 14 ON READER-SERVICE CARD FOR MORE INFORMATION

RADAR PULSE PACKAGES

solve
pulse system
problems with
FILTRON

*Balanced
and
Matched*
**PULSE
PACKAGES**



FILTRON DUAL PULSE PACKAGE
Part No. PP 2218

CHARACTERISTICS

Input: 500 VDC.
Output Pulse: 3 KV. positive at 2.5 amps.
Pulse Width: 0.8 μ sec. at half power points.
Repetition Rate: 410 nominal in each of two channels.
Operating Temperature: -55°C to +70°C ambient.
Altitude: 65,000 ft.
Shock & Vibration: Per MIL Specifications.

Let Filtron engineers design, build and test pre-engineered pulse packages for your radar transmitter system. Saves tedious trial-and-error development work. Eliminates assembly and testing. Reduces inventory.

FILTRON'S TRIGGER-PULSE PACKAGES are designed around a carefully matched and balanced (1) pulse network (2) charging choke and (3) pulse transformer of the line-type modulator. They can be engineered to generate pulses having sufficient power and impedance to trigger any high power hydrogen thyratron.

FILTRON'S HIGH-POWER PULSE PACKAGES are schematically similar, but will generate an optimum required pulse shape for specific radar system transmitted-pulse parameters. Call on Filtron's field engineers... they will visit your plant to assure optimum performance of the pulse package in your system.

All Filtron pulse packages are balanced, inspected and 100% tested before leaving the plant. Don't take chances on unmatched components purchased separately. Don't waste valuable engineering man-hours. Find out what Filtron's pre-engineered pulse packages can do for you.

Canadian Representative: Aircraft Appliances & Equipment Ltd., 585 Dixon Side Road, Toronto 15, Ont., Canada

FILTRON CO., INC., FLUSHING, LONG ISLAND, NEW YORK
PLANTS IN FLUSHING, NEW YORK, AND CULVER CITY, CALIFORNIA

RF INTERFERENCE FILTERS • FIXED CAPACITORS • PULSE NETWORKS • DELAY LINES
CIRCLE 15 ON READER-SERVICE CARD FOR MORE INFORMATION

Feb. 7-8: Special Conference on Nucleonics In Industry

Hotel Statler, New York, N.Y. Principle subjects for discussion will be the present and prospective profitability of atomic investment. Sessions will cover industrial applications as the use of nuclear energy for processing purposes, development of auxiliary power, and the uses of isotopes. Conducted by the American Management Association, 1515 Broadway, New York, N.Y.

February 14-15: 1957 Transistor and Solid State Circuits Conference.

University of Pennsylvania, Philadelphia, Pa. Sponsored by the Institute of Radio Engineers, American Institute of Electrical Engineers, and the University of Pennsylvania. For further information contact G. H. Kunststadt, Radio Corporation of America, Defense Electronic Products, Camden 2, N. J.

Feb. 14-15: ASQC Mid-Atlantic Conference

Ben Franklin Hotel, Philadelphia, Pa. Sponsored by the American Society for Quality Control.

Feb. 25-27: Special Conference on Electronics In Action

Statler Hotel, New York, N.Y. Several major companies will show electronic data-processing equipment in action through closed-circuit television. Sponsored by the American Management Association's Finance Division, 1515 Broadway, New York, N.Y.

Feb. 26-28: Western Joint Computer Conference.

Statler Hotel, Los Angeles, Calif. The Conference is under the joint sponsorship of the IRE, AIEE, and ACM. Theme of the meetings will be "Techniques For Reliability." For further information contact S. Dean Wanlass, Aeronutronic Systems, Inc., 13729 Victory Blvd., Van Nuys, Calif.

March 11-15: The 1957 Nuclear Congress

Convention Hall, Philadelphia, Pa. Exhibits and conference sessions covering latest developments relating to the utilization of atomic energy in its various non-military forms for civilian use. For further information contact Atomic Exposition Office, 304 Architects Bldg., Phila. 3, Pa.

March 18-21: The 1957 SPI Annual National Conference and Pacific Coast Plastics Exposition.

Hotel Biltmore, Los Angeles, Calif., sponsored by the Society of the Plastics Industry, Inc. Sessions will cover plastics in the fields of electronics, aircraft and defense, building, and processing. Exposition will be held at the Shrine Exposition Hall. Further information may be obtained from the Society of the Plastics Industry, Inc., 250 Park Ave. New York, N. Y.

March 18-21: IRE National Convention

Waldorf-Astoria Hotel, New York, N.Y. Sponsored by the IRE. For further information contact the IRE, 1 East 79th St., New York, N.Y.

May 1-3: Electronic Components Conference

Hotel Morrison, Chicago, Illinois. Sponsored by the IRE, AIEE, and RETMA. Further information may be obtained by contacting the IRE, 1 East 79th St., New York, N.Y.

April 8-11, 1957: Fourth National Electrical Industries Show.

71st Regiment Armory, New York, N.Y. Sponsored by the Eastern Electrical Wholesalers Association. For more information, contact William S. Orkin, Co-Producer, The American Electrical Industries Expositions, Inc., 19 W. 44th St., New York, N.Y.

April 11-13, 1957: Southwestern IRE Conference and Electronics Show.

Houston, Texas. Sponsored by the Houston Section of the IRE. This conference will be augmented by the National Simulation Conference which will be sponsored by the IRE Professional Group on Electronic Computers. For information, write to Ninth Southwestern IRE Conference and Electronics Show, P. O. Box 1234, Houston 1, Texas.

April 23-25: International Symposium on the Role of Solid State Phenomena in Electrical Circuits.

Auditorium of the Engineering Societies Building, New York, N. Y. Symposium will cover recent developments in application to electrical circuits on systems of unusual physical effects in solids. For information write to the Polytechnic Institute of Brooklyn, Microwave Research Institute, 55 Johnson St., Brooklyn 1, N.Y.

May 16-18: Eighth Annual Conference and Convention, American Institute of Industrial Engineers.

New York City, Hotel Statler. For information write to AIIE, P.O. Box 8, Substation 135, The Bronx 53, New York.

May 27-29: 1957 National Telemetering Conference. El Paso, Texas.

The theme of the conference will be "Industry-Government Co-operation in Telemetering." There will be 32 papers and three panels. Papers will be made available to the attendees in advance whereby they can ask better questions. The papers will not be read, but more or less of an abstract will be given followed by a questioning period. For further information contact Lawrence Gardenhire, Box 112, State College, New Mexico.



TINY *in size*
MIGHTY *in performance*

CLAROSTAT* MINIATURIZED CONTROLS

These CLAROSTAT miniaturized controls (U.S. Pat. No. 2,706,760) in both *stabilized composition-element* and *wire-wound* versions, are mass-produced so that they are now available *when wanted* and *at the price you can afford to pay*.

Series 48M (*stabilized composition-element*) is smaller than a dime. Series 49M is the size of a penny. Yet either type is mighty in performance. Over half a million of these tiny potentiometers have been put to use in the past eight years.



COMPOSITION-ELEMENT

Series 48M. $\frac{5}{8}$ " dia. Featuring Clarostat's stabilized composition element. 500 ohms to 5 megohms. 0.2 watt rating. Choice of tapers. Single or dual. Conforms to Style RV-1 of MIL-R-94A proposed Military Specification.

WIRE-WOUND

Series 49M. $\frac{3}{4}$ " dia. 1 ohm to 20,000 ohms. 1.5 watt rating. Single or dual. Conforms to Style RA-10 of MIL-R-19A proposed Military Specification.

WITH SWITCH

Available in factory-attached S.P.S.T. switch for both Series 48M and 49M. Single or dual. Also with choice of different shafts.

Consult us regarding your control or resistor requirements for miniaturized assemblies. Take full advantage of CLAROSTAT ENGINEERING. Write for engineering data.

*Reg. U. S. Pat. Off.



CONTROLS and RESISTORS

CLAROSTAT MFG. CO., INC.

DOVER, NEW HAMPSHIRE

In Canada: CANADIAN MARCONI CO., LTD., Toronto 17, Ont.

CIRCLE 16 ON READER-SERVICE CARD FOR MORE INFORMATION

TRANSISTORIZED dc amplifiers offer several advantages over vacuum tube dc amplifiers because of their small size, small power consumption, and increased reliability. However, the inherent drift in the I_{co} of transistors and the extreme sensitivity of all of the transistor parameters to ambient temperature changes have discouraged and delayed the application of transistors to dc amplifiers. This is generally true for all transistors, but is particularly true for germanium transistors. This article describes a unique compensating current generator circuit which has been used as the basis for practical transistorized dc amplifiers. The compensating circuit, which uses a transistor, may be used to stabilize either germanium or silicon transistor circuits. It is certainly not the only solution, but it will help to indicate some of the problems involved in the design of transistor dc amplifiers.

Basic Considerations

The general block diagram of an uncompensated transistorized dc amplifier is shown in Fig. 1. The amplifier is a two-stage amplifier, and each stage is represented as a perfect amplifier with a current amplification A_i and a drift current generator, I_s . I_s is the component of drift current in the output of each stage due to a change in the ambient temperature. A constant current I_c is supplied to the two amplifier stages to bias each stage to its proper operating point.

I_s is due mainly to two major sources. These sources are transistor parameter variations which cause the current amplification of each stage to be a function of temperature and the exponential increase in the collector saturation current I_{co} , where I_{co} is defined as the collector current when the emitter current is zero and the collector-to-base voltage is of the order of 4 or 5 v. At high temperatures, I_s is largely the result of changes in I_{co} and at low temperatures I_s is largely the result of changes in the transistor parameters.

All transistor parameters are sensitive to ambient temperature changes; nevertheless, in a well-designed transistorized dc amplifier, the effect of transistor parameter variations, other than I_{co} , may be practically eliminated. Feedback may be used to reduce I_s . However, overall feedback will not reduce the effect

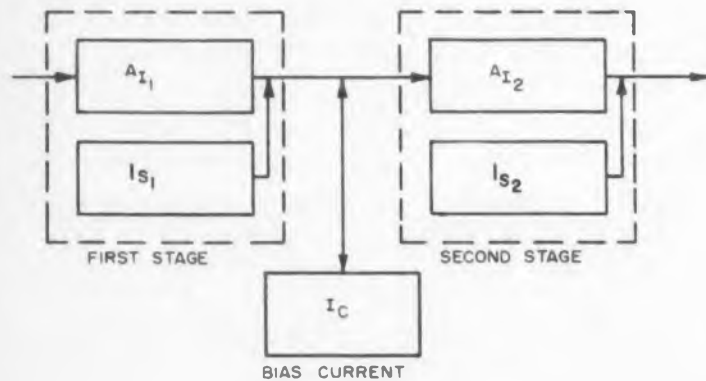


Fig. 1. Block diagram of an uncompensated transistorized d-c amplifier.

of I_s on the equivalent input drift current. The effect of overall negative feedback is shown in Fig. 2.

Curve A in Fig. 2 shows maximum amplification and curve B shows the effect of reducing the amplification by using overall negative feedback. By reducing the amplification, the output current variations may be reduced approximately proportional to the reduction in gain. The operating point of each stage may be adjusted in this way so it will not be temperature-shifted out of the linear operating range of the transistor. It must be remembered that reducing the output current variations does not necessarily increase the sensitivity of the amplifier; in fact, the sensitivity of the amplifier is the same for curve A as for curve B. It is possible to use feedback in individual stages to reduce the effect of parameter variations, and then to couple two stages so that the parameter variations in one stage will modify the feedback in the other stage in a manner that will cancel the effect of parameter variations. This technique is used in the circuit to be described.

Compensated Circuit

Fig. 3a shows the block diagram of a compensated transistorized dc amplifier with the basic schematic diagram shown in Fig. 3b. This amplifier has the same general configuration as in Fig. 1, with the addition of a compensating current generator I_{s3} to compensate for the effect of I_{co} , and to a smaller extent, for other variations. It should be noted that the compensating current generator is a transistor (TR_3).

The output impedance of the first stage is made so low that it controls the base-to-ground voltage of the second stage. Since the emitter-to-base voltage in the second stage is made small compared to the voltage drop across R_4 , the output current is then controlled

Designing Transistor D-C Amplifiers

James W. Stanton

G.E. Advanced Electronics Center
Cornell University, Ithaca, N. Y.

by the first stage, and transistors may be substituted quite freely in the second stage. The equivalent circuit of the amplifier is shown in Fig. 4a.

It is apparent from this equivalent circuit that the circuit is not as simple as it appears to be in Fig. 3. The analysis of the circuit is made difficult by the fact that all of the parameters of the transistors are functions of the ambient temperature. By proper choice of the resistors external to the transistors, the equivalent circuit may be simplified to that shown in Fig. 4b.

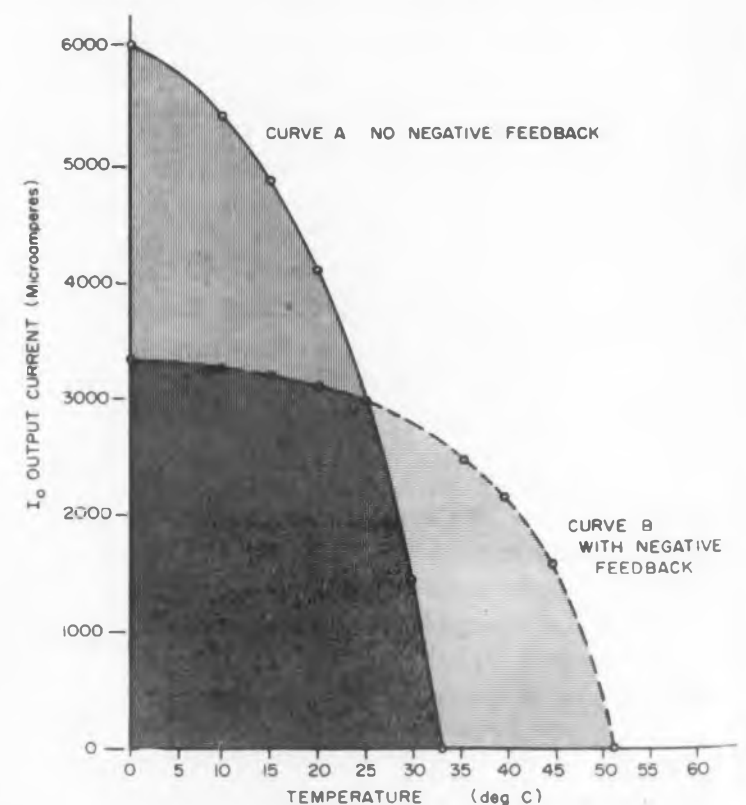


Fig. 2. Effect of drift current on output current of two-stage grounded-emitter amplifier.

This circuit is only an approximation, but it shows that the desired result is to eliminate from the effective circuit all of the internal parameters of the transistor except the current amplification factor. The approximate equivalent circuit holds true when the inequalities given below are true.

$$R_1 < \frac{r_{c1}}{b_1 + 1} \quad \text{and} \quad R_2 > \frac{r_{c1}}{b_1 + 1}$$

$$R_{in} \gg r_{b1} + r_{e1}(b_1 + 1)$$

$$R_4 \gg r_{e3}$$

$$R_L + R_4 + r_{e3} \ll \frac{r_{c3}}{b_3 + 1}$$

The voltages V_{eb1} and V_{eb3} effectively cancel in the circuit when R_{in} is large. This voltage is due mainly to the emitter diode and decreases approximately 2.4 mv per degree Centigrade for germanium transistors as the temperature is increased. It is this voltage which may cause a large error in low impedance circuits. Variations in I_{co} and the current amplification factor b are the only factors left in the equivalent circuit which are temperature-sensitive. I_{co} can be compensated for by some cancellation method since it may be predicted. To compensate for I_{co} , a predictable compensating current I_{s3} is injected in the first stage, which compensates for the effect of I_{co1} and I_{co3} of the first and second stages respectively. Then the effect of the variations in the current amplification factor b of the transistors used may be minimized by choosing transistors with high values of b and choosing the ratio of R_1/R_4 to be approximately equal to $b/2$. The actual choice of the ratio of R_1/R_4 will be determined by the current amplification desired, but the ratio should be

between $b/2$ and b . If the ratio is too high, the current amplification will be temperature-sensitive, and if the ratio is too low the current amplification will be low. The effect of the value of b on the current amplification is shown in Fig. 5.

The current amplification A_i , based on the simplified equivalent circuit, is shown in Fig. 5, and is given by the equation in the insert at the top of this figure.

The effect of b on the current amplification A_i of the amplifier is given for two cases. First, when the ratio of R_1/R_4 is equal to 30, the current amplification is shown by the curve at the bottom of the slide. Notice that the current amplification is nearly flat for values of b greater than 30. Second, when R_1/R_4 is equal to 100, the current amplification is given by the curve at the top of the figure. In this case the current amplification begins to be independent of b for values of b greater than 70 to 100.

Fig. 6 shows the equivalent input current as a function of b for a given bias current. This curve clearly indicates the value of having a transistor in the first stage with a beta of 60 or greater. It also shows that the bias current should be as low as practical. The actual value of bias current will depend on the amplifiers use, but for most purposes I_c should be between 500 and 1000 μ amp. The equation may be used only under the conditions that the simplified circuit may be used to represent the actual circuit.

A closer approximation may be obtained by including the effect of the collector resistance of the transistors, but the current amplification A_i will then be given as a function of the collector resistances. In order to minimize the effect of the collector resistance, the impedance seen by the collector circuit of the

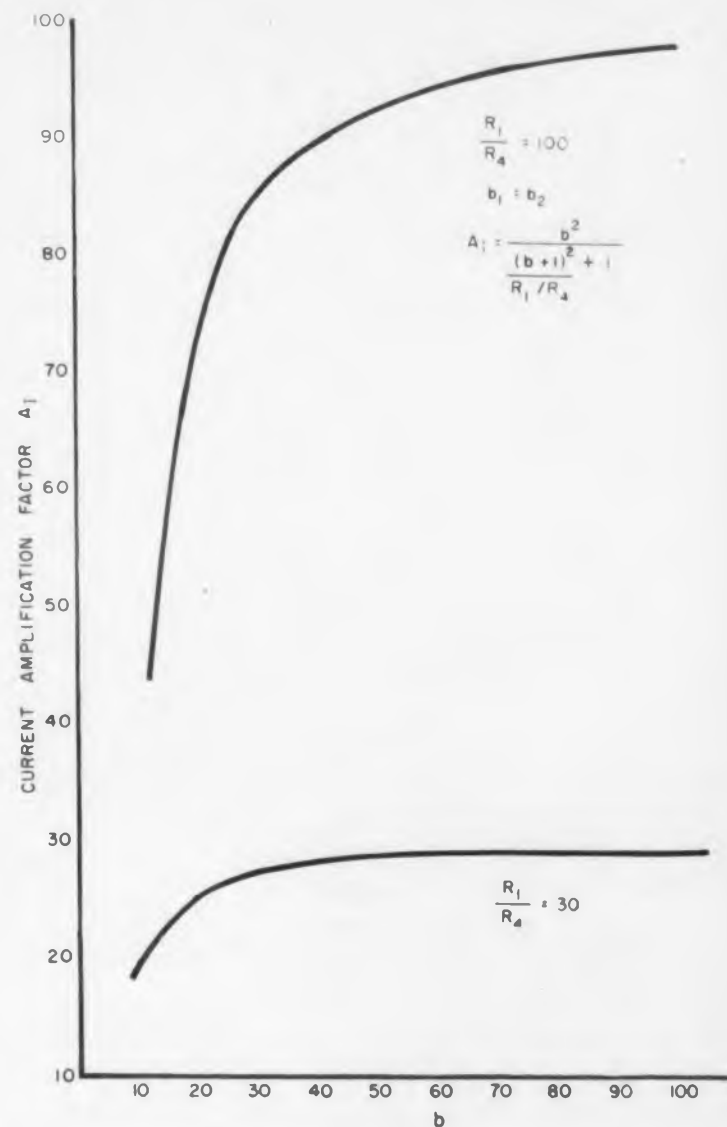


Fig. 5. Variation of A_i with b .

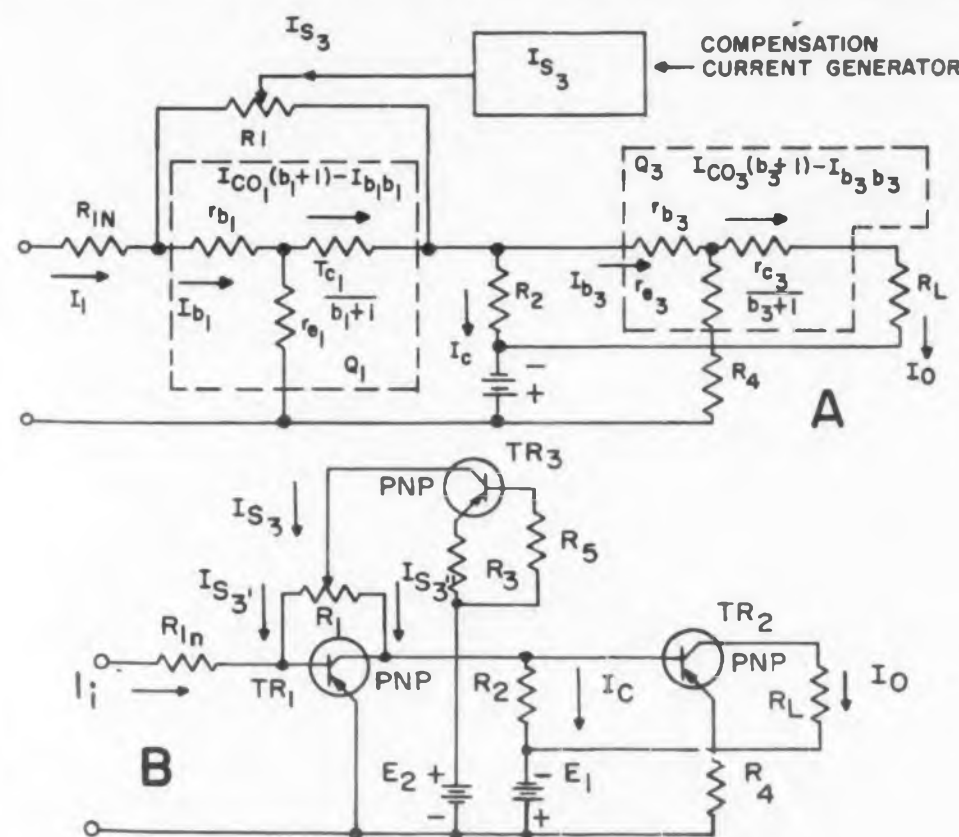


Fig. 3. Block diagram, a, and schematic diagram, b, of the transistorized d-c amplifier.

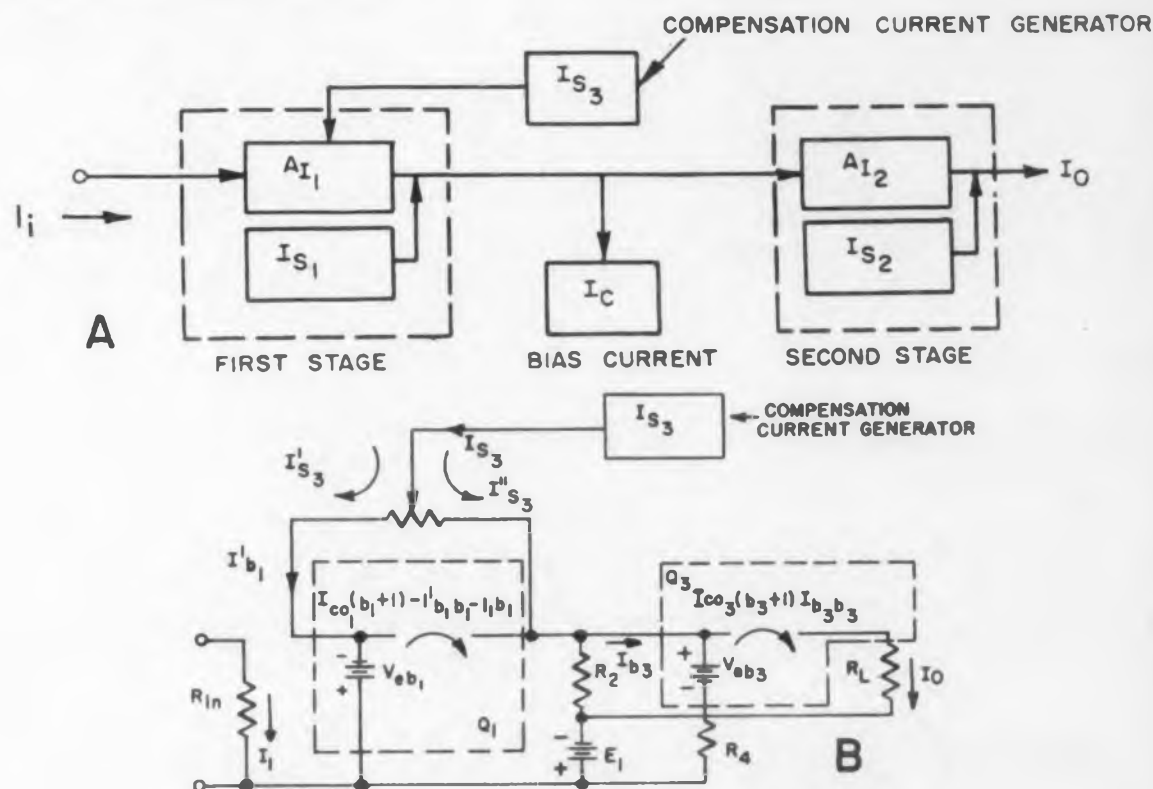


Fig. 4. Equivalent circuit of the compensated transistorized d-c amplifier, a, and simplified approximate equivalent circuit, b.

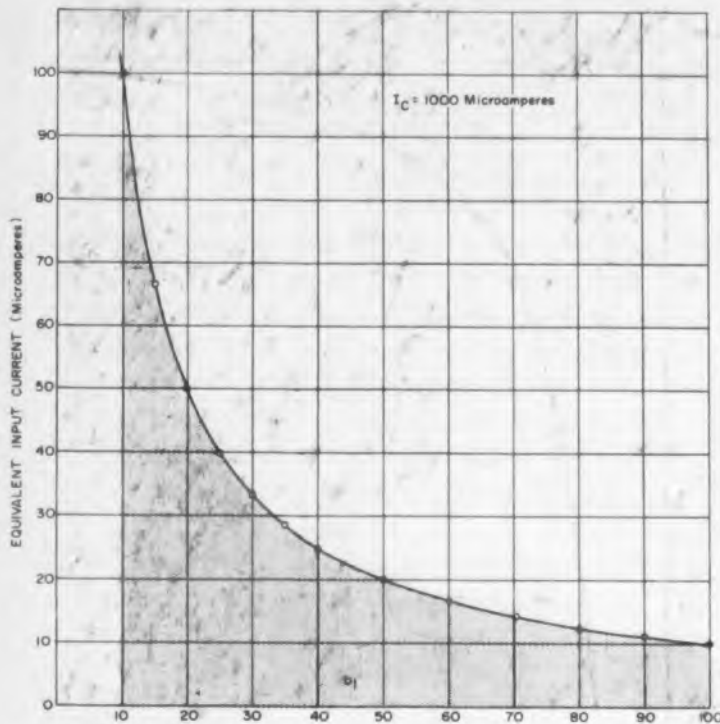


Fig. 6. Equivalent input current as a function of b .

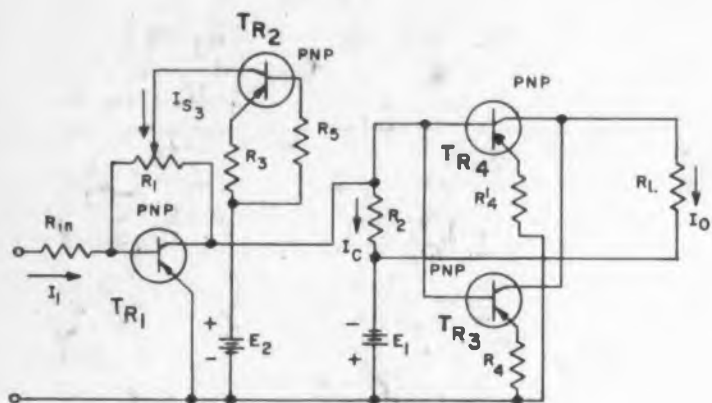


Fig. 7. Compensated transistorized d-c amplifier using two transistors in the second stage.

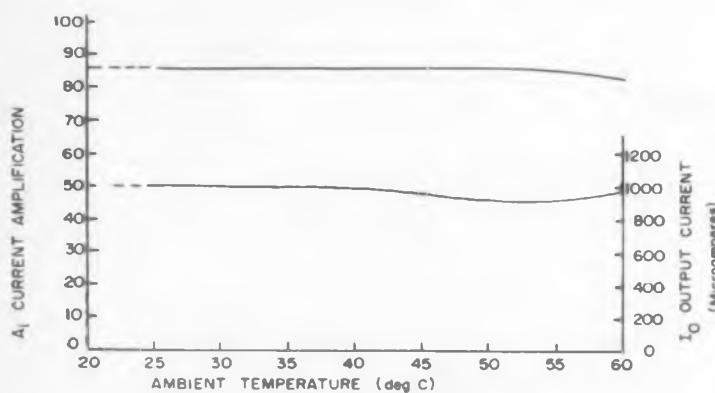


Fig. 8 & 9. Variation of output current and current amplification with temperature.

transistors must be low. This can be done by making R_1 low, which will reduce the current gain of the amplifier. However, in order to increase the current gain and allow low values of R_1 , several transistors may be used in the second stage. In this way the conditions for the simplified approximate equivalent circuit may be more nearly met. In general, one transistor in the first stage and two in the second stage will give good results. If more power output and low drift at high temperatures are desired, more transistors may be used in the second stage. The schematic diagram of an amplifier using two transistors in the second stage is shown in Fig. 7.

The collectors and bases of the transistors in the second stage are connected together, but to make the transistors take equal collector currents, separate external emitter resistors must be used. To show the results which may be obtained by using equations derived from the approximate equivalent circuit, the following circuit parameters were used to calculate the current amplification.

$$\begin{aligned} b_3 &= 105 & R_{in} &= 1 \text{ megohm} \\ b_1 &= 42 & R_2 &= 22 \text{ K ohm} \\ b_4 &= 185 & r_{c3} &= 5.2 \text{ megohm} \\ R_1 &= 60 \text{ K} & r_{c4} &= 5.87 \text{ megohm} \\ R_4 &= 1 \text{ K} & r_{e4} &= 5.27 \text{ megohm} \\ R'_4 &= 1 \text{ K} \end{aligned}$$

The calculated current amplification was 110 for the type amplifier illustrated, and the actual measured current amplification was 100. The results are close enough for most practical purposes. In practice, the amplification may be set to the desired value by adjusting R_1 . Once current amplification is set, the changes in parameters have very little effect on A_i . A number of combinations of transistors were substituted in this circuit without any noticeable change in the amplification. In addition, the gain was constant with temperature.

As was noted before, a transistor is used to generate the compensating current because it will generate a current which has the exponential function of temperature needed to compensate for I_{co} . Since these

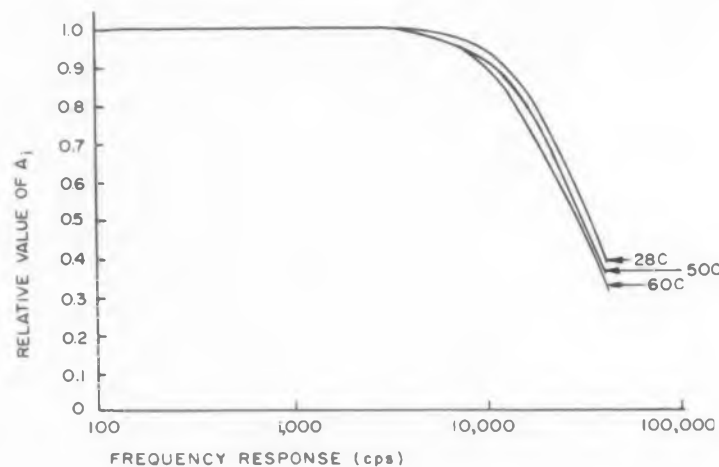


Fig. 10. Frequency response of amplifier for 28, 50 and 60 C.

currents increase exponentially with temperature, a slight difference in the exponents will result in a large compensation error. Also, since a transistor is used in the compensating circuit, the same technique of eliminating parameter variations must be employed as was done in the amplifier circuit.

The compensation current I_{S3} divides into R_1 . Part of this compensation current is fed into the input of the first stage and part of the current is fed into the junction of the output of the first stage and the input of the second stage. The division of I_{S3} is determined by the position of the potentiometer R_1 . Therefore, by designing the compensating current generator to give a certain value of current, such as two to four times the saturation current I_{co2} of the compensating transistor, R_1 may be adjusted to correct for any deviation of I_{co2} from an assumed standard I_{co} .

The value of I_{S3} , equal to two times I_{co2} , will allow a reasonable adjustment of R_1 to obtain the proper value of compensation current, and at the same time, make the multiplying factor of I_{co2} independent of the current amplification, b_2 , of the compensating transistor.

Since the successful operation of the amplifier at high temperatures depends upon how well the saturation current I_{co} may be predicted, it is essential that transistors with low leakage currents be used. Transistors with high leakage currents will give a false value of I_{co} which will vary with collector voltage and cause the exponential function of the drift current to vary from transistor to transistor.

The results of the temperature compensation may be seen in Figs. 8, 9, and 10. The frequency response of the amplifier is shown in Fig. 10 for three temperatures, 28, 50 and 60 C. The effect of the ambient temperature changes on the frequency response of the amplifier is relatively small. The transistors used here had an alpha cutoff frequency of the order of 500 kc to 1 mc. The actual physical appearance of this amplifier is shown in Fig. 12. The amplifier is relatively small and the construction is such that the transistors have all approximately the same ambient temperature.

Quite often it is necessary to obtain an output signal

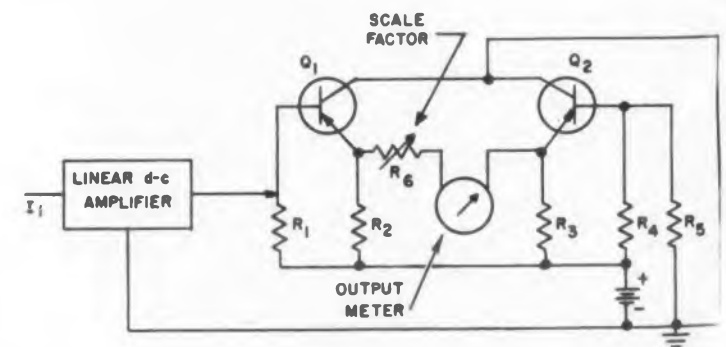


Fig. 11. Schematic of a difference amplifier output stage.



Fig. 12. Potted transistorized d-c amplifier.

that is zero when the input current is zero. A difference amplifier circuit which may be used to do this is shown in Fig. 11.

The techniques just described were used to build a transistorized dc amplifier circuit for a nuclear reactor control system. In this type of system there are three basic amplifier circuits: (1) linear dc amplifiers, (2) logarithmic dc amplifiers, and (3) derivative amplifiers. Transistorized dc amplifiers were used in conjunction with passive elements in order to obtain the particular transfer characteristics that were desired. For over a year this experimental system has been operating 24 hours a day at the Knowles Atomic Power Laboratory in Schenectady, New York, which is operated by the General Electric Company. During this time, no aging effects have been noticed, the drift has been negligible, and no faulty operation or failures have occurred.

A linear transistorized dc amplifier which was designed as an instrument-type amplifier had a sensitivity of better than 10^{-7} amperes, and an equivalent input drift current of less than 10^{-6} amps when the ambient temperature changed from 0 to 50 C for an output current swing of 10 ma. The linearity of this amplifier was better than one-half of one percent.

A logarithmic amplifier was designed which used a diode shaping network, a linear dc amplifier and a difference output stage.

A derivative amplifier used two linear dc amplifiers in cascade and the output stage was the difference amplifier that was shown in Fig. 11.

Conclusion

In conclusion, results obtained on experimental models show that reliable transistorized dc amplifiers may be built. Sensitivities in the microampere and millimicroampere range have been obtained even when the ambient temperature is varied over a wide range. Experimental circuits have been built with sensitivities of better than 0.01 μ amp. The drift at room temperature is less than 0.05 percent full-scale per twenty-four hours. A linearity of better than 0.2 percent and an equivalent input drift current of less than 0.5 μ amp over an ambient temperature range of 0 to 50 C have been achieved. Observations for relatively long periods of time have shown no noticeable transistor aging effects.

Radio Manufacturers ... Jump into print wire board assembly NOW



Be ready for quick market demand with a printed circuit 5-tube AM radio chassis board, with no engineering or design costs to you.

You can now buy a G-E print wire board with a 5-tube high-performance circuit for immediate use in your radio or communications line.

FAST DELIVERY —Initial quantity of this board can be shipped immediately.

EASY ASSEMBLY —Board design and use of standard parts permit hand or dip solder assembly techniques.

COMPACT SIZE —Two sided G-E "THRU-CON" board gives small size, and permits wide range of cabinet styles and applications: radio lamps, hobby kits, low-cost-price leaders, intercom systems.

General Electric will supply you with a complete list of readily available standard components, as well as complete information on assembly and soldering techniques. The General Electric "Thru-Con" process of print wire board manufacture is a positive plating process which provides plating through the holes for superior solder filleting and less line rejects.

This standard 5-tube AM radio board is another product of the Specialty Electronic Components Department, a pioneer in the field of print wire manufacture. The services of our engineers are available to assist manufacturers in their application problems.



STANDARD 5-TUBE RADIO BOARD
Sample of this board and complete technical information on the assembly of an operating unit is yours on request.

General Electric Company
741 26 Electronic Components Building
Auburn, New York
Please send samples and full technical information on General Electric standard 5-tube AM radio board.

NAME _____
TITLE _____
COMPANY _____
ADDRESS _____
CITY _____ STATE _____

Progress Is Our Most Important Product

GENERAL  ELECTRIC

CIRCLE 17 ON READER-SERVICE CARD FOR MORE INFORMATION



XD BODY

*new Solar by-pass
disc capacitors offer*

35%

**increased
capacity**

Solar's new XD body now makes available capacitors meeting RETMA specifications REC-107A with Z5Z characteristics, and having an increase of 35% more capacity per comparable size. This bonus capacity is achieved with no sacrifice in temperature stability or voltage rating.

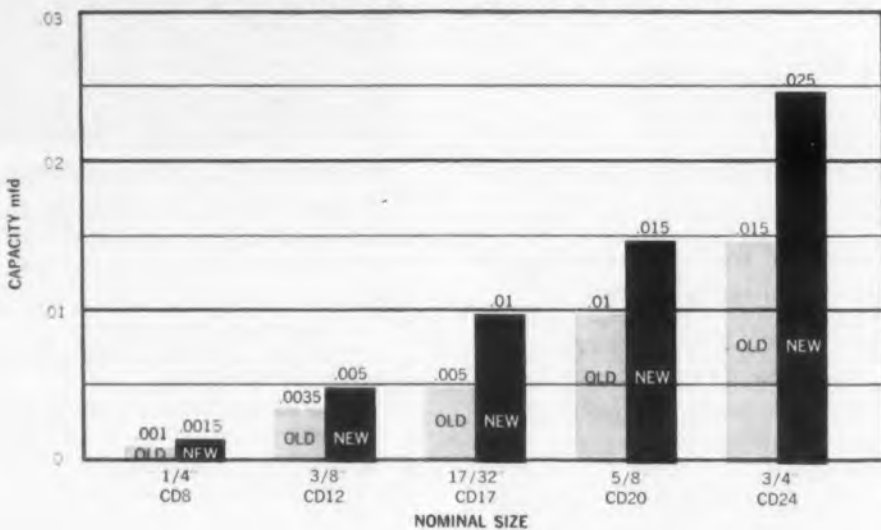
You'll find these units widely useful in miniaturized circuitry. Specify them where you want increased capacity without increased size—or where a smaller size is imperative.

Voltage ratings are conservative. Capacitance change is less than 50% from its value at 25°C. as the temperature varies from +10°C. to +75°C.

SPECIFICATIONS

Capacity	See chart
Capacity Tolerance	GMV
Working Voltage	500 VDC
Test Voltage	1250 VDC
Min. Leakage Resistance	10 K megohms
Max. Power Factor	2%

COMPARATIVE CAPACITY CHART



Write for literature

SOLAR MANUFACTURING CORP.
New York, N. Y.

"QUALITY ALWAYS"



SALES OFFICES: *46th & Seville, Los Angeles 58, Calif.*
4000 W. North Ave., Chicago 39, Ill.

CERAMIC CAPACITORS • PRINTED NETWORKS • PIEZO CERAMICS
CIRCLE 18 ON READER-SERVICE CARD FOR MORE INFORMATION

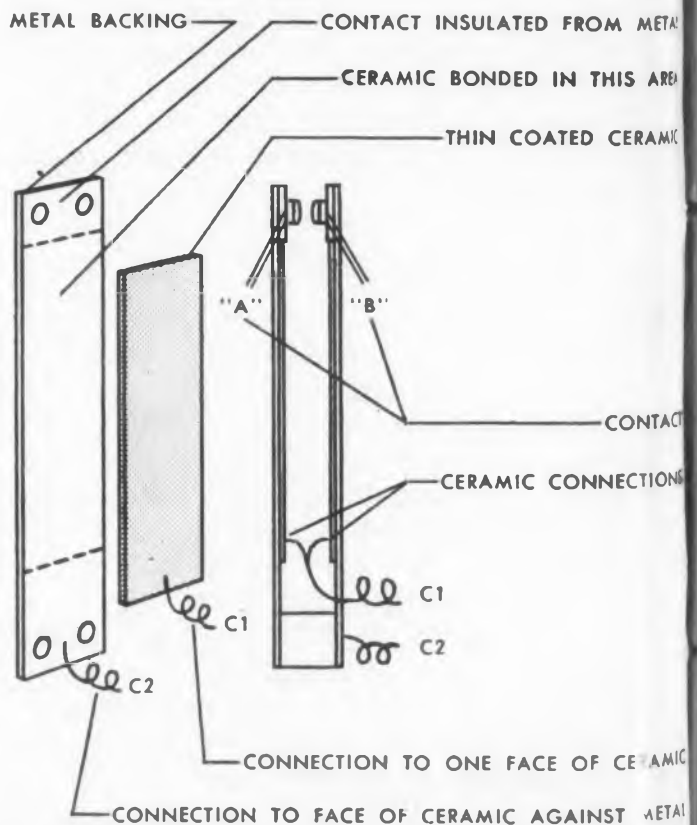
Electrostrictive Relay

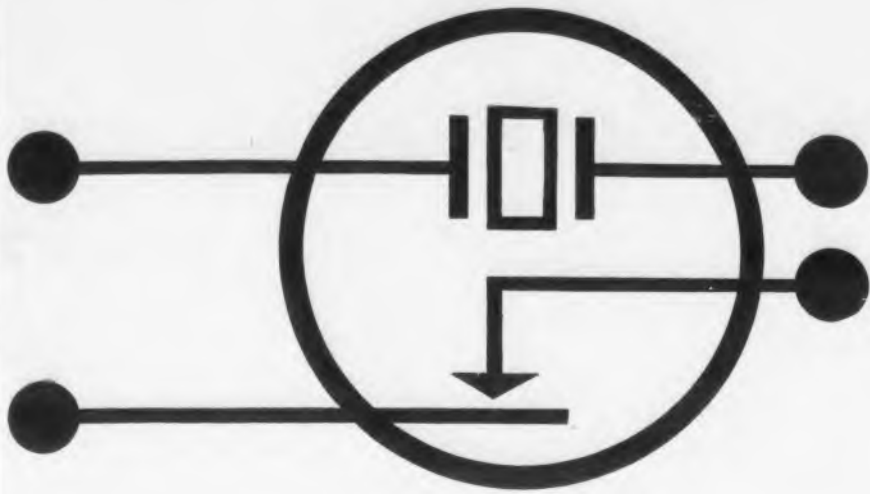
Acts as Capacitor

APPROACHING the concept of the perfect relay in that it consumes almost no power, this unique unit uses an electrostrictive ceramic element to provide the mechanical actuating force. The usual electromagnet is eliminated and there is no magnetic field set up. Short pulses are sufficient to close the relay, since the ceramic element is essentially reactive and retains a charge like a capacitor. This feature also permits the relay to be used as a capacitive component in electronic oscillator or time-delay circuits, where it appears as a 0.08-0.1 μ fd capacitor. High input resistance, insignificant temperature rise, and extreme power sensitivity makes it an ideal component for sensitive control circuitry such as a mercury capillary thermo-

regulator or photoelectric devices.

The heart of the unit, called a Capacitor Switch and manufactured by the Mullenbach Div., Electric Machinery Manufacturing Co., 2100 East 27 St., Los Angeles 58, Calif., is a highly modified barium titanate ceramic crystal coated on both sides with conductive material, and bonded under heat and pressure to a stainless steel reel. The conductive coating makes each ceramic slab a capacitor, which when charged, becomes thicker and contracts in area. As the change occurs, the composite beam acts somewhat like a bimetal, bending in the direction of the contracted ceramic regardless of the polarity of charge. The motion of the bonded element is .015 to .020 in. with a 200 v charge, and each relay uses





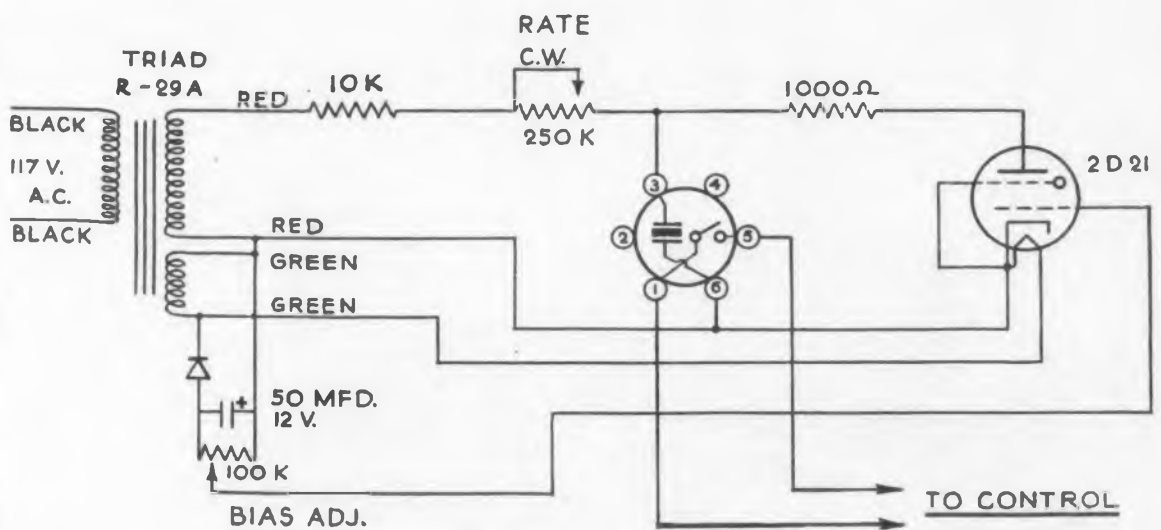
two beams face-to-face. The ceramic, which can be designed to specification, is stable with an electrostrictive coefficient five to ten times that of previous materials.

Pulses as short as 5 μ sec having 1 milliwatt-second of energy will transfer the contacts, and an extremely low holding power of 50 μ w will keep the contacts closed. The high leakage resistance of 100 megohms minimum gives the relay unique hold-in characteristics. The operating time, including bounce ranges from 2.5 to 10 milliseconds for different models.

The operating voltage is 200 v \pm 10 v dc, and the test voltage is 400 v dc. The maximum repetition rate is 10 cycles per second. The life expectancy is 10,000,000 cycles at 1 cycle per second and no load; with a 1

amp load at 115 v ac resistive the minimum life is 100,000 cycles. Various models have a total temperature range of -5 to $+125$ F. The relay weighs 1.6 ozs. is 3 3/8 in. long. It cannot operate under heavy shock.

Since it has no coil and no magnetic field, the Capaswitch is particularly applicable in sensitive magnetic recording and sensing devices. Its ability to operate on single pulses may make it useful in Thyatron circuits, and computers. The negligible power consumption permits closely spaced banks of relays to be used without heat dissipation problems. Priced competitively with other sensitive relays, it may find wide application in calculating and business machines. For additional information, fill out Reader's Service Card and circle 19.



This relaxation oscillator uses an electrostrictive relay as a capacitor. Several units in parallel with separate series resistors might be used in this circuit as a progressive recycling timer. The relay is also applicable to sensitive photoelectric circuits, thermoregulators, digitizers, and thyatron circuits.

INTRODUCING A NEW
TECHNIQUE IN AIRBORNE
THERMOCOUPLE INSTRUMENTATION
WHICH OBSOLETES CRACKED
ICE AND THERMOS BOTTLES

ARNOUX

Thermocouple Reference Junction

Model RJ-8



ARNOUX "hot" reference junctions eliminate the need for obsolete, inaccurate ice baths or cold junction compensation, and require no attention prior to use.

Extremely rugged and compact, these units provide constant 250°F. temperature at the junction of thermocouple wires and copper leads. Regulated within 1.7°F., throughout MIL-E-5272 A ambients.

Models are available for 24 volt d.c. or 115 volt, 60 or 400 cps. Choice of thermocouple materials. Sizes range from 2 to 12 channels.

Write for Bulletin 400.

ARNOUX is headquarters for Temperature
Measurement Equipment, including: Transducers,
Accessories and Custom Engineered Systems.



11924 W. Washington Blvd.
Los Angeles 66, California

Designers and Manufacturers of Precision Instrumentation

CIRCLE 20 ON READER-SERVICE CARD FOR MORE INFORMATION

Advances in RF Calorimetric Power Measurement

Samuel Freedman

Chemalloy Electronics Corp.
Santee, Calif.

CALORIMETRIC techniques are particularly useful and efficient when the frequencies of the energy to be measured become so high that physical dimensions of circuitry or components approach or exceed the wavelength. Some equipment advances are reviewed in this article. Loads for coaxial and waveguide systems are covered.

Liquid-filled, suitably shaped, rf-transparent load structures housed in waveguide or coaxial terminating sections absorb electromagnetic energy quite satisfactorily. They are efficient dummy loads and as rf wattmeters do not build up excessive heat. Thus their stability with time is good. They are suitable for use particularly between 100 and 40,000 Mc at any level of power from a fraction of a watt on up.

If the liquid is circulated in a load, the temperature, due to absorbed rf power, rises and the liquid flow rate is directly related to the power level. The basic equation for water is:

$$\text{Watts} = \frac{\text{Flow in cc/minute} \times \text{temperature rise in deg. C}}{14.334}$$

If the liquid is other than water, then the right-hand terms are further multiplied by the specific heat of the liquid employed. Water has a specific heat of unity. Any other liquid, including contaminated water, will be less than unity. Flow rate in cc/minute multiplied by temperature change in degrees Centigrade and the specific heat (if it is other than unity water) directly computes to calories. Since one calorie is 1/14.334 of a watt, the product of flow rate and temperature rise is divided by 14.334 to get watts.

Advantages of Calorimetric Techniques

The advantages of such loads or wattmeter devices when compared to other methods include:

1. Ability to handle any level of power, particularly the maximum without cumulative heat buildup or excessive temperatures. At very high power levels, it is the only available direct method. Only at very low power do other alternatives favorably compare.

2. Ability to absorb and to measure power at its

natural levels regardless of the magnitude of the average power with respect to its peak power. No directional couplers, attenuators or ratio power takeoffs are necessary. By the load being capable of direct exposure to the rf energy, all mismatches and losses due to transitions or improvisations are absent.

3. The ability to work with any flow rate or with any temperature desired since they are interrelated at all times. The lower the temperature, the higher the flow rate and vice versa.

4. The simplicity of the technique with its apparent accuracy. No special skill or training time are required to attain proficiency in its use.

5. Its performance as well as accuracy can be well understood. Comprising little more than a liquid containing load, a pair of thermometers or temperature sensitive provisions and a flowmeter; the apparatus may be devoid of all circuitry, tubes or electrical consumption.

Types of Calorimeters and Advances

In every case, a calorimeter as used in the measurement and absorption of rf energy normally comprises a load, a means of measuring or comparing temperature between before and after rf exposure of circulating liquid, and a flow indicating device with means of changing flow.



Fig. 1. Complete RF Calorimeter System for water tap operation. Power capability is unlimited. May be used with either waveguide or coaxial lines from vhf to higher frequencies.

The first commercial version, developed in 1948, was for the S band. It utilizes a simple load housed in the waveguide with provisions to connect to two thermometers. By setting a slide rule to the input temperature, the output in watts can be read opposite the output temperature. When operation was needed on a higher frequency band, a tapered waveguide adapter had to be connected between housing containing the load and the higher frequency apparatus. The disadvantages were inability to measure power below the 3000 mc band and the need for adapters, etc. on frequencies higher than 3000 mc. It also requires a perfect flowrate meter and a pair of perfectly matched and calibrated thermometers of same physical dimensions and scaling (which do not exist in practice). As the order of mode increases for frequencies higher than dominant mode 3000 mc band, errors can become increasingly appreciable.

A 1950 refinement had the S Band load reshaped to comprise a coiled section 3 wavelengths long, thence a tip section 3 wavelengths long and finally a wafer section also 3 wavelengths long and located within the coil section. Such a load is very efficient, has a typical VSWR of 1.03 and a typical absorption of nearly 80 db. It was designed to function at the dominant mode or with change of mode with comparable efficiency. Tests have shown this load to have a VSWR below 1.1 from 2600 to 55,000 mc with a minor exception in the 12,000 mc region. The deviation was caused by the connection between tip section and coil section. Its advantages were high efficiency on

change of mode operation as well as dominant mode operation. Its disadvantages were the tendency for air to get into system where thermometers lift out of wells and the high cost of manufacture. Also, tapered waveguide adapters were required for the higher frequency bands. Inability to function below 2600 mc was a limitation.

The thermopile method has been in existence commercially about the same length of time as have thermometer models. The thermopile approach uses multi-fingered bimetallic strips with one set of fingers intersecting water en route to load and the other set intersecting water en route from load. The small electrical changes in the thermocouple are connected to a millivolt meter calibrated in watts. This is normally less sensitive at reduced power and the calibrated power is more approximate.

Thermistors and bridging methods can be employed. Thermistors are normally non-linear devices and need to be carefully selected. Thermometers are more easily used over wider ranges.

Another approach has a divided water path with one branch leading through the load exposed to rf energy and the other branch going through a resistive element into which dc or 60 cycles is applied to create equivalent water heat rise. These two are matched on a null indicator. At the null point, the volts and amperes computed in watts is checked to find the power needed to achieve the match and this is presumed to be the power of the energy source under measurement. This has to presume that equivalent

dc or low frequency ac is equivalent to microwave frequencies and that there is no connector mismatch.

The Chemalloy-Kahl Model SME Calorimeter, first released in 1954 and subsequently refined in details, has many design features. It permits dominant mode operation in waveguide or coaxial cable on all frequencies and for all levels of power, particularly above fractional watts.

Modern Calorimeters

Despite the simplicity of the basic calorimeter concept, the attainment of maximum capabilities at extreme accuracy require excellent physical design and attention paid to critical details. The following description points out some features of modern calorimeters. A complete system with a single liquid control is shown in Fig. 1. It is designed for use with a water tap. Water, in this model, is not recirculated. Another model with a reservoir and cooling unit can be used if a water tap is not available, or if it is not desirable to expend the water.

Some of the various dominant mode loads that are available are shown in Figs. 2 and 3. Eight loads cover the range 2600 to 40,000 mc. The large L-Band load has a dominant mode for the 1100-1700 mc band. To shift from band to band, it is only necessary to snap on a new load. A modern coaxial load removed from its 1-5/8 in. coaxial housing is shown in Fig. 4.

Speed—Supersensitive and instant-responding thermometry detect minute power level changes. These features are achieved by making the mercury reservoir a helical coil, Fig. 2. The mercury column travels in a colored-mirror capillary tube which provides magnification and directivity to prevent reading errors from oblique angles.

Low power—Ability to keep the water circulation continuous even at a flow rate as low as drops per minute permit low power readings. The dewar flask that seals the base of the helical coil of the thermometer makes this feasible. Ten milliwatt measurements have been reported.

The unit can operate also at a zero flow rate to detect feeblest energy as a function of time rather than flow. This is readily done by cutting off the flow. This will cause heat rise cumulatively of the water in load. When the flow is commenced again, the thermometer reads a surge. The magnitude of this surge and its duration can be related to low levels of power.

Flexibility—Ability to both regulate and stabilize the circulating liquid regardless of incoming water pressure variations is accomplished by use of special flow control regulator/stabilizer units with double spring-loaded diaphragms. They can handle up to 150 psi incoming pressure and take it down to as low as 0 psi output.

Flowmeters used are highly accurate, yet the moving float construction is simple. Various scales are ordinarily used. They usually are 0-200 cc/minute for very low power use, 0-500 cc/minute for low-medium power, 0-1000 cc/minute for medium-high power, and



Fig. 2. Calorimeter waveguide loads for dominant mode operation between 2600 and 40,000 megacycles. Thermometer is shown at left.



Fig. 3. L-band waveguide load for use between 1100-1700 Mc. Up to 5 megawatt peak power can be read with water pressure of 5 psi.

0-2000 cc/minute for very high pressurized systems. Zero-10,000 cc/minute and other sizes are also available but become larger and heavier. Flowmeters with 200 and 2000 cc flowrates are identical in size and appearance and weight and are interchangeable.

Load design—Minimum VSWR and also maximum absorption loads are achieved by using a sharp tip flaring out to full i.d. of a waveguide. If this is 6 wavelengths free space (dielectric constant 1) or 54 wavelengths when water filled, the typical VSWR is 1.03 and the typical absorption is 60 db.

Since the dielectric constant of water is 81, the wavelength shortens by the square root of that dielectric constant or 9 times. This makes the water-filled load approximately 54 wavelengths long electrically. In the case of the coaxial load of Fig. 4, the concept is the same except that the o.d. of the inner conductor is considered equivalent to tip of waveguide load.

The lower S Band load shows a double jet at the inner load tip, Fig. 3. This is designed to permit more water circulation at reduced water pressure. For example, enough flow to easily measure 5000 w average power at 5 megawatts peak power is accomplished with less than 10 psi water pressure. In the case of the L Band version, it can be done with less than 5 psi. In practice, less than 10 psi takes care of practically every situation on every frequency band for the powers now used in microwave or radar work.

Glass loads are preferred to plastic ones. Glass has a higher dielectric constant than plastic (about two to one) and heats more than plastic. However, with glass being a good conductor, heat is transferred to circulating water. Plastic, on the other hand is a poor conductor, melts at one-sixth the temperature of glass, and develops cumulative hot spots which destroy the load at high power. Loads absorb power sinusoidally with hot nodal points, particularly in the tip section.

In the case of coaxial loads such as illustrated in Fig. 4, a glass load comprises two water compartments and one hollow compartment. The central hollow tube corresponds to the inner conductor of a coaxial cable and it is metallized on the inside to mate with mating bullet of a coaxial termination. Matching provisions exist in the mating bullet by screw provisions. Concentric to central tube is a second tube which may be used for water inlet traversing to the mating bullet end but with water itself never coming in contact with any metal, being always isolated by a glass wall. Concentric to the second tube and tapering outward to the full i.d. of outer coaxial housing is the return water path. In other respects, the coaxial load connects and operates exactly like the waveguide load with the same calorimeter.

Liquids—Liquids other than water can be used. If the liquid is other than pure water (specific heat unity or 1), an initial comparison may be made by measuring a particular power with fresh water and then with the liquid desired. If fresh water shows 143 calory count for 10, while another liquid shows 146 calories, it means the specific heat of that liquid is $143/146$ ths of 1. Multiplying indicated power by that fraction

gives true power for that liquid. Anti-freeze, chloroform and other liquids have been used either because of low operating space temperature or to get greater sensitivity and temperature response at minimum power. Chloroform with specific heat of 0.234 can be made to read 5 times lower power with same ease because thermometers respond 5 times as high in differential.

Operation

In operation, liquid comes in from water tap or a reservoir unit at whatever higher-than-required pressure available. It is regulated down directly to what is needed in the case of single control for the desired flowmeter indication, Fig. 5. In the case of dual or triple control instruments, the first regulator reduces

it to some intermediate pressure, for example water tap pressure may be 50 psi and the first regulator is preset to take it down to 10 psi. Then the second regulator takes it down to anything needed for the flowmeter scale. The advantage of dual controls in tandem is double regulation. The disadvantage is need for more pressure of water and slight increase in system friction, as well as duplication of control.

From the regulator or reducer, water continues to the flowmeter, thence to the input thermometer to measure temperature before rf exposure. It then goes through the snapon valve-seal fitting to any selected waveguide or coaxial load terminating energy source, and back to the output thermometer for temperature measurement after rf exposure. To complete the cycle, the water is expended, measured in measuring cup

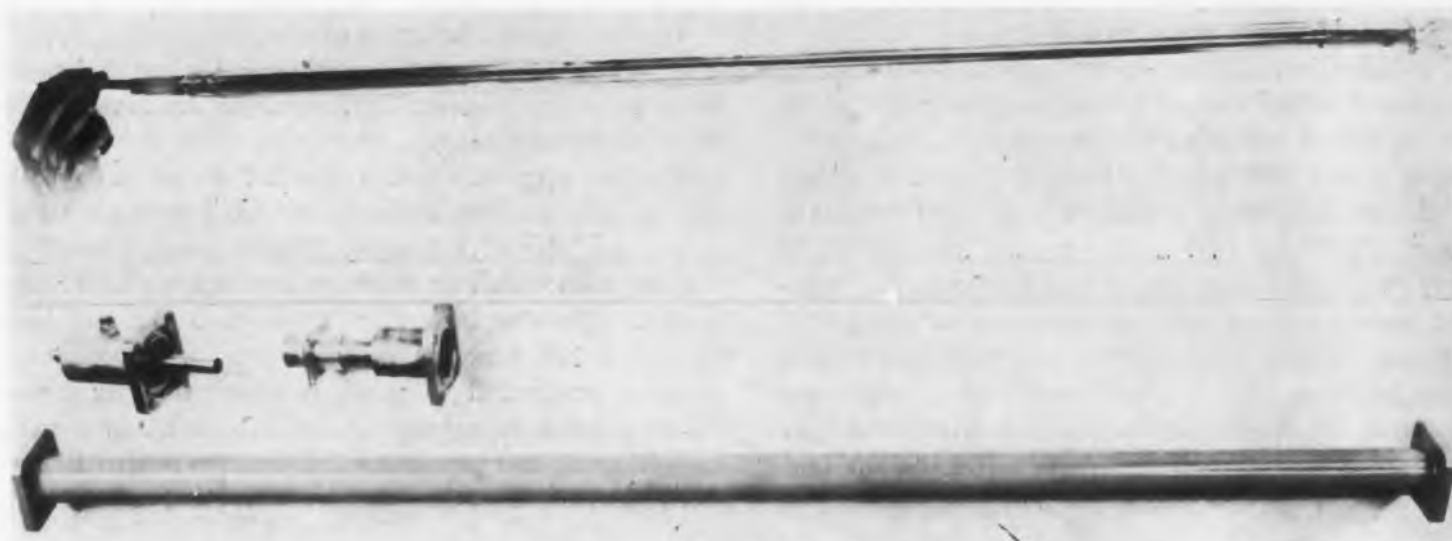


Fig. 4. Coaxial load, top, for use with Model SME Calorimeter is shown outside its 1-5/8 in. coaxial housing, below. Typical fittings are also illustrated.

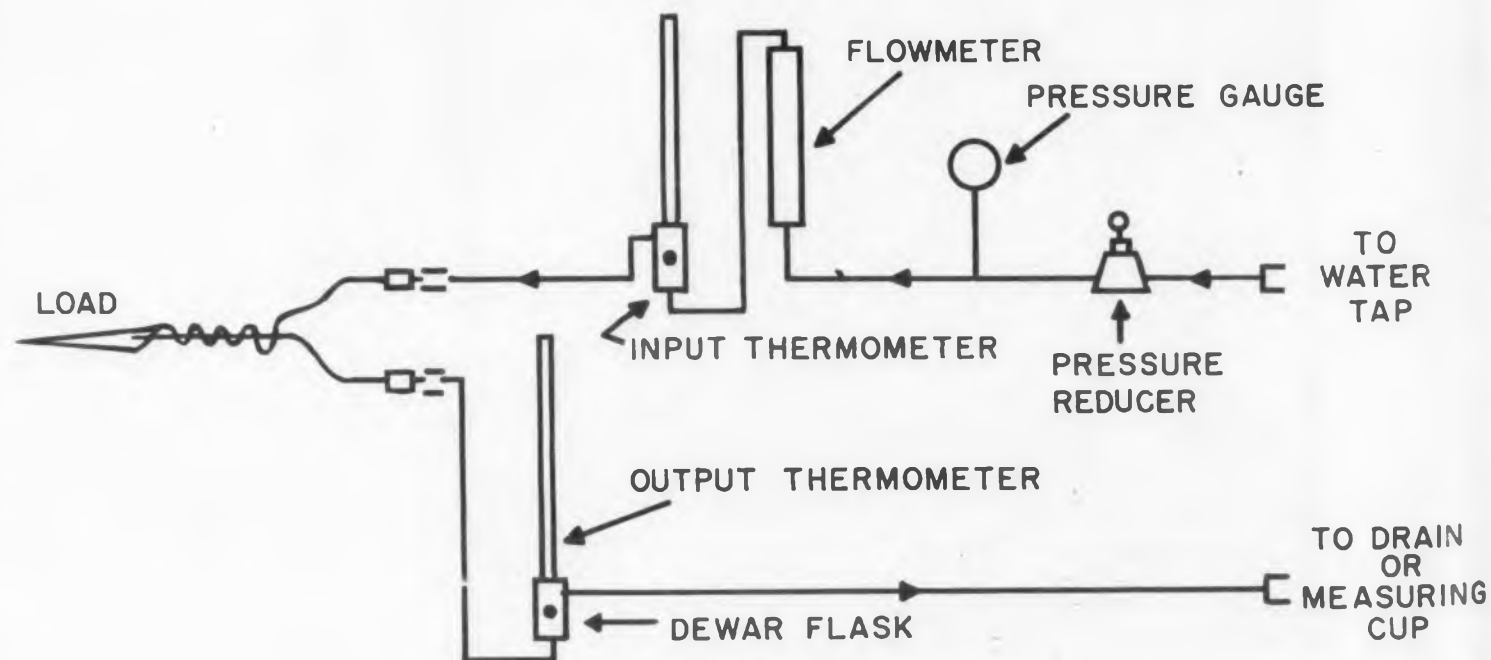


Fig. 5. Diagram of single control Calorimeter. Dual control version has reducer-regulator on each side of pressure gauge. A toggle valve for zero flow can also be added.

or returned to a reservoir/cooling unit for re-use, depending on the model used.

Accuracy

The errors in a calorimeter may total five as follows: **VSWR Error**—A typical load with a VSWR of 1.03 has a loss in power measurement of 0.226 parts of 1 per cent. For low readings, accuracy is approximately 1/2 per cent.

Specific Heat Error—Water contaminated by its path (or initially contaminated) produces an error normally of a magnitude equal to and of a direction opposite to the VSWR error. It will have specific heat less than unity and read high on thermometers. This error balances out VSWR error.

Flowmeter Error—This is accurately determinable by measuring exit water in calibrated measuring cup.

Thermometry—Temperature can be read accurately to a tenth of a division. Thermometer scales are available from 10 to 100 divisions per degree C. Scales greater than 20 divisions per degree are special. Calorimeter thermometers cover usually 10-35 degrees C (20 divisions per degree) for low-medium power, or 10-65 degrees C (10 divisions per degree) for medium-high power use. In practice, temperature reading with helical-type thermometers is accurate to about 0.1 per cent.

Heat Radiation Loss—This loss is minimized by using higher flow rate and lower temperature differential. It can be eliminated by plotting power vs temperature differential for 2 or more flow rates and projecting the graph line resulting therefrom back to zero degrees differential.


Having a typical accuracy of 1/2 to 2 per cent depending on level of power measured with respect to size of a load, the calorimeter approach in practice may be as much as 20 times or more better in accuracy than noncalorimetric devices. Sensitivity and accuracy are, of course, better for higher powers or smaller loads. In a typical test against standard test equipment of many types and manufacture, the Model SME Calorimeter reproduces in calorimeter after calorimeter while dry type test equipment of non-calorimetric principle vary as much as 20 per cent in both directions with respect to the power of energy source.

Standards Instruments

The equipment may be used to check flowmeters, thermometers or specific heat by reverse and equivalent uses of the calorimetric formula. The same apparatus is a temperature standard since this computes to power in calories divided by flow in cubic centimeters per minute. It is likewise a flow standard since this computes to power divided by temperature. It is a power standard since power computes to temperature times flow. Some users make such power-temperature-flow-specific heat standards in their organization with a single calorimeter system having accessory or expanded thermometry and flowmeters.



CONDENSE AND SAVE!

 Plastic condenser block capacitors save you space, labor, money!

Multiple capacitors in one block! Now you can install one capacitor case and use 125% less space than before — at a saving in labor costs of up to 300%.


Let us solve your condenser block problems. Send us your requirements. Many case sizes and configurations are available with polystyrene or MYLAR* dielectric to tolerances as close as 1%.

now after years of intense research and development of military requirements

 offers you **RC NETWORKS**
PITCH FILTERS
INTEGRATOR NETWORKS

RC NETWORK as low as 1/2% capacitors and 1/2% resistors for reliable RC value of 1%.

- Hermetically sealed and potted
- Meets exacting military specifications
- SAVES SPACE & LABOR

 **PRECISION**
DECADE CAPACITORS with attached rotary switch or completely boxed!

Now on special order! Decade capacitors with higher voltage ratings, closer tolerances and capacitance from .001 to 10 M.F.D. with polystyrene or MYLAR* dielectric to tolerances as low as 1%.

CHECK THESE OUTSTANDING FEATURES:

- Standard voltage rating . . . 200 V.D.C.
- Very high insulation resistance
- Low dissipation factor
- Low dielectric absorption
- Small sizes

SOUTHERN ELECTRONICS
Corporation




For your most exacting requirements—
always specify S.E.C.

Wire, write or phone for a complete catalog today!

239 West Orange Grove Ave., Burbank, California

CIRCLE 21 ON READER-SERVICE CARD FOR MORE INFORMATION



Precision WHEATSTONE BRIDGES

**Highest Accuracy... Minimum Size
for Field, Lab, and Production Use**

There's a Shallcross Bridge for measuring resistance to any desired precision—indoors or out. Field models have aluminum cases with controls easily adjustable even with a gloved hand. Models for lab, production, and school use feature high readability and simple operation—even for unskilled users.

Accuracy, Stability, and Ruggedness—unsurpassed in any instrument of comparable price.

Selections from the complete Shallcross line are described below. Additional specifications on these, and many other types, are available from SHALLCROSS MFG. CO., 526 Pusey Ave., Collingdale, Pa.

Deliveries
from
Stock ✓

WHEATSTONE—FAULT LOCATION BRIDGE No. 6100: 5-dial field model. Locates grounds, crosses, opens, and shorts by Murray, Varley, Hilborn, or Fisher Loop and Capacitance tests. Range: 1 to 1,011,000 ohms. Accuracy: $\pm 0.1\%$, + 0.01 ohm. $8\frac{7}{8}'' \times 7\frac{3}{8}'' \times 5\frac{3}{4}''$. 8 lbs. Price: \$175.

KELVIN-WHEATSTONE BRIDGE No. 638-R: Shallcross has pioneered this compact combination of two bridges in one. Range: 0.001 to 11,110,000 ohms. Accuracy: $\pm 0.3\%$ - 1 to 111,100 ohms. $12\frac{1}{2}'' \times 10\frac{1}{2}'' \times 6\frac{3}{4}''$. 9 lbs. Price: \$260.

WHEATSTONE-LIMIT BRIDGE No. 6320: Combines 5-dial Wheatstone and Percent-Limit features. Range: 0.1 to 111,110,000 ohms. Accuracy—Ratio resistors: $\pm .01\%$, Rheostat: $\pm (.01\%$ to $.05\%$ + .005 ohms). $15\frac{3}{4}'' \times 9\frac{1}{4}'' \times 5\frac{1}{2}''$. 15 lbs. Price: \$700.

Shallcross

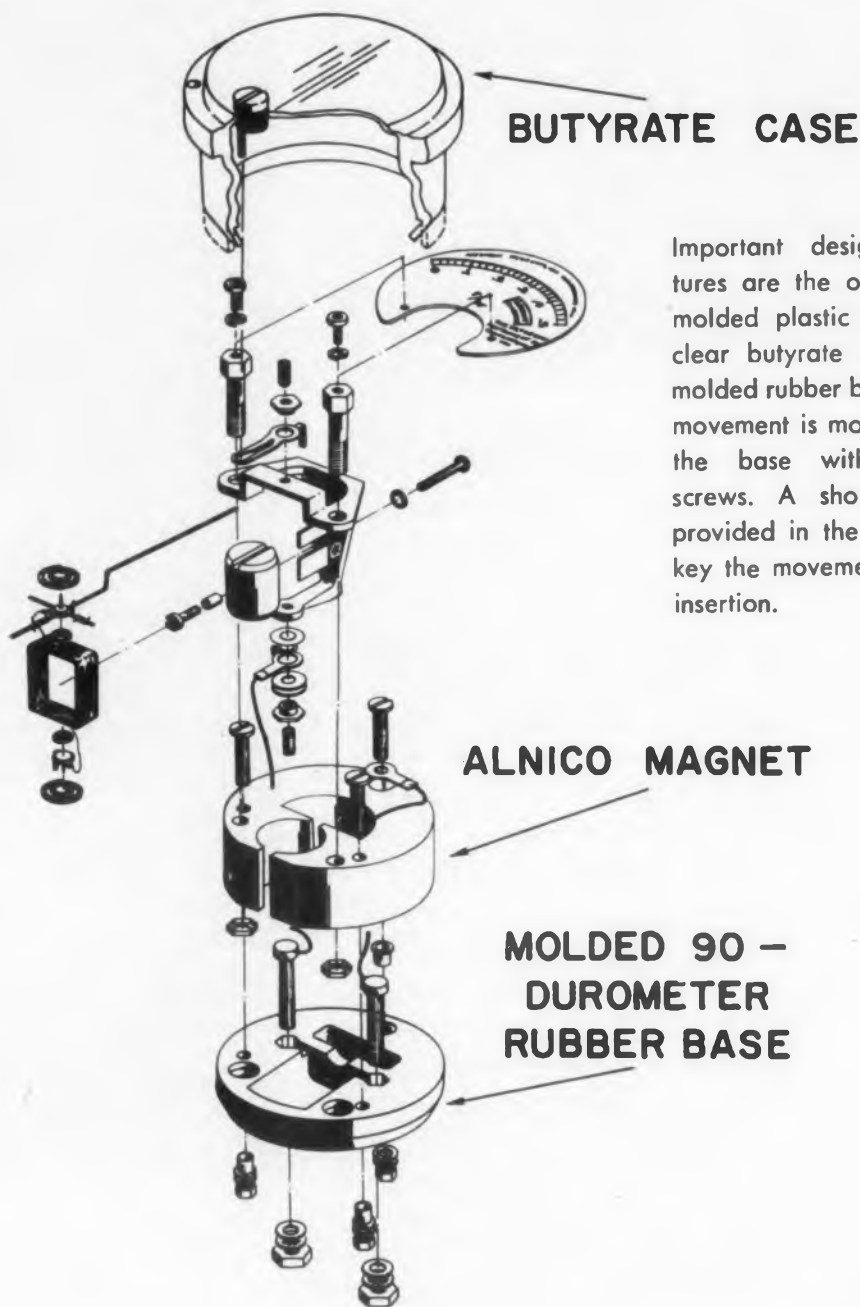
CIRCLE 22 ON READER-SERVICE CARD FOR MORE INFORMATION

Bold Meter Redesign

BY USE of plastics and molded rubber in a carefully engineered design, a highly sensitive panel meter has been made extremely rugged, yet with actual cost reduction in its manufacture. It features a one-piece molded plastic case of clear butyrate, including the lens and flange but not the back. Butyrate was chosen because of its flexibility and "give" under shock.

This design, by engineers John Saint Amour, Bob Jones, and George Hammond, of Assembly Products Inc., Chesterland, Ohio, produced a meter completely sealed from the front. The only possible leakage point was the zero adjuster, which was rubber-gasket-sealed.

Use of butyrate raised the problem of static electricity, however. To prevent static charges from disturbing the meter readings, the butyrate is treated with a special liquid compound that renders it non-static.



Important design features are the one-piece molded plastic case of clear butyrate and the molded rubber base. The movement is mounted in the base with small screws. A shoulder is provided in the case to key the movement upon insertion.



The entire base of the meter, upon which the movement is mounted by means of small screws, is molded 90-durometer rubber without metal inserts. This is believed to be the first all-rubber base ever used in an indicating meter. The base has a beveled outer edge. After the case is slipped over the rest of the meter, the base end of the case is sealed to the rubber by a special machine that first crimps the case, by means of controlled heat, to the beveled edge of the rubber.

Inexpensive glass jewels, made shock resistant by rubber backing, are used instead of the usual sapphire jewels.

Special coil cementing and baking techniques were developed so that the coil can be used without the aluminum bobbin on which it is originally wound. The free-standing coil, obviously much lighter than it would be if the bobbin had not been removed, will withstand a four-pound crush test. The bobbin is Teflon coated, so that the wire and cement will not stick to it when it is removed after the coil is baked.

Further design features include making the pointer and balance arms a single piece of stamped brass, instead of the conventional two or three separate pieces that are more expensive and not as strong; redesigning the balance weights on the moving coil so that they now screw on instead of being pushed on; and deliberately setting the pivot axis off-center on the coil so that balancing time can be cut to a minimum. This latter feature permits making the tail piece weight smaller than usual (less than one-third conventional size) and using only one cross-arm weight instead of two.

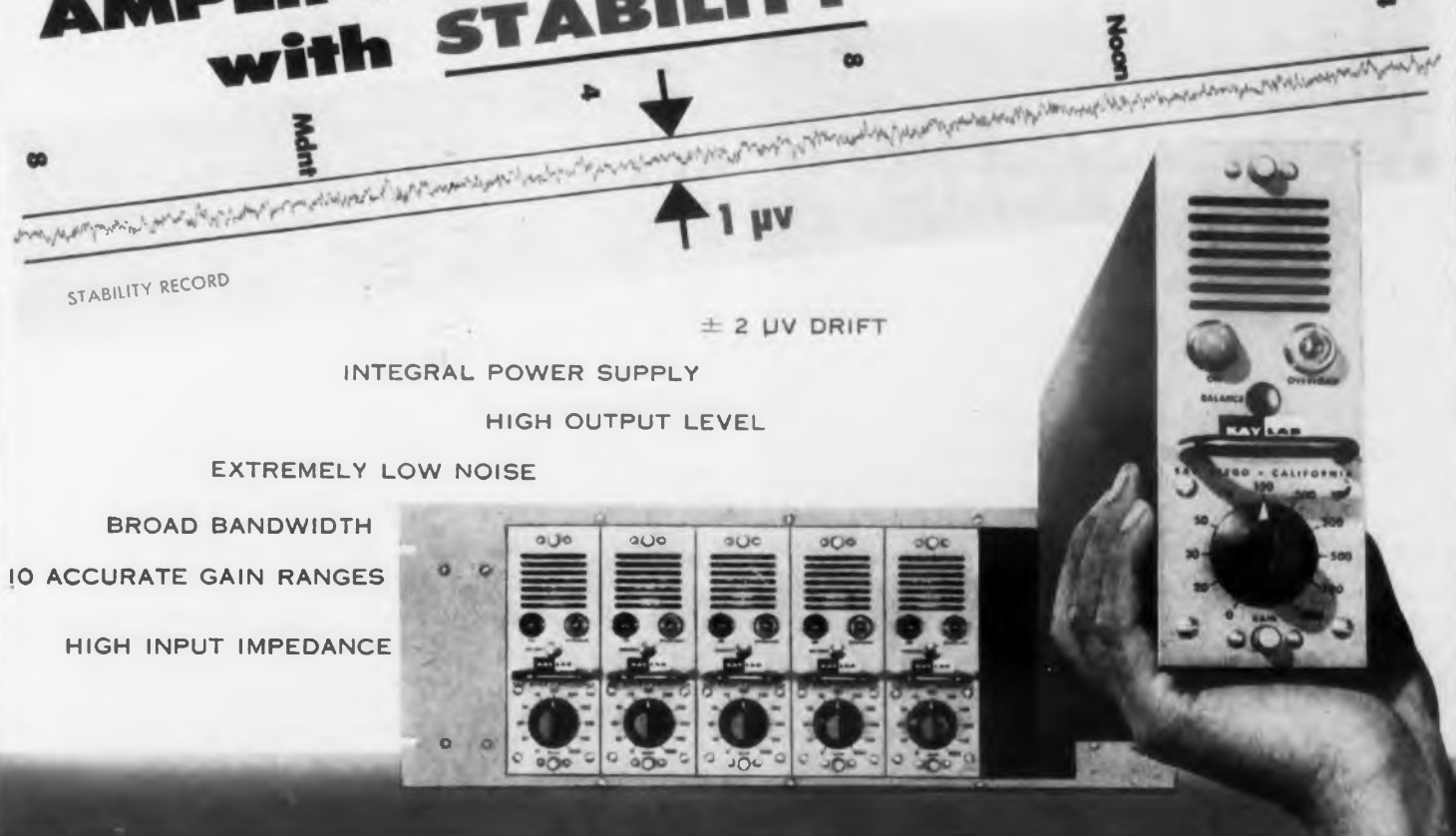
To translate the design improvement into volume production, the company developed "assembly line" techniques including a conveyor belt. Such an arrangement has been rare in an industry where the emphasis is on skilled precision work. For more data turn to Reader's Service Card and circle 23.

KAY LAB

CALIFORNIA

FOR DRIFT-FREE DC INSTRUMENTATION

**AMPLIFY MICROVOLTS
with STABILITY**



The **KAY LAB** Model 111 amplifier provides maximum stability and the lowest drift of any commercially available broadband d.c. amplifier. It is the end result of years of research in the field of chopper stabilized broadband d.c. amplifiers. Thousands of **KAY LAB** amplifiers are in daily use.

The Model 111 incorporates **KAY LAB's** proven chopper amplifier circuitry and provides ten extremely precise, feedback controlled gain ranges. Several feedback loops assure high accuracy, stability and uniform frequency response. The completely new and unique circuit provides rapid recovery from severe overloading and unsurpassed dynamic performance — unaffected by load or gain changes.

The Model 111 is available in a single-unit cabinet or in a six-unit rack-mountable module. The amplifiers are extremely compact, the six-unit module occupies only a 19-inch rack width.

APPLICATIONS: The Model 111 is ideal for permanent low level d.c. instrumentation, telemetering, or as a strain gage amplifier, transducer amplifier, scope preamplifier, recorder driver amplifier, or general purpose laboratory amplifier.

SPECIFICATIONS

Gain	0, 20, 30, 50, 70, 100, 200, 300, 500, 700, 1000	Power Requirements:	
Gain Accuracy	± 1% DC to 2 KC	Amplifier	117 V — 60 cycles — 70 VA
Input Impedance	100,000 Ω	Cabinet	117 V — 60 cycles — 15 VA
Output Capability at DC	0 to ± 35 V where $R_L > 1000 \Omega$ 0 to ± 40 MA where R_L is 10 to 400 Ω	6 Unit Rack Adaptor	117 V — 60 cycles — 45 VA
Output Impedance	Less than 1 Ω in series with 25 μh	Dimensions: Amplifier Unit	2 7/8" wide, 7 3/4" high, 1 3/4" deep
Equivalent Input Drift	± 2 μv with regulated line	Rack Adaptor for 6 Units	19" wide, 8 3/4" high, 1 3/4" deep
Equivalent Input Noise	0 to 3 cps, less than 5 μv peak to peak 0 to 750 cps, less than 5 μv RMS 0 to 50 kc, less than 12 μv RMS	Net Weight — Amplifier	11 pounds
Chopper Intermodulation	Less than 0.1%	PRICE: Amplifier Unit	\$550.00
Linearity	Better than 0.1% to 2 KC	19-inch Rack Adaptor for 6 amplifier (with fans and connectors)	200.00
Frequency Response	± 3% (0.3 db) DC to 10 KC, less than 3 db down at 40 KC	Cabinet for single amplifier (with fan and connector) is available.	

... the Standard in chopper-stabilized instruments

KAY LAB

Representatives in all major cities.

STABILITY



locked in!

WITH CHOPPER AMPLIFIERS

5725 KEARNEY VILLA ROAD, SAN DIEGO 11, CALIFORNIA · BROWNING 7-6700.
CIRCLE 24 ON READER-SERVICE CARD FOR MORE INFORMATION

E and I Regulation With Non-linear Resistors

Gene J. Hegedus

Hughes Aircraft Co.
El Segundo, Calif.

USE OF proper elements in a simple bridge circuit can solve the problem for a constant voltage source. The circuit described here is equally effective for regulating ac or dc voltages, introduces no phase shift or distortion on ac, and is not frequency sensitive.

In the Wheatstone bridge (Fig. 1) the output voltage is proportional to input if the "r" values differ from the "R" values and if linear resistances are employed. It will be shown, however, that if the "r" elements are non-linear resistors, the output can be held essentially constant with quite wide input voltage variations.

For optimum regulation, proper selection of values for r and R is necessary. To determine what these values should be, it is necessary to express the Wheatstone bridge output in terms of its input. To facilitate this, the circuit is redrawn as in Fig. 2.

It has been found that an incandescent bulb, Fig. 3, can be used for "r" if properly selected. Such a bulb will behave according to the curve of Fig. 4.

$$\frac{\Delta I_r}{\Delta r} = \lambda; \text{ or } \Delta I_r = \lambda \Delta r$$

For constant slope (occurring over top $\frac{1}{3}$ of curve),

$$I_r = \lambda r$$

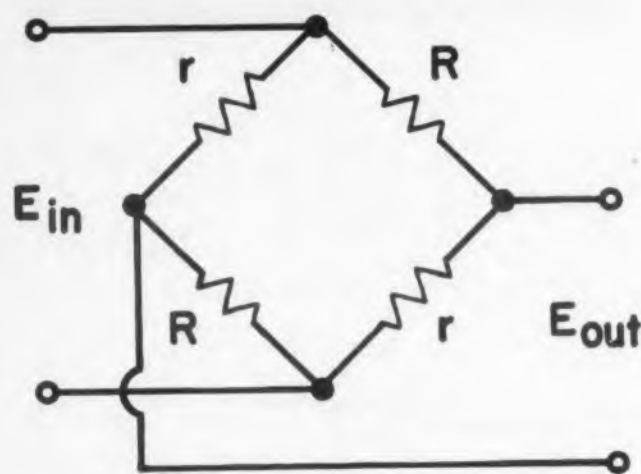


Fig. 1. In this Wheatstone Bridge circuit, if $R = r$, E_{out} is proportional to E_{in} . By selecting r values with proper non-linear characteristics, E_{out} can be held constant with wide variations of E_{in} .

$$\text{also, } I_r = \frac{e}{r} \text{ (From Fig. 2); } \lambda r = \frac{e}{r};$$

$$r^2 = \frac{e}{\lambda}; \quad r = \frac{\sqrt{e}}{\sqrt{\lambda}} \quad (1)$$

$$\text{From Fig. 2, } e = E_{in} \frac{r}{R+r}$$

$$\text{Substit. (1) for } r, \quad e = \frac{E_{in} \frac{\sqrt{e}}{\sqrt{\lambda}}}{R + \frac{\sqrt{e}}{\sqrt{\lambda}}} \quad (2)$$

$$\text{Expanding (2), } \frac{e \sqrt{e}}{\sqrt{\lambda}} + eR = \frac{E_{in} \sqrt{e}}{\sqrt{\lambda}}$$

$$M\sqrt{\lambda}, \quad e \sqrt{e} + e \sqrt{\lambda} R = E_{in} \sqrt{e}$$

$$e + \sqrt{e} \sqrt{\lambda} R - E_{in} = 0$$

Solving for \sqrt{e} ;

$$\sqrt{e} = -\frac{\sqrt{\lambda} R}{2} \pm \sqrt{\frac{\lambda R^2}{4} + E_{in}}$$

Squaring both sides,

$$e = \frac{\lambda R}{4} - \frac{2\sqrt{\lambda} R}{2} \sqrt{\frac{\lambda R^2}{4} + E_{in}} + \frac{\lambda R^2}{4} + E_{in}$$

From which,

$$e = -\sqrt{\lambda} R \sqrt{\frac{\lambda R^2}{4} + E_{in}} + \frac{\lambda R^2}{2} + E_{in} \quad (3)$$

From Fig. 2,

$$E_R = E_{in} \frac{R}{R+r} = E_{in} - e$$

Therefore,

$$E_{in} \frac{R}{R+r} = \sqrt{\lambda} R \sqrt{\frac{\lambda R^2}{4} + E_{in}} + \frac{\lambda R^2}{2} + E_{in}$$

$$E_{out} = E_{in} \frac{R}{R+r} - e$$

$$= 2\sqrt{\lambda} R \sqrt{\frac{\lambda R^2}{4} + E_{in}} - (\lambda R^2 + E_{in}) \quad (4)$$

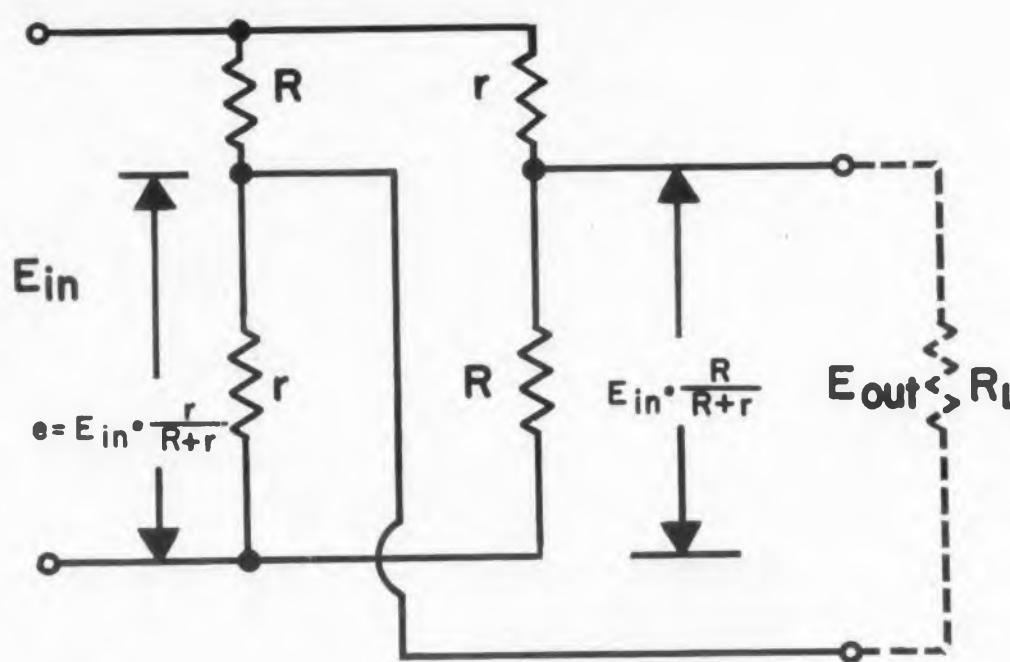
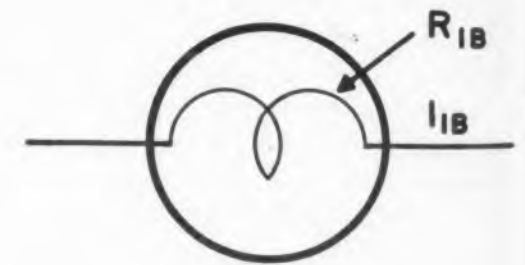


Fig. 2. Bridge circuit of Fig. 1 redrawn to facilitate analysis.



INCANDESCENT BULB

Fig. 3. Regulating bridge element "r"; a non-linear resistance. Resistance, R_{IB} , is almost directly proportional to the current flowing through it, I_{IB} , over the range of 0.65 to full rated current.

Selecting Optimum Values

The values of R and E_{out} should be selected which allow the smallest possible change in E_{out} with variations of E_{in} . Investigation shows this to be:

$$R_{optimum} = \sqrt{\frac{4 E_{in}}{3 \lambda}} \quad (5)$$

$$E_{out} = \frac{E_{in}}{3} \quad (6)$$

Using the incandescent lamps for "r", and providing a voltage drop across them of 2/3 normal value, the bridge input voltage, E_{in} , should be twice their nominal value. The regulation for the unloaded bridge under such conditions is then:

$$\frac{\Delta E_{out}}{E_{out}} = \left(\frac{3}{4} \frac{\Delta E_{in}}{E_{in}} \right)^2 \quad (7)$$

A variation of 5% in E_{in} will cause a variation in E_{out} of approximately 0.14%. Better regulation occurs when the bridge is loaded. For best regulation under load the ratio of load currents to currents in the legs of the bridge should be as small as possible. In no case should this ratio exceed 0.20.

Under loaded-bridge conditions R will necessarily be different than the no-load R .

$$R_{(loaded)} = \frac{R_L R_{(no-load)}}{R_L - \frac{R_{(no-load)}}{2}} \quad (8)$$

Where R_L is the value of load resistor desired.

Use of Formulae

A typical problem would be the determination of components for a regulated 80 v supply working into

a 10,000 ohm load. Line voltage is 240 nominal. Solution: Select an incandescent lamp for "r" of 120 v nominal rating (about half the bridge input voltage) and 40 ma or more current rating. A 10 w lamp will do nicely. Its nominal current value is 83 ma.

$$\lambda = \frac{I_r^2}{E_r} = \frac{0.083^2}{120} = 0.0000575$$

$$R_{(no-load)} = \sqrt{\frac{4 E_{in}}{3 \lambda}} = \sqrt{\frac{4 (240)}{3 (0.0000575)}} = 2375 \text{ ohms}$$

An R_L of 10,000 ohms is all right since, with 80 v across it, 8 ma will flow.

$$R_{(loaded)} = \frac{R_L R_{(no-load)}}{R_L - \frac{R_{(no-load)}}{2}} = \frac{10,000 (2375)}{10,000 - \frac{2375}{2}} = 2700 \text{ ohms}$$

For good regulating action, it is necessary for the two lamps to be matched. For matching, use the circuit shown. Select lamps that have the same voltage drop across them as indicated by the lamp balance voltmeter in Fig. 5.

To compensate for commercial tolerances in components and to adjust the bridge output to a specific value, adjust the values of the linear resistors "R". These should have a good temperature coefficient and be non-inductive.

Results

Developed by empirical methods, this bridge will keep its output constant with comparatively large changes in line voltages and can be used over a wide range of frequencies if the "R" components are non-inductive. The only limitation is due to the thermal inertia of the lamp filaments; because of this, it is not possible to compensate for fast transients.

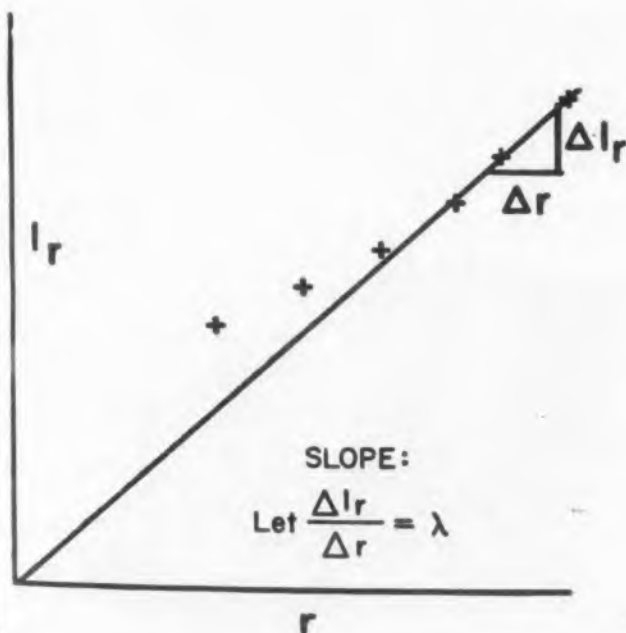


Fig. 4. Characteristic of incandescent lamp upon which calculations are based.

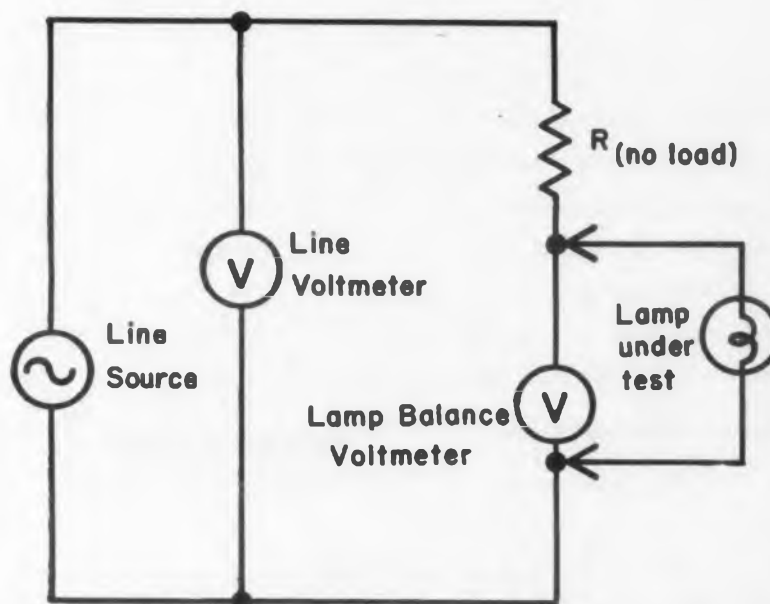



Fig. 5. Lamp matching circuit. The two "r"s must be properly matched for best regulation.

Model
SG 132



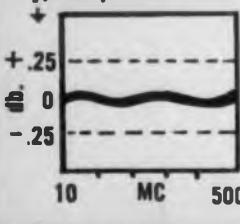
PRECISION VHF-UHF SWEEP GENERATOR

Combines all the essential features of a Standard CW and AM Signal Generator and a Wide Band Sweep Generator of unusual characteristics.

OUTSTANDING FEATURES

- Center frequency range — 15 to 400 mc, fundamental
- FM deviation 1 to 40% at any center frequency
- Internal crystal markers accurate to ± 0.01%
- Dial accuracy 0.01% crystal corrected, 0.5% nominal
- Calibrated output ± 1 db, 0.1 to 150,000 μV
- Integral D.C. coupled Oscilloscope
- Power output variation ± 0.25 db

Typ. Output Variation



TRANSITRON, INC.



186 GRANITE ST., MANCHESTER, N.H.
Subsidiary of Van Norman Industries Inc.

Model
T 4



HIGH VOLTAGE INSULATION TESTER

A precision instrument designed for insulation leakage resistance measurements and non-destructive breakdown tests on motor windings, ignition systems, wiring harnesses, insulators, connectors, electrical and electronic components, etc.

OUTSTANDING FEATURES

- 1 to 15 KVDC, continuously adjustable
- All meters protected against overload
- Measures actual leakage current
- 115 VAC, 6, 12 or 24 VDC Input
- Makes measurements rapidly; no capacity errors

POSITIONS AVAILABLE FOR QUALIFIED ENGINEERS

CIRCLE 25 ON READER-SERVICE CARD FOR MORE INFORMATION

1957
DEPENDABILITY
 1958
 1959
Guaranteed for 5 years
 1960
 1961



The best guarantee in the business!
 The 401 is so dependable, we're
 backing it with a *five year guarantee*
 on all printed wiring and power transformers
 . . . and, all other components, including
 the cathode-ray tube, carry a
 full one-year guarantee.

DU MONT
 401

- **IDENTICAL X- AND Y- AMPLIFIERS:** Sensitivity, 10 mv/cm. Sinewave response extends flat from dc to 150 kc. Calibration standards built-in for both amplifiers.
- **SWEEPS:** 18 calibrated ranges extending from 50 ms/cm to 4 us/cm. 3 times sweep expansion available.
- **RELATIVE PHASE SHIFT BETWEEN AMPLIFIERS:** Easily set for less than 1° at frequencies below 150 kc.
- **CATHODE-RAY TUBE:** Tight tolerance Type 5ADP-, operated at 3000 volts acceleration.
- **STABLE OPERATION:** Regulation of all power supply potentials, including heaters, provides complete stability.

Best buy in the medium price range—a general-purpose, low-frequency oscillograph for complete, high-quality quantitative measurement. The 401 offers a new high in precision, ease of operation and convenience as a result of “human engineering”—an exclusive of the Du Mont 400 philosophy of instrument design.

WRITE FOR DETAILS.

\$420.00

(slightly higher for 50-cycle areas)

DU MONT®

One of the **400** Series

TECHNICAL SALES DEPARTMENT, ALLEN B. DU MONT LABORATORIES, INC. • CLIFTON, N. J.

CIRCLE 26 ON READER-SERVICE CARD FOR MORE INFORMATION

Close Tolerance Snap-Action Thermostat

SNAP action, a setting tolerance of ± 3 F or better, and a differential of 3 F or better combine to make this precision set, sealed thermostat reliably useful for critical applications. Contacts are either ON or OFF; the mechanical construction of the unit assures high sensitivity, within the range of 50 to 300 F. The thermostat has a non-inductive capacity of 40 w at 30 v ac-dc, 100 w at 120 v ac-dc. Miniature in size, the 3/8 in. diam capsule is only 15/16 in. long.

The cross-section view shows the operation of the friction coupled, snap-action principle. Pointed screw A is mounted on a bimetal strip B. The duranickel strip C carries the moving contact D away from the fixed contact E. The bimetal warps from the heat uniformly until A touches C. Motion is stopped until enough heat energy is stored in the bimetal to overcome the starting friction. When this energy is released suddenly, the point A moves slightly across strip



Shown is a partially-assembled crystal oven with thermostat mounted and wired for operation as used by Bulova.



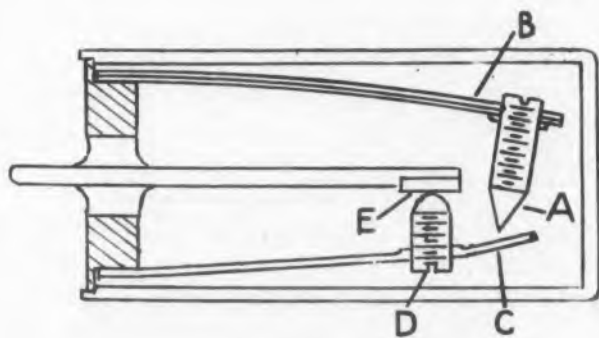
High "g" shock resistant, miniaturized, snap-action thermostat, Model VAL 90.

C. Simultaneously, contact *D* moves away from contact *E*, and the circuit opens sharply.

The thermostat, manufactured by Valverde Laboratories, 252 Lafayette St., New York 12, N. Y., is housed in a vitamin-pill-sized brass capsule whose header body is one terminal. The other terminal is the pin in a compression-type hermetic header.

Each unit is given an accelerated 2-day life test before shipment from the factory. Useful life of the thermostat is stated as a minimum of 1 yr. of continuous operation. The device has withstood endurance tests for one year's continuous cycling. The differential cycle takes a little more than a minute, totalling about a half-million cycles a year. In addition, exposure to high "g" shock does not cause thermostatic chatter.

For additional information about this product, fill out the Reader's Service Card and circle 27.



Cut-away view of sealed thermostat, showing screw adjustments. Customer temperature level specifications are satisfied accordingly.



For a wide range of requirements

PIN TYPE Capacitors

*Designed for upright mounting in

PRINTED CIRCUITS

Rely on the experience of Good-All in supplying millions of capacitors for printed circuit use to the nation's leading manufacturers of:

TELEVISION • HOME RADIOS • BUSINESS MACHINES
AUTO RADIOS • TEST EQUIPMENT • MILITARY COMPUTERS

Case Style (Illustrated at Right)	TYPE DESIGNATIONS			
	Paper Dielectric		Mylar Dielectric	
	Type No.	Application Notes	Type No.	Application Notes
A	503PM 522PM	Paper dielectric designs are in most common use for general purpose applications. Types in the 503 "Marbelite" series are impregnated with solid plastic. Types in the 522 "Miracle X" series are oil impregnated.	620PM	Mylar dielectric is most often used where small physical size is essential. Also important, however, are such properties as high IR, low power factor, and stability with life. *Du Pont's trade mark for their Polyester Film
B	503PS 522PS		620PS	
C	503E		600UPE	
D	503PB 522PB		620PB	
E	503PBK 522PBK		620PBK	
F	All ceramic disc types are available with leads spaced and cut to special dimensions. Good-All epoxy coated discs are ideal for printed circuit use because of the physical and electrical ruggedness of the coating material.			

Take advantage of these quality features of Good-All Pin Types:
Accurately spaced leads • Lead treatment to make soldering easy
Rugged, moisture-resisting case construction • Secure bonding to the leads and case • Conservatively designed capacitor elements.

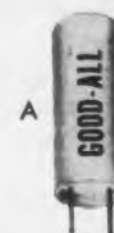
Write or phone for consultation on specific design problems or to secure detailed specifications on the various capacitor types shown.



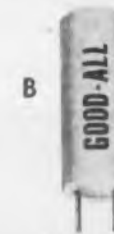
GOOD-ALL ELECTRIC MFG. CO. OGALLALA, WYOMING

A LEADER IN THE FIELD OF TUBULAR CAPACITORS

CIRCLE 28 ON READER-SERVICE CARD FOR MORE INFORMATION



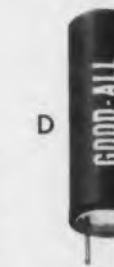
**PLASTIC
IMPREGNATED
PAPER CASE**



CERAMIC CASE



MOLDED IN EPOXY



**MOLDED MARBELITE
CASE** (Impregnated)



**MOLDED MARBELITE
CASE** (With locking tabs)



**EPOXY COATED
CERAMIC DISCS**

WHY SETTLE FOR LESS?

WHEN YOU SPECIFY POWER SUPPLIES

... you are entitled to all of the benefits of complete facilities, thoroughly experienced engineers, wide product range, prompt delivery and competitive prices.

WHY SETTLE FOR LESS?

Take a standard DC requirement, anywhere between 6 and 1000 volts. You need a good, reliable standard DC source — you want to be able to install it and forget it. You want it promptly and, since it's a standard item, you want it for a reasonable price.

If you investigate Sorensen's "Nobatron" group — more than 70 models available "off the shelf" — and look a bit deeper than the electrical and mechanical specs, here's what you'll find:

*Reg. U.S. Pat. Off. (NO BATTERIES — ELECTRONIC CONTROL)

THE OUTSIDE APPEARANCE —



clean, functional, careful attention to small details. Not always vital, but indicators of quality design, workmanship, and materials.

NEAT, UNCLUTTERED WIRING —



firm, long lasting connections — hallmark of skilled people. You don't learn this workmanship overnight, but it's the key to a reputation for precision.

THE ACCUMULATED EXPERIENCE OF SORENSEN'S ENGINEERING STAFF —



specializing in power control — a more than 312 man-year. That means less "newbie messing" and engineering time, faster delivery, lower cost, and better work.

INSIDE TOP QUALITY COMPONENTS —



rugged construction — sound engineering proved by tens of thousands of successful units.

IF WE CAN MAKE A COMPONENT BETTER, WE DO



If somebody else can do it better, more economically and faster — like we make power supplies — we buy it. Either way, it means better quality for you.

OUR SALES ENGINEERING STAFF AND MANUFACTURERS REPRESENTATIVES



work together to put all of their facilities, all of their experience, at your immediate disposal. All it takes is a phone call.

"Don't just buy a power supply." Member of a precision regulated power source control job, or a standard low cost unit, start with Sorensen.



SORENSEN & COMPANY, INC. 375 FAIRFIELD AVE., STAMFORD, CONN.

"The authority on controlled power for research and industry"

In Europe, contact Sorensen-Ardag, Eichstrasse 29, Zurich, Switzerland, for all products including 50 cycle, 220 volt equipment.

CIRCLE 29 ON READER-SERVICE CARD FOR MORE INFORMATION

Determining Optimum Temperature Compensation

Ray Kozinsky

Design & Application Engineer
General Electric Co.
Detroit, Mich.

Network Component Multipliers for Temperature Compensation

Temp°C	+150	+120	+100	+85	+70	+50	+35	
-60	r_t	1.64	0.70	0.38	0.34	0.21	0.20	0.09
	r_s	0.82	0.70	0.63	0.57	0.52	0.50	0.43
	$r_{ave.}$	1.52	1.37	1.28	1.25	1.18	1.17	1.07
	% Dev.	5.45	5.12	4.42	3.55	3.05	2.13	1.81
-40	r_t	3.26	1.33	0.91	0.53	0.30	0.28	0.17
	r_s	0.82	0.66	0.61	0.53	0.50	0.46	0.41
	$r_{ave.}$	1.60	1.43	1.36	1.28	1.21	1.19	1.12
	% Dev.	3.82	2.80	2.44	1.83	1.65	1.17	0.73
-20	r_t	2.80	1.82	1.11	0.79	0.49	0.46	0.24
	r_s	0.70	0.61	0.56	0.53	0.49	0.46	0.40
	$r_{ave.}$	1.53	1.43	1.36	1.32	1.25	1.23	1.15
	% Dev.	3.22	1.69	1.44	1.2	0.97	0.55	0.35
0	r_t	4.13	2.43	1.65	1.01	0.72	0.43	0.25
	r_s	0.69	0.61	0.55	0.51	0.48	0.43	0.41
	$r_{ave.}$	1.57	1.47	1.40	1.33	1.29	1.22	1.16
	% Dev.	1.76	1.24	0.86	0.76	0.63	0.36	0.31
+20	r_t	4.11	3.55	2.15	1.56	0.95	0.64	0.26
	r_s	0.69	0.59	0.54	0.52	0.48	0.43	0.43
	$r_{ave.}$	1.56	1.51	1.43	1.38	1.31	1.26	1.17
	% Dev.	1.75	0.78	0.57	0.49	0.37	0.17	0.11

Network Terms:

R_c = Copper component
 R_t = Thermistor, grade 2
 R_s = Shunt resistance (low temperature coefficient material such as manganin, cupron, etc.)
 $R_{ave.}$ = Average network resistance
 % Dev. = Percent deviation from average network resistance.

Per Unit Circuit Terms:

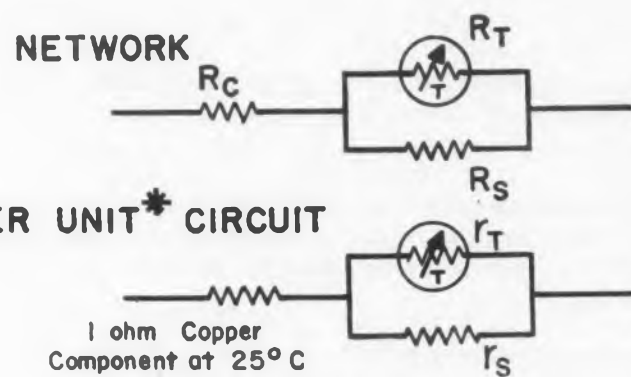
r_t = per unit thermistor, grade 2, resistance at 25 C, ohms.
 r_s = per unit shunt resistance at 25 C, ohms.
 $r_{ave.}$ = per unit average circuit resistance over temperature range, ohms.

ONE OF the time-consuming problems in applying a temperature compensator, like a Thermistor, in electrical circuits is the determination of the best level of temperature compensation that can be obtained over large temperature ranges. A trial and error approach is usually made which involves checking several networks before arriving at an acceptable solution. Following such an approach, there is no guarantee of a correct optimum solution. Also, since each problem involves a different resistance temperature requirement, a previous solution cannot be used.

The table presented here simplifies the task of applying Thermistors for temperature compensation of copper components. It saves time and facilitates compensator selection by reducing every problem into a "building block," which can then be used with a multiplier to arrive at a good solution for a given temperature range. This table is reduced to a per unit basis (a 1 ohm copper component) and applies to grade 2 Thermistors. It indicates directly the maximum deviation from average of any selected temperature range, and permits rapid selection of components for Thermistor temperature compensation networks.

In employing the table, the indicated figures for a selected temperature range are simply multiplied by the actual copper resistance measured at 25 C to obtain the required values (except the per cent deviation, which remains the same).

For example, if a 900 ohm copper coil (at 25 C) is to be compensated for the temperature range of minus 60 to plus 85 C, one simply multiplies by 900 the figures in the square at the intersection of the minus 60 C and plus 85 C columns in the table, excluding per cent deviation. Thus the resistance of the grade 2 Thermistor should be 306 ohms at 25 C, and the resistance of the low temperature coefficient shunt (such as manganin, cupron or other) should be 513 ohms. The percent deviation from the 1125 ohm average circuit resistance should not exceed 3.55 percent. The table can be used for any given resistance within a specified temperature range.



$$R_a = r_a \times R_c \quad R_t = r_t \times R_c$$

$$R_{ave.} = r_{ave.} \times R_c$$

% Dev. = read directly from Table

* based on a 1 ohm copper component

absorb SHOCK like a stack of cushions

Components must be *more* than tough to stand up under the punishment to which ground support equipment is subjected. That's why WESTON Ruggedized instruments are favorites for applications when severe shock and vibration are encountered . . . as well as for mobile equipment requiring instruments that will continue functioning—*accurately*—through shock, vibration, moisture, or temperature extremes. AVAILABLE IN ALL REQUIRED SIZES, IN A-C, D-C, RF AND THERMO TYPES. For the complete story on Weston Ruggedized instruments, or on other instruments for panel, laboratory, production or servicing needs, consult your nearest Weston representative, or write Weston Electrical Instrument Corp., Newark 5, N. J.



WESTON
Ruggedized
PANEL INSTRUMENTS



CIRCLE 30 ON READER-SERVICE CARD FOR MORE INFORMATION

INDEX OF ARTICLES

JULY 1, 1956 — DEC. 15, 1956

Components

Amplifiers—Aug. 1, 102; Aug. 15, 48; Oct. 15, 48; Nov. 15, 132
 Capacitors—Aug. 1, 104; Dec. 1, 28
 Computers—Oct. 15, 58
 Connectors—Jul. 15, 106; Oct. 1, 26
 Converters—Jul. 15, 36
 Counters—Aug. 15, 46; Sept. 1, 38
 Crystals—Oct. 1, 100
 Delay Line—Oct. 1, 30; Nov. 15, 32
 Electrostatic Loudspeakers—Sept. 1, 30
 Ferrite Devices—Aug. 1, 32; Nov. 15, 134
 Integrator—Dec. 1, 22
 Lacing—Jul. 1, 32
 Lock Washer—Sept. 15, 46
 Modular Units—Oct. 15, 56; Dec. 1, 32
 Motors—Oct. 1, 43
 Probes—Sept. 15, 44
 Quality Acceptance—Sept. 15, 118; Nov. 1, 98; Dec. 1, 100
 Radios—Aug. 1, 24; Oct. 15, 38
 Relays—Jul. 15, 28; Aug. 15, 36; Aug. 15, 42; Nov. 15, 22; Dec. 15, 24
 Resistors—Sept. 15, 42; Nov. 15, 136
 Survey—Jul. 1, 50; Jul. 15, 48; Aug. 1, 106; Aug. 15, 116
 Switches—Sept. 1, 44; Dec. 1, 28
 Thermistors—Oct. 15, 34; Dec. 15, 36
 Thermostat—Dec. 15, 34
 Transducers—Aug. 1, 26; Sept. 1, 42
 Transformers—Nov. 15, 26
 Transistors—Jul. 1, 38; Jul. 1, 40; Jul. 1, 50; Sept. 1, 26; Sept. 15, 116; Nov. 1, 24; Nov. 1, 48
 Transmitter—Oct. 15, 64
 Tubes—Aug. 15, 40; Sept. 1, 40; Oct. 1, 98; Nov. 1, 32

Design

Amplifiers—Nov. 15, 48; Nov. 15, 50; Dec. 1, 96; Dec. 15, 116
 Audio—Dec. 15, 116
 Circuits—Sept. 1, 96; Sept. 15, 30; Nov. 15, 34; Dec. 1, 96
 Computers—Jul. 1, 94; Jul. 15, 96; Sept. 1, 100; Sept. 15, 120
 Data Charts—Sept. 15, 22; Sept. 15, 114; Oct. 1, 22; Oct. 15, 44; Oct. 15, 46; Oct. 15, 62; Nov. 1, 34; Nov. 15, 108; Dec. 1, 38
 Design Aids—Sept. 1, 28; Oct. 1, 32; Oct. 1, 38; Oct. 15, 42; Oct. 15, 128; Nov. 1, 44; Nov. 15, 38; Dec. 15, 128
 Design Problems—Aug. 1, 18
 Generators—Sept. 1, 92; Dec. 1, 24

Inductors—Nov. 15, 44

Instruments—Jul. 15, 38; Dec. 15, 30

Measurements—Dec. 15, 26

Miniaturizing—Aug. 1, 34

Mixer—Oct. 15, 140

Packaging—Aug. 1, 28; Aug. 15, 38; Oct. 1, 102

Power Supplies—Jul. 15, 22

Receivers—Aug. 15, 108; Oct. 15, 60

Regulation—Dec. 15, 32

Reliability—Oct. 1, 18; Nov. 15, 138

Television—Aug. 15, 44

Transformers—Jul. 15, 44

Transistor Circuits—Jul. 1, 22; Jul. 1, 32; Jul. 1, 34; Jul. 1, 46; Jul. 1, 50; Jul. 15, 30; Sept. 1, 36; Sept. 1, 98; Oct. 15, 22; Oct. 15, 26; Nov. 15, 28; Dec. 15, 20

Transistorized Power Supplies—Nov. 15, 40

Tubes—Aug. 1, 22; Aug. 1, 36; Aug. 15, 22; Sept. 1, 22; Oct. 1, 36; Oct. 15, 52; Nov. 1, 26

Tuning—Sept. 15, 112

Materials

Absorption—Oct. 15, 134; Nov. 1, 38

Ceramics—Sept. 15, 36; Nov. 1, 20

Epoxy Resins—Dec. 1, 34; Dec. 15, 128

Insulation—Jul. 15, 46

Metals—Aug. 15, 32; Sept. 1, 32

Phosphors—Oct. 15, 28

Solvents—Dec. 15, 46

Test Equipment

Ammeters—Dec. 15, 130

Bridges—Oct. 15, 40

Damping—Sept. 15, 28

Field Strength Meter—Sept. 1, 48

Magnetic Flux—Jul. 1, 26

Microwave Test Equipment—Sept. 1, 46; Nov. 1, 30

Oscillators—Aug. 1, 40; Sept. 15, 40; Nov. 15, 36

Oscilloscopes—Aug. 1, 38; Aug. 15, 28; Aug. 15, 110

Pulse Equipment—Jul. 1, 44; Jul. 15, 42

Recorders—Jul. 15, 34; Sept. 15, 48; Nov. 1, 43; Nov. 1, 96

Signal Generator—Aug. 15, 26; Sept. 15, 26

Test Meters—Jul. 15, 26; Aug. 15, 50; Oct. 1, 28; Oct. 15, 33; Oct. 15, 136; Oct. 15, 138; Nov. 1, 40

Transistors—Jul. 1, 50; Dec. 1, 20

Tube Tester—Sept. 15, 110

What's Inside Transac—1, by A. L. Cavalleri, Jr., (p 22) A description of transistorized automatic computer circuitry featuring high-speed operation, low power requirements and direct coupling.

3-D Flux Meter (p 26) This flux meter measures the strength of a three-dimensional magnetic field in terms of its space components along each of the three rectangular axes. Its long thin probe makes it particularly suitable for taking measurements in narrow cylinders. (Federal Telephone and Radio Company)

Automatic Curve Tracing Aids Transistor Circuit Design, by N. H. Goldich, (p 28) Curve tracer applications in transistor design. Particularly useful in analyzing changes in transistor characteristics with load, operating time, and environmental conditions.

Wire Lacing With Plastic Tubing (p 32) A spirally-cut polyethylene tubing that insulates and protects a bundle of wires. It features easy application. (Computer Control Co.)

Transistor Circuit Design With Intermediate Terminal Connections, by A. Jorysz (p 34) Low frequency applications of junction transistors, which will permit the use of purely resistive equivalent circuit parameters are examined. The circuits are analyzed with the aid of matrix algebra.

Transistors in 1956, by N. B. Saunders (p 38) A general discussion of the application and development of the transistor for 1956.

Transistor Contour Curves, by K. A. Pullen, Jr. (p 40) Included in this article are transistor contour curves using g parameters on the SB-100, L-5117, and the 2N96. Also an experimental curve using h parameters is included for the 2N96.

Transistorized Pulse Programming Equipment (p 44) A portable pulse programming system designed for the development engineer working with transistor switching circuits and magnetic core logic circuits. (Navigation Computer Corp.)

Designing Transistorized Test Equipment, by T. E. Lommasson and K. D. Hardin (p 46) Design problems encountered in the design of a small transistorized test set are discussed.

Transistor Data Chart (insert p ii) Convenient-to-use charts for picking the proper transistor for a particular circuit are developed. The reliability of the data is discussed.

What's Needed in Transistor Components, by W. I. Bull (insert p viii) Some of the general requirements of components required to complement the transistor.

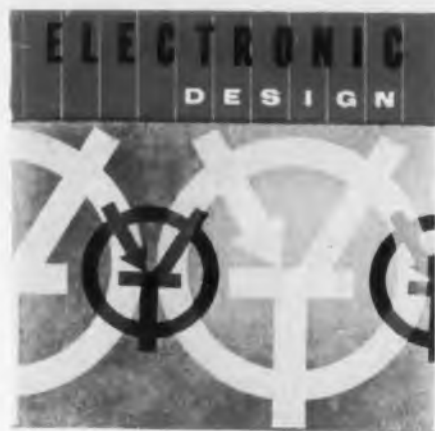
Transistor Components Chart (insert p xi) Specialized components presently available from manufacturer's stock are listed in this chart.

Equipment For Testing Transistors, by Sol Prenskey (insert p xii) Laboratory-type analyzers and equipment for quick checking of transistors are listed with auxiliary equipment required.

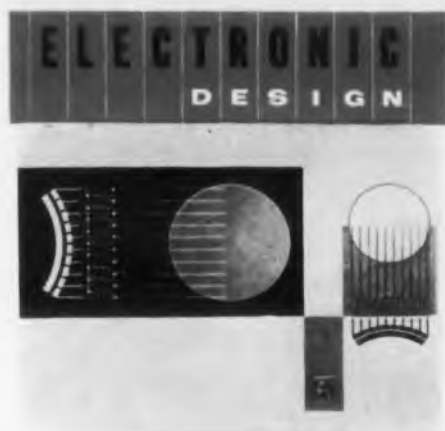
Some Russian Transistor Applications (p 90) A transistorized clock, two video amplifiers, a tape recorder and a superheterodyne receiver developed by the Russians are illustrated. (Russian Translation)

What The Russians Are Writing (p 92) Annotated Table of Contents of Radiotekhnika, January 1956. A mathematical analysis of non-linear distortion and stability of reflex circuits is discussed. (Russian Translation)

Interconnecting Electronic Computers (p 94) Data-processing shared by two interconnected electronic digital computers. (Abstract)



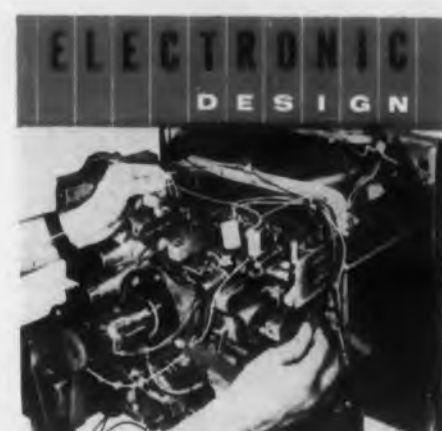
July 1, 1956



July 15, 1956



August 1, 1956



August 15, 1956

July 15, 1956

Design Considerations for Semiconductor Regulated Power Supplies, by S. Sherr and P. M. Levy (p 22) Compact low voltage power supplies to meet the requirements of transistors are considered. Semiconductor power supplies are analyzed and discussed.

Self-Calibrating DC Voltmeter (p 26) A high-accuracy dc voltmeter, featuring a built-in calibration circuit is reviewed. (Nucleonics Engineering Laboratories, Inc.)

High Sensitivity Relay (p 28) High sensitivity and long operating life are design features of this relay. An essentially friction-free armature movement, wiping contacts, and elimination of residual magnetic effects permit a sensitivity as low as 5 mw. (Hedin Tele-Technical Corp.)

What's Inside Transac-11, by A. L. Cavaliere, Jr. (p 30) This is the second part of an article describing Transac. It discusses control, memory circuits, and communications within the computer.

Acoustic Damped Rectilinear Recorder (p 34) Acoustical damping of the pen, elimination of curvilinear distortion, and elimination of massive magnets are features of the high-speed direct inking chart recorder illustrated here. (Massa Laboratories, Inc.)

Meter-Type Analog-to-Digital Converter (p 36) The device uses the meter pointer of an ordinary D'Arsonval meter movement to complete an electrical circuit between contacts on the scale of the meter assembly. Digital output depends upon the position of the pointer and may be read out at predetermined intervals. (Assembly Products Inc.)

European Instrument Designs, by R. Feldt (p 38) Presented here are unusual and interesting design features of some of the foreign equipment. Designers abroad have been successful in developing precise and versatile instruments which are simple to read.

Quadruple Pulse Generator (p 42) Generator supplies a series of pulse trains of variable amplitude and width for calibrating and testing pulse systems, such as computers and nuclear counters. (Electrical and Physical Instrument Corp.)

Transformer Odd-Impedance Nomograph, by R. W. Thorpe (p 44) Use of odd impedances, between various secondary taps of multiple winding transforms, to match a given generator to an unusual value of load impedance is explained.

Epoxy-Resin Tape Insulation (p 46) Advantages of epoxy-resin impregnated glass cloth and non-woven polyester mats as insulating materials. (Minnesota Mining and Manufacturing Co.)

Current Trends in Transistor Radios, by S. D. Prenskey (p 48) A tabulated description of transistor receivers showing the type, number and function of the transistors being used and also emphasizing the outstanding advantages of these new sets.

Soviet Analog Computer (p 96) Design objectives and capabilities of an analog computer developed by Russian engineers in 1954. Basic circuits are shown. (Russian Translation)

New Russian Electronic Monthly (p 100) Radiotekhnika i Elektronika (Radio Engineering and Electronics) is a new monthly published by USSR Academy of Sciences, devoted to original reports and survey articles on theoretical and experimental advances in electronics and electron physics. (Russian Translation)

Naval Research Laboratory Reports (p 102) An Office of Technical Service, U. S. Dept. of Commerce report brings to the attention of industry engineers results of work either being done by the government or under government sponsorship. (Abstracts)

Soldering Miniature Connectors (p 106) Special soldering irons or other soldering equipment to successfully solder the small components found in miniaturized electronic equipment. (Abstract)

August 1, 1956

Management's Responsibility to Reliability, by J. M. Bridges (p 18) Analysis of factors affecting thoroughness and adequacy of design engineering.

Ceramic Receiving Tubes (p 22) Stacked ceramic receiving tubes designed to resist heavy shock and vibration. (Eitel-McCullough Inc.)

Hybrid Auto Radios, by W. D. Beville (p 24) A combination of power transistor and low-voltage tubes for use in auto radios.

Adjustable Nonlinear Transducer (p 26) A rotary autotransformer with immediately adjustable output voltage curve. (Perkin-Elmer Corp.)

Packaging Design, by R. Heath (p 28) Some packaging ideas as incorporated in a new amplifier.

X-Band Ferrite Duplexer (p 32) Theory and description of a duplexer to act as a switch and isolator in high power radar designs. (Airtron Inc.)

Miniaturized Dictating Machine (p 34) Miniaturization by reducing space, weight and heat of Sound-Scriber Model 200. (Sound-Scriber)

Backward Wave Oscillator (p 36) Theory and description of a backward wave tube for use in production equipment. (Varian Associates)

Modified Oscilloscope Analyzes Engine Performance (p 38) An oscilloscope designed for ignition system analysis with engine running. (Allen B. DuMont Labs. Inc.)

Plug-In Driver for 400 Cycle Chopper (p 40) A plug-in one-tube oscillator inverter provides 400 cps power to drive one or two miniature choppers. (Airtax Products Co.)

What the Russians Are Writing (p 100) Annotated table of contents of Avtomatika i Telemekhanika, 1956 No. 2. A comparison of several standard magnetic amplifiers with internal positive feedback is included. (Russian Translation)

Amplifier For Stroboscopic Oscillograph (p 102) High-speed recurrent voltages are observed or photographed by measuring instantaneously selected points of the pulse-modulated unknown voltage. (Russian Translation)

Capacitors (p 104) A discussion of the capabilities and limitations of many types of capacitors presently available. (Abstract)

Tube Reliability (p 106) Discusses the significance of tube data and its value in estimating tube life. (Abstract)

August 15, 1956

Tubes For Direct Digital Counting, by Philip Chellik (p 22) Discussion of tube construction—Philips Tube, Burroughs Tube, Bi-directional Glow Tube, Uni-directional Glow Tube, IBM Tube, and applications.

Random Noise Signal Generator (p 26) Circuit analysis of Model G-1000 which generates a random signal with Gaussian amplitude probability distribution and a flat "white" power frequency spectrum from 0 to 100 cps. (International Dynamics Corp.)

All New Oscilloscopes (p 28) Discusses packaging and circuits of Models 130A and 150A. (Hewlett-Packard Co.)

Cold Metal Extrusions—1, by Edward S. Cornell, Jr. (p 32) A discussion of the art of applying pressure which results in the cold flow of metals, the plastic deformation of metal.

Subminiature Reed Relay (p 36) Remote control of up to 5 circuits from one control channel is possible. (W. S. Deans Co.)

Self-Servicing TV Receiver (p 38) Discussion of packaging for ease of servicing. (Crosley & Bendix Home Appliances Div. of Avco Mfg. Corp.)



September 1, 1956

Traveling Wave Tube Impedance, by Charles Ammerman (p 40) Discussion on the influence of tube operating conditions, load or source impedance, and frequency on input and output impedances.

Sweep-Operated Relay (p 42) Transient studies can be performed by initiating the transient at a convenient part of the oscilloscope trace: how this can be done is discussed. (Englehardt Engineering Co.)

Supersonic Sound Operates TV Set (p 44) In the 40 kc range, supersonic sound is radiated from this new remote tuning unit to operate various TV receiver controls. (Zenith).

Precise Low Frequency Counter (p 46) Five place accuracy in the range of 1 cps to 20 kc is possible with this preset wave timer. (Ransom Research).

Transistor Mixer Amplifier (p 48) Discussion of Model JG2, a portable unit for remote broadcasting and recording. (Baird Associates).

Manual Core Tester (p 50) Test jig for analyzing the induced voltage response of miniature ferrite and metallic-tape magnetic cores. (Rese Engineering Inc.)

What the Russians Are Writing (p 106) A pulsed exciter for fm, uhf transmitter and a frequency-modulated oscillator with reactance tube, from "Electrosviaz" No. 2, 1956. (Russian Translation.)

Dual Channel Single Sideband Receiver (p 108) Discussion and diagram of a dual-channel single-sideband receiver using quartz filters. (Russian Translation).

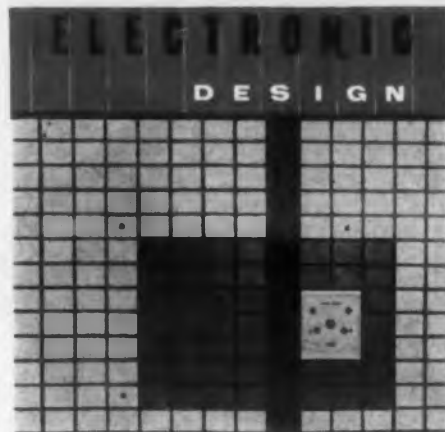
Design Ideas From Germany, by Alfred Jorysz (p 110) The use of waveguides to stabilize oscillators, an inverterless push-pull dc amplifier, rod wavemeters, and the new concepts of field and hybrid quadripole. (Abstract).

Relation Between Performance and Reliability of Tubes (p 116) A review of factors influencing the life and performance of tubes. (Abstract).

September 1, 1956

Low Voltage Beam Switching Tube, by R. A. Cola (p 22) An extended theoretical and practical discussion of tube types 6700-6701, with several applications.

Scheme For Designating Semiconductors, by R. B. Hurley (p 26) A proposed method of coding transistors and semiconductor diodes, indicating type and polarity.



September 15, 1956

More Definitive Symbols, by L. M. Balter (p 28) A description of a more explicit system of notation used in Western Germany.

Electrostatic Loudspeaker (p 30) A new high-frequency speaker, with directivity pattern and schematics. (International Standard Trading Corp.)

Cold Metal Extrusions-11, by E. S. Cornell, Jr. (p 32) Mechanics and principles of extrusion, with references. (continued from Aug. 15, 1956).

Transistorized Geiger Counter (p 36) A miniaturized counter, with schematic, featuring printed circuits, multi-deck construction and mercury batteries. (Seezak, Div. of U. H. & F. Mfg. Corp.)

Compact Counter Chronograph (p 38) A portable high-speed, high capacity counter with precision chronograph. (Jacob Instrument Co.)

Conversion Factors For Tube Characteristics (p 40) A nomograph for determining tube-characteristics conversion factors. (Radio Corp. of America).

Proximity Impulse Transducer (p 42) Midget transducer converts motion to electrical signal without mechanical contact. (Mina-tron Corp.)

Tiny Coaxial Switches (p 44) The design of the switches illustrated here attempt to embody mechanical simplicity, lightness, low power consumption, and repeatability in a compact sealed unit. (Electromation Co.)

Automatic Impedance Plotter (p 46) Microwave impedances read on the face of a cathode-ray tube (Cascade Research Corp.)

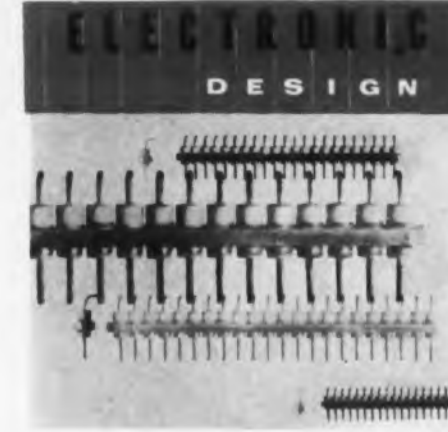
Portable VHF Field Strength Meter (p 48) A lightweight dry battery-operated meter, with telescoping dipole. (Federal Tele. & Radio Co.)

What the Russians Are Writing (p 90) Articles on electro-acoustic developments abstracted from Akusticheskii Zhurnal Vol. 2 No. 1. (Russian Translation).

Diode Function Generator Design (p 92) Theory and circuitry of diode function generators. (Russian Translation).

The Modular Concept (p 96) The three-dimensional modular approach to circuit construction. (Abstract).

Transistorized Magnetic Core Memory (p 98) Drive and read amplifiers for transistor-operated magnetic core memory. (Abstract).



October 1, 1956

High-Speed Parallel Adder (p 100) Principles of a new adder for use in a computer arithmetic unit. (Government Reports).

September 15, 1956

Modern Synthesis Network Design From Tables—1, by L. Weinberg (p 22) In this series of articles, tables are presented which give the element values of normalized low-pass ladders having maximally-flat magnitude characteristic, equal-ripple magnitude characteristics, and a maximally-flat time delay.

Portable Video Generator (p 26) This Dyna-Scan Model 1000 Picture and Pattern Video Generator is a self-contained flying spot scanner. It produces a composite video and sync signal that operates any standard black and white or color TV receiver on any vhf channel. (B & K Mfg. Co.)

Automatic Measurement of Damped Oscillations (p 28) Instantaneous measurement of damping characteristics of aircraft structures, certain electronic circuits, and the like is a feature of the Dampometer, an instrument combining several unique design features. (Oltronix Co.)

Three-Dimensional Cam Circuit, by M. Fogiel (p 30) An electronic circuit, described in this article, will develop an output which is a function of two variable inputs and effectively replaces the mechanical three-dimensional cam.

Patents Are Valuable, by M. Russo (p 32) This article is in response to one by Mr. R. C. Miles, "What Good Are Patents", which appeared in the May 15th issue of ELECTRONIC DESIGN. The present article is intended to refute some of the contentions raised by Mr. Miles and to present, according to the author, "a more thorough and complete picture of the patent system in general."

Ceramics and Design, by H. W. Huffcut (p 36) Development of ceramics in electron tube design and other electronic design activities.

Variphase Oscillator (p 40) Featuring an unusually wide frequency range, 0.2 cps to 20 kc, this Variphase Oscillator has two independent signal outputs of the same frequency but with controllable relative phase. (Dubrow Development Co.)

Miniature 25 Watt Power Resistor (p 42) High power in miniature size and single hole chassis mounting are the features of this wire wound resistor. (Dale Products, Inc.)

Probes for Multimeters for H-F Test Leakage, by R. C. Middleton (p 44) Several probe accessories are discussed in this article including a signal tracing probe, and a high-ohm probe.

ELECTRONIC DESIGN • December 15, 1956

Liquid Lock Washer (p 46) Threaded fasteners can be vibration-proofed with a new liquid sealant. Heavy vibration does not loosen the locking action but simple torque tools easily separate the threaded hardware. (American Sealants Co.).

Multi-Media Recorder (p 48) This 6-channel recording oscillograph offers the choice of three different media for recording. It permits the use of ink or electric-sensitive paper for rectilinear recording. (Offner Electronics, Inc.)

What The Russians Are Writing (p 108) Annotated table of contents of Radiotekhnika, No. 2, 1956. An abstract of the connection between the (van der Pol) Approximate Equation and Power Balance is included. (Russian Translations).

Field Testing of Electron Tubes (p 110) Evaluation of the parameters of an electron tube in conjunction with the specific circuitry connected with the application. (Abstract).

"On-The Nose" FM Tuning (p 112) Described here is a means for accurately tuning in fm signals where ratio detectors are employed. (Abstract).

Determining Combined Power of Two Signals (114) A chart is used to simplify the power addition of two signals whose levels are expressed in db. (Abstract).

Industrial Preparedness Studies On Transistors and Rectifiers (p 116) This article along with Analog-Computer Simulators and Categorized Reports is abstracted. (Government Report).

Standardizing Quality Acceptance (p 118) Recommendations for standardizing quality acceptance are included in this article. (Abstract).

Ferromagnetic Core Circuitry in Digital Computers (p 120) In this paper, the data gathered through a survey plus the author's own work in the field, has been set down to explain the use of magnetic core logical circuitry in the digital computation field. (Govt. Reports).

October 1, 1956

Meaning and Prediction of System Reliability, by A. Kohlenberg (p 18) System reliability is discussed in terms of the probable value of a system's performance of its intended function.

Modern Synthesis Network Design from Tables—II, by L. Weinberg (p 22) Tables presented in this series of articles make the design of three classes of practical networks simple. The tables give the element values for the normalized low-pass network with a Butterworth, Tscheybscheff, or Bessel-polynomial characteristic.

Miniature Ceramic Connectors (p 26) Miniature ceramic connectors for applications where space is at a premium, and where unusual operating conditions are encountered. (Raytheon Mfg. Co.).

Precision Contact Making Deflection Meter (p 28) This precise deflection contact-making meter has a wide range of application in controlling other circuits. (Sensitive Research Instrument Corp.)

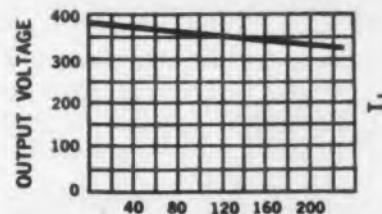
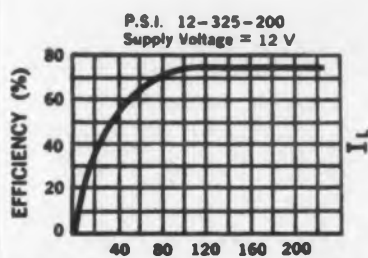
Elliptical Delay Line (p 30) Representing a new approach to delay-line construction is this inexpensive, high-quality, flat form delay line. (Columbia Technical Corp.).

- ▶ Four standard models provide inputs for 12 or 28 volts DC — filtered outputs of 325 volts DC at 100 or 200 ma.
- ▶ Over-designed proven circuitry, super quality components, conservatively rated for electrical and mechanical performance.
- ▶ Withstand vibration and shock loads over 100 G's during operation. No moving parts to break or malfunction.
- ▶ Life greatly exceeds all vibrator or rotary equipment.
- ▶ Exclusive control circuit provides high conversion efficiency over widely variable loads — protects transistors under no load and the supply from shorts or severe overload output.
- ▶ Electrical efficiency up to 90% operating in ambients of -55°C. to 75°C. voltage regulation is 20% standard.
- ▶ Compact — hermetically sealed cases measure $3\frac{1}{16}'' \times 3\frac{1}{16}'' \times 2\frac{5}{8}''$.
- ▶ Light — weighs only 2 lbs. 13 ozs. for 200 watt capacity . . . a fraction of comparable rotary equipment.

These new, rugged converters are recommended where a premium is placed on exceptional reliability, light weight and small size — in severe operating conditions such as missile beacon power supplies, airborne and other mobile communications equipment.

semiconductor power converters

DC



COMPARE ALL THREE TYPES OF POWER SUPPLIES

	HERMETICALLY SEALED PSE CONVERTER	DYNAMOTOR WITH FILTER	HERMETICALLY SEALED VIBRATOR WITH TRANSFORMER AND FILTER
High Altitude Operation	Sealed	Sparking	Sealed
High Humidity	Sealed	Susceptible to corrosion	Sealed
High Shock Vibration Acceleration	Negligible due to no moving parts	Moving armature susceptible to damage and brush bounce	Contact assembly susceptible to damage and erratic performance
Storage Ambient	-55° to $+95^{\circ}\text{C}$	-55° to $+125^{\circ}\text{C}$	-55° to $+125^{\circ}\text{C}$
Operating Ambient	-55° to $+75^{\circ}\text{C}$	-55° to $+125^{\circ}\text{C}$	-55° to $+125^{\circ}\text{C}$
Conversion Efficiency	75% to 90%	~60%	~80%
Operating Maintenance	None	Periodic service required.	Periodic vibrator replacement
Storage Maintenance	None	Periodic service required.	None
Operating Life	Excellent	Good with maintenance	Poor
Watts per lb.	~30	~12	~8
Cu. inches per Watt	<1	~1.5	~3
Overload Protection	Cannot be damaged by overload	Required	Required
Radio Interference	Negligible	Yes	Yes

CUSTOM PACKAGES

We also design and produce to your individual requirements. We can handle DC inputs from 6 to 32 volts DC, output voltages up to 1000, regulation to 0.5%, and output capacity of 500 watts. Typical of our custom designs is the power supply for the AN/DPN-19 Radio Beacon and Control Fuel Cut-Off C — 1297 (XE-1)/DPN.



WRITE FOR TECHNICAL DATA AND PRICES

POWER SOURCES INC.

6 SCHOUER COURT
ARLINGTON, MASS.
TWX: ARL., MASS. 945

CIRCLE 31 ON READER-SERVICE CARD FOR MORE INFORMATION

Design Techniques Using Conductance Curves, by K. A. Pullen, Jr. (p 32) Use of conductance curves as a means of evaluating and predicting circuit behavior is demonstrated. Modified equations are included as required.

Pentode Does Two Jobs, by L. M. Balter (p 36) A circuit design which permits the same pentode tube to be used as a sound intermediate frequency amplifier and also the first video voltage amplifier.

Design Tips (p 38) Suggestions for electronic equipment which is simpler, more reliable and more usable and at the same time will save costs in manufacture. (U. S. Navy Electronics Lab., Reliability and Standards Branch).

Magnetostriction Motor (p 43) This linear actuator can be used in all feed mechanisms requiring microinch (0.000,005 in. to 0.0001 in.) dimensional control. (Airborne Instruments Lab. Inc.).

What The Russians Are Writing (p 96) Annotated table of contents of Measurement Engineering, No. 2, March-April 1956. An abstract is included on an inductive recording meter for small displacements. (Russian Translation).

New German Tubes (p 98) A German tube for pulse work with two independent control grids, two independent plates, high mutual conductance g_m with optimum g_m/C ratio, and high plate current with optimum current distribution between plate and screen grid is discussed. (Abstract).

Crystal Diodes—Forward and Reverse Types (p 100) Important features and characteristics of mixer crystals are discussed. Cross-sectional diagrams of the different types of crystals are shown. (Govt. Report).

Making Electronic Chassis Splashproof (p 102) Drawings here are cross sections of configurations of several degrees of splash proofing. These configurations provide protection ranging from a slight improvement in splash resistance over that given by standard louvers, to complete splashproofing. (Govt. Report).

October 15, 1956

Transistor Design, by C. H. Zierdt (p 22) This article examines transistor design from the standpoint of end-use requirements. A list of design requirements is included.

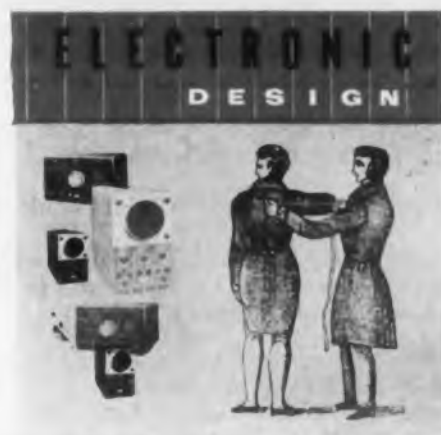
Circuit Design For Transistor Interchangeability, by W. J. Maloney (p 26) Practical suggestions are offered to designers for developing circuits that allow germanium triode interchangeability in IF power amplifier circuits.

How To Evaluate Screen Phosphors, by Dr. J. Bramley (p 28) Results of various screens are discussed in a question and answer type article to enable an equipment designer to arrive at the best compromise.

Direct Reading X-Band Frequency Meter (p 33) Designed for use on a waveguide, this X-band frequency meter is provided with a direct reading dial which permits extremely accurate frequency measurement. (Hewlett-Packard Co.).

Tolerance Compensation of Thermistors, by C. J. Kaiser (p 34) This article outlines a method for using zero-temperature-coefficient resistors for compensation. One resistor is in series with the nonlinear element and one shunts it.

Two-In-One Design (p 38) A simple radio easily converted into an intercom system or a Geiger counter. (Sylvania Electric Products Inc.)



October 15, 1956

C-R Dual-Null Glow Bridge (p 40) This bridge is intended for use where measurement of capacitance and resistance must be made rapidly with moderate accuracy. (Industrial Development Lab. Inc.)

Human Engineered Instrument Designs (p 42) Instrument design for reliability, visual and mechanical efficiency, and virtual elimination of human inaccuracy. (Allen B. DuMont Labs. Inc.)

Polar-to-Rectangular Conversion Chart, by H. E. Schrank (p 44) Designed to aid in calculations which involve converting complex numbers from rectangular to polar form, this chart is particularly suited for circuit and transmission line problems involving impedances or admittances.

Modern Synthesis Network Design from Tables—III, by L. Weinberg (p 46) In this third part of the article Bessel functions for constant time delays are given.

Reluctance Amplifier (p 48) This patented amplifier is intended primarily for driving servo motors. The unit has the desirable characteristics of a Class B vacuum tube amplifier, yet is smaller in size and weight. (Servo Corp. of America)

Designing Deflection Systems Around Available Tubes, by W. F. Massey (p 52) It is the purpose here to consider the various factors that tubes impose on design and to give some suggestions for satisfactory circuit development.

Pre-Fab Cabinets (p 56) Using the basic frame components of various dimensions, designs can be fabricated quickly and economically for housing electronic equipment. (British Industries Corp.)

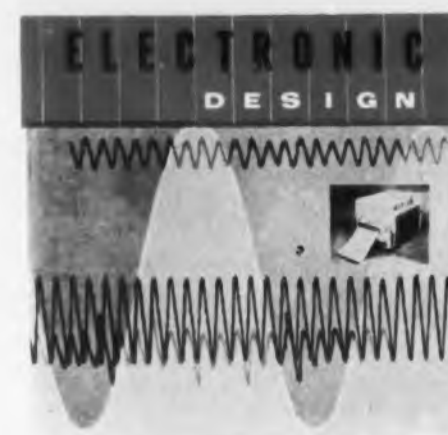
Mechanical Equation Finder (p 58) Harmonic analysis and curve fitting from plotted or recorded curves is possible with this electrically-driven analog computer. (Gerber Scientific Instrument Co.)

Telefunken Opus 6, by L. M. Balter (p 60) An imported German made receiver which matches six speakers to a push-pull audio output stage is reviewed.

Nomogram for Some Transistor Parameters, by H. Letkowitz (p 62) The nomogram permits alpha to be determined directly.

X-Band Antenna-Pattern Transmitter (p 64) This is a high powered, compact x-band antenna-pattern transmitter which permits measurements to be made far down on the secondary antenna lobes. (Color Television Inc.)

Russian Germanium Diodes (p 128) Tables, graphs and cross-sectional diagrams of typical germanium diodes used by the Russians. (Russian Translations)



November 1, 1956

What The Russians Are Writing (p 130) Annotated table of contents of Elektrosviaz, No. 3, 1956 plus Radiotekhnika, No. 3, 1956. An analysis of a regenerative frequency divider with a ring type converter is included. (Russian Translation)

Design Ideas From Germany (p 134) Absorption materials for short electromagnetic waves which are needed to produce reflection-free test spaces are examined. (Abstract)

Measuring G's Electrically (p 136) Described here is a simple electrical measurement for the determination of mechanical motion of high voltage contacts. (Abstract)

Simple Computer Tester (p 138) This article describes apparatus which uses an electrostatic pick-up to check the logic of circuits requiring numerous pulse streams for their operation. (Abstract)

FM Mixer Design for Selectivity and Low Radiation (p 140) Outlined here is how the problems of good selectivity and low local-oscillator radiation are attacked in mixer design of the Phillips fm receivers. (Abstract)

November 1, 1956

Ceramics In Electronic Design, by P. L. Lazarkis (p 20) Basic questions concerning the importance of ceramics in electronic design are discussed in this question and answer type article.

Low-Cost Power Transistors (p 24) These transistors have been designed expressly for experimental purposes. (CBS-Hytron)

Guides to Tube Selection, by K. A. Pullen, Jr. (p 26) Factors affecting the selection of the best tube for a specific application are listed in this article.

The Wamoscope—A New Microwave Display Device (p 30) This cathode-ray tube for radar, TV and other display applications incorporates most conventional receiver functions in a single package. (Sylvania Elec. Prod. Inc.)

Miniature Camera Tube (p 32) The spectral response of this miniature photoconductive camera tube 0.595 inches in diameter and 3.5 inches long closely approximates that of the human eye. (Resistron Laboratories Inc.)

Modern Synthesis Network Design from Tables—IV, by L. Weinberg (p 34) In this Part IV, normalization, duality, reciprocity theorem, frequency transformations, and transformation of symmetrical networks are given. Additional Tschebyscheff characteristics are also included.

Flexible Foam Microwave Absorber (p 38) A microwave absorbing material for lining antenna nacelles and enclosures with the

unusual properties of flexibility and thinness, yet with a reflectivity of less than 2% of incident energy. (Emerson & Cuming Inc.)

Electronic Automatic Digital Micrometer (p 40) The direct reading, counter type automatic electronic digital micrometer described here permits measurements with laboratory accuracy quickly and with no pressure on the work. (J. W. Dice Co.)

Instant Printing HF Oscillograph (p 42) Instant permanent records are produced by this light-beam oscillograph featuring flat frequency response to 2 kc from dc. (Minneapolis-Honeywell Regulator Co.)

Location of Maximum Loading Errors in Potentiometers, by D. A. Landauer (p 44) This article tells how the point of maximum error can be found, explains why this point is important to know, and offers a graphical solution for a common range of load ratios.

High-Frequency PNP Transistor (p 48) High-gain and stability well up into the short wave bands is made possible by a design which reduces interelectrode capacitances to a very low order. (Radio Corp. of America)

Automatic Micro-image File (p 96) The data storage and retrieval device described here provides rapid access to any one of 10,000 information-containing frames recorded in miniature on a 10 in. square sheet of microfilm. (Abstract)

Laboratory Testing to Achieve Reliability (p 98) The necessity of laboratory testing to achieve reliability in system construction is explained. (Abstract)

What The Russians Are Writing (p 100) Annotated table of contents of Radiotekhnika i Elektronika No. 1, 1956, Avtomatika i Telemekhanika No. 3, 1956 and Elektrosviaz' No. 4, 1956. Among the topics considered is an electronic differential analyzer at the USSR Academy of Sciences. (Russian Translations)

Phase Measurement with a Lissajous Ellipse (p 108) Covering the frequency range from 50 cy to 30 mc, the phase meter described here has an accuracy of plus or minus one degree. It uses a Lissajous ellipse for the determination of the phase angle. (Abstract)

November 15, 1956

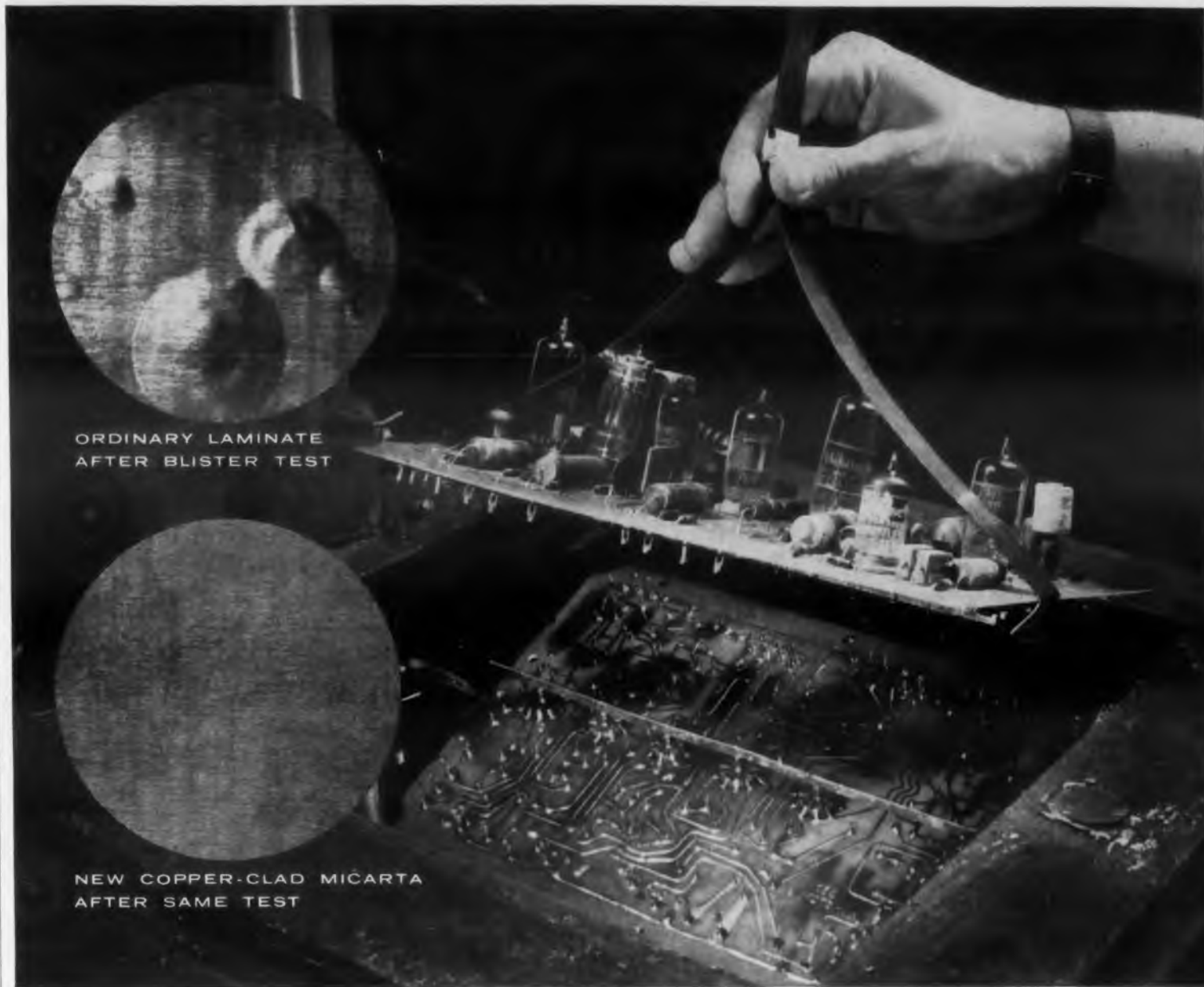
Rectifiers and Circuits for DC Relays by F. W. Parrish (p 22) This article deals with rectifiers for relay applications including some of the less well known circuits and applications.

Rotary Ratio Transformer (p 26) Extremely accurate automatic translation of digital information to mechanical movement can be effected by using this transducer. (Gertsch Products, Inc.)

Temperature Compensation Method For Transistor Amplifiers, by A. N. DeSautels (p 28) This article presents a method of alleviating gain losses by using temperature-sensitive resistance in an inverse feed-back loop. Experimental data verifying the effectiveness of this method are presented for three-stage direct-coupled and r-c coupled transistor amplifiers.

42 Microsec Daily Line (p 32) This delay incorporates the basic properties of magnetostriction to give a pulse delay of 42 microsec. (Deltima, Inc.)

Circuitry For Photodiodes by J. Grant (p 34) Circuitry for using photodiodes is shown and described in this article.



New copper-clad **MICARTA**[®] takes dip solder bath without blistering!

New H-3032 copper-clad MICARTA[®] cuts costs and production time of printed circuits. Copper-clad MICARTA speeds up soldering, without the normal accompaniment of an increase in rejects and missed connections. It can be cold punched without cracking or chipping.

The laminate won't blister even when dip soldered for 10 seconds at 500°F! Examine the two close-up photographs. One shows an ordinary laminate after a laboratory test. Note the blistering, then look at the MICARTA dip soldered for the same length of time—and there is no blistering!

A special adhesive is used which has the same

high electrical properties, solvent resistance and low moisture absorption as the MICARTA laminate itself. Actually, adhesive strength is increased during soldering.

Because of a new adhesive process, copper-clad MICARTA keeps its high bond strength—from 10 to 13 pounds versus an industry standard of six pounds—even after heating and cooling is repeated many times. This is especially valuable for electronic circuits.

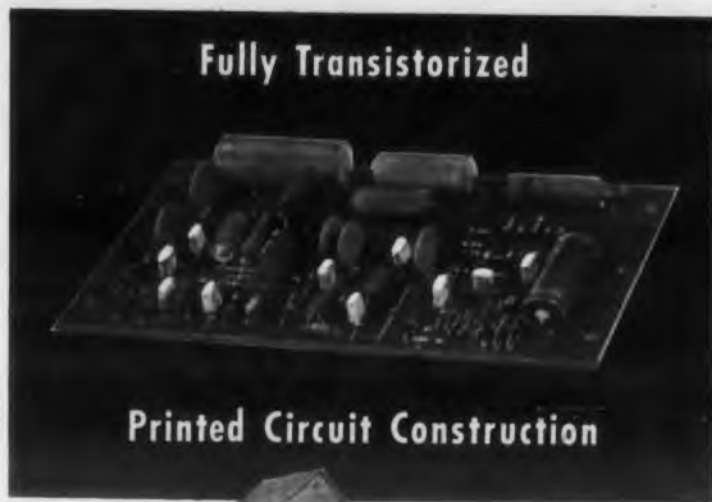
Copper-clad MICARTA may be the answer to your circuit assembly problem. Write for further information and technical data to Westinghouse Electric Corp., MICARTA Div., Hampton, S. C.,

J-06624-X

WATCH WESTINGHOUSE!

WHERE BIG THINGS ARE HAPPENING FOR YOU!

CIRCLE 32 ON READER-SERVICE CARD FOR MORE INFORMATION



NEW CUBIC WAVEFORM GENERATOR

NON-MICROPHONIC

compact design in 8½"x5"x4½" steel case...total weight 5 pounds.

SELF-POWERED

with 500-hour 22.5-volt battery. Continuously variable output with amplitude up to 7 volts maximum...approximately 2000 ohms output impedance...300 milliwatts power dissipation.

VERSATILE

with switch-selected waveforms (waveshapes independent of pulse repetition frequency) as follows:

- * Clipped sawtooth—10 pps to 50,000 pps—0.5 microsecond rise time—linear within 2%.
- * Pulse—10 pps to 50,000 pps—continuously variable 5 to 200 microseconds.
- * Square wave—5 pps to 25,000 pps. Pulse and square wave maximum rise and fall time 1.0 microsecond...overshoot less than 1%...slope and tilt less than 0.5%.

LOW COST

only \$135.00, including tax and postage.

ORDER TODAY FOR IMMEDIATE SHIPMENT

CUBIC CORPORATION

5575 KEARNY VILLA ROAD • SAN DIEGO 11, CALIFORNIA

"First in instruments for progress in electronics"

CIRCLE 33 ON READER-SERVICE CARD FOR MORE INFORMATION

UHF Oscillator Stability Tester (p 36) Changes in the frequency of uhf oscillators can be measured with a particularly high degree of accuracy by this test unit. (Laboratory for Electronics Inc.)

Producing 3D Visual Patterns (p 38) A scheme for producing true 3D in a volume by the localized glow discharge between two wires is discussed. (Martin Rudjer)

Transistorized Power Sources by R. R. Smyth and M. G. Schorr (p 40) Operation and performance results of transistorized power circuits are described in this article.

Designing Iron-Core Inductances by J. H. Davis (p 44) A procedure for designing inductors carrying appreciable amounts of both ac and dc is explained.

AC Decade Amplifier (p 48) No power cord, long battery life, small size, transistor reliability, and broad band pass add up to make this AC Decade Amplifier a neat laboratory tool. (Burr-Brown Research Corp)

Bandwidth Curves For Designing Amplifier Stages by H. D. Webb (p 50) Presented here are curves for use in amplifier design of two or more cascaded L-C stages.

What the Russians Are Writing (p 124) Annotated Table of Contents of Automatika and Telemechanika No. 4, Radiotekhnika i Elektronika No. 2, 1956, Radiotekhnika No. 4. A delay unit employing magnetic recording is discussed. (Russian Translation)

Grid Current Components in Power Amplifiers (p 132) The direct current, fundamental and harmonic components of the grid current are discussed in determining input power, grid dissipation and overall efficiency. (Abstract)

Design With Ferristors (p 134) Ferristors are discussed as an electronic circuit component. (Abstract)

Reliability of Resistors (p 136) An analysis of hermetically sealed composition resistors (Abstract)

Missile Electronics Reliability (p 138) The random failure law applied to missile components. (Abstract)



November 15, 1956



December 1, 1956

December 1, 1956

Transistor Thermal Resistance Measurement by B. Reich (p 20) A method is presented for the measurement of thermal resistance of germanium power transistors requiring no prior transistor calibrations.

Floating Ring Integrator (p 22) This floating ring integrator can be controlled from a minute force acting through a small distance. (Optimum Eng. Co.)

Phase-Shift Generator (p 24) Simple, accurate phase shifting is made possible by this electro-mechanical device of unlimited life and stability (Theta Instrument Co.)

Rotary Waveguide Switch (p 26) This four-arm waveguide switch for microwave relay service can be applied to stand-by operations, or used for switching the direction of transmission. (N.R.K. Mfg. & Eng. Co.)

Modular Cabinets (p 32) A large variety of assemblies can be created from six standard basic frame units. A custom built appearance is easily obtained. (Amco Eng. Co.)

Potting With Epoxy Resins by W. H. Crandell (p 34) The advantages of potting with epoxy resins and the potting procedure are outlined in this article.

Attenuation and Phase Shift in RC Sections From Curves by S. K. Benjamin (p 38) The curves given here may be used to find the percentage change in attenuation and the percentage change in phase shift for a given percentage change in corner frequency for one section (either high or low pass).

Insulation Resistance of Capacitors by G. Mistic (p 28) This article shows the common methods by which leakage resistance of capacitors is measured, and gives applications to show where a knowledge of this factor will aid the circuit designer in overcoming shortcomings of circuit operation.

Simplified Equivalent Circuits for Transistor Amplifiers (p 96) Diagrams are shown which reduce the equivalent diagram of the output circuit of a transistor to that of a vacuum tube. (Russian Translation)

What the Russians Are Writing (p 98) A table of contents of Acoustic Journal, Vol. 2, No. 2, Apr.-June, 1956 is given. Annotated table of contents of Radiotekhnika No. 5, 1956. (Russian Translation)

Report on Transistor Reliability (p 100) Two questions are analyzed: How much has transistor liability improved? Is transistorized equipment reliable? (Govt. Reports)

ELECTRONIC DESIGN • December 15, 1956



December 15, 1956

December 15, 1956

Designing Transistor DC Amplifiers by J. W. Stanton (p 20) Discusses dc amplifier circuits that have been successfully transistorized. Stabilization techniques are discussed fully.

Electrostrictive Relay Acts as Capacitor (p 24) Relay using an electrostrictive element to actuate the contacts. The element holds a charge and acts like a capacitor. (Electric Machinery Mfg. Co.)

Advances in RF Calorimetric Power Measurement by S. Freedman (p 26) The status of rf calorimetry for microwave power measurements is reviewed.

Bold Meter Redesign (p 30) Incorporation of one piece construction and rubber mounting in mass production techniques are discussed in this article. (Assembly Products Inc.)

E and I Regulation With Non-Linear Resistors by B. J. Hegadus (p 32) Good regulation of ac and dc voltages and currents using a simple Wheatstone Bridge circuit in which two of the network impedances are incandescent lamp bulbs. Criteria for selection of network values are given.

Close Tolerance Snap Action Thermostat (p 34) A unique, reliable fast-acting sensitive thermostat in miniature size for control applications. (Volverde Labs)

Determining Optimum Temperature Compensation by R. Kozinsky (p 36) Background and table for determining optimum thermistor shunt resistances for a given temperature range.

Hot Solvent Sprayer for Rapid Precision Cleaning (p 46) Technique and apparatus developed for high-velocity hot solvent spray cleaning of circuit boards and precision parts. (Cobhen, Inc.)

Positive Feedback in Audio-Amplifiers (p 116) Theory of using positive feedback to eliminate or compensate for phase and frequency distortion. (Russian Translation)

What the Russians Are Writing (p 120) Abstracted contents of Radiotekhnika i Elektronika No. 3, 1956, and Avtomatika i Telemekhanika No. 5, 1956. (Russian Translation)

British Epoxide Resins (p 128) A chart shows tabulation by properties of the several epoxide resins presently in use by the British. (Abstract)

High-Q Resonators—Equivalent Circuit Constants (p 126) High-Q resonator equivalent circuits constants are theoretically analyzed in this article. (Abstract)

Voltage Drop Compensators For DC Microammeters (p 130) A scheme of using dc amplifiers as a device for ammeter compensation for meter voltage drop. (Abstract)

A complete line of power transistors—to meet your specific needs

New rugged terminals—
permit easy soldering of
connections.



New welded case—gives
a hermetic seal for
superior ruggedness and
durability.

Honeywell

High Gain

Weld-Seal

Transistors!

The H5, H6, and H7

They're welded—so you can build new ruggedness and durability into your equipment! And the new line of Honeywell transistors gives you superior electrical performance and high, uniform power gain over a wide range of collector current values. You get long life along with outstanding performance.

Take advantage of these new and improved transistors *now*.

Note these new specifications—developed with
the design engineer in mind

	H5	H6	H7
Input Resistance	24 —48 ohms	27—54 ohms	30—60 ohms
Power Conductance	17.5—35 mhos	35—71 mhos	71—141 mhos
Current Gain, Median	30	40	60

(for collector current of 2 amps.)

Also the famous XH10 HIGH POWER
WELD-SEAL TRANSISTOR. The giant of
the industry—with 10 Amp. maximum collector current.

For additional information on the Honeywell transistor line, write or phone for complete specifications, prices and list of current available literature.

UNION, N. J.
MURdock 8-9000
P. O. Box 161
CHICAGO
IRving 8-9266
7350 N. Lincoln Ave.

MINNEAPOLIS
FEderal 2-5225
2749 4th Ave. So.
LOS ANGELES
RAmond 3-6611 or
PARKview 8-7311
6620 Telegraph Road

BOSTON
ALgonquin 4-8730
1230 Soldier Field Rd.

CLEVELAND
TOWer 1-0400
1900 Superior Ave.

MINNEAPOLIS Honeywell

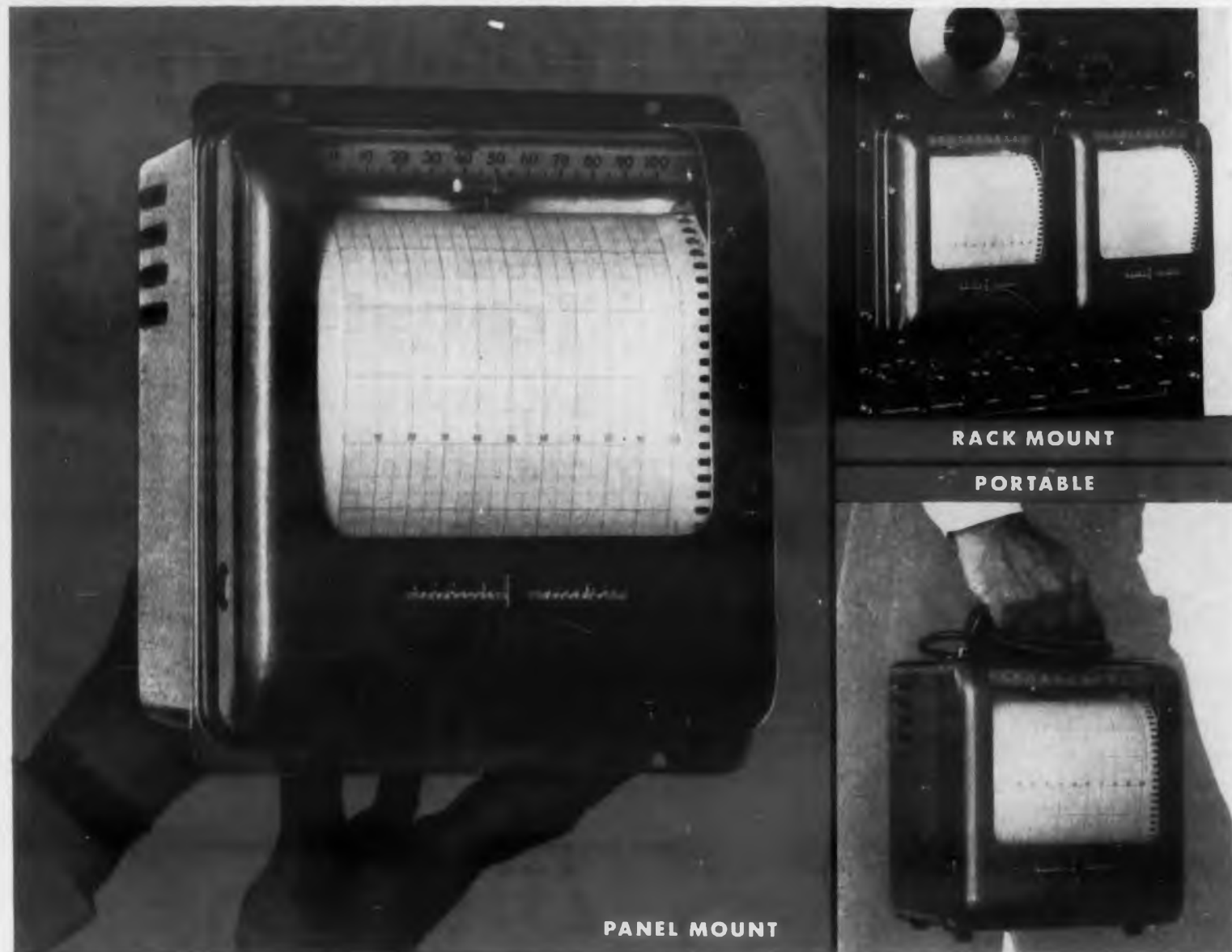


First in Power Transistors

CIRCLE 34 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW STRIP CHART POTENTIOMETER RECORDER \$395

THE G-11 . . . VARIAN'S NEWEST ACHIEVEMENT



RACK MOUNT

PORTABLE

PANEL MOUNT



ATOMIZED particles of solvent, driven by a high-velocity heated air stream, enable critical cleaning of electronic circuit boards, electromechanical components, and instrument bearings. The equipment illustrated here, combining a high-pressure sprayer and special solvent, cuts and works away rosin flux and grease from components. It is especially useful for cleaning electrical contacts and semiconductor units during fabrication.

Acting upon both soluble and insoluble contamination in the two-fold process developed by Cobhen, Inc., Passaic Ave., Caldwell, N. J., the solvent is first warmed, atomized, and driven at high velocity into the component. This dissolves all soluble materials such as oil, grease or silicone binders, and releases insoluble foreign matter from suspension. A blast of warm, dry air is then triggered, which expels the liberated foreign matter and leaves the component clean, warm and dry. No film or residue remains due to the solvent's high chemical purity and extreme volatility, reducing danger of corrosion.

Major components of the equipment include a sprayer operating at 80 psi, an air heater, filter, pressure regulator, and gage. The heater automatically compensates for heat loss through tubing and housing. The special solvent used is a neutral, fractionally distilled organic compound which completely dissolves grease, silicone lubricants, oil rosin flux, waxes and tars. Non-flammable, non-corrosive, and non-ionic, the solvent will not liberate free chlorides in hermetically sealed units. Anti-contamination features include bottling under an inert-gas blanket and design of the sprayer for insertion directly into the solvent bottle.

Although conceived for exacting laboratory use, this technique offers speed and economy which makes it ideal for production requirements. One quart of solvent cleans approximately 3000 diodes or transistors. The average cleaning cycle time per unit is 6 to 8 seconds, allowing cleaning of almost 400 units per hour. Designed for simplicity of operation and maintenance, the equipment comes as a portable unit, or it can be quickly installed as a simple bench setup.

For additional information about this product, fill out the Reader's Service Card and circle 36.

- This new, low-cost recorder with **unitized measuring circuit** makes field adjustment to your requirements as simple as changing a tube. Quantity production from precision tooling assures uniformly high quality and fast delivery.
- 9 mv to 100 mv span, continuously adjustable
 - 1 sec. balancing time — 1% limit of error
 - High permissible source resistance — in excess of 50 K ohms
 - Weighs less than 15 pounds
 - Compact: only 8 $\frac{5}{8}$ " x 10 $\frac{3}{8}$ " x 7 $\frac{3}{4}$ " (5 $\frac{1}{4}$ " behind panel)

WRITE TODAY FOR COMPLETE SPECIFICATIONS
on the new G-11 Recorder and its unique companion, the G-10 Graphic Recorder.

Microwave Tubes • Instruments



Representatives in all principal cities

PALO ALTO 21, CALIFORNIA

CIRCLE 35 ON READER-SERVICE CARD FOR MORE INFORMATION

Hot Solvent Sprayer

FOR
RAPID
PRECISION CLEANING



Cleaning electronic assembly
with high-velocity solvent spray

Sylvania is
your source!

high purity **GERMANIUM**

for
transistors

for
diodes

Need germanium of critical purity? Sylvania is your source for zone-purified and single crystal germanium of 40-ohm cm resistivity—for your most exacting electronic applications.

Every step in germanium production, from concentrated ore to monocrystalline material, is performed in Sylvania's own plant, under the most rigid quality control checks known to metallurgical science. Starting with spectrographically pure germanium dioxide powder, ingots are produced in a reducing atmosphere. After cleaning and etching, each ingot is repeatedly zone purified. When impurities are reduced to the necessary minimum, undoped crystals are grown by the vertical (Czochralski) method.

TUNGSTEN • MOLYBDENUM • CHEMICALS • PHOSPHORS • SEMICONDUCTORS

 **SYLVANIA**

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY

CIRCLE 37 ON READER-SERVICE CARD FOR MORE INFORMATION

Ge

Ge

Ge

New Products

Peak Meter Measures Surges



The PM 1 will catch and hold any peak voltage such as would show on a dc cathode-ray oscilloscope. Its dc system holds

correct zero reference level for a single transient, steadily repeated, a dc signal or any combination. Heart of the PM 1 is a diode and condenser system which traps the peak level of the signal and allows it to be read as steady value on the meter.

It will catch max CRO readings on meter, measure electrical surges, or operate with strain gages and other transducers through suitable controls and amplifiers. Peak voltage is 1 v to 300 v full scale, + or - side selected, regardless of waveform. Frequency response is dc to 30 kc, accuracy is within 2 per cent full scale, and a control circuit can be actuated by the meter.

Ellis Associates, Dept. ED, Box 77, Pelham, N.Y.

CIRCLE 38 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature AC VTVM For Panel Mounting



Miniature ac VTVM's designed for panel-mounting in military equipment, are available in two configurations meeting military specifications, MIL T-945A and MIL E-5400. The instruments feature signal lead isolation from power circuit and case, enabling voltage measurement between any two independent test points.

Drawing less than 10 w from a 115 V, 60 or 400 cps line, the Model SD152 instruments have a frequency response of 20-50,000 cps and an input impedance of 1 megohm. Overall accuracy is 3 percent of full scale, although 2 percent accuracy can be provided.

Trio Labs., Inc., Dept. ED, 4025 Merrick Rd., Seaford, N.Y.

CIRCLE 39 ON READER-SERVICE CARD FOR MORE INFORMATION

Vernier Potentiometer Includes Two Decades



This vernier potentiometer has a single knob which operates either of two resistance decades or the interpolating potentiometer with positive drive. The knob is pushed or pulled and the number read out as the knob is turned.

Parallax is eliminated and three turns of the knob cover the full range.

The complete unit mounts similar to a three inch square cased panel meter. This voltage divider has an input resistance of 10,000 ohms plus or minus 0.05 per cent; linearity of plus or minus 0.01 per cent; resolution of 0.002 per cent and is rated at 5 w.

Research Instrument Co., Dept. ED, P.O. Box 9168, Portland 16, Ore.

CIRCLE 40 ON READER-SERVICE CARD FOR MORE INFORMATION

High-Frequency Galvanometers Sensitive Miniatures



Three instruments with extended frequency and sensitivity ranges are the newest members of the 7-340 family of galvanometers designed to provide higher frequency response with high sensitivity for low-output strain-gage applications.

Two of the three new types, 7-347 and 7-348, are designed to match the commonly-used strain-gage-bridge resistances of 120 ohms. The third type, 7-341, matches resistance bridges of 350 ohms.

Model 7-348 has a natural frequency of 100 cps, a sensitivity of 6.8 μ a/in., and a source impedance of 120 ohms.

Consolidated Electrodynamics Corp., Dept. ED, 300 N. Sierra Madre Villa, Pasadena, Calif.

CIRCLE 41 ON READER-SERVICE CARD FOR MORE INFORMATION

Storage Oscilloscope Uses Memotron Tube



Model 103 MemoScope incorporates the memotron ray storage tube, combining the quality of information persistence with all the features of a laboratory oscilloscope. The unit captures and retains any number of traces indefinitely at a constant intensity until intentionally

erased. Traces are visible in a brightly-lighted laboratory and may be easily photographed. The scope is available in two models; portable and rack mounted.

Hughes Products, Electron Tubes, Dept. ED, International Airport Station, Los Angeles 45, Calif.

CIRCLE 42 ON READER-SERVICE CARD FOR MORE INFORMATION

Random Voltage Generator For Low Frequency Noise



A new line of random voltage generators produces low frequency noise with precisely controlled power frequency spectra and predetermined amplitude probability characteristics.

These generators are designed to provide ultra-stable, accurate statistical functions for computer analysis, or as a driving source for random vibration and shaker testing.

Available in six different models covering the frequency ranges from 0.01 to 50, 1000, 3000 and 5000 cycles, and to 1 and 5 mc, the generators provide noise signals whose amplitude distribution with time is accurately Gaussian, at an output level of 5 v rms into 600 ohms with direct reading calibrated attenuation. White noise is produced having power frequency spectra flat within 1 db for all frequency ranges.

Intercontinental Dynamics Corp., Dept. ED, 170 Coolidge Ave., Englewood, N.J.

CIRCLE 43 ON READER-SERVICE CARD FOR MORE INFORMATION

Epoxy Resins

For Casting

Rubber-like resin No. 636 is a tough, flexible compound with high dimensional stability, resistance to heat and chemicals, excellent recovery characteristics, and good adhesion to many materials. It has a 200 per cent elongation rate, and a tensile strength of 2500 to 3500 lbs psi. Plaster of paris forms can be employed to produce low-cost castings from resin No. 636 in unlimited thicknesses and a wide range of hardnesses. These run the gamut from molds as flexible as vinyl to products as firm as hard rubber.

Casting resin No. 650 is a low-irritant formulation both rigid and resilient in a single resin system. Its rigidity is marked by its Rockwell M 100 hardness and its ultimate compressive strength of 40,000 lbs psi. Its resilient properties include an elongation rate of between 3 per cent and 5 per cent and an impact strength of 7 ft-lbs/in.

Marblette Corp., Dept. ED, 37-31 Thirtieth St., Long Island City 1, N.Y.

CIRCLE 44 ON READER-SERVICE CARD

Contact Label

Permanently Adhesive

A permanently adhesive Contact Label, No. 131, may be used where an easily affixed but impossible-to-remove label is required. It sticks instantly to any smooth surface and after application, the adherence increases without additional pressure. They are used to carry brand information, instructions, wiring diagrams or other information of a permanent nature.

Archer Label Co., Dept. ED, 783 Kohler St., Los Angeles 21, Calif.

CIRCLE 45 ON READER-SERVICE CARD

Silver Contact Cleaner

Removes Tarnish From Contacts

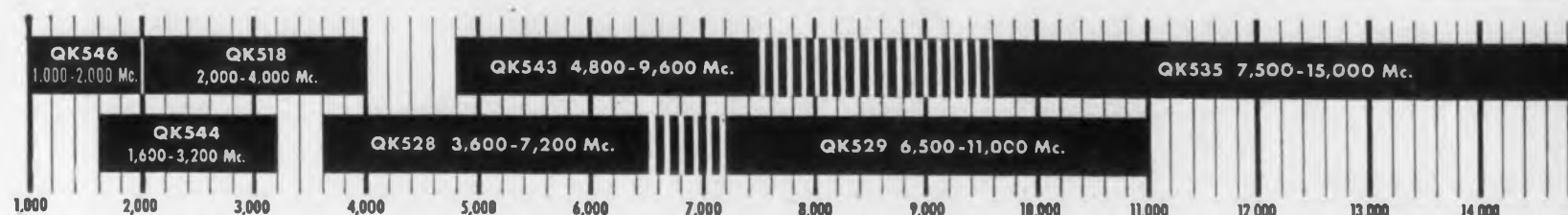
This new solution is ideally suited for removing tarnish from silver and silver plated electrical contacts. Economical, this silver cleaner can be used again and again. The solution is non-flammable and non-abrasive.

L & R Manufacturing Company, Dept. ED, 577 Elm St., Arlington, N.J.

CIRCLE 46 ON READER-SERVICE CARD

CIRCLE 47 ON READER-SERVICE CARD

VOLTAGE TUNABLE



QK518 specifications

Frequency: 2,000-4,000 Mc.
 Rapid electronic tuning by varying delay line voltage from 150-1,500 Volts.
 Power output: 0.1 to 1 watt.
 Complete with compact permanent magnet.
 Approximate maximum dimensions: 10" long, 4 3/8" high, 4 7/8" wide.

NEW Raytheon Backward Wave Oscillator Series

for wide, rapid electronic tuning — 1,000 Mc. to 15,000 Mc.

The tubes in this revolutionary new line of Raytheon Backward Wave Oscillators give you four outstanding performance advantages:

1. Electronically tunable over an extremely wide range of frequencies
2. Frequency insensitive to load variations
3. High signal-to-noise ratio
4. Can be operated under conditions of amplitude or pulse modulation

These new tubes are finding fast-growing applications in microwave equipment, including radar and signal generators.

Write today for free Data Sheets on this series of Backward Wave Oscillators. We'll also be happy to answer any questions you may have on this new line.

Excellence in Electronics



RAYTHEON MANUFACTURING COMPANY

Microwave and Power Tube Operations, Section PT-79, Waltham 54, Mass.

Regional Sales Offices: 9501 W. Grand Avenue, Franklin Park, Illinois; 622 S. LaBrea Avenue, Los Angeles 36, California

Raytheon makes: Magnetrons and Klystrons, Backward Wave Oscillators, Traveling Wave Tubes, Storage Tubes, Power Tubes, Receiving Tubes, Picture Tubes, Transistors

for
**HEARING
AIDS**



or
**RECORDING
HEADS**



or ANY MAGNETIC MATERIALS JOB ...

Write for
your Copy
"MAGNETIC
MATERIALS"

This 32-page book contains valuable data on all Allegheny Ludlum magnetic materials, silicon steels and special electrical alloys. Illustrated in full color, includes essential information on properties, characteristics, applications, etc. Your copy gladly sent free.

ADDRESS DEPT. ED-84

You can rely on core materials like the Allegheny 4750 components illustrated above, in your receivers, recording heads or microphone assemblies.

In fact, whether your equipment is small or large, the extra-broad line of A-L magnetic materials will solve your magnetic core problems. It includes all grades of silicon steel sheets or coil strip, as well as Allegheny Silectron (grain-oriented silicon steel), and a wide selection of high-permea-

bility alloys such as 4750, Mumetal, Permendur, etc.

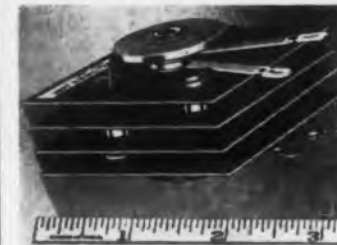
Our service on these materials also includes complete facilities for the fabrication and heat treatment of laminations. (For users of electrical sheets and strip, our lamination know-how is a real bonus value!) Either way, we'll welcome the chance to serve you. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

STEELMAKERS to the Electrical Industry
Allegheny Ludlum



CIRCLE 48 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicon Rectifier 600 Volt Stacks



These 600 v Silicon rectifiers are not available in all circuit types with rms inverse voltage ratings of 70 v, 105 v, 140 v, 210 v, 280 v, 350 v, and 420 v, with dc output currents up to 4.5 amp at 75 C ambient temperature. It is possible to arrange the stacks in series and parallel to increase voltage or current ratings. They are carefully selected to insure equal load distribution, adequate voltage ratings and maximum reliability.

The silicon junctions are hermetically sealed. The junction diodes are mounted on copper cooling fins and then stacked or assembled.

International Rectifier Corp., Dept. ED, El Segundo, Calif.

CIRCLE 49 ON READER-SERVICE CARD FOR MORE INFORMATION

Piezoelectric Accelerometers Linear From -65 to 230 F



This new line piezoelectric accelerometers, pressure pickups and force gages operate with less than 10 percent change of sensitivity over the temperature range of -65 F to 230 F, providing stability under major test conditions. Additional features are high sensitivity, 10 mv/g, high natural frequency, 35 kc, high g range, 10,000 g, and thimble size. Other sizes, weights, natural frequency and higher g pickups are available.

Endevco Corp., Dept. ED, 161 E. California St., Pasadena, Calif.

CIRCLE 50 ON READER-SERVICE CARD FOR MORE INFORMATION

Lamp Extractor For Switchboard



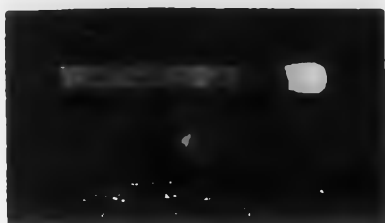
A switchboard lamp extractor and injector with a plastic chuck that slips over and firmly grips the lamp to be removed, this device can enter a pilot hole as small as 0.330 in. diameter. When replacing, the new lamp is slipped into the chuck, seated, and released by means of a plunger.

Atocon Corp., Dept. ED, Galion, Ohio.

CIRCLE 51 ON READER-SERVICE CARD FOR MORE INFORMATION

High Temperature Coils

Custom-Wound Miniatures



Designed to meet the requirements of subminiature construction and high temperature needs, a new type coil wound on a zytel

nylon 101 bobbin has a resistance up to 500 ohms available with No. 50 wire. Coils are wound to meet customer specifications. The dimensions are: height, 0.155; diameter, 0.104; wall thickness, 0.007 in.

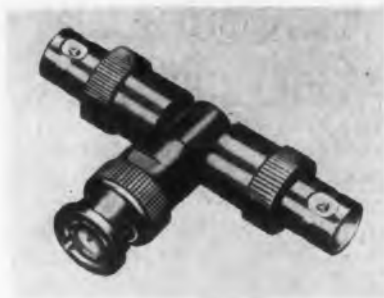
Operation of the coils is rated at temperatures from -65°C to $+125^{\circ}\text{C}$.

Electronic Coil Engineers, Dept. ED, 5830 Main St., Hollydale, Calif.

CIRCLE 52 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Coaxial Components

Using BNC Connectors



Designed for airborne and other applications requiring compact, lightweight components, a line of miniaturized coaxial components have been announced. Included

are fixed pad attenuators, coaxial terminations, low pass and high pass filters, power dividers, crystal mounts, and double stub tuners. Improved type BNC connectors are employed.

Microlab, Dept. ED, 71 Okner Parkway, Livingston, N.J.

CIRCLE 53 ON READER-SERVICE CARD FOR MORE INFORMATION

Computer Twin Triode

Subminiature



Designed especially for dc amplifier and computer applications, the type CK6832 is a subminiature twin triode with very low microphonics and

grid current. In addition, this new type is controlled for balance between the two sections including stability with time, shock and variation in heater voltage. The CK6832 is electrically similar to the well-known miniature type CK5755.

Raytheon Mfg. Co., Dept. ED, 55 Chapel St., Newton 58, Mass.

CIRCLE 54 ON READER-SERVICE CARD FOR MORE INFORMATION

-the heat's off!



This Electronic Reliability Engineer just discovered the IERC way to insure his chances of meeting equipment reliability specifications and military acceptance schedules.

Tubes failures (too often and too soon) caused by heat and vibration, *the major causes of electron tube failures*, were his problem.

With IERC Heat-dissipating Tube Shields, the "heat was off" both the suffering tubes and our man with the problem! Tube operating temperatures were lowered as much as 150°C and tubes are lasting 5 times longer. Schedules were met—time and money saved—highest tube reliability achieved!

Suspect and investigate the heat and vibration menace when tube failures plague you. Eliminate it with IERC Heat-dissipating Tube Shields—available in sizes for Miniature, Subminiature, Octal and Power types of electron tubes.

PATENTED OR PATS. PEND. IERC T 12 SHIELD AND BASE WITH 6080 TUBE ILLUSTRATED.
CROSS-LICENSED WITH NORTH AMERICAN AVIATION, INC.

RC literature and latest Octal and Power tube shield Technical Bulletin

available now—FREE!

International
electronic research corporation

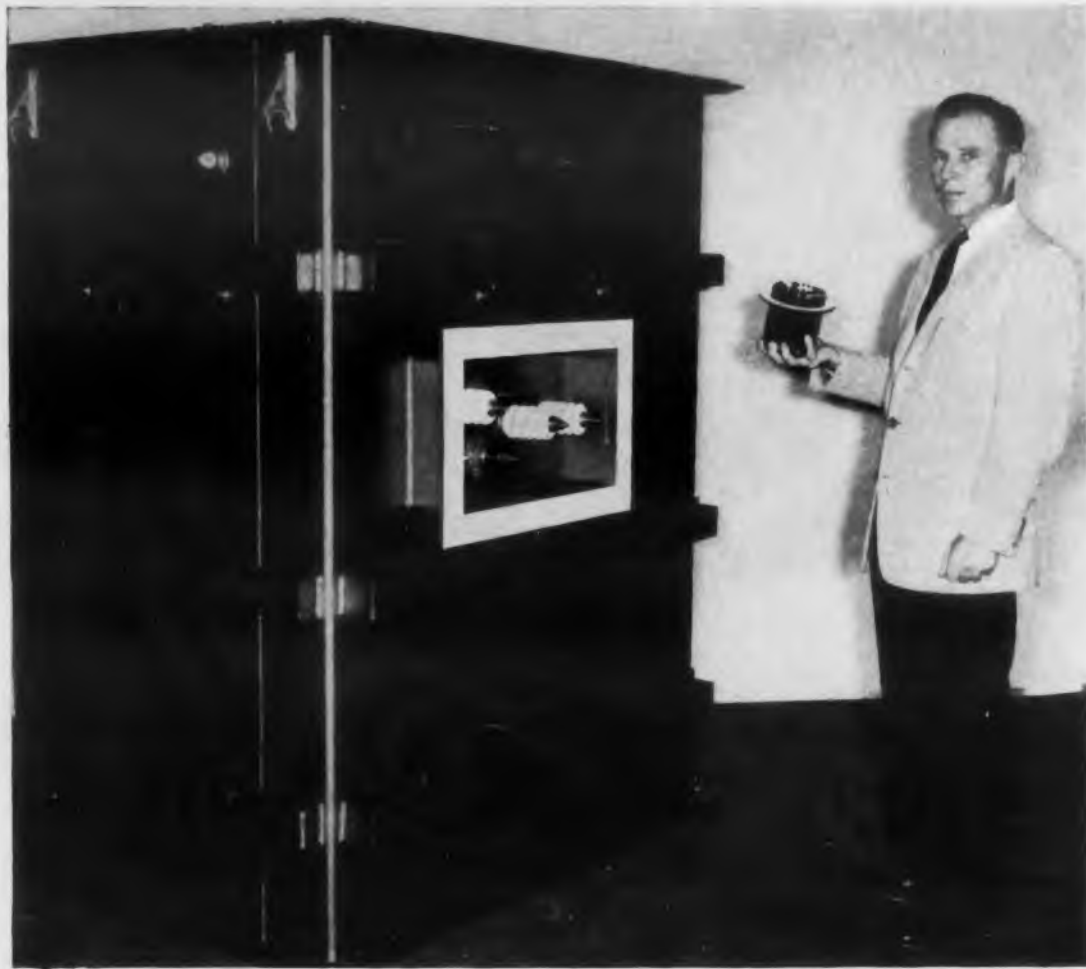


CIRCLE 55 ON READER-SERVICE CARD FOR MORE INFORMATION



DESIGNER'S

Now in production, precision-made radar transformers up to 15 tons



To meet the increasing demand of the radar industry for radar transformers and components, General Electric has extensively modified and expanded its manufacturing facilities in its Holyoke, Mass. plant. As a result, radar transformers up to 10,000 pounds are now being built and the facilities are adequate for building units up to 30,000 pounds on a production-line basis. These units, among the largest being manufactured today, are made and will continue to be made with the same care and precision as the smallest pulse transformers.

Typical radar transformers, being produced at General Electric's Holyoke plant, are shown in the photo at left. The large unit—73 7/8 inches high—weighs 8750 pounds. It is an oil-filled unit, hermetically sealed with an air head and internal cooling coils which carry water as a coolant.

The small unit—an airborne radar transformer—weighs four pounds. Also oil filled and hermetically sealed, it utilizes expansion bellows permitting it to be operated in any position.

But whether it's four pounds or 30,000 pounds, every radar transformer that is custom-built to your particular specifications by General Electric benefits from the same degree of design and engineering skill. For further information, write for GEA-5963.



New 1 1/2-inch starting relay operates 1,000,000 times

Dependable, long-life performance has been built into General Electric's new silver-dollar-sized Type ARR-2 accelerating relay designed for more than 1,000,000 operations in such applications as starting single-phase hermetically sealed refrigerator compressor motors. Contact pressure and action are always the same, regardless of line voltage or motor-performance variations, because there are no pivots to wear out, contact tips are independent of solenoid plunger, and relay is enclosed in sturdy plastic case.

Wiring is fast and easy, with readily accessible terminals available in push-on, screw or lead-type. There's no need for special mounting brackets because the relay is easily mounted from any direction.

You can install this relay in many compact applications because unique design combines high horsepower and current ratings with small, space-saving size. Further versatility is provided by its adaptability for use over a wide range of horsepower and current ratings. At 115 volts this relay will make and break 15 amperes; at 230 volts, 7 1/2 amperes. In addition, this new relay is extremely quiet in operation because there is no armature-to-magnet contact. It is especially applicable where adverse atmospheric conditions exist or remote control is needed. G-E control engineers co-operate with you on every application. See Handbook Sheet 3286, page 23 for details.

Rugged motor-alternators help provide reliable railway communications



For power supplies in railway radiotelephone transmitting and receiving equipment, G.E. offers designers both open and totally enclosed motor-alternator sets. Open model is for inside mounting only; totally enclosed model for severe duty inside and outside the cab. Housed to withstand vibration and heavy handling, these power supplies can be furnished for operation with 32, 64, or 115 volts d-c, to meet AAR Specifications 12-10 and 12-22.

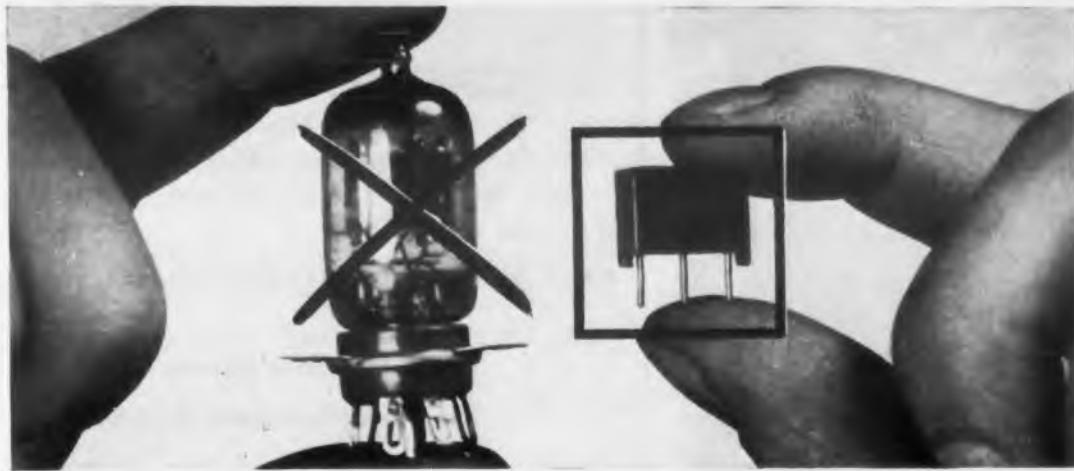
Open model is rated at 117 volts a-c, 60 cycle, 3600 rpm, 300 watts continuous at 0.9 power factor. Totally enclosed model, rated 175 watts, is same otherwise. Both sets have built-in automatic-reset thermal overload protection. See Bulletin GEA-6370.

GENERAL ELECTRIC

DIGEST

GENERAL ELECTRIC COMPONENTS FOR ELECTRONIC MANUFACTURERS

New low-cost double-diode *Vac-U-Sel** selenium rectifier replaces present 6AL5 tube in printed circuits



Longer life, smaller size and lower first cost make the new miniature General Electric Vac-U-Sel selenium rectifier an ideal replacement for the 6AL5 tube-in-socket rectifier now used in TV-horizontal-phase-detector circuits. This new rectifier measures 5/8 x 19/32 inches in profile, 1/4 x 19/32 inches from the top.

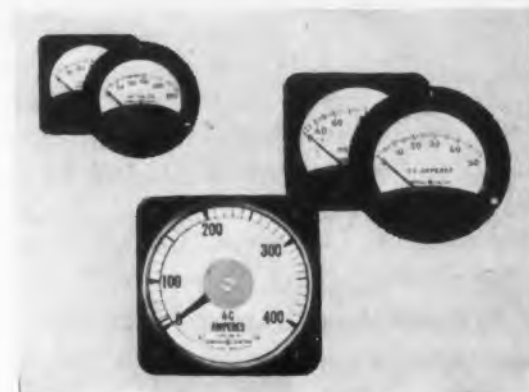
Encased in tough, durable, moisture-resistant plastic, the unit offers greater product uniformity, longer life and low cell capacitance. Ratings: 0.5 ma at 2.0 v d-c, 5.0 ma at 20 v d-c, 50 uuf 10% per section. Spacing between terminals is accurately maintained for automatic assembly in printed circuits. Wide range of uses in-

cludes its application as low-cost replacement of tube and socket rectifiers, as a voltage doubler, or in conventional wiring applications which require leads up to 1 1/2 inches in length.

Series is also available in common cathode and double circuits with a higher forward current rating of 1.5 ma continuous at 1.5 v d-c. Terminals are plainly oriented for easy identification. Tough over-all construction of this new General Electric unit practically eliminates breakage from handling. Ratings and mechanical configurations other than those described are also available. Send for descriptive bulletin GEA-6538.

*Trade-mark of General Electric Company.

Space-saving panel and switchboard instruments are accurate, easy to read



Designers no longer need be limited to large-size instruments to get a high accuracy and readability in panels and switchboards.

General Electric's line of miniature panel instruments combines these features with space-saving design—at low cost. The 2 1/2-, 3 1/2-, and 4 1/2-inch miniatures (above) are accurate within 2 per cent of full scale. Minimum depth behind panel provides economy of space. Alnico V magnets with sintered iron pole pieces, polished steel pivots, and tough low-friction jewels to withstand normal shock, assure extreme reliability.

General Electric's line of long-scale switchboard instruments feature minimum behind-panel depth, operate within 1 per cent accuracy. Shadow-proof covers, anti-parallax scale and pointer permit reading from any reasonable distance or angle. Available in 4 1/4-inch types (7.1-inch scale); or in 8 3/4-inch types (14.2-inch scale) for long range reading. Both scales span 250 degrees. See Bulletins GEC-218E and GEC-368H.

Miniature aircraft relay operates 300,197,234 times without a miss!



Unerring performance under severe climatic conditions, stress and shock makes this General Electric hermetically-sealed miniature relay a trustworthy component for electronic applications in aircraft, aboard ship, and on portable units. Designed to meet or better all provisions of MIL-R-6106 (Joint Military Service Specifications for Relays), this miniature relay outperforms its competitors. In tip-pressure tests, its magnetic structure gives 40-55 grams to its competitors' 22-40 grams while its load life proves to be from 220% to 625% longer. Greater pull force, higher dielectric strength and arc resistance, non-annealing contact fingers, and greater leakage resistance, assure a high degree of dependability. This relay is available in 2, 3 or 4-pole double throw and 6-pole normally open forms, in voltage sensitive, current sensitive and standard forms. See Bulletin GEA-6213.

New Permafil capacitors operate at 125 C ambients

Designed for operation in 125 C ambient temperatures at full rated voltage, General Electric's new Permafil capacitors meet the performance requirements of MIL-C-25A characteristic "K." They feature high insulation resistance values, and will not change in capacitance more than ± 10 per cent over a temperature range from -55 C to 125 C.

Because Permafil—a solid—is used as the impregnant, these General Electric capacitors cannot leak, and easily withstand the shocks and vibration of missile and airborne electronic systems. They have 100 per cent rating at altitudes up to 50,000 feet, save space because no derating is needed for high-temperature operation.

Permafil capacitors—now available in rectangular case styles—come in ratings .01 uf

to 10 uf; 100 v d-c to 1500 v d-c. For more data on how Permafil capacitors meet your application check Bulletin GEC-811.



GENERAL ELECTRIC COMPANY, APPARATUS SALES DIVISION, SECTION B667-35, SCHEENCTADY 5, NEW YORK.

Please send me the following:

for reference only

for planning immediate project

- | | | | |
|-----------------------------------|--------------------------------------|---|-------------------------|
| <input type="checkbox"/> GEA-5963 | Transformers and Inductors for Radar | <input type="checkbox"/> GEA-6538 | Selenium Rectifiers |
| <input type="checkbox"/> GEA-6213 | Miniature Relay | <input type="checkbox"/> GEC-218E | Switchboard Instruments |
| <input type="checkbox"/> GEA-6370 | Motor-alternators | <input type="checkbox"/> GEC-368H | Panel Instruments |
| | | <input type="checkbox"/> GEC-811 | Permafil Capacitors |
| | | <input type="checkbox"/> HB-3286, P. 23 | ARR-2 Relay |

For information on other products, contact your nearest G-E Apparatus Sales Office

NAME.....
COMPANY.....
CITY..... STATE.....

CIRCLE 56 ON READER-SERVICE CARD FOR MORE INFORMATION



BENDIX SUPERMARKET FOR PRECISION SYNCHROS

If you're in the market for precision synchros, it will pay you to make sure it's the *Bendix* "market" you're in. There you'll get—

FAST DELIVERY: Because of our heavy volume—as the country's largest producer of synchros—we can offer immediate delivery of practically all synchro types.

MINIMUM COST: Again, because of our heavy volume, we can fill even small-quantity synchro orders at production prices.

ALL TYPES—PREMIUM PRECISION: We make just about any type of synchro you could want—all built to the exacting precision standards that long ago made Bendix the "buy-word" for synchros.

So, when you're shopping for precision synchros to use as transmitters, receivers, control transformers, differentials, or resolvers . . . including corrosion-resistant and high-temperature models . . . be sure to find out what we have to offer.

District Offices: Burbank, Calif.; Dayton, Ohio; Seattle, Wash.
Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.

Eclipse-Pioneer Division

TETERBORO, N. J.



CIRCLE 65 ON READER-SERVICE CARD FOR MORE INFORMATION

**SIZE 8
CORROSION-
RESISTANT**




✓ **SYNCHROS**
Outstanding electrical characteristics.

✓ **MOTOR GENERATORS**
Smallest on market. Linearity
1/2 of 1% to 3000 rpm.



✓ **LOW-INERTIA
SERVO MOTORS**
High torque-to-inertia ratio.

Carrying Cases

Meet Mil Specs



A complete line of aluminum deep-drawn carrying cases has a seamless construction combining ruggedness with precision. Built to military specifications, MIL-T-945A, MIL-STD-1C8 and MIL-C-4150D, the cases have an extruded gasket retainer to provide a positive seal. Pressure relief valves can also be installed. Relative depths of cover and case may vary.

Zero Man. Co., Dept. ED, 1123 Chestnut St., Burbank, Calif.

CIRCLE 66 ON READER-SERVICE CARD FOR MORE INFORMATION

Ultra-Reliable Electrolytics

For Computer Power Supplies



A series of high-capacitance electrolytic capacitors is designed especially for filtering power supplies in digital computers and other applications which require an unusual degree of long and trouble-free service life. These Type 32D capacitors come in ratings ranging from 3600 μ f at 5 v to 700 μ f at 350 v dc working.

Sprague Electric Co., Dept. ED, Marshall St., No. Adams, Mass.

CIRCLE 67 ON READER-SERVICE CARD FOR MORE INFORMATION

Bearing Mounting Plates

Eliminate Jig Boring



These type AP bearing mounting plates are available in three shaft sizes, 1/8, 3/16 and 1/4 with clearance holes or tap holes to suit mounting requirements.

They eliminate the jig boring requirement to maintain tenth dimension on center to center distance allowing adjustable or floating center distances, and minimizing backlash.

The adapter is made of cast aluminum and is finished in chromic acid anodized for protective purposes.

PIC Design Corp., Dept. ED, Div. of Benrus Watch Co., P.O. Box C, E. Rockaway, N.Y.

CIRCLE 68 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • December 15, 1956

Signal Generator

Broad Frequency Coverage



Combining a frequency coverage of 10 mc to 490 mc with high accuracy and stability, the model 555 signal generator has 56 inches of scale

in 8 equal ranges. Hand calibrated to 1/2 per cent, dials are illuminated when in use, masked when idle. A piston attenuator of 0.2 μ v to 0.2 v operates without backlash. Modulation is cw, 400 cy, or 1000 cy, with standby switch. Output accuracy is 10 per cent at 0.2 v.

Clough-Bregle Co., Dept. ED, 6014 N. Broadway, Chicago 40, Ill.

CIRCLE 69 ON READER-SERVICE CARD FOR MORE INFORMATION

Feed-Through Terminal

Sub-Miniature



A sub-miniature feed through terminal is especially adapted to applications where space is at a premium. Standard basic dimensions are 0.770 in. overall length, .047 turret diameter and 3/16 in. hex nut diameter.

Standard body material is melamine, electrical grade (Mil-P-14, Type MME). The terminal is silver plated, the nut nickel plated. Flashover voltage of the new feed through terminal is normally rated at 8.4 high, 7.0 low, for an average of 7.9 kv dc.

Whitso, Inc., Dept. ED, EKN, 9330 Byron St., Schiller Pk., Ill.

CIRCLE 70 ON READER-SERVICE CARD FOR MORE INFORMATION

Cooling Panel

For Relay Racks



The Model RF cooling panel flushes clean, cool air through standard 19 in. enclosed relay racks. A built-in fan pulls air through a 2 in. thick fiberglass dustfilter on

which there is a novel Filter Pilot (white circle), which automatically indicates when filter replacement is due. Panel is capable of handling 2000 w dissipation with a 40 F temperature rise and can operate continuously in 125 F ambients. Height is 7 in. and total weight 7 lbs.

Rotron Mfg. Co., Dept. ED, Woodstock, N.Y.

CIRCLE 71 ON READER-SERVICE CARD FOR MORE INFORMATION

DOW CORNING
CORPORATION

Silicone Dielectrics

ELECTRICAL AND ELECTRONIC NEWS

No. 9

Giant Log Stacker Attains Peak Power With Class H Motors

Engineers designing large electrically powered equipment are attaining more power per pound while gaining the many advantages of placing the power unit closer to the work by using motors insulated with Dow Corning Silicones. An excellent example is the giant Electric Log Stacker produced by R. G. LeTourneau, Inc., Longview, Texas.

A separate high torque a/c motor connects directly to every point of load — lift fork, hold-down tusks, boom tilt and rear axle steering. And there is a separate d/c motor inside each of the four rubber-tired drive wheels. A diesel-generator set supplies power to any or all motors on demand.



The work potential of these mechanical giants is worthy of Paul Bunyan. A single bite of the lift forks conveys up to 25 tons of logs; one stacker can move more logs in 5 minutes than three conventional yard lifts can handle in 30 minutes!

To provide maximum power and reliability, every working motor — like all drive motors on all LeTourneau "electric wheel" equipment — is Class H insulated with Dow Corning Silicones. No. 35

Encapsulating Electrical and Electronic Parts with Silastic is the subject of a data sheet that provides details of handling heat-vulcanizable and room-temperature-vulcanizable silicone rubbers in such applications. No. 36

All New — 1957 Guide to Dow Corning Silicones is a twelve page, fact-filled catalog which briefly describes the silicone products of interest to most industries. Containing latest data and information, the guide is designed expressly to help you enjoy the advantages, profits, and savings made possible through imaginative use of these unique engineering materials. No. 37

ATLANTA • BOSTON • CHICAGO • CLEVELAND • DALLAS • DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D. C. (Silver Spring, Md.)
Canada: Dow Corning Silicones Ltd., Toronto; Great Britain: Midland Silicones Ltd., London; France: St. Gobain, Paris

CIRCLE 72 ON READER-SERVICE CARD FOR MORE INFORMATION

Improve Percolator With Silicone Laminate At No Extra Cost

Designers who make imaginative use of silicones to increase the life and reliability of toasters, steam irons and other appliances can often do so without adding a single penny to the cost of the finished product. A recent example is provided by Aluminum Goods Manufacturing Company, manufacturer of Mirro-Matic Percolators.

While Mirro-Matic's terminal pin insulators made of phenolic had proven satisfactory in normal use, the designers reasoned that abuse of the percolator could loosen electrical connectors and cause arcing. Phenolic is also prone to absorb moisture when splashed or dunked by careless users, raising a further possibility of insulator failure.



The risk of such breakdown, however, was entirely eliminated by the superior dielectric strength, heat and moisture resistance of silicone-glass laminates manufactured by Taylor Fibre Company. The moisture absorption of silicone laminate, for example, is only 0.02% compared with about 2% for phenolic.

And, because of the higher physical strength of silicone laminate, plain low cost stampings could be used instead of expensive molded parts. A further saving was produced by reducing breakage during assembly.

The score: greater reliability for the Mirro-Matic Percolator without adding a cent to production costs! No. 39

Silicone Insulated Conductors, a reprint from WIRE AND WIRE PRODUCTS, describes and compares eight different types of silicone insulated wire and cable currently available for different applications. No. 40

COIL BOBBINS OF SILASTIC RESIST HEAT, HIGH VOLTAGE

Combine high temperatures and high voltage and you'll quickly expose any weak link in an electrical insulation system. That's what happened when technicians at Transformer Engineers, Pasadena, California, tested conventional choke coils intended for use on aircraft fire control apparatus.

The tests revealed that conventional coil bobbins all too often developed "electrical punctures" in the tube-to-flange joints when subjected to 15,000 volts at 140 C operating temperatures.

The problem was overcome, however, with



bobbins molded in one piece of Silastic, the Dow Corning silicone rubber. Featuring excellent thermal stability and dielectric strength after prolonged exposure to high temperatures, their one-piece construction avoided tube-to-flange joints entirely. Over 3000 of them have been put into service in the last two years; not one failure has been reported to date. No. 38

Send Coupon for More Information

DOW CORNING CORPORATION - Dept. 4712
Midland, Michigan

Please send me 35 36 37 38 39 40

NAME _____

TITLE _____

COMPANY _____

STREET _____

CITY _____ ZONE _____ STATE _____

Linear Amplifier Single Channel Analyzer



Combining amplifier and single channel analyzer in a single compact unit, the Model 348A is suitable for such

applications as fission computing, oil well logging, and scintillation spectrometry.

Built to ORNL specifications, the unit utilizes silver-plated, teflon-insulated wire and the latest long-life, stabilized-characteristic, premium tubes.

Franklin Electronics Inc., Dept. ED, 225 E. 4th St., Bridgeport, Pa.

CIRCLE 74 ON READER-SERVICE CARD FOR MORE INFORMATION

Microphone Connectors Eliminate Soldering



Two new microphone connectors with wide terminals have broad headed screws for fast attachment of leads without soldering. Both connectors fit standard

single contact microphone connectors. No. 2501FL has long nickel plated handle with built in cable clamp in the end cap. Overall length is 2-5/8 in. Cable opening on end of handle is 1/4 in.

Switchcraft Inc., Dept. ED, 1328 N. Halstead St., Chicago 22, Ill.

CIRCLE 75 ON READER-SERVICE CARD FOR MORE INFORMATION

Test Probe Self-Hooking



A test probe equipped with a self-holding hook connector features a built-in terminal board which makes it easier to build special test probe assemblies, such as detectors, isolation networks, or low capacity probes. Available in five colors for lead identification.

E-Z Hook Test Products, Dept. ED, 1536 Woodburn Ave., Covington, Ky.

CIRCLE 76 ON READER-SERVICE CARD FOR MORE INFORMATION

**DOES THE COMPUTER INDUSTRY Need More
Specialized Equipment?
Read DESIGN '57—JAN. 1st ED**

Sylvania

NPN transistor complements



*—offer stage-by-stage
flexibility for every
basic portable
radio design*

A full line of NPN transistors for portable radio

—offers uniformly high quality, highest gain, and a stage-by-stage choice for desired power supply, sensitivity and output

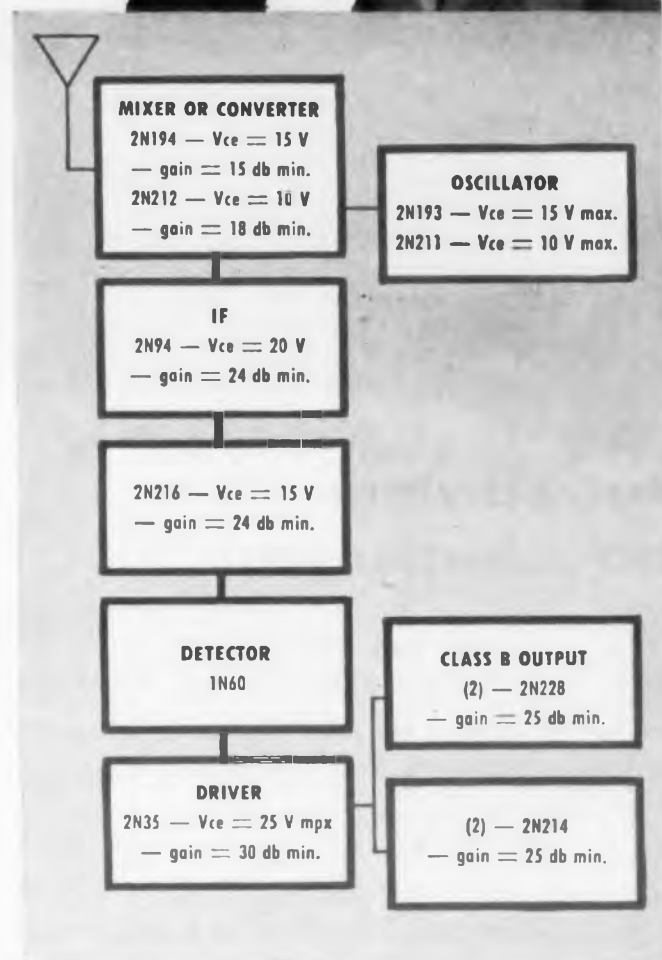
LEADING manufacturers who insist on the highest quality components for their transistorized portable radio designs are choosing Sylvania All-NPN transistor complements for good reasons.

Sylvania's experience in volume manufacture of NPN alloy junction transistors assures uniformly high quality—amazingly few line rejects.

And, whatever the power supply requirements, sensitivity, or output, Sylvania offers the designer complete flexibility in a line of transistors which can be interchangeable with PNP types.

Check this block diagram. It outlines the stage-by-stage choice which is afforded the designer. Mixer-oscillator or converter stage is a matter of desired balance between sensitivity and signal-to-noise ratio. There's a choice of IF for most economical design based bandwidth, power supply, and required output.

For complete details write on your company letterhead. Address Dept. M22R.



Silicon Diodes Diffused Junction



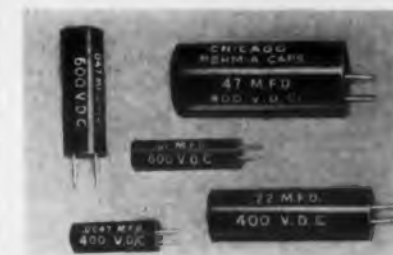
Solid state diffused junction silicon diodes available in six types, CK840 through CK845, have the following characteristics at 100 C: peak inverse voltage, 100 to 600 in steps of 100; reverse current at PIV, 0.2 ma max; forward current, 350 ma max; forward voltage drop at 350 ma 0.75.

Raytheon Mfg. Co., Dept. ED, 55 Chapel St., Newton 58, Mass.

CIRCLE 78 ON READER-SERVICE CARD FOR MORE INFORMATION

Printed Circuit Capacitor

For Automatic Insertion



Designed for automatic insertion, the Perm-A-Cap is a plastic-cased unit with parallel wire leads.

Tubular in shape, the unit may have

paper or Mylar dielectric. Epoxy resin seals the capacitor section against moisture. Performance characteristics and construction are carefully detailed in a catalog available from the company.

Chicago Condenser Corp., Dept. ED, 3255 W. Armitage Ave., Chicago 47, Ill.

CIRCLE 79 ON READER-SERVICE CARD FOR MORE INFORMATION

Junction Transistor

For Low Frequencies



A new germanium P-N-P alloyed junction 3 lead transistor type GT-109, is designed primarily for use in low frequency push-pull stages and low frequency rf amplifiers. Used in class B circuitry, the GT-109 offers high efficiency and low battery drain.

The entire unit is hermetically sealed in a metal case with glass headers.

The tinned flexible leads may be soldered into the circuit or used with standard plug-in sockets. They may be mounted in any position.

General Transistor Corp., Richmond Hill, N.Y.

CIRCLE 80 ON READER-SERVICE CARD FOR MORE INFORMATION

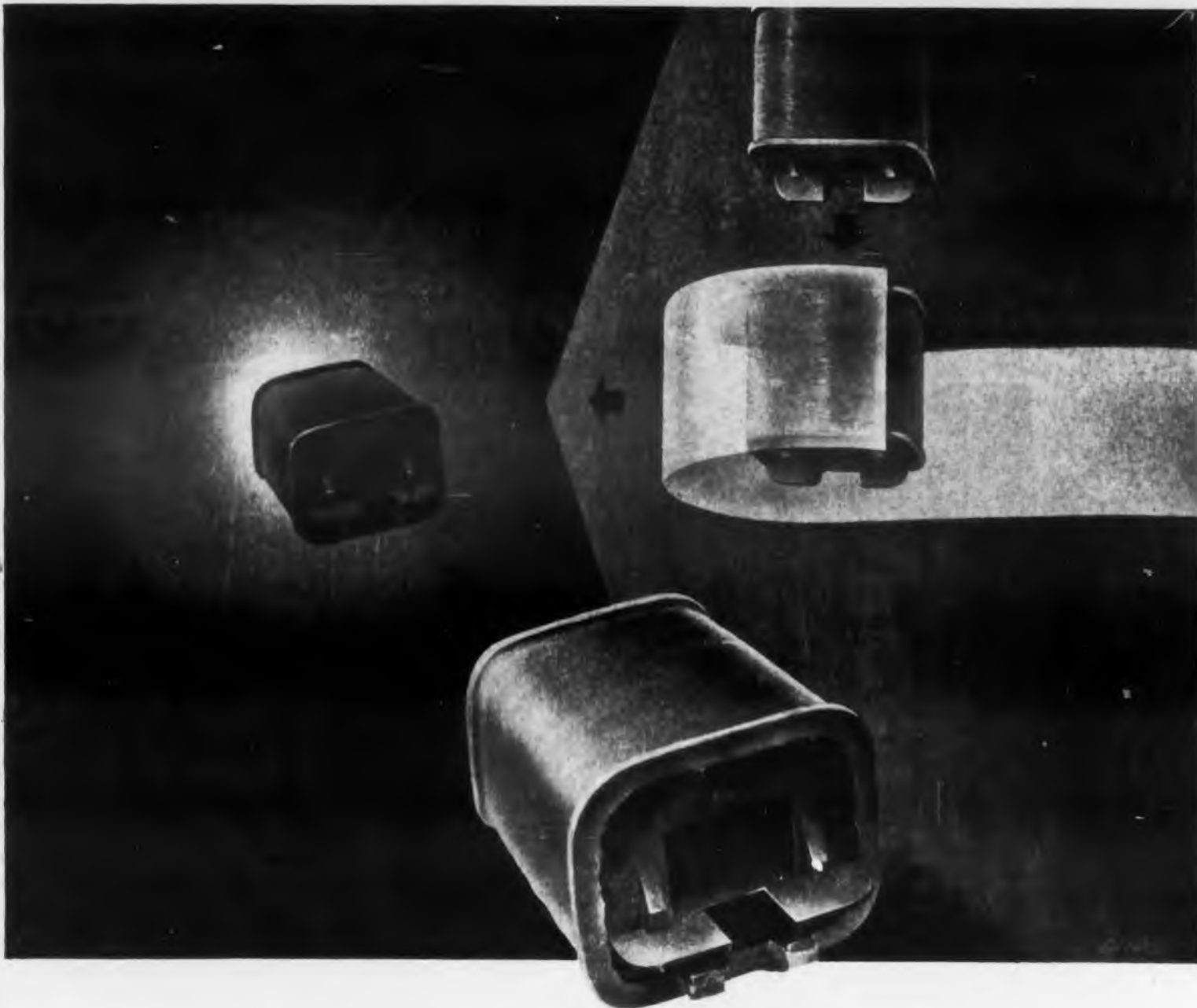


SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.
 1740 Broadway, New York 19, N. Y.
 In Canada: Sylvania Electric (Canada) Ltd.
 Shell Tower Building, Montreal

LIGHTING • RADIO • TELEVISION • ELECTRONICS • ATOMIC ENERGY

CIRCLE 77 ON READER-SERVICE CARD FOR MORE INFORMATION



New Irradiated Polyethylene Film shrinks . . . to do a better job

It's called **Irrathene**® irradiated polyethylene—this new plastic insulation which General Electric created by bombarding polyethylene with high-energy electrons. This *nonmelting* polyethylene film is ideal for "encapsulation" applications. It shrinks under heat to form a tight, tough, form-fitting, protective sheath.

The electrical industry is among the first to utilize Irrathene irradiated polyethylene. Wrapped around coils, as shown above, it heat-shrinks and bonds to press out air pockets, seal out moisture, provide tough, space-saving, low-cost insulation.

How can YOU benefit by switching to Irrathene insulation?

Irrathene irradiated polyethylene is the result of General Electric's advances in radiation chemistry. Flexible, nonmelting, impervious to water even on direct immersion, this new high-dielectric insulation offers superior protection for motors, bus bars, power cable, transformers. If you have not yet looked into the possibilities of Irrathene insulation for *your* equipment . . .

write today to General Electric Company, Chemical Development Department, Section U2, Pittsfield, Mass.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

CIRCLE 81 ON READER-SERVICE CARD FOR MORE INFORMATION

Decade Capacitors

Polystyrene Dielectric



The individual polystyrene capacitor units are non-inductively wound with purified high-molecular-weight polystyrene tape, heat treated, and hermetically sealed in brass cans with Teflon insulators. Polystyrene and Teflon are used as dielectrics in the decade switches. The decade assembly has an insulation

resistance of greater than 10^{12} ohms at 100 v. Dissipation factor is specified to be less than 0.0002 in the audio range and is usually about half that amount.

Individual type 980 decade capacitor units in steps of 0.001, 0.01, and 0.1 μf are available as well as a 3-dial type 1419-A decade capacitor with a range to 1.11 μf in steps of 0.001 μf . The low dielectric absorption of these units makes them particularly useful in research and development work on computer and integrator circuits, and on low-level dc amplifiers.

General Radio Co., Dept. ED, 275 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE 82 ON READER-SERVICE CARD FOR MORE INFORMATION

Single-Turn Potentiometer

For Instrumentation



A single turn potentiometer, with an operating temperature range of from -55 C to $+100$ C has wide application in instrumentation servomechanisms due to its compact size, high ac-

curacy and its adaptability to both mechanical and manual settings. Weighing approximately 1-1/2 ozs the 13-100-1 potentiometer has a diameter of 1-5/16 in. and a length of 57/64 in. beyond bushing. Total resistance range is 50 to 40,000 ohms, with linearity as close as ± 0.25 per cent. Dimensional stability, impact strength and heat dissipation are provided through one piece anodized aluminum alloy housing. Torque is 0.5 oz in.

The unit has electrical rotation of 356 degrees ± 2 degrees, continuous mechanical rotation, low noise level and long life. Up to 8 taps can be added during manufacture with each tap welded to a single turn of resistance wire.

Electromath Corp., Dept. ED, 190 Henry St., Stamford, Conn.

CIRCLE 83 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • December 15, 1956

Video Amplifier Transistorized



The Transifier, Model 126A, is a completely transistorized broad-band video amplifier. A true modular plug-in unit fully transistorized with feedback circuit built in for stabilized signal gain, it has the advantages of small size, long-life, low power consumption and high conversion efficiency. It may

be used as a preamp for oscilloscopes and vacuum tube voltmeters; as a humless audio amplifier; or as a wide band video amplifier.

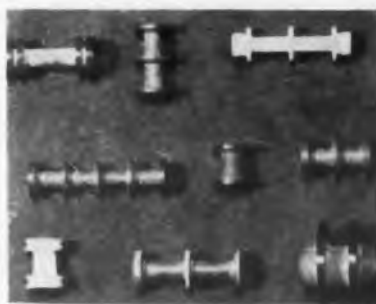
Frequency response in 10 db position is 3 db down at 20 cy and 15 mc. Gain is 10 db and 20 db switchable. Input impedance is a capacitance of 15 μ f and a resistive component of 20,000 ohms at 1 mc to 15,000 ohms at 10 mc. Output impedance is 500 ohms, approximately. Maximum output voltage is 0.15 v db position, 0.30 v 20 db position.

Kay Electric Co., Dept. ED, 14 Maple Ave., Pine Brook, N.J.

CIRCLE 86 ON READER-SERVICE CARD FOR MORE INFORMATION

HOW WILL INNOVATIONS in Air Navigational Systems Affect the Component Picture in '57?
Find the Answers in DESIGN '57—JAN. 1st ED

Epoxide Resin Bobbins For Wire Resistors



These bobbins, used for the construction of hermetically sealed resistors, are machined from filled thermosetting Epoxide resin rods. This resin has been selected

because its outstanding adhesion quality is ideal for hermetic sealing of wire wound resistors.

The bobbins are not affected by extremes in humidity, altitudes nor corrosive influences. The potting compound used for the encapsulating of the resistors is composed of the same resin as the bobbin form. This technique insures the hermetically sealed condition of the resistor at extreme temperatures.

Norrich Plastics Corp., Dept. ED, 35 E. 32nd St., New York, N.Y.

CIRCLE 87 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • December 15, 1956

HETHERINGTON

SWITCHES • INDICATOR LIGHTS • SPECIAL ASSEMBLIES

ENGINEERING NEWS #2

Space-Saver Toggle Gives Big Switch Performance

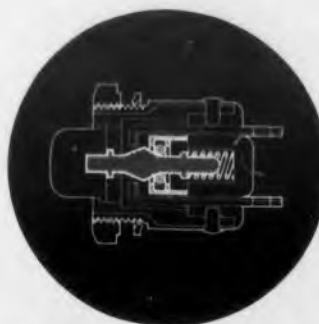


When it comes to making a *real* saving in space, this new SP-DT Hetherington Toggle Switch is the answer. It is only $1\frac{1}{32}$ " in diameter by $1\frac{1}{32}$ " long. It weighs less than $\frac{1}{4}$ oz. Yet it breaks 5 amp. resistive loads at 28 volts dc ($2\frac{1}{2}$ amps @ 115 v ac) for 50,000 operations.

Best of all, Hetherington's tease-proof cam-roller snap-action gives the T3103 the "feel" of a real heavy-duty switch. Details are in Data Sheet S-3a.

The Switch Design That Says "NO FOOLIN"

No Tease . . . No Deceptive Clicks



Higher ratings in smaller, lighter-weight switches are made possible by this little beryllium device . . . the heart of every Hetherington snap-action switch.

A polished tapered rod operates through two compression springs in the shorting bar and against the return spring. Its lightning-fast, double-break snap action reduces arcing and contact welding to negligible proportions—even with high momentary overloads. Contact pressure is actually greatest at the point of "make" or "break" thus preventing deceptive "clicks" or contact teasing.

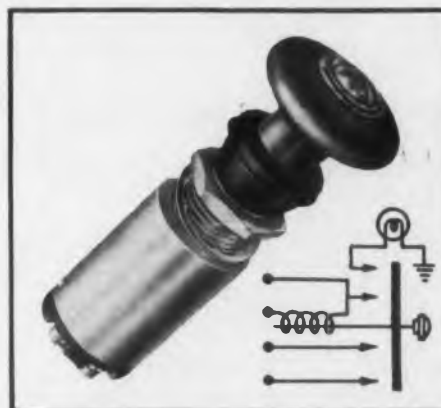


Relay, Switch, and Pilot Light Functions in One Unit Only $1\frac{1}{16}$ " x $3\frac{3}{8}$ "

This "control engineer's delight" does the work of *two* conventional switches plus a holding relay and an indicator light. All of this is accomplished in only a fraction of the space, weight, and wiring needed for separate components.

Once the button is pressed, a built-in 28-volt solenoid holds the switch on contact until either the coil circuit is externally interrupted or the button is pulled out. A built-in indicator light shows when the coil circuit is energized.

Modifications of this basic Hetherington Holding Coil Switch design include a variety of circuit arrangements. Pull-on and push-on pushbutton types as well as a toggle type are available. Their many aviation and industrial uses center



around jobs where the switch is manually "closed" to start an operation; then electrically "opened" at the end of the sequence. In an emergency, the switch may be manually opened in the middle of the sequence if desired.



W-I-D-E Angle Visibility from Indicator Lights only $1\frac{1}{4}$ " Long

Almost 50 percent of the surface of these tiny units is useful illuminated area. Thanks to a specially-beveled lens cap, light is "piped" evenly throughout the entire lens. Full 180-degree visibility is assured on either standard or edge-lit panels.

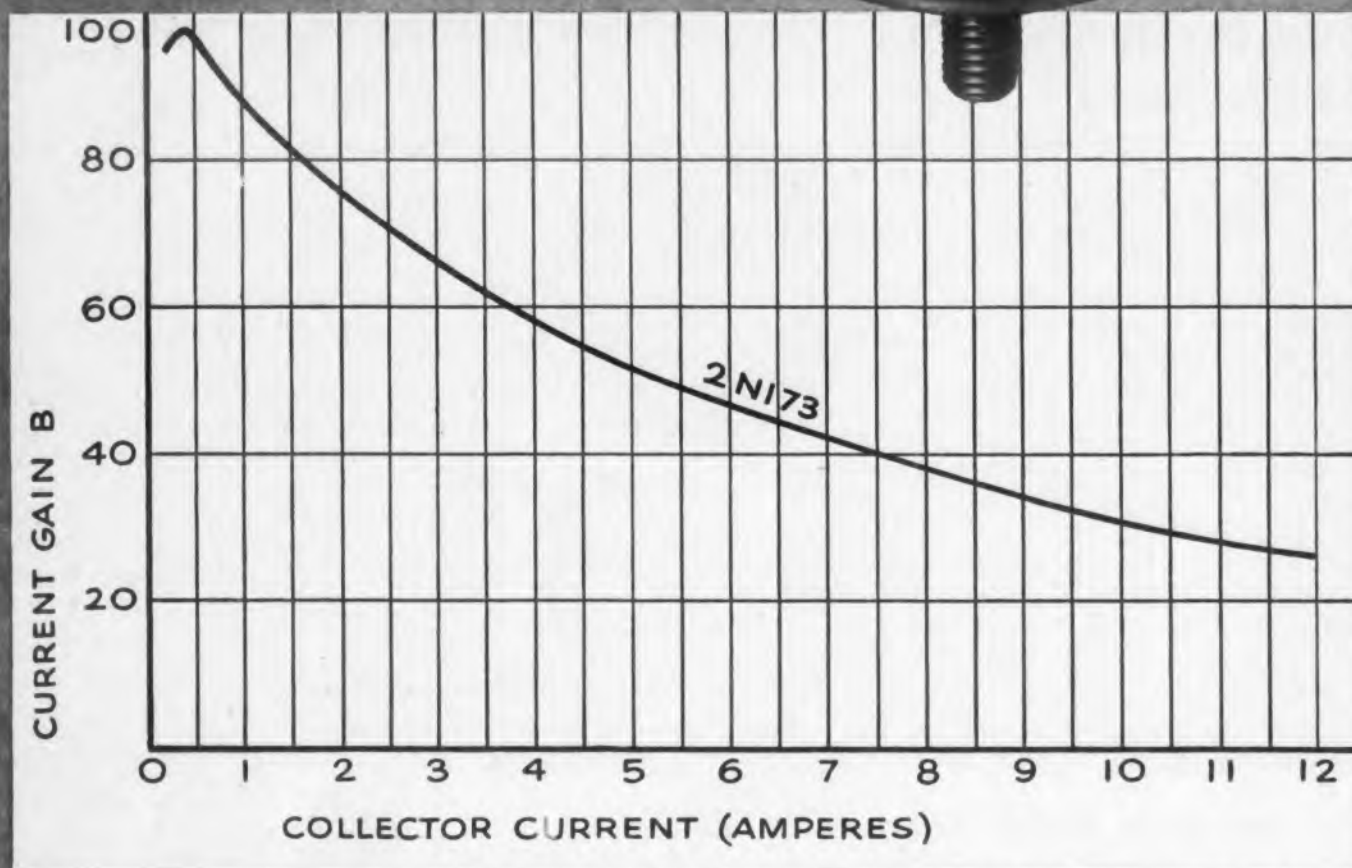
These miniature Hetherington Series L6000 lights come in both 2-terminal ungrounded, or 1-terminal case-ground styles. Single piece terminals and contacts cannot be torn loose by heavy wires. Request Bulletin L-2b.

HETHERINGTON INC. 1200 ELMWOOD AVE., SHARON HILL, PA. • 139 Illinois St., El Segundo, Calif.

Over 455 PRECISION push-button Switch Types

CIRCLE 88 ON READER-SERVICE CARD FOR MORE INFORMATION

Industry's Highest Power Transistors



Delco Radio "High-Power" Transistors set a new industry standard of performance—
Produced by the thousands each day!

Delco Radio alloy junction germanium PNP power transistors 2N173 and 2N174, now in volume production, are characterized by high output power, high gain and low distortion. Stabilizing processes eliminate the effect of time on performance characteristics.

The high power handling ability does not exclude applications for low and medium power levels. Performance at low levels exceeds that of many low power transistors and will provide a higher degree of safety and stability to equipment design.

TYPICAL CHARACTERISTICS		
Properties (25°C)	2N173	2N174
	12 Volts	28 Volts
Maximum current	12	12 amps
Maximum collector voltage	60	80 volts
Saturation voltage (12 amp.)	0.7	0.7 volts
Power gain (Class A, 10 watts)	38	38 db
Alpha cutoff frequency	0.4	0.4 Mc
Power dissipation	55	55 watts
Thermal gradient from junction to mounting base	1.2°	1.2° °C/watt
Distortion (Class A, 10 watts)	5%	5%

DELCO RADIO DIVISION OF GENERAL MOTORS
KOKOMO, INDIANA

CIRCLE 91 ON READER-SERVICE CARD FOR MORE INFORMATION

Two Power Tubes

For Industry



These two new three-electrode tube types, 7C25 and 7C23 are designed for a wide range of military and industrial applications. The 7C25 is a forced air cooled tube with anode dissipation of 2500 and plate input of 7000 w, calculated at 30 mc. The tubes can be operated up to 50 mc with proper derating. Type 7C23 is recommended for pulse-type operation because its peak power output is 120 kw, maximum pulse width is 90 μ sec and it has a maximum duty cycle of 0.005.

Central Elec. Mfg. Inc., Dept. ED, Denville, N.J.

CIRCLE 92 ON READER-SERVICE CARD FOR MORE INFORMATION

Vinyl Lacing Cord

High Elasticity



Bindtite .060 black vinyl lacing cord has good elasticity and tenacity and can be used in place of a waxed or other type cord for the lacing of cables in the construction of radio and electronic equipment. Because of its elasticity and tenacity, knot tying becomes a simple operation. It is also an excellent insulator, is resistant to heat and cold and impervious to fungus and termites. The lacing cord carries JAN approval under Certificate No. ANEESA-13004, Specification JAN-1-572.

Kenmore Sales Co., Dept. ED, Industrial Pk., Lowell, Mass.

CIRCLE 93 ON READER-SERVICE CARD FOR MORE INFORMATION

Open Transmission Line

Ready Made, Heavy Duty

A ready made heavy duty high frequency open wire transmission line is available in a variety of sizes to meet exacting impedance and capacitance requirements.

Wire size ranges from 6 ga to 16 ga, spacing from 3-3/4 to 12 in., with insulator spacing from 12 to 48 in. The over-all construction represents a rugged transmission line for use in temperatures ranging from +60 to -60 F. This wire is catalogued under military specifications.

Fretco, Inc., Dept. ED, 406 N. Craig St., Pittsburgh, Pa.

CIRCLE 94 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • December 15, 1956

**AUDIO
INSTRUMENTS & CONTROLS
AIRCRAFT ELECTRONICS**
Read DESIGN '57—JAN. 1st ED

**Your Customers
List Their
Requirements**

**Magnetic Storage Unit
1092 Character Capacity**



The 1092-BU-7 coincident-current magnetic core storage unit is designed for application as a temporary store, buffer or delay unit in data-processing, computing and automation systems. It has a capacity of up to 1092 characters, each of which may

be up to 7 binary digits in length. The 7 bits of each character are loaded and unloaded from the memory in parallel. The characters are introduced sequentially and are available at the output in the same sequence. Minimum time for loading or unloading operation is 14 μ sec per character with 6 μ sec being required to switch from loading to unloading, or vice versa.

Telemetry Magnetics, Inc., Dept. ED, 2245 Pontius Ave., Los Angeles 64, Calif.

CIRCLE 95 ON READER-SERVICE CARD FOR MORE INFORMATION

AC-DC Solenoid

Small, Lightweight



The new Model DS Solenoid, engineered to meet the requirements of a small, light, actuator, is designed for both continuous and intermittent duty in industrial and commercial use. It is suitable for ac and dc applications in automatic machines requiring a moderate

amount of power, such as recording equipment.

The coil of the new Model DS solenoid is varnish impregnated, a smooth brass tube provides low friction characteristics; and all ferrous parts are cadmium plated. The solenoid has a maximum stroke of 3/8 in. and is available in three mounting styles for operation from 3 to 115 v, and a model is available for high temperature conditions.

Artisan Electronics Corp., Dept. ED, Morristown, N.J.

CIRCLE 96 ON READER-SERVICE CARD FOR MORE INFORMATION

Microwave Frequency Meters
by
FREQUENCY STANDARDS



In offering these frequency meters we have endeavored to bring to the electronics industry instruments for frequency measurement which are fairly priced yet without sacrificing a high degree of accuracy resulting from precision manufacture. The frequency determining element of these instruments is a cylindrical resonator with a tuneable choke plunger that provides a smooth and accurate interpolation of frequency. Four models are offered, each model covering a wide frequency range and employing standard waveguide and flanges. Three types, described below, are offered in each frequency range. All models have been designed to use the standard FS Model M-1000 Micrometer Head which has been widely accepted by the electronics industry. Construction is of Invar and accuracy is .01% under laboratory conditions.

Three Types Available

WAVEGUIDE ABSORPTION TYPE I cavity is mounted on the broad face of waveguide. The transmission indication is secured by a crystal loop monitor located opposite the iris input coupling hole. (Type illustrated)

WAVEGUIDE FEED TYPE II cavity is mounted as the termination of a short section of waveguide. The cavity body and output coupling loop are the same as Type I.

WAVEGUIDE TRANSMISSION TYPE III cavity is the same as Types I and II but waveguide is used for input and output coupling.

DESCRIPTIVE LITERATURE AVAILABLE ON REQUEST

TYPE	FREQUENCY RANGE	WAVEGUIDE
Models 8211— 3	8200 to 11500 MC	RG-52/U
Models 7010— 3	7000 to 10000 MC	RG-51/U
Models 5882—1, 2, 3	5800 to 8200 MC	RG-50/U
Models 4458—1, 2, 3	4400 to 5800 MC	RG-49/U

Frequency Standards
General Offices: ASBURY PARK, NEW JERSEY

Address inquiries to
BOX 504



CIRCLE 97 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC a HAYDEN publication WEEK





**Wilson Directive Shortens Army Missile
Range to 200 Miles page 23**

December 3, 1956

**Semiconductor Business
to Quintuple
by 1960 6**

**Air Force Seeks
Foolproof World-Wide
Communications 10**

**Value Engineering
Saves Money
For the Navy 25**



Complete Electronic News Coverage— Every Week—From All Over The World



ELECTRONIC WEEK is reporting America's fastest-growing industry—clearly—concisely in a single publication. Here is *all* the electronic news brought to you from world-wide electronic centers by correspondents experienced in the electronic field. *The Week in Electronics... Washington Report... Electronics and the Law... Broadcasting... Labor... Finance... Inside Wall Street... Taxwise Tips... Marketing... Contract Awards... Foreign News... People... Plants.* This is information of value to management of all levels.

If you haven't seen ELECTRONIC WEEK recently, write today for a sample copy.



a HAYDEN publication
19 East 62nd Street, New York 21, N.Y.

WRITE FOR YOUR

FREE SAMPLE COPY

Circle ED Number 500

on Reader Service Card or Write Direct for a
Sample Copy

Qualification for Subscription is Based on
Job Function

No Fooling
with Tooling

Instrument and Control
Knobs—PRICED RIGHT

High quality—
low cost stand-
ard parts

Hard finish ther-
mosetting plastic.
Available fast—
often from stock

Many more de-
signs than shown
—complete size
range in most



Send for complete catalog

KURZ-KASCH, INC.

Standard Parts Division
1422 S. Broadway, Dayton 1, Ohio

CIRCLE 101 ON READER-SERVICE CARD FOR MORE INFORMATION

a proven performer
always in control



the **A. W. HAYDON CO.**
delayed reset time delay relays

Protect power
tubes in
expensive
transmitting,
receiving or
control
equipment

SPECIFICATIONS

1. Operating temperature range: -65°F to 160°F .
2. Vibration: 5-55 CPS with 10g maximum acceleration.
3. Shock: 30g (11ms duration)
4. Hermetically sealed units meet military requirements for fungus, humidity, and salt spray.

Write for Bulletin AWH TD402 describing 6400 Series DC, 11400 Series AC, 24300 Series 400 Cycle.



A.W. HAYDON
COMPANY
227 NORTH ELM STREET
WATERBURY 20, CONNECTICUT

Design and Manufacture of Electro-Mechanical Timing Devices

PREFERRED
WHERE
PERFORMANCE
IS
PARAMOUNT

CIRCLE 102 ON READER-SERVICE CARD FOR MORE INFORMATION

High Pressure Transducer

Sensitive and Accurate



In full-scale ranges from 1000 to 10,000 psig, a magnetic reluctance pressure transducer of the diaphragm type is now available. For use in recording and control systems com-

patible with inductance-ratio input devices, the instrument makes possible static and dynamic pressure measurements which are accurate to within ± 1 percent of full scale.

Direct use of corrosive liquids and gases at temperatures from -65 to $+250$ F are possible since 416 SS is used. A 18-8 SS modification can be substituted on special request.

Model P2G weighs 18 oz, has a diameter of 1-3/4 in. and an overall length of 3-5/8 in.

Pace Engineering Co., Dept. ED, 6914 Beck Ave., North Hollywood, Calif.

CIRCLE 103 ON READER-SERVICE CARD FOR MORE INFORMATION

**WHAT NEW PROGRAMMING METHODS Are
Causing Major Design Changes?**

Read DESIGN '57—JAN. 1st ED

Slotted Lines

2.6 to 18 KMc



Six portable slotted lines, Models 319 to 324, incorporate a carriage drive mechanism that is integral with the waveguide assembly, insuring minimum slope and elim-

inating readjustments.

These impedance meters can be used to measure VSWR and impedance from 2600 to 18,000 mc per second covering the waveguide sizes from 3 x 1-1/2 in. to 0.702 x 0.391 in.

The residual VSWR is under 1.01 and both slope and slot leakage are imperceptible.

The carriage is provided with a mounting hole for use with standard military and commercial probes and detectors.

The Narda Corp. Dept. ED, Mineola, L.I., N.Y.

CIRCLE 104 ON READER-SERVICE CARD FOR MORE INFORMATION

Here are
the facts
you
need!



to cut your fastening costs

Write today for this 40-page Catalog

Comprehensive 40-page catalog covers complete line of Simmons Fasteners. Contains dimensional drawings of each fastener type, engineering data, installation details and instructions for ordering. Pictures and describes numerous applications throughout electrical, electronics, automotive, railroad, aviation, building, furniture, appliance and other industries.

SIMMONS FASTENERS

Quick-Lock • Spring-Lock • Roto-Lock • Link-Lock • Dual-Lock

SIMMONS FASTENER CORPORATION

1763 North Broadway, Albany 1, N. Y.

CIRCLE 106 ON READER-SERVICE CARD FOR MORE INFORMATION



GAMBLE?

sure . . . if the odds
are in YOUR favor . . .

DECISION/INC—nationwide specialists in recruitment of engineering personnel—have an active and enviable record in developing job opportunities for men who want bigger salaries and a chance for greater personal achievement.

DECISION/INC is retained by more top-ranking firms thruout the nation than any other organization to find the right man for each job. This confidential service costs you nothing.

It takes **TIME—MONEY—EFFORT** to improve your job situation. If you are an engineer or scientist, particularly in the **ELECTRONIC—AERO-NAUTICAL** or **GUIDED-MISSILE** field, **DECISION/INC** will do this quickly, effectively at no cost to you.

HOW? Our placement specialist develops a plan "tailor-made" for you—which includes a resume of your experience . . . and then a review by selected companies leading to confidential interviews at your convenience and our client's expense.

NOW is the time for DECISION!

All you do Now is . . . send us your name, home address, job interest or title. We take it from there.

Write or phone:

OLIVER P. BARDES,
President—
DECISION/INC
1440-71 FIRST NATIONAL
BANK BLDG.
CINCINNATI 2, OHIO
GARfield 1-1700



Publishers of the authoritative Engineers' Job Directory

CIRCLE 107 ON READER-SERVICE CARD FOR MORE INFORMATION

FOR THE QUESTION...

What will
happen?

THE ANSWER IS...

A53+MR-1*

To obtain missile break-up data, the combination of Model A53 high current output accelerometers and a Model MR-1 recorder has proven to be a successful system.

STATHAM Model A53 accelerometers produce a signal of ± 0.4 milliampere into a 40 ohm load. They are small in size and light in weight.

*Please request
Statham Bulletin
No. A53.*

The Model MR-1 is a miniature airborne magnetic tape recorder manufactured by North American Instruments, Inc., 2420 N. Lake Ave., Altadena, California, and is described in their Bulletin 104.

* The formula "A53 + MR-1" demonstrates the ability of Statham Laboratories to cooperate with recorder manufacturers in a joint effort to serve the engineering field.

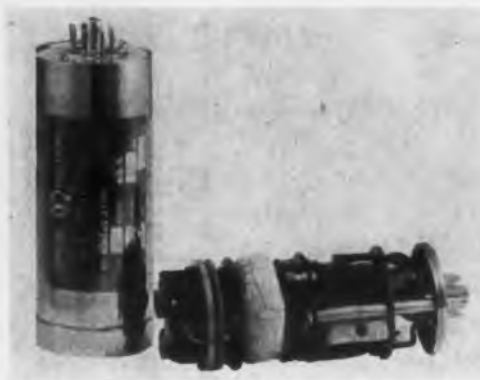
Statham
LABORATORIES

12401 W. Olympic Blvd. Los Angeles 64 Calif.

CIRCLE 109 ON READER-SERVICE CARD

DC Power Converter

Transistorized



Converting 6, 12, and 24 battery voltage to higher dc voltages for vacuum tube plate supplies, a new line of transistorized power units claim advan-

tages over rotary equipment, including smaller size, lighter weight, and higher conversion efficiency. The devices are capable of long life under adverse conditions of vibration, acceleration, and humidity. The converters feature a unique free-running transistor multivibrator, high efficiency filtering, and a semi-conductor bridge rectifier.

The unit pictured is 5-1/8 by 2 inches, and delivers 25 w at 70 C ambient temperature.

Quantum Electronics, Inc., Dept. ED, 1921 Virginia St., NE, Albuquerque, N. Mex.

CIRCLE 110 ON READER-SERVICE CARD FOR MORE INFORMATION

Electrical Contacts

Stand Large Currents



These electrical contacts are able to withstand large currents without welding or sticking. Containing silver and cadmium oxide, the Gibsiloy compositions provide excellent arc-quenching traits, low contact

resistance, high conductivity and low material loss. KA-2 and KA-3 silver and cadmium oxide materials are sintered powdered-metal mixtures. KB-2 and KB-3 materials are fabricated from wrought alloy compositions.

KA contacts are supplied in the form of discs, rectangles, irregular shapes in sizes up to 1 in. thick x 8 in. square maximum. KB contacts are supplied as rivets beaded from wire, rectangles cut from stock, projection-weld-backed discs.

Gibson Electric Co., Dept. ED, 8444 Frankstown Ave., Pittsburgh 21, Pa.

CIRCLE 111 ON READER-SERVICE CARD FOR MORE INFORMATION

WHAT ARE THE LATEST TRENDS in Instrumentation?

Be Sure to Read DESIGN '57—JAN. 1st ED

DIEHL

Instrument Servo Motors with Tachometer Generators and Gear Reducers

Two phase 60 cycle servo motor designed with high torque-to-inertia ratio furnished with either high or low impedances for use with transistor, vacuum tube or magnetic amplifiers.

Providing three servo system components that can be obtained separately or in any combination. Built to meet high humidity requirements but competitively priced for commercial application.

Servo motor with gear reducer offers five different ratios. Rugged spur gear construction can carry a continuous load torque of 90 oz. inches.

Servo motor with AC tachometer generator provides an easy adjustment to stabilize the system. Residual voltage of 100 millivolts with 115 volt excitation.

Servo motor with gear reducer and AC tachometer forms a convenient package of three components ready for your application.

Diehl design and engineering staff will be happy to help any manufacturer in the selection of designed-for-the-job combinations of Instrument Servo Motors and ancillary units.



other available components

- AC SERVOMOTORS •
- AC SERVOMOTORS WITH AC TACHOMETERS •
- AC SERVOMOTORS WITH DC TACHOMETERS •
- AC AND DC TACHOMETERS •
- DC SERVO SETS • RESOLVERS

DIEHL MANUFACTURING COMPANY

Electrical Division of THE SINGER MANUFACTURING COMPANY
Finderne Plant, SOMERVILLE, N. J.

Please mail Manual RPT-355, describing Diehl Servo Motors and related equipment.

NAME _____ ED
COMPANY _____
STREET _____
CITY _____ STATE _____

CIRCLE 112 ON READER-SERVICE CARD FOR MORE INFORMATION



*Elco
Screws
are
Good
Screws*

... Ask a man who has used them

ELCO SEMS The "Sems" method of pre-assembled screws and washers is used by ELCO to produce cost-reducing units of many kinds. Stock SEMS are made up of standard screws and washers — *special SEMS* can be designed, engineered, and produced to order as required. Let us quote on your standard requirements — send us your prints on specials. Write for free package of samples.



REMEMBER ELCO

WOOD SCREWS
MACHINE SCREWS
MACHINE SCREW NUTS
TAPPING SCREWS
THREAD-CUTTING SCREWS
PHILLIPS AND SEMS SCREWS
PIPE PLUGS
STOVE BOLTS
CAP SCREWS
LAG SCREWS
DRIVE SCREWS
SPECIAL SCREWS
COLD HEADED PRODUCTS

WE ALSO SPECIALIZE IN
MAKING ANY OF OUR
PRODUCTS OF THE
FOLLOWING MATERIALS

Stainless Steel
Bronze
Brass
Copper
Silicon Bronze
Ambrac
Monel
Aluminum
Special Analysis

ELCO TOOL AND SCREW CORPORATION
1948 BROADWAY • ROCKFORD, ILLINOIS

CIRCLE 114 ON READER-SERVICE CARD FOR MORE INFORMATION

Megohm Decade Box

Precision Standard



Each of the 10 standard resistors contained in this unit are 100,000 ohm precision wire wound; accurate to ± 0.005 per cent absolute; matched to within 0.002 per cent absolute. The temperature coefficient of resistance wire is 0.000005 per degree

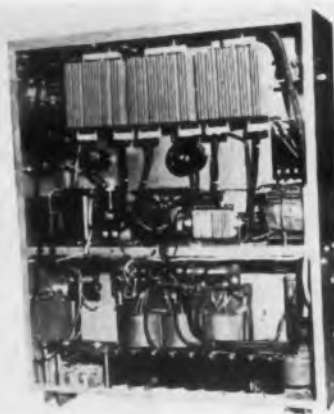
C. Voltage rating of each resistor or combination thereof is 200 v ac. Resistors calibrated at 25 C. Each resistor is terminated to individual terminal posts, and the use of gold plated links makes it possible to select any resistance value from 10,000 ohms to 1,000,000 ohms in intermediate steps.

Eastern Precision Resistor Corp., Dept. ED, 675 Barbey St., Brooklyn, N.Y.

CIRCLE 115 ON READER-SERVICE CARD FOR MORE INFORMATION

**WILL CHANGES IN THE GROWTH of the
Magnetic Tape Market Affect
Component Requirements?
Find Out in DESIGN '57—JAN. 1st ED**

**Regulated DC Supply
Uses Magnetic Amplifier**



This regulated power supply utilizes magnetic amplification to maintain selected output voltage within 10 percent voltage variation in input voltage. It has an input of 208, 220/440 v, 3 phase, 60 cy, an output of 44-52 v, 60 amp.

Efficiency is approximately 75 percent, regulation is $\pm 1/2$ percent of pre-set voltage, and ripple is 0.1 v rms.

Design utilizes a 3 phase bridge circuit, selenium rectification, and a magnetic amplifier to supply regulated dc power for computer systems. Convection cooled selenium rectifier stacks are electrically balanced and fully protected against prolonged overheating by a thermal warning switch.

Rapid Elec. Co., Dept. ED, 2881 Middletown Rd., Bronx 61, N.Y.

CIRCLE 116 ON READER-SERVICE CARD FOR MORE INFORMATION



ACTUAL SIZE
OF NEW
BLILEY BG6A

A New
**CRYSTAL UNIT
WITH PLUS
FEATURES FOR
PRECISION
APPLICATIONS
IN RANGE
3 mc to 100 mc**

This all-glass vacuum mounted crystal unit offers *high reliability for applications which require minimum ageing*. When used with drive level less than one milliwatt, frequency shift due to ageing will not exceed .0002% during the first year of service.

Supplied for oven or non-oven operation. Specify Bliley type BG6A.



BLILEY ELECTRIC CO.

UNION STATION BUILDING • ERIE, PA.

CIRCLE 117 ON READER-SERVICE CARD FOR MORE INFORMATION

Berkeley NEWS NOTES



NEW IN-LINE, IN-PLANE READOUT

- One-plane presentation; easily read from any angle
- Reduces fatigue, reading error
- Speeds data observation
- High reliability, low maintenance

BRIEF SPECIFICATIONS:

No. digits: 4, 5 or 6
Digit size: $3/4$ " to $1 1/4$ "
Operating speed: To 15 readouts per second
Input: Binary voltages from counting instruments
Overall dim.: $5 1/2$ " H x $20 3/4$ " W x 17" D; 35 lbs.
Price: \$610.00 (4 digit) to \$775.00 (6 digit) (f.o.b. factory)

Write today for complete data; please address Dept. D-12.

Berkeley

division

BECKMAN INSTRUMENTS INC.

2200 Wright Avenue • Richmond 3, Calif.

CIRCLE 118 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • December 15, 1956

How to select a Thermistor

Fenwal Electronics has just completed a comprehensive catalog on thermistors. It tells what thermistors are; what they do; where they are used; and how to select a thermistor for different types of applications. It's comprehensive. It has complete technical data. And it's free.

Fenwal engineers are highly experienced in the manufacture of precision thermistors. Fenwal Electronics produces a complete line of highly stable thermistors in the form of small beads, discs, washers and rods. Because Fenwal thermistors have such a high sensitivity and great stability they are ideal for many applications.

Send for free catalog. Whether you are now using thermistors or not, you'll find it handy to have on file. Write to Fenwal Electronics Incorporated, 51 Mellen St., Framingham, Mass.



Makers of Precision Thermistors

CIRCLE 120 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW ENGLAND Junior Utility Ovens

- Low cost • Easy to operate
- Minimum maintenance

Junior Sized: 24" x 24" x 34"
Temp. range to 1000°F.

4 Models to choose from

Model	Internal dimensions	Temperature range
CA 250	22" w by 20" d by 23" h	up to 250°F
CA 550	20" w by 17" d by 22" h	100° to 550°F
CA 650	20" w by 17" d by 22" h	100° to 650°F
CA 1000	18" w by 15" d by 21" h	100° to 1000°F

Ideal for:
Baking
Drying
Curing
Processing
Heat Treating
Product Control
Sample Testing

90 day Guarantee on workmanship and materials.

All 4 models have baked hammertone gray finish with an inside lining of Armco aluminized sheet steel.

STANDARD EQUIPMENT: Bottom drip pan, 2" above oven floor; interlocking switches for fan and heating element prevents heat element being turned on unless fan is running; pilot light for oven; pilot light for heating element.

SPECIAL EQUIPMENT: Temperature control instrumentation and non-standard power supply arrangement available.

ALSO A COMPLETE LINE OF HEAVY DUTY, CUSTOM BUILT INDUSTRIAL OVENS AND DRIERS.
Representatives in most major cities.

NEW ENGLAND OVEN & FURNACE COMPANY INC.
ORANGE, CONN.

CIRCLE 121 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • December 15, 1956

Receptacles

Fuse and Sign Types



The No. 266A and No. 266 receptacles have been added to this firm's line. The 266A is a Bakelite fuse receptacle with a solid center contact, rated 30 amp 125 v and measuring 1-19/64 in. diam x 1-11/32 in. high. The No. 266 is a Bakelite keyless, medium-base, sign receptacle in one piece, rated 660 w 600 v and measuring 1-19/64 in. diam x 1-1/2 in. high.

Fuse and lamp mounting hole size of the two units is 1-21/64 in. diam. Ear mounting holes are spaced at 1-3/4 in. Both units are available with male push-on terminals instead of binding screws and can be had with an insulating cover for binding screw terminals only.

Circle F Mfg. Co., Dept. ED, Trenton 4, N.J.

CIRCLE 122 ON READER-SERVICE CARD FOR MORE INFORMATION

WHAT IMPORTANT DEVELOPMENTS Will Affect the Design of Microwave Equipment? Components? General Communication?
See DESIGN '57—JAN. 1st ED

Transistor Curve Tracer Used With Oscilloscope



This transistor curve tracer, when used with an oscilloscope, presents one curve at a time of the collector family (V_c vs I_c), with I_b held constant. This may be done on all npn, pnp, surface barrier, grown or diffused junction transistors. The base current is indicated at all times on a four inch panel meter and can be varied from zero to 500 μ amp. The collector current can sweep out to 10 ma while the limits of collector voltage being swept are controlled. Calibrated coordinate axes are displayed at all times.

Another use is the presentation of the forward and reverse characteristics of crystal diodes with the calibrated axes. The voltage versus current characteristic of thermistors and varistors can also be displayed simultaneously with calibrated axes. Sonex, Inc., Dept. ED, Upper Darby, Penna.

CIRCLE 123 ON READER-SERVICE CARD FOR MORE INFORMATION



announces an unusually precise

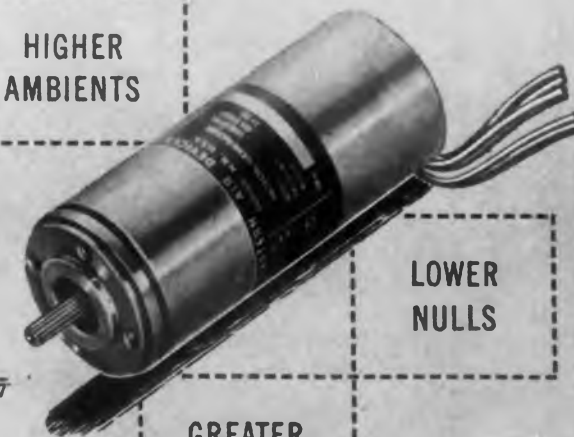
SERVOMOTOR-TACHOMETER GENERATOR

HIGHER AMBIENTS

LOWER NULLS

GREATER RUGGEDNESS

SIZE 11
S11HLX7



for
**INSTRUMENTATION
FIRE CONTROL
AUTOPILOTS
MISSILES
COMPUTERS**

FEATURES:

Zero Speed Voltage (RMS)

8.0 mv in phase
15.0 mv quadrature
19.0 mv total

Ambient temp. Linearity

150°C

0.5% @3600 rpm
Servo meets Bu. Ord. MK-14 specifications.
Equipped with precision gearhead for lower backlash.
Rugged, one-piece assembly.

WRITE for complete detailed information

EASTERN AIR DEVICES, INC.

SOLVING SPECIAL PROBLEMS IS ROUTINE AT EAD

391 CENTRAL AVENUE • DOVER, NEW HAMPSHIRE

CIRCLE 124 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW ROBERTS TESTER

PERFECTLY MATCHED
CORES . . .



Eliminate major cause of magnetic amplifier rejects

Westinghouse is now offering tape-wound cores of Hipernik® V that are guaranteed perfectly matched. Now, manufacturers of magnetic amplifiers no longer need be faced with the problem of having to reject finished units that do not meet performance standards because of poor core matching or testing.

Development of the first practical sine-current, flux-reset core tester has made perfect core matching possible. This equipment is shown above with its developer, R. W. Roberts of the Westinghouse Research Laboratories.

It is not necessary for magnetic amplifier designers to work with the entire characteristic curve of the core . . . a cumbersome task. The Roberts Tester determines test points T, AT, DAT and SAT which give an accurate picture of the range of characteristics. These test figures can be used directly in magnetic amplifier design—no cut and try is necessary.

For further details, circle the proper number on the reader-service card, see your Westinghouse sales engineer or write to Westinghouse Electric Corporation, Specialty Transformer Department, P. O. Box 231, Greenville, Pa.

J-70773-X

WATCH WESTINGHOUSE!

WHERE BIG THINGS ARE HAPPENING FOR YOU!

CIRCLE 125 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature DC Motors

1 Inch Generators



Miniature DC motors and generators 0.875 inches in diameter, 1.625 in. long and .098 in. shaft diameter have self-aligning sleeve bearings with nylon retainer to assure quiet running. Units can be supplied with ball bearings and have a hardened, ground, lapped shaft, and Alnico TV ring type stator. An adjustable brush bracket is provided for accurate speed of voltage out-put for CW or CCW rotation.

Heinz Mueller Eng. Co. Dept. ED, 1906-08 No. Cicero Ave., Chicago 39, Ill.

CIRCLE 126 ON READER-SERVICE CARD FOR MORE INFORMATION

Card-Tape Converter

For X-Y Recorders



The Card-Tape converter, Model 150, converts contact closures from an IBM Punch, Flexowriter Tape, or E-1 10 keyboard (Model

175), to proportioned resistance or voltage values.

Data is programmed into the Converter memory by a control circuit which programs the Converter and interlocks the machine during the "read" cycle. This insures that errors due to stray pulses are eliminated. Speed is 50-80 cards per minute, and scale factors 0-999 counts per inch.

Electro Instruments, Inc., Dept. ED, 3794 Rosecrans St., San Diego, Calif.

CIRCLE 127 ON READER-SERVICE CARD FOR MORE INFORMATION

Sensitive Relay

Low-Drain Miniature



A new sensitive relay operates on as little as 10 mw of power. The relay measures 1-3/4 in. in height, is 0.968 in. square, and weighs but 3 oz. It operates over a temperature range of from -65 C to +105 C with high vibration resistance in both SPDT

and DPDT models. At the 10 mw power rating the relay has coil resistances of 8000 and 10,000 ohms and at 40 mw ratings of 500, 2500, 8000 and 10,000 ohms.

Elgin National Watch Co., Dept. ED, Elgin, Ill.

CIRCLE 128 ON READER-SERVICE CARD FOR MORE INFORMATION



ALLEN
MINICAP
AND
MINISET
SOCKET SCREWS!

#0 THRU #3

*Dependable fastening,
easier assembly, for your
"miniaturized" products*

Count on these Allen Miniature Cap and Set Screws for Allen accuracy and uniformity — in sockets, threads, heads and sizes. Extremely close tolerances are maintained in these very small screws. Strength is so great that you can use fewer, or smaller, screws to hold securely.

Sockets are highly accurate, for maximum tightening — so accurate that these miniature screws will hold to the key for placing and starting. Allen Minicaps are knurled, and *trimmed* on top and under the heads, for better fit and appearance.

Allen's long experience in dependable fastening is at your service when you're developing your "miniaturized" designs. Just call on the Allen engineers for prompt and practical help.

Your Industrial Distributor has Allen Minicaps and Minisets now.

*Sold Only Through Leading
Industrial Distributors.*



ALLEN
MANUFACTURING COMPANY
Hartford 2, Connecticut, U.S.A.

CIRCLE 129 FOR MORE INFORMATION

Molded Units Have All-Weather Protection



A Raytheon transformer molded with Acme compound

WITHOUT METAL CASES

For example—

ACME 2002 POTTING COMPOUND is unaffected by climatic changes and assures 100% protection against extremes of temperature ranging from -100° F. to $+185^{\circ}$ F.

Developed to withstand elevated and subzero conditions, ACME 2002 forms a hard, moisture-proof seal that will not crack or become brittle when subjected even to sudden changes in temperature. Exterior casings are not necessary.

There are many Acme Compounds for various applications. Let us help you.



Integrated Electrical Products
of Highest Quality for
Over Fifty Years

ACME WIRE CO.

NEW HAVEN, CONN.

MAGNET WIRE • COILS
VARNISHED INSULATIONS
INSULATING VARNISHES
AND COMPOUNDS

CIRCLE 131 FOR MORE INFORMATION

HOW WILL COLOR TV Affect the Component Parts Picture? Get Your Copy of DESIGN '57—JAN. 1st ED

DC Microvoltmeter Has Transistor Amplifier



The MV-51A dc transistor voltmeter has a sensitivity of $0-10 \mu\text{v}$ and covers a total measuring range to 10 v with a total of 13 ranges. Input impedance is 1 k on all low ranges, up to $0-1 \text{ mv}$; it then increases proportionate with the measuring range until it reaches 10 m on the 10 v range. This new instrument does not use a chopper in spite of its high sensitivity. Instead, a low-drift direct-coupled transistor amplifier is used which operates in a so-called "hushed condition" (zero or reversed collector junction voltage). Drifts are further minimized by a temperature compensation amplifier, which is also transistorized, and a transistor battery voltage regulator. Long term drift stability is $10 \mu\text{v}$ and short term drift stability is $4 \mu\text{v}$.

Millivac Instrument Corp., Dept. ED, 444 Second St., Schenectady, N.Y.

CIRCLE 132 ON READER-SERVICE CARD FOR MORE INFORMATION

10 MC Decade Scaler Large Bias Range

The Model 414 fast decade scale of 1000 has been designed to allow accurate high speed nuclear and other counting with a long term reliability.



The gated decade system makes possible a decade with a large bias range and an inherent reliability approaching that of a binary.

Diode input coupling to each flip-flop in the 10 mc and 1 mc sections and at the input of the slower decades further enhance reliability.

A five digit electrical register resets automatically with the scaling stages and follows a scale of 1000 which can be increased on special order up to a scale of 1,000,000. The pulse resolution is $0.1 \mu\text{sec}$ and continuous counting rates to 10,000,000 per second can be provided.

Electrical and Physical Instrument Corp., Dept. ED, 42-19 27th St., Long Island City 1, N.Y.

CIRCLE 133 ON READER-SERVICE CARD FOR MORE INFORMATION

For Miniature Helical Potentiometers

Call...

CIRCUIT

INSTRUMENTS INC.



TYPES H-150 and H-155

Miniature 1½" diameter size. Turret type terminals. Rotation: Type H-150 3600, -0 +4°; Type H-155 1800, -0 +4°. Power rating 6 watts and 5 watts respectively. Patented stop mechanism completely separate from element and brush.



TYPE H-151

Only 1½" diameter x ¾", exclusive of shaft and turret terminals. Continuous rotation; stops available on special order. Standard linearity ±0.5%. Power rating 3 watts. Standard resistance values from 50 to 15,000 ohms. Weight 2 ounces.



TYPES H-100 and H-105

Slim 1" diameter. 5 and 10 turn types. Rotation: Type H-100 3600, -0 +4°; Type H-105 1800, -0 +4°. Power rating 4 watts and 3 watts respectively. Flexible silver plated terminals or rigid turrets available.



TYPE H-101

Tiny 1" diameter by ¾", exclusive of shaft and turret terminals. Weight is 1 ounce. Power rating 1½ watts. Standard resistance values from 50 to 10,000 ohms. Continuous rotation; stops available on special order.



TYPES H-750 and H-755

Ultra-thin ¾" diameter size. Type H-750 3 watts, standard resistance values from 250 to 50,000 ohms. Type H-755, standard resistance values from 125 to 25,000 ohms. Either flexible silver plated terminals or rigid turrets available.



TYPE H-751

Small ¾" diameter by ¾" body size, exclusive of shaft and turret terminals. Weight 1 ounce. Power rating 1 watt. Standard resistance values from 100 to 10,000 ohms. Continuous rotation; stops available on special order.

Note: Linearities (independent) can be supplied to ±0.1% for most resistance values.

SEND COUPON FOR
SPECIFICATION SHEETS

Subsidiary of



INTERNATIONAL RESISTANCE CO

CIRCUIT INSTRUMENTS INC.

Dept. D, P.O. Box 355, St. Petersburg, Florida
St. Petersburg, Florida

Send technical data sheets on the following Type H Potentiometers:

() () () ()

Name _____

Address _____

City _____ State _____

CIRCLE 134 ON READER-SERVICE CARD FOR MORE INFORMATION

Q

What is an attenuator?



A

An attenuator is a resistive network, either fixed or variable, designed to reduce the power output of a signal system by a definite amount. Furthermore, it can keep the input impedance or output impedance, or both impedances, constant, depending on the type of network.

Q

What are the uses of attenuators?

A

- Volume controls in multi-channel mixers • Meter multiplier controls
- Equalizer controls • Sound level controls • Video and R. F. line controls
- Controls in transmission systems and transmission measuring equipment

Q

Why use a step-type attenuator?

A

A high degree of accuracy and repeatability is obtainable in a step-type, since the resistors are individually calibrated • The switch contact noise is practically eliminated by the use of precious metal contacts • Life of the unit is increased greatly over units in which the rotor arm makes contact with the resistor elements • Indexing by positive detent action is available for resetting of readings at an exact resistive position, or a position with a specific decibel loss.

Q

Where can complete information be obtained on the various types and designs of attenuators?

A

From the Daven Attenuator Catalog—the "BIBLE" of attenuator users. Daven has over 2,000 listed catalog types to solve your problem. Step-type Potentiometers, Ladder Networks, "T" Pads, Balanced "H" Units. Attenuators are available covering the audio, video or R. F. frequency ranges. Fixed pads . . . plus variable units with 10, 20, 30 and 45 steps are but some of the units covered.

Our Engineering Department will be glad to work with you on attenuators for specialized applications.



THE DAVEN CO. 524 West Mt. Pleasant Avenue
Route 10, Livingston, New Jersey

WORLD'S LARGEST MANUFACTURER OF ATTENUATORS

**RADIO & TV
COMMUNICATIONS
COMPUTERS**

**Your Customers
List Their
Requirements**

Read **DESIGN '57—JAN. 1st ED**

Power Positioner Has High Torque



This remote positioning system features torque capacity independent of error signal magnitude, high speed operation

without overshoot or oscillation, and small size actuator with high torque capacity.

The systems have been designed for industrial applications and operate from 115 v ac 60 cy power. The basic components are an amplifier and a high torque motor. Torque capacities are up to 100 in. lbs depending on output speed, for which standard gear ratios are available up to 100 rpm.

Globe Industries, Inc., Dept. ED, 1784 Stanley Ave., Dayton 4, Ohio.

CIRCLE 430 ON READER-SERVICE CARD FOR MORE INFORMATION

Time Delay Relays Dial Head Adjustment



For time delay applications requiring frequent time adjustments these time delay relays have dial markings permitting calibration for accurate adjustment and each dial is color coded to identify the timing range. Four timing ranges available are 1/10 second to 3 seconds, 1/10 second to 10 seconds,

10 seconds to 2 minutes, 30 seconds to 15 minutes. The new dial head models consist of a pneumatic timing head, a solenoid assembly, a switch, a coil and terminals.

Relays are relatively unaffected by temperature changes from -65 to +160 F. They are available for ac operation at all standard voltages from 6 to 550 v, 60 cy and 25 cy, or for dc operation from 6 to 230 v.

Elastic Stop Nut Corp. of America, A'G'A Div., Dept. ED, Elizabeth, N.J.

CIRCLE 431 ON READER-SERVICE CARD FOR MORE INFORMATION

◀ CIRCLE 135 ON READER-SERVICE CARD

New Twin Triode, Diode, Beam Power, and CRO Tubes

The 6201 is a "premium" high-mu Twin Triode of the 9-pin miniature type, constructed to perform under shock and vibration. This version of the 12AT7 is especially suited for use in mobile and aircraft equipment at frequencies up to 300 mc. Design features include a U-frame construction to keep the mount rigid, and the use of precise tube parts to lock the parts firmly in place.

The 19AU4 is a half-wave Rectifier Tube of the glass-octal type intended for use as a damper diode in horizontal-deflection circuits of TV receivers. This tube is designed with an 18.9 v 600 ma heater having a controlled heating. Rated for a maximum peak inverse plate voltage of 4500 v, the 19AU4 can supply a maximum peak plate current of 1050 ma and a maximum dc plate current of 175 ma.

The 6CD6-GA is a high perveance Beam Power Tube of the glass-octal type designed for use as a horizontal-deflection amplifier in television receivers. Utilizing a button-stem construction in a T-12 envelope, the 6CD6-GA is smaller and more compact than the 6CD6-G, but permits operation at higher ratings. The 6CD6-GA has a maximum peak positive-pulse plate voltage rating at 7000 v, and a maximum plate dissipation of 20 w.

The 6DG6-GT is a Beam Power Tube, glass-octal type, designed for service as an output tube in audio amplifiers requiring high power sensitivity and high efficiency at low plate and grid-No. 2 voltages. In class A1 audio-amplifier service, a single 6DG6-GT operating at a plate voltage of 200 v and a grid-No. 2 voltage of 125 v, will deliver 3.8 w with a peak af grid-No. 1 voltage of 8.5 v.

The 5FP14-A is a 5-inch Oscilloscope Tube featuring high resolution capability and a medium-long persistence characteristic. It is intended particularly for pulse-modulated applications.

Radio Corporation of America, Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 432 ON READER-SERVICE CARD

CIRCLE 433 ON READER-SERVICE CARD ➤

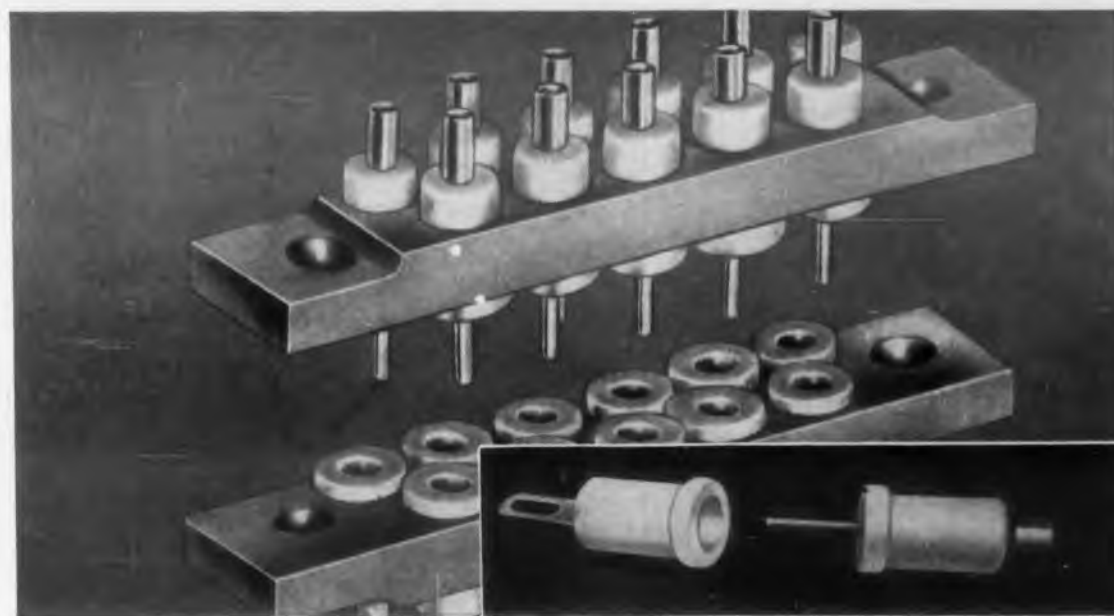
DU PONT

ELECTRONIC DESIGN

NEWS

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

Electronic connectors of Du Pont TEFLON® unaffected by temperature changes, humidity and mechanical shock



"Connectors of Teflon" with their respective mating parts. Male and female connector pins can be compression-mounted directly into drilled or

punched chassis holes. Available in various RMA colors. (Manufactured by Fluorocarbon Products, Inc., Division of United States Gasket Co., Camden 1, N.J.)

Laminations of TEFLON® for printed circuit bases

Typical uses for laminations of glass cloth and Du Pont "Teflon" tetrafluoroethylene resin include: conductor and ground insulation, hookup wire, power cable, printed circuit bases and structural parts. The laminations combine the dielectric properties, chemical inertness and heat resistance of "Teflon" with the tensile strength, resistance to cut-through, and resistance to creep of woven glass fiber.

An informative free bulletin describing the preparation and uses of laminations and impregnations of glass cloth employing "Teflon" tetrafluoroethylene resin is now available. Specify Bulletin X-64.

SEND FOR MORE INFORMATION

For complete details that will help you further evaluate the Du Pont engineering materials for use in your product-development programs, mail the coupon at the right. Specific property and application data will be sent to you.



Magnifying lens of LUCITE® for Stromberg-Carlson communication-system control panel. Names or numbers under the lens are magnified with maximum optical clarity—easily visible from a distance. "Lucite" resists cracking, crazing and chipping and is unaffected by age. (Lens extruded by Anchor Plastics Co., Long Island City, New York.)

New connectors with bodies of "Teflon" are designed for low-loss, high-frequency service in interconnection of radio, radar and other electronic equipment—where connectors are subjected to a wide range of temperatures, pressure, humidity and mechanical shock and vibration.

Continuous current rating is 3 amp. for .040 pins and 5 amp. for .063 pins. Voltage rating is 3,300 V. RMS (short time test at sea level).

Du Pont "Teflon" tetrafluoroethylene resin was selected for this particular insulation job because of its unique properties. In this application, it is serviceable at temperatures from -110°F. and operates in pressure altitudes from sea level to 60,000 ft. It has zero water absorption by ASTM test D570-42.

"Teflon" is nonflammable and will not carbonize under arcing; it has good dielectric strength. Resiliency of "Teflon" enables the insulation to expand to original diameter after it is pressed into the hole—and locks the connector securely and permanently in place.

Have you investigated the possibilities for "Teflon" in your electronic design application? Do you require material that is chemically inert, suitable for use at extreme temperatures of -450°F. to 500°F., tough and resilient? For complete property data on this versatile Du Pont engineering material, mail the coupon below.

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department
Room 2212 Du Pont Building, Wilmington 98, Delaware.
In Canada: Du Pont Company of Canada Limited, P.O. Box 660, Montreal, Quebec.

Please send me more information on the Du Pont engineering materials checked:
"Teflon"* , "Lucite"* . I am interested in evaluating these materials for _____

Name _____ Position _____

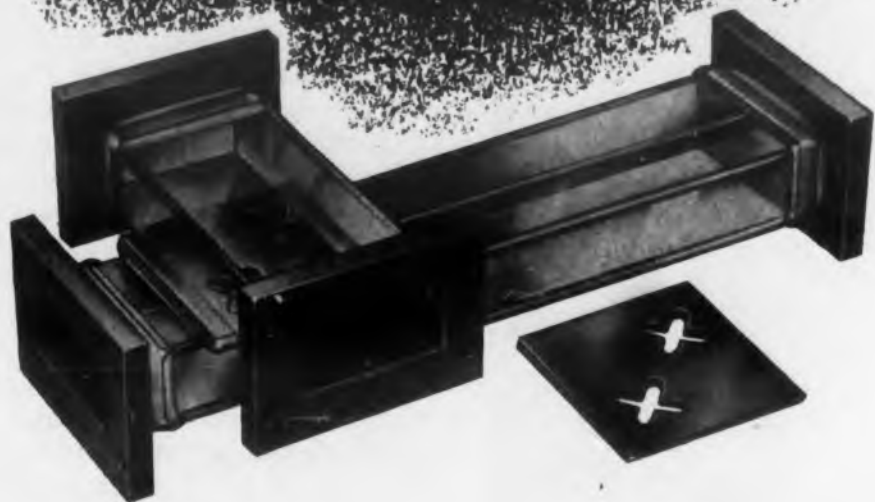
Company _____

Street _____ City _____ State _____

Type of Business _____

*Registered trademark of E. I. du Pont de Nemours & Co. (Inc.)

GAR-FORMING



for extreme accuracy and exact duplication

complex internal shapes made "INSIDE OUT"

This unique electroforming process produces precision, internally-shaped parts, such as this microwave coupler, with internal accuracies, fine surface finish, and configurations unobtainable or economically prohibitive with any other method.

The intricate interior is formed from the inside out, and may include machined parts that are grown in place during electroforming to produce an integral assembly of unusual accuracy, rigidity, and lightness.

Machined flanges are also grown in exact position to eliminate heat distortion associated with fabrication methods.

Offering new concepts in the design of intricate precision parts, Gar-forming provides highest accuracy in any quantities at surprisingly low costs.

Send today for full information

GAR PRECISION PARTS, INC.
5 LUDLOW STREET, STAMFORD, CONNECTICUT

CIRCLE 136 ON READER-SERVICE CARD FOR MORE INFORMATION

Cooling Tube Clamps

Have Integral Sockets



The 6A-4 and 6A-5 are additions to a line of integral sockets built into a rigid socket mount. Featuring a sleeve of heat-treated silver alloy, the cool clamps are silver

plated copper sleeves, which are in turn soldered to silver plated hard-drawn copper bases. The MIL approved sockets are mechanically locked into the copper base, providing a rigid mount to withstand vibration.

The Birtcher Corp., Industrial Div. Dept. ED, 4371 Valley Blvd., Los Angeles 32, Calif.

CIRCLE 137 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Thermostat

For Surface Sensing



This hermetically sealed surface-sensing miniature thermostat shows high stability and rapid temperature response. It has a design which shortens the heat path between the mounting surface and thermal-

sensing element thus decreasing the response time over 50 per cent.

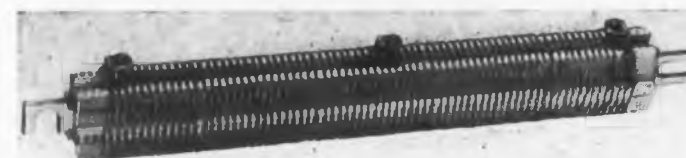
Units are pre-calibrated, and strain relief construction prevents calibration drift when unit is subjected to temperature variation between minus 50 C and plus 200 C.

George Ulanet Co., Dept. ED, 425 Market St., Newark 5, N.J.

CIRCLE 138 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Resistors

For High Currents



A new line of resistors for high-current, low-resistance applications are known as round-wire type, power-rib resistors. The units consist of ceramic insulators assembled on a metal bar and wound with resistance alloy wire. The construction is designed to provide flexibility and resistance to shock, plus efficient heat dissipation. Brackets and terminals are heavily plated to prevent oxidation.

Ohmite Mfg. Co., Dept. ED, 3649 Howard St., Skokie, Ill.

CIRCLE 139 ON READER-SERVICE CARD FOR MORE INFORMATION

for a
good connection..



USE
**Automatic
CONNECTORS**

Up to date production facilities using the most modern high speed, automatic machinery producing quality components for the Electronics and Telecommunications Industries.

Automatic's high standards of quality are based on over 15 years experience manufacturing precision parts for the Army, Navy, Air Force and Atomic Energy Commission.

Prompt engineering service is available for design and production of any special connector or component you may require.

Manufacturers of

**RF FITTINGS • RF CONNECTORS
COAXIAL RELAYS • COAXIAL
SWITCHES • INSULATED CONNECT-
ING RODS AND SHAFTS • POWER
PLUGS • AUDIO PLUGS • COAXIAL
CABLE ASSEMBLIES**

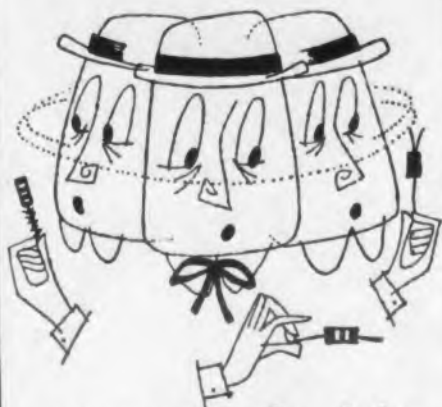
WRITE, WIRE OR PHONE FOR FURTHER
INFORMATION.

Automatic
METAL PRODUCTS CORP.

319 Barry Street, Brooklyn 11, N.Y. • EVergreen 8-0364

CIRCLE 140 ON READER-SERVICE CARD

Looking for the right resistor?



*you can find it
in this catalog...*



...along with everything you'll want to know about the complete standard line of Speer Resistor Products — specifications, characteristics and applications:

- Fixed Composition Resistors
- Phenolic Coil Forms
- Iron Coil Forms

Be sure to send for your copy today.

Other Speer Products for the Electronics Industry

anodes • contacts • fixed carbon resistors
coil forms • discs • brushes • battery
carbon • graphite plates and rods
also R. F. coils • fixed composition capacitors • chokes made by Jeffers Electronics



SPEER RESISTOR DIVISION
SPEER CARBON COMPANY
Bradford, Pennsylvania

Send copy of the Speer Resistor Catalog.

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

CIRCLE 142 ON READER-SERVICE CARD

Circle Template

1/64 Inch Increments



The No. 140 large circle template has 45 circles, diameter sizes from 1/16 in. to 2-1/4 in., increments 64ths to 11/32 in., 32nds to 3/4 in., 16ths to 1 in. and 8ths to 2-1/4 in.

Each circle is milled for precision and smoothness. Pencil allowance is provided for accuracy. Made of 0.030 matte finish plastic, printing is on the matte finish, and an etch ink is employed for durability. Actual size of the template is 8-1/4 in. by 7-1/4 in.

Rapidesign Inc., Box 592, Dept. ED, Glendale, Calif.

CIRCLE 143 ON READER-SERVICE CARD FOR MORE INFORMATION

Noise Measuring Set And Sound-Level Meter



A portable, self-contained battery operated noise measuring instrument Type 34-B is designed primarily to measure noise over telephone

circuits. It can also measure acoustic sound levels, function as a transmission measuring set, and as a high gain calibrated amplifier for audio frequency measurements.

The Daven Co., Dept. ED, 530 W. Mount Pleasant Ave., Livingston, N.J.

CIRCLE 144 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistor Tester In Kit Form

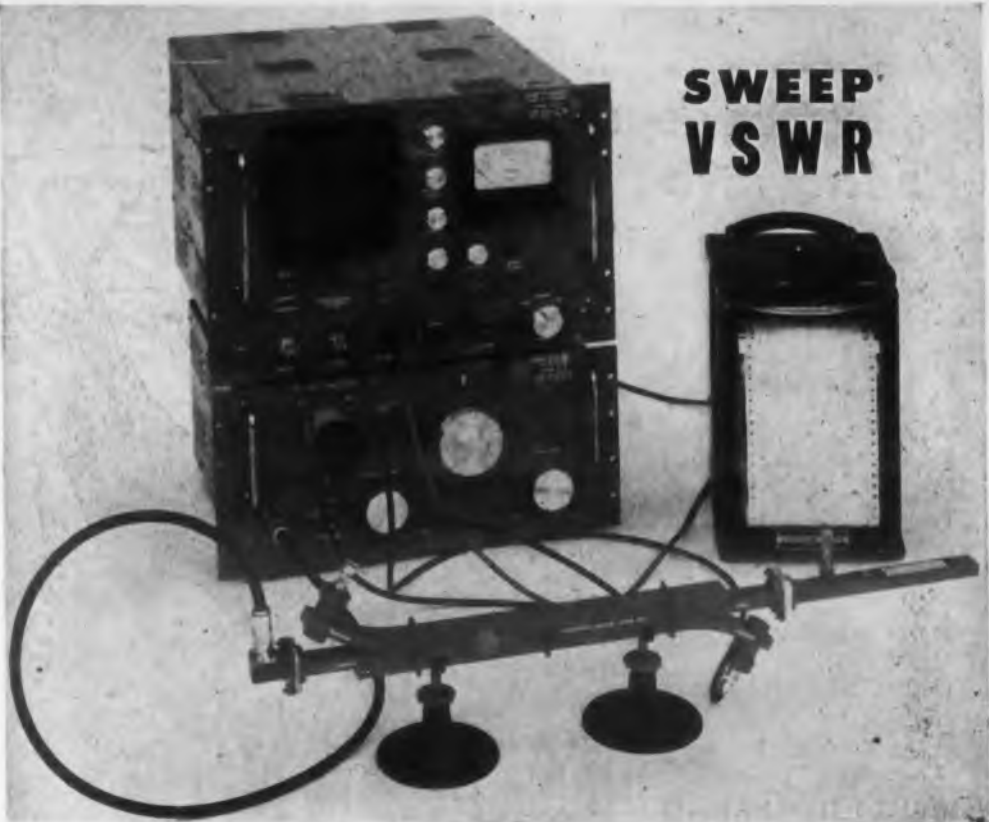


The Model TT2 is a precision tester which measures the basic transistor characteristics. The transistor can be measured for short, open and leakage. A reference bias is established, using 1 per cent calibration components. A small known signal is automatically applied

to the input terminals of the transistor and the current gain read on the beta scale.

Kit-Tronics, Dept. ED, 2315 Hendola Dr., N.E., Albuquerque, N. Mex.

CIRCLE 145 ON READER-SERVICE CARD FOR MORE INFORMATION



**SWEEP
VSWR**

8500 to 9600 mc AT A GLANCE

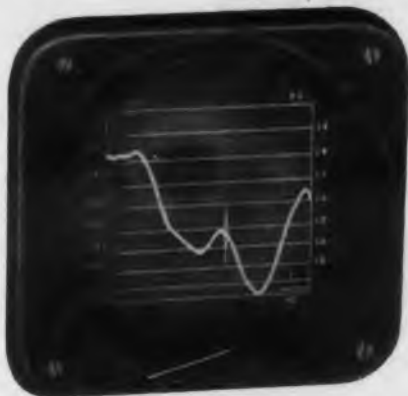
Automatically sweeping all or any segment of the frequency range of 8500 to 9600 mc at rates of 1 or 0.1 cps, the CTI Model 125 Sweep VSWR Measuring System provides better than 2% overall accuracy throughout the band. High accuracy plus simplicity of operation result from the complete system concept of the basic design.

Getting the entire VSWR picture at a glance, the operator can make adjustments on broadband components being tested and see the effects instantly. This simplicity makes the Model 125 ideal for both laboratory investigations and production-line go/no-go testing. Output is provided for graphic recording when desired.

The compact bi-directional coupler has over 45 db of directivity and is designed specifically for the system. Using the optimum value of coupling (16 db) both arms, including bolometer mounts, are matched within 0.1 db. The built-in oscilloscope requires no adjusting as the independent sweep-width, center-frequency, or sweep-rate controls are changed.

In development: An 8400 to 12,400 mc Sweep VSWR System.

Also available: Model 110B for manual scanning.



Ingeniously edge-lighted scales identify the individual VSWR range in use—1.02 to 1.20 or 1.1 to 2.0.



COLOR TELEVISION INCORPORATED

BELMONT 9 CALIFORNIA

CIRCLE 146 ON READER-SERVICE CARD FOR MORE INFORMATION

Looking for dependable
microwave
test equipment?



NARDA'S NOTED FOR IT!

The most complete line of UHF and microwave test equipment including such instruments as:

WAVEGUIDE COUPLERS

COAXIAL COUPLERS

WAVEGUIDE TERMINATIONS

COAXIAL TERMINATIONS

FREQUENCY METERS

HORNS

TUNERS

ECHO BOXES

MIXERS

SLOTTED LINES

BENDS

ATTENUATORS

STANDARD REFLECTIONS

From L Band (1120-1700mc)
to KA Band (26,500-39,500mc)



◀ Ask for catalog

Narda also makes a complete line of bolometers and thermistors,
available for same-day delivery



160 HERRICKS ROAD, MINEOLA, N. Y., PIONEER 6-4650

COMPLETE INSTRUMENTATION FOR MICROWAVE AND UHF
CIRCLE 148 ON RADEER-SERVICE CARD FOR MORE INFORMATION

ARE THE RESULTS OF RESEARCH AND DEVELOPMENT PROGRAMS for Guided Missiles Beginning to Affect Suppliers? See DESIGN '57—JAN. 1st ED

Size E Ignitron

For Resistance Welding



A new size E ignitron for resistance welding control, the NL-1054, is a mercury pool, metal constructed tube capable of controlling high peak currents. It is water cooled with an internal cooling coil for efficient cooling.

Ratings for two tubes connected in inverse parallel: anode volts, 250 to 500

at 50 to 60 cy; maximum demand, 4800 KVA with corresponding maximum average anode current per tube of 486 amp dc; maximum average anode current per tube, 900 amp dc with a corresponding maximum demand of 1600 KVA.

National Electronics, Inc., Dept. ED, Geneva, Ill.

CIRCLE 149 ON READER-SERVICE CARD FOR MORE INFORMATION

Filtered Power Supply

Building-Block Type



This regulated and filtered power supply, Model 2621 is designed for use with acceleration, vibration, pressure and force measuring systems.

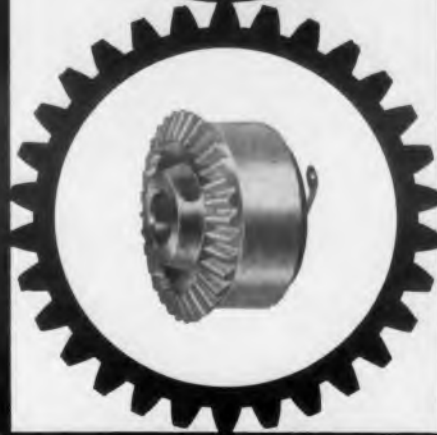
A building block type of equipment, it satisfies single channel instrumentation needs with capacity for expansion. It provides 1 per cent regulated

B+ voltage between 100 and 180 v dc and filament voltage of 6 v dc with extremely low ripple. Both voltage sources are adjustable and metered. The unit operates from 110 v ac \pm 10 per cent, 50 to 400 cps and is filtered to reduce line transient effects.

High measurement accuracies and precise resolution are due to low system noise levels. Power supply case provides for storage of four channels of transducers and amplifiers.

Endevco Corp., Dept. ED, 161 E. California St., Pasadena, Calif.

CIRCLE 150 ON READER-SERVICE CARD FOR MORE INFORMATION



Only 1 watt of power required ...

to develop 15 oz. in. of torque with a response time of 5 milliseconds. Only two moving parts which eliminate all maintenance problems.

Minimum dimensions (only 1" o.d.) facilitate their use in compact assemblies. Extremely low cost enables designers to utilize the benefits of multiple clutching in inexpensive electronic equipment.

Send for Bulletin C-1 for complete details

Hycor's systems engineers will be pleased to assist in special design applications.

Representatives in principal cities

HYCOR

DIVISION OF INTERNATIONAL RESISTANCE COMPANY
12970 Bradley Avenue, Sylmar 4, Calif.

CIRCLE 151 ON READER-SERVICE CARD

COMING JANUARY 1st
DESIGN '57
Yearly Feature Issue of ED

Ceramic Disc Capacitors Temperature Stable

Ceramic disc capacitors with three new capacitance-temperature stability characteristics are known as Types JA, JB and JC. All three are Tiny Mike capacitors insulated with phenolic and high-temperature wax vacuum impregnation. All three types have high insulation resistance characteristics; initial: 30,000 megohms; after humidity: 5000 megohms, at 25 c and 100 v dc. Working voltage of the types JA, JB and JC is 600 v dc.

Type JA stability tolerance is controlled to within ± 5 per cent of the 25 C. value over the temperature range — 55 C to + 125 C. Maximum capacitance available in Type JA is 3800 μ f. Maximum power factor at 1 kc is 1.5 percent.

Cornell-Dubilier Elec. Corp., Dept. ED, So. Plainfield, N.J.

CIRCLE 153 ON READER-SERVICE CARD

High Pressure Seals For Rotary Switches

Hexseal Series N-900 are designed for shafts which pass through panels or housings, and for rotary switches. The N series incorporate a hexagonal nut which accommodates standard panel knobs. They can be tightened with an ordinary open end wrench or pliers. The seal consists of a grooved nut, to which is molded a silicone rubber boot. Sealing is accomplished by a gasket-rib, which seats firmly against the panel and two O-ribs which form a double seal against the shaft. A lubricant enables the seal to function at intermittent speeds up to 3600 rpm. The silicone rubber will operate at temperatures from —120 F to 500 F. Present models fit 1/8 in., 1/4 in., 3/8 in. and 1/2 in. shafts.

Automatic & Precision Mfg. Co., Dept. ED, 252 Hawthorne Ave., Yonkers, N.Y.

CIRCLE 154 ON READER-SERVICE CARD

CIRCLE 155 ON READER-SERVICE CARD >

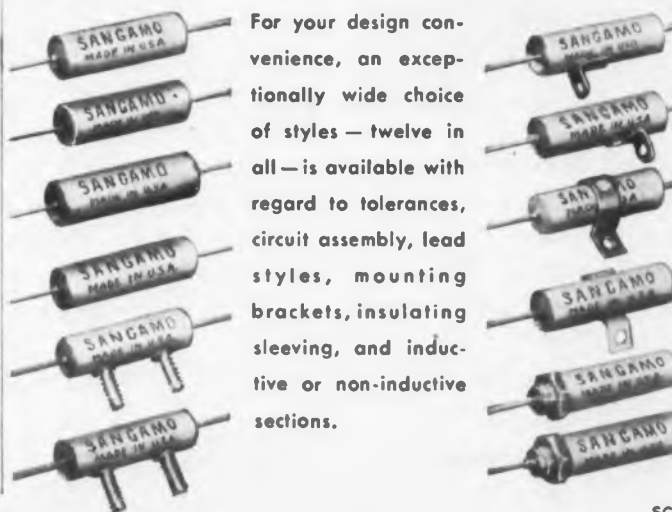
High reliability manufacturing of miniaturized paper tubular capacitors - hermetically sealed in metal cans

To produce subminiature paper capacitors free from any possibility of latent defects, for use in the most critical applications, the Sangamo Electric Company has recently intensified its high reliability program of fabrication and inspection methods.

Incoming materials for these capacitors are rigidly inspected to meet stringent high reliability standards and are stored in areas where temperature, humidity and dust are controlled at all times.

Complete production histories are kept on the basis of small capacitor lots. X-raying of individual units, heat tests, vibration tests, altitude tests, and total destruction tests of a given percentage of all finished units assure components with an extremely low AQL. Testing facilities and resultant performance characteristics are far in excess of military specifications. Specify these high reliability capacitors for your critical applications.

Mail the coupon below for Sangamo's *NEW Engineering Catalog TS-105A*. It contains full information, including an easy-to-follow cross reference showing each variation listed in MIL-C-25 versus the comparable Sangamo unit.



For your design convenience, an exceptionally wide choice of styles — twelve in all — is available with regard to tolerances, circuit assembly, lead styles, mounting brackets, insulating sleeving, and inductive or non-inductive sections.



SEPARATE FACILITIES are maintained for the exclusive processing and manufacture of high reliability capacitors. Only specially trained, highly skilled operators, who wear special clothing to prevent any possible source contamination, work here.



OIL-FILLED CAPACITORS are subjected to vacuum under elevated temperatures, then are individually examined to insure complete hermetic seal.

SANGAMO ELECTRIC COMPANY

Capacitor Division
SPRINGFIELD, ILLINOIS

Please send me your NEW Engineering Bulletin TS-105A.

Name _____

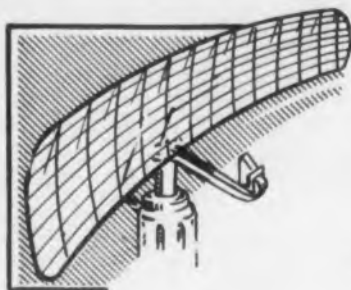
Company _____

Address _____

City _____ Zone _____ State _____

RAYTHEON

A
D
A
R



... guides 7 of 10 ocean-going ships around the world

... guards our freedom — arctic DEW line, navy picket subs, long-range bombers

... controls civil air traffic

... forecasts the weather

RADAR ENGINEERS

Systems & Design

Our success in obtaining prime, long-range contracts for Aircraft Weapons Systems, major Defense Radars, Fire Control Systems and many others provides lasting and challenging opportunities for good Systems and Design Engineers who are ready, willing and able to work on some of the most advanced radar and weapons systems being designed today.

SYSTEMS ANALYSIS AND COORDINATION

MICROWAVE DESIGN

ELECTRONIC CIRCUITRY

MECHANICAL DESIGN

SERVO SYSTEMS

ELECTRONIC PACKAGING

Send resume to:

Radar Professional Personnel

Box 242-C

Raytheon Manufacturing Company

Wayland, Massachusetts



WAYLAND LAB

Silicon Rectifiers 1500 Volt Element



Four new production types of 1500 v single element grown junction rectifiers featuring welded case construction are ideal for use in series in cathode ray tube power supplies and similar high voltage circuits. These miniature silicon rectifiers operate stably to 150 C and have

forward current ratings to 125 ma.

The welded case rectifiers are available in two types of axial and stud half-wave models. The axial models are 1N588 and 1N589, while stud models, 1N590 and 1N591, are designed to provide maximum heat dissipation and offer a choice of anode or cathode stud, eliminating high voltage insulation between stud and chassis.

All units are temperature cycled from -55 C to $+150\text{ C}$ for four cycles.

Texas Instruments Inc., Dept. ED, 6000 Lemmon Ave., Dallas 9, Tex.

CIRCLE 159 ON READER-SERVICE CARD FOR MORE INFORMATION

WHAT NEW PLANS Will Directly Affect the Component Parts Manufacturer in '57 See DESIGN '57—JAN. 1st ED

Plug-In Modules For Printed Circuits



Featuring plug-ins for the quick replacement kind of servicing, modular construction using standard printed circuit materials is now available. A standard size is offered, approximately 1-3/8 in. square and 2-1/2 in. high. Choice of unit includes either an octal plug-in base, which makes the unit directly interchangeable with many hand wired mo-

dules, or a new type of "Plus" Base plug which provides up to 32 contacts. A 7 or 9 pin tube socket is incorporated in the unit top. It can also be adapted to transistors or sub-miniature tubes. Other sizes and shapes can be made, supporting two or more tubes.

Arthur Ansley Manufacturing Co., Dept. ED, New Hope, Pa.

CIRCLE 160 ON READER-SERVICE CARD FOR MORE INFORMATION



Infinite resolution and absolute dependability distinguish CIC ultra-precise Potentiometers. In the generation of the sine wave CIC Pots provide smooth, reliable performance, distortion free at all angles of rotation.

CIC carbon film Sine-Cosine Pots, the proven product of a unique research program, provide greater accuracy in smaller case sizes. Sizes range from 1" to 5" diameter with corresponding best conformities from .3% to .03%. Compensation for loading can be provided with no loss of performance.

At speeds in excess of 1,000 r.p.m. CIC guarantees life in excess of two million revolutions.

Many firms with critical specifications for industrial instrumentation, military fire control and flight guidance equipment rely only on CIC Potentiometers.

Our highly qualified engineers are ready to discuss your specific requirements with you. Call us today.

"For Precision Performance ... specify CIC"

Detailed Technical Data Sheets available on request.

cic **COMPUTER INSTRUMENTS CORPORATION**

1 Vanhoo 3 8200
92 Madison Ave. • Hempstead, Long Island, N. Y.

CIRCLE 161 ON READER-SERVICE CARD

New Rhodium Plate Won't Curl, Crack or Peel!



RHODEX

A rhodium plating process that produces *Compressively Stressed deposits . . . developed specifically for industrial applications. RHODEX will materially increase the fatigue resistance of the metal over which it is deposited.

*Patent Pending

SEL-REX CORPORATION

Precious Metals Division

155 Manchester Place • Newark 4, N. J.

Please rush descriptive literature and technical data on Sel-Rex RHODEX (Compressively Stressed Rhodium.) ED-12

NAME _____
COMPANY _____
ADDRESS _____
CITY _____
ZONE _____ STATE _____

CIRCLE 164 ON READER-SERVICE CARD

Time Interval Meter Range of 10 μ sec to 1 Sec



Designed for the precise measurement of elapsed time between two events occurring in the range of 10 μ sec to 1 sec,

the time interval meter capacity can be extended to 10 or 100,000 secs. Accuracy is to $\pm 10 \mu$ sec. Measurement interval may be started and stopped by independent or common voltages, representing optical, mechanical or electrical events. Two independent, continuously adjustable trigger level controls permit full rated sensitivity, 0.07 v rms, at any voltage level between -50 to $+50$ v. Provision is made for oscilloscope marker signals for trigger level adjustment of start and stop points for complex waveforms measurement.

Computer-Measurement Corp., Dept. ED, 5528 Vineland Ave., North Hollywood, Calif.

CIRCLE 165 ON READER-SERVICE CARD FOR MORE INFORMATION

4-Channel Receiver For Telemetry



This receiver rack contains 4 Type 1401 receivers, visual signal indicator, four 30 circuit amplifiers with dc output, a crystal calibrator for simultaneous calibration of 4 recorder channels, a storage drawer containing 28 crystals and accessories, and a blower used with ducts to supply filtered air directly to individual equipment.

This rack is used to receive 4 simultaneous channels of telemetered information as well as to supply equipment in auxiliary racks to required frequencies and field strength.

Nems Clarke Inc., Dept. ED, Jesup-Blair Dr., Silver Spring, Md.

CIRCLE 166 ON READER-SERVICE CARD FOR MORE INFORMATION

Correction

The November 1st issue carried a review on "Magnetizer Produces 500,000 Gauss" and inadvertently omitted the name of the manufacturer. Interested engineers can write to Raytheon Mfg. Co., Commercial Equip. Div., Waltham 54, Mass. for more information.

REGULATED DC POWER SUPPLIES

HI-VOLTAGE SERIES

Designed for powering airborne electronics equipment under the most adverse environmental conditions, Arnoux High Voltage DC Power Supplies assure the utmost in reliability. These magnetic-amplifier regulated supplies are available in the range of 108 to 450 volts DC, with current ratings from 50 ma to 800 ma. Other ratings are also available on special order.



Model 250 S 025

ARNOUX

Input Power:	115 volts, 400 cps	
Regulation:	Input (Variation)	Output (% Rated)
Line Voltage:	$\pm 10\%$	± 0.25
Line Frequency:	± 20 cps	± 0.1
Load Current:	20-100%	± 0.1
	0-100%	± 0.2

Ripple: Less than 0.05% rms at full load.

Output Adjustment: 5% adjustment available on request at slightly higher price.

Environmental: Meets specification MIL-E5272 A for acceleration, vibration, altitude, humidity and temperature operating at 20% to 100% rated load.
Also meets MIL-I 6181 B.

Connector: AN-type connector.

Mounting: Stud-mounted.

(Write for Bulletin 200)

LO-VOLTAGE SERIES

Intended for use in precision airborne instrumentation systems, Arnoux Low-Voltage DC Power Supplies are available in both single and dual output. Ranging from 5 to 50 volts at currents up to 10 amperes, these rugged units are hermetically sealed.



Model 5 S 10

ARNOUX

Input Power:	115 volts, 400 cps	
Regulation:	Input (Variation)	Output (% Rated)
Line Voltage:	± 15 volts	± 0.10
Line Frequency:	± 20 cps	± 0.15
Output Load:	20-100%	± 0.05
	0-100%	± 0.10

Temperature Stability: 0.5% per 100°F.
(-60°F. to +160°F.)

Ripple: Less than 0.1% rms at full load.

Output Adjustment: Screwdriver adjustment provides ± 0.5 volt change. Wider range of adjustment available on request.

Connector: Standard AN-type connector, or hermetically sealed header on request.

Mounting: Stud-mounted.

Environmental: Meets specification MIL-E5272 A for acceleration, vibration, altitude, temperature and humidity.

(Write for Bulletin 100)

Designers and Manufacturers of
PRECISION INSTRUMENTATION

11924 West Washington Blvd.
Los Angeles 66, California



CIRCLE 167 ON READER-SERVICE CARD FOR MORE INFORMATION



Electronic Systems Specialists

SYLVANIA'S

rapid growth is almost twice that of the electronics industry as a whole... think what this can mean to *you* in opportunity and rapid advancement. And Sylvania helps underwrite your advanced studies in leading universities in both locations... because we want you to assume greater responsibility and leadership. Here are some typical problems being solved by Sylvania engineers and physicists in our Buffalo, N. Y. and Waltham, Mass. laboratories.

AT BUFFALO:

- 1.** *How do you design 10 similar microsecond timing circuits whose delay times can be varied over a range of 100 times by analog control voltage maintaining a tracking accuracy of $\pm 0.1\%$ in an environment of -65°C to $+125^{\circ}\text{C}$ at sea level to 100,000 feet?*
- 2.** *If you know which bits of a code group are in error, can you modify the hamming code to use these data to provide maximum information capacity in a noisy channel?*
- 3.** *Can you design a crystal mixer to operate with latest production type crystals and having a noise figure less than 12db above KTB operating in the "S"-band?*

AT WALTHAM:

- 4.** *What are the statistical factors to be considered in calculating the detection probability of a search radar?*
- 5.** *What is the effect of atmosphere turbulence on high gain antenna performance?*
- 6.** *How is the sidelobe level of a radar antenna effected by random perturbations of phase and amplitude over the aperture?*
- 7.** *How does the AGC bandwidth effect the accuracy of angle-tracking?*

If you believe that you can assist us in the solving of these problems, please write:

BUFFALO LABORATORY

E. F. Culverhouse
175 Great Arrow Ave.
Buffalo 7, N. Y.

WALTHAM LABORATORIES

Erling Mostue
100 First Ave.
Waltham, Mass.

*Your inquiries
will be answered
within 2 weeks.*



SYLVANIA



SYLVANIA ELECTRIC PRODUCTS INC.

Insulation Tester

Totalizes Faults



The P-1 tester counts insulation faults (pinholes) in insulated wire at speeds up to 600 feet per minute. For use as an insulation continuity tester, the model P-1 insulation tester features continuous display

of total number of pinholes, continuously adjustable voltage control and panel meter to set voltage for single or multiple coated wire (0-250 v dc), and a small moistened sponge electrode using tap water. A high sensitivity detector operates magnetic counter and buzzer. The small test current of 10 μ a, enables use of high resistance electrode circuit, will not harm the finest wire and will detect through 10 megohms. The unit is available in other voltage ranges for use with other electrodes.

Peschel Electronics Inc., Dept. ED, 9 Garden St., New Rochelle, N.Y.

CIRCLE 171 ON READER-SERVICE CARD FOR MORE INFORMATION

WHAT IS NEEDED by the Manufacturer of Communication Equipment in '57? Read DESIGN '57—JAN. 1st ED

Millivoltmeter

Checks Thermocouples



This millivoltmeter, for checking the voltage output of safety thermocouples on gas-fired equipment, is a pocket-size tester with ranges of 10, 30, 100, 300 and 1000 mv.

Large binding posts are used for range selection. Accuracy is 3 per cent of full scale at ambient temperatures of 50 to 120 F. From -55 to +185 F, an additional error of no more

than 2 per cent can be expected. Model 387 has a current draw of only 750 μ a which is calibrated to within ± 2 per cent of full scale. The unit measures 3 in. x 5-7/8 in. x 2-1/2 in., and has a molded, black bakelite case including leads.

Simpson Electric Co., Dept. ED, 5200 W. Kinzie St., Chicago 44, Ill.

CIRCLE 172 ON READER-SERVICE CARD FOR MORE INFORMATION

ROTRON "GREEN LABEL" LINE

A NEW LINE
OF COMMERCIAL SPECIFICATION PRODUCTS

200 CFM NAFM CODE

115 VOLT • 60 CPS • 1 PHASE • SHADED POLE
• SLEEVE BEARINGS •
ALL ANGLE • 100 CFM AT 0.2" S.P. • PUSH OR PULL

\$14.25

QUANTITY DISCOUNTS

WRITE FOR ROTRON'S CATALOG SHEET #50106-1



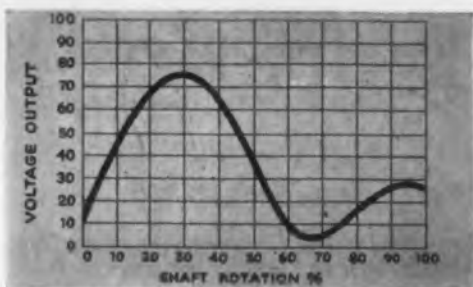
MODEL PF FAN OF THE "GREEN LABEL" LINE



ROTRON MFG. CO., INC.

WOODSTOCK • NEW YORK

CIRCLE 173 ON READER-SERVICE CARD



How would you match this curve to shaft rotation?

The **VERNISTAT Adjustable Function Generator** will do it for you! Here it is:



The VERNISTAT Adjustable Function Generator—a variation of the VERNISTAT a.c. potentiometer—permits quick and easy alteration of any nonlinear function. The adjusting mechanism provides a graphic display of the function which may be mathematical or empirical, including those with multiple slope reversals.

CHARACTERISTICS:

- 100-transformer taps connected to 31-pole, 100-position printed circuit switch.
- any pole can be switched to any tap.
- size: 6¼" x 7⅞" x 2⅞".
- potential of each pole adjustable to $\pm 0.5\%$.
- minimum slope of voltage output curve: zero.
- maximum voltage between adjacent poles: 12.
- frequency rating: 400 or 60 cps @ 130 volts depending on model.
- output impedance: 130 ohms maximum.

vernistat[®]

division

PERKIN-ELMER CORPORATION
Norwalk, Connecticut

CIRCLE 176 ON READER-SERVICE CARD

Cable Fault Finder

Uses Pulse Radar



Problems of cable and connector inspection and maintenance are simplified by the model 60A fault finder. This is accomplished by applying the pulse radar principle of time interval measurement between a transmitted and reflected pulse. Cables with lengths between 10

and 200 ft may be checked for the location of open circuits as well as grounds and short circuits.

The characteristic impedance of cables may be determined by using the Model 60A with a calibrated variable resistance connected across the end of the cable. With the cable terminated in its characteristic impedance, no reflections will be seen on the screen.

Radar Eng., Dept. ED, 401 E. 45th St., Seattle 5, Wash.

CIRCLE 177 ON READER-SERVICE CARD FOR MORE INFORMATION

WHAT NEW PROGRAMMING METHODS Are Causing Major Design Changes? Read DESIGN '57—JAN. 1st ED

Silicon Transistors

Meet Navy Specs



Built in accordance with MIL-T-19112A (ships) and MIL-T-19502 (ships) and available only to manufacturers of military equipment, these high temperature grown junction devices are designed to provide high gain in small signal applications at temperatures to 125 C. Both transistors, USN-2N117

and USN-2N118, feature close parameter control to ensure uniformity and welded case construction for reliability under extreme environmental conditions. Maximum collector dissipation is 150 mw.

Also adhering to the same stringent requirements as these TI-developed USN devices are commercial versions, 2N117 and 2N118.

Texas Instruments Inc., Dept. ED, 6000 Lemmon Ave., Dallas 9, Texas.

CIRCLE 178 ON READER-SERVICE CARD FOR MORE INFORMATION



Model 1 Variable Resistors

— they fit the tight spots

*Adopted as standard
where only the best will
do, by designers of...*

Transistor circuits

Telephone systems






Hearing aids

Car radios

Military electronic devices

Business machines

Computers

-  Centralab Model 1 Radiohms, with or without switches, can solve your variable resistor problems where size, ruggedness, and high quality are desired.
-  Rated at 1/10 watt. Resistance range, 500 ohms to 10 megohms. Seven standard tapers.
-  Enclosed in laminated phenolic dust cover. Metal electro-static shield available.
-  Knob and slotted-shaft types.
-  Not a laboratory curiosity — 6,000,000 are now in use.

Technical Bulletin 42-164 gives complete engineering data. Write for it.

Centralab

A DIVISION OF GLOBE-UNION INC.

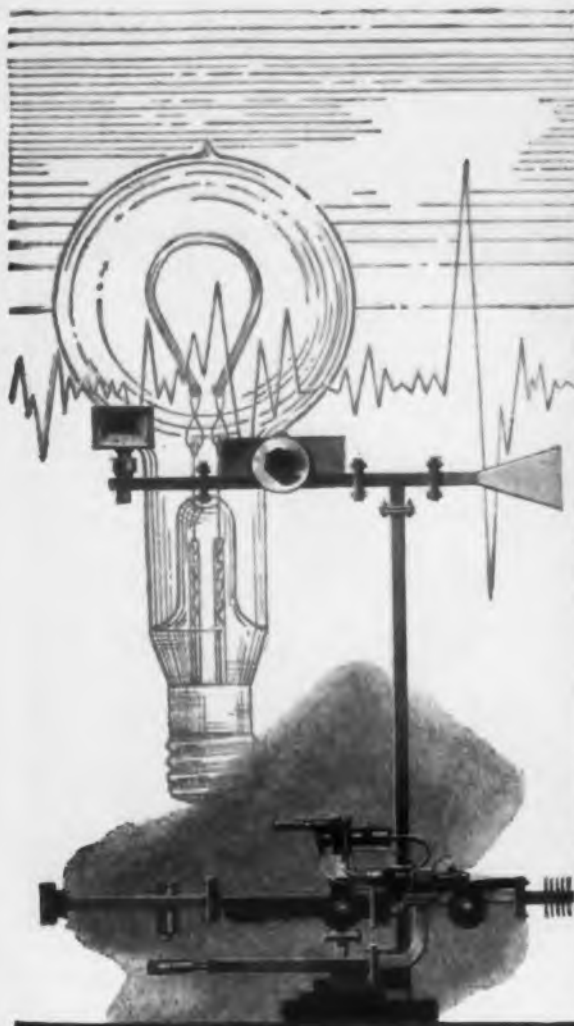
960L East Keefe Avenue • Milwaukee 1, Wisconsin
In Canada: 804 Mt. Pleasant Road, Toronto, Ontario

B-2156

*Trademark



CIRCLE 179 ON READER-SERVICE CARD FOR MORE INFORMATION



ONE OF A SERIES — depicting electronics — "Yesterday, Today and Tomorrow"

spanning the spectrum

It's a big step from Edison's light bulb to DeForest's "audion" . . . a shorter step from the "audion" to the klystron tube. In bridging the gaps, scientific frontiersmen have founded a new industry. The growing applications of electronics are creating a fantastic industrial revolution. These developments are not only changing the weapons concept, but also the very basis of our civilization.

Bell Aircraft is a leader in electronics among the aircraft industries. Its achievements *span the spectrum* in the electromagnetic field. Intricate missile guidance systems, remote-controlled aircraft, landing systems for aircraft, and the recovery system used in several missiles are among Bell's notable advances.

To the engineer desiring top assignments . . . assignments requiring creative thinking . . . Bell offers an unparalleled opportunity for professional achievement. New contracts on missiles and other projects have created openings in our electronics staff for progressive minds seeking advancement. For the engineer with a B.S. or advanced degree interested in scientific frontiers contact . . .

ELECTRONIC ENGINEERS Manager Engineering Personnel Dept. K

SERYC ENGINEERS

INSTRUMENTATION ENGINEERS

LABORATORY ENGINEERS

TEST EQUIPMENT DESIGN ENGINEERS

MISSILE SYSTEMS TEST ENGINEERS

P. O. Box 1

Buffalo 5, N. Y.



Variable Attenuator Precision Calibrated



Long life and accurate service is promised by a new precision calibrated attenuator featuring a simple and very rugged design. It is not affected by changes in humidity

or temperature variations. The accuracy at calibration frequency is 0.2 db. VSWR at the maximum 40 db attenuation is 1.15. In the range of 0.20 db insertion it is less than 1.1 VSWR.

Admittance-Namco Corp., Dept. ED, Farmingdale, N.Y.

CIRCLE 182 ON READER-SERVICE CARD FOR MORE INFORMATION

High Pressure Transducer Up to 15 psi Loads



This type of high pressure load cell is available in pressure increments of 1000 psi from 1000 to 15,000 psi. The size of all values are 1 in. diameter x 1-1/4 in. high.

The unit changes resistance over the entire pressure range, with a change of pressure, shock or vibration. An-

other design is suitable for pressure from 20 to 300 tons.

Clark Electronic Lab. Box 165, Dept. ED, Palm Springs, Calif.

CIRCLE 183 ON READER-SERVICE CARD FOR MORE INFORMATION

Knob Heads and Stems In Many Combinations



Working on an assembly principle, a variety of types, sizes, and colors of knob heads can be combined with any number of various types and lengths of stems, thus giving a large variety of knobs from a

small basic stock of standard parts.

This makes any desired knob available from stock parts, for pilot runs, short-run production, or experimental models of electronic equipment. 15 different knob-head sizes are carried in stock in ten different colors.

Colman Tool & Machine Co., Dept. ED, Amarillo, Texas.

CIRCLE 184 ON READER-SERVICE CARD FOR MORE INFORMATION

Reliable Sensitive Relays Now available for quick delivery



the electronics division of IRON FIREMAN

is now mass-producing its new 400 series sensitive relay. This new relay possesses high sensitivity and reliability even under extremely severe environmental conditions. Many leading manufacturers with prime military contracts for electronic systems are using these 400 series Iron Fireman sensitive relays.

A 60-page Certified Quali- fication Report*

showing compliance of this relay to military specifications is now in the hands of the Iron Fireman Electronics representatives listed here. They will be pleased to go over this report with you.

M. D. Gilbert Co.
6214 W. Manchester Ave.
Los Angeles 45, California

Jules J. Brossier Co.
4808 Borgenline Ave.
Union City, New Jersey

Massey Associates
529 Brookhurst Ave.
Narbeth, Pennsylvania

Massey Associates
1 Thomas Circle N. W.
Washington, D. C.

Seatronics, Inc.
911 Western Ave.
Seattle 4, Washington

*Qualified to MIL-R-5757B in 40 milliwatt adjustment.



Send today for "Sensitive Relay Data File" Contains specification sheets, operational charts, temperature conversion charts, and other helpful information.

IRON FIREMAN Sensitive Relays

2810 S. E. Ninth Avenue, Portland 2, Oregon

CIRCLE 185 ON READER-SERVICE CARD

designers

do you have
a "special"

MOUNTING BASE PROBLEM?

Call in Finn. Here's a
short story of two who did



ONE COMPANY isolated a delicate gyro amplifier with this unusual base. Finn-designed, it licked crucial space and weight problems with its lightweight construction and sub-miniature Finn Mounts. To MIL-C 172-B, it has company and Air Force approvals.

These are only two examples of the technical skill, experience and facilities available at Finn. An approved source, Finn can lick your "tough specials" at a competitive price. What's more, many "special" and standard mounting bases are stocked for immediate delivery.



LEAR, INC. fitted an auto pilot component way up in the TF-102's nose with this Finn base. Space envelope was extremely critical; hence, sub-miniature Finn Mounts and space-saving design. Approvals: Lear, Inc., Air Force, Air Frame. To MIL-C 172-B, of course.

For more information,
write to the address below. Or call
HAWTHORNE 7-4100

FINN

ELECTRONICS DIVISION

T. R. FINN & Company, Inc.
200 Central Ave., Hawthorne, N.J.

*Pioneers in Lightweight
Mounting Bases*

CIRCLE 188 ON READER-SERVICE CARD

High-Current Thyatron

Gas Filled



A new 30 ampere thyatron tube, NL-732, is gas and mercury-vapor filled for long life, quick-starting, and use without gas clean-up cushioning circuits. It is designed for motor speed control and ac control applications.

NL-732 ratings are filament volts, 2.5; filament current, 55 amps; peak inverse and forward volts, 1500; anode current, 30 amps; peak anode current, 160 amps; anode current averaging time, 30 seconds; and filament heating time, 180 seconds.

National Electronics, Inc.,
Dept. ED, Geneva, Ill.

CIRCLE 189 ON READER-SERVICE CARD FOR MORE INFORMATION

Polystyrene Capacitors

Range to 500 V DC



These fixed polystyrene dielectric capacitors, operate in a temperature range from -10 to $+70$ C. They are available in sizes from $5 \mu\text{f}$ to $.025 \mu\text{f}$ with voltage ratings up to 500 v dc, in three voltage

ranges of 125, 250, and 500 v. There is also a miniature line and a low-inductive line available. Stability is within ± 5 per cent per year.

Pimex, Inc., 2 E 82nd St., New York 28, N.Y.

CIRCLE 190 ON READER-SERVICE CARD FOR MORE INFORMATION

Lever Speed Control

For Fast Speed Change



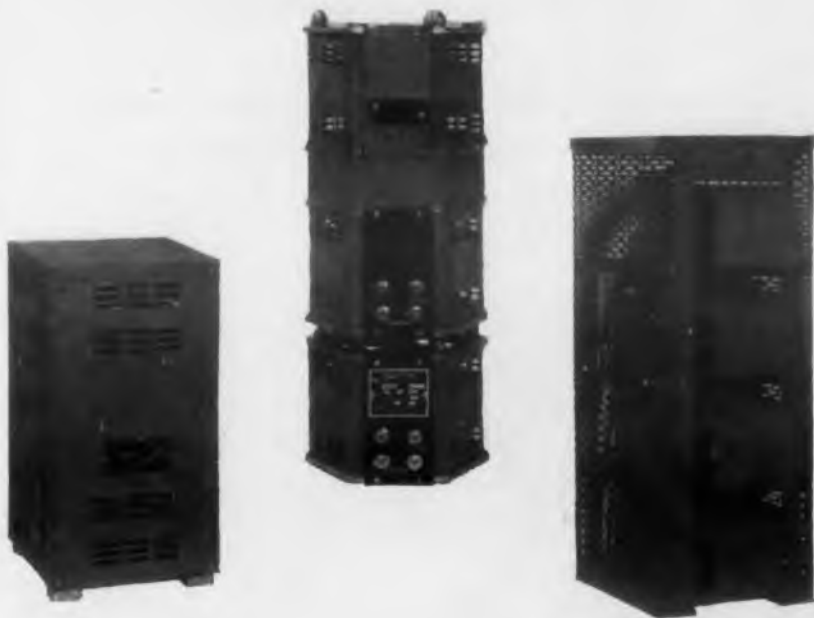
This lever control on the Model 24 Zero-Max infinitely variable speed reducer permits the output speed setting to be changed instantly. This can be done while the unit is operating or stopped and the output shaft can be stopped by means of the control without stopping the power source. Forces required to move the control lever are small even when the unit is under load.

Revco Inc., Dept. ED, 1900 Lyndale Ave. So., Minneapolis, Minn.

CIRCLE 191 ON READER-SERVICE CARD FOR MORE INFORMATION

new *Adjust-A-Volts*

Motor-driven variable transformers for remote control operation



You'll like the design and performance of these compact, durably constructed motor-driven units for commercial and military applications where remote control of variable voltage by push button or switch is desired.

They have all the features of manually operated Adjust-A-Volt variable transformers plus a standard 115 V, 60 cycle motor, all enclosed in a well-ventilated and protective grey wrinkle finished case.

Choose from twenty-two basic models—single or up to 6 ganged assemblies with a load rating range from .35 to 28KVA—115 V or 230 V input.

Full range travel speeds of 6, 13, 26, or 45 seconds available to suit your need. All units are equipped with clockwise and counter-clockwise limit switches.



Send for your copy of the new 22 page Adjust-A-Volt catalog A56 which describes and illustrates the entire Adjust-A-Volt line and features dimensional drawings and a specification and application index.

STANDARD ELECTRICAL PRODUCTS CO.

2240 E. THIRD ST. • DAYTON, OHIO, U.S.A.

CIRCLE 192 ON READER-SERVICE CARD FOR MORE INFORMATION

Langevin TRANSFORMERS

**- to military specifications
and for special
performance requirements**



**Quality deserving the
serious consideration
of responsible engineers**

- Separate sample and short run facilities to provide high speed service
- Approved for in-plant MIL-T-27 qualification testing
- Quotations supplied promptly on receipt of your requirements

Maxson Instruments

47-37 Austell Place, Long Island City 1, New York
Tel: RAvenswood 9-1850

Division of the
W. L. Maxson
Corporation

CIRCLE 194 ON READER-SERVICE CARD FOR MORE INFORMATION

**THE ELECTRONICS INDUSTRY LOOKS AHEAD
SEE DESIGN '57 — JAN. 1 ISSUE ED**

**Subminiature Relays
Withstand 50 G's**



Extremely small, light-weight two-pole subminiature relays, the SM-310 Series, show dimensions of 3/4 in. wide & 27/32 in. in length to the flange. The large 2 PDT in the S-310

subminiature is also 3/4 in. wide but length comes to 1-19/32 in. to the flange.

Characteristics are a coil sensitivity of 60 mw per pole, a coil sensitivity of 25 mw per pole, and they can withstand 50 G operational shock. Complete ambient temperature range from -65 to +125 C.

The relays feature non-gaseous silicone materials throughout, and use no internal wiring.

Contact pressures are electronically measured, with final adjustments made after sealing. Special mounting arrangements are available.

U.S. Relay Co., Dept. ED, 1744 Albion St., Los Angeles, Calif.

CIRCLE 195 ON READER-SERVICE CARD FOR MORE INFORMATION

**Stabilizer Tube
For Low Voltage**

A 75 volt stabilizer tube, the 75C1, combines high stability and good regulation. Maximum striking voltage is 110 v in both daylight and darkness. Current range is 2. to 60 ma with a regulation of 9 v and a variation of burning voltage of less than 1 percent per 1,000 hrs.

The burning voltage of 20 ma is confined within 73 to 79 v.

International Elec. Corp., Dept. ED, 81 Spring St., New York 12, N.Y.

CIRCLE 196 ON READER-SERVICE CARD FOR MORE INFORMATION

**Silicon Junction Diodes
Have Quick Recovery**

Types available in this silicon junction diode series are 1N625, 1N626, 1N627, 1N628, and 1N629. These diodes afford a combination of high speed, high voltage, and high temperature. These devices are capable of operating at high voltages and high temperatures.

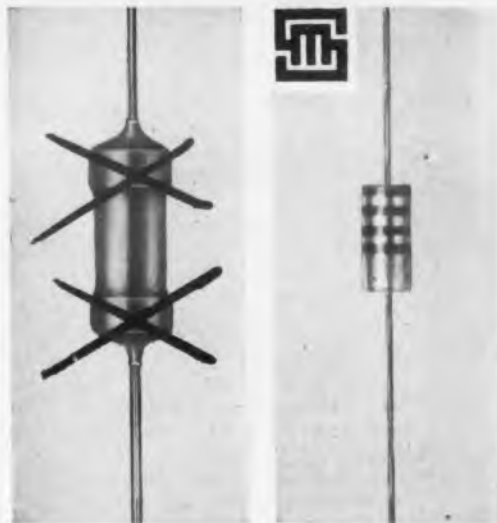
They can be used in high-frequency or fast-switching circuits. Ambient operating temperature range is from -55 C to +135 C.

Maximum power dissipation is 200 mw at 25 C. All types recover to a minimum of 400 k ohms in one μ sec when switched from 30 ma forward to 35 v.

Hughes Products, Semiconductors, Dept. ED, International Airport Station, Los Angeles 45, Calif.

CIRCLE 197 ON READER-SERVICE CARD FOR MORE INFORMATION

**STEMAG PRESENTS
THE FIRST
CAPLESS*
FILM RESISTOR**



1 w Regular Carbon Film Resistor with end caps. 1 w patented STEMAG Film Resistor without end caps.

Now you can obtain long life stability of carbon film resistors with small size and low price of carbon composition types. Available in the same wattage ratings, dimensions, tolerances and color code as carbon composition type resistors.

NOTE THESE FEATURES:

- **Derating:** 75° C. (1/2 w type)
- **Load-Life Test:** MIL-R-11A max. change 1.3%
- **TC:** 200 to 400 PPM per °C
- **Lead Connection:** Direct capless contact inside resistor body
- **Noise Level:** Extremely low. No noise generating end caps
- **Tolerances:** ± 5 % and ± 10 %
- **Sizes:** 1/2, 1, 2 watt

*U. S. Pat. 2658980

For complete specifications and test data write to:

Arnhold ARNHOLD CERAMICS, INC.

1 East 57th St., New York 22, N. Y.
CIRCLE 198 ON READER-SERVICE CARD

SANDERS MINICUBE BLOWER

*ruggedly
constructed
for use on aircraft
and guided
missiles*



The Sanders Minicube Blower contains both miniature blower and motor in a rugged, 1" cube. A single package, it is designed for use on aircraft and guided missiles operating under severe environmental conditions. It is operable over wide ranges of vibration, acceleration and temperature, and is suitable for many exacting applications.

The Sanders Minicube Blower can be used to:

- Eliminate hot spots in subminiature equipment
- Prevent fogging of lens or viewing glasses
- Cool Klystrons and other electronic tubes and devices
- Maintain uniform flow of air in restricted space

SPECIFICATIONS

Output: 3 cubic feet of air/minute
Speed: 22,000 RPM
Input: 400 cps, 4 watts
Size: 1" x 1" x 1"
Voltage: Model 1: 6 volts
Weight: 1 oz.
Model 2: 26 volts

For detailed specifications,
write Dept. ED-12



CIRCLE 200 ON READER-SERVICE CARD

Coaxial Terminations

Have Low VSWR

The Model 535 coaxial terminations are available with male or female connectors in types N, C, BNC and QDS, with low VSWR in 50 ohm systems at frequencies from dc to 10k mc. Accurate calibrations at seven or more frequencies are supplied for each unit.



Applications include precision VSWR measurements of transmission lines, coaxial cables and connectors, and of insertion devices. They are also useful as terminations of directional couplers for precise directivity determinations.

A maximum power of 1 w average or 1 kw peak can be dissipated. Excellent stability and shock resistance are additional features.

Weinschel Engineering, Dept. ED, 10503 Metropolitan Ave., Kensington, Md.

CIRCLE 201 ON READER-SERVICE CARD FOR MORE INFORMATION

Epoxide Foam

Is Packed in Place

An epoxide foam of extremely uniform and fine structure is produced from Eccofoam PT foam. The foam is intended for use in potting electronic assemblies, for void filling in aircraft, insulation and buoyancy applications.

Supplied as two components which are mixed together, the material resembles foundry molding sand prior to use. It is packed or tamped into place in the cavity to be filled. Cure is affected at room or elevated temperature.

The foam is useable to 350 F. Density is less than 20 lbs per cu ft; flexural strength is 800 psi. It is of low dielectric constant and low dissipation factor.

Emerson & Cuming, Inc., Dept. ED, 869 Washington St., Canton, Mass.

CIRCLE 202 ON READER-SERVICE CARD FOR MORE INFORMATION

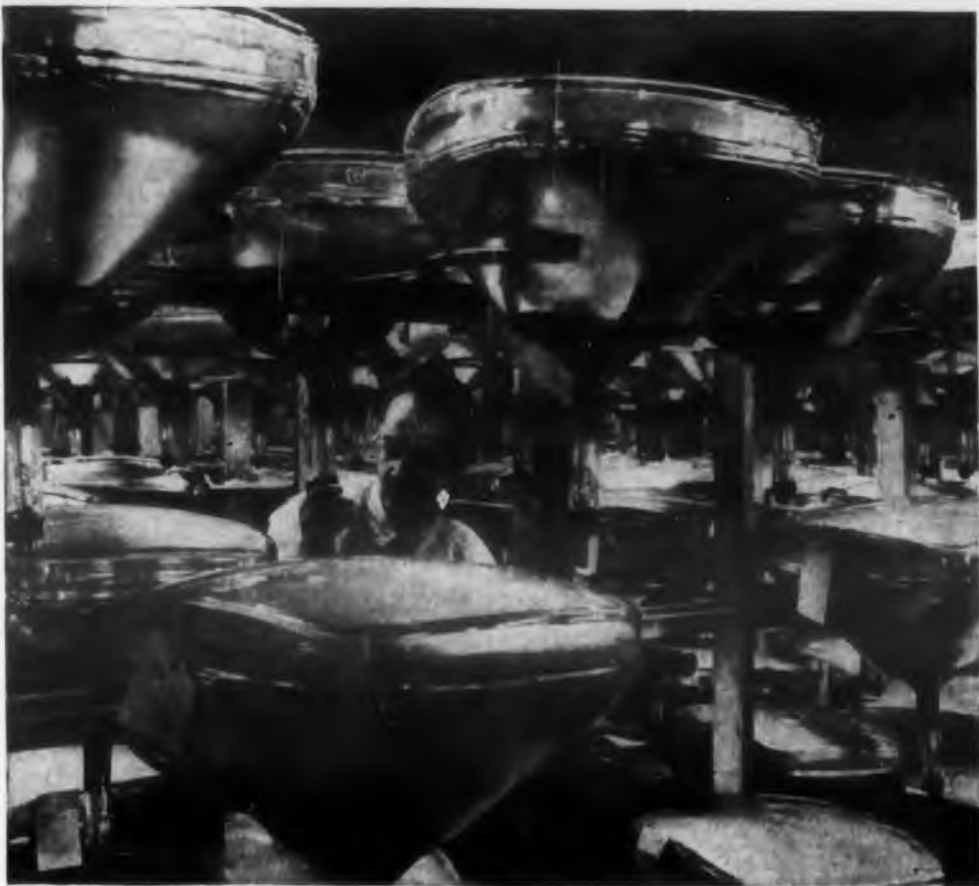
Insulation Sleeving

For High Temperatures

This vinyl electrical insulation sleeving meets governmental specification MIL-I-631C, Grade C. Designated Resinite Hi-Heat 105A, the new material provides a working temperature range from -21 C to +105 C and a dielectric strength of 1000 v per mil average. It is fungus, flame and oil resistant and is highly resistant to cut-through.

Resin Industries, Dept. ED, Santa Barbara, Calif.

CIRCLE 203 ON READER-SERVICE CARD FOR MORE INFORMATION



Use 'dag' Colloidal Graphite in CRT manufacture because . . .

1. A uniform, conductive film produced by a dispersion of colloidal graphite in de-ionized water on inside walls functions as a ray-focusing anode, retards secondary emission, absorbs gases.
2. A special 'dag' dispersion in lacquer used on outside walls dries in 2-3 minutes, forms an electrically-conductive graphite film which is opaque and tenacious.
3. 'dag' Colloidal Graphite produces films which adhere equally well to all types of glass.

Other ways in which 'dag' dispersions are used in electrical and electronic applications are described in a free bulletin. Ask for Bulletin 433-K-12.



*'dag' is a registered trademark
of Acheson Industries, Inc.*



ACHESON COLLOIDS COMPANY

PORT HURON, MICHIGAN

Offices in:

BOSTON • CHICAGO • CLEVELAND • DAYTON • DETROIT • LOS ANGELES • MILWAUKEE
NEW YORK • PHILADELPHIA • PITTSBURGH • ROCHESTER • ST. LOUIS • TORONTO

CIRCLE 204 ON READER-SERVICE CARD FOR MORE INFORMATION

FANSTEEL

HI-TEMP Tantalum Capacitors

*...life tested for over
2000 hours at 125°C
and still within
specification limits*

*Write for further
information*



FANSTEEL METALLURGICAL CORPORATION
North Chicago, Illinois, U. S. A.

TANTALUM CAPACITORS...DEPENDABLE SINCE 1930

CIRCLE 206 ON READER-SERVICE CARD FOR MORE INFORMATION

DC/AC Vibrating Converter

Ultra-High Impedance

Suited to applications where a rugged, ultra-high impedance, plug-in, dc to ac mechanical converter is essential, these Vibron Electrometer units operate with extreme stability. This stability is assured by sealing the gold-plated electrodes in a gas filled, metal envelope.

These components are valuable in measurement of small ionization currents, very high resistances, ph, and infra-red signals.

They can also be furnished with a matching Vibron dc amplifier Type 33B, input impedance of 10^{13} ohms.

The amplifier offers six individual ranges that cover 10 to 1000 mv with a stability of better than $\pm 100 \mu\text{v}$ over a 12 hr. period.

Nuclear Corp. of Amer. Inc., Dept. ED, Suite 4219 Empire State Bldg., New York 1, N.Y.

CIRCLE 207 ON READER-SERVICE CARD FOR MORE INFORMATION

Reclaiming Solvent

Dissolves Epoxy Resins

A recent resin solvent, labeled DE-SOLV 292, disintegrates epoxy or polyester resins in which electronic components have been embedded, by immersing the electronic units in the solution. The solution can be reused.

It is suitable for use with parts based on nylon, formvar and linen wrapped wire; metallic components; ceramic capacitors and resistors; as well as miniature and sub-miniature electronic tubes, and will not harm phenolic base systems such as printed circuits.

It is a non-inflammable, neutral, and has low toxicity. Available in one, five and fifty gallon containers.

Ram Chemicals, Dept. ED, P. O. Box 192, Gardena, Calif.

CIRCLE 208 ON READER-SERVICE CARD FOR MORE INFORMATION

Encapsulating Compounds

Flexible or Foam

These new compounds are available in three distinct types and formulae: transparent, flexible and foam. The transparent compound is quick setting in 15 minutes at a temperature of 180 F, consists of two components, and is easily released from the molds.

The flexible compound is an epoxy formulation of variable flexibility consisting of two components. Large castings of 7 to 8 lbs can be cured at room temperatures.

The foam compounds are available in various densities and require low temperatures up to 150 F for curing. These foam components readily flush air when expanding.

Telectro Industries Corp., Dept. ED, 35-18 37th St., Long Island City 1, N.Y.

CIRCLE 209 ON READER-SERVICE CARD FOR MORE INFORMATION



PRECISION-EERING

THE DIFFERENCE IN ATLAS DIFFERENTIALS

● Every tooth a masterpiece in finish, fit and motion. Atlas differentials are "precisioneered" to provide Nth degree accuracy in addition, subtraction and other electro-mechanical applications. The high sensitivity and minimal lost motion of precision Zerol gears... plus corrosion and wear resistance assure long life in every assembly. Atlas gears and assemblies are made to meet your design and specifications. Have proved themselves by their acceptance and constant re-orders from the world's largest users of electro-mechanical equipment. From drawing board to production line Atlas design, production and methods engineers and skilled tool-makers work with you on a job basis. Let them help you. Write for your copy of "Precision-eering Electro-mechanical Equipment" to Atlas Precision Products, Philadelphia 24, Pa.

FROM DRAWING BOARD

TO PRODUCTION LINE



ATLAS
Precision Products

CIRCLE 210 ON READER-SERVICE CARD

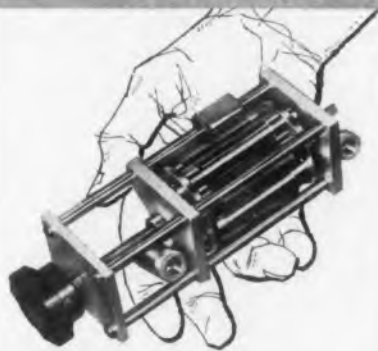
PRECISION ATTENUATION to 3000 mc!

SINGLE "in-the-line" ATTENUATOR PADS and 50 ohm COAXIAL TERMINATIONS



PROTECTED UNDER STODDART PATENTS

This new group of pads and terminations features the popular Types C and N connectors, and permits any conceivable combination of the two styles.



PROTECTED UNDER STODDART PATENTS

six-position

TURRET ATTENUATOR

- Frequency Range: dc to 3000 mc.
- Characteristic Impedance: 50 ohms.
- Available Attenuation: Any value from 1 db to 60 db.
- Accuracy: ± 0.5 db.
- Power Rating: One watt sine wave power dissipation.

STODDART

Aircraft Radio Co., Inc.
6644-J SANTA MONICA BLVD.
HOLLYWOOD 38, CALIF. • HO 4-9294

CIRCLE 211 ON READER-SERVICE CARD

DC Microvoltmeter

Highly Stabilized

The new MV-51A dc transistor voltmeter has a sensitivity of 0-10 μ v and covers a total measuring range to 10 v with a total of 13 ranges. Input impedance is 1 K on all low ranges, up to 0-1 mv; it then increases proportionate with the measuring range until it reaches 10 meg on the 10 v range.

The most unusual feature of this new instrument is that in spite of its high sensitivity it does not use a chopper.

Instead, a low-drift direct-coupled transistor amplifier is used which operates in a so-called "hushed condition" (zero or reversed collector junction voltage).

Drifts are further minimized by a temperature compensation amplifier, which is also transistorized, and a transistor battery voltage regulator.

Long term drift stability is 10 μ v and short term drift stability is 4 μ v.

Millivac Instrument Corp., Dept. ED, 444 Second St., Schenectady, N.Y.

CIRCLE 212 ON READER-SERVICE CARD FOR MORE INFORMATION

Ultra-Thin Metal Strip

Precision Gage

Ultra-thin metal strip held to exceptionally close thickness tolerances is now being furnished in widths up to 4 ins. and in thicknesses from .01 in. down to .00012 in, with thickness guaranteed uniform to a tolerance of .00005 in. This strip has a high degree of freedom from camber across the width of the strip.

The cold rolled precision gage strip can be produced in a wide range of metals, from the hard high-temperature alloys down to very soft light metals. It is available in ribbons as narrow as .04 in. with widths held to a tolerance of $\pm .001$ in.

Allied Products Division, Dept. ED, Hamilton Watch Co., Lancaster, Pa.

CIRCLE 213 ON READER-SERVICE CARD FOR MORE INFORMATION

Epoxy Resin Adhesive

High Shear Strength

A new epoxy resin adhesive, meeting MIL-A-5090B, has high shear strength at bond temperature of 300 F. It has exceptional resistance to water and salt spray, and can be cured with or without the addition of a catalyst.

The EC-1469 epoxy resin adhesive is particularly well suited for honeycomb applications because of self-filleting properties that produce solid bonds between the honeycomb core and plate, and lack of volatile components. This adhesive can be used at service temperatures from minus 65 F to 300 F.

Minnesota Mining & Mfg. Co., Dept. ED, Adhesives & Coating Div., 423 Piquette Ave., Detroit 2, Mich.

CIRCLE 214 ON READER-SERVICE CARD FOR MORE INFORMATION

FANSTEEL

Silicon Power Rectifiers



Minimum Size.....

Maximum Performance...

Fansteel Dependability

Write for Sizes
and Ratings

FANSTEEL METALLURGICAL CORPORATION
North Chicago, Illinois, U.S.A.

DEPENDABLE RECTIFIERS SINCE 1924

CIRCLE 215 ON READER-SERVICE CARD FOR MORE INFORMATION

KODAK COLOR PRINTER

USES

TIC

LOGARITHMIC POT FOR PRECISE

EXPOSURE

TIMING



An important requirement in the design of the precision Kodak Color Printer, Model 1599C, is its highly accurate electronic exposure timing device. Rigid specifications set by Eastman Kodak Co. engineers for a precision 6:1 ratio logarithmic potentiometer were met by TIC—specialists in the design of non-linear function potentiometers.

TIC manufactures standard 50 db and 20 db logarithmic potentiometers of high resolution and high conformity. The unique double-contoured resistance-element card makes possible the high accuracy of all TIC non-linear potentiometers. This card design (contoured symmetrically on both edges) also permits greater flexibility in the design of non-linear functions—flexibility required for special designs like the pot used in the Kodak Color Printer.

Low temperature coefficient of resistance . . . high resolution . . . complete environmental protection . . . and precision mechanical construction add to the high conformity and reliability of TIC non-linear potentiometers. As leaders in the field, TIC design experience can help you in selecting a non-linear pot, standard or special, for your application.

Complete specifications on TIC non-linear potentiometers available upon request.

TECHNOLOGY INSTRUMENT CORP.

555 Main Street, Acton, Mass., COLonial 3-7711

West Coast Mail Address, Box 3941, No. Hollywood, Calif., POplar 5-8620

CIRCLE 217 ON READER-SERVICE CARD FOR MORE INFORMATION

HOW FAR WILL COMPUTERS Penetrate Industrial Applications in '57?
Read DESIGN '57—JAN. 1st ED

Mercury Switch
Magnetically Actuated

In this 3 amp 115 v ac magnetically actuated mercury switch, contacts are moved in or out of the mercury by a 1/10 oz, moving magnet, or electromagnetic field.

Hermetically sealed in glass, the switch remains stationary, operating up to 60 times per second. It makes a relay by adding a small coil and core. Dimensions are 1/2 in. diam by 2-1/8 in. long.

Hamlin, Inc., Dept. ED, 1316 Sherman Ave., Evanston, Ill.



CIRCLE 218 ON READER-SERVICE CARD FOR MORE INFORMATION

Molding Compound
Arc-Resistant Phenolic

A two-step mineral- and flock-filled material, Durez 18001 black, is designed to provide arc of 120 seconds plus greater impact strength. When molded around large inserts, cracking is apparently reduced to a minimum. Prepared in small nodular form, it is a free-flowing material for preforming and for use on automatic molding machines. Its dimensional stability is outstanding for this type of material, with low water absorption and high dielectric strength. The compound evidences low preform weight variation, uniform preheating, and is dust-free.

Hooker Electrochemical Co., Dept. ED, Box 344, Niagara Falls, N.Y.

CIRCLE 219 ON READER-SERVICE CARD FOR MORE INFORMATION

DC Recording Amplifier
Six Channels

For use where flexibility and limited space is a factor, a multi-channel dc amplifier, Model BL-536, consists of six interchangeable plug-in dc amplifier sections, power supply, and a six-channel oscillograph. It is particularly suited for such applications as computer readout, or similar jobs.

The amplifier unit has a measurement range from 0.050 to 400 v, excellent zero line stability, an internal calibration system, and a frequency response dc to 100 cy.

Brush Electronics Co., Dept. ED, 3405 Perkins Ave., Cleveland 14, Ohio.

CIRCLE 220 ON READER-SERVICE CARD FOR MORE INFORMATION



permanent magnets

Thomas & Skinner offers a complete line of alloy steel and Alnico Grade permanent magnets to meet every industrial requirement — no matter how specialized.

Thomas & Skinner 17% and 37% cobalt steels are recommended for hysteresis motor applications. The Alnico grades, either conventionally cast or fill moulded, find use in thousands of applications . . . magnetos, motors, generators, meters, microwave applications and many others.

T&S furnishes all Alnico Grades—including T&S's Alnico 5Cb. Incorporating *columbium* for increased stability, Alnico 5Cb has a nominal energy product of 5.70 × 10⁶, offering unusually high magnetic value for low physical volume.

Besides complete assurance of quality and specification conformity, T&S offers its highly qualified engineering assistance—based on more than 50 years experience in the magnetic materials industry—to help you select the permanent magnets best suited for your applications.

Write today for Bulletin No. 151.

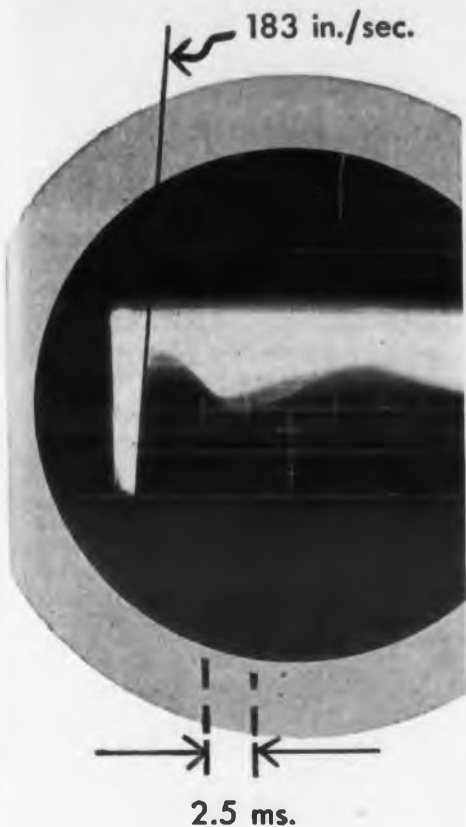


Specialists in magnetic materials



1157 East 23rd Street
 Indianapolis 7, Indiana

CIRCLE 221 ON READER-SERVICE CARD



How to move a plunger at 900 g's

Problem: Design an assembly to release a gate on the sorting mechanism of a business machine.

The assembly must actuate a plunger, getting it out of the way in 2.5 milliseconds.

It must be reliable over a long life. Keep it small. Keep cost low.

Our solution: A marriage of pulse circuit techniques and electromagnetic plunger techniques in an electromechanical transducer.

The final unit develops an acceleration of 950 g's and a peak velocity of 183 inches per second. A force of 74 pounds moves the 1.25 ounce plunger .051 inches. The plunger moves 90% of this distance in only 0.5 millisecond—only 1/5th of the time allowed.

If you want an electronic assembly, designed and produced in large or small quantities, contact...

CALEDONIA
ELECTRONICS AND TRANSFORMER CORPORATION

Dept. ED-12, Caledonia, N.Y.

In Canada: Hackbusch Electronics, Ltd.
23 Primrose Ave., Toronto 4

CIRCLE 223 ON READER-SERVICE CARD

Two New Power Tubes For Industrial Use



The tubes, types 5680 and 6366, are general purpose, three-electrode power tubes specially designed for industrial and communication applications.

Each type features sturdy double spiral thoriated tungsten filaments for long life, a Kovar grid and filament seals. The flexible leads of the 6366 are constructed of OFHS copper which can be individually tailored. Full input ratings apply to 30 mc, reduced ratings to 50 mc.

Partial specifications for tube type 5680 include anode dissipation of 2500 w and plate input of 12,000 w.

Tube type 6366 has a high efficiency, low pressure drop radiator, an anode dissipation of 3000 w, and plate input of 7000 w.

Central Electric Mfg. Inc., Dept. ED, Denville, N.J.

CIRCLE 224 ON READER-SERVICE CARD FOR MORE INFORMATION

WHAT IS THE TREND in Printed Circuits? Transistors?

Watch for DESIGN '57—JAN. 1st ED

AC High Power Supply Versatile Kit



This instrument Model 711 and Model 713 Power-Lab is a combined battery eliminator and dc-ac high power supply. It can act as a battery eliminator or charger, a high current line

voltage variac, an ac line voltage meter, ammeter, wattmeter, or line isolation transformer, a low voltage, high ac supply, a dc line voltage variable supply, high current ammeter, or as an ac bias box. This power supply is available in kit form or wired, from 100 to 300 w.

Precise Development Corp., Dept. ED, Ocean-side, N.Y.

CIRCLE 225 ON READER-SERVICE CARD FOR MORE INFORMATION

Kearfott Components

FOR EVERY SYSTEM
APPLICATION



KEARFOTT offers the systems manufacturer the most complete line of precision made components available anywhere. Quantity production enables quick deliveries and reasonable prices.

SYNCHROS—Transmitters, Control Transformers, Resolvers, Repeaters, and Differentials in Bu Ord Sizes 8, 11 and 15. High Accuracy and environmental resistance.

SERVO MOTORS—High torque, low inertia Servo Motors, Inertial and Viscous damped Servo Motors, in Bu Ord Sizes 8, 11, 15, 18 and 23.

TACHOMETER GENERATORS—Available as damping generators, rate generators and integrators. They feature high output to null ratio and extremely linear outputs. Temperature stabilization may be provided.

GYROS—Directional, floated rate integrating, free, vertical, and spring restrained rate gyros for all airborne navigation, stabilization or fire control applications.

Bulletins giving physical and technical data of the various Kearfott Products will be sent on request. The Kearfott organization is available to assist in the development and manufacture of other precision components you may require.



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 226 ON READER-SERVICE CARD FOR MORE INFORMATION

SPECTROL

Precision

Potentiometers

MODEL 100



Precision 1 $\frac{1}{4}$ " dia. single-turn potentiometer. Standard Resistance Range—10 Ω to 30 K Ω \pm 3.0%. Standard linearity \pm 0.5%. May be ganged—2 to 15 sections. Up to 14 extra taps per section.

MODEL 200



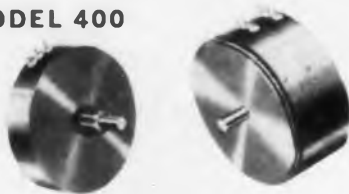
Precision 1 $\frac{1}{4}$ " dia. single-turn potentiometer. Standard Resistance Range—5 Ω to 65 K Ω \pm 3.0%. Standard linearity \pm 0.3%. May be ganged—2 to 15 sections. Up to 21 extra taps per section.

MODEL 300



Precision 2" dia. single-turn potentiometer. Standard Resistance Range—20 Ω to 75 K Ω \pm 3.0%. Standard linearity \pm 0.3%. May be ganged—2 to 15 sections. Up to 21 extra taps per section.

MODEL 400



Precision 3" dia. single-turn potentiometer. Standard Resistance Range—100 Ω to 100 K Ω \pm 3.0%. Standard linearity \pm 0.3%. May be ganged—2 to 15 sections. Up to 33 extra taps per section.

MODEL 500



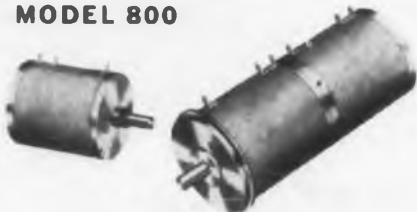
Precision $\frac{7}{8}$ " dia. miniature 10-turn potentiometer. Standard Resistance Range—25 Ω to 120 K Ω \pm 3.0%. Standard linearity \pm 0.3%. Up to 38 extra taps per section.

MODEL 700



Precision $\frac{7}{8}$ " dia. miniature single-turn potentiometer. Standard Resistance Range—10 Ω to 20 K Ω \pm 3.0%. Standard linearity \pm 0.5%. May be ganged—2 to 6 sections. Up to 9 extra taps per section.

MODEL 800



Precision 1 $\frac{1}{4}$ " dia. 10-turn potentiometer. Standard Resistance Range—50 Ω to 400 K Ω \pm 3.0%. Standard linearity \pm 0.3%. May be ganged—2 to 3 sections. Up to 48 extra taps per section.

MODEL 850



Precision 1 $\frac{1}{4}$ " dia. 3-turn potentiometer. Standard Resistance Range—20 Ω to 120 K Ω \pm 3.0%. Standard linearity \pm 0.3%. May be ganged—2 to 3 sections. Up to 18 extra taps per section.

Spectrol potentiometers may be tailored to comply with a wide variety of electrical and mechanical requirements.

Write for complete details

SPECTROL

SPECTROL ELECTRONICS
DIVISION OF
CARRIER CORPORATION

1704 South Del Mar, San Gabriel, California

CIRCLE 228 ON READER-SERVICE CARD FOR MORE INFORMATION

Beam Power Pentodes For TV Deflection



Two 7-pin miniature beam power amplifiers, designed for television sets up to the 14 in. size, fill the need for miniature tubes of pentode construction for vertical deflection service.

The 12R5 and 17R5 are of particular use in series string TV sets with relatively low B+ supply. The type 12R5 has a 600 ma heater, while the 17R5 has a 450 ma heater. Both are controlled for heater warm-up time. They have pentode connected deflection amplifier ratings which permit peak positive pulse plate voltages up to a value of 1500 v and a plate dissipation of 4.5 w.

Sylvania Elec. Prod. Inc., Dept. ED, 1740 Bway, N.Y. 19, N.Y.

CIRCLE 229 ON READER-SERVICE CARD FOR MORE INFORMATION

Treated Teflon Yarn High Temperature Insulation

Teflon coated glass yarn that doesn't change colors when exposed to high temperatures is now available in white and all colors. It can be furnished semi-cured or sintered.

Treated Teflon yarn has good tensile strength and an operating range from -100 F to +500 F. In addition to a high degree of chemical inertness it has good electrical properties over a wide range of temperatures and frequencies. Treated Teflon yarn has low flow under heat and pressure.

Principal uses for this new yarn are for insulation on aircraft control cable and high temperature lead wire.

Chemo Textiles Inc., Dept. ED, West Warwick, R. I.

CIRCLE 230 ON READER-SERVICE CARD FOR MORE INFORMATION

Insulating Varnish For Wire Enamel

A new Class B insulating varnish is designed for use with Class B wire enamel systems.

Designated as Isonel varnish, it is a polyester type closely related to Isonel wire enamel. The varnish has a heat resistance similar to the new Class B wire enamels.

The varnish has 2 to 8 times the life of conventional Class A varnishes when aged at 200 C and subjected periodically to a 2000 v dielectric test. The varnish cures at 375-400 F, the length of the baking cycle depending on the size of the impregnated coil.

Schenectady Varnish Co., Inc., Dept. ED, Schenectady, N.Y.

CIRCLE 231 ON READER-SERVICE CARD FOR MORE INFORMATION



FIRST COMPLETE BOOK COVERING ALL COMMERCIAL TRANSISTOR APPLICATIONS TRANSISTOR ENGINEERING REFERENCE HANDBOOK

by H. E. Marrows

A *must* for every design, development, research and production engineer and purchasing agent concerned with transistorized equipment.

Increasing transistor applications in electronic equipment of all kinds have made necessary an easy reference handbook for use in engineering, scientific research, and manufacturing of transistor devices.

The content of the handbook

Section 1: Chronology, transistor materials, structure and fabrication of all types of transistors; characteristics of all types of junction transistors; special bibliography on transistors.

Section 2: Numerical index of transistor types, data sheets showing physical specifications, electrical specifications, typical operating parameters, characteristic curves, performance curves of all types of transistors.

Section 3: Physical specifications, electrical specifications and manufacturer type number and part number of all components — capacitors, transformers, batteries, thermistors, miscellaneous items — designed for use with transistors. List of transistor test sets.

Section 4: Commercial application of transistors with schematic diagrams.

Section 5: Directory of manufacturers making transistors and components designed for use with transistors.

Large 9" x 12" coated paper for easy readability. Each section individually indexed.

#193 Cloth Bound, 288 pp., \$9.95

Read These New Rider Books

... Up-to-the-Minute — Authoritative — Informative

PICTORIAL MICROWAVE DICTIONARY

by Victor J. Young & Merideth W. Jones

A pictorial dictionary serving as a ready reference which defines and explains present day microwave terminology. Derivation, explanation, definition are combined for complete coverage of microwave activity.

#188, soft cover, 116 pp., \$2.95

BASICS OF PHOTOTUBES & PHOTOCELLS

by David Mark

Explains the principles and practices surrounding phototubes and photocells with the utmost in visual presentation.

#184, soft cover, 136 pp., \$2.90

INTRODUCTION TO PRINTED CIRCUITS

by Robert L. Swiggett

Comprehensive text on Printed Circuits by an authority in the field covers thoroughly the various manufacturing processes used. Numerous practical applications discussed. Explains maintenance techniques peculiar to printed circuits.

#185, soft cover, 112 pp., \$2.70

FUNDAMENTALS OF TRANSISTORS

by Leonard Krugman

Explains the BIG thing in electronics today... the transistor! Written by one of the pioneers in transistor development, this book deals with basic operation, characteristics, performance and application.

#160, soft cover, 144 pp., \$2.70

Buy these books at your electronics parts jobber or bookstore, or mail this coupon today for prompt delivery.

Add state and city sales tax where applicable.
Canadian prices 6% higher.

JOHN F. RIDER PUBLISHER, INC.
116 West 14th Street, New York 11, N. Y.

Enclosed is \$_____ Please rush books checked

- ___ #193 Transistor Engineering Reference \$9.95
- ___ #188 Pictorial Microwave Dictionary \$2.95
- ___ #184 Basics of Phototubes & Photocells \$2.90
- ___ #185 Introduction to Printed Circuits \$2.70
- ___ #160 Fundamentals of Transistors \$2.70

Name.....

Company.....

Address.....

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

ED-12

CIRCLE 232 ON READER-SERVICE CARD

COAXIAL SWITCHES

-the complete line for broad-band, high efficiency RF switching

You'll find TRANSCO switches reliable under all conditions described in existing military specifications. Reliability—plus minimum insertion loss, low V S W R, and high isolation between channels—make TRANSCO the most specified coaxial switches in the industry.

Send your coaxial switching problems to TRANSCO. Technical data on any unit or the complete line sent on request.

1460 series
MOTOR OPERATED
—SP2T to SP6T; also DP transfer and DPDT. Frequencies to 11,000 MC.

M1460 series
MANUALLY OPERATED
—same contact arrangement and RF head as the 1460 Series.

11000 series
MINIATURE—SPDT
—remote-control unit, excellent RF characteristics over wide frequency range.

14000 series
MINIATURE—SP4T
—for wide application flexibility. Weight only 0.75 lbs. Frequencies to 10,000 MC.

TRANSCO
PRODUCTS, INC.
Always the Finest in Avionics
12210 NEBRASKA AVE.,
LOS ANGELES 25, CALIF.

REPRESENTATIVES IN MAJOR AREAS

CIRCLE 233 ON READER-SERVICE CARD

Formica-Aluminum Boards

For Control Panels

This new panel material is 1/16 in. sheet formica bonded to either side of 1/4 in. aluminum plate. It is available for control room panel applications, including conventional large case, large case graphic, and miniature graphic panels.

Ease of reworking this new laminate permits reduction of the time and effort of panel revisions in the field. At the same time, the smooth, durable formica facing offers enhanced panel appearance and high-resistance to scratching and denting. The use of formica on aluminum material for control panels has proved feasible because of near-equality in the components' coefficient of expansion.

Panellit, Inc., Dept. ED, 7401 No. Hamlin Ave., Skokie, Ill.

CIRCLE 234 ON READER-SERVICE CARD FOR MORE INFORMATION

Microwave Guide Shield

Counters Magnetic Fields

A non-absorbent non-retentive Fernetec shield manufactured from coated high permeability Netic steel protects traveling microwave guides, tubes and ferrite isolators from the earth's and other disturbing magnetic fields.

There is no loss in efficiency or wave distortion even when the wave guide is shielded in close proximity to small or large disturbing magnetic fields up to 8000 gauss and higher. Absorption or retention of high frequency waves is prevented by a ferrous and ferrite powder coating on the Fernetec shield, so that at 5000 mc, Fernetec is 96 percent reflective. The shield is thin, lightweight, and can be furnished in any size or shape.

Perfection Mica Co., Magnetic Shield Div., Dept. ED, 20 No. Wacker Dr., Chicago 6, Ill.

CIRCLE 235 ON READER-SERVICE CARD FOR MORE INFORMATION

Klystron Power Supplies

Variable to 30 KV

Developed as a beam supply for high-power klystrons the Model PC 33 power supply provides continuously variable voltages from zero to 30 kv at currents from zero to 2 amp dc. Voltage ripple is less than 0.04 percent.

Included are facilities to monitor output voltage and current; and for klystron operation, collector current, and body current.

The unit is completely interlocked and overvoltage and overcurrent protection are provided. The supply can be connected to the external interlock system of associated equipment. Power input is 208 v, 3 phase, 60 cps.

Levinthal Elec. Prod. Inc., Dept. ED, 2758 Fair Oaks Ave., Redwood City, Calif.

CIRCLE 236 ON READER-SERVICE CARD FOR MORE INFORMATION

WHAT ADVANCED COMPONENTS and Assembly Methods are in Sight?

Find Out in DESIGN '57—JAN. 1st ED

electronic engineers

SENIOR and JUNIOR

*Continued Expansion
Opens Up New Opportunities with*



Greenwich, Connecticut

Excellent positions are available with the General Engineering Laboratories of American Machine & Foundry Company, a recognized leader in the design, development and manufacture of atomic, electronic and mechanical equipment for the consumer, industry and defense.

If you qualify in any of the fields listed below, investigate these opportunities now:

- *High power radar system development*
- *Tropospheric scatter systems*
- *Microwave theory & component design*
- *Electronic packaging*
- *Missile control and handling systems*
- *Antenna design*
- *Electronic countermeasures*
- *Telemetry*
- *Data handling*
- *Circuit theory*
- *Navigation systems*
- *Instruments*



Good opportunities for advancement through advanced education on the premises as well as at nearby graduate schools in addition to a liberal tuition reimbursement plan, excellent employee benefits and an ideal location in Connecticut, surrounded by fine suburban communities. Relocation expenses paid.

Advanced electronic equipment
recently designed by **AMF**

*Please send your resume to Mr. J. F. Weigandt
OR for additional technical information,
contact Mr. D. R. Barker or Mr. H. R. Holloway
NOrmandy 1-7400*

General Engineering Laboratories

American Machine & Foundry Company

Fawcett Bldg. • Fawcett Place
Greenwich, Connecticut

CIRCLE 237 ON READER-SERVICE CARD FOR MORE INFORMATION

THE 2 IN 1 WIRE THAT GIVES YOU...



•Electrical and Heat
Conductivity of Copper
plus Heat Resistance of Nickel

ALLOY'S NICKEL-CLAD COPPER WIRE

A core of high conductivity oxygen-free copper, metallurgically bonded to a sheathing of "A" Nickel — that's Alloy's Nickel-Clad Copper Wire. Widely used in aircraft industry for spark plug electrodes and bunched instrument wiring, this bimetal wire offers the design engineer a versatile tool for many other electrical and heat-transfer applications.

Nickel-Clad Copper Wire can be obtained in almost any variation of copper core and nickel sheathing. Two grades — 27% Nickel and 64% Nickel are in general use today. Additional combinations will be made to your specifications.

Other clad-metal wires are also available, including Inconel-Clad Copper and Inconel-Clad Nickel.

For complete engineering and application data on our Nickel-Clad Copper Wire, send today for Technical Bulletin T-3.



ALLOY METAL WIRE DIVISION

HKP H. K. PORTER COMPANY, INC.
Prospect Park, Pennsylvania

CIRCLE 239 ON READER-SERVICE CARD FOR MORE INFORMATION

Current Transformers

Custom-Built



These precision multirange current transformers are custom-built to specified primary ranges, and provide compensation and calibration for a specific secondary burden.

As many as 18 ranges can be provided in one unit chosen from a total of 33 primary current ranges from 0.5 amp to 200 amp inclusive.

The transformers are of 1200-ampere-turn, ring-core design and feature excellent ratio and phase-angle performance on all ranges with values of secondary current from 10 per cent to 100 per cent load.

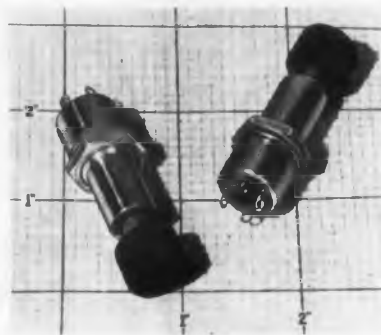
The ratio and phase angle are well within a few hundredths of 1 per cent and 2 minutes.

Knopp Inc., Dept. ED, 4294 Holden St., Oakland 8, Calif.

CIRCLE 240 ON READER-SERVICE CARD FOR MORE INFORMATION

Pushbutton Switch

For Calculators



This pushbutton switch is designed for computers and calculators using whole banks of adding machine-type key switches

The type B5023 is a momentary-contact switch with a

non-snap action that closely approaches the speed of operation and general "feel" of mechanical-type pushbuttons used on calculating machines.

The switch responds to an operating pressure of only 1/2 lb and has a total button travel of 1/4 in.

Contact arrangement is 2 circuit, break-before-make. The switches are designed for a life of over 100,000 cycles at rated load of 28 v, 3 amp.

Hetherington Inc., Dept. ED, 1200 Elmwood Ave., Sharon Hill, Pa.

CIRCLE 241 ON READER-SERVICE CARD FOR MORE INFORMATION

RADIO & TV
COMMUNICATIONS
COMPUTERS

Your Customers
List Their
Requirements

Read DESIGN '57—JAN. 1st ED

molded Black Nylon screws and nuts

Insulate and Fasten
without bushings,
washers, etc. In Stock
4-40, 6-32, 8-32,
10-32 and 1/4-20.



Black Nylon "NyGrip" cable clips

Light-weight non-
conducting support
for wiring, tubing, etc.
In Stock 1/16" to
1 1/2" Dia.



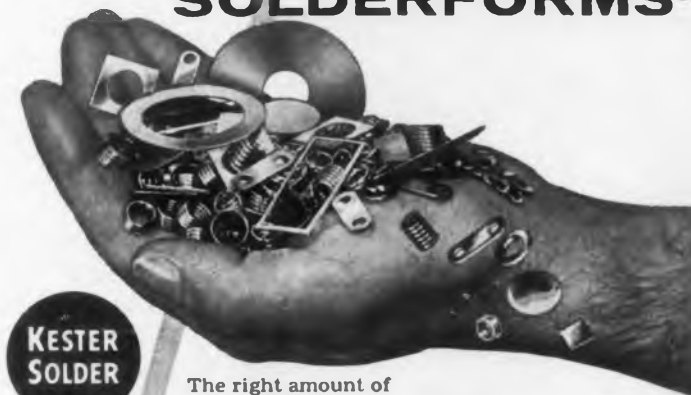
Free samples • write **WECKESSER CO.**

5703-05 Northwest Hwy • Chicago 30, Ill.

CIRCLE 242 ON READER-SERVICE CARD FOR MORE INFORMATION

no limit on shape / versatility... economy!
when you use

KESTER SOLDERFORMS®



KESTER
SOLDER

The right amount of
solder every time when you use
Kester Solderforms in your assembly operation.
Produce better looking and more efficient products
as well as greatly increase speed
of manufacturing.

WHERE TO USE KESTER SOLDERFORMS

Capacitors • Switches • Resistors • Transformers
Relays • TV and Radio Tuners • Gauges • Small
Metal Assemblies and Controls... many, many others.

WRITE TODAY for free samples and complete information

KESTER SOLDER COMPANY

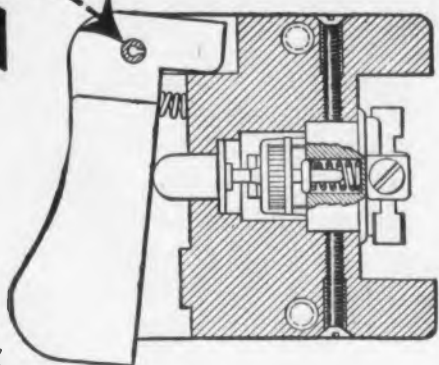
4266 Wrightwood Avenue, Chicago 39, Illinois
Newark 5, New Jersey • Brantford, Canada

CIRCLE 243 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • December 15, 1956

ROLLPIN
TRADEMARK

**cuts
rejects
on this
plastic
assembly 25%**



If your assembly is made of plastics, check up on Rollpin. In applications like the phenolic trigger switch above, it cut production costs and actually reduced, from 25% to zero, rejections due to cracking of the plastic parts during seating of the pivot pin. Rollpin is a slotted, hollow steel spring pin with chamfered ends. Pressed into holes molded or drilled to normal production tolerances, it compresses as inserted. It makes a self-locking, vibration-proof fastener. It is light, easily removable, and reusable. Available in diameters .062, .078, .094, .125, .140, .156, .187, and up to .500 in a broad range of standard lengths.



For detailed information and help with electronic fastening problems, write Dept. R32-1257.

**ELASTIC STOP NUT CORPORATION
OF AMERICA**

2330 Vauxhall Road, Union, N. J.

DESIGN HEADQUARTERS FOR SELF-LOCKING FASTENERS
CIRCLE 245 ON READER-SERVICE CARD FOR MORE INFORMATION

**ELECTRONIC
RESEARCH
ENGINEERS
for
SYLVANIA'S
Applied
Research
Laboratory**

If you are an electronic research engineer qualified to assume major project responsibility, there are excellent opportunities at Sylvania's new Applied Research Laboratory. We are presently forming groups to carry out theoretical and experimental research to establish system requirements for future aircraft ECM systems and airborne radars; devise and evaluate counter-countermeasures techniques; study low altitude clutter rejection problems; and investigate passive detection system requirements.

If your interest is in one of these fields, you will find stimulating associates and unlimited opportunities to contribute and gain recognition at Sylvania.

For further information send resume to:

Dr. L. S. Sheingold,
Manager
Applied Research Laboratory

SYLVANIA
SYLVANIA ELECTRIC PRODUCTS INC.

Waltham Laboratories
100-J3 First Avenue
Waltham, Massachusetts

**WHAT NEW PLANS Will Directly Affect the
Component Parts Manufacturer in '57
See DESIGN '57—JAN. 1st ED**

Alpha Display Unit

Sweep to 50 MC

The Transalyzer measures alpha and alpha cut-off characteristics of point contact, junction and tetrode transistors. It provides an oscilloscopic display of the alpha characteristic of point contact and tetrode transistors and of the quantity of either pnp or npn junction transistors.



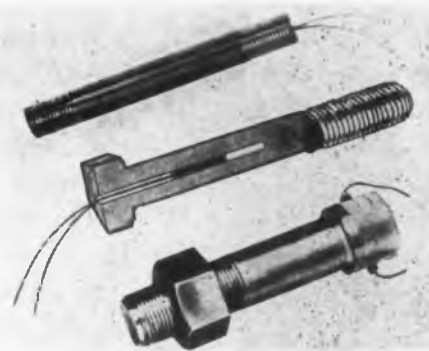
Included are a sweep generator, attenuators, dc biasing and metering circuits for the transistor, and an rf amplifier and detector. All transistor biases are electronically regulated.

An oscilloscope is the only auxiliary equipment necessary for measurement.

Kay Electric Co., 14 Maple Ave., Pine Brook, N.J.

CIRCLE 247 ON READER-SERVICE CARD FOR MORE INFORMATION

**Load Sensitive Bolts
High Temperature Rods**



High temperature units, capable of operation at temperatures up to 425 F, are now available in standard load sensitive screws or furnished special bolts or rods.

These new high temperature primary load measuring elements sense tension and compression through a special resistance type strain gage potted axially at the center of the part.

Accurate direct measurement of actual bolt load is possible with standard strain measuring instruments.

Response is only to tension and compression. The gage is also protected, waterproofed, and shielded. Polyphase Instrument Co., Dept. ED, Bryn Mawr, Pa.

CIRCLE 248 ON READER-SERVICE CARD FOR MORE INFORMATION



**TRY THIS
NEW FIC₀
SERVO MOTOR
FOR SIZE**



the SM-58—a truly subminiature servo motor
Nominal Size: 5/8" diam. x 1" long (excluding shaft)
Weight: Under 1 ounce

We believe this is the smallest of small servo motors—and it's a HIGH PRECISION, VERY MODERATELY PRICED unit, with EXTREMELY HIGH torque to inertia ratio.

Applications include

Servomechanisms	Missile Control Systems
Computers	Aircraft Control Equipment
Indicating Devices	—and similar uses

Typical Characteristics include

Line: 26 v 400 cy	No Load Speed: 8800 rpm
Control Voltage: 26 v (max)	Ambient Range: -75 to 200 F
Input: 2-1/2 w	Rotor Inertia: 0.00038 oz-in ²
Output: 1/10 w	Theoretical Acceleration at
Stall Torque: 0.063 in-oz	Stall: 64,000 rad/sec ²

Available with Smooth or Splined Shafts

DELIVERY IS GOOD!

Write to: Components Sales

FORD INSTRUMENT COMPANY

Division of Sperry Rand Corporation
31-10 Thomson Ave. Long Island City 1, N. Y.
Telephone: E. McKinnon, ST 4-9000, Ext. 613

California
Representatives
J. F. Sodaro Co.
3895 Main St.
Culver City, Calif.

Central and South Central
Representatives
Automatic General Sales
6550-B Troost Ave.
Kansas City, Missouri

CIRCLE 249 ON READER-SERVICE CARD FOR MORE INFORMATION



on Brand's silicone rubber coated glass tubing

Long noted for high temperature resistance, low temperature flexibility and excellent dielectric strength . . . BRAND'S TURBO 117 offers abrasion resistance not found in ordinary silicone rubber coated glass tubing. Try this simple test:

Run your fingernail along the surface of TURBO 117. See how hard you have to scrape to peel the coating.

But abrasion resistance is just one feature of TURBO 117. It has permanence of color too . . . even at sustained high temperatures.

For complete factual information on how TURBO 117 meets all applicable commercial and military specifications write for Bulletin T117.

Include specifications if a quotation is desired.

WILLIAM BRAND & COMPANY, INC.

WILLIMANTIC 2



CONNECTICUT

ELECTRICAL AND ELECTRONIC WIRES AND CABLES • HARNESSES AND CABLE ASSEMBLIES
PLASTIC AND COATED INSULATING TUBINGS • IDENTIFICATION MARKERS
CIRCLE 252 ON READER-SERVICE CARD FOR MORE INFORMATION

Analog-Digital Converter

Yields Binary Digits

A compact and lightweight digitizer converts analog information into binary-coded decimal digital information. In a typical application, analog data is trans-

lated into angular rotation by a servo, which drives the input shaft of the digitizer providing a binary-coded decimal readout signal.

Modular construction provides any desired number of decimal digits through addition of modules to the assembly.

A typical assembly providing three decimal digits weighs 8 oz. and measures 2-11/16 in. in length and 2 in. in diameter.

Federal Telephone and Radio Co., Dept. ED, 100 Kingsland Rd., Clifton, N.J.

CIRCLE 253 ON READER-SERVICE CARD FOR MORE INFORMATION

AUDIO INSTRUMENTS & CONTROLS **Your Customers List Their Requirements**
AIRCRAFT ELECTRONICS **Read DESIGN '57—JAN. 1st ED**

Vacuum Pressure Switch

for Aircraft

Designed especially for use in airborne electronic systems, the GAB 1000 series respond to pressure as low as 2 in. of mercury absolute, retain their accuracy to ± 1 in. of mercury pressure under extreme environmental conditions in aircraft and missile systems. The basic operating element is the rigid miniature bellows which resists self-actuation under severe vibration up to

2000 cps at 10 g.

The GAB 1000 series is specifically designed for use in inert gas vacuums, while for fluid vacuum and absolute pressures the GAB 2000 series is used. The 3 oz switch has an over-all length of 3-1/2 in.

Gorn Aircraft Cont. Co., Dept. ED, Div. of Gorn Elec. Co., 845 Main St., Stamford, Conn.

CIRCLE 254 ON READER-SERVICE CARD FOR MORE INFORMATION

surprise
another product from Helipot



Beckman® Linear Scale AC Ammeter

There's no peck-a-boo with our new BECKMAN Linear Scale AC Ammeter, designed for rapid, accurate monitoring of generator load. We'll fly upside down to prove you can get quick readings from any angle. And no bunched-up graduations...the needle deflection is always directly proportional to amperage.

It's plain to see that the Helipot engineers responsible for our 22-ounce meter-transformer unit know their onions as well as their ohms. They gave it intestinal fortitude (that's right—guts!)...to withstand extreme vibration, shock, moisture, salt spray and fungus. They gave it airworthy performance...anywhere from sea level to 50,000 feet and from -55° to $+71^{\circ}\text{C}$. And they gave it flexibility...the compact meter can be installed on your instrument panel, the potted transformer as far away as 150 feet (with negligible effect on accuracy).

In your next free moment (like right now), write for data file 1245, which has complete information on our standard units.



Beckman®
Helipot Corporation
Newport Beach, California
a division of Beckman Instruments, Inc.
Engineering representatives in principal cities

845

CIRCLE 255 ON READER-SERVICE CARD

High Voltage Supply

Fast Recovery Time



The Model 2500 voltage regulated power supply features a 0 to 2500 v, 0 to 50 ma continuous duty dc output. In the range 0 to 2500 v, the output voltage variation is less than 0.1 v for

load variations from 0 to maximum current and less than 0.2 v for line fluctuation from 105 to 125 v. The ripple is less than 3 mv rms. Recovery time is less than 25 μ sec.

Stability for a period of 8 hours is within 0.2 v. Output impedance is less than 0.1 ohms from 20 cycles to 100 kc and less than 0.5 ohms from dc to 20 cycles.

Kepeco Labs., Dept. ED, 131-38 Sanford Ave., Flushing 55, N.Y.

CIRCLE 260 ON READER-SERVICE CARD FOR MORE INFORMATION

Square Wave Modulator

High Stability



Model MO-1A square wave modulator can be used to provide 100% square wave modulation of rf signals. The device is used where high stability is required for the audio frequency of the modulated

rf signal. Often, this is necessary in test set-ups utilizing narrow-band audio amplifiers.

Within 0.01 percent, a 1000 cps tuning fork maintains the 1000 cps square wave.

The square wave output voltage is sufficient to modulate most commercial medium-power klystrons.

Weinschel Engineering, Dept. ED, Kensington, Maryland.

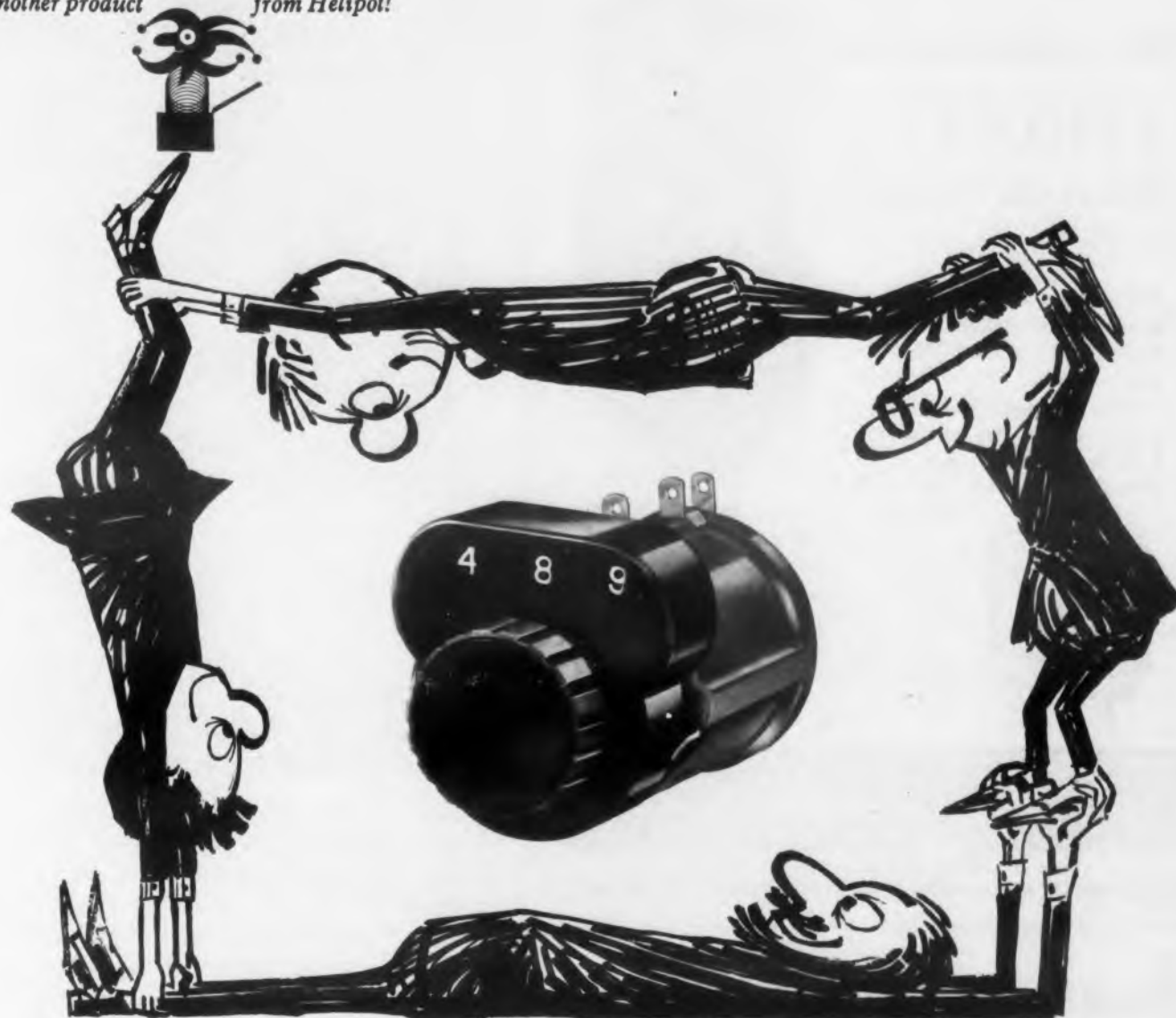
CIRCLE 261 ON READER-SERVICE CARD FOR MORE INFORMATION

**WILL CHANGES IN THE GROWTH of the
Magnetic Tape Market Affect
Component Requirements?**

Find Out in DESIGN '57—JAN. 1st ED

ELECTRONIC DESIGN • December 15, 1956

Another product surprise from Helipot!



A Dial to reckon with

When position is everything, you can count on the new DIGIDIAL* ten-turn decimal-counting dial... for indicating shaft position from 0° to 3,600°... with reading resolution of 0.05% of full scale or better.

The DIGIDIAL reads by the numbers. This means farewell to interpolations and operator errors... hail and hello to fast, accurate reading from as far as six feet away... from just about any angle except behind the panel. You'll welcome its compact construction, light weight, simple installation and smooth operation. You'll utter gleeful greetings to the positive, non-distorting locking mechanism.

If position is important to you, you'll want to know more about the DIGIDIAL... to get the whole story, write for data file 1225.

Beckman®

Helipot Corporation: Newport Beach, California
a division of Beckman Instruments, Inc.
Engineering representatives in principal cities

844 *TRADEMARK

CIRCLE 262 ON READER-SERVICE CARD FOR MORE INFORMATION

for printed circuits
PHILCO uses
INSUROK® laminate

Philco engineers use Richardson Copper-Clad INSUROK T-725 laminate for printed TV and radio circuits.

In the manufacture of printed circuit materials, the most important single consideration is the laminate. Richardson Copper-Clad

INSUROK T-725 is a laminate of outstanding excellence . . . its electrical qualities remain remarkably stable under repeated temperature and humidity cycling.

For further information, write, or phone . . . Chicago number, MAAnsfield 6-8900.



The **RICHARDSON COMPANY**
LAMINATED AND MOLDED PLASTICS

Dept. 11, 2682 Lake St., Melrose Park, Ill.
CIRCLE 266 ON READER-SERVICE CARD FOR MORE INFORMATION

use new **Deutsch push-pull**

Where the connection is remote . . .

With three strong men, a sackful of special tools, and a world of patience . . . you can make remote electrical connections with conventional connectors. In hours.

Or, you can use a new Deutsch Miniature Push-Pull Electrical Connector. Simply push it in with a tube for automatic lock and seal . . . pull back on a lanyard for instant quick-disconnect. In seconds.

Which would you choose?



Deutsch Push-Pull Connectors operate in the direction of plug travel, without threading, bayonet or coupling nut . . . they meet AN "E" requirements . . . they, and all Deutsch miniature connectors, are described and illustrated in Bulletin 1202 which is yours for the asking.

The Deutsch Company
 7000 Avalon Blvd., Los Angeles 3, California

CIRCLE 267 ON READER-SERVICE CARD FOR MORE INFORMATION

Matching Unit
 For Audio Oscillator



The T-10 matching unit for use with the 510B audio oscillator consists of a repeat coil and resistive network designed to furnish a balanced signal of up to +8 dbm. Impedances of 150 or 600 ohms ± 5 per cent over the range 18 cps to 50 kc are selected by means of straps at the binding posts. The unit is housed in a sheet metal enclosure which forms a permanent part

of the oscillator assembly.

Waveforms, Inc., Dept. ED, 333 Sixth Ave., New York 14, N.Y.

CIRCLE 268 ON READER-SERVICE CARD FOR MORE INFORMATION

Solder Resist
 For Printed Circuits

A new solder resist which permits selective soldering, minimizes bridging over close tolerances and reduces solder waste. Developed for printed circuits, the PC No. 33 solder resist is an organic coating which affords high insulating resistance across the circuit pattern. It has a low temperature cure of 200 F and requires a cure time of 20 to 30 minutes. The hard film it deposits is resistant to peeling, and will not break down at solder pot temperatures up to 650 F, with immersion of 10 to 15 seconds.

London Chemical Co. Inc., Dept. ED-EKN, 1535 N. 31st Ave., Melrose Pk., Ill.

CIRCLE 269 ON READER-SERVICE CARD FOR MORE INFORMATION

Turbulence Gage
 For Wind Tunnels



Designed to measure turbulent pressures in wind tunnels, along skin surfaces of model structures, for the study of fluid flow in gas and hydraulic lines and

in microphone applications, this Turbulence Gage provides 40 mv sensitivity per psi minimum with a pressure range of 0 to 10 psi.

The model 2503 gage is 3/8 in. diameter x 1/4 in. thick and may be flush mounted with wax, 0 rings or retaining rings. Rigid mounting is not required at these low pressure ranges.

Endevco Corp., Dept. ED, 161 E. California St., Pasadena, Calif.

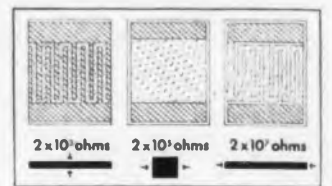
CIRCLE 270 ON READER-SERVICE CARD FOR MORE INFORMATION

Kodak
Ektron
Detector . . .



A unique lead sulfide photosensitive resistor with the following characteristics:

- Response extends from 0.25 microns to 3.5 microns with maximum sensitivity at 2.2 microns in the infrared
- High signal-to-noise ratio in infrared
- Signal response is almost independent of size of sensitive area
- Unaffected by vibration, small in size
- Available in complex and exact arrays and mosaics



For a booklet giving detailed information on Kodak Ektron Detectors, write Military and Special Products Sales,

EASTMAN KODAK COMPANY
 Rochester 4, N. Y.

CIRCLE 271 ON READER-SERVICE CARD FOR MORE INFORMATION

specify standard

FLEXLOC® SELF-LOCKING NUTS

Regular and Thin Types



Regular FLEXLOCs are one-piece, all-metal, standard height nuts that lock securely, even under extreme vibration. Thin nuts have the same one-piece, all-metal construction and the same positive locking principle, but these nuts are approximately 30% thinner. Your FLEXLOC industrial distributor stocks both types: regular FLEXLOCs in sizes from #0 to 2"; thin FLEXLOCs in sizes from #6 to 1 1/2". Ask him for catalog information and samples. Or write STANDARD PRESSED STEEL CO., Jenkintown 12, Pa.

STANDARD PRESSED STEEL CO.

FLEXLOC LOCKNUT DIVISION

SPS
 JENKINTOWN PENNSYLVANIA

CIRCLE 272 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • December 15, 1956

AM Signal Generator

For Broadcast Band



The Model 290X is a high speed am generator which provides an accurate and stable source of rf power for alignment of am broadcast receivers.

Five present calibrated frequencies, 262, 455, 465, 600 and 1400 kc are quickly obtained by a selector switch on the front panel and rf output is modulated or unmodulated.

Rf output is variable from $2\mu\text{v}$ to $200\mu\text{v}$ and audio output is 400 cps.

Crystal accuracy may be obtained through the addition of a crystal in the holder provided.

Hickok Electrical Instrument Co., Dept. ED, 10525 Dupont Ave., Cleveland 8, Ohio.

CIRCLE 273 ON READER-SERVICE CARD FOR MORE INFORMATION

WHAT IMPORTANT DEVELOPMENTS Will Affect the Design of Microwave Equipment? Components? General Communication?

See DESIGN '57—JAN. 1st ED

Impulse Counter High Speed Unit



A compact panel mounting electrical impulse counter is designed for heavy duty operation where accuracy of count is required at high speeds. Maximum counting

rate of Model F 106HD is 40 per second with electronic drives or electromechanical actuators and resistors in series. Reset to zero by knob. For dc operation only with coils from 6 to 220 v.

Current consumption of 8 w. Digits are 3/16 in. high and machine engraved for legibility.

Counter dimensions are 1-3/4 in. wide, 1-3/16 in. high, 2-1/2 in. long. Also available with one electronic decade for counting rates to 400 per second.

Presin Co., Dept. ED, 12128 W. Pico Blvd., Los Angeles 64, Calif.

CIRCLE 274 ON READER-SERVICE CARD FOR MORE INFORMATION



LABORATORY TECHNICIAN carefully measures quality of sample of enamel before it is allowed on the production floor. Results of these tests are recorded and checked against rigid specifications.

CIRCLE 275 ON READER-SERVICE CARD FOR MORE INFORMATION

This worker can help you cut rejects in winding

This technician and her co-workers check the quality of all raw materials received at Anaconda mills. Only after they are sure that Anaconda's rigid raw materials specifications are met is the material released for production.

This same rigid control is exercised over Anaconda Magnet Wire throughout its entire manufacture—even into shipping.

The result is the finest magnet wire on the market today. A production run will show you how this insistent demand for quality pays off in your winding room—in fewer rejects, longer break-free runs. Many customers are able to eliminate incoming inspection, too.

The Man from Anaconda will be glad to cooperate. Offices in 27 cities—see "Anaconda" in your phone book. Or write: Anaconda Wire & Cable Company, Magnet Wire Headquarters, Muskegon, Michigan.

56:20B

SCHEDULE A

PRODUCTION RUN OF **ANACONDA**[®]

QUALITY-CONTROLLED MAGNET WIRE

THE ONLY PUBLICATION SERVING MANAGEMENT IN THE ELECTRONIC INDUSTRIES

- LAST MINUTE NEWS
- THE WEEK IN ELECTRONICS
- WASHINGTON REPORT
- LABOR
- MARKETING
- TAXWISE TIPS
- FINANCE
- BROADCASTING

ELECTRONIC WEEK thoroughly covers every aspect of news pertinent to management. Opens a vital new means of communication in the electronic industries. Subscriptions are now open at special introductory rates . . . only \$3.00 for 52 issues. Use convenient order form below:

ELECTRONIC WEEK

19 East 62nd Street, New York 21, N.Y.

Name

Title

Company

Address

City Zone

State

Company Product

Bill me Bill company Check enclosed

a HAYDEN publication

FOR FREE SAMPLE COPY, CIRCLE READER SERVICE
NUMBER BELOW

CIRCLE 276 ON READER-SERVICE CARD FOR MORE INFORMATION



Type 561-D
\$850.



Vacuum-Tube Bridge

for Accurate, Easy, Rapid and Independent
Direct-Reading Measurements

of Forward and Reverse Amplification Factor
☆ Resistance ☆ Transconductance
of Vacuum-Tubes and Transistors

Interelectrode and other stray capacitances balanced out — awkward correction factors commonly encountered not required — all three parameters measured independently of each other. Both negative and positive values of coefficients measured easily. Eleven adaptor plates supplied; 10 with different standard tube sockets; one a "universal" type for non-standard tubes.

Write for complete data

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Massachusetts, U.S.A.

Broad Avenue at Linden, Ridgefield, N. J. NEW YORK AREA 920 S. Michigan Ave. CHICAGO 5

1150 York Road, Abington, Pa. PHILADELPHIA

8055 13th St., Silver Spring, Md. WASHINGTON, D. C. 1000 N. Seward St. LOS ANGELES 38

CIRCLE 302 ON READER-SERVICE CARD FOR MORE INFORMATION

CORNING GLASS MIDGET TRIMMERS ... ROTARY AND DIRECT TRAVERSE TYPES

available through

ERIE
distributors

The Corning Glass Midget Rotary Trimmer Capacitor offers outstanding performance coupled with economy and is made with a variety of mounting types and terminals.

The Corning Glass Midget Direct Traverse Type Trimmer Capacitor possesses extreme ruggedness combined with thermal stability and a smooth tuning characteristic. Used extensively in Military Field Communications and similar equipments, wherever extreme operating conditions are encountered.

Write to us for the Distributor's name in your locality.

ERIE
Electronics

ERIE ELECTRONICS DISTRIBUTOR DIVISION
ERIE RESISTOR CORPORATION
ERIE, PA.
ERIE, PA. • LONDON, ENGLAND • TRENTON, ONTARIO

CIRCLE 303 ON READER-SERVICE CARD FOR MORE INFORMATION

Production Products

ONLY those new products which might ordinarily be specified by the designer of electronic equipment are selected for publication in **ELECTRONIC DESIGN**.

For example, a test instrument intended strictly for production line testing is not published. Neither are we interested in mentioning conventional production tools, etc.

Occasionally, however, a new machine tool or some special processing equipment is developed which offers a basically different approach to fabrication techniques. The design engineer should be aware of these develop-

ments as the new technique may permit him to redesign his product completely for such things as greater reliability, lower cost, faster production. He may be able to achieve better performance characteristics if, for example, greater vacuums are reached, better purifying processes worked out, new sealing methods achieved, closer tolerance equipment produced.

ELECTRONIC DESIGN will hereafter publish descriptions of production type items, if they might affect the decisions a design engineer would make.

Automatic Molding Press

High Production At Low Cost



Model 450-B fully automatic, high-speed compression molding press is equipped with a flexible mechanism which permits feeding controlled amounts of powder from 1 to 2 cu in. per station for different size mold cavities. The output of several stations can

be combined as required, to fill larger cavities. Smooth take-off of finished parts is provided by a motor-driven reversing carriage. A comb on the carriage slides between knockout pins and receives ejected finished parts which it transfers into a receptacle.

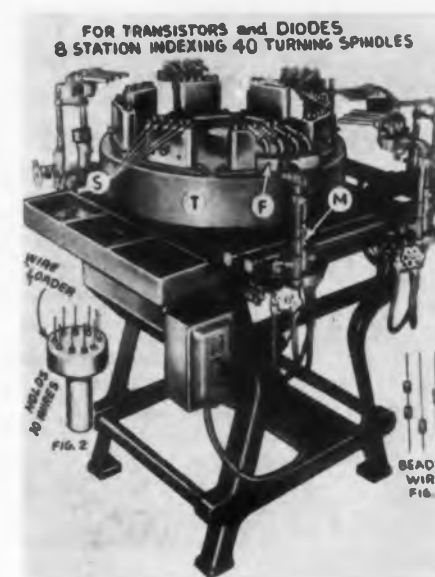
The complete dry cell time is 12 secs. The die area is 18 x 18-3/4 in. Platen stroke is 7 in. One man can operate as many as 10 machines at a time, since he is needed only to refill the hoppers and remove the containers of finished pieces. The machine can also be operated as a semi-automatic press for trial runs. The automatic cycle includes filling of mold cavities with accurately measured charges, closing, precision-controlled breathing, curing, opening and ejecting finished pieces into a container.

Hull-Standard Corp., Dept. ED, Abington, Pa.

CIRCLE 280 ON READER-SERVICE CARD FOR MORE INFORMATION

Glass Beading Machine

For Wired Components



Melting glass beads onto wire is possible with this machine for the construction of diodes, audio tubes and other such electronic devices. The machine can be used for annealing, brazing, soldering, flame hardening, spraying and other applications where ro-

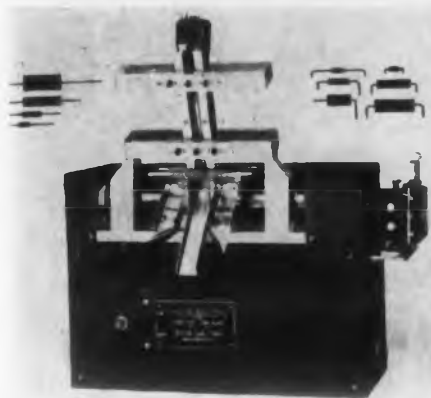
tating and indexing are important. Turret T indexes intermittently by means of an 8-station Geneva Gear located on the underside of the turret. Each of the 8 stations consists of a nest of 5 rotating spindles S. Each rotary spindle accommodates 5 wires in the beading operation. When the machine is operated at a speed of 500 indexes per hour, 25,000 wires per hour can be produced. Gas burners F, using gas and air, provide the proper heat for melting the glass to the wire. Micrometer adjustment M makes possible accurate adjustment of the gas burner flames. Fig. 2 shows the pre-loaded spindles. The operator places the pre-load spindles onto the machine and removes them after processing.

Eisler Engineering Co., Inc., Dept. ED, South 13 St., Newark 3, N.J.

CIRCLE 281 ON READER-SERVICE CARD FOR MORE INFORMATION

Automatic Lead Bender and Cutter

Handles 14,000 Parts Per Hour



Especially designed for use with printed circuit boards, this "Lead Bender" machine automatically bends to right angles and cuts to any length the coaxial leads of resistors, capaci-

tors, diodes, coils and other such wired components. Simple easy adjustments permit quick set-ups and rapid changes in lead length and distance from angle to component body.

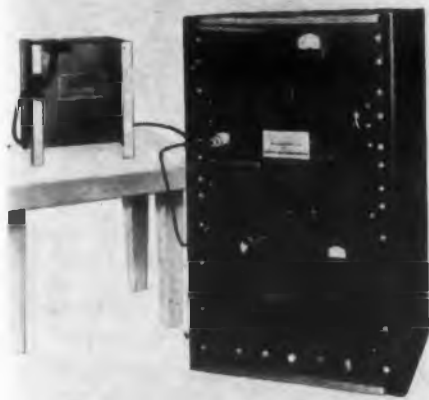
Up to 2 in. body lengths, 1 in. body diameters, and individual pigtail leads up to 2-1/2 in. long can be processed by the machine at the rate of 14,000 components per hour. This large production quantity is made possible because of the pneumatic vibrator and "air assist" which is attached to the chute to force feed the components at the desired rate. The force feed attachment is not required at production speeds of less than 8000 parts per hour. The machine weighs 80 pounds, is 20 x 8-1/2 x 20 in. and can be readily moved from one location to another.

Design Tool Corp., Dept. ED, 80 Washington St., New York, N.Y.

CIRCLE 284 ON READER-SERVICE CARD FOR MORE INFORMATION

Ultra-Sonic Solder Pot

Fluxless Dip Soldering

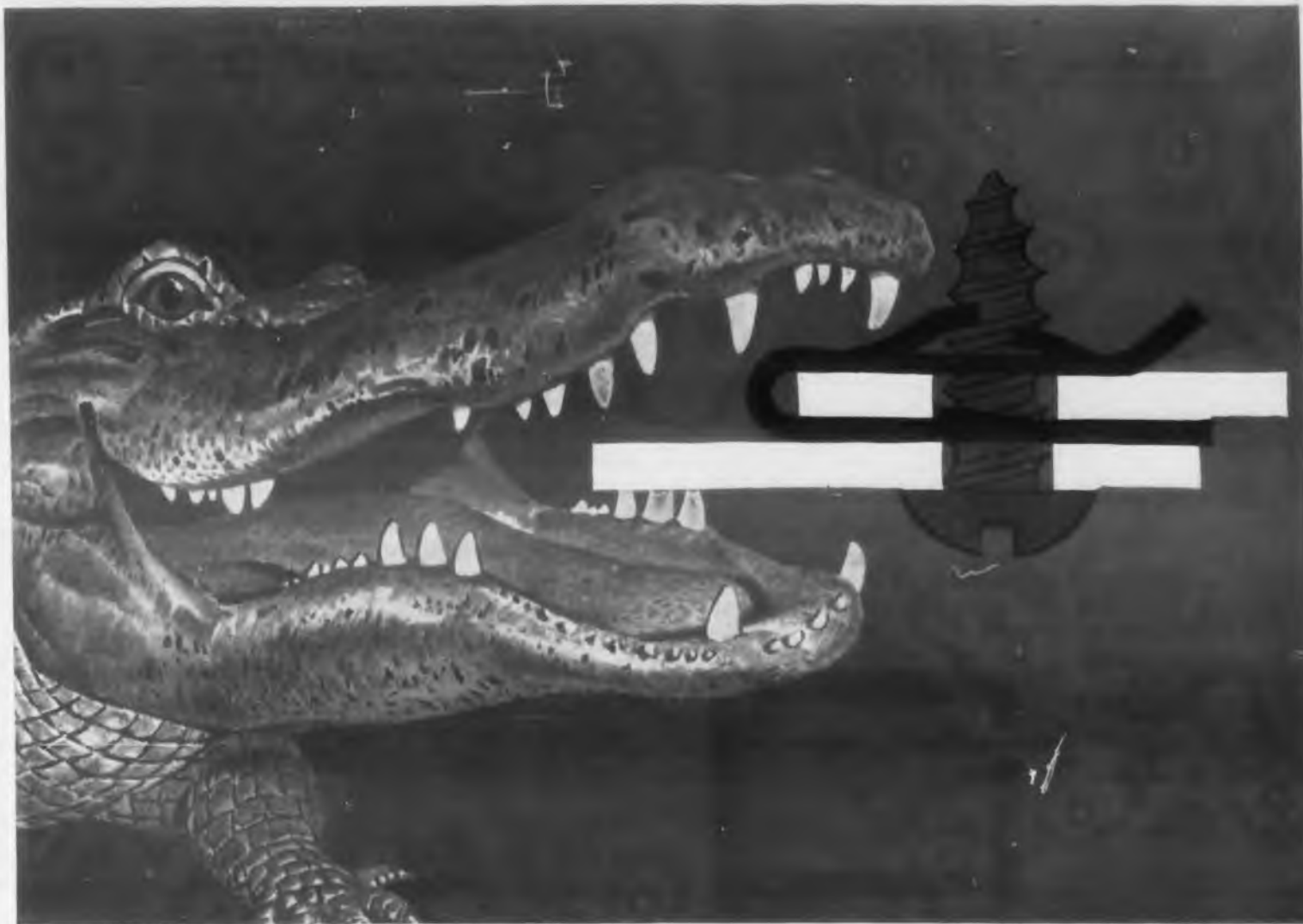


Fluxless dip soldering of aluminum and copper wire, foil, tube bases, cans, germanium and silicon are possible with this large ultra-sonic solder pot. The standard unit consists of a 1 kw electronic generator, operating in the 12 to

50 kc range. The 9 x 9 in. oil and water-cooled solder pot has a thermostat. Ultra-sonic energy in the solder pot demolishes the oxides or coatings on metals and allows the solder to wet the material without the use of corrosive fluxes. Special shaped pots are available.

Alcar Instruments, Inc., Dept. ED, 17 Industrial Ave., Little Ferry, N.J.

CIRCLE 285 ON READER-SERVICE CARD FOR MORE INFORMATION



STEEL JAWS THAT NEVER RELAX fasten a fastener in place

Alligator jaws have nothing on Tinnerman "U" and "J" type fasteners in gripping power. These fasteners press easily into locked-on position over panel edge or center panel locations. Yet they provide positive self-retention, ending the need for welding, staking or other secondary fastening devices. They are ideally suited for blind assembly or hard-to-reach locations.

When combined with the familiar Tinnerman SPEED NUT, this unique fastening principle provides a one-piece, self-locking, self-retaining fastener that is fast and easy to apply. The "U"

or "J" feature can be combined with wire and tube retainers, latches, catches and a host of other fastening requirements to save time, material and production costs.

Find out about these and more than 8,000 other types of SPEED NUT brand fasteners now serving industry all around the world. They can make important savings for you, can also simplify your assemblies. See your Tinnerman representative soon or write to us. Tinnerman Products, Inc., Box 6688, Dept. 12, Cleveland 1, Ohio.

TINNERMAN

Speed Nuts

FASTEST THING IN FASTENINGS®



Greater flexibility for control equipment enclosures is provided by self-retaining "J" type SPEED NUTS at 30% less production cost.



Assembly costs on this sheet-metal skylight frame are reduced 66% by Tinnerman "U" type SPEED NUTS.



Gas range assembly costs are reduced 25% to 50% by using Tinnerman "U" and "J" type SPEED NUTS.

CIRCLE 286 ON READER-SERVICE CARD FOR MORE INFORMATION

Thomas A. Edison
A GREAT NAME CONTINUES GREAT NEW ACHIEVEMENTS

This relay



... in place of an amplifier

Edison sensitive magnetic relay

The Edison Sensitive Magnetic Relay is ideal for use as a null detector in d-c bridge circuits or for aircraft temperature warning systems with simple lock-in device in contact circuit. Available in SPST or SPDT, hermetically sealed or gasket seal. Contacts rated at 1/3 ampere, 28 volts d-c.

- magnifies power 500,000 times
- operates on input current of 30 microamperes
- takes overload of 10,000 times power input
- repeatability averages $\pm 1.5\%$
- takes 50 g shock
- polarized or differential operation

For full information write for Bulletin 3037.

CIRCLE 289 ON READER-SERVICE CARD FOR MORE INFORMATION

Thomas A. Edison
INCORPORATED
INSTRUMENT DIVISION
55 LAKESIDE AVENUE
WEST ORANGE, NEW JERSEY

Automatic Pinch Welder

Seals Metal Tabulations



High speed production of electronic tubes with metal tabulations is possible with the employment of this automatic pinch welder for sealing metal tubes. Production

speeds of up to 60 welds per minute are easily accomplished; the tubes are automatically self-centered for consistent quality and ease of operation. Electronic controls regulates each condenser-discharge weld. Welding tips used are all standard and commercially available and to assure long dependable operation, only moderate air line pressure is required. The unit can be adapted for use with either stationary or rotary exhaust equipment. Standard units can be supplied in a variety of sizes or can be customized to meet individual specifications, and are so tested at the factory before shipment.

Kahle Engineering Company, Dept. ED, 1400 Seventh St., North Bergen, N.J.

CIRCLE 291 ON READER-SERVICE CARD FOR MORE INFORMATION



Resists OIL, GREASE, VIBRATION, ACID, VAPOR, HEAT and PRESSURE

Nothing cracks the bond between new Varband Bonding Tape and the wires it holds or encases. That's because Varband Tape is composed of hundreds of parallel strands of Fiberglass which are twisted and impregnated with a special polyester resin. You simply wind Varband Bonding Tape around wires as you would ordinary tape. Soldering iron heat-seals ends without tying. Then cure (recommended curing is 3 hours at 125° C or less time at higher temperature) ...

MANY OUTSTANDING PROPERTIES
High Tensile Strength
High Mechanical Strength
High Impact Strength
High Dielectric Strength
No Interference with Magnetic Field
No Arc-Over Danger
High Thermal Stability
Varband Bonding Tape is pre-treated, eliminating separate dipping operation. Steel handling wire and metal shields are no longer necessary. Provides valuable savings! Reduces weight!

and Varband becomes a homogeneous machinable mass that is impregnated not just on the surface ... but all the way through.

THOUSANDS OF INDUSTRIAL APPLICATIONS. Armature banding, core winding, coil supports and stator windings are but a few of Varband's thousands of industrial applications. Particularly ideal for anchoring wires in vibrating power tools or any wire assemblies that rotate at high speeds.

EXAMINE A SAMPLE TODAY! Available in 6 widths, .015" to .030" thick — Varband can also be designed to meet your requirements.



VARFLEX CORPORATION, 514 W. COURT STREET, ROME, N. Y.

CIRCLE 293 ON READER-SERVICE CARD FOR MORE INFORMATION

3 BASIC REASONS WHY DERINGER CONTACTS ARE YOUR BEST BUY

UNIFORM HIGH QUALITY

Modern facilities and equipment are designed for efficient precision manufacture.

Skilled craftsmen specialize on just one product—the finest electrical contacts.

Double check quality control plus 100% inspection assures uniform high quality.

ADVANTAGEOUSLY PRICED

In accordance with precious or base metal market. Substantial savings made possible by efficient operation are passed on to you in superior contacts and service.

UNUSUALLY QUICK DELIVERY

Deringer now offers the largest selection of standard sizes in the industry—300 flat and radius faced contacts and rivets. Delivery of small quantities for emergency or pilot runs can normally be made quickly, dependent chiefly on the supply of the particular metal specified. Delivery of larger quantities depends on your needs.

Write for our new catalog listing 300 standard contacts and rivets.

DERINGER
METALLURGICAL CORPORATION

8123 MONTICELLO AVE. • SKOKIE, ILLINOIS
PHONES: CHICAGO—KEystone 9-8502 SKOKIE—ORchard 5-1030

CIRCLE 290 ON READER-SERVICE CARD FOR MORE INFORMATION

WHAT ARE THE LATEST TRENDS in Instrumentation? Be Sure to Read DESIGN '57—JAN. 1st ED

Crystal Pulling Furnace For Semi-Conductors

For the fabrication of either germanium or silicon semi-conductors, a single crystal pulling furnace has been introduced. The unit consists of two resistance or induction heating pulling furnaces with duplicate sets of raising, lowering, and rotating mechanisms. In the case of the resistance heating furnace, the heating element is a high purity graphite helical coil. In the induction heated furnace, energy is supplied to the melt by water-cooled rf coils surrounding the crucible.

Both types of furnace are provided with the same basic pulling and rotating mechanisms. The sole difference is the heating element and the outer water jacket. The induction unit has a heating element replacing the graphite helical coil, and has a vicor or quartz tube replacing the outer water jacket.

U.S. Dynamics Corp., Dept. ED, 1250 Columbus Ave., Boston, Mass.

CIRCLE 292 ON READER-SERVICE CARD FOR MORE INFORMATION

HERE IS THE MOTOR TO FIT YOUR SPECS

El Ray manufactures fractional H.P. electrical motors to meet any specifications



Model 1700-3

CHECK THE SPECS:

VOLTAGE:
28 VDC

CURRENT:
1.3 amps, full load

OUTPUT:
150 oz. inches @ 60 RPM, Clutch
Setting for slippage at 165 oz. inches

LENGTH:
From mounting flange, 4.025 inches

DIAMETER:
1.125 inches

WEIGHT:
12 ounces

Typical of the fractional H. P. Electrical Motors designed and manufactured by El Ray is the Model 1700-3, a D. C. planetary geared motor with clutch.

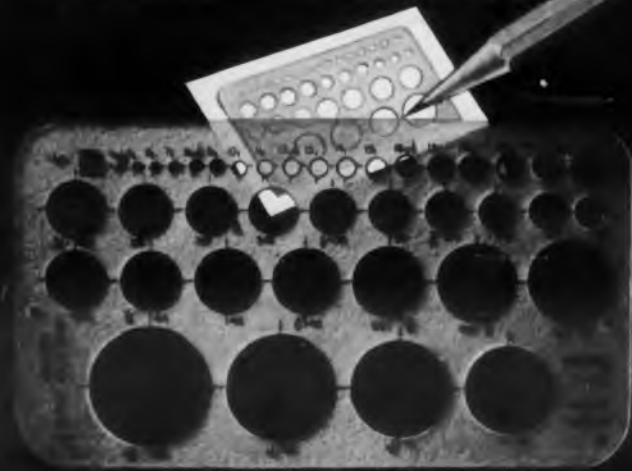
On all designs, mountings lead configurations, shaft lengths and shaft diameters are furnished to your specifications. All units meet or exceed Government environmental standards. Write for literature showing complete line of basic designs.



EL RAY
MOTOR CO., INC.
11747 Vose Street
North Hollywood
California

CIRCLE 294 ON READER-SERVICE CARD FOR MORE INFORMATION

Another Arm-The NO. 40 CIRCLE TEMPLATE



\$1.00 AT YOUR LOCAL DEALER

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

CATALOGUE NO. 49 AVAILABLE UPON REQUEST

RAPIDESIGN INC.
P. O. BOX 592 GLENDALE, CALIF.

CIRCLE 296 ON READER-SERVICE CARD FOR MORE INFORMATION

"J" Type
"U" Type
"Latching Type"

FREE TRIAL SHOWS HOW!

FASTEX
TRADE MARK

"SPEED-NUTS"

SAVE TIME . . . REDUCE COSTS!

Designed to clip quickly and easily in place, FASTEX "SPEED NUTS" eliminate costly riveting, staking or welding operations. Light weight and easy handling speeds assembly.

SEND FOR FREE TEST KIT NOW!

* T M REG U S PAT OFF
BY TINNEMAN PRODUCTS, INC.

FASTEX

195 Algonquin Road • Des Plaines, Illinois

FASTEX DIVISIONS OF ILLINOIS TOOL WORKS
SHAKEPROOF

CIRCLE 297 ON READER-SERVICE CARD FOR MORE INFORMATION

Screen Process Printer

Imprints 20 Objects Per Minute



Rapid, simple operation is afforded by this air operated, electrically controlled silk screen printing machine. Depending upon fixtures used,

flat articles, such as instrument dials, printed circuits, cards, fabrics, as well as cylindrical shapes, can be imprinted. Marking compounds in various colors are possible. Heavy ink deposit with fine detail is featured. Specifications of the Model 90S printing machine include a maximum imprint size of 5-1/2 x 7-1/2 in., and cylindrical objects having diameters of 1-1/2 to 4 in. can be accommodated. The manufacturer can also supply screens when furnished with the customer's artwork.

Markem Machine Co., Dept. ED, Keene 57, N.H.

CIRCLE 298 ON READER-SERVICE CARD FOR MORE INFORMATION

1 KVA Welder

Available As a Complete Unit



Designed for production hand welding of small parts, the Model TW-1 package unit finds extensive application for the microscopic resistance welding of vacuum tube elements, transistor parts and subminiature components. The total unit includes the single electrode welding head, 1 kva transformer, heat control, timer and foot switch.

The foot pedal actuates the upper electrode assembly and cam, which works against the cantilever spring for constant, even pressure during the welding operation. An adjustable microswitch, operating at a 5 percent lag behind the electrode closing, completes the welding circuit during the cam dwell period. A 1 kva capacitor discharge power pack supplies the power.

Federal Tool Engineering Co., Dept. ED, 1390 Pompton Ave., Cedar Grove, N.J.

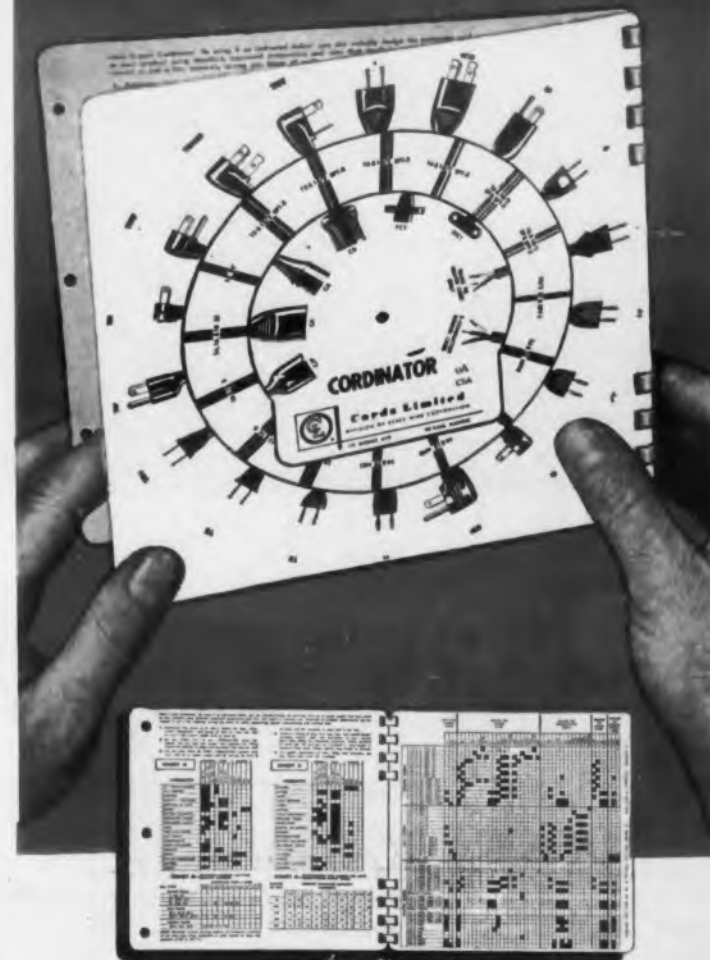
CIRCLE 299 ON READER-SERVICE CARD FOR MORE INFORMATION

**HOW WILL INNOVATIONS in Air Navigational
Systems Affect the Component Picture in '57?**
Find the Answers in **DESIGN '57—JAN. 1st ED**

NOW!

**DESIGN NEW CORD SIZES
and
POWER SUPPLY CORDS
with a**

Cordinator



THIS new tool for purchasing agents and designers permits actual visual fabrication of hundreds of cord sets and power supply cords . . . at your desk . . . in a few short moments.

Simplified charts give quick selection of approved wire for your specific product . . . and all Cords, Ltd. types of standard plugs and connectors that are best adapted to it. The dial side of the Cordinator then permits visual construction of the Cord Set you have selected.

All wire, plugs and connectors are standard approved components which minimize costs . . . assure you scheduled delivery!

For your **FREE Cordinator** . . .

ask your Purchasing Department to send for this cost-reduction tool.



CORDS LIMITED

DIVISION ESSEX WIRE CORPORATION
121 DODGE STREET, DEKALB, ILLINOIS

CIRCLE 300 ON READER-SERVICE CARD FOR MORE INFORMATION



Rugged and stable under high temperature conditions, these Corning S-Type resistors provide savings in space and cost.

Now you can have resistors with all these advantages . . .

1. 120° C. operation with 100% power, derating to 200° C.
2. Same size as deposited carbons
3. Wide resistance range
4. Economical cost

To help you solve the problem of small space and high ambient temperature Corning has developed these Type S resistors.

These are not ordinary film-type resistors. They are integral units made by bonding a metallic oxide to a PYREX glass rod at red heat. They're non-inductive and completely impervious to moisture.

Three sizes are now available in production quantities:

S-20—½-watt at 120° C. (or 1-watt at 40° C.). Range from 10 ohms to 100,000 ohms.

S-25—1-watt at 120° C. (or 2-watts at 40° C.). Resistance range from 10 ohms to 400,000 ohms.

S-30—2-watts at 120° C. (or 4-watts at 40° C.). Resistance range from 30

ohms to 1 megohm.

Corning Type S resistors have an average change in resistance of less than 1.5% after 1,000 hours at rated power.

Tolerances of 1%, 2%, 5% and 10% are available to meet your exact applications.

And how does a volume price of 25¢ each for the S-20 ± 1% tolerance sound to you?

Write for detailed descriptive bulletin.

Ask for information on these other Corning resistors:

Type LP—Low-cost, low-power. In 3-, 4-, 5-, and 7-watt sizes.

Type R—Power resistor to MIL-R-11804B. Tolerances of 2% or 5%, 7 to 115 watts. Range: 10 to 1,000,000 ohms.

Type H—High-frequency 2% or 5% tolerance. Standard ranges from 10 to 1,000,000 ohms and ratings from 7 to 140 watts.

Type HP—High-power resistors. 17, 30, 70, and 150 watts. Tolerances of 2% or 5%. 20 to 500,000 ohms.

Type WC-5—Water-cooled. Range—35 to 300 ohms. Versatile and adaptable.

Type N—Accurate grade. Made to meet all requirements of MIL-R-10509B.

Other products for Electronics by Corning Components Department: Fixed Glass Capacitors*, Transmitting Capacitors, Canned High-Capacitance Capacitors, Subminiature Tab-Lead Capacitors, Special Combination Capacitors, Direct-Traverse and Midget-Rotary Capacitors*, Metallized Glass Inductances, Attenuator Plates.

*Distributed by Erie Resistor Corporation



CORNING GLASS WORKS, 97-12 Crystal Street, CORNING, N.Y.

Corning means research in Glass

CIRCLE 306 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

Welding Alloy Wall Chart

307

A welding shop wall chart, TIS 2616, lists 150 low temperature welding alloys. Shown are torch and arc welding applications for cast iron, copper and copper alloys, stainless steels, nickel and nickel alloys, and aluminum. Specific recommendations are given for repair of carburetors, grilles, and electronic, radio, and refrigeration parts. The chart includes rod-by-rod bonding temperatures and tensile strengths, and serves as a guide to determining deposited hardness of overlays. It also designates low temperature welding alloys suitable for inert arc, and has a tip color rod and electrode identification column. Eutectic Welding Alloys Corp., 40-40 172 St., Flushing 58, N.Y.

Photoelectric Edge Guidance System

308

Continuously processed material with the elimination of edge waste is offered by the Photoelectric Edge Guidance System. There is a choice of seven sensing heads that operate by means of electric light beams, and no force or pressure of any kind is applied to the material under control. The system is capable of maintaining control accuracies within 1/32 inch at any speed. The pamphlet includes illustrations and tables showing specifications. Intercontinental Dynamics Corp., 170 Coolidge Ave., Englewood, N.J.

Shaded Pole Motors

309

A 12-page two-color bulletin describing shaded-pole motors for fan and blower applications in ratings 1.5 watts through 1/4 hp has just been released. It contains application, rating, and dimension data on 5-1/2 inch (39 frame) motor rated 1/12 through 1/4 hp, 5 inch (21 frame) motor rated 25 mhp through 1/12 hp, 4 inch (11 frame) motor rated 15 mhp through 35 mhp, and 3-1/2 inch (51 frame) motor rated 1.5 through 16 watts. The illustrated publication shows features and also accessories available. General Electric Co., Schenectady, N.Y.

Arc-Cast Molybdenum 311

Five articles of interest in technicians who machine arc-cast molybdenum or its alloys have been reprinted in the 8-pages of Special Report 431. Three individual machine shops tell how they machined specific parts, while a fourth article discusses general practice for all types of machining operations. Facts and figures on how to obtain better accuracy and finish on any material by using molybdenum for parts requiring high rigidity are given in the last of the articles. Climax Molybdenum Co., 500 Fifth Ave., New York 38, N.Y.

Ferrite Cord Inductors 312

Three engineering sample kits on high Q ferrite cored inductors which range in value from .33 μ h to 1 h are illustrated and described on a 2-page sheet. A related bulletin of 8-pages gives fuller treatment to the inductors contained in the kits and lists the firm's complete line. The booklet contains illustrations, specification tables, and text describing the inductors and their applications. Aladdin Radio Industries, Inc., Subsidiary of Aladdin Industries, Inc., Nashville 10, Tenn.

Tubes Replacement Guide 313

The publication of a Preferred Tubes Replacement Guide has been announced. This comprehensive chart lists types and prices of tubes for British and European equipment, for high fidelity audio amplifiers, FM and AM tuners, tape recorders, and TV sets. One of the features of the guide is the cross reference data showing the interchangeability of tubes with American and European types. International Electronics Corp. (Mullard Products), 81 Spring St., New York 12, N.Y.

Synchros 314

A 12-page 2 color brochure describes and illustrates the standard line of Size 1, 3 and 5 synchros. Engineered to high military and commercial standards, these units are available as transmitters, receivers, control transformers, and differential units. Brochure gives application information as well as detailed specifications and performance data. Ford Instrument Co., Div. A Sperry Rand Corp., 31-10 Thomson Ave., Long Island City, N.Y.

CIRCLE 315 ON READER-SERVICE CARD ➤



DRY G-E water-activated batteries are made dry, stored dry. Contain no electrolyte to leak or freeze. Demand no maintenance during storage other than normal precaution against moisture.



WET To activate, simply immerse in water. Batteries reach operating voltage as fast as 2 seconds . . . operate efficiently in extreme temperatures . . . are unaffected by external hydrostatic pressure.



POWER These silver-chloride/magnesium type batteries deliver up to 42 watt hours per pound and 3 watt hours per cubic inch, with nearly level power output over total operating life.

WHERE CAN YOU USE G-E WATER-ACTIVATED BATTERIES? Probably wherever you need a versatile source of d-c power, wrapped inside a small, light-weight package.

Delivering tremendous power for relative size and weight, these primary batteries can be used as "power packs" in any number of series, parallel, or series-parallel combinations you may need.

Though a wide range of ratings and

sizes is available, G-E water-activated batteries can be designed in nearly any combination of sizes, weights, and ratings to fit your specific application.

Examine your power needs now. If space, weight, and exceptional reliability are critical, phone your G-E Apparatus Sales Office, today. A representative will be glad to give you additional information on how G-E water-activated batteries can help solve these problems.

GENERAL  ELECTRIC

General Electric's

**New
Water-
Activated
Batteries
Deliver up to
42 Watt Hours
Per Pound!**

For descriptive bulletin GEA-6238A on G-E water-activated batteries, send coupon to:

General Electric Co., Section D223-5
Schenectady 5, N. Y.

for immediate project for reference only

Name

Position

Company

Street

City State

A TOUCH OF THE TOE
keeps production stepped-up



5 1/2" x 3 1/4" x 1 1/4"
weighs only 1 lb.

LINEMASTER, JR. FOOT SWITCH

Ideal for women workers!

The hand that pulls the switch wastes time! Sensitive LINEMASTER, JR. Foot SWITCH keeps both hands at work—needs only tip-toe control. Your women workers, especially, will appreciate LINEMASTER, JR.'s instant response to the toe alone—heels remain comfortably on the floor, lessening fatigue and increasing production. Light-weight, streamlined aluminum housing with black crackle enamel finish.

Let us quote on your special switch requirements.

Representatives: Some choice territories open.

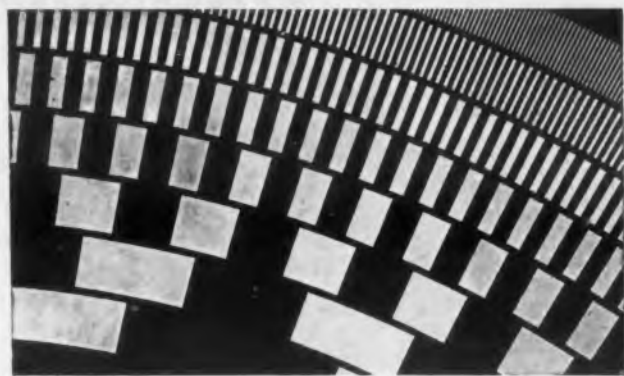
LINEMASTER SWITCH CORP.

130 Putnam Road, Woodstock, Conn.

Write today
for catalog
and price list

CIRCLE 317 ON READER-SERVICE CARD FOR MORE INFORMATION

Gurley Standard Binary Code Discs Now Available in Four Versions



Gurley, manufacturer of the standard binary code disc for the electronics industries, is now able to supply four versions for use in either photo-electric, magnetic or contact types of pickups.

Containing concentric zones of information in the gray (reflected) code, the Gurley discs contain alternate clear and opaque sectors. Thin annular rings separating adjacent zones are opaque. Varying patterns record up to 8192 bits of information (65,536 on special designs!).

Four coatings are available: "Type T"—photoengraver's glue with colloidal (black) silver, essentially grainless; "Type R" with etched metal coating, for reflectivity and transmission contrast; "Type M" with chemically deposited ferrous alloy possessing both magnetic and optical transmission contrast; and "Type C"—metal bonded on glass for electrical contact use as well as in contrast of optical transmission. WRITE FOR BULLETIN 7000.

W. & L. E. GURLEY • 525 Fulton Street, Troy, N. Y.

GURLEY since 1845

CIRCLE 318 ON READER-SERVICE CARD FOR MORE INFORMATION

Thermal Time Delay Relays 319

Three illustrated bulletins on thermal time delay relays and thermostats have been issued. Each bulletin treats a single instrument, giving specification, application and construction information. Covered are the "G" series glass thermal time delay relay, the "Snapper" thermal time delay relay, and the "Snapper" thermostat. Curtiss-Wright Corp., Electronics Div., 631 Central Ave., Carlstadt, N.J.

Induction Motor Catalog 320

Induction motors and blowers are set forth in a catalog of 12-pages. Diagrams, photographs, and performance and dimension tables are used to describe each type. The booklet also contains a brief section on special products, among them a dynamotor, an inverter, and a hand ring generator. Redmond Co., Inc., Owosso, Mich.

Testing and Calibration Equipment 321

A 4-page brochure describes four types of portable kits for testing and/or setting the operation temperature of all types of thermostats, fire detectors, and heater controls in aviation. The bulletin shows the various kits available, their applications, physical dimensions, electrical ratings and other pertinent specifications. Fenwal Inc., Ashland, Mass.

Operation and Application Manual 322

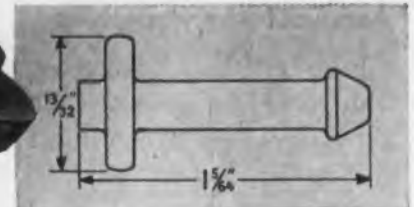
Two-color thirty-two page illustrated bulletin describes manual, magnetic, and reduced-voltage starters; push button; relays; limit switches; solenoids; pressure and vacuum, float, and plugging and anti-plugging switches. General Elec. Co., Schenectady 5, N.Y.

Switches and Relays 323

Approximately forty different switches and relays, ranging from standard size units to the miniature, are catalogued in a 12-page booklet. Information on operation and characteristics and an illustration is given for each instrument. The catalog shows some recent developments in switches and relays and gives complete specifications. Jaidinger Mfg. Co., 1921 W. Hubbard St., Chicago 22, Ill.

Data System 324

A 16-page brochure describing Model "111" data System which performs three fundamental functions—monitoring, recording and processing is now available. The brochure is illustrated and contains information on the various applications of the system. Beckman Instruments Inc., Scientific Inst. Div., 2500 Fullerton Rd., Fullerton, Calif.



SCREW MACHINE	\$14.00 per thousand
COLD HEADED	\$5.20 per thousand
SAVING	\$8.80 per thousand

How about your fasteners or small parts? Have you had an estimate from HASSALL?

This is a typical example of how HASSALL saves thousands of dollars for cost-conscious manufacturers in hundreds of industries. This part is made in one piece by cold heading . . . the part is not only lower in cost but also stronger and just as accurate. Savings amount to \$8.80 per thousand and this manufacturer used hundreds of thousands a year!

WRITE FOR CATALOG . . . with it we will send you our popular decimal equivalent wall chart. John Hassall, Inc., Box 2202 Westbury, L. I., N. Y.

HASSALL

SINCE
1850



NAILS, RIVETS, SCREWS
AND OTHER COLD-HEADED
FASTENERS AND SPECIALTIES

CIRCLE 325 ON READER-SERVICE CARD FOR MORE INFORMATION



GIVE YOUR DOCTOR A CHANCE

400,000 Americans, leading active lives today, are living proof of the fact that cancer can be cured if detected in time. Give your doctor a chance to give you this protection by having a physical checkup every year of your life. This should include a chest x-ray for men; for women, a pelvic examination. Make it a habit . . . for life.

AMERICAN CANCER SOCIETY 

NEW ACE BULLETIN

LUCITE* & PLEXIGLAS†
RODS, TUBES & SHAPES
(in stock for immediate delivery)



FASTEST WAY
TO CHECK
YOUR NEEDS

Send today for
new illustrated
Ace Bulletin.
Shows listings of
all available sizes,
tolerances, and
tables of physical
properties.

* Reg'd T.M. of
duPont

† Reg'd T.M. of
Rohm & Haas



ACE PLASTIC COMPANY

Extrusion Molders and Fabricators

91-58 VAN WYCK EXPRESSWAY, JAMAICA 35, N.Y., JAMAICA 3-5500

CIRCLE 327 ON READER-SERVICE CARD FOR MORE INFORMATION

GET the FACTS



**GRC tiny molded
PLASTIC
PARTS**
specializing in
NYLON

SEND FOR YOUR COPY OF THE
NEW GRIES PLASTICS BULLETIN

Find out how Gries' exclusive
techniques make possible product
designs using tiny components that
might be production problems by
ordinary means. How Gries uses
special machines which mean ex-
tremely low tooling costs, high
speed production for volume re-
quirements. Bulletin is packed with
examples, charts, engineers' check list

Write today for new Bulletin
and Samples.

Send prints for quotation.

GRIES REPRODUCER CORP.

World's Foremost Producer of Small Die Castings
40 Second St., New Rochelle, N.Y. • NEW Rochelle 3-8600

CIRCLE 328 ON READER-SERVICE CARD FOR MORE INFORMATION

- Completely automatic injection molding.
- Continuous or individual insert molding.
- GRC molds ALL thermoplastics. . . nylon, a specialty.

Quick deliveries on quantities of 25,000 to millions
NO MINIMUM SIZE!

Maximum size: .03 oz.-1/4" long



Gas Analysis Instruments 329

Instruments for gas analysis are featured in the 4 pages of Bulletin GMH 9-56. To the general specification data is added a description and flow diagram for three meter models. A list of parts is clarified by two labeled photographs, and a table enumerates typical deflection values. A bibliography on gas analysis completes the booklet. Gow-Mac Instrument Co., 100 Kings Rd., Madison, N.J.

ARE THE RESULTS OF RESEARCH AND DEVELOPMENT PROGRAMS for Guided Missiles Beginning to Affect Suppliers?
See DESIGN '57—JAN. 1st ED

Remote Digital Weights 330

A digital scanner and electronic decade counter and translator can bridge almost any gap between scale and recording instrument, according to a recent illustrated booklet. In 8-pages, the bulletin tells what this digital scanner system can do. Shown are a number of the instruments to which remote weight readings can be transmitted without possibility of human error. Toledo Scale Co., Toledo, Ohio.

Metal Laminates 331

Two and three-layer metal laminates are discussed in an 8-page technical publication. Illustrated with graphs and drawings, the text points out properties, applications, and other engineering data. Noted are types and sizes in which laminates are available. A list of district sales offices is included. Bridgeport Brass Co., 30 Grand St., Bridgeport, Conn.

Miniature Incandescent Lamps 332

An illustrated catalog of 8 pages offers comprehensive data on a full range of miniature incandescent lamps. Included are lamps for flashlight, radio panel, toy train and automotive service. Of special interest is a chart which graphically illustrates how lamp characteristics change with variations in applied voltage. Hudson Lamp Co., 528 Elm St., Kearney, N.J.

Noise Analyzers 333

Catalogs A-356, C-356, G-356, D-356 and N-356 have been made available describing attenuators, crystal mixers, impulse generators, and noise and distribution analyzers. Also available are engineering data sheets on the Model VP-400 variable frequency power supply. Empire Devices Products Corp., 38-15 Bell Blvd., Bayside 61, N.Y.

JOHNSON Performance Tested STEATITE AND PORCELAIN INSULATORS

Johnson low-loss steatite and porcelain insulators are rugged . . . performance tested under the most adverse operating conditions. Fracture resistant, dense molded and glazed for low moisture absorption, Johnson stand-off and feed-thru types are designed with extended creepage paths for maximum voltage breakdown ratings. Many types are available with built-in jacks to accommodate standard banana plugs. Hardware is heavily nickel-plated brass—excellent for exposed application.

For complete information
on the Johnson insulator line write for
components catalog 976.



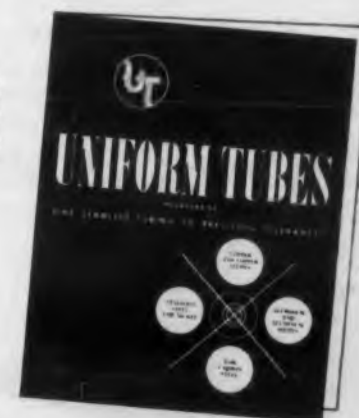
E. F. JOHNSON COMPANY

2529 SECOND AVENUE S.W. • WASECA, MINNESOTA

CIRCLE 334 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW TUBING CATALOG

... Covers
small seamless
tubing and small tubular components



Our new catalog is just off press, and a copy is yours for the asking. Contains up-to-the-minute data on Uniform's complete line of fine seamless tubing in aluminum alloys, copper alloys, nickel alloys, stainless and low carbon steel . . . OD's from .625 to .005 in.

Also covered in detail are such special products as pointer tubing, coil forms, and metal-shielded wire, as well as Uniform's complete forming and machining service. Write for your free copy today.

A complete small tubing service
Straight • Formed • Machined



UNIFORM TUBES, INC.

1200 Level Road, Collegeville 2, Pennsylvania

CIRCLE 335 ON READER-SERVICE CARD FOR MORE INFORMATION

Giannini ROTOSTEPPER

Pulse-to-shaft Position Converter



Powerful, rapid, absolutely controllable shaft rotation in precise 2° increments... for DC pulse-to-analog shaft positioning in computers, sequence switching, algebraic counting, remote shaft positioning.

Pulsed DC from hand operated switches, choppers, or any similar manual or automatic pulsing devices controls the Giannini Rotostepper in precise 2° angles of rotation.... unlimited in either direction, at the rate of one step per pulse.

Optional control mechanisms available on the versatile Rotostepper provide homing to a fixed reference angle, automatic continuous stepping with a steady DC voltage, and/or potentiometric divided voltage functional to shaft position.

SPECIFICATIONS:

- TORQUE: Up to 14 oz-in
- SPEED: Up to 60 steps per second
- ROTATION: Unlimited CW or CCW in 2° increments
- LOCK: Spring detent locks shaft in a position accurate to ±6'
- INPUT: 28 volts DC, 10 milliseconds minimum duration per step

Giannini

PRECISION INSTRUMENTS & CONTROLS

For further information write for Rotostepper Bulletin 8915

G. M. GIANNINI & CO., INC., 918 E. GREEN ST., PASADENA, CALIF.

CIRCLE 336 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistor List 337

Component Data List No. 15T-756 provides a complete listing of commercial transistors of both American and foreign manufacture, and indicating all manufacturers of a particular type. For convenient use of the list, a Beta to Alpha Conversion Chart and a Formula Conversion Chart will be included.

DATA, Inc., 67 Lawrence Ave., West Orange, N. J.

Wire-Wound Resistors 338

To facilitate accurate selection and application of precision wire-wound resistors for any purpose is the aim of a 32-page illustrated catalog. Commencing with a discussion of general characteristics, construction and design, the catalog goes on to list a complete line of resistors, their applications and specifications. Where applicable, latest government specifications are cross-referenced. The Daven Co., Rte. 10, Livingston, N.J.

Flight Research Cameras 339

Two multidata flight research cameras, the Mod IV-C 35mm and Mod III 16mm are presented in an 8-page bulletin. Outstanding features and detailed specifications are listed for each camera, and cutaway photographs show their construction. There is a section which explains how the cameras are set up for different operations. Brief mention is given to accessories. Flight Research, Inc., Richmond, Va.

Custom Coils 340

Announcement of facilities for the design and manufacture of coils is made in a 4-page pamphlet. Illustrations show important steps in the development process. Tele Coil Co., 2733 Saunders St., Camden 5, N.J.

Electrical Delay Lines 341

An illustrated folder catalogs standard lumped-parameter electrical delay lines. Listed are delay, rise time, impedance, attenuation and dimensional specifications for typical delay lines in the 1D, 2D and 4D series, and also for the DD-1, DD-2 and DD-3 variable delay series. Underwood Corp., Electronic Computer Div., 35-10 36th Ave., Long Island City 6, N.Y.

Four Volumes of Data Sheets 342

A 4-volume set of electronics test equipment descriptive data sheets may now be purchased. The outgrowth of an evaluation program for the U. S. Air Force, the set has over 3000 pages covering almost 1100 separate test equipments. It contains nomenclature and commercial indexes and a cross-reference by designation and functional classification. Purchasers may subscribe to the planned periodic additions and revisions at a nominal cost. Addition and Revision No. 1 comes with the set. The price, \$135.00. Carl L. Frederick & Assoc., 4630 Montgomery Ave., Bethesda, Md.

Torque Motors 343

A bulletin covers torque motors, special motors and collector rings for completing electric circuits between stationary and rotating parts. The 8-page illustrated bulletin describes the special torque and continuous stall characteristics available in company motors. It also gives full information on eight standard size collector rings. B. A. Wesche Electric Co., 1623 Vine St., Cincinnati 10, Ohio.

Flexible Polyethylene Pipe 344

Bulletin CE-57 describes flexible polyethylene plastic pipe and fittings in 8 pages. Contents of the bulletin include: applications, sizes, and fittings, installation instructions, technical properties, and estimated flow rates for water in various pipe sizes. Of interest is a chart listing common industrial liquids and noting which the piping will carry. American Hard Rubber Co., 93 Worth St., New York 13, N.Y.

Electronic Micrometers 345

Bulletin 4003 covers four reference standard electronic micrometers for making direct measurements to 20 millionths of an inch. The 4-page booklet gives specifications, a list of uses, and an illustration for each instrument. J. W. Dice Co., Englewood, N.J.

Precision Teflon Tape 346

Bulletin T-956 is a 1-page price schedule on precision teflon tape. Tables show tolerances and available sizes (from .002-.125 in.). Tri-Point Mfg., Inc., 401 Grand St., Brooklyn 11, N.Y.

GET YOUR NEW

1957 *Radio Electronic* MASTER

(21st EDITION)

- What product best fills your needs?
 - What does it look like?
- How does it compare? • Who makes it?
 - What does it cost?

Up-to-the-minute answers to all these questions are in The MASTER. Containing four to five times the product coverage of any other buying guide — there is no catalog like it. It is 350 factory-prepared catalogs in one bound volume.

1546 PAGES...

the world's largest electronic parts catalog!



ONLY **\$2⁹⁵**
from parts distributors

Over 93% of those who buy, specify or design electronic components rely upon and buy from up-to-date MASTER information. Its 125,000 products for research and production applications are systematically arranged by product sections for instant reference.

1546 PAGES OF THE MOST CURRENT DATA ON:

SPECIAL PURPOSE TUBES
TRANSISTORS—PRINTED CIRCUITS
MODULES—TEST EQUIPMENT
CAPACITORS—CONTROLS
TRANSFORMERS—RELAYS
WIRE & CABLE—TOOLS
HI-FI—PA SYSTEMS, ETC.

- Over 125,000 items
- Complete descriptions
- Specifications—Prices
- 11,250 illustrations
- Fully indexed
- 8½ x 11", 6 lbs.

No matter what electronic component you look for

**YOU FIND IT FASTER
IN THE MASTER**

Get the 1957 edition from local parts distributors — or write for list.

THE Radio-Electronic MASTER
110 Lafayette St., New York 13, N. Y.

CIRCLE 347 FOR MORE INFORMATION

Molded Case Circuit Breakers

348

The two-color, eight page bulletin describes a method of co-ordinating molded case circuit breakers with current-limiting fuses for protecting low-voltage feeder circuits against fault currents up to 100,000 amp. (RMS Asymmetrical). It shows how the method can be employed both in planning new and in replacing old systems where there is a need for higher levels of interrupting capacity. The bulletin includes tables and illustrations. General Elec. Co. Circuit Prot. Devices Dept., Plainville, Conn.

Control Transformers

349

Voltage ratings, frequency, frame size, weight, application, price and specification data on auto-transformers, control panel and machine-tool transformers is now available in a 32-page booklet. The two-color illustrated bulletin contains accessory information, wiring diagrams, and voltage regulation curves for use in selecting the proper transformer for a given application. General Electric Co., Schenectady 5, N.Y.

Semiconductor Power Converters

350

Catalog 56P describes dc to dc converters using all semiconductor devices to replace the usual vibrator or dynamotor conversion. The 4-page brochure is illustrated and includes tables and circuit information. Subjects discussed include a comparison of semiconductor and electromechanical conversion, standard converters, principles of operation, and custom designs. Power Sources, Inc., 8 Schouler Ct., Arlington, Mass.

Automatic Control

351

A comprehensive article on "New Applications of Devices for Automatic Control" is now available in reprint form (R-88). It traces the growth of analytical instrumentation in process control operations. The illustrated article explains the advantages and disadvantages of the various types of process stream analyzers and examples of their uses are included. Beckman Instruments, Inc., Scientific Instruments Div., 2500 Fullerton Rd., Fullerton, Calif.

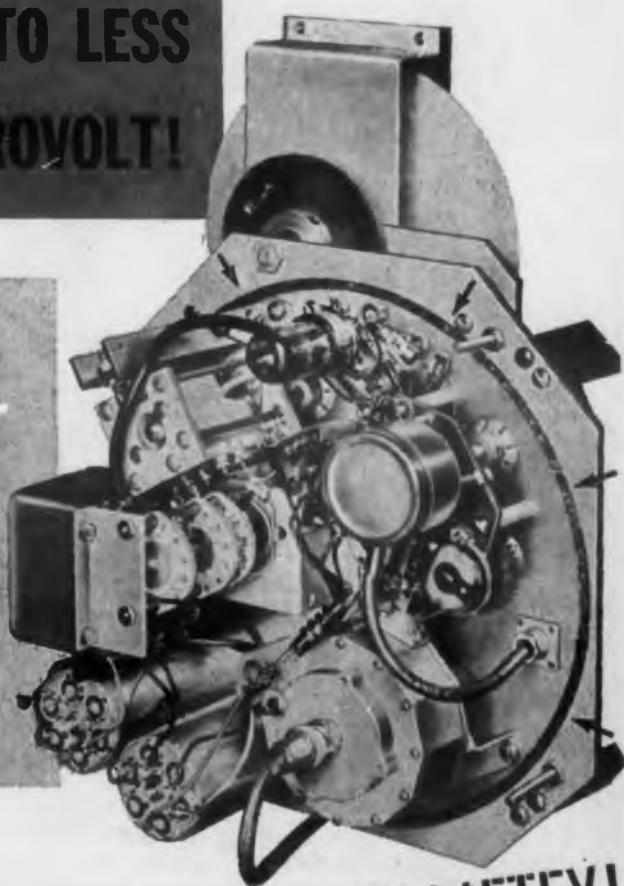
Differential Transformers

352

Two new price and specifications sheets have been issued on Differential Transformers. The present units cover a range of ± 0.003 in. to ± 3.00 in. They feature infinite resolution, teflon leads and epoxy potting and are available from 220 F to 500 F continuous ambient temperature. Minatron Corp., Belle Mead 1, N.J.

RF LEAKAGE

**CONTROLLED TO LESS
THAN 1/10 MICROVOLT!**



ANOTHER PROBLEM SOLVED BY METEX!

This Type 240-A Sweep Signal Generator built by Boonton Radio Corp., Boonton, N. J., is designed to operate at controlled output levels down to 1/10 microvolt. To prevent RF leakage between the oscillator chassis and oscillator cover, Boonton engineers specified a METEX RF gasket at this critical joint. This METEX RF gasket, knitted of monel wire, prevents RF leakage so successfully that peak performance is obtained at minimum output levels where leakage was previously experienced.

METEX RF Shielding, knitted of monel, aluminum or silver plated brass wire, combines maximum *conductivity* for efficient performance with inherent *resiliency* that assures continuous line contact between imperfect mating surfaces. Interlocked loops, knitted of continuous wire strands, assure maximum *cohesion*.

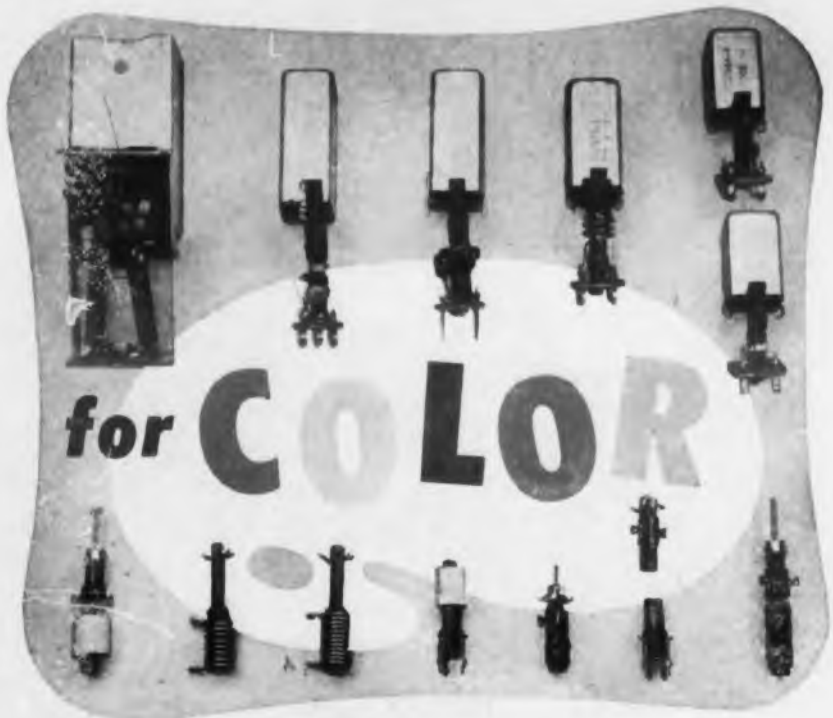
If you have a problem involving RF shielding in electronics or related equipment, write METEX, today!

**ELECTRONICS DIVISION
METAL TEXTILE CORPORATION**

ROSELLE, NEW JERSEY

CIRCLE 353 ON READER-SERVICE CARD FOR MORE INFORMATION

CONTACT *Clippard* NOW



Coils and Sub-Assemblies!

Years of electronic manufacturing experience, unique engineering "know how" and months of planning, tooling and testing have preceded our production runs of finest quality COLOR TV coils, windings and sub-assemblies for some of America's largest radio and TV concerns.

Enlarged facilities, a seasoned staff of trained skilled workers and the latest in automatic production equipment now permits us to supply a few more manufacturers with precision RF windings and sub-assemblies for critical TV circuitry.

Can you use some of our experience in the design, development and production of TV color coils? If so, write or wire us your problems or requirements, TODAY, and we will be happy to help.



CLIPPARD PC-5
Automatic Capacitance Comparator



CLIPPARD PR-6
Automatic Resistance Comparator

SPEED Testing and Production with these Unique Instruments that "THINK FOR THEMSELVES!"

If you would like to speed the checking, matching or grading of capacitors and resistors at your plant or laboratory, or automatically check specific circuitry, write for details of the CLIPPARD PC-5 and PR-6 Automatic Capacitance and Resistance Comparators shown at the left. Both are of finest laboratory quality made for millions of cycles of trouble-free operation and are accurate up to $\pm 1\%$. In your plant or laboratory, used individually or incorporated into automatic work operations, they will soon pay for themselves

Clippard

INSTRUMENT LABORATORY, INC.

7374-E Colerain Road, Cincinnati 24, Ohio



Write, also for literature describing these other aids to automation — Clippard Miniature Air Cylinders, Valves, Manifolds, Fittings and Accessories.



Manufacturers of R. F. Coils, Electronic Equipment, Miniature Pneumatic Devices

CIRCLE 354 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicone Rubber Products 355

Some outstanding properties of silicone rubber preface a list of allied products in an 8-page folder. Rubber tapes and tubing, rubber coated fabrics, and conductive gaskets are among the products for which characteristics and specifications are cited. Where they apply, military specifications and standards are noted. The Connecticut Hard Rubber Co., 407 East St., New Haven, Conn.

Stainless Steel Fasteners 356

Now available is an 8-page condensed stock list of stainless steel fasteners. Thirty-seven different basic fastening devices are illustrated. Included are screws, bolts, nuts, washers, rivets, pins, and AN specification fasteners. Diameters and lengths for each type are shown in chart form. Allmetal Screw Products Co., Inc., 821 Stewart Ave., Garden City, N.Y.

Electronic Parts Catalog 357

Availability of an electronic parts and high fidelity catalog has been announced. Forty-eight of the catalog's 200-pages are devoted to hi-fi equipment. Arthur Nagel, Inc., 918 E. 55th St., Chicago, Ill.

Tube Retention Devices 358

A 4-page illustrated brochure introduces Top-Tainers. These military approved devices are used to retain electronic tubes and components under shock. Features of the retainers are pointed out and a variety of sizes are listed. Other clamps are also illustrated. A separate sheet giving prices may be obtained with the bulletin. The Birtcher Corp., 4371 Valley Blvd., Los Angeles 32, Calif.

Closed-Circuit TV 359

Closed-circuit television for industrial and institutional use is discussed in a 4-page brochure. Illustrations show several cameras, receivers and control units. A series of brief write-ups point out ways in which the systems have increased efficiency for a number of organizations. General Precision Laboratory, Inc., 63 Bedford Rd., Pleasantville, N.Y.

Solderless Wiring Devices 360

An 8-page technical bulletin illustrates and describes time-saving solderless terminals and connectors for crimping to wire extremities. Electric Terminals Corp., 2021 Center St., Cleveland 13, Ohio.

In a HURRY? order GTC Custom-Specified TRANSFORMERS

NOW . . . through a unique method . . . "GTC" representatives are prepared to give you on-the-spot answers on delivery time, price and all other pertinent details . . . to precisely order to your particular electrical and mechanical requirements and still provide for quick delivery.

"GTC" calls it "Custom-specified"

Catalog illustrates prototype transformer in detail to: Realize cost economies through application of mass production techniques to limited quantities. Eliminate time-consuming liaison between your engineers and ours, reduce time for processing orders because sample submission is usually unnecessary.

Simplify and assure more accurate specifying of your requirements. Write today for the "GTC" representative in your area . . . he'll be glad to call 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 . . . TODAY!

GENERAL TRANSFORMER COMPANY
 serving industry since 1928
 18240 Harwood Avenue,
 Homewood, Illinois
 (Suburb of Chicago)




CIRCLE 361 ON READER-SERVICE CARD FOR MORE INFORMATION

Graphite-Carbon Compound 364

Electro-mechanical, thermal, and mechanical properties for a material made from various combinations of graphite and carbon are listed in a 4-page illustrated folder. Some of its many applications are illustrated. The Ohio Carbon Co., 12508 Berea Rd., Cleveland 11, Ohio.

Vacuum Tubes 365

Now available is a 12-page quick-reference catalog listing a complete line of production vacuum tubes and accessories. Also obtainable are a tentative data sheet and two brochures describing the 4CX300A ceramic power tetrode. Eitel-McCullough, Inc., San Bruno, Calif.

Submicron Water Filter 366

Bulletin No. 141 tells how the Model MF-1 Submicron Filter removes particles as small as 0.45 Micron from distilled or demineralized water. Photographs and complete mechanical specifications are included on the 2-page sheet. Barnstead Still & Demineralizer Co., Lanesville Terr. Jamaica Plain, Boston 31, Mass.

Recording Oscillograph 367

The 5-117 recording oscillograph is depicted and described in Bulletin 1533B. Included in the 4-page brochure are specifications and a brief section on associated instruments. Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

A Control Guide 368

Pocket Control Guide No. 4 has been made available. This control cross reference guide is published semi-annually to make the up-to-date replacement control information available to everyone. Centralab, Div. of Globe Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.

Gaussmeter 369

A brochure has been issued describing the Model M-2 precision gaussmeter, an instrument for the measurement of homogeneous magnetic fields. The 4-page brochure gives a description of the instrument, lists applications, and gives specifications. Magnetics Corp., 154 Boylston St., Boston, Mass.

PHAOSTRON

N O M E F I N E R



2 1/2" or 3 1/2" Square



CUSTOM
PANEL
METERS

4" x 6" Rect.
with Mirrored Scale

4 1/2" Rect.
Chrome or Black
also available
illuminated



2 1/2" or 3 1/2"
Round



The appearance of your equipment will be enhanced by PHAOSTRON meters with their high style, die cast bezels and large easy-to-read scales.

You can depend upon 2% accuracy because these meters are calibrated to within 1% of full-scale deflection with controlled, certified standards.

Continuous accuracy is assured by the UNITIZED METER MOVEMENT ASSEMBLY which provides integral mechanical stability. The aged alnico magnet of the meter is protected from the effects of stray magnetic fields by the steel case.

These units are also equipped with insulated zero adjustments.

Nine Types in 77 Standard Ranges are available at your Parts Distributor. If you have a special requirement, write to the Product Development Department for a practical recommendation.

PHAOSTRON INSTRUMENT AND ELECTRONIC COMPANY
151 PASADENA AVE., SOUTH PASADENA, CALIF.

CIRCLE 371 ON READER-SERVICE CARD FOR MORE INFORMATION

Specify TENSOLON for all your

TEFLON[®] HOOK-UP WIRE REQUIREMENTS



- EXTRUDED TEFLON insulation featuring greater abrasion resistance in a rugged construction, in sizes 10 through 30 AWG in 14 solid colors or spirally striped.
- PARALLEL WRAPPED TEFLON insulation utilizing our patented technique which provides longest continuous lengths, ease of stripping, greater cut-thru resistance and maximum flexibility. Sizes 20 through 34 AWG, in 14 solid colors.
- SPIRAL WRAPPED TEFLON insulation with special cross-lapped construction and unlimited color coding, with striping that meets commercial (GEN-104) and military (MIL-W-76A) specifications. Sizes 8 through 30 AWG.

Tensolite

INSULATED WIRE CO. INC.

198 MAIN STREET, TARRYTOWN, NEW YORK

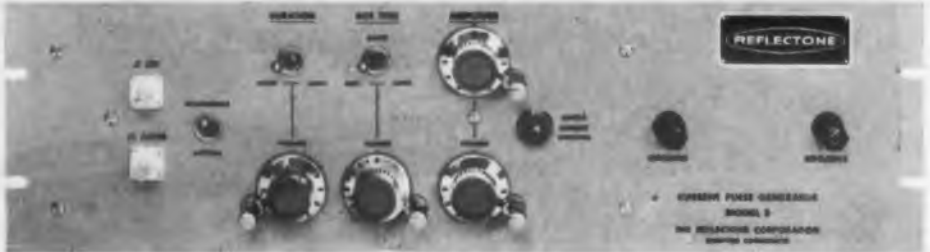
Tel. MEdford 1-2300

All Tensolon Hook-up Wire Constructions are in accordance with MIL-W-16878A, Type E and EE. Call or write for Tensolite catalog.

CIRCLE 370 ON READER-SERVICE CARD FOR MORE INFORMATION

T W O N E W PULSE GENERATORS

pulse widths variable 1-40 usec current up to 2 amps peak



Model 5 — negative going pulses — Model 6 is similar, delivering positive going pulses

● The Reflectone Model 5 high current pulse generator delivers negative going rectangular wave current pulses of variable duration, rise time and amplitude. Model 6 is similar, delivering positive going pulses.

Each of these new pulse generators is a four stage unit — multivibrator, inverter-amplifier, cathode follower, and current amplifier. The design of the multivibrator stage permits the selection of any pulse width from 1-40 microseconds by either instrument controls or the use of two external trigger pulses.

The inverter amplifier stage provides a rise time range from .15-1.0 microseconds.

Output amplitude can be varied from 0-2 amperes. Input Requirements: Standard 0.1 microsecond pulses, negative, 13-30V.; +150V. DC, 2.03 amps; -150V. DC, .04 amps; 6.3V. AC, 10.6 amps.

Either Model 5 or Model 6 is available in a standard 19" relay rack mounting 5¼" high by 8" deep.

Write today for complete details!

A P P L I C A T I O N S

- precision measurement of core characteristics in magnetic logic circuits
- transistor testing
- high current for memory circuit testing
- high speed ferrite study
- switch core investigation

OTHER REFLECTONE PRODUCTS: integrators • differentials • couplings • power supplies • simulators • procedure trainers

R E P R E S E N T A T I V E S

MR. ROBERT A. POTTER
Potter & Daggon
64 Woodland Avenue
Summit, New Jersey

MR. GORDON E. GRAY
Hill-Gray
41½ Harrison Street
Oak Park, Illinois

MR. H. G. WEIGHTMAN
Weightman and Assoc.
4101 Burbank Boulevard
Burbank, California

MR. J. J. DAGGON
Potter & Daggon
8 Westcott Road
Stamford, Connecticut

MR. R. L. SPRINGFIELD
The Gay Sales Co. Assoc.
420 Sul Ross Street
Houston, Texas

MR. B. S. WOODMAN
B. S. Woodman, Inc.
1570 Northside Drive, N.W.
Box No. 1057
Atlanta 1, Georgia



THE REFLECTONE CORPORATION • STAMFORD, CONNECTICUT

CIRCLE 374 ON READER-SERVICE CARD FOR MORE INFORMATION

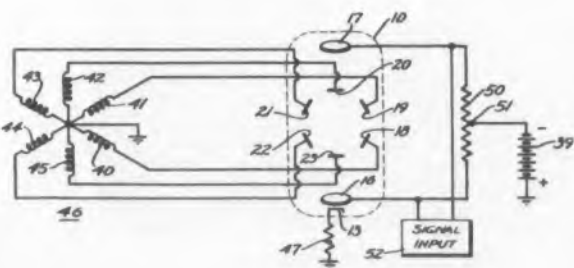
Patents

Two-Dimensional Scanner of Focussed Rotary Radial Beam Type

Patent No. 2,742,590 P. W. Charton et al
(Assigned to National Union Electric Corp.)

The circuit and tube of the patent provides a simple means for making a continuous visual indication of an input signal. A polyphase source of voltage is applied to the windings 40 through 45, each of which controls the potential on a grid 18 through 23. The plurality of grids are disposed circularly within an evacuated envelope 10. A rod cathode, centrally located with respect to the grids, provides an electron source of sheet form. Through the action of a proper negative potential applied to spaced plates 16 and 17, the electron sheet is compressed to a point at the fluorescent screen on the envelope wall. The polyphase voltage source rotates the beam around the tube.

The spaced plates 16 and 17 are disposed at opposite ends of the grids and in axial alignment with the circularly disposed grids. The figure shows graphically that the plate 17 actually is located centrally within the grids space and the plate 16 is below the plate 17. A negative voltage is applied to the plates from a voltage source 39 through a resistor 50. The input signal is applied across the resistor or across the two plates. As the input signal varies, the beam is shifted axially as it rotates to produce a trace on the fluorescent screen, much in the fashion of a conventional cathode ray tube except that it is a continuously rotating trace. Numerous modifications of the circuit and tube are illustrated and described in the specification.



Interconnection of Transmission Lines

Patent No. 2,755,445, Harold A. Rhodes,
(Assigned to American Tel. and Tel. Co.)

A method of connecting six communication lines without unwanted interference; each communication line contains two transmitting wires and two receiving wires. The circuit is so arranged that each of the six transmitting legs is coupled to the five receiving circuits of the other communication lines, but is not coupled to the transmitting circuits or to its own receiving circuit. These six line units may then be interconnected to provide interconnection between any number of four wire lines.

Demodulator

Patent No. 2,755,380, Norman P. Laverty
and Walter E. Peterson (Assigned to Northrop Aircraft, Inc., Hawthor, Calif.)

This patent describes an FM detector which operates in the following manner: (a) the sinusoidal input is passed through a limiter to produce a square wave of the same frequency as the input, (b) the square wave is converted into a sawtooth wave whose amplitude is proportional to the signal frequency, (c) the amplitude on the sawtooth is converted into a dc voltage whose magnitude is thus proportional to the signal frequency.

Ground Track Indicator

Patent No. 2,755,464, Britton Chance, and
Ivan A. Greenwood, Jr., (Assigned to the United States of America)

This patent describes a control system for a radio object locating system. The circuit provides for either of two possibilities. (a) The antenna drive mechanism directs the antenna in a direction which is set on an electrochemical control device, (b) The antenna rotates at a constant speed and supplies an output pulse when the direction of the antenna coincides with the direction which is set on the control device.

Modulator Circuit

Patent No. 2,728,892. T. M. Gluyas, Jr. (Assigned to Radio Corp. of America)

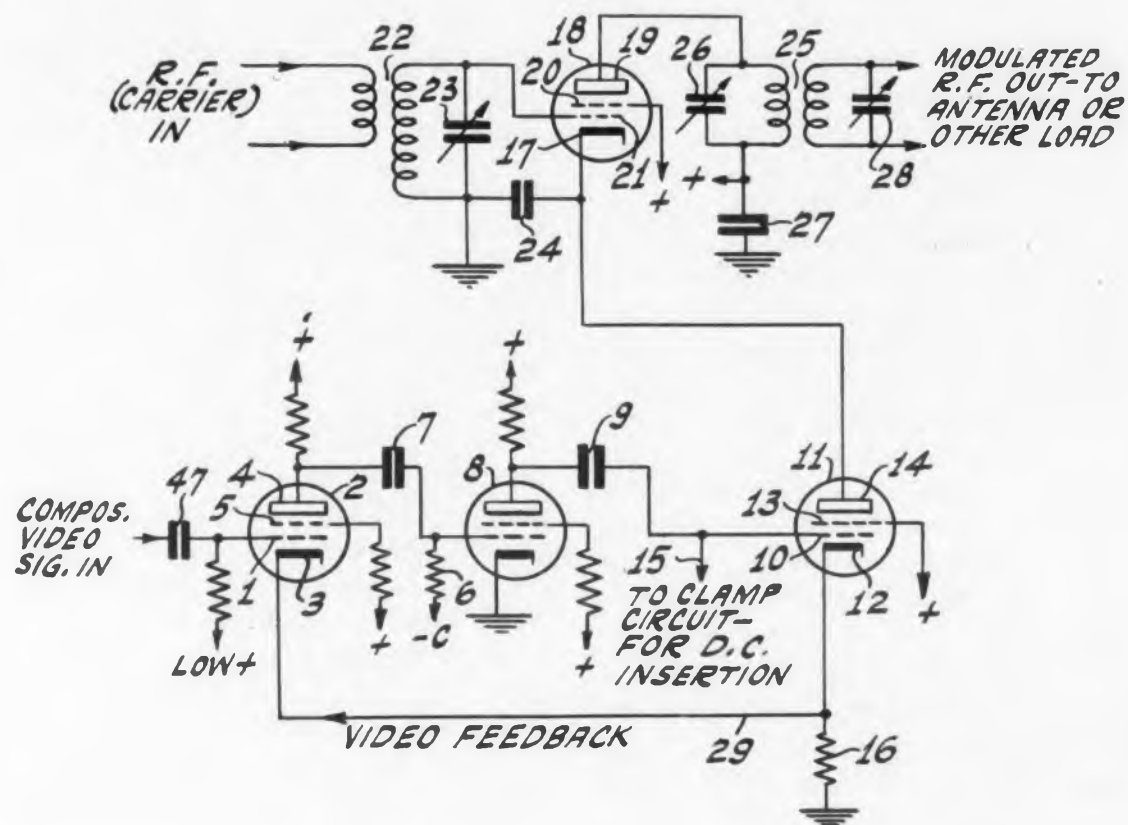
The modulation circuits known to TV have been plate modulated or grid bias modulated. It is difficult to secure the required high video voltage throughout a wide band of video frequencies with plate modulation. This type of modulation also results in undesired variation in input impedance. These effects with plate modulation do not obtain where grid bias modulation is used; however, this type of modulation is inherently non-linear.

The modulator circuit illustrated overcomes these problems. Briefly, the circuit includes two stages of video signal amplification provided by tubes 2 and 8. The

amplified signal is applied to the grid of modulator tube 11 having resistor 16 in its cathode circuit. Video feed-back is provided through connection 29, between the cathode of the modulator tube and the cathode of the first tube of the amplifier stage.

The carrier signal is applied to the grid of tube 18 which is connected in series with tube 11. The r-f carrier is amplitude modulated in the modulating stage provided by tube 18. Suitable tuned circuits are provided in the input and output circuits.

The circuit provides distinctly improved linearity of the output potential with respect to the instantaneous video potential. It also will develop the necessary potential required as well as presenting a substantially fixed input impedance.



Tuning Unit

Patent No. 2,755,448, Wendell A. Fuller. (Assigned to Sarks Tarzian, Inc., Bloomington, Ind.)

An ultra high frequency tuner for tuning through the ultra high frequency television band. The device utilizes a cavity with conducting walls and a variable condenser mounted within the cavity. The rotor plates of the condenser are connected to one wall of the cavity while the stator is connected to the opposite wall. Oppositely disposed coupling loops extend into the cavity an amount determined by the position of the capacitor rotor.

Subscription Television System

Patent No. 2,755,332 and 2,755,333, Walter S. Druz. (Assigned to Zenith Radio Corp.)

These patents describe, respectively, a transmitting and receiving system for subscriber television service. The first patent covers a method of coding a normal television signal so that it can not be satisfactorily received by a conventional receiver. The second patent covers a system which is placed at the receiver location and combines the coded television signal and a decoding signal, received by other means, into a signal which can be utilized by a conventional receiver.



GLOBE'S NEW PRECISION PLANETARY GEARMOTOR. This new a.c. power unit, custom-engineered to your applications, mates Globe's advanced design hysteresis-synchronous motor with a built-in planetary gearing system . . . all in one, compact, lightweight, environment-proof package. Units are inherently accurate for precise timing and control. Motors supplied for normal frequency ranges and speeds, provide absolute synchronous rotation, extremely smooth operation, and high starting and running torque. High efficiency planetary gearing features low backlash and low composite error. Broad selection of gear ratios includes odd and even speed reductions, and torques up to 1500 oz. in. Dimensions, 1.675" dia. x 3.186" to 4.095" long; and weight, 16 to 20 ounces, depend on ratio. Induction and variable frequency types also available. Units meet military specifications. Prompt delivery on prototype and production orders. Write for bulletin 1270.



INDUSTRIES, inc.

dayton 4, ohio

"dedicated to the best in product and in service"

CIRCLE 375 ON READER-SERVICE CARD FOR MORE INFORMATION

AERIAL "WORK HORSE"

Type 99 Transmitter, built by Wilcox Electric Company, Inc., is used in many hundreds of aeronautical stations throughout the world for ground to air communications, and may be equipped with an LF Channel for radio beacon service. The flexibility of having any combination of four RF channels (LF, HF or VHF), plus the ability to operate on 2 or more channels, make this transmitter a "work horse" for the air industry and Military and Air Defense services. For their dependable precision, Thermador heavy duty transformers are selected for this multi-frequency transmitter.



When precision is vital...

specify **THERMADOR**

...transformers for guided missiles, radar, supersonic aircraft and other applications demanding absolute accuracy... Available to your most rigid specifications and all MIL requirements... Technical consultation provided without obligation... Write, phone or wire Thermador today.



Electronics Division, Dept. ED-1256

THERMADOR ELECTRICAL MANUFACTURING CO.

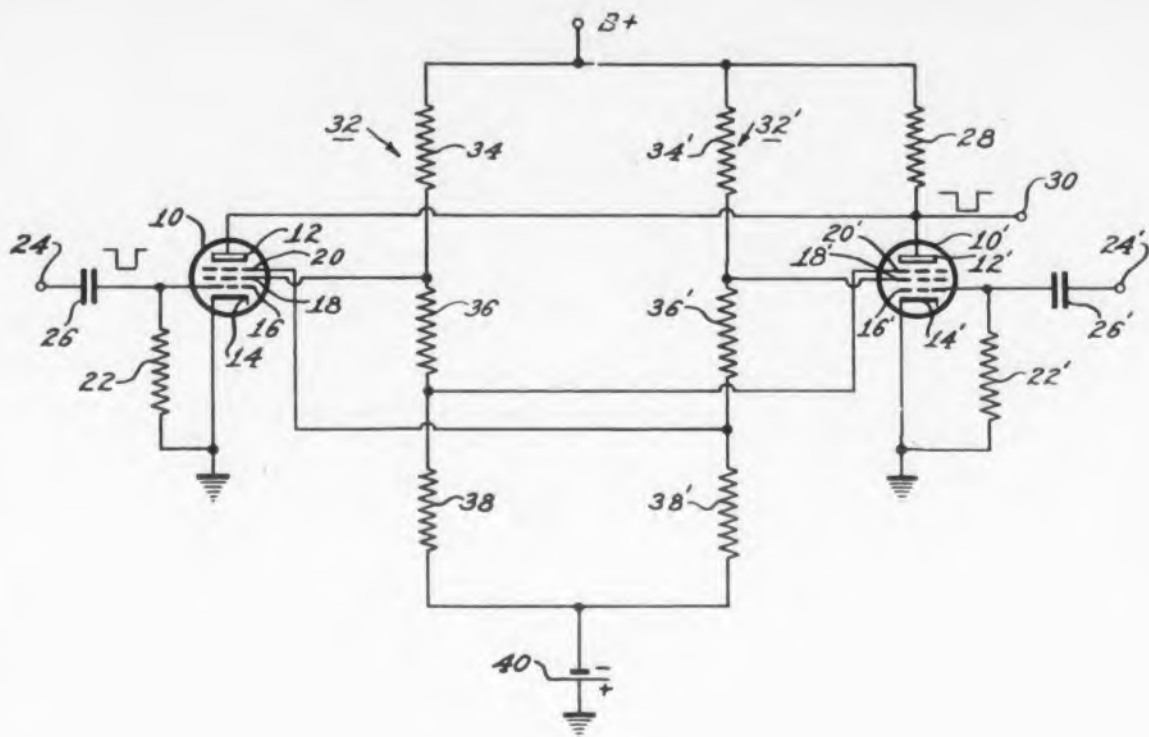
Division of Norris-Thermador Corporation

2000 South Camfield Avenue, Los Angeles 22, California
Parkview 8-2105

CIRCLE 376 ON READER-SERVICE CARD FOR MORE INFORMATION



9-1109



Signal Responsive Circuit

Patent No. 2,737,583. H. N. Crooks and L. C. Hobbs. (Assigned to Radio Corp. of America)

A common circuit used in computers is of the type usually designated as "either but not both." It includes two tubes such that if either of the tubes receives an input pulse or signal, an output pulse is generated. If both tubes receive an input pulse, an output pulse is not generated. For accurate computer service, it is necessary that this circuit be reliable and, in view of the great number of circuits of this type used, a simple circuit is desirable. The circuit of the patent has these characteristics.

The circuit uses a pair of tubes 10 and 10' with a minimum of two grids but preferably having three grids. The first grid 16 is used as an input grid and is normally biased for conduction through the tube. The second or screen grid 18 is connected, with a three resistor voltage divider 32, between the second and third resistors of the divider. The third grid is under the control of the voltage divider for the other tube, by a connection between the first and second resistors 36', 38' of the divider. The potential on this grid normally cuts off current to the anode; however, current flows through the tube to the second grid.

With current in the second grid circuit of each tube, the potential on the third grid cuts off anode current. A negative input pulse, applied at the input terminal 24,

biases the first grid of the tube 10 to non-conducting condition so that current flow to the screen grid is cut off. The potential drop across the resistor 34 decreases, so that the potential between resistors 36 and 38 and on the third grid of tube 10' increases, with the result that this tube becomes conducting to the anode. Conduction to the anode of tube 10' generates a pulse at the anode of the tube and at the output terminal 30. The same action takes place if a negative input pulse is applied to the terminal 24' of tube 10'. If, however, a negative pulse is applied to both input terminals, both tubes are rendered non-conducting and, without anode current in either of the tubes, a pulse will not be generated at the anode and hence at the output terminal 30.

Photo-Electric Musical Device

Patent No. 2,754,713. Gabriel Bajolet, Haroue, France

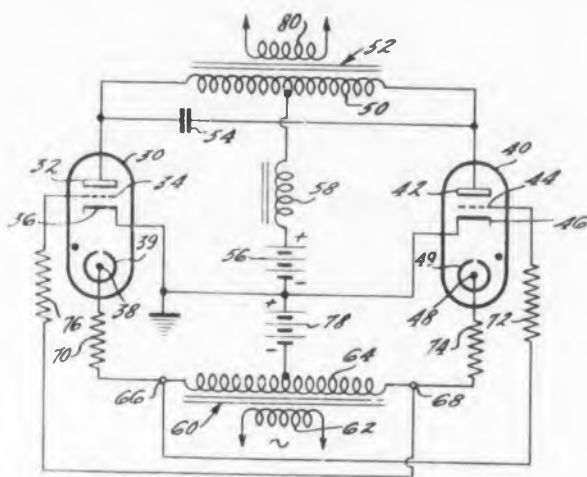
A device for producing sound, which utilizes a vibrating screen to interrupt a light beam. The amount of light falling on a photoelectric cell is modulated by a vibrating screen. The aperture of the screen is designed to produce the desired waveform while the frequency of vibration determines the frequency of the resulting sound. The output of the photoelectric cell is used to drive an amplifier and speaker system.

Inverter Circuit

Patent No. 2,735,977. W. M. Webster, Jr. (Assigned to the United States of America)

In circuits for converting a dc potential or energy into an ac potential or energy form, there is need for an efficient circuit for accomplishing this conversion. Thyatron tubes have been used in such circuits, but there is a substantial loss in energy in such tubes. The circuit shown in the figure uses high efficiency gas tubes in a new circuit.

The dc power source is shown as a battery 56, which supplies dc potential to the two gas tubes 30 and 40. These gas tubes have auxiliary cathodes 38 and 48, which have a potential which is negative with respect to the primary tube cathodes 36 and 46. The negative potential is supplied by a dc source 78. The two tubes are fired alternately by supplying an ac potential to the primary winding of a transformer 60.



The ends of the transformer secondary winding 64 are connected with the auxiliary cathodes of the two tubes, so that opposite polarity is supplied. Also, the end of the secondary winding at terminal 66 for the cathode of one tube 30 is connected to the control grid 44 of the other tube 40. A similar connection is made from terminal 68 to the control grid of the tube 30 so that the control grid of one tube has its polarity change correspond with the polarity change of the auxiliary cathode of the other tube.

When the terminal 66 becomes negative from the ac potential applied at the primary winding 62, the potential difference between the auxiliary cathode 38 and the principal cathode 36 is sufficient to ionize the gas in the tube. At this same time that the terminal 66 goes negative, the terminal

68 goes positive and, with ionization of the gas in the tube 30, the tube fires. The opposite action prevents the other tube 40 from firing. Upon a reverse of potential at the terminals 66 and 68, under the ac potential of the transformer primary winding, the tube 30 is extinguished and the tube 40 fires. A good sine wave output is developed in the output winding 80 with an efficient circuit because of the lower tube power losses.

Electroluminescent Lamp

Patent No. 2,755,406, Laurence Burns. (Assigned to Sylvania Elec. Prod., Inc., Salem, Mass.)

A cathode ray tube for producing a dark trace on a light background. This tube utilizes an electron beam which strikes a target screen and forms an image thereon. The screen contains a layer of dark trace ionic material to develop elemental areas of corresponding variable opacity on a backing of a sheet of light transparent, electrically conducting material. An ultraviolet radiation source is contained within the tube and can provide either of two energy levels of radiation; the first level illuminates the storage screen to provide a dark trace, while the second energy level is sufficient to erase the trace.

Delay Line Trigger Circuit

Patent No. 2,755,381, Eugene L. Woodcock, (Assigned to Sperry Rand Corp.)

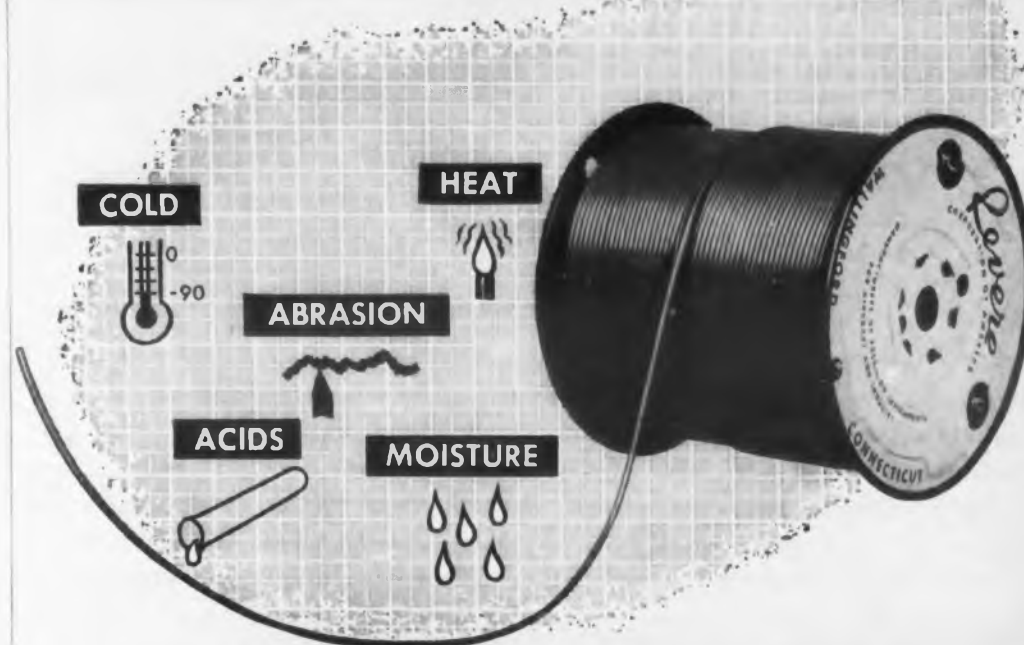
An apparatus for generating a sharp output pulse at any desired interval of time following an initiating input pulse. The circuit utilizes a conversional delay line with blocking oscillators coupled to the line at regular intervals. As a pulse moves down the line it triggers the blocking oscillators which then regenerate the pulse and maintain its shape and amplitude. The recovery time for the blocking oscillators is greater than the two-way transmission time of the line so that the circuit cannot break into self sustained oscillation.

Corner Horn

Patent No. 2,754,926, Warren A. Rice (Assigned to Asa M. Stackhouse, Ann Arbor, Mich., trustee)

A speaker baffle for low frequency audio ranges. The baffle is designed for corner mounting and utilizes an effective horn loading of the speaker back radiation.

Insure Product Performance... REVERE SPECIALTY WIRES



For those tough design jobs where ordinary hook-up and thermocouple wires die from the heat, get brittle in cold, abrade and corrode . . . Revere SPECIALTY wires stand up. Built to MIL and customer specifications, Revere's wide range includes:

For High Temperatures

REVCOTHENE—(Extruded Monochlorotrifluoroethylene) —40°F to +275°F, AWG 28 to 10, silver plated copper conductors, inert, excellent dielectric strength, no volatile plasticizers, non-flammable, thin wall, abrasion and moisture resistant.

For Extremely High Temperatures

Fiber glass (to 700°F), asbestos (to 900°F), pure silica glass fiber (to 1500°F) wrapped or carded with outer braid and saturant as required by application.

HOOK-UP WIRES

MULTI-CONDUCTOR CABLES

A variety of telemetering and other multi-conductor cables constructed to customer specifications. Polyethylene, polyvinyl, nylon, glass, Revcothene, asbestos insulations for singles and jackets. Twisting, braiding, shielding, color coding to suit conditions.

THERMO-COUPLE WIRES

Iron-constantan, copper-constantan, Chromel-Alumel conductors, AWG 36 to 14, various insulation combinations and protective braids, temperature range from -100°F to +1500°F, constructed to rigid tolerances.

Saturants for flame and abrasion resistance, metallic braids for severe service and electrical shielding. Color coding in fourteen solid colors and stripes.

Prompt delivery of standard stock wires. Write for samples and literature on specialty hook-up or thermocouple wire.

 **Revere CORPORATION OF AMERICA** 

WALLINGFORD, CONNECTICUT A Subsidiary of Neptune Meter Company
CIRCLE 377 ON READER-SERVICE CARD FOR MORE INFORMATION

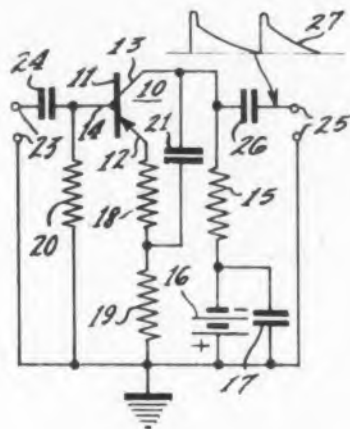
Transistor Relaxation Oscillator

Patent 2,731,567. G. C. Sziklai et al. (Assigned to Radio Corporation of America)

A relaxation oscillator using a transistor provides a circuit utilizing a minimum of circuit elements. This type of circuit also should be stable. The circuit of the patent may be adjusted or circuit elements chosen to give a relatively wide choice of output wave forms.

The transistor 11 of the circuit has the usual emitter electrode 12, collector electrode 13 and a base electrode 14. A dc source 16 has its positive terminal grounded and the negative terminal is connected with the collector electrode through an output resistor 15 to provide the proper bias. The emitter electrode has a current limiting resistor 18 in series with a bias resistor 19. The charging condenser 21 for the relaxation oscillator is connected between the junction of these two resistors and the collector electrode.

The condenser 21 is charged from the dc source through bias resistor 19 and output resistor 15. The charging current flow maintains the transistor in its low current stable



condition. As the condenser becomes charged, however, the current flow through the bias resistor 19 decreases which changes the potential applied to the transistor electrodes to the potential corresponding with the state of high current flow and the condenser discharges through the resistor 18, emitter electrode 12 and collector electrode 13. Upon discharge of the condenser, the potentials on the electrodes are restored to their original low current state.

With the resistor 19 having a value of about 5000 ohms and the load resistor having a value of about 12,000 ohms the form of the output wave secured at the output terminal 25 is that of wave 27. This wave has an initial pulse succeeded by a saw

tooth wave. By changing the ratio of the value of resistor 15 and 19, the output wave may be of sharply peaked form. The circuit may be triggered by a negative pulse applied to the base electrode through input terminals 23. The patent also describes a transistor circuit for a television transmitter which has a frequency divider using the basic oscillator circuit shown in the figure.

Device of the Kind Comprising an Energy Amplifying Tube Having a Pentode Characteristic Curve

Patent No. 2,755,411, Zeger Van Gelder, Eindhoven, Netherlands. (Assigned to Hartford National Bank and Trust Company)

A beam power discharge device having pentode anode voltage-anode current characteristic. The structure is similar to that of a conventional beam tetrode except that a plurality of screens disposed in close proximity to and outside of the screen grid and outside the path of the electron flow. These auxiliary screens are connected to the screen grid and attract the electrons which are reflected from the space charge region, and thus prevent them from striking the screen.

Recording Apparatus for Recording the Listening Habits of Wave Signal Receiver Users.

Patent No. 2,755,162, Fred Krahulec, Skokie, Henry A. Rahmel and Robert L. Freeman, Evanston, Ill. (Assigned to A. C. Nielsen Co., Chicago)

The patent describes a means of recording in binary code the tuning condition of the receiver. These recordings may then be transcribed at a later date to determine the receiving history of a number of receivers.

Apparatus for Indicating at a Remote Point the Tuning Condition of a Plurality of Wave Signal Receivers.

Patent No. 2,755,161, Henry A. Rahmel. (Assigned to A. C. Nielsen Co., Chicago)

These patents describe means for determining the frequencies to which a number of radio receivers are tuned without the necessity of personal observation. The first patent describes a means of producing a signal whose frequency is related to the tuning condition of a receiver. This signal may then be transmitted to a remote location where observation of the receiving frequency of a number of receivers may be made simultaneously.

NEW TYPE OF HIGH VOLTAGE CAPACITORS



SEND FOR
FREE
LITERATURE

Type OT capacitors are designed for operation to a maximum of 65°C and are available in voltage ranges to 120 KVDC. These capacitors extend the voltage and capacitance range of the tubular style as exemplified by the popular glasscaps and are primarily designed for operation under oil. Type OT capacitors are supplied with a corona shield permitting operation in close quarters.



Plastic Capacitors, Inc.

2620 N. CLYBOURN AVE., CHICAGO 14, ILL.

CIRCLE 380 ON READER-SERVICE CARD FOR MORE INFORMATION

STOCK KNOBS

IN ANY QUANTITY
NEVER A MOLD CHARGE

GEE-LAR—The House of Knobs—can give you a wide selection of knobs for every application. Hundreds of patterns and styles always in stock, and you're never concerned with a tool charge.

WRITE TODAY for illustrated GEE-LAR Catalog. Free!

GOLD INLAY KNOBS

Select your knobs or pointers from GEE-LAR'S huge stock of quality products. Fast service... lower cost—always at GEE-LAR!

GEE-LAR MANUFACTURING COMPANY

424 South Wyman Street • Rockford, Illinois

* build
reliability into
every circuit



Specify *BIRTCHER TUBE CLAMPS

MATERIAL

Type 302
stainless steel.

SIZES

Over 6,000 modifications
in size and design
available to fit
any electronic
tube or component.

Millions of Birtcher TUBE CLAMPS have been manufactured for use in military and civilian equipment. Made in three complete series, with over six thousand modifications in size and design, there is a Birtcher Tube Clamp that will solve your particular problem of tube or component retention.

THE BIRTCHER CORPORATION

INDUSTRIAL
DIVISION

4371 Valley Blvd.,
Los Angeles 32, Calif.

Write for catalog

CIRCLE 382 ON READER-SERVICE CARD FOR MORE INFORMATION

The Curtiss-Wright "SNAPPER"

NEW CONCEPT... ADVANCED DESIGN IN THERMAL TIME DELAY RELAYS

Designed for high performance and long life, the Curtiss-Wright "SNAPPER" Thermal Time Delay Relay is proving itself in countless applications involving time delay in electrical circuits. Such applications include circuits to provide definite on-off time intervals to delay the application of high voltage until after warm-up period and for over and under voltage protection with simultaneous fault indication.

These relays have single-pole double-throw contact action, high ambient temperature range, freedom from chatter and arcing, and are small in size. The "SNAPPER" thermal time delay relays are factory pre-set from 3 to 90 seconds. They are available in metal envelope, miniature (7 and 9 pin) or octal (8 pin) and in a glass envelope in 9 pin only.

Curtiss-Wright manufactures the High-Low "SNAPPER" Differential Thermostat with high precision characteristics. Write to Thermal Devices for complete data.



ELECTRONICS DIVISION
CURTISS-WRIGHT
CORPORATION • CARLSTADT, N. J.

CIRCLE 383 ON READER-SERVICE CARD FOR MORE INFORMATION

Books

A Scientific Sampler

Raymond Stevens, Howard F. Hamacher, and Alan A. Smith. D. Van Nostrand Company Inc., 120 Alexander Street, Princeton, N.J. 413 pages. Price: \$6.00.

A book of reports, predictions and reflections on the past, present and future of scientific possibilities and progress. These are short and highly readable essays on science as it affects man, and the scientific method. Originally published in the Industrial Bulletin of Arthur D. Little Inc., these articles provide early and authoritative information on the present status and future trends of industrial development. Brief, informative, and free of technical jargon, this collection makes good reading for anyone interested in the how and why of scientific progress.

Radio Telemetry (Second Edition)

Myron H. Nichols and Lawrence L. Rauch. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N.Y. 459 pages. Price: \$12.00.

This book gathers basic theory and a cross section of current practice in radio telemetry. The authors present a thorough background in environmental errors, frequency and time domain analysis, modulation and multiplexing, minimum signal strengths and thresholds, sampled data smoothing, and interpolation. On the basis of this they compare existing telemetry equipment and compare them in terms of minimum required signal strength, crosstalk, susceptibility to environmental errors, and information efficiency.



For Maximum Frequency Control



JKTO TRANSISTOR CRYSTAL OSCILLATORS

Dimensions: 1.26" dia.
by 3.75" seated height

Frequency Range: 1 kc to 25 mc
(higher available)

Frequency stability: (24 hour period)
1 part in 10⁶ or better at 50 kc up

Supply voltage: Heater
6V to 115V ac or dc

THE JAMES KNIGHTS COMPANY—Sandwich, Illinois



CIRCLE 384 ON READER-SERVICE CARD FOR MORE INFORMATION

Modern Science and Human Values

Everett W. Hall. D. Van Nostrand Co., Inc.,
120 Alexander St., Princeton, N.J. 483
pages. Price: \$8.00.

This book is a philosophical study in the distinction between scientific laws and standards of value together with differences in the ways of establishing them. To explain this disparity, the author looks back into history, concentrating on a few key developments. As representative of the scientific method he follows the evolution of laws of motion in physics and price laws in economics; as examples of value discipline he chooses ethics and political legal theory.

Management for Tomorrow

Society for Advancement of Management.
Chilton Co., Philadelphia, Pa. 175 pages.
Price: \$6.00.

Management principles and problems in such basic fields as general administration, production, distribution, finance, industrial relations, and related staff services, are discussed by outstanding personalities, professionals, executives, and administrators in business or government.

Elements of Pulse Circuits

F. J. M. Farley. John Wiley & Sons, Inc.,
440 Fourth Avenue, New York 16, N.Y. 143
pages, 74 illustrations. Price: \$2.00.

This book is addressed primarily to physicists and research workers with some knowledge of electronics; the application to pulse waveforms is then tackled immediately. The approach is non-mathematical, the emphasis being on a direct understanding of the physical principles involved. The contents include fundamental circuits, square wave generators, trigger circuits, time bases, pulse amplifiers, and applications.

Abacs or Nomograms

A. Giet. Philosophical Library, New York,
N.Y. 235 pages, 152 illustrations. Price:
\$12.00.

This is an essentially practical book, and not only demonstrates the many and varied applications of the abac or nomogram but shows how even those without highly specialized mathematical knowledge may construct their own charts. It deals both with Cartesian abacs and alignment charts, and contains a large number of practical examples drawn from the fields of mechanics, physics, and electrical engineering.



**Harnesses...
Cable Assemblies...
Cord Sets...**

We Invite Your Inquiries
We are equipped to manufacture any of the following:

- Electronic Cables
- Braided Cables
- Molded Cables
- Shielded Cables
- Harnesses
- Extension Cords and Cables
- Leads with Terminals
- Power Supply Cords and Cables

Columbia WIRE & SUPPLY CO. 2850 IRVING PARK ROAD
CHICAGO 18, ILLINOIS

CIRCLE 385 ON READER-SERVICE CARD FOR MORE INFORMATION

TDI TYPE 1202A VOLTAGE CONTROLLED OSCILLATOR*



TINY! Only 8 oz. in weight,
3 $\frac{3}{8}$ inches in height, 1 $\frac{1}{2}$ inches
in width and 1 $\frac{1}{4}$ inches in depth!

TOUGH! Environmentalized
for extreme variations in tem-
perature, altitude, acceleration,
shock, vibration and humidity!

TERRIFIC! Provides stable,
linear signal and exceptional
reliability under all of the above

conditions. For use in missiles,
drones and piloted aircraft.

Complete technical data and specifications
on TDI Type 1202A Voltage Controlled
Oscillator, or other TDI remote instrumenta-
tion components and systems sent on request.
*Pat. Pending



CIRCLE 386 ON READER-SERVICE CARD FOR MORE INFORMATION

A New Technique by Wayne Kerr



Measurement of X Band power now
becomes accurate and quick with the
Wayne Kerr torque operated Wattmeter.
Standards room and production line both
benefit from its high accuracy and ease
of operation.

SUPERIOR TO CALORIMETERS because:

- Easy to operate
- Absorbs negligible power
- Needs no warming up or pre-calibration
- Extremely accurate. Calibration is stable
- Suitable for rapid production measurements

BRIEF SPECIFICATION:

Frequency range: 8690-9840 Mc
VSWR: better than 1.1:1
Insertion loss: 0.1 db
Power range: 10-200 watts, mean.
Accuracy: $\pm 2\%$

PRICE \$1450.

Immediate Delivery

Watch for further
announcements by



Specialists in
RF Measurement

Exclusive Sales & Service in U.S.A.

MARCONI Instruments • 44 NEW STREET • NEW YORK 4, N. Y.

CIRCLE 387 ON READER-SERVICE CARD FOR MORE INFORMATION

Positive Current Feedback in Audio Amplifiers

J. G. Adashko

THE extensive use and thorough study of negative-feedback amplifiers has somewhat obscured the fact that equivalent results can be obtained in audio amplifiers by using positive feedback. In this article, translated from *Radiotekhnika* No. 6, 1956, the following conclusions are drawn:

1. The use of positive current feedback in If amplifiers, picked off a certain impedance, fully compensates for the frequency and phase distortion introduced by a series impedance of the same type.

2. Unlike negative feedback, positive current feedback compensates for the above types of distortion without reducing the gain, although there is a limit to the amount of feedback that can be used.

3. The improvement effected by positive current feedback in a low-frequency amplifier makes possible the use of additional negative voltage feedback without danger of causing the stage to oscillate.

Elimination of Frequency and Phase Distortion

Frequency and phase distortion are caused at high frequencies by the leakage inductance of the output transformer. Consider a transformer-coupled output stage, Fig. 1, with series positive current feedback obtained with the aid of an inductance. Fig. 2 shows the equivalent circuit of the stage (with the feedback disconnected) at high frequencies. Here L_s is the leakage inductance of the transformer, Z_L and L' the load impedances (Z_L) and the added inductance (L), referred to the primary side; R_i and μ are the internal resistance and the amplification factor of the tube, respectively. The output-transformer turn ratio is denoted by n .

The gain of the stage without feedback (the ratio of the output voltage, i.e., the voltage across Z_L , to the input voltage U) can be obtained from the equivalent circuit:

$$K = \frac{nZ'_L}{R_i + Z'_L + j\omega L_s + j\omega L'} \quad (1)$$

The coefficient of positive feedback (the ratio of

the voltage drop across inductance L to the output voltage) is

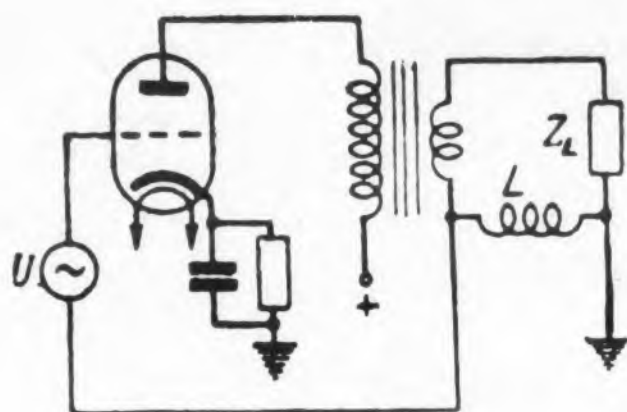
$$\beta = \frac{j\omega L}{Z_L} = \frac{j\omega L'}{Z'_L} \quad (2)$$

The feedback is made positive by choosing the proper terminal of the secondary winding.

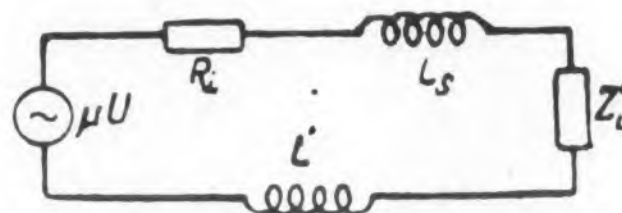
Let us determine the gain of the stage in the presence of feedback:

$$\begin{aligned} K_f &= \frac{K}{1 - \beta K} = \left(\frac{1}{K} - \beta \right)^{-1} \\ &= \left(\frac{R_i + Z'_L + j\omega L_s + j\omega L'}{\mu n Z'_L} \right)^{-1} \\ &= \frac{\mu n Z'_L}{R_i + Z'_L + j\omega (L_s + L' - \mu n L')} \quad (3) \end{aligned}$$

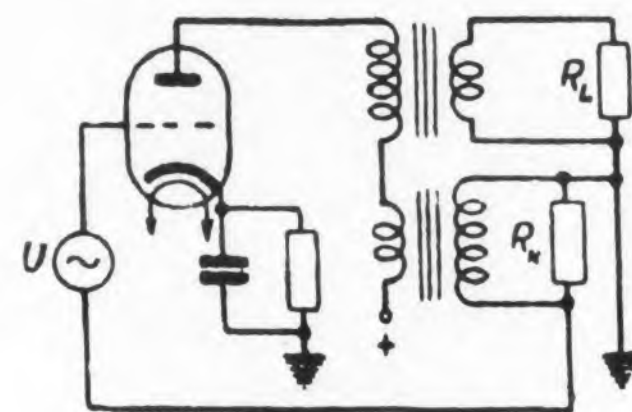
It follows from (3) that for complete cancellation of the effect of the inductance, we must have



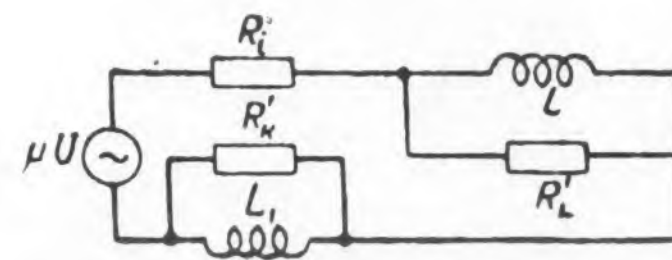
1



2



3



4

$$L'_k = \frac{L_s}{\mu n - 1}$$

or, accordingly

$$L = \frac{L_s \cdot n^2}{\mu n - 1} \quad (4)$$

With this, the gain of the stage with feedback becomes:

$$K_f = \mu n \frac{Z'_L}{R_i + Z'_L} \quad (5)$$

Thus, the circuit of Fig. 1 makes possible complete compensation for the effect of the transformer leakage reactance. It is equivalent to a circuit that contains neither the leakage inductance L_s , nor the added inductance L . If the load is purely resistive, the output voltage is independent of frequency and is in phase with the amplified voltage. This makes possible the use of negative feedback for reduction of non-linear distortion (for example, using a resistor in the cathode circuit) without the danger of self-oscillation at high frequencies. Naturally, the use of the above circuit simplifies considerably the choice of output transformer (higher leakage reactance can be tolerated) without sacrificing quality at the higher amplified frequencies.

Full cancellation of frequency and phase distortion at higher frequencies can be obtained also with an inductive load. Thus, to compensate for the inductance L_L of an inductive load, it is evidently enough to have

$$L = \frac{L_s n^2 + L_L}{\mu n - 1} \quad (6)$$

Compensation of Frequency and Phase Distortion

Frequency and phase distortion are produced in a transformer-coupled output stage at low frequencies because of shunting of the load impedance by



BACKED by efficient distributors.

BACKED by the finest engineering and manufacturing facilities.

BACKED by Scintilla Division field service specialists.

THE FINEST ELECTRICAL CONNECTOR MONEY CAN BUY!

When you specify Bendix Scinflex* electrical connectors you can be certain of receiving the finest possible service from a product that is the result of advanced engineering design and the most modern production techniques.

Significant proof of the outstanding performance and reliability of these connectors is given by the fact that, within a relatively short period of time after the start of manufacturing operations, Scintilla Division of Bendix has achieved a recognized position of prominence in the electrical connector manufacturing industry.

Further reassurance is offered the user by the fact that Bendix Scinflex electrical connectors are backed by a nation-wide field service organization and by especially trained, well-staffed and adequately stocked distributors.

AVIATION PRODUCTS: Low and high tension ignition systems for piston, jet, turbo-jet engines and rocket motors . . . ignition analyzers . . . radio shielding harness and noise filters . . . switches . . . booster coils . . . electrical connectors. *REG. U.S. PAT. OFF.



SCINTILLA DIVISION of
SIDNEY, NEW YORK



CIRCLE 388 ON READER-SERVICE CARD FOR MORE INFORMATION

MV-18C




WIDE CHOICE OF PROBES
Contact tips
Binding posts
Coaxial connectors



RF MILLIVOLTMETER
1 mV to 1 kV — 1 MC to 2.5 KMC

FILLS THE GAP

Designed particularly for low level voltage measurements in the vital gap between sensitive low frequency (amplifier type) meters and non-sensitive high frequency (rectifier-probe type) meters.

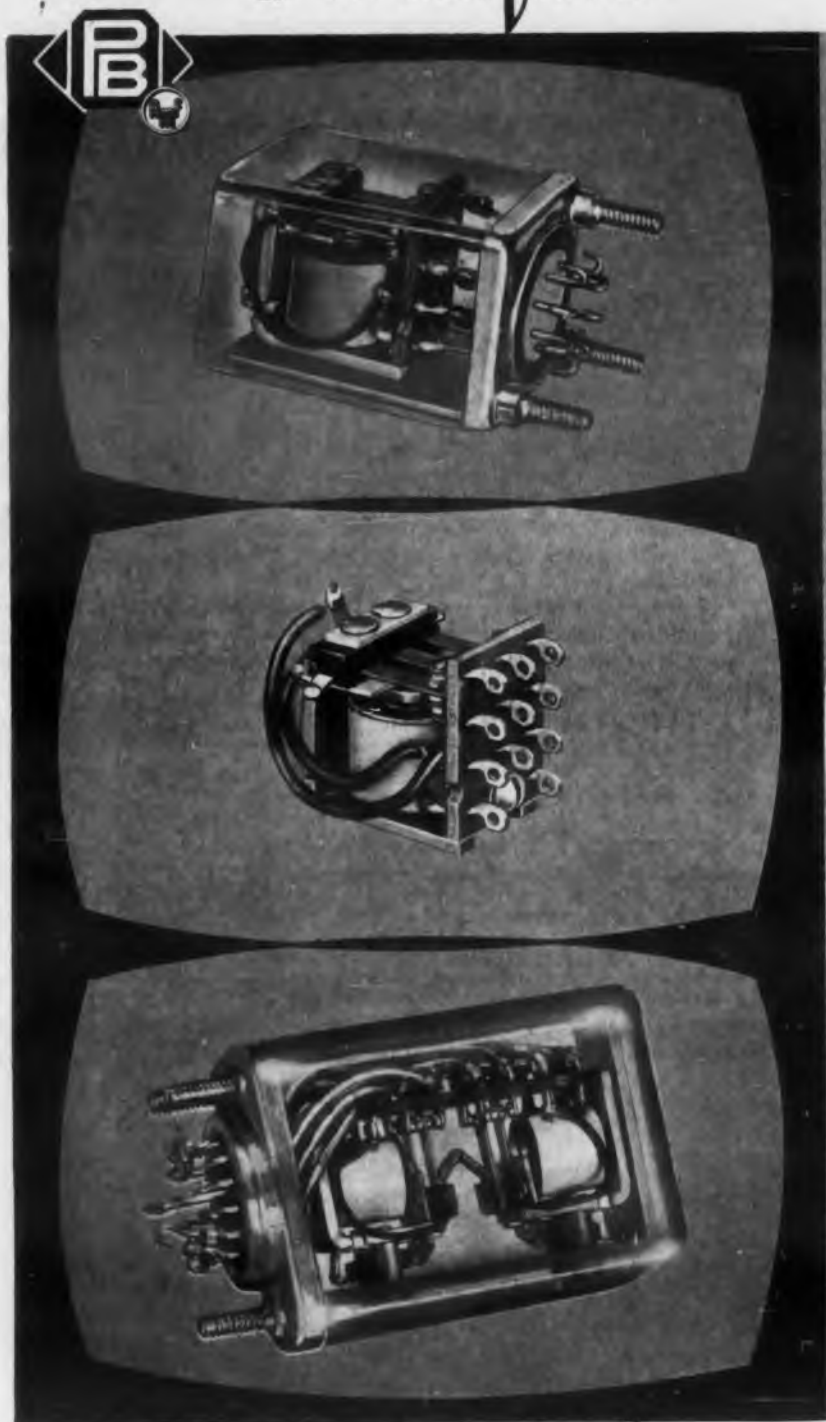
Valued by researchers in radar, TV, HF and UHF communications, the MV-18C millivoltmeter features a high impedance chopper-type DC amplifier and a wide selection of low capacity (1.25 MMF) RF crystal probes. Voltage measurements at frequencies above 6 MC (1 MC-2.5 KMC) are possible at levels low as 1 mV. Whether your problem is monitoring signal generator output, or measuring stage gain at true, low signal operating levels, you'll find the MV-18C an exceptionally sensitive, yet reliable instrument.

TOMORROW IS OUR YESTERDAY

Millivac
Instrument Corp.
Box 997, Schenectady, N. Y.

CIRCLE 389 ON READER-SERVICE CARD FOR MORE INFORMATION

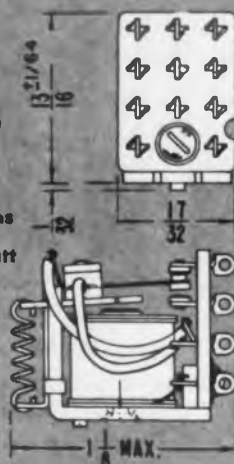
R **Potter & Brumfield** PRESENTS AN IMPORTANT NEW RELAY SERIES



A three-pole, hermetically sealed version of the KM provides a multiplicity of action yet requires a minimum of space. Mounted with three #6-32 studs; eight solder terminals. This relay is especially useful in low voltage, DC applications where size and weight are critical factors.

**ENGINEERING DATA
KM SERIES**

CONTACTS: Max. 3PDT. 3/32" Dia.
Silver 2 amps, 115V 60 cy. resistive
VOLTAGE RANGE: Up to 48V DC
nominal
COIL RESISTANCE: Up to 6700 ohms
COIL POWER REQUIREMENT: 1 watt
TEMP RANGE: -45° C to +55° C
PULL-IN: 75% of nominal voltage
TERMINALS: Solder lugs



Designated as the KE, this latching relay combines two KMs for minimum size and weight. It operates on momentary impulse to either coil with a mechanical latch and electric release. Available up to 6 PDT. This relay was designed for intermittent duty only. Three-stud mounted with solder terminals. Hermetically sealed model is shown at left. Also available in open version.

the inductance of the transformer primary. It was shown above that an inductance connected in a certain manner in a positive-feedback loop is equivalent to a "negative" inductance, which cancels the series-connected inductance of the circuit. It is analogously possible to cancel an active resistance in series with the transformer (for example, the internal resistance of a tube) by connecting, also in series, a suitable "negative" resistance. Such compensation, naturally, makes the voltage drop across the transformer primary independent of any impedance, active or reactive, connected in parallel with the windings of this transformer.

If the positive-feedback loop is to cover a single stage only, the added resistance can be inserted in series with the transformer primary only by using an added transformer. Let us examine such a case. An audio-amplification stage, employing a tube with internal resistance R_i and amplification factor μ , feeds a load resistance R_L through an output transformer with a turn ratio n . The drop across the compensating resistor R_c is applied to the grid through a special transformer with turn ratio n_1 in addition to the signal voltage U . In the lf equivalent circuit Fig. 4, drawn to determine the gain of the stage without feedback, the inductances of the transformer primary and of the added transformer are denoted by L and L_1 , while R_L and R_c are the values of resistances R_L and R_c referred to the primary side. Z denotes the total impedance of R and $j\omega L$ in parallel.

In the following equations we shall assume that

$$\omega L_1 \gg R'_K \quad (7)$$

The correctness of this assumption will be examined below. The gain of the stage without feedback, at lower frequencies, will be

$$K = \frac{\mu n Z}{R_i + Z + R'_K} \quad (8)$$

The coefficient of positive feedback is

$$\beta = \frac{R'_K}{Z} \cdot \frac{n_1}{n} \quad (9)$$

The gain in the presence of feedback is given by

$$K_f = \left(\frac{1}{K} - \beta \right)^{-1} = \frac{\mu n Z}{R_i + Z + R'_K (1 - \mu n_1)} \quad (10)$$

As can be seen from (10), complete cancellation calls for

$$R'_K = \frac{R_i}{\mu n_1 - 1}$$

or, correspondingly

$$R_K = \frac{R_i \cdot n^2_1}{\mu n_1 - 1} \quad (11)$$

In this case the gain with feedback assumes the following value:

Good Relay News! **KM SERIES ANSWERS DESIGN NEEDS**

Designers plagued with problems of miniaturization welcome the KM series as good relay news.

These subminiature relays—open, hermetically sealed and latching—are wonderfully versatile, light in weight, and amazingly compact. The open KM occupies less than a cubic inch of space!

Application possibilities range over such diverse fields as remote control systems, automated toys, small business machines and alarm systems. New applications suggest themselves daily to engineers working with designs where component size and weight must be kept to barest minimums. Your inquiries about our KM series relays are invited!

POTTER & BRUMFIELD, INC. A Subsidiary of American Machine & Foundry Co.
PRINCETON, INDIANA Manufacturing Divisions in Franklin, Ky., and Laconia, N. H.

CIRCLE 390 ON READER-SERVICE CARD FOR MORE INFORMATION



$$K_f = \mu n \quad (12)$$

Equation (12) confirms the complete absence at low frequencies of frequency and phase distortion due to the shunting of the load impedance by the inductance of the transformer primary.

Let us return now to inequality (7). Does this condition, on which the compensation is based, really hold and can it be readily realized? Combining (7) and (11) we get the inequality

$$\omega L_1 \gg \frac{R_i}{\mu n_1 - 1} \quad (13)$$

Let us compare (13) with the usual condition for the absence of distortion at low frequencies from a transformer-coupled output stage

$$\omega L \gg R'_L = \alpha R_i \quad (14)$$

where α is the load coefficient. It is easy to see that for the usual values of μ and for the values of α normally employed, the inequality

$$\alpha \gg \frac{1}{\mu n_1 - 1} \quad (15)$$

holds even for small values of n_1 (on the order of unity).

It follows that it is much easier to satisfy condition (13) than condition (14), even with a very low-quality supplementary transformer.

The use of additional resistor R_c naturally involves a power loss. However, the power dissipated in this resistor is much less than the useful power delivered to the load resistance. In fact, as can be seen from the equivalent circuit (Fig. 4), the power ratio is

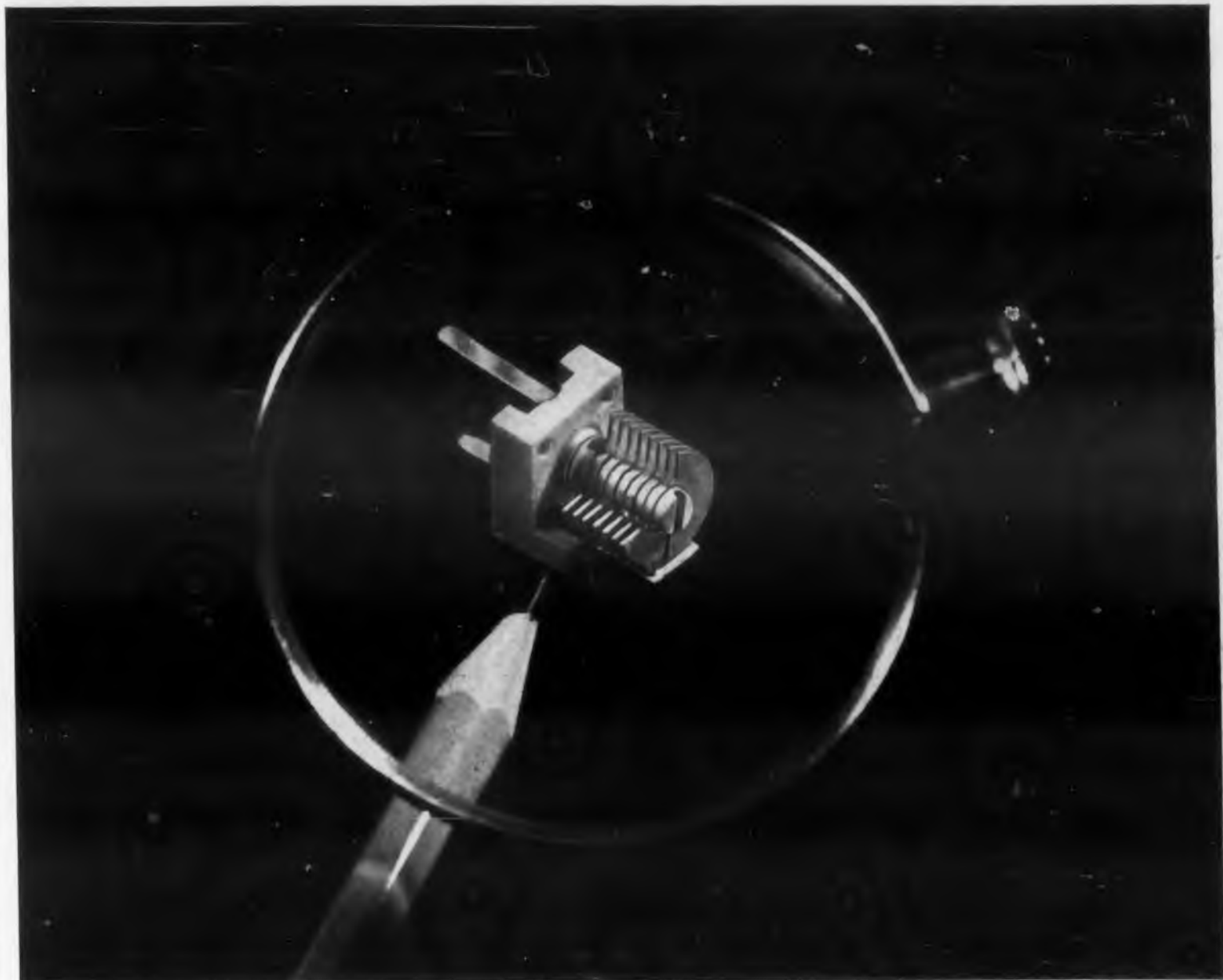
$$\frac{R'_K}{R'_L} = \frac{R_i}{(\mu n_1 - 1) \alpha R_i} = \frac{1}{\alpha (\mu n_1 - 1)} \quad (16)$$

This ratio, as follows from (15), is considerably less than unity.

Further analysis of (12) leads to the conclusion that positive feedback can fully compensate for the frequency and phase distortion at lower frequencies, while the gain of the stage actually increases, rather than diminish as when negative feedback is used.

It is evident that a certain increase in non-linear distortion, due to the introduction of positive feedback, can be readily compensated by using an equal amount of negative voltage feedback picked off the load resistor. Such a circuit, while compensating for the frequency and phase distortion, affects neither the gain of the stage nor the value of the non-linear distortion.

The essential feature of the circuit considered is the independence of the gain (12) from the value of load resistance. The most important practical significance, particularly for wired-broadcast amplifiers (very extensively used in the USSR-tr.) is that the gain is independent of the connected load.



More than 1/2 times actual size.

NOW! even smaller air trimmer capacitors

For every type of electronic equipment—printed wiring board or conventional chassis—Radio Condenser's new Series 75 trimmers mean more circuit in less space. Measuring just 25/64" x 7/16" x 17/32" behind mounting surface, they're the tiniest trimmers ever made in the United States.

Three capacitance ranges are available, as tabulated below. Each is equipped with plug-in tabs for printed wiring board insertion, as well as two holes for conventional screw mounting. The sturdy low loss ceramic body, brass plates soldered and silver plated, assure a rugged unit, able to take extreme shock, vibration and temperature change. Capacitance is easily varied by means of a screwdriver slot in the rotor shaft.

Insulation resistance, "Q" and thermal stability characteristics are excellent.

Complete Engineering data and specifications for the new Series 75 Subminiature Trimmer capacitors are provided in Bulletin TR-123, available free on request. Write Radio Condenser now for your copy.

RADIO CONDENSER
MINIATURE AIR TRIMMER CAPACITORS

Type No.	Min. Cap. $\mu\mu\text{F}$	Effective Max. Cap. $\mu\mu\text{F}$	Air Gap	No. Plates
875001	1.2	5	.014	9
875002	1.2	10	.008	11
875003	1.5	15	.008	15



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
CANADA: Radio Condenser Co. Ltd., 6 Bermondsey Rd., Toronto, Ontario

CIRCLE 391 ON READER-SERVICE CARD FOR MORE INFORMATION

The use of Electronic Simulators in the Investigation of Slow Automatic-Regulation Processes. V. V. Gurov, (6 pp, 5 figs).

Another article in the series describing the latest analog computers of the USSR Academy of Sciences (See ED July 15, Nov. 1, 1956).

Up to recent times it was assumed that electric analogue computers, when employed as dynamic simulators can be used in conjunction with regulators only if the regulation process does not last more than 100 or 150 seconds. This limitation is due to the null drift and to leakage discharge of the integrating capacitors in the solution amplifiers. The article describes methods of combatting leakage without employing excessively large capacitors or feedback-loop resistors. Leakage is eliminated by placing grounded metallic shields between the input and output circuits (compare Figs. 1a and 1b). Leakage between relay contacts is eliminated in the manner shown in Fig. 2a. The result is that leakage between input and output is converted into leakage between input to ground and output to ground, as shown in Fig. 2b. Although this increases somewhat the capacitance between the amplifier input and ground, and reduces the pass band of the amplifier, such an increase does not matter in the case of slow processes.

The use of amplifiers with automatic drift stabilization in conjunction with voltage dividers at the input and output of the amplifier, as shown in Figs. 3a and 3b, makes possible the use of very large time constants. For example, in Fig. 3a using $R_{12} = 1$ meg, $C = 1 \mu f$, a voltage-divider ratio $\alpha_1 = 0.001$ yields $T = 1000$ seconds. Similarly, in Fig. 3b, properly chosen parameters yield a time constant of 15 minutes.

The oscillograms of Fig. 4 show the experimental results obtained solving second-order differential equations representing undamped processes with periods of 9000, 3000, and 300 seconds respectively. These were obtained with the EMU-6 analogue computer (See ED Nov. 1, 1951) and the leakage error does not exceed 5 per cent for 2 hours (see Fig 4a).

On the Autonomy of Multi-Loop Systems that remain Stable as the Steady-State Accuracy is Increased without Limit, M. V. Meerov, (15 pp, 9 figs, 1 table).

Discussion of regulating systems in which several separate closed-loop systems, each regulating a different parameter of a machine or process are all coupled through the regulated machine or process.

Use of the "Potential-Stability" Theory in the Investigation of Noise Stability of Transmission of Remote-Control Commands, G. A. Shastova, (8 pp, 4 figs, 3 tables).

Second part of an article previously reported in ED.

Russian Translation

What The Russians Are Writing

Approximate Probability Analysis of the Accuracy of Inherently Non-linear Automatic Systems, I. E. Kazakov, (25 pp, 22 figs).

Statistical linearization of several representative non-linear functions. Refers to works by Booton and Zadeh.

Design of Magnetic Amplifiers with Toroidal Cores, O. A. Sedykh, (15 pp, 9 figs, 2 tables).

Optimization of core dimensions and winding parameters for maximum gain. Evaluation of effect of deviations from optimum dimensions, necessitated by the use of standard parts. Discussion of weight minimization. Practical examples.

Other Articles in this Issue

Simultaneous Reproduction of Random and Non-Random Signals by Linear Servomechanisms, V. I. Kukhtenko, (6 pp, 1 fig); Pneumatic Ratio Regulators without Mechanical Dividers, G. T. Berezo- vets, (7 pp, 6 figs); Use of Operational Calculus in Investigation of Transients in Servomechanism with Saturation (Non-Linear) Amplifiers, M. Nadler, 4 pp, 5 figs); Bibliography of Foreign and Russian Literature on Magnetic Amplifiers, 1951-1954 (17 pp—very extensive).

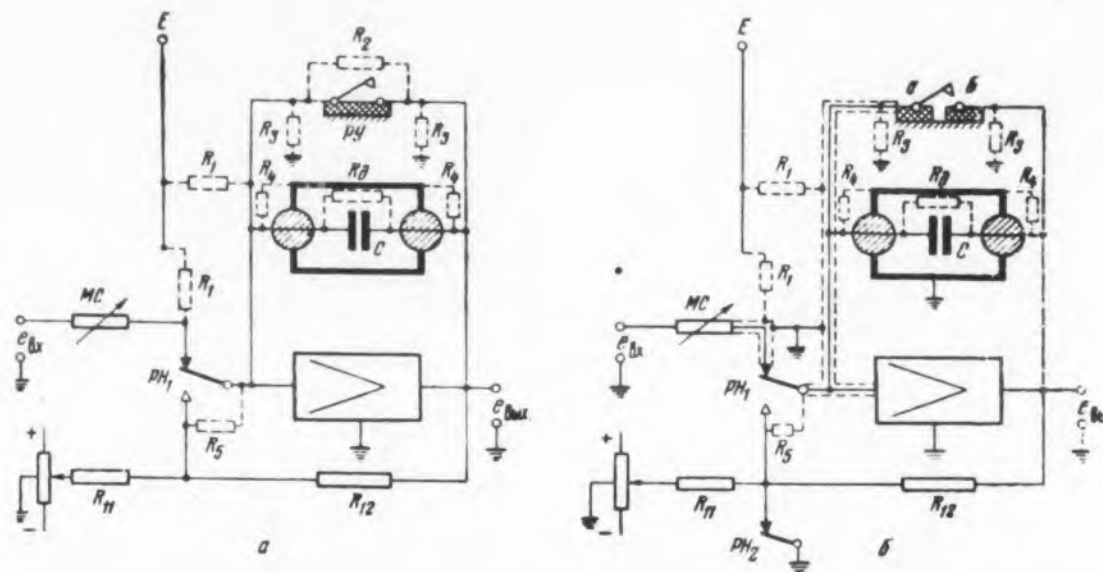


Fig. 1. a—Diagram of integrating solution amplifier showing the possible leakage points. b—Solution amplifier employing the "insulation by grounding" principle.

R_1 —Insulation Resistance of current-carrying conductors at the summation point, R_2 —insulation resistance between the relay contacts that discharge the integrating capacitor, R_3 —leakage resistance of the relay contacts to the relay case, R_4 —insulation resistance of the integrating-capacitor leads, R_5 —insulation resistance between the "initial condition" relay contacts, R_6 —resistance of integrating capacitor dielectric, E—source of supply, C—integrating capacitor, MC—input-resistance decade box, RY—control-relay contact, PH1—initial-condition relay contacts, PH2—supplementary contact of initial condition relay.

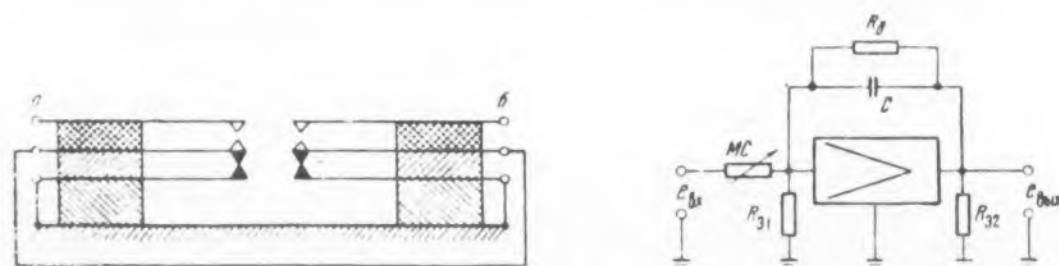
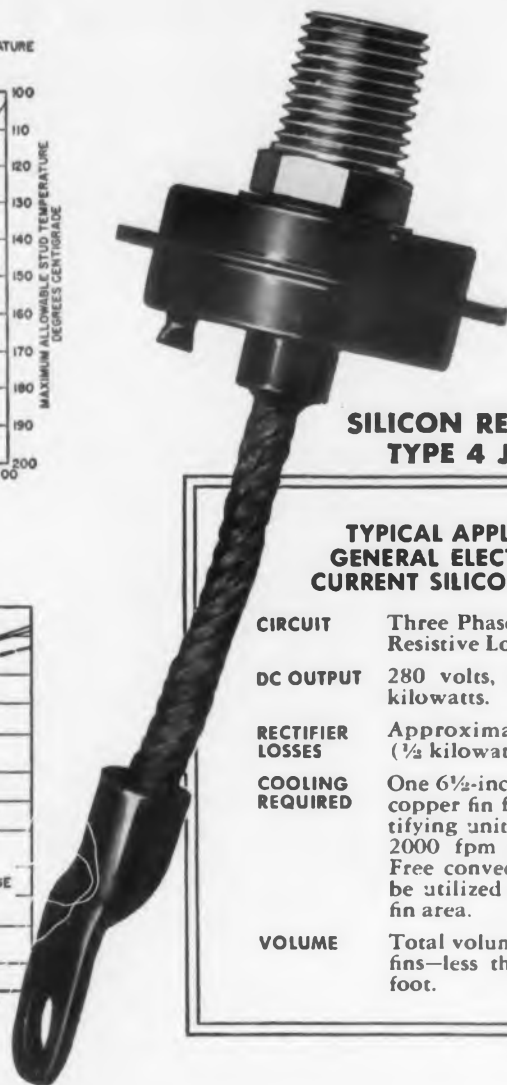
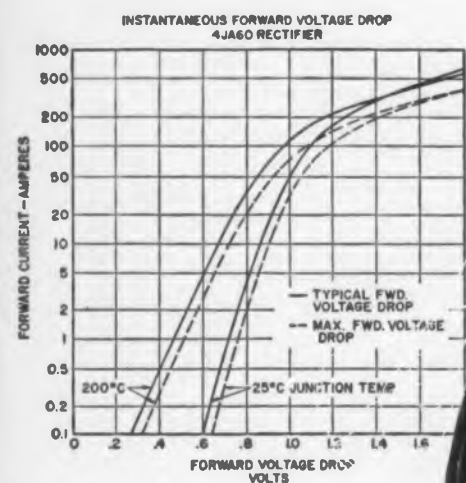
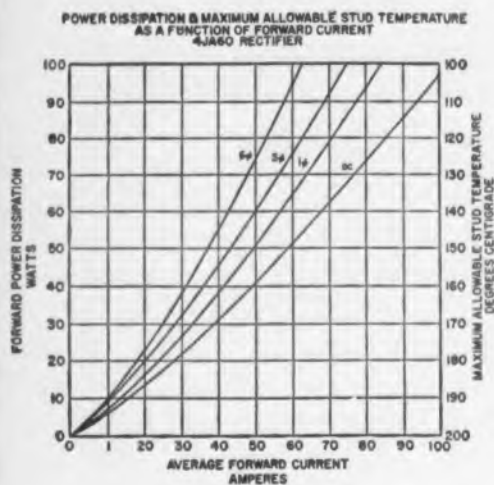


Fig. 2a

Fig. 2b

DESIGN PROBLEM:

More Rectifier Power per Dollar?



**SILICON RECTIFIER
TYPE 4 JA60**

TYPICAL APPLICATION GENERAL ELECTRIC HIGH CURRENT SILICON RECTIFIER

CIRCUIT	Three Phase Bridge Rectifier, Resistive Load.
DC OUTPUT	280 volts, 215 amperes, 60 kilowatts.
RECTIFIER LOSSES	Approximately one percent ($\frac{1}{2}$ kilowatt).
COOLING REQUIRED	One $6\frac{1}{2}$ -inch square $\frac{1}{4}$ " thick copper fin for each of six rectifying units when used with 2000 fpm 30°C forced air. Free convection cooling may be utilized by increasing the fin area.
VOLUME	Total volume of rectifiers and fins—less than $\frac{1}{8}$ of a cubic foot.

High Current SILICON RECTIFIERS, available now, cost less than other rectifying devices!



High Capacity Silicon Rectifiers—with rating up to 85 amps at 300 volt operating levels—now cost no more than other junction type rectifiers. These high-efficiency silicon rectifiers are produced using the alloy technique developed by General Electric research. Extended life tests show no deterioration in rectifier characteristics when operated at full rated condition.

All-Welded Seal for Trouble-Free Service. With the large area silicon element hermetically sealed within a steel housing, General Electric Silicon Rectifiers are immune to troubles caused by moisture, vibration, dust, or corrosion. They may be mounted in any position; and have a safe temperature range greater than any of the other junction-type units. Their "plumbing type" stud fitting assures fast cooling through heat sink connections.

Work Anywhere. General Electric Silicon Rectifiers can be

CIRCLE 393 ON READER-SERVICE CARD FOR MORE INFORMATION

used in *any* rectifier application. They are being installed now in many applications including:

Arc Furnaces	Magnetic Devices
Cathodic Protection	Shop DC Supply
DC Motor Supply	Welding Equipment

All General Electric Silicon Rectifiers meet rigid military requirements. They are now available in four voltage ranges. For detailed application engineering information, consult your General Electric representative, or write to *General Electric Company, Semiconductor Products, Section X74126, Electronics Park, Syracuse, New York.*

Progress Is Our Most Important Product

GENERAL  ELECTRIC

Russian Translation

Radiotekhnika i Elektronika No. 3, 1956

Application of Orthogonal Power Polynomials to the Analysis of Transients in Multistage Amplifiers, S. V. Samsonenko, (5 pp, 1 fig).

The development of pulse methods has raised considerably the interest in transient analysis of multi-stage amplifiers. The conventional operational methods, although theoretically capable of analyzing any multi-stage system, involve cumbersome equations and computations, the complexity of which increases with the number of stages. Expansion of the transient time function into a series of orthogonal Hermite or Laguerre polynomials yields simpler solutions and reduces the computation time and labor.

Effect of the Nature of the Variation of the Dielectric Constant of Air with Altitude on the Refraction of Radio Waves in the Lower Layers of the Atmosphere, A. V. Shabel'nikov, (4 pp, 1 fig).

The calculus of variation is used to determine the dependence of the angle of refraction on the distribution function of the dielectric constant of air. It is shown that the angle is almost independent of this function over a wide range of elevation angles, 0 to 80 degrees.

Determination of the Field of Long and Very Long Radio Waves over the Earth's Surface under Actual Conditions, Ia. L. Al'pert, (12 pp, 8 figs, 4 tables).

Field-intensity values for 500-30,000 cycle waves were computed, under certain assumptions concerning the inhomogeneity of the ionosphere, for distances ranging from 500 to 10,000 km. The computed data were in good agreement with experiment.

Oscillograph for UHF Oscillations and Certain Results of its Use in the Study of Pulsed Magnetrons, A. M. Chernushenko, (12 pp, 16 figs).

The novelty of this oscillograph lies in a new deflecting system, constructed in the form of a cavity resonator. The resonator comprises two cylindrical spaces, which act as inductances, interconnected by a slit, which acts as a centered capacitor and serves as the deflecting system. Microwave power flows from the generator through the deflecting system into the magnetron over a pair of coaxial guides. The outer conductor is capacitively coupled to the body of the resonator, and the inner conductor is directly connected to the loop. A 13LO2S CRT is used in conjunction with this deflection system.

The frequency characteristic of the deflection system is such that not less than 90 percent of the power passes through the deflection system

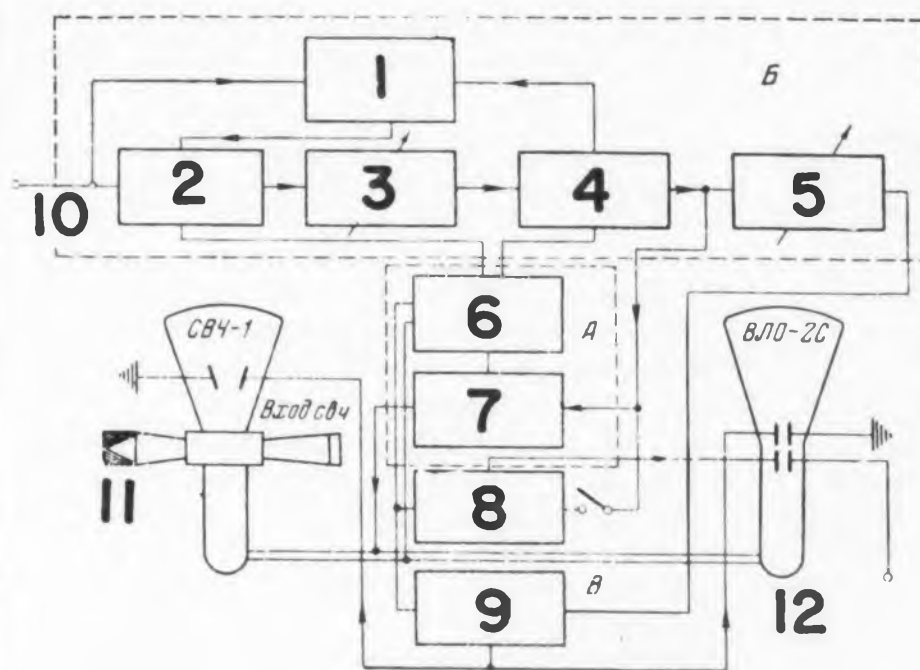
wavelengths from 8 to 12 cm. Such close coupling makes the deflection system almost aperiodic and results in distortionless recording of the very fast transients in modern magnetrons. The frequency characteristic of the entire tube confirms the broadband character of the deflection system.

The oscillograph circuitry calls for faster sweep, faster recording, more linear sweep, and more rigid synchronization between sweep and transient. The synchronization is controlled by an automatic switch which triggers the oscillograph as desired, either once, or 50 times a second, or with each magnetron pulse. A conventional CRT is used along with the UHF one to permit observation of the magnetron anode-voltage or current pulse simultaneously with the hf pulse.

In addition to producing photographs of single pulses, the periodic sweep of the oscillograph can be used for visual observation. Although it cannot take the place of photographs, visual observation is useful, for example, in the comparison of two magnetrons, one operating at nominal rating, the other operating at reduced power and excessively wide spectrum. The oscillograph traces show various anode-voltage pulses and the corresponding hf magnetron oscillations.



Cavity resonator of deflecting system.



Block diagram of oscillograph. 1—Automatic synchronization switch, 2—Synchronization amplifier, 3—Delay line (coarse), 4—Sync. amplifier, 5—Delay line (smooth), 6—Power pack, 7—Generator of HV pulses, 8—Generator of time markers, 9—Sweep generator, 10—UHF input, 11—Pulse input, 12—Matched load, 13—Synchronization.



a)

CBU-1 tube assembly.



b)

To the forward-looking engineer...



STICK-FORCE REVERSAL problems at sonic speeds are solved by this sensitive, accurate AiResearch air data system incorporating transducer, computer and actuator

Garrett Corporation engineers are constantly called upon to provide solutions for seemingly insurmountable problems. The high degree of respect in which the Garrett engineer is held by his profession is a tribute to the accomplishments of our team.

If you qualify to join us, stimulating assignments in the work you like best are only part of what we offer. We pay a premium for ability. You'll work with the finest research and laboratory facilities at your disposal...live in the most desirable areas in America—California, Arizona, the East Coast.

All modern U.S. and many foreign aircraft are Garrett equipped. We have pioneered such fields as refrigeration systems, pneumatic valves and controls, temperature controls, cabin air compressors, turbine motors, gas turbine engines, cabin pressure controls, heat transfer equipment, electro-mechanical equipment, electronic computers and controls.

We are seeking engineers in all categories to help us advance our knowledge in these and other fields. Send resume of education and experience today to: Mr. G. D. Bradley



DIVISIONS:

AIRESEARCH MANUFACTURING, LOS ANGELES • AIRESEARCH MANUFACTURING, PHOENIX

AIRESEARCH INDUSTRIAL • REX • AERO ENGINEERING

AIR SUPPLY • AIR CRUISERS • AIRESEARCH AVIATION SERVICE

CIRCLE 394 ON READER-SERVICE CARD FOR MORE INFORMATION

**Sensitive,
Rugged,
Fast . . .**



the *Electronik* Null Indicator has easy readability

THIS completely electronic instrument has a big, clearly legible scale that reduces the chance of error. There's no need to shade the dial—it's easy to read in any light. And a handy leather grip makes it easy to carry from job to job.

It's sensitive enough for all electrical bridge measurements. And it's rugged enough for production line work. It's fast, simple, compact. It withstands vibration and shock . . . needs no special mounting, no leveling.

Heavy overloads won't damage it. There's no "loss of spot" when excessive signal is applied; you always know which direction to go for bridge correction.

The modern successor to the galvanometer, the *Electronik* Null Indicator is available for immediate delivery. The price is \$175.00, f.o.b. Philadelphia. Order today—and put new convenience in your own test work!

MINNEAPOLIS-HONEYWELL REGULATOR Co., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

● REFERENCE DATA: Write for Data Sheet 10.0-12.



MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS

First in Controls

COMPARE THESE SPECIFICATIONS

Period—less than $\frac{1}{2}$ second
Current Sensitivity—.001 microamp/mm.
Voltage Sensitivity—1 microvolt/mm.
Input Impedance—1000 ohms at max. sensitivity
Overload Rating—1 volt at max. sensitivity
Stability—less than 1 mm. zero shift/hour
Damping—critically damped; independent of external resistance
Terminals—input and ground; for spade, pin or banana plugs
Power—115 volts, 60 cycles
Scale Markings—
 -1 to +1 in mm. } over $2\frac{1}{4}$ " radius
 -4 to +4 in cm. }
Dimensions— $17\frac{1}{8}$ " long x $5\frac{3}{8}$ " wide x $7\frac{3}{4}$ " high
Weight—15 lbs.

Effect of External Excitation on Self-Excited UHF Oscillating Systems, E. S. Vorobeichikov, F. M. Klement'ev. (4 pp, 2 figs).

The behavior of vacuum-tube oscillator with an externally-applied sinusoidal voltage of near-resonant frequency has been studied extensively by many investigators. This article takes into account the effect of the finite travel time of the electron in the tube, and applies the analysis to triode and klystron oscillators.

Fluctuations of Space-Charge Cloud in Cylindrical Magnetron. V. P. Tychinski, Iu. T. Derkach, Part II (experimental), (14 pp, 15 figs, 4 tables).

Part I (Theoretical was published in Radiotekhnika for February 1956 and reported in ED, Nov. 15, 1956.) The experimental part contains a description of the apparatus, the measurement procedure, and the results. The investigations covered the connection between the current-voltage characteristics of the magnetron and the electron fluctuations, and the transformation of the electron-cloud fluctuations into the oscillations of the resonant system. The results confirm the existence of wave dispersion in the electron stream and establish the periodic structure of the fluctuation zones. The experimental results show a good qualitative (sometimes even quantitative) agreement with experiment. Refers to "Effect of Space Charge on Frequency Characteristics of Magnetrons," by H. W. Welch, *Proc. IRE*, 1950, vol. 38, p 1434.

Elimination of "Inverted Operation" of an Amplitude-Phase Detector in the Presence of Fluctuating Noise, Iu. S. Lezin, (6 pp, 4 figs).

Although the use of phase modulation in radio telegraphy results in a four-fold increase in transmitter power over amplitude modulation and twice the power compared with frequency modulation, the method is handicapped by the fact that noise in the detector can cause the signals to reverse polarity. Such reversal interchanges the positions of positive and negative signals, and evidently ruins the transmission.

A new detector, called the amplitude-phase detector and proposed by D. V. Ageev in 1948, Fig. 9, eliminates this shortcoming. The author shows theoretically that the probability of "inverted operation" is almost zero with this detector.

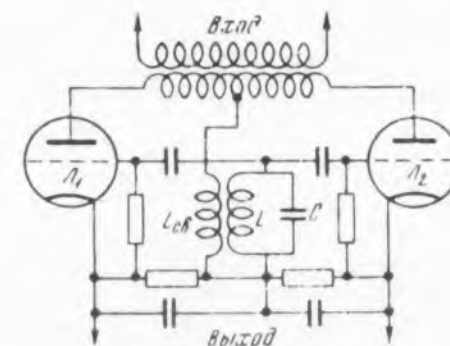
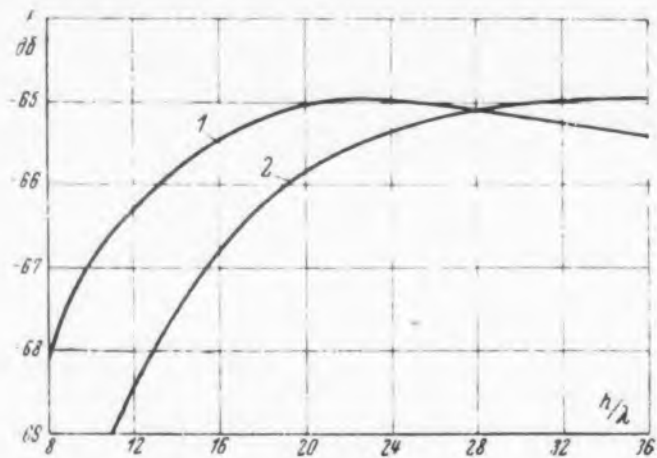


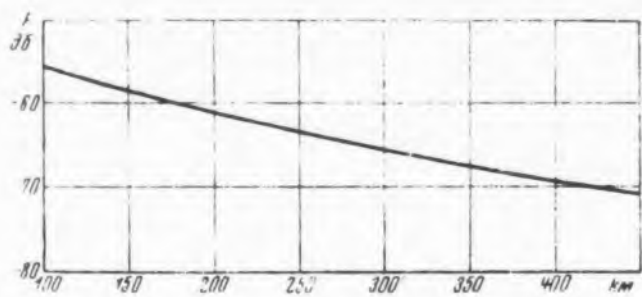
Fig. 9. Diagram of amplitude-phase detector.

Allowance for Antenna Height in the Theory of Scattering of Meter Waves by the Troposphere. O. I. Iakovlev, (4 pp, 3 figs).

Analysis of the dependence of the field intensity beyond the horizon on the height of the antenna. It is shown that the calculation of the scattered field must include the interference nature of the field in the scattering region. Computation of the inter-



Variation of Field Strength F with the height-to-wavelength ratio (h/λ) at $d = 300$ km. 1—Dielectric constant of troposphere assumed inversely proportional to the altitude above the earth's surface. 2—Dielectric constant inversely proportional to the square of the altitude.



Variation in field strength F with distance for $h/\lambda = 20$ and dielectric constant of troposphere assumed inversely proportional to the altitude.

ference between the direct wave and the wave reflected from the earth establishes the dependence of the received signal on antenna height. Refers to articles by Booker and Gordon (*Proc. IRE*, April 1950, pp 401-412) and Gordon (*Proc. IRE*, Jan. 1955, pp 23-28).

Signals of Finite Duration Containing the Maximum Energy Fraction in a Specified Frequency Band. M. S. Gurevich, (7 pp, 2 figs).

A similar problem was treated by J. H. H. Chalk in "The Optimum Pulse Shape for Pulse Communications" (*Proc. I. E. E.*, 1950, 87, 88-92). It involves essentially the solution of a homogeneous Fredholm integral equation with a symmetric positive definite kernel. The author determines the bandwidth which contains 99% of the energy of an optimum-shape pulse. The statement of the problem and the solution method are applicable to problems in the theory of linear antennas and of high-frequency filters.

Measurement of Complex Dielectric Constant and Magnetic Permeability of Magneto-Dielectrics at Cm Frequencies. V. I. Sarafanov, (9 pp, 5 figs).

The complex dielectric constant and the complex permeability of magneto-dielectrics (substances having low electric conductivity) at microwave frequencies are usually measured with slotted lines using the "short-circuit—open-circuit" technique, as proposed by Birks (*Proc. Phys. Soc.*, 1948, 60, 282) and others. The method described in this article is a modification of the procedure used by Horner et al (*Jl. IEE*, 1946, 93, part III, 53), who used H_{01} waves to measure the dielectric constant.

Two variants of the method are given. The first employs two specimens, in the form of disks, one twice as thick as the other. The cavity is tuned to resonance with and without the two disks, and the parameters of the material are determined by solving the simultaneous equations obtained for the three positions. The second variant, which calls for only one specimen of the material, employs the "short-circuit—open-circuit" method.

Investigation of Fatigue of Silver-Oxygen Caesium Photocathodes. P. G. Borziak, V. F. Bibik, G. S. Kramarenko, (12 pp, 10 figs).

The tests described gave results that did not conform to currently-held ideas concerning fatigue of photocathodes. It is suggested that volume changes produced in oxygen-caesium films by illumination may play an important role in this matter.

Effective Utilization of Light in Films of Antimony-Caesium Photocathodes. P. G. Borziak, B. I. Diatlovitskaia, T. N. Chernysheva, (7 pp, 7 figs, 3 tables).

Previously-obtained values of optical constants and photoelectron-emission depth for Cs_3Sb are used to compute the light absorption required to obtain maximum effectiveness with cathodes of various photocells.

Use of Pulse Methods to Determine the Temperature of Vacuum-Tube Control Grids by Measuring the Emission Current. V. Ia. Kunin, M. O. Ratsun, (4 pp, 5 figs).

Knowledge of the emission current leads to a relationship between the total power absorbed by the grid and the power supplied to the tube electrodes. This in turn determines the temperature of the grid under various conditions.

Other Articles in this Issue:

Certain Features of Analysis of the Refraction of Radio Waves, D. M. Vysokovsky (3 pp). Investigation of the Propagation of Long and Very Long Radio Waves by Harmonic Analysis of the Waveform of Atmospheric Discharges, Ia. L Al'pert, S. V. Borodina (16 pp, 10 figs). Symmetric Dielectric Transition Piece in Circular Waveguide for H_{01} Waves, B. Z. Katsenelenbaum (5 pp).

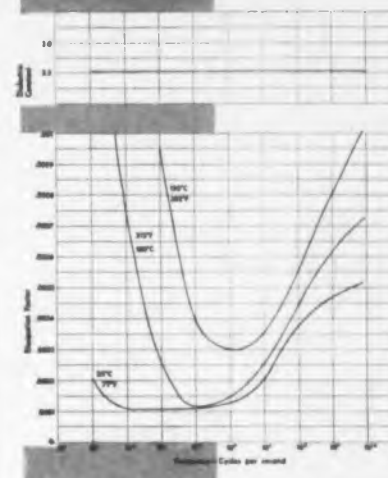
For Ultra High Frequency Insulation

REXOLITE 1422

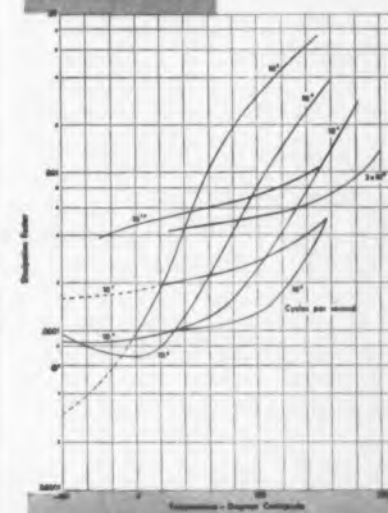
In cast rods of diameters to 6" and plates up to 36" x 36", from .031" to 1 1/2" thickness.



REXOLITE 1422 CHARACTERISTICS



- Withstands high temperatures — to 400° F.
- Does not exhibit cold flow.
- Has low dielectric constant and power factor.
- Specific gravity of 1.045-1.050.
- Is strong and rigid with good tensile and impact strengths.
- Unusual chemical inertness permits its use where others fail.
- Readily machinable to close tolerances.



WHERE PERFORMANCE PLUS PRICE IS A FACTOR
REXOLITE 2200

UHF insulation in thermosetting sheets 36" x 36", .031"-.125" thick

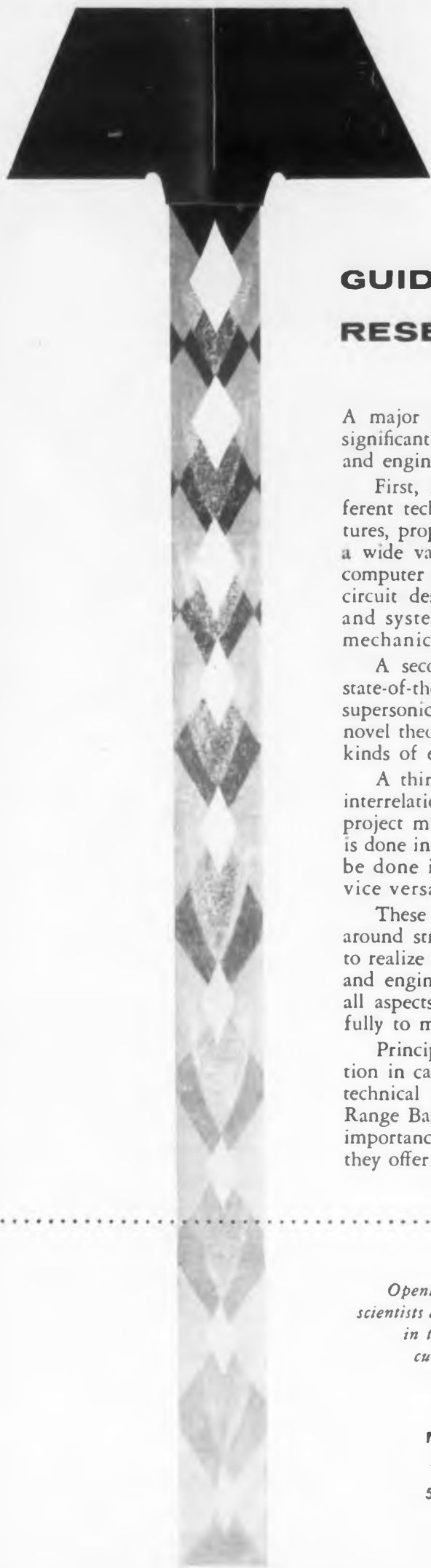
- Has good punching properties.
- High impact strength.
- Good machinability.
- Dielectric constant 10-10,000mc, 2.77.

Send for complete technical data and samples

The REX CORPORATION
Electronics Division

210 HAYWARD RD., WEST ACTON, MASS.

CIRCLE 396 ON READER-SERVICE CARD FOR MORE INFORMATION



GUIDED MISSILE

RESEARCH and DEVELOPMENT

A major guided missile research and development program has several significant characteristics that are of particular interest to the scientist and engineer.

First, it requires concurrent development work in a number of different technical areas such as guidance and control, aerodynamics, structures, propulsion and warhead. Each of these large areas in turn contains a wide variety of specialized technical activities. As an example, digital computer projects in the guidance and control area involve logical design, circuit design, programming, data conversion and handling, component and system reliability, input-output design, and environmental and mechanical design.

A second characteristic is frequently the requirement for important state-of-the-art advances in several of the technical areas. For instance, the supersonic airframe needed for a new missile may necessitate not only novel theoretical calculations, but also the design and performance of new kinds of experiments.

A third characteristic of missile development work is that such close interrelationships exist among the various technical areas that the entire project must be treated as a single, indivisible entity. For example, what is done in the guidance portion of the system can affect directly what must be done in the propulsion and airframe portions of the system, and vice versa.

These characteristics make it clear why such work must be organized around strong teams of scientists and engineers. Further, for such teams to realize their full potential, they must be headed by competent scientists and engineers to provide the proper technical management. And finally, all aspects of the organization and its procedures must be tailored carefully to maximize the effectiveness of the technical people.

Principles such as these have guided The Ramo-Wooldridge Corporation in carrying out its responsibility for overall systems engineering and technical direction for the Air Force Intercontinental and Intermediate Range Ballistic Missiles. These major programs are characterized by their importance to the national welfare and by the high degree of challenge they offer to the qualified engineer and scientist.

*Openings exist for
scientists and engineers
in these fields of
current activity:*

Guided Missile Research and Development
Aerodynamics and Propulsion Systems
Communications Systems
Automation and Data Processing
Digital Computers and Control Systems
Airborne Electronic and Control Systems

The Ramo-Wooldridge Corporation

5730 ARBOR VITAE STREET • LOS ANGELES 45, CALIFORNIA

German Abstract

High Q R

A NEW and improved method for the determination of the equivalent circuit constants of high Q resonators is described. Knowledge of these circuit constants is required in the design of filters containing ferrite or piezoelectric resonators.

A ferrite resonator consists of a coil wound on a pre-magnetized magnetostrictive ferrite core. Strong mechanical vibrations may be excited in the core by application of an ac voltage of a frequency near the resonator's magneto-mechanical resonance.

The resonator impedance near the resonance frequency can be approximated by the equivalent circuit of Fig. 1a. L_0 is the coil inductance at frequencies much lower than resonance, while f_r represents the resonance frequency of the series resonance circuit. Fig. 1b depicts the equivalent circuit of a piezoelectric resonator, demonstrating the close resemblance between the systems except for the low frequency element.

The constants of the equivalent circuit quite often are determined by point to point impedance measurements, using a bridge circuit with excellent oscillator stability. In another procedure a fixed capacitor is connected in parallel with the ferrite resonator, thereby producing two parallel resonances. These frequencies then are used to compute the equivalent circuit.

In the newly developed method use is made of the fact that the impedance circle of the resonator is traversed in such a small frequency interval that the basic coil impedance $j\omega L_0 = j\omega_0$ may be assumed constant over this range. Fig. 2 presents a resonator impedance curve, the extreme values being indicated by points P_1 and P_2 . Fig. 3 shows the resulting impedance curve if an external reactance W is added in series with the resonator. The new points P_1 and P_2 are assumed to correspond to frequencies f_1 and f_2 , with $\Delta f = f_1 - f_2$. Simple geometrical considerations lead to

$$4\pi^2 L^2 (\Delta f)^2 = \left(\frac{W_0}{W_0 + W^2} \right)^2 \left(\frac{W_0}{2} \right)^2 + R^2 \quad (1)$$

Resonators—Equivalent Circuit Constants

The measurement procedure involves the following steps: After W_0 has been determined, a number of reactances jW' are added to the resonator, one at a time, and the frequency intervals Δf are determined at which the total impedance goes through its extremes. A plot of $(\Delta f)^2$ versus $\left(\frac{W_0}{W_0 + W'}\right)^2 \left(\frac{W_0}{2}\right)^2$ results then in a straight line with a slope $4\pi^2 L^2$, which intersects the ordinate axis at a distance $-R^2$ from the origin.

Use of the pentode circuit shown in Fig. 4 insures constant current through the ferrite resonator at all frequencies, which is an important measurement prerequisite. Choke coupling is needed to prevent pre-magnetization of the ferrite core by the tube plate current.

The advantages of the new method lie in a) the greater accuracy obtainable in frequency rather than voltage measurements, b) the less stringent oscillator stability requirements, since the latter is only important during a relatively short time interval, and c) the simple graphical method, which permits an easy check, not only of the achieved accuracy, but also of the correctness of the equivalent circuit assumption.

Abstracted from an article by E. Frisch, "The Determination of the Equivalent Circuit Constants of High Q Resonators", Nachrichtentechnische Zeitschrift, vol. 9, pp. 182-185; April 1956.

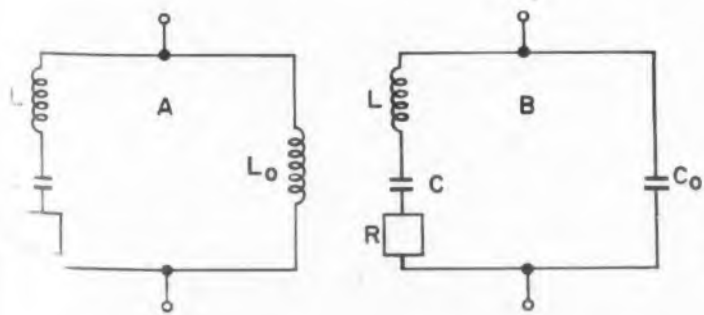


Fig. 1. Equivalent circuit of a ferrite resonator (a), a piezoelectric resonator (b).

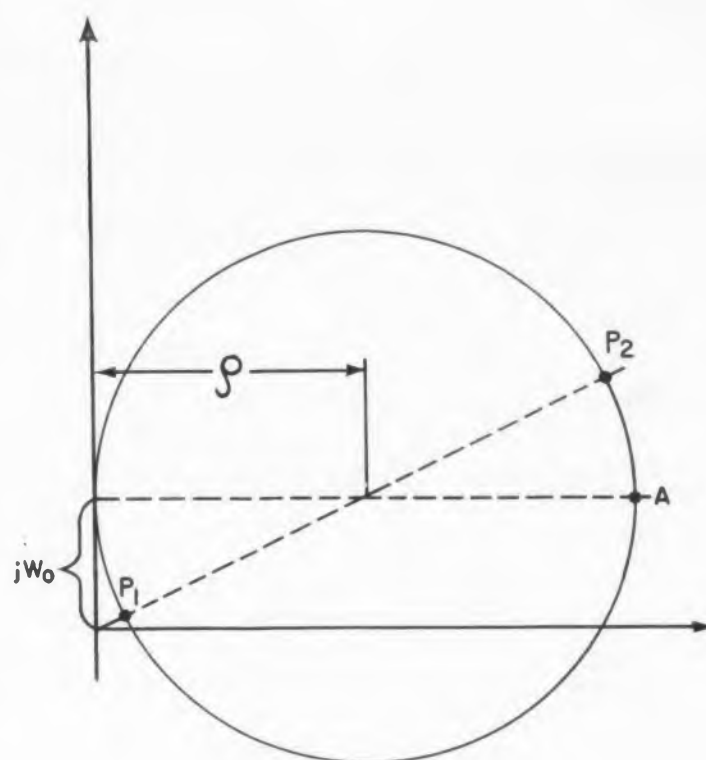


Fig. 2. Impedance circle diagram of resonator.

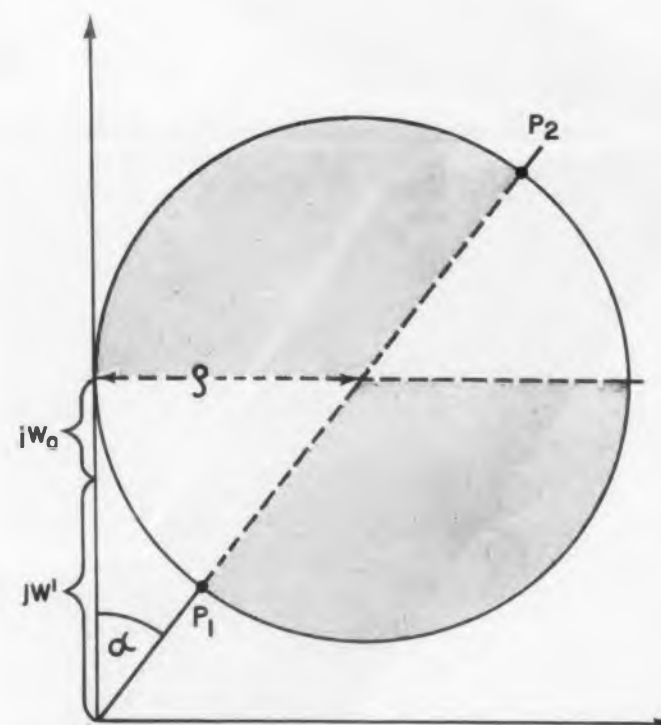


Fig. 3. Impedance curve of series combination of resonator and series impedance jW' .

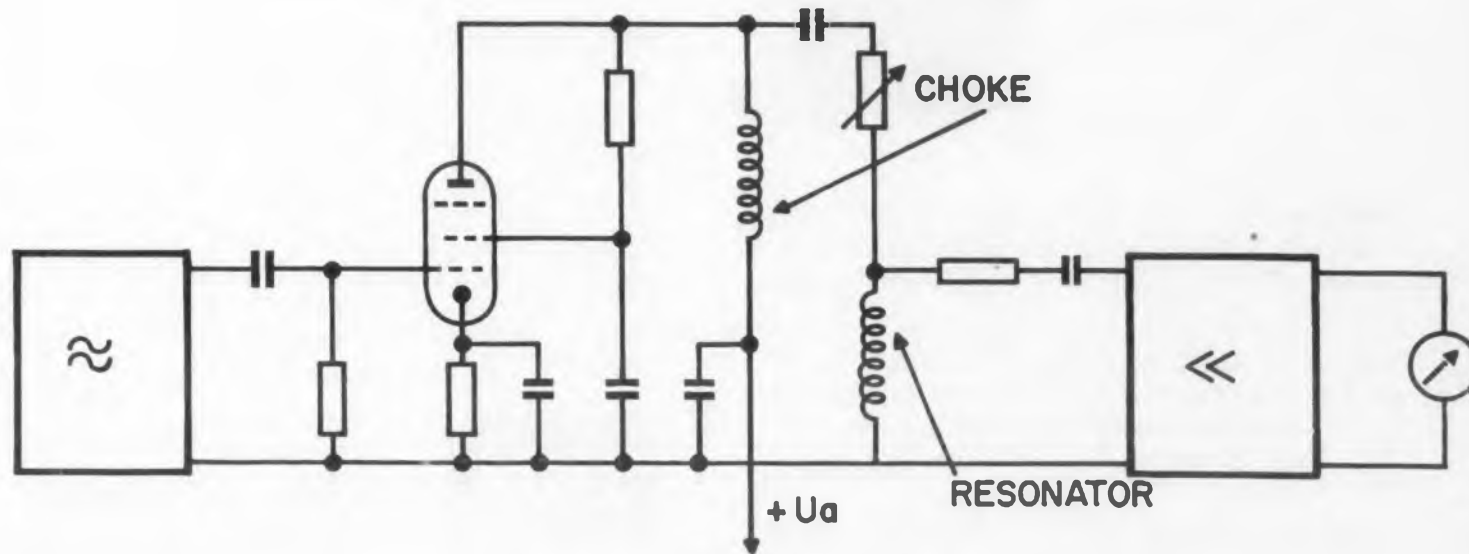


Fig. 4. Block diagram of circuit.



DESTINATION:

PEACE!

Heat of a new weapon system in America's inventory of counter-measures that guard the peace is an IBM airborne computer—specially designed to guide America's most powerful bombers with unbelievable precision.

To build *complete systems reliability* into this airborne computer, IBM submits the finest available components to tests of torturing extremes. Only those that survive are used. But, from this test data, IBM electronic computers figure ways to improve the failures and make those selected even better. In this way, IBM helps strengthen the general reliability of all electronic systems, and give to America's airborne defenders a mighty—and dependable—weapon for guarding the peace.

ENGINEERS:

IBM offers exciting opportunities to work on computers, control systems, inertial guidance, and microwave circuitry.

In addition to excellent starting salaries and on-the-job training with pay, IBM offers a chance for rapid promotion through its individual merit system. You'll work in some of the choicest locations in all America and enjoy the advantages of IBM's industry-famous employee-benefit policies.

WRITE, giving details of background and interests, to: R.A. Whitehorne, Room 912, International Business Machines Corporation, 590 Madison Avenue, New York 22, N. Y.

Positions available in Owego and Kingston, N. Y. IBM Laboratories and Manufacturing Plants also located in: Poughkeepsie and Endicott, N. Y.; San Jose, Calif.; Rochester, Minn.; and Lexington, Ky.

IBM

**MILITARY
PRODUCTS**

MILITARY PRODUCTS • DATA PROCESSING • ELECTRIC TYPEWRITERS • TIME EQUIPMENT

Abstract

British Epoxide Resins

EPOXIDE resins as a potting medium are particularly useful to the electronic industries because they are available as liquids or low-melting point solids, which can be converted irreversibly and with little shrinkage into solid masses. The British, no less than ourselves, have put them to good application too. The end product combines good electrical insulation and mechanical properties with outstanding adhesion to materials such as metals, porcelain, mica and quartz. This adhesion ensures a hermetic seal around metal or ceramic parts and improves the electrical performance under humid conditions.

The table shown lists a representative sampling of the epoxide resins presently in wide use by the British. *Abstracted from Epoxide Resins in the Electronics Industry, A. G. Goodchild, British Communications and Electronics, Heywood & Co., Ltd., London, June 1956, pp 293-299.*

Specs. as follows:—

- (A) A.S.T.M. D257-49T.
- (B) A.S.T.M. D257-54T.
- (C) A.S.T.M. D257-52T.
95° F., 90% r.h. conditioned for 96 hr.
- (D) A.S.T.M. D149-44.
- (E) A.S.T.M. D150-47T.
- (F) A.S.T.M. D648.
- (G) A.S.T.M. D696-44.
- (H) Barcol GYZJ-934-1.
- (I) Shore D. A.S.T.M. D395-49T, method B.
- (J) Barcol (Impressor Model) No. GYZJ-935
- (K) A.S.T.M. D638-49T.
- (L) A.S.T.M. D790-49T.
- (M) A.S.T.M. D695-49T.
- (N) A.S.T.M. D695-42T.
- (O) A.S.T.M. D256-47T.
- (P) Free falling ball, Mi-C-16923
Ships, on 2 x 2 in. slabs.
- (Q) A.S.T.M. D570-42.
- (R) A.S.T.M. D412-49T.
- (S) A.S.T.M. D785-48T.
- (T) A.S.T.M. D651-48
- (U) Cencofitch Lab. method.

Properties of some typical Epoxide Resin Potting Compositions

Formula (Parts by Weight)	Epikote 828: 100 MPD: (Metaphenylene diamine)	Epikote 828: 100 K.61B: 10.5	Epikote 828: 100 Piperidine: 6	Epikote 828: 100 Thiokol LP-3: 100 Triethylene tetramine: 10	Epikote 828: 7 Versamid 115: 3	Araldite B: 100 Hard. 901: 25-30	Araldite D: 100 Hard. 951: 8-10	Araldite F: 100 Hard. 951: 12	Araldite F: 100 Hard. 972: 27	Araldite F: 55 Versamid 115: 45	Bakelite R.18774: 100 Q.18884: 7	Bakelite R.18774: 100 Q.18905: 25
Pot Life	7 hr. at 20° C. 2½ hr. at 50° C.	7 hr. at 20° C. 5 hr. at 40° C.	6 hr. at 20° C.	50 g. at 26° C.: 35 min.	½ gall. at 27° C.: 70 min.	60-90 min. at 120° C. 20-25 min. at 160° C.	2-3 hr. at 20° C.	100 g. at 23° C.: 32 min. 400 g. at 23° C.: 28 min.	8 hr. at 20° C. 2 hr. at 60° C.	5 lb. at 25° C.: 70 min. (approx.)	5 hr. at 20° C.	1 lb. at 20° C.: 1½ hr.
Curing Cycle	2 hr. at 90° C. followed by 1 hr. at 200° C.	4 hr. at 65° C.	3 hr. at 100° C.	24 hr. at 20° C. followed by 70 hr. at 100° C.	20 min. at 150° C.	14-20 hr. at 100° C. or 7-10 hr. at 140° C. or 1-2 hr. at 200° C.	24 hr. at 20° C. or 2-3 hr. at 60° C. or 10-20 min. at 100° C.	14-24 hr. at 20° C. or 9-7 hr. at 40° C. or 1-3 hr. at 70° C. or 10-20 min. at 100° C.	2 hr. at 80° C. or ½ hr. at 100° C. or 20 min. at 140° C. For max. heat dis- tortion post cure 1 hr. at 200° C.	20 min. at 150° C.	6 hr. at 70° C. followed by 2 hr. at 100° C.	20° C. followed by 2 hr. at 100° C.
Volume Resistivity (Ohm-cm.) Low Temp. (25° C.)	10 ¹⁶	(A) 10 ¹⁵	(A) 8.7 × 10 ¹⁴	(A) 1.5 × 10 ¹¹ (at 50% r.h.)	(A) 10 ¹² - 10 ¹⁴ (C)	10 ¹⁵	(A) 6 × 10 ¹⁴	(A) 6 × 10 ¹⁴	(A) —	10 ¹² - 10 ¹⁴ (A)	—	—
High Temp. (150° C.)	10 ¹²	(A) 2 × 10 ⁹	(A) 10 ⁹	(A) 3.3 × 10 ¹⁰ (at 71° C.)	—	—	—	—	—	—	—	—
Dielectric Strength (volts/mil.)	—	—	400-500	(D) 400-500 (at 25° C., 50% r.h.)	—	400-410 (D) (Short time, ½ in. thick)	400-500 (Short time, ½ in. thick)	400-450 (Short time, ½ in. thick)	400-450 (Short time, ½ in. thick)	—	310	185
Dielectric Constant Low Frequency (10 ³ c/s) Low Temp. (20-25° C.)	—	3.7	(E) 3.8	(E) 6.0 (at 50% r.h.) 7.7 (at 71° C.)	(E) 3.2 (at 60 c/s)	3.67	(E) 4.05	(E) 4.0	3.9	3.2 (at 60 c/s)	(E) 5.1	4.9 (at 800 c/s)
High Temp. (70-125° C.)	—	4.8 (at 125° C.)	(E) —	—	(E) —	4.25 (at 100° C.)	(E) 4.6 (at 60° C.)	(E) 4.2 (at 100° C.)	4.0 (at 100° C.)	—	—	—
High Frequency (10 ⁶ c/s) Low Temp. (20-25° C.)	—	—	3.0 (at 10 ⁶ c/s)	(E) —	(E) 2.8	3.5	(E) 3.8	(E) —	—	2.8	(E) 3.4	3.5
High Temp. (100-125° C.)	—	—	—	—	—	3.75 (at 100° C.)	(E) —	—	—	—	—	—
Dissipation Factor (tan δ) Low Frequency (10 ³ c/s) Low Temp. (25° C.)	0.012	(E) 0.003	(E) 0.0035	(E) 0.064	(E) 0.025 (at 60 c/s)	0.0024	(E) 0.019	(E) 0.002	0.015	0.025	(E) < 0.005	0.0049 (at 800 c/s)
High Temp. (60-130° C.)	0.01 (at 130° C.)	(E) 0.11 (at 130° C.)	(E) —	0.238 (at 71° C.)	(E) —	0.0075 (at 100° C.)	(E) 0.024 (at 60° C.)	(E) 0.01 (at 100° C.)	0.0075 (at 130° C.)	—	—	—
High Frequency (10 ⁶ c/s) Low Temp. (25° C.)	—	—	0.015 (at 10 ⁶ c/s)	(E) —	(E) 0.015	0.026	(E) 0.02	(E) —	—	0.015	(E) 0.025	0.045
High Temp. (100-130° C.)	—	—	—	—	—	0.011 (at 100° C.)	(E) —	—	—	—	—	—
Heat-Distortion Temp. (° C.)	150	(F) 72	(F) 91	(F) Flexible	64	109 (at 264 lb/sq. in.)	(F) 70	103	(F) 155	(N) 78	76	69
Coeff. of Thermal Expansion (in./in./° C.)	4.8 × 10 ⁻⁵ (G)	6.0 × 10 ⁻⁵ (G)	6.7 × 10 ⁻⁵ (G)	—	—	4.8 × 10 ⁻⁵ (G)	9.0 × 10 ⁻⁵ (G)	—	4.8 × 10 ⁻⁵ (G)	—	6.4 × 10 ⁻⁵	—
Hardness	—	25	(H) 36	(H) 43	(I) 65	(J) Rockwell M100	(S) Rockwell M81-83	(S) Rockwell M101-108 Barcol 86-88	—	60	(H) —	—
Tensile Strength (lb./sq. in.)	—	11,100	(K) 8,000 (E _B 1.6%)	(K) 1,800 (E _B 30%; Cure cycle 70 hr. at 100° C.)	—	11,500-12,500 (T)	8,000-9,000 (K)	8,000-9,000 (K)	8,000-9,000 (K)	—	—	—
Flexural Strength (lb./sq. in.)	—	18,500	(L) 21,000	(L) —	—	18,000-19,000 (L)	14,000-15,000 (L)	16,000-18,000 (L)	19,000 (L)	—	18,600	17,500 (L)
Modulus (lb./sq. in.)	0.4 × 10 ⁶	0.49 × 10 ⁶ (L)	0.54 × 10 ⁶ (L)	—	—	—	—	—	—	—	—	—
Compressive Strength (lb./sq. in.)	—	14,200	(M) 18,400	(M) —	9,200	(N) 15,000-16,000 (M)	16,000-18,000 (M)	22,000-24,000 (M)	15,000-16,000 (M)	12,000	(M) 15,600	14,200 (N)
Impact Strength Izod Notch (ft. lb./in.)	—	—	0.36	(O) > 78 (at 26° C.) 3.5 (at -37° C.)	(P) —	0.70	(O) 0.39	(O) 0.3-0.4	(O) 0.42	(O) —	0.59	0.55
Water Absorption (%)	—	7 days: 0.72 (Q)	1 day: 0.07 (Q) 7 days: 0.2 1 month: 0.47	1 day: 0.4 7 days: 0.9 24 days: 1.2	—	1 day: 0.08 (Q)	1 day: 0.12-0.13 (Q)	1 day: 0.12 (Q)	1 day: 0.08 (Q)	—	—	—
Thermal Conductivity (cal./sec./cm ² /°C./cm.)	—	—	4.8 × 10 ⁻⁴	—	—	4.0 × 10 ⁻⁴ (U)	4.0 × 10 ⁻⁴ (U)	4.8 × 10 ⁻⁴ (U)	—	—	—	—



Approximate overall dimensions: 7" long, 1" wide, 1" high. Resistance at 25° C nominally 200 ohms. Temperature coefficient -3% per degree C at 25° C. Maximum body temperature at center washers for continuous operation +150° C.

THIS GLOBAR® THERMISTOR ASSEMBLY consists of 10 series-grouped washer-type thermistors. The assembly has relatively high power-handling capability and a high negative temperature coefficient, which makes it especially useful for such applications as compensating for changes in resistance with temperature of D. C. generator field windings.

The washer-type thermistors can be mounted in groups of from one to ten, in assemblies similar to the one pictured, to satisfy your circuit's requirements for power handling and resistance value. The individual washer-type thermistors are manufactured in values ranging from 5 ohms upward @ 25° C.

If you have a need for GLOBAR® thermistor assemblies such as these, we will arrange for a GLOBAR® sales engineer to call and discuss your application. Or write details of your problem direct. Address Globar Division, The Carborundum Company, Dept. ED 87-645, Niagara Falls, New York.

Globar®

Ceramic Resistors

Over 30 years experience in the field of special ceramic resistance devices at your service

CIRCLE 399 ON READER-SERVICE CARD FOR MORE INFORMATION

Voltage-Drop Co

A CROSS ammeters having a full-scale deflection of approximately 100 μ a, the voltage drop is generally a few tenths of a volt. In many applications, it is desirable to reduce this voltage-drop by a factor of ten or more. This reduction of voltage drop can be accomplished by replacing the meter by the input resistance of a dc amplifier, the output of which drives the meter.

The fact that the meter is driven across an amplifying network imposes upon the linearity of this network conditions which often cannot be met easily. The circuit, Fig. 1, uses a dc amplifier only to create a voltage drop in a resistor. If the control of the amplifier needs no current (a condition easy to realize with tubes but not with transistors), the meter indicates the current flowing into terminal 1 and out of terminal 2.

Three conditions are imposed upon the dc amplifier: 1. one input and one output terminal (I_1 and O_1) must be common, 2. the quiescent voltage drop across the output resistor R must be zero for zero current in the ammeter, 3. the current increment i , produced by a current I through the ammeter must oppose I . Accordingly, $i = eg = kIg$, where e is the meter voltage drop, g is the transconductance of the amplifier (assumed constant and independent of R), and k is the internal meter resistance. Apparent resistance R' of the whole device between terminals 1 and 2 is expressed as:

$$R' = \frac{e + v}{I} = \frac{kI + (I - i)R}{I} \\ = (k + R) - kRg \\ = R^+ - R^-$$

Positive resistance R^+ is the first term of the above expression. Negative resistance R^- is the term kRg .

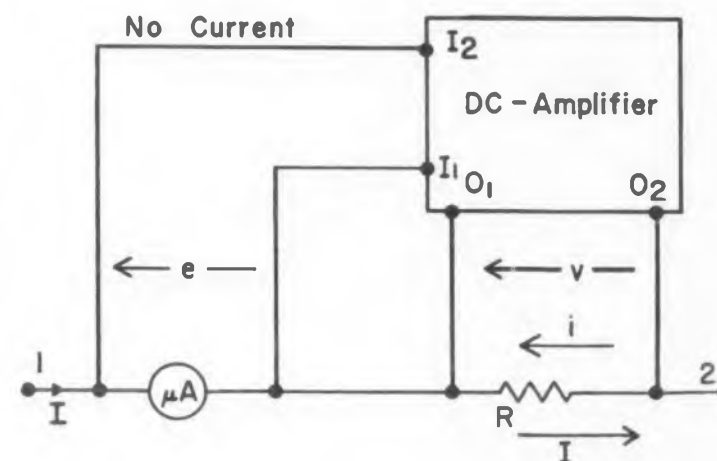


Fig. 1. Simple compensator circuit showing minimum required components.

Compensators for DC Microammeters

Devices are short-circuit stable when $R^- < R^+$. When $R^- > R^+$, they are likely to go into oscillation if connected to low-resistance exterior circuits.

A sensitive and stable circuit employing this principle of compensation is shown in Fig. 2. To zero the ammeter, the IN and OUT terminals are short circuited and the 2K potentiometer is adjusted. There is no gain control. As long as the device is connected to a high resistance circuit, there is no drift because of an unbalanced voltage in the plate circuits then causes a negligible additional current. For a circuit resistance of 10 K and properly matched tubes, drift is less than $2 \mu\text{A/hr}$, after a suitable 15 minute warm-up period.

Abstracted from *Voltage-Drop Compensators For DC Microammeters*, W. Poppelbaum, Illinois University Engineering Experiment Station, OTS, U.S. Dept. of Commerce, Washington 25, D. C., Sept. 1954, 12 pp, 50 Cents.

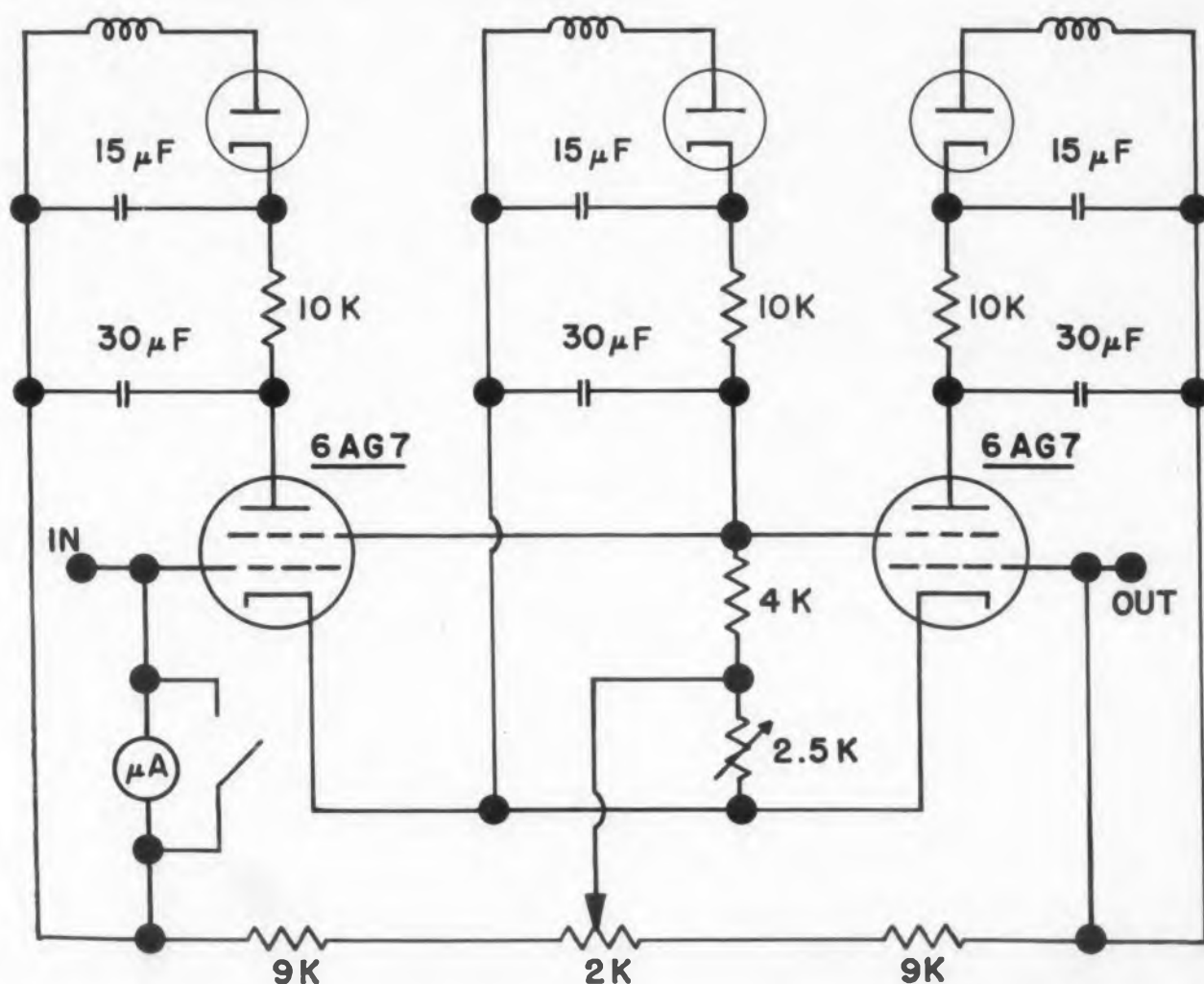


Fig. 2. Balanced cathode-follower compensator circuit. Potential divider between the cathodes and screen grids gives the cathodes a negative polarization which offsets the negative grid voltage, since the grids are tied to the negative side of the plate resistors.

Abstract

Electronic Designers:

OVER 240 MODELS OF JOY FANS...

... Designed especially for
your applications

LIGHTWEIGHT because they are made of aluminum or magnesium castings produced in Joy's own foundries.

COMPACT design—with motor mounted inside the fan—permits installation anywhere... even inside a duct.

EFFICIENT vaneaxial design provides more air per given size than any other type fan.

Joy's vaneaxial design is rugged and simple. The outer casing, the vanes, and motor mounts are cast in one piece... vibration free. Experience as the world's largest manufacturer and supplier of vaneaxial fans to G. E., Hallicrafters, Lear, Motorola, R.C.A., Raytheon, Sylvania, means Joy has the background to help you with your problems.

Joy has a complete line of fans... over 240 standard models with custom designs available to your specifications... fans from 1/500th hp up. Let us help... Write Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa. In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario.



Write for FREE
Bulletin 135-57

WSW 16948-135

JOY

WORLD'S LARGEST MANUFACTURER
OF VANEAXIAL-TYPE FANS

CIRCLE 400 ON READER-SERVICE CARD FOR MORE INFORMATION

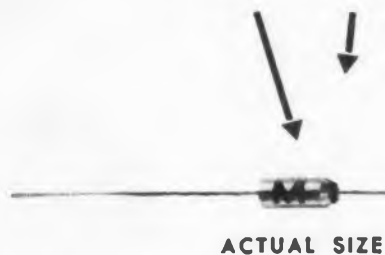
80 MFD 3 VOLTS

50 MFD 6 VOLTS

25 MFD 15 VOLTS

15 MFD 30 VOLTS

8 MFD 50 VOLTS



Never before
such **BIG**
capacitor
ratings

... in such small size!

Another Mallory First

... the new Mallory Type TNT† Subminiature
Tantalum Capacitor*

Only .145" in diameter, 3/8" long.

Especially designed for transistorized miniature circuits.

Write today for complete technical information.

Serving Industry with These Products:

Electromechanical—Resistors • Switches • Tuning Devices • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Batteries
Metallurgical—Contacts • Special Metals • Welding Materials

†Trade Mark
*Patent Pending

CIRCLE 401 ON READER-SERVICE CARD FOR MORE INFORMATION

Expect more... get more from:



Report Briefs

Improved RF Tuning Slug

For use in the vhf range, a new type of rf tuning slug has been developed by H. C. Hoffman, Jr., Missiles Div., NOL. Employing a silver-coated plastic core, the tuning slug can be used to raise the frequency or lower the inductance of a circuit without adding an appreciable amount of capacitance.

The silver coating provides the eddy current tuning, but the polystyrene center insulates the slug from the adjustment screw and thus insulates the slug from ground. Thus, the slug capacity is not added to the circuit. *Abstracted from Report, NOL, White Oak, Silver Spring, Md., Nov. 1956, p 3.*

Cooling Equipment Manual

This manual serves as a guide to electronic equipment designers, pointing out heat dissipation characteristics and problems, and showing how to determine the best heat transfer methods. It is written so that an electronics person, having but a limited knowledge of thermodynamics, can readily apply the information effectively. #D211.6:E12/2 *Guide Manual Of Cooling Methods For Electronic Equipment, Govt. Printing Office, Washington 25, D. C., 1956, 198 pp, \$2.00.*

Magnetic Properties of Alfenol Alloys

Magnetic data is given for a number of laminated cores of Alfenol varying in aluminum content from 10 to 17 percent. The magnetic properties exhibited by varying the heat treatment, of a given Al-Fe alloy, indicates clearly the significant part played by the order-disorder phenomenon in alloys containing this percentage of aluminum. A list of possible applications for these materials is given.

Improved methods of melting and casting, to obtain a fine equiaxed cast grain structure, are described. Techniques for surfacing the cast slabs prior to hot rolling and variations in hot rolling procedure are discussed. PB 11152S *The Fabrication and Properties of Alfenol Alloys (Al-Fe) Containing 10 to 17 Percent Aluminum, Nachman and Buehler, NAVORD Report 4130, OTS, U.S. Dept. of Commerce, Washington 25, D. C., Dec. 1955, 20 pp, 75 Cents.*

Sonar Digital Recorder

The Digiter system described in this report is a step towards the automatic processing of data. The system is capable of printing a number equal to the echo or signal level, in db, and the range, in yards, between the source and the target, or source and receiver. This can be accomplished for both round-trip and one-way propagation. The Digiter measures the mean value of db echo level with an accuracy of 5 to 10 times better than is possible by the visual reading of a record produced by a logarithmic-response, pen-and-ink recorder.

There are potential uses for this system in other fields of research or in unmanned monitoring stations where a signal or db noise level must be recorded. *PB 121220 Sonar Digital Recorder—"Digiter", A. G. Pieper and R. Q. Tillman, NRL Report 4762, OTS, U. S. Dept. of Commerce, Washington 25, D. C., May 1956, 8 pp, \$0.50.*

Magnetic Core Materials Tester

A simple dynamic hysteresis loop tracer for testing magnetic core materials has been developed by Dr. W. A. Geyger, Magnetics Div., NOL. Called the NOL Ferrotracer, this new system permits point-by-point automatic plotting of the dynamic B-H properties of a magnetic material in the range up to 20 kc. The B-H loop characteristics can be made available as meter readings, or in permanent record form when connected to an X-Y plotter.

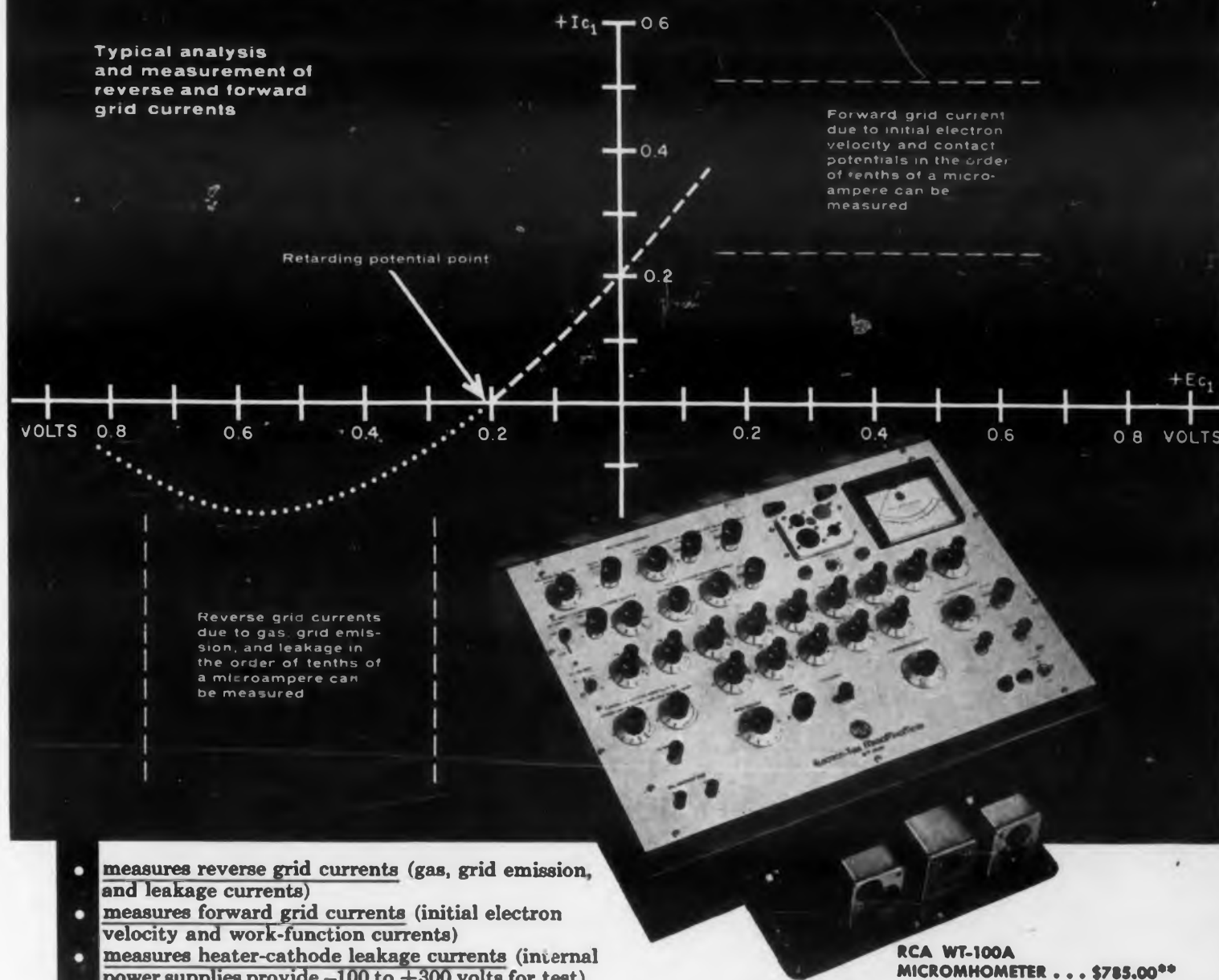
The system uses silicon junction diodes, no vacuum tubes or transistors. Overall accuracy of ± 2 percent or better is expected with the Ferrotracer. *Abstracted from Report, NOL, White Oak, Silver Spring, Md., Nov. 1956, pp 1 & 8.*

TACAN Evaluation

This report summarizes the joint Rome Air Development Center and Wright Air Development Center engineering tests and evaluation of production AN/TRN-6(AN/URN-3) and AN/ARN-21's, obtained through cross service procurement from the U.S. Navy. Tests were performed during the interval from Jan. 1956 to Mar. 1956, and for purposes of identification was called the NETT (North East TACAN Test) program. Measurements were made of the System azimuth accuracy, range, pattern coverage, reliability, altitude capability, traffic capacity, and channel interference. *PB 121453 RADC-WADC Evaluation of TACAN (NETT Report), R. Brooks and R. C. Anderson, OTS, U. S. Dept. of Commerce, Washington 25, D. C., June 1956, 82 pp, \$2.25.*

Electron-Tube Transconductance (g_m) Tester measures Electrode Currents as low as 0.0000001 ampere!

RCA WT-100A MicroMhoMeter enables equipment design engineers to measure electron-tube grid and interelectrode-leakage currents for critical circuit applications



- measures reverse grid currents (gas, grid emission, and leakage currents)
- measures forward grid currents (initial electron velocity and work-function currents)
- measures heater-cathode leakage currents (internal power supplies provide -100 to +300 volts for test)
- measures interelectrode leakage currents between any combination of electrodes (internal power supplies provide -100 to +300 volts for test)

RCA WT-100A Electron-Tube MicroMhoMeter is a laboratory-quality instrument which brings a reliable concept of tube-testing technique to users of tubes—on the production line, in the laboratory, and in circuit design. Uniquely designed, compact, and self-contained, the WT-100A offers versatility and accuracy comparable to that of more elaborate and complex laboratory equipment used for measuring transconductance and electrode currents. For detailed brochure, write RCA, Commercial Engineering, Section L18W-2, Harrison, N. J.

RCA TEST EQUIPMENT
Radio Corporation of America, Harrison, New Jersey

SPECIAL FEATURES OF THIS REMARKABLE INSTRUMENT

- Measures true transconductance with better than $\pm 3\%$ accuracy
- Built-in shorts test for any combination of tube elements
- Measures transconductance up to 100,000 μmhos —in 6 ranges
- Measures transconductance of low-plate-resistance types and high-perveance types
- Measures control-grid-to-plate, screen-grid-to-plate, and suppressor-grid-to-plate transconductances
- Measures heater currents including 600-ma series-string TV types
- Built-in calibrating circuit—no null meters or extra devices required
- Has easy-to-read meter for all measurements
- VoltOhmyst[®]-type circuit for current measurements—has full-scale, reading of 3 μamps on lowest current range
- Electronically protected burn-out-proof meter
- Regulated power supplies for all dc voltages
- 250-ma dc supply for filaments of battery operated tube types.

**Registered U.S. trademark

**User Price (optional)

CIRCLE 402 ON READER-SERVICE CARD FOR MORE INFORMATION



"LIFE INSURANCE" The preservation of the peace and security of this nation depends upon two things: Our diplomatic wisdom in a troubled world, and the power to protect ourselves if peaceful negotiation should fail.

Point 2 is part of *our* responsibility. This is

the Martin-U.S. Air Force TITAN program... one of the most advanced and critically important development projects in America today... an Inter-Continental Ballistic Missile conceived in peace and dedicated to the proposition that no aggressor shall ever take the life of this country.

MARTIN
BALTIMORE • DENVER

Standards and Specs

Sherman H. Hubelbank

This department surveys new issues, revisions, and amendments, covering military and industry standards and specifications. Our sources of information include the Armed Services Electro-Standards Agency (ASESA), the cumulative indexes to Military Specifications, Vols. II, IV, American Standards Association (ASA) and other standards societies.

Wire

RETMA RS-169, THERMOPLASTIC INSULATED AND JACKED HOOK-UP WIRE, OCTOBER 1956

Hook-up wire, described by this standard, consists of a tinned annealed copper conductor insulated with a concentric wall of a heat-resisting synthetic resin compound, and covered with an extruded thin wall of nylon. These wires are primarily intended for general radio, electronic, and instrument chassis wiring in circuits up to 600 rms volts maximum and for operation at temperatures between 105 C and -54 C. Copies of this standard are available from Radio-Electronics-Television Manufacturers Association, 11 West 42 St., New York 36, N.Y., for 60 cents per copy.

MIL-W-583A, WIRE, MAGNET, ELECTRICAL, 29 AUGUST 1956

Electrical magnet wire for fabricating armature coils, solenoid coils, field coils, transformer coils, and other such windings intended for electrical and electronic equipment are covered in this spec. Wire covered has either single or multiple insulations, and may be round, square, or rectangular.

Transformers

MIL-T-27A, TRANSFORMERS AND INDUCTORS (AUDIO, POWER, AND PULSE), AMENDMENT 1, 21 AUGUST 1956

The insulation test between windings has been deleted. The requirement that uninsulated wire, for use in flexible wire terminals, be in accordance with MIL-W-3861 has been deleted. The basis for selection of a basic transformer mechanical design, on which Group C, Subgroup I inspection tests will be performed, has been more clearly defined. All electrical inspection tests specified on complementary specs may be tested in actual circuits in lieu of the test circuits specified in the basic section of the spec.

Transistors

MIL-T-19502 (SHIPS), TRANSISTOR, TYPE 2N117, 4 JUNE 1956

A silicon NPN grown junction transistor type 2N117 is covered by this spec. Transistors under this spec also must conform to the requirements of spec MIL-T-19500.

Ferrite Inspection

MPA 20-56, RECOMMENDED PROCEDURE FOR INCOMING INSPECTION OF FERRITE FLYBACK TRANSFORMER CORES, SEPTEMBER 1956

A complete evaluation of the core material is not attempted by this standard. It, however, provides a means of unifying the methods of measurement and inspection throughout the ferrite core consuming industry. Test conditions are specified for nickel-zinc ferrites and manganese-zinc ferrites. The method employs a signal generator audio power amplifier and Fluke volt ammeter wattmeter. Copies of the standard may be obtained from the Metal Powder Association, 130 West 42 St., New York 36, N.Y., at 25 cents per copy.

Insulation

NEMA VF-5-1956, SILICONE VARNISHED GLASS FABRIC

Standards for silicone varnished glass fabric in sheet form, full-width rolls and tapes to be used as electrical insulation between metal parts in electrical apparatus are established by this publication. These standards cover methods of test, dimensions and permissible variations, physical and electrical properties, splices, typical finished weights and typical curve of alternating-current dielectric loss characteristics. Copies are available from National Electrical Manufacturers Association, 155 East 44th Street, New York 17, N.Y., for \$0.75 per copy.

Capacitors

NEMA CP 8-1956, FIXED PAPER DIELECTRIC CAPACITORS FOR ENERGY STORAGE USE

Fixed paper dielectric capacitors which are hermetically sealed in metal cases are dealt with in this standards publication. These capacitors are designed primarily for energy storage purposes where the alternating-current component is negligible, but the charging currents, and especially the discharge currents, may be high. Information is given on service conditions, voltage and capacitance ratings, base dimensions, cases, terminals, discharge devices, marking and tests. Copies are available from National Electrical Manufacturers Association, 155 East 44th Street, New York 17, N.Y., for \$1.00 per copy.

Electrical Code

NEMA 200-1956, ANALYSIS OF 1956 REVISION OF THE NATIONAL ELECTRICAL CODE

The analysis details all changes made in the 1956 edition of the National Electrical Code since the publishing of the 1953 edition. It eliminates the necessity for each user to make painstaking comparisons between the old and new editions of the Code. Available from the National Electrical Manufacturers Association, 155 East 44th Street, New York 17, New York, for 25 cents per copy.

ELECTRONIC DESIGN • December 15, 1956



ZENITH
Hearing Aid Chassis

ACTUAL SIZE

The tiny chassis of the Zenith "Crest" hearing aid carries the components for the transistorized amplifier, with 6 Allen-Bradley Type TR tiny resistors.

**Where space is cramped,
use Allen-Bradley Type TR resistors**

If you have a miniaturization problem and you must cramp a handful of components into an "impossibly small space," then install Allen-Bradley Type TR tiny resistors. They really are small . . . 0.067 in. diameter and 0.140 in. long. The maximum continuous wattage rating at 70 C is 0.1 watt.

ACTUAL SIZE

These solid molded units have an insulating coating and can be operated continuously with the insulation subjected to a maximum potential of 200 v, d-c.

Type TR resistors are available in standard RETMA and MIL resistance values at standard tolerances of plus or minus 5, 10, and 20%.

The lead wires are 1 1/4" long and are specially processed so they can be soldered with amazing ease, even after long periods in stock.

The Type TR resistor is not only the smallest resistor on the market but, as is true for all Allen-Bradley resistors, catastrophic failure (except through physical abuse) cannot happen!

Write, today, for complete Type TR data.


ALLEN-BRADLEY
RADIO & TELEVISION COMPONENTS
QUALITY


Allen-Bradley Co.
1334 S. Second St., Milwaukee 4, Wis.
Please send me technical data on the A-B Type TR resistors.

Name _____

Address _____

City _____ State _____

CIRCLE 404 ON READER-SERVICE CARD FOR MORE INFORMATION



Rugged EIMAC 2C39B UHF Ceramic Triode Operates up to 250°C

TYPICAL OPERATION (RF Oscillator 2500mc)

D-C Plate Voltage	900v
D-C Grid Voltage	-22v
D-C Plate Current	90ma
D-C Grid Current	27ma
Useful Power Output	15w

Unilaterally interchangeable with the 2C39A, but designed with outstanding extras, Eimac's ceramic-and-metal 2C39B has proved its advantages in such UHF applications as missiles, air navigational systems and communications systems.

Because of its unique design and ceramic-metal construction, this air-cooled, planar-type, 100 watt triode has an envelope temperature rating of 250°C, and operates with minimum RF losses. All external terminal surfaces are silver plated. Sturdy, low-loss ceramic replaces glass, and the copper anode is fitted with light-weight fins for forced air cooling.

Used in systems up to 3000mc, the 2C39B has all the virtues of the 2C39A plus a longer life, more useful power output, and a greater immunity to damage by thermal and physical shock.

For additional information, contact our Application Engineering Department.



EITEL-M^cCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
The World's Largest Manufacturer of Transmitting Tubes

CIRCLE 405 ON READER-SERVICE CARD FOR MORE INFORMATION

Preferred Parts Lists

ASESA 49-1, PREFERRED PARTS LISTS (ELECTRONIC COMPONENTS)

The following preferred parts lists have either been newly issued or revised:

Part Name	PPL No. & Date
Meters, Electrical-Indicating, Panel Type	6-MR 7 September 1956
Resistors, Fixed, Wire-wound, Power Type	26-RW 21 September 1956
Resistors, Fixed, Film (High Stability)	10509-RN 21 September 1956
Capacitors, Fixed, Ceramic-Dielectric (General Purpose)	11272-CY 7 September 1956

Sockets

RETMA RS-167, TYPE DESIGNATIONS FOR RECEIVER TYPE TUBE SOCKETS, OCTOBER 1956

Revising RETMA REC-135-B, this standard covers the dimensional, electrical, and mechanical characteristics of receiver type tube sockets. Copies of this standard are available from Radio-Electronics-Television Manufacturers Association, 11 West 42 St., New York 36, N.Y., for 80 cents per copy.

RETMA RS-168, DIMENSIONAL AND ELECTRICAL CHARACTERISTICS DEFINING RECEIVER TYPE TUBE SOCKETS, OCTOBER 1956

The actual dimensional and electrical characteristics for 35 receiver type tube sockets are covered in this spec, which is a revision of REC-136-A. Copies of this standard are available from RETMA for \$2.60 per copy.

Waveguide Flanges

RETMA RS-166, MINIATURE WAVEGUIDE FLANGES, UNPRESSURIZED CONTACT TYPE, OCTOBER 1956

Miniature unpressurized contact flanges for use with rectangular waveguides as specified in the latest issue of RETMA Standard TR-108 are covered by this newly issued standard. It contains a list of waveguide flange assemblies together with pertinent drawing dimensions. By specifying assembly dimensions in lieu of detail part drawings it provides for interchangeability and permits manufacturing flexibility with regard to the method of joining the flange to the waveguide. Copies of the standard are available from Radio-Electronics-Television Manufacturers Association, 11 West 42 St., New York 36, N.Y. for 40 cents per copy.

ADVERTISING INDEX

December 15, 1956

Advertiser	Page
Ace Plastic Co.	103
Acheson Colloids Co.	83
Acme Wire Co.	69
AMP Inc.	15
Allegheny Ludlum Steel Corp.	50
Allen-Bradley Co.	135
Allen Mfg. Co.	68
Alloy Metal Wire Div. of H. K. Porter Co., Inc.	90
American Machine & Foundry Co.	89
Anaconda Wire & Cable Co.	95
Arnhold Ceramics, Inc.	82
Arnoux Corp.	25, 77
Atlas Precision Products Co.	84
Automatic Metal Products Corp.	72
Bell Aircraft Corp.	80
Bendix Aviation Corp., Eclipse Pioneer Div.	54
Bendix Aviation Corp., Scintilla Div.	117
Berkeley Div. of Beckmans Instruments, Inc.	66
Birtcher Corp.	114
Bliley Electric Co.	66
Brand, Wm. & Co., Inc.	92
Caledonia Electronics & Transformer Corp.	87
Carborundum Co., The	130
Centralab, Div. of Globe Union Inc.	79
Circuit Instruments Inc.	69
Clarostat Manufacturing Co., Inc.	19
Clevite Transistor Products	138
Clippard Instrument Laboratory, Inc.	106
Color Television Inc.	73
Columbia Wire & Supply Co.	115
Computer Instruments Corp.	76
Corning Glass Works	100
Cubic Corp.	44
Curtiss-Wright Corp.	114
Daven Co., The	70
Decision Inc.	64
Delco Radio Div., General Motors Corp.	60
Deringer Metallurgical Corp.	98
Deutsch Co., The	94
Diehl Manufacturing Co.	65
Dow Corning Corp.	55
DuMont, Allen B. Laboratories Int.	34
DuPont, E. I. de Nemours & Co.	71
Eastern Air Devices, Inc.	67
Eastman Kodak Co.	94
Edison, Thomas A. Instrument Div.	98
Eitel-McCullough Inc.	136
Elastic Stop Nut Corp.	91
Elco Tool & Screw Corp.	66
Eldema Corp.	112
Electrical Industries	11
El Ray Motor Co.	98
Erie Resistor Corp.	100
Essex Wire Corp., Cords Ltd. Div.	99
Fairchild Controls Corp., Components Div.	112



NEW DEPARTURE IS A HELPING HAND IN MINIATURIZATION

Volume is one of the big reasons why New Departure is the preferred source for miniature ball bearings.

And, of course, another big reason is ultra-precision! Despite their small size ($\frac{5}{32}$ " to $\frac{1}{2}$ " O.D.), New Departure miniature bearings are fully precision-ground, lapped, and honed to within tolerances of ABEC 5 or better.

Actually, precision starts with proper preparation of the stainless steel, where optimum metallurgical characteristics are assured by

exacting heat treat equipment and processes. Finished bearings undergo rigorous testing and microscopic inspection on special equipment. Assembly and packaging take place in completely air-conditioned and pressurized areas to keep out contaminants.

However exacting your performance requirements, call on New Departure for miniature bearings unexcelled for precision, accuracy, and long life. New Departure, Division of General Motors, Bristol, Connecticut.

BALL BEARINGS MAKE GOOD PRODUCTS BETTER



SEE NEW DEPARTURE ON
"WIDE WIDE WORLD" SUNDAYS—NBC-TV

New Departure Division
General Motors Corporation
Bristol, Connecticut
Att. Dept. A

Gentlemen: Please send me free catalog on miniature bearings.

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____



NOTHING ROLLS LIKE A BALL

CIRCLE 406 ON READER-SERVICE CARD FOR MORE INFORMATION



Clevite Power Transistors are used in leading auto radios.

POWER TRANSISTORS

- High power ratings
- High power gain
- Rugged, compact mechanical design
- Welded, hermetically sealed package for stability and long life
- Excellent heat dissipation characteristics

Now Clevite can supply you with power transistors that fit your needs for audio applications, portable power supplies, etc., from a full line of six types. All are available in production quantities. All are rated at 25 watts continuous operation with infinite heat sink — 15 watts with 36 sq. in. heat sink.

Clevite Power Transistor packaging is compact. Vacuum baking and hermetic sealing of the package insure stability and long life. Low thermal resistance between collector junction and large copper flange insures excellent heat conduction from the package to the heat sink.

OUTLINE SPECIFICATIONS

TYPE	2N268	CTP 1111	2N257	CTP 1104	CTP 1109	CTP 1108	Units
Instantaneous Collector-to-Base Voltage (absolute maximum)	80	80	40	40	20	20	Volts
Junction Temperature (absolute maximum)	85	85	85	85	85	85	°C
Average Total Power Dissipation (with inf. heat sink @ 25°C)	25	25	25	25	25	25	Watts
Average Total Power Dissipation (with 36 sq. in. heat sink @ 25°C)	15	15	15	15	15	15	Watts
Power Gain	28 ^a	23 ^a	30 ^a	23 ^a	27 ^b	20 ^b	db
Frequency Cutoff	6	4	7	4	6	4	kc/s

^a $V_{cc} = -14V$; $I_c = 500$ ma; $R_L = 30 \Omega$ (choke coupled); $R_e = 10 \Omega$

^b $V_{cc} = -7V$; $I_c = 500$ ma; $R_L = 15 \Omega$ (choke coupled); $R_e = 10 \Omega$

Write for Data Sheet B-211



CLEVITE

TRANSISTOR PRODUCTS

241 Crescent St., Waltham 54, Mass. TWinbrook 4-9330

Clevite Divisions: Brush Electronics Co. • Cleveland Graphite Bronze Co. • Clevite Harris Products Inc. • Clevite Research Center • Clevite Ltd.

CIRCLE 407 ON READER-SERVICE CARD FOR MORE INFORMATION

Advertiser

Page

Fansteel Metallurgical Corp.	84, 85
Fastex Div., of Illinois Tool Works	99
Fenwal Electronics, Inc.	67
Filtron Co., Inc.	18
Finn, T. R. & Co.	81
Ford Instrument Co., Inc.	91
Frequency Standards	61
G V Controls Inc.	3
Gar Precision Parts, Inc.	72
Garrett Corp.	123
Gee Lar Manufacturing Co.	113
General Electric Co., Apparatus Div.	52, 53, 101
General Electric Co., Fabricated Silicone Div.	17, 122
General Electric Co., Electronics Div.	23
General Electric Co., Irrathene Div.	58
General Radio Co.	100
General Motors Corp., New Departure Div.	137
General Transformer Co.	106
Giannini, G. M. & Co.	104
Globe Industries, Inc.	109
Good All Electric Manufacturing Co.	35
Gries Reproducer Corp.	103
Gurley, W. & L. E.	102
Hassall, John, Inc.	102
Haydon, A. W. Co., Inc.	64
Helipot Corp. Div. Beckman Instruments, Inc.	92, 93
Hetherington, Inc.	59
Hewlett-Packard Co.	139
Hoffman Semiconductor Div. of Hoffman Electronics Corp.	14
Hycor Co., Inc.	74
International Business Machines Corp.	128
International Electronics Research Corp.	51
International Resistance Co.	2
Iron Fireman Mfg. Co.	80
Johnson, E. F. Co.	103
Joy Manufacturing Co.	131
Kay Lab.	31
Kearfott Co., Inc.	87
Kester Solder Co.	90
Knights, The James Co.	114
Kurz-Kasch, Inc.	64
Lambda Electronics Corp.	10
Linemaster Switch Corp.	102
Mallory, P. R. & Co.	132
Marconi Instrument Co.	115
Martin, Glenn L. Co.	134
Maxson Instruments, Longevine Div.	82
Metal Textile Corp.	105
Millivac Instrument Corp.	117
Minneapolis-Honeywell Regulator Co., Industrial Div.	124
Minneapolis-Honeywell Regulator Co., Transistor Div.	45
Narda Corporation, The	74
New England Oven & Furnace Co., Inc.	67
Pacific Automation Products, Inc.	121
Perkin-Elmer Corp., Vernistat Div.	79
Phaostron Co.	107
Phelps Dodge Copper Products	8, 9
Plastic Capacitors, Inc.	113
Potter & Brumfield, Inc.	118

Power Sources, Inc.	41
Radio Condenser Co.	119
Radio Corporation of America	133, 140
Radio-Electronic Master	105
Ramo-Wooldridge Corp., The	126
RapiDesign, Inc.	99
Raytheon Mfg. Co.	76
Raytheon Mfg. Co., Semi-Conductor Div.	4
Raytheon Mfg. Co., Microwave & Power Tube Div. ...	49
Reflectone Co., The	108
Remington Rand Inc.	6
Revere Corp. of America	111
Rex Corp., The	125
Richardson Co., The	94
Rider, John F. Publishing, Inc.	88
Rosen, Raymond Engineering Products, (Tele-Dynamics, Inc.)	115
Rotron Mfg. Co.	78
Sanders Associates, Inc.	83
Sangamo Electric Co.	75
Sel-Rex Corp., Precious Metals Div.	77
Shalleross Manufacturing Co.	30
Simmons Fastener Corp.	64
Solar Manufacturing Co.	24
Sorensen & Co., Inc.	36
Southern Electronics Corp.	29
Spectrol, Inc.	88
Speer Carbon Co.	73
Stackpole Carbon Co.	13
Standard Electrical Products Co.	81
Standard Pressed Steel	94
Statham Laboratories, Inc.	65
Stoddart Aircraft Radio Co., Inc.	85
Sylvania Electric Products, Inc., Electronic Div.	78
Sylvania Electric Products, Inc., Equipment Div. ...	56, 57
Sylvania Electric Products, Inc., Chemical Div.	47
Sylvania Electric Products, Inc.	91
Technology Instrument Corp.	86
Tele-Dynamics, A. Raymond Rosen Corp.	115
Tensolite Insulated Wire Co., Inc.	107
Texas Instruments Incorporated	12
Thermador Electrical Mfg. Div. of Norris Thermador Corp.	110
Thomas & Skinner Steel Products	86
Finnerman Products, Inc.	97
Transco Products, Inc.	89
Transitron, Inc.	33
Uniform Tubes, Inc.	103
United Transformer Co.	7
Varflex Corp.	98
Varian Associates	46
Weckesser Co.	90
Westinghouse Electric Corp.	43, 68
Weston Electrical Instrument Corp.	37
Wincharger Corp.	16

Complete
coverage,

highest
quality,

outstanding
value



OSCILLATORS

0.008 cps to 10 MC

Hewlett-Packard, pioneer of the now-standard resistance capacity or RC oscillator circuit, today offers 11 stable, wide range, RC oscillators covering all frequencies 0.008 cps to 10 MC. Each instrument is a precision, quality built equipment guaranteeing you highest stability, long term trouble free operation, and the convenience of compact size and wide frequency range. Brief specifications are given here; for complete details see your *-hp-* representative or write direct.

Instrument	Primary Uses	Frequency Range	Output	Price
-hp- 200AB	Audio tests	20 cps to 40 KC	1 watt/24.5 v	\$130.00
-hp- 200CD	Audio and ultrasonic tests	5 cps to 600 KC	160 mw/20 v open circuit	180.00
-hp- 200J	Interpolation, frequency measurements	6 cps to 6 KC	100 mw/10 v	225.00
-hp- 200T	Telemetry, carrier current tests	250 cps to 100 KC	160 mw or 10 v/600 ohms; 20 v open circuit	350.00
-hp- 201C	High quality audio tests	20 cps to 20 KC	3 w/42.5 v	250.00
-hp- 202A	Low frequency measurements	.008 to 1200 cps	20 mw/10 v	465.00Δ
-hp- 202C	Low frequency measurements	1/2 cps to 50 KC	100 mw/10 v	363.00Δ
-hp- 205AG	High power tests, gain measurements	20 cps to 20 KC	5 watts	440.00Δ
-hp- 206A	High quality, high accuracy audio tests	20 cps to 20 KC	+ 15 dbm	585.00Δ
-hp- 233A	Carrier test oscillator	50 cps to 500 KC	3 w/600 ohms	475.00
-hp- 650A	Wide range video tests	10 cps to 10 MC	15 mw/3 v	490.00Δ

3 of 11 famous *-hp-* oscillators



-hp- 200CD, 5 cps to 600 kc. Probably America's fastest selling precision audio oscillator. Offers highest stability, constant output, year after year dependability. 5 ranges, frequency response ± 1 db, distortion less than 0.5%. Compact, weighs only 22 lbs. 300° logarithmic dial, 60" effective scale length. \$160.00.

ΔRack mounted instrument available for \$15.00 less.



-hp- 202A Low Frequency Function Generator. Convenient, highly stable, multi-purpose source of transient-free test voltages from 0.008 cps to 1,200 cps. 5 bands, distortion less than 1%, provides sine, square or triangular waveforms. 30 volts peak output, frequency response flat within 0.2 db. \$465.00Δ.



-hp- 650A Test Oscillator. Provides fast, accurate tests from 10 cps to 10 MC. Extreme stability; output flat within 1 db full range. Voltage range 0.00003 volts to 3 volts. Output impedance 600 ohms. No zero set, no adjustment during operation. Output voltage attenuator, self-contained VTVM. \$490.00Δ.



HEWLETT-PACKARD COMPANY

3336H Page Mill Road • Palo Alto, California, U.S.A.
Cable "HEWPACK"

Field Representatives in all principal areas

Data subject to change without notice

PLEASE SEND INFORMATION ON MODEL _____ OSCILLATOR

Name _____

Company _____

Street _____

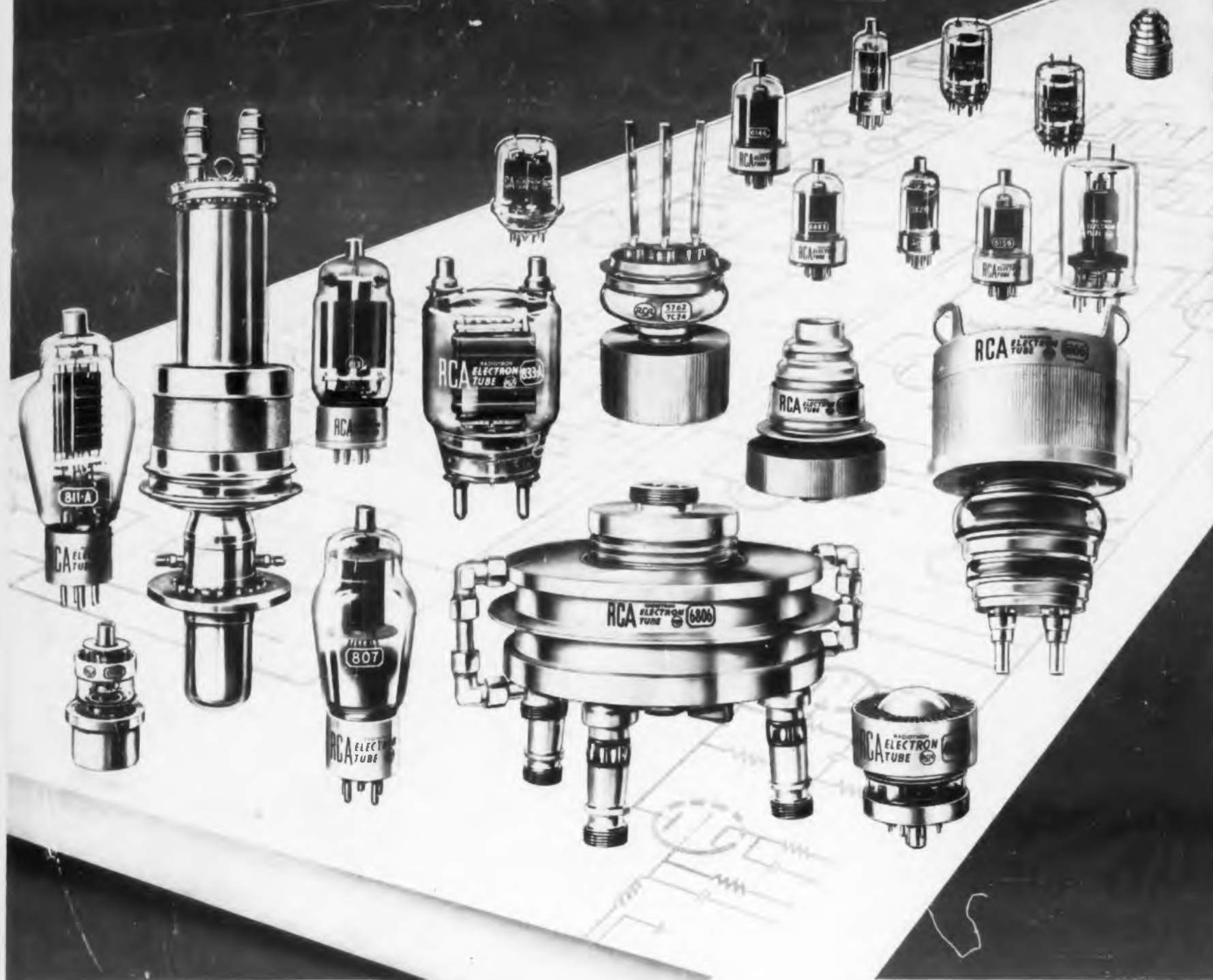
City _____ Zone _____ State _____

ELECTRONIC MEASURING INSTRUMENTS

CIRCLE 408 ON READER-SERVICE CARD FOR MORE INFORMATION

for SINGLE-SIDEBAND DESIGNS
...from watts to hundreds of kilowatts...

SPECIFY RCA POWER TUBES



RCA offers a group of power tubes exhibiting performance characteristics that make possible the design of SSB transmitting equipment having excellent linearity, low modulation distortion, high power gain, wide band tunability, high efficiency, and reliable low-cost operation.

Outstanding power tube types offered by RCA for this important new field include: 2E24, 2E26, 807, 6524, 6850, 6146, 6883, 6159, 6816, 6884, 5894, 829-B, 811-A, 4X150-A, 4X150-D, 813, 6161, 833-A, 6181, 5762, 6166, 6806, and 6949.



RADIO CORPORATION OF AMERICA
 Tube Division
 Harrison, N. J.

Your RCA FIELD REPRESENTATIVE will be glad to discuss RCA POWER TUBES relative to your specific single-sideband designs. Contact him at the district office nearest you.

EAST: Humboldt 5-3900
 744 Broad Street
 Newark 2, N. J.

MIDWEST: Whitehall 4-2900
 Suite 1181
 Merchandise Mart Plaza
 Chicago 54, Illinois

WEST: Raymond 3-8361
 6355 East Washington Blvd.
 Los Angeles 22, Calif.

◀ CIRCLE 439 ON READER-SERVICE CARD

HAYDEN PUBLISHING COMPANY, INC.
 19 East 62nd Street, New York 21, N. Y.

ELECTRONIC
 DESIGN

