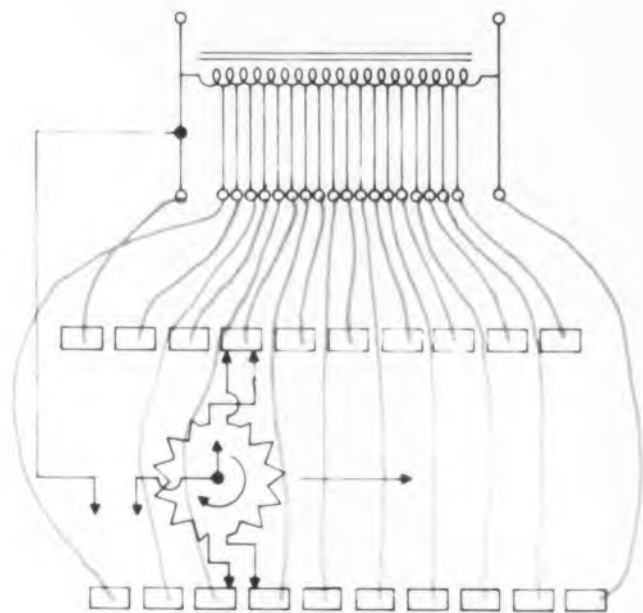


ELECTRONIC DESIGN

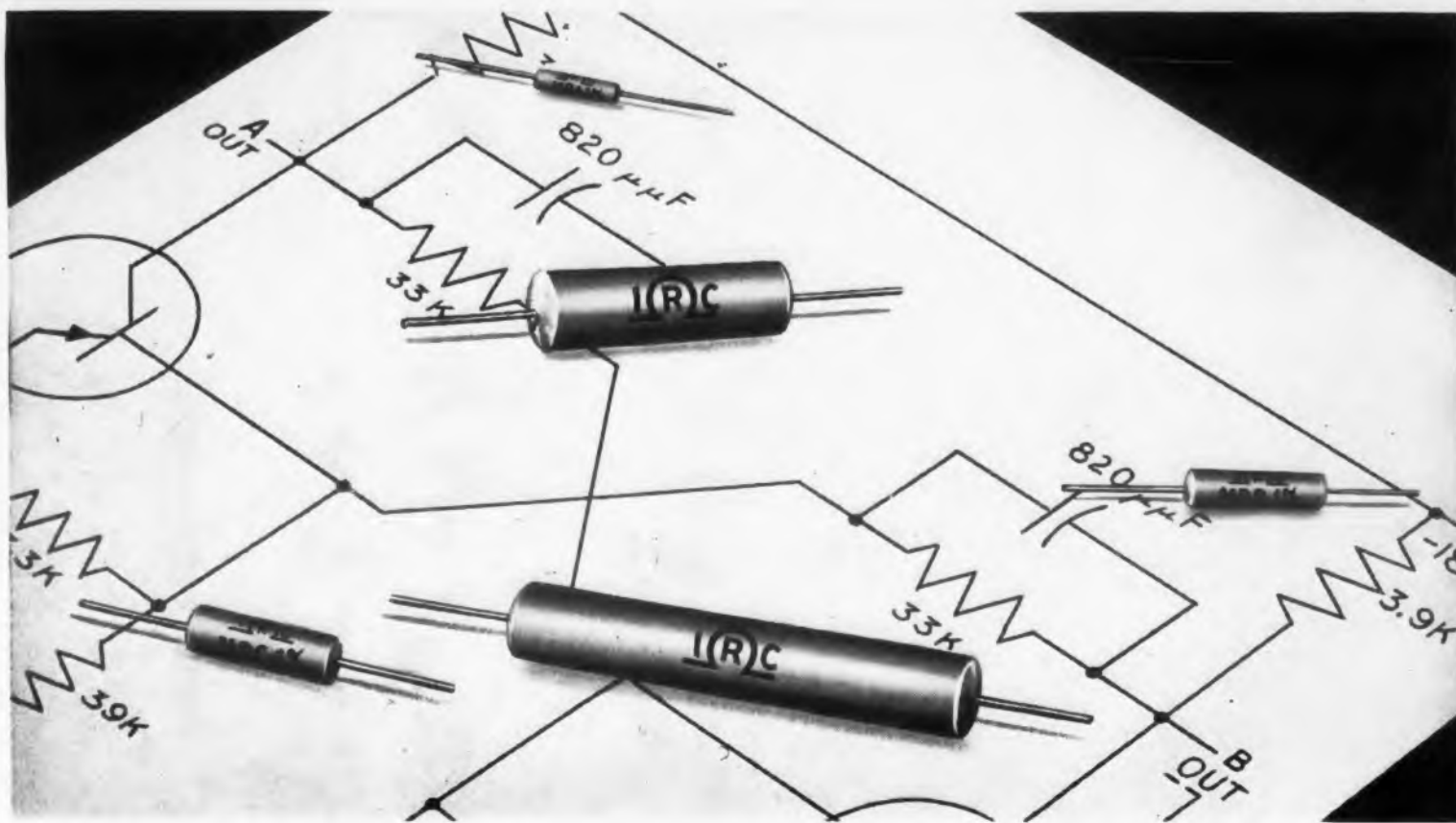
NOVEMBER 15, 1956

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Rotary Ratio Transformer page 26





WHY SPECIFY 1 WATT WHEN YOU NEED 1/2 WATT?

Use **IRC**® Deposited and Boron Carbon Resistors

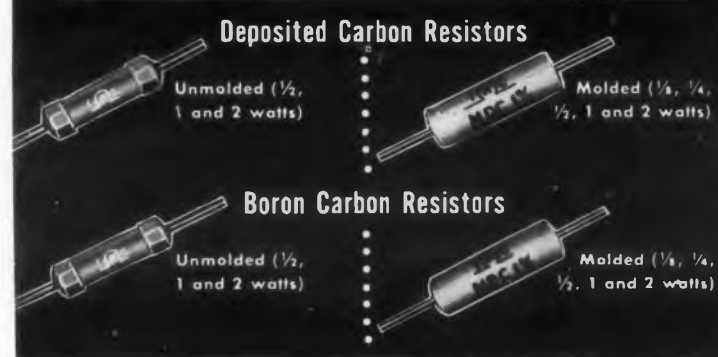
Now you can save two ways whenever circuits call for high precision resistors with long term stability and built-in overload protection. IRC Molded Deposited and Boron Carbon Resistors can withstand substantial overloads for considerable periods without exceeding tolerances. This means savings in *space, weight and cost!* The conservative rating of these units assures you of reliability—no need to specify larger resistors.

Announcing a new high-range process featuring stability! With a unit as small as IRC's 1/2 watt Deposited Carbon Resistor, you can cover a resistance range from 10 ohms up to 25 megohms. With IRC's 2 watt resistor, you can go from 15 ohms as high as 100 megohms.

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ELECTRONIC DESIGN

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OUR MILLIONTH FILTER SHIPPED THIS YEAR...

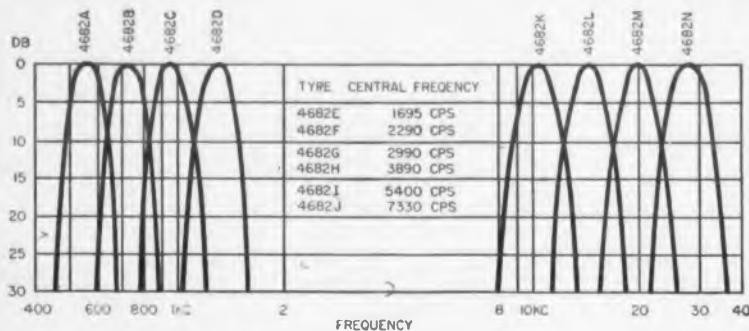
FILTERS

FOR EVERY APPLICATION



TELEMETERING FILTERS

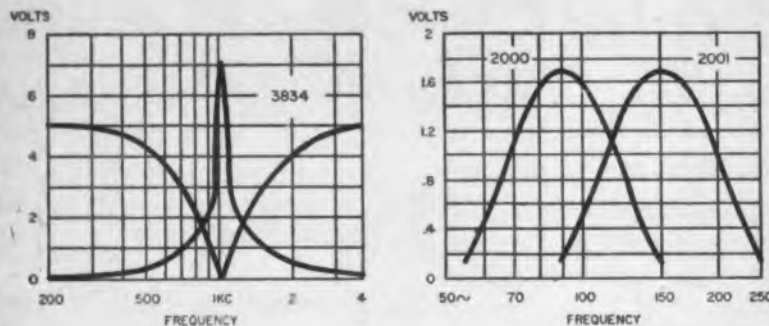
UTC manufactures a wide variety of band pass filters for multi-channel telemetering. Illustrated are a group of filters supplied for 400 cycle to 40 KC service. Miniaturized units have been made for many applications. For example a group of 4 cubic inch units which provide 50 channels between 4 KC and 100 KC.



Dimensions:
(4682A) 1½ x 2 x 4"



Dimensions:
(3034) 1¼ x 1¼ x 2-3/16"
(2000, 1) 1¼ x 1¼ x 1½"



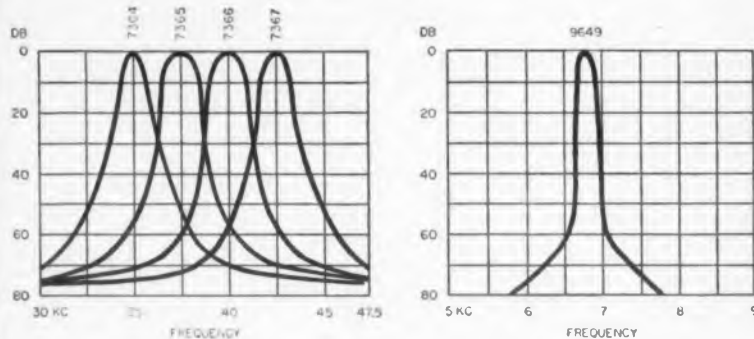
AIRCRAFT FILTERS

UTC has produced the bulk of filters used in aircraft equipment for over a decade. The curve at the left is that of a miniaturized (1020 cycles) range filter providing high attenuation between voice and range frequencies.

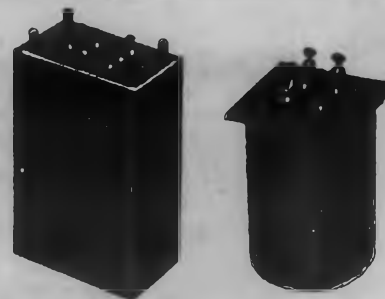
Curves at the right are that of our miniaturized 90 and 150 cycle filters for glide path systems.

CARRIER FILTERS

A wide variety of carrier filters are available for specific applications. This type of tone channel filter can be supplied in a varied range of band widths and attenuations. The curves shown are typical units.

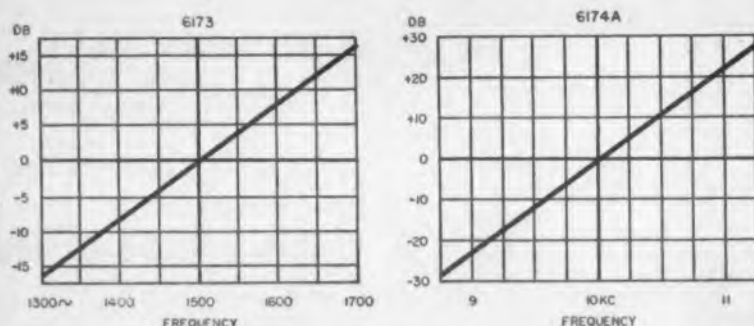


Dimensions:
(7304 series) 1½ x 1½ x 2¼"
(9649) 1½ x 2 x 4"



DISCRIMINATORS

These high Q discriminators provide exceptional amplification and linearity. Typical characteristics available are illustrated by the low and higher frequency curves shown.



Dimensions:
(6173) 1-1/16 x 1½ x 3"
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Editorial

Common Sense Is Not the Answer

Only about five per cent of all engineers can be classed as really creative according to a leading research director. From this small body must come the really significant ideas. Should technological superiority be the test for the survival of America, creative talent is of first order concern to us.

"Average" engineers, duly proud of being endowed with common sense might take vigorous exception to the statement that they are not the really creative types. After all, it is not the designer's daily application of common sense that has come up with practical answers to many of our technical problems?

But just how good is the common sense approach? The revolutionary discoveries of relativity theory and quantum mechanics came about despite common sense. Length and weight changing with motion? Ridiculous. Quantum theory explains things which could not be understood on the basis of common sense views of matter held at the time. You can't predict transistor operation from every day electron flow theories. For that matter, common sense would have made the odds on the Tower of Pisa experiment astronomically high. According to scientist P. W. Bridgman, "We cannot regard man as well educated who does not intuitively recognize that common sense can't be taken for granted . . ." Philosopher-logician Alfred North Whitehead would echo this.

Common sense, for example, has yet to produce such a thing as a simple 100 per cent reliable connector. Mr. J. Toyzer of RCA at the Radio Fall Meeting challenged us to try wholly new concepts to overcome the deficiencies of soldered joints. The engineer who discards some old common-sense assumptions and comes up with a new approach could become as famous as de Forrest or Einstein overnight. The average engineer who recognizes the limitations of common sense is in a good position to do the job.—JAL

◀ CIRCLE 3 ON READER-SERVICE CARD

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150 Varick Street, New York 13, N. Y. EXPORT DIVISION, 12 E. 40th St., New York 17, N. Y. CABLE: UNTRAF

For full data on stock UTC transformers, reactors, filters, and high Q coils, write to Sales Dept.

Engineering Review

Britain Opens Atomic Power Plant

Britain has supplemented coal as a fuel source and have built and are operating at Calder Hall, Cumberland, NW England, the first station in the world to produce on an industrial scale electric power from nuclear energy. The Calder Hall power station, one of four identical plants whose individual output is over 60,000 kw, is part of a 10-year nuclear power program.

It is estimated, according to the British Information Services, 30 Rockefeller Plaza, New York 20, N.Y., that the total cost of power from this early nuclear station is approximately the same as from coal or oil-fired stations in Britain, about 0.6 pence per kw. The Calder Hall station design is of the graphite-moderated, pressurized, gas-cooled type, which also produces plutonium as a by-product.

Non-Degaussable Magnet Developed by GE

Although still in the laboratory stage, W. H. Meiklejohn of GE Measurements Laboratory, West Lynn, Mass., has found a new way to improve permanent magnets so that they will be truly permanent—difficult, if not impossible to demagnetize. The process consists of encasing ferromagnetic cobalt in an anti-ferromagnetic case of cobaltous oxide. This shifts the hysteresis loop completely to the left of the zero axis in the second and third quadrants. So far the tests have been made at below room temperature (the temperature of liquid nitrogen); but it is expected in time to be entirely practical at ordinarily encountered temperatures. The cause of this effect between the ferromagnetic and anti-ferromagnetic materials is known as “exchange anisotropy.”



Post Office To Try Electromechanics

Early in 1957, the Silver Spring, Maryland, Post Office anticipates using Transorma, an electromechanical keyboard-controlled letter sorter. Capable of handling about 3000 letters per hour, after the operator has gained skill and experience, the unit may well be part of the solution to reduce the number of handlings for each piece of mail. The US Post Office, in conjunction with the National Bureau of Standards, has embarked on a program of study and seeks to raise the overall efficiency through industrial engineering techniques.

Transorma, manufactured by Werkspoor of Amsterdam, Holland, and sold in this country by Pitney-Bowes, utilizes a two-handed keyboard and a conveyor system. Although capable of generating about 400 different identification combinations, the Post Office Department plans to use only about 300 for its sorting. The coding or memory device is an assembly of 9 or 10 pins which control the ejection process. The operator “types” out the proper code and the mail is fed onto a conveyor.



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SUPRAMICA® ceramoplastics

... THE WORLD'S MOST NEARLY PERFECT INSULATION

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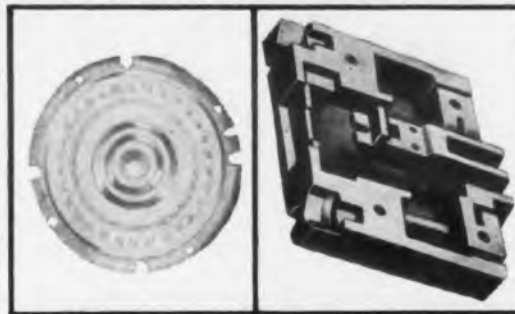
the first commercially produced synthetic mica... and a completely new ceramoplastic — SUPRAMICA* — for applications that demand the ideal combination of physical, thermal and electrical characteristics.

SUPRAMICA® 555 is moldable!

This superior ceramoplastic insulation features... operation at temperatures up to 950°F... complete dimensional stability... moldable to precision tolerances... positive bonding to metal inserts... low electrical loss... very high

arc resistance... carbonization... resistance to moisture, oil and organic solvents... permanent radiation resistance... high dielectric strength... thermal expansion coefficient same as steel.

TYPICAL APPLICATIONS



SUPRAMICA® 500 is machineable!

This superior ceramoplastic insulation features... operation at temperatures as high as 1000°F... machineable to precision tolerances... absolute dimensional stability... high dielectric strength... low electrical loss... very

high arc resistance... no carbonization... thermal expansion matching steel... water-, organic solvent-, and oil-proof performance... permanent radiation resistance... good mechanical strength.

TYPICAL APPLICATIONS



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MYCALEX 410®

Standard quality moldable glass-bonded mica insulation.

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MYCALEX® K and KM

Capacitor dielectrics.

TELEMETERING EQUIPMENT and COMPONENTS

Mycalex TM55 series commutation switches and SUPRAMICA 555 ceramoplastic commutator plates... perfect for low-voltage, low-noise-level switching... write to Department 111 for full technical information.

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World's largest manufacturer of glass-bonded mica and ceramoplastic products

Over-The-Horizon Microwave

Without using any repeater stations, a 238-mile microwave link between San Juan, Puerto Rico and Ciudad Trujillo, Dominican Republic is expected to be completed early in 1957. Over-the-horizon microwave radiotelephony will serve to meet the needs for additional inter-island telephone service occasioned by the influx of new industries and increased tourist trade in the Caribbean Sea area. Federal Telecommunication Laboratories, Nutley, New Jersey, is engineering the project for the Radio Corporation of Puerto Rico and the Compania Dominicana de Telefonos C. por A.

Airborne Infrared Lab Exported

The French Air Ministry has received an airborne infrared radiation laboratory for infrared analysis of airborne targets. Known as the Infrared Monochromator, the system is to be used for aircraft and missile design, and aircraft defense, anti-aircraft and missile research. Suitable for bomber type aircraft mounting, the gyro-stabilized monochromator detects, analyzes, and records information about missiles and jet aircraft by their exhaust gasses and skin temperature heat radiations.

This particular unit delivered to the French is one of 21 systems produced by Servo Corporation of America, New Hyde Park, N.Y.

Annals of Physics

A new monthly journal of physics, under the editorship of Philip M. Morse, Professor of Physics, Massachusetts Institute of Technology, has been announced by Academic Press, Publishers, N. Y.

Original articles on research in any branch of physics are intended to be covered. The publication hopes to provide a medium for the publication of important articles which are internally complete and thus are generally understandable to professional physicists working in other fields. The length of articles will not be a limiting factor.

The first issue is scheduled for release in April 1957.

◀ CIRCLE 4 ON READER-SERVICE CARD

AT&T Patents Available

Approximately 8600 patented inventions owned by the American Telephone and Telegraph Co., have been made available. A listing showing US Patent Office classification, subclass and issue numbers of the inventions may be obtained from Manager, Licensing Dept., Western Electric Co., 195 Broadway, New York, N.Y. General information concerning these inventions and a guide designed to assist in identifying the classifications of the inventions may be obtained from the Small Business Administration, Washington 25, D.C.

Swedes View TV Commercials

Picture-type commercials were viewed by over 300,000 Swedes at the U.S. Pavilion at the Stockholm International Trade Fair. Paul Bolton, Vice President of the National Association of Wholesalers, reports that the commercials that were closed-circuited to some 15 TV monitors located in and around the U.S. pavilion were a huge success and may leave a definite mark on the future of TV in Sweden.

600 F Plastic Insulation

Irradiation of polyethylene with Cobalt 60 gamma rays has produced a plastic electrical insulator which can withstand temperatures up to 600 F.

By utilizing a new low pressure process in addition to the irradiation, the W. R. Grace & Co. of Baton Rouge, La., has produced a plastic insulator which retains all the properties of unirradiated polyethylene plus new high temperature abilities.

IBM Patents Available

Approximately 2400 International Business Machine Corp. patented inventions are available to the public. On request, a listing will be sent by The Manager, Contract Relations Dept., IBM, 590 Madison Avenue, New York, New York. The listing indicates US Patent Office issue number, date of patent issuance and title of the invention.

CIRCLE 5 ON READER-SERVICE CARD >

WHERE ELECTRONICS MEETS THE EYE



MARION MEDALIST METERS bring color harmony and functional beauty to panel design. Crystal clear, high temperature Plexiglas** fronts are available in many standard colors with harmonizing or contrasting dials. Custom case and dial colors can also be supplied.

Models include standard 1 1/2, 2 1/2 and 3 1/2 inch sizes, interchangeable with ASA/MIL type mounting, and all standard DC ranges of microamperes, milliamperes, amperes, millivolts, volts, kilovolts, and AC rectifier types including VU and DB meters. The 1 1/2" Medalists are also available as self-contained DC ammeters, rectifier-type AC voltmeters and VU meters.

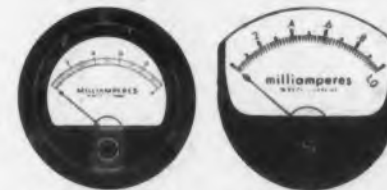
*T.M. Reg. U. S. Pat. Off. U. S. & Foreign Patents
**Reg. T.M. Rohn & Haas Co.

marion

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in instrument
design

Modern equipment styling directs attention to that critical area, the indicator — where electronics meets the eye of the user. Now, Marion Medalist* meters in your equipment will provide added eye appeal and sales appeal by successfully combining accuracy and reliability with color harmony and distinctive styling.

Marion Medalists have another important advantage — increased readability. In the same panel space, a Medalist provides up to 50% more scale length — longer pointer — larger numerals — and greater natural dial illumination, than a standard round or square meter of the same size.



STANDARD METER MARION MEDALIST

These are the reasons that Marion Medalist Meters are setting new standards of appearance and readability, where electronics meets the eye.

marion meters

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GRENIER FIELD, MANCHESTER, NEW HAMPSHIRE

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NEW OCTAL SOCKET

—LETS YOU STANDARDIZE
PRINTED CIRCUIT TECHNIQUES

● Sylvania introduces a new octal socket designed for printed circuits. It incorporates the basic design features of the widely used 7- and 9-pin sockets, making it possible for you to develop new, more compact printed circuitry which can be standardized in production.

Current production can be speeded, too, by incorporating the new Sylvania printed-circuit octal socket wherever standard or compromise mountings are now being used.

Sylvania printed circuit sockets offer these important features

- All molded insulator
- Superior contact characteristics
- Top surface insulation
- Nesting for automatic feeding
- Positive orientation
- Cross-contact wiring

NEW SPECIAL SOCKETS

Neo-diheptal socket assembly for color TV picture tubes. Molded in low loss phenolic or alkyd. Compact design, only 11/16" deep. Leads can be supplied taped, stripped, twisted and solder dipped.



Counter Tube Socket with "zero-adjust" feature. Provides $\pm 10^\circ$ adjustment of socket orientation, providing for positive zero adjustment upon original installation as well as replacement.



PARTS DIVISION

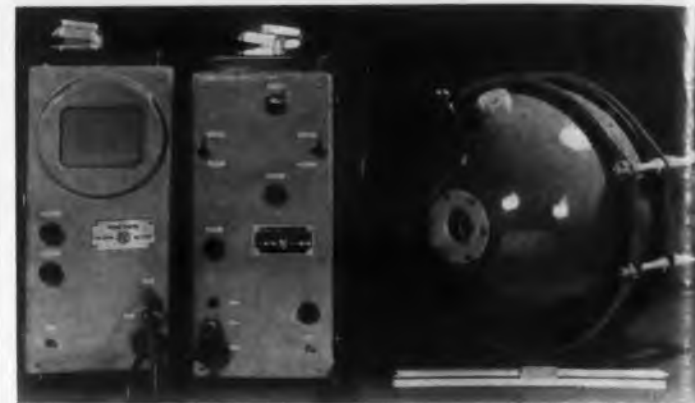


SYLVANIA ELECTRIC PRODUCTS INC.
Parts Division,
Warren, Pennsylvania

SYLVANIA®

LIGHTING • RADIO • TELEVISION • ELECTRONICS • ATOMIC ENERGY

CIRCLE 6 ON READER-SERVICE CARD FOR MORE INFORMATION



Underwater TV Camera

A TV camera designed for underwater use has been developed by Pye Ltd., of Cambridge, England. Its pictures are carried on 14 inch display monitors aboard ship. Usually one diver will hold the camera while another works. The camera enables supervisors following operations on the monitors to relay instructions by underwater communications.

The spherical shaped camera unit, 12 inches in diameter and weighing 38 lbs is intended for use at a depth of 250 feet. The camera adjustments are made by a control unit aboard ship.

Solid State Research

A new multi-million dollar research laboratory recently opened at Parma, Ohio by the National Carbon Company, expects to come up with new solid state devices as significant as transistors.

The growth of the new electronic applications of solids has led to a demand for an analysis of existing materials and the creation of new materials with custom-built properties.

National Carbon also intends to investigate nuclear furnaces, electrochemical battery systems, high temperature refractory materials and many other products dependent on a solid state analysis.

Education for Automation

A non-profit Foundation for Instrumentation Education and Research is being planned by the Instrument Society of America. The Foundation is designed to answer the need for appraisal and action with respect to the research needs facing the nation as a result of automation.

The Society has been studying production and research needs since 1951 and concluded that there were several areas of weakness. Recommendations included: a fundamental training of personnel and whole industries with respect to automation, bringing school and college facilities up to date, translating research results into industrial practice, and making science more attractive to young people.

The Foundation will function as a separate corporation under the direction of a Board of Trustees representative of industry, government, and education.

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Please send complete information on the following

- octal 7-pin 9-pin
 Neo-diheptal socket assembly
 Counter tube socket

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Company _____

Address _____

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Submarine Simulator Envy of Capt. Nemo

Realistic dockside training for new recruits is possible with an elaborate electronic trainer installed recently at the US Submarine School, Groton, Conn. Built by the Electric Boat Div., General Dynamics Corp., the simulator employs a complex computer system manufactured by the Mid-Century Instrument Corp., N.Y.

Submarine maneuvers are simulated from a control room mounted on a hydraulically actuated cradle anchored firmly in concrete. Torpedoes can be fired on "enemy" targets. Scoring is determined by computer. Conditions of start up, dive, turn, climb, in fair or foul weather, as well as equipment failure can be artificially produced.



U. S. Airmen Studied For Stress

Medical research is taking giant strides in its study of airmen under stress with a period analyzer, developed jointly by American Machine & Foundry Co., Mechanics Research Dept., 261 Madison Ave., N.Y., N.Y. and USAF Wright Air Development Center. The period analyzer measures certain physiological changes affecting the shape and frequency of brain waves, and an attempt is being made to establish a mathematical basis for the characterization of brain waves.

Industry Aids Science Students

Master of Science fellowships are being awarded to 200 engineer and physicists for their education at one of three schools, University of So. California, University of California and California Inst. of Technology, while they work part-time at Hughes Aircraft Co., Culver City, Calif. Additional fellowships have been established at Stanford, Purdue and West Virginia Universities.

out of the



— COME THE *new Astron* TYPE AP CAPACITORS IN SUPER-TIGHT STEATITE CONSTRUCTION

Astron enlists a Billion-year-old principle — mechanical fusion — to create a rock-like physical barrier against *all* environmental conditions. New Type AP Paper Tubulars combine a tough Steatite case with cement compound end-seals, forming a completely impregnable shield against heat and moisture — truly impregnable because Steatite is one of nature's *most effective insulators*.

Designed specifically for *economy applications*, Type AP Tubulars fill electronic equipment manufacturers' needs for high performance capacitors at *competitive* prices. These non-inductive, precision-wound paper tubulars operate continuously with exceptionally long life at 85°C, their leads locked securely in place by non-melting end-seals. Special production techniques and meticulously controlled processes assure long shelf life and minimum capacitance change over a wide operating range (-40°C to +85°C) . . . high insulation resistance . . . small size and weight. The dependable operation of Type AP compares favorably with more expensive molded paper capacitors. They exceed RETMA specifications. Type AP Ceramic Cased Tubulars are backed by the famous Astron guarantee. *Ten* separate production tests and 100% final inspection are your absolute protection against costly rejects.

A large, detailed illustration of a hand holding a cylindrical capacitor. The capacitor is labeled "ASTRON" and "5 MF 600 VDC". A thin wire is inserted through the center of the capacitor. Sand is falling from the bottom of the capacitor, creating a stream that falls into a pile of sand at the bottom of the hand. The background shows a landscape with mountains and a body of water.

Want greater performance and economy for your capacitor dollar?
Write for full information about Astron AP Tubulars — Today!

ASTRON

CORPORATION

ELECTRONICS

SMITH CORPORATION

Wholly owned subsidiary of

CIRCLE 7 ON READER-SERVICE CARD FOR MORE INFORMATION

1949— Ferramic A Magnetic Core Material, first produced by General Ceramics in 1949, gave sufficient promise of useability as a gyrator element to encourage General Ceramics engineers to further develop the Faraday rotational effects of Ferrites.

1952— Variations of Schoenberg's original formula resulted in MF 1331 in May, 1952.

1953— Other refinements resulted in General Ceramics Ferramic R1, available for several years for X Band applications.



Progress Report

by **GENERAL CERAMICS**
on the development of

MICROWAVE FERRITES



TV and Radio Cores



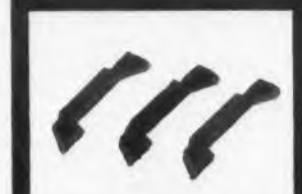
Magnetic Memory Cores



Magnetic Memory Planes



General Purpose Cores



Recording Head Cores

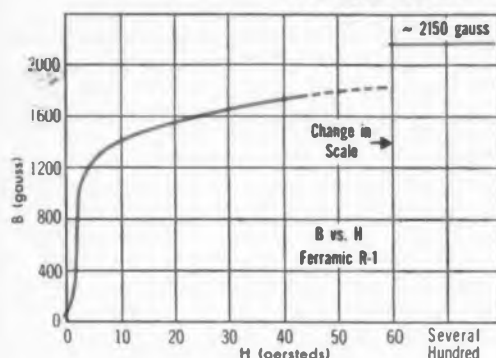


Microwave Ferrites

Now S Band Ferramic R4 is available!

This new ferrite material, designated Ferramic R4 by General Ceramics, is suitable for use in many S Band applications. Complete information will be supplied on receipt of full details of your specific application. Please address inquiries to Dept. P.

Properties of Ferramic R1



Frequency CPS	Dielectric Properties		Magnetic Properties	
	Σ / Σ_0	$\tan \delta_d$	μ' / μ_0	$\tan \delta_m$
10^9	13	.007	3	1.5
1.5×10^9	13	.006	1.7	2.6
3×10^9	13	.004	0	200 (peak)
10^{10}	13	.002	+ .7	.004

Curie Temperature **270°C**
Volume Resistivity **High**
Density **4.3 grams/cc**

General CERAMICS CORPORATION
Telephone VALLEY 6-5100
General Offices and Plant: KEASBEY, NEW JERSEY

MANUFACTURERS OF FERRAMIC CORES, MAGNETIC MEMORY CORES, MEMORY PLANES, MICROWAVE FERRITES, SOLDERSEAL TERMINALS, HIGH TEMP. SEALS, STEATITE, ALUMINA & CHEMICAL STONWARE

CIRCLE 8 ON READER-SERVICE CARD FOR MORE INFORMATION



Consolidated Computer for Jet Fighters

Small, portable building blocks containing nearly 1000 transistors each make up the TRANSAC computer system introduced by Philco. Direct-coupling circuits cut down size.

Currently under study by the government for inclusion in a large computing setup, TRANSAC appears to be a significant advancement in functional packaging of complex computer components. It may be possible to consolidate the functions of many conventional airborne computers into a single compact system suitable for jet fighters.

Ultrasonic Fog Dispenser

A new ultrasonic device has been developed in Paris, France to solve the problem of fog dissipation at airports. The air jet (or steam jet) ultrasonic generator, called a Multiwhistle RD is currently being used extensively in Europe to generate high intensity sonic energy ranging from 4 to 40 kc. The French Air Force is sponsoring modification of the super foghorn for ultrasonic uses. It is being marketed in the United States by Gulton Industries.

Automated Farms

Automation is spreading to farms, according to a General Electric spokesman, and devices to electrically round up cattle, harvest fruit, and spray fields by remote control are not impossible in the future.

He pointed out that electrification research has already resulted in cathode-ray sterilization of wheat, gamma ray treatment to prevent potato sprouting and electronic detection of infection in eggs. The farm business in the future will even be using electronic computers to solve complex agricultural problems, he contends. Greater use of electricity and electronics on the farm is essential to keep pace with America's expanding population and limited farm acreage.

Ultrasonics And Cold Water Cleans Surgicals

Surgical instruments can be cleaned 10-times faster than hand methods and at 1/10 the cost, using a new ultrasonic device designed by the Pioneer Central Div., Bendix Aviation and marketed by American Sterilizer Co. Cold water can be used in conjunction with the high frequency sound waves generated by the equipment. Studies at St. Luke's Hospital in Cleveland indicate a 97.2 percent efficiency with this method.

Federal Communications Commission

An FCC decision has given users of mobile radio in the 152 to 162 mc range a seven-year warning to cut down the width of their channels. This width now stands at 60 kc, and will have to be cut to 30 kc for remote-area use and 15 kc for more adjacent operations. In many instances this means major modification to existing equipment. However, FCC studies have shown that most equipment now in use will be about 10 years old in 1963—therefore, ready for replacement. Moreover, manufacturers of mobile equipment (used by taxis, trucks, police, fire trucks, and railroads) have been given two years to start manufacturing narrow channel equipment. By splitting the existing channels, FCC hopes to squeeze in many more applicants and users of the mobile channels.

Training Aids For Industry

Prepared by RETMA, three basic manuals can serve as instructional material designed to produce skilled electronic technicians. "Basic Electricity," "Basic Electronics" and "Basic Radio and Receiver Servicing" can be obtained from McGraw-Hill, New York. Instructors' guides are also supplied by RETMA to qualified trade, vocational and technical schools.



"I don't exactly understand what you do as an electronics engineer. Could you explain it in dollars and cents?"

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t/i progress report on silicon rectifiers

NEWEST ADVANCE...

1500 VOLT

welded case
single junction
silicon rectifiers

You can now practically *double* the output of your miniature high voltage power supplies . . . by designing your circuits with TI grown junction silicon rectifiers . . . with virtually twice the operating voltage previously obtainable from silicon rectifiers. You get greater output with fewer units . . . assuring greater circuit reliability. The cases of these 1500-volt rectifiers are welded for long service life and have single element construction for more dependable operation. All this, *plus* the tremendous savings in size, space, power and weight that semiconductor devices can contribute to your miniaturization programs.

TI miniaturized silicon rectifiers feature forward current ratings to 125 ma . . . have high mechanical reliability . . . and operate stably to 150°C. They require no filament power . . . no warm-up time. Four production types give you a choice of axial and stud half-wave types in welded cases. Axial models allow point-to-point wiring. Stud models provide maximum heat dissipation . . . are made with either an anode or a cathode stud so no high voltage insulation is necessary between stud and chassis.



Also in production and immediately available — TI 1500-volt full-wave plug-in model in hermetic soldered case . . . replaces JAN 6X4 rectifier tube in many applications.

For exacting circuit requirements, select from TI's line of 65 SILICON JUNCTION DIODES, including:



GENERAL PURPOSE



VOLTAGE REFERENCE



UNIFORM FORWARD CHARACTERISTIC



All these devices are available now!

Write today for complete data

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS

CIRCLE 9 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.

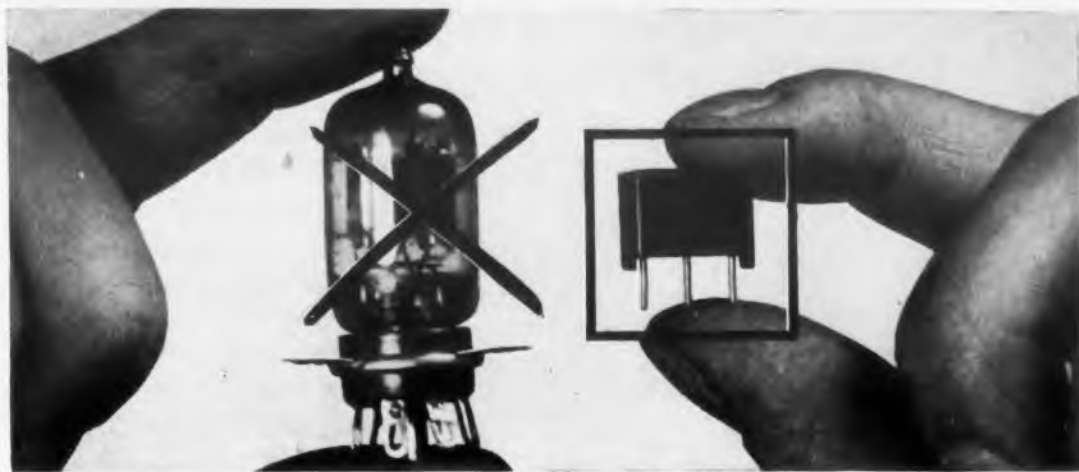
GENERAL ELECTRIC

CIRCLE 10 ON READER-SERVICE CARD FOR MORE INFORMATION

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 A667-35, SCHENECTADY 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"/> HB-3286, P. 23 ARR-2 Relay | <input type="checkbox"/> GEC-811 | Permafil Capacitors |

For information on other products, contact your nearest G-E Apparatus Sales Office

NAME.....
COMPANY.....
CITY..... STATE.....

CIRCLE 10 ON READER-SERVICE CARD FOR MORE INFORMATION

THE NEW AMPEX FR-1100

*The best things
magnetic tape recording can do
combined in a single instrument
of moderate cost*

THIS RECORDER IS YOUR BEST CHOICE

- **IF** you are equipping a laboratory and want facility for everything that comes along.
- **IF** you are an expert improving your methods before a bigger equipment purchase.
- **IF** you are starting from scratch to evaluate magnetic tape as a data or control technique.
- **IF** you have a specific need for an instrumentation recorder with a maximum of two tracks.

Features of the FR-1100 include interchangeable plug-in amplifiers, interchangeable heads and four tape speeds. It can equal (and surpass) five standard two-track recorders in Ampex's familiar 300 Series (303, 306, 307, 309 and 311 — also a 303/306 combination). Photograph shows a two-track FR-1100 equipped with a meter panel and Servo Speed Control.

Both tracks are available for data, even when the Servo Speed Control signal is recorded on one of them.

In addition to its versatility, the FR-1100 has basic improvements in performance over the previous models it supplants. Specifications and a complete description should be in your information files.

Write today to Dept ZZ-2968



District Offices: Atlanta; Chicago;
Dallas; Dayton; Los Angeles;
Montclair, New Jersey (New York Area);
Palo Alto, California; Silver Spring,
Maryland (Washington D. C. Area);
Toronto, Ontario (Ampex-American).

INSTRUMENTATION
DIVISION

AMPEX

CORPORATION

FIRST IN MAGNETIC TAPE INSTRUMENTATION

934 Charter Street • Redwood City, California

Two-Stage Hypersonic Rocket

Reaching several times the speed of sound in just two seconds, this 13 ft, 2-stage hypersonic test vehicle (HTV) was developed by the Aerophysics Development Corp., Santa Barbara, California, subsidiary of Curtiss-Wright Corp., in conjunction with the USAF. Recovery of the airframe after the flight permits analysis of the data gathered and recorded at hypersonic speeds.

Electronic Photo Printer

Negatives considered unprintable can now produce useful results by utilizing electronic controls in dodging negatives during printing.

The printing is done with a brilliant spot of light, projected from a cathode ray tube, which scans the negative and photoprinting material. Variations of density in the negatives are sensed and evaluated in special electronic circuits. These circuits compare the light value provided with that actually required to give the best possible print for the photo printing material in use. This information is fed back instantaneously to control the intensity of the printing beam; and in so doing automatically and correctly exposes each small area of the negative. The device was developed by Norden-Ketay Corp., 99 Park Ave., New York, N.Y.

11-Million Gauss-Oersted Permanent Magnet

Philips of Eindhoven have developed a practical "Alnico-5" permanent magnet having energy of 11,000,000 gauss-oersteds. This is more than twice that previously reported. Energy of 5,000,000 gauss-oersteds has been considered about tops. The implications are obvious in that it will mean smaller magnets, increasing the applications enormously. It is understood that this feat was accomplished using the single-crystal Alnico technique. Processing refinements were also made to get the necessary high coercive force.

◀ CIRCLE 11 ON READER-SERVICE CARD

Mental Telepathy Needs Engineers

In order to instrument and develop controlled mental telepathy, help from electronic engineers and physical scientists are needed. According to Dr. J. B. Rhine, head of Duke University's parapsychology laboratory, extrasensory perception, or ESP as it is known, may well replace radio for communication in the future, if more facts are discovered about the phenomenon.

Extrasensory perception, which knows no distance barriers, occurs today in a random manner, says Dr. Rhine. The existence of ESP, according to Dr. Rhine, has been proven by thirty years of careful scientific study. If proper measurements can now be made with physical instruments, such as electronic meters perhaps enough data can be compiled to enable engineers and scientists to predict clairvoyance with accuracy and to control mental telepathy transmissions.

Gas-Filled Transformer

A decidedly different new power transformer—insulated and cooled by gas instead of oil—was recently completed at General Electric's Power Transformer Department, Pittsfield, Mass. By using a gas—sulphur-hexafluoride—it is possible to build lighter, safer and quieter transformers. This stable, nontoxic and nonflammable gas is an excellent electrical insulator and heat transfer medium, making possible 2000 kva units. It is sealed in the transformer at a pressure of 30 pounds per square inch and is forced through the transformer's magnetic steel core and copper coils.

Up to now, oilless, or "dry type" transformers, which are required by underwriters for all interior locations, have been limited to about 15,000 volts. General Electric believes gas insulation to be the most radical change in transformer design since the introduction of non-aging silicon core steel more than fifty years ago.



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's

New

Water-

Activated

Batteries

Deliver up to

42 Watt Hours

Per Pound!

CIRCLE 12 ON READER-SERVICE CARD >

GENERAL  ELECTRIC

For descriptive bulletin GEA-6238A on G-E water-activated batteries, send coupon to:

General Electric Co., Section B223-5
Schenectady 5, N. Y.

for immediate project for reference only

Name

Position

Company

Street

City State

RIGHT ARM of industrial research

Sanborn's galvanometer writing arms record valuable data to help solve the countless measurement problems of research, design, and production testing.

SINGLE to 8-channel inkless and permanent recording in true rectangular coordinates of 0-100 cps phenomena — ranging from telemetered aircraft data to atomic reactor characteristics — is the vital and growing role of Sanborn oscillographic recording systems in industry. The Sanborn file of users indicates that such recordings are aiding in the dynamic analysis of jet engine starters, machine tools, agricultural machinery and oil drilling equipment; performance of pilotless target aircraft, modern submarines and tracking radar systems; and the production testing of servo components, valve positioners and precision potentiometers. Sanborn systems designed especially for recording analog computer output extend applications further — in simulated flight set-ups, solution of complex problems with six or eight variables, etc.

The advantages of making Sanborn equipment the "right arm" of your recording problems include extreme flexibility, by means of a dozen different interchangeable, plug-in "150 Series" preamplifiers which quickly and economically adapt a basic system to changing requirements; choice of 1-, 2-, 4-, 6- or 8-channel systems, in vertical mobile cabinets or "portably packaged"; numerous chart speeds, many individual channel controls, and high over-all system linearity.

To see how oscillographic recording the Sanborn way can become the "Right Arm" of your analysis work, write for detailed information or contact your Sanborn Representative. Sixteen-page "150 System" catalog on request.

SANBORN COMPANY

Industrial Division, Cambridge 39, Mass.



CIRCLE 13 ON READER-SERVICE CARD FOR MORE INFORMATION

Air-to-Ground Loudspeaker

A loudspeaker system which can be dropped from altitudes up to 60,000 feet is timed to deliver five-minute messages to ground areas before hitting the earth.

Parachute-braked in the final phase of its descent, the device consists of a lightweight magnetic tape playback unit, a 500-watt battery powered audio amplifier, a horn assembly, and a pressure sensitive control which releases a three-stage parachute arrangement. When the center section of the missile reaches an altitude of 4000 feet the sound system is placed in operation and descends to earth at the rate of 14 feet per second.

The complete system is housed in a bomb-shaped container weighing 850 lbs, and was developed by the Cook Research Laboratories. A high degree of intelligibility was obtained from the system with 500 watts of audio power as compared with kilowatts of power required for airborne system.

Study 50 Weeks, Vacation 2 Weeks

There can be no termination to the education of the electrical engineer; his learning period is perpetual, Dr. F. E. Terman of Stanford indicated recently. And as part of this program of study, the long summer vacation for students at college should be shortened to 2 weeks to permit greater utilization of the time. The present 4-year course of study is not sufficient for present-day needs.

Electronic Telephone Switching

The value of the transistor as a simple electronic switch for telephone cross bar use has long been recognized. Just recently a developmental model, capable of switching ten telephone lines was demonstrated. Transistors are used instead of vacuum tubes, printed circuits instead of conventional wiring and tone signaling replaces the usual ringing arrangement. According to the Automatic Electric Company, 1033 West Van Buren Street, Chicago 7, Illinois, electronic switching is approximately one thousand times faster than electro-mechanical relays. Because electronic switching equipment utilizes transistors, it will be highly compact, and telephone companies will be able to conserve on building space heretofore needed to house telephone central office equipment.

Heart Murmur Analyzed Electronically

By means of band pass filters and frequency-sensitive amplifiers, a technician may listen to a patient's heart and later the doctor, at his leisure, can analyze the machine's results. This device was but one of the analyzers described at the recent Toronto IRE Medical Electronics Convention.

Washington Report

Herbert H. Rosen

Calling All Inventors: The National Inventors Council, whose job it is to seek out inventions that may solve military problems, has issued a new call for solutions to some 35 problems. Of this number, 21 are related to electronics or electronic techniques. Generally, these include instruments and gadgets for use in counter-countermeasures, radar clutter, radar three-dimensional coverage, radar display, sounding devices, and vibrations indicators.

The Council is set up to carry on all correspondence, interviews, and work related to getting an idea of merit before the proper military body. All interested in further information should contact The National Inventors Council, U.S. Department of Commerce, Washington 25, D.C.

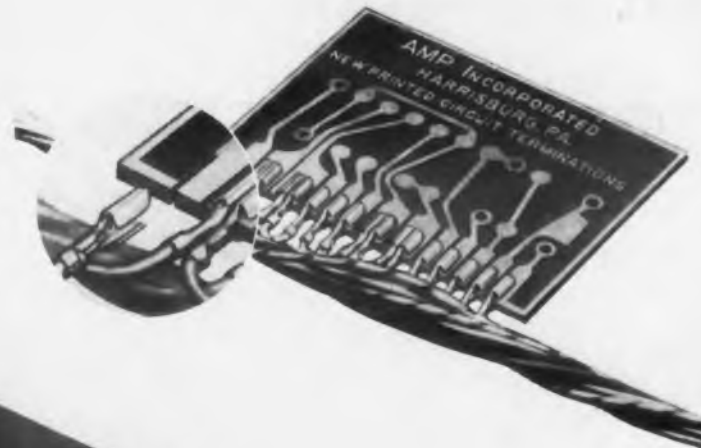
Transistor Anthology: For transistor engineers, the Office of Technical Services has recently released a 500-page, illustrated volume on transistor technology and applications. The book, however, will find greatest use as a reference volume since it is a collection of papers presented in 1953 during a symposium on the application of transistors to military electronic equipment. Included are thirty-two papers presented by engineers and theoreticians from both military and industrial laboratories. The applications described range from power sources and amplifiers through signal generators and oscillators to circuit theory and practice.

IGY Rocketry: An Aerobee Rocket, loaded with electronic instruments in its nose, was launched late in October from a site near Fort Churchill, Canada. Scientists hoped the missile would reach a height greater than the 165 miles previously achieved by an Aerobee fired at White Sands. Part of the instrumentation is an NRL telemetry transmitter with an average power output of 50 watts. Although the rocketry aspect of the launching serves as a test for the IGY satellite, the instrumentation gives only an indication of what can be detected from outer space. The satellite transmitter, which must weigh little more than 5 pounds (the Aerobee unit weighs 45 pounds), will have a power output of only 10 or 15 milliwatts. Also, the Aerobee telemeter operates at 27 mc, while the Satellite Minitrack unit functions at 108 mc. Complications on complications can be anticipated while trying to transmit data at the power over a range of 300 miles, minimum.

AMP-EDGE HAS THE EDGE ON PRINTED CIRCUITS

Design-Engineered with
Positive Wiping Contact
and
Frictional Grippage

The new
AMP-Edge
Connector gives you . . .



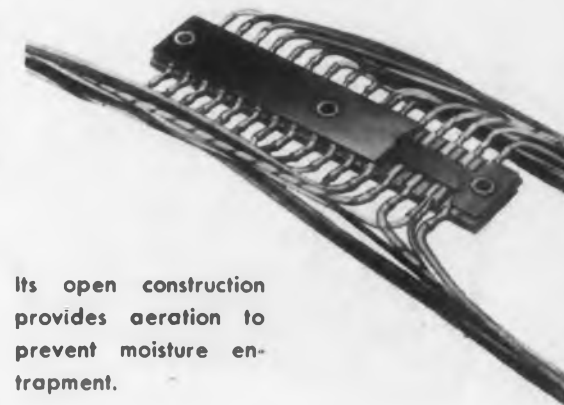
greater flexibility—your printed circuit area and completed unit are not limited by the size of connection, as found in alternate methods of edge connection.

greater design versatility—they can be applied in any arrangement to any section of the perimeter of the printed circuit.

two-way cost reduction—production time and labor costs are reduced through solderless termination of the connector to the wire (4,000 terminations per hour) and the ease of applying the Edge Connector to the printed circuit.

Amp's **Creative Approach**
TO BETTER WIRING

Another of the many unique designs made available by the AMP-Edge technique is the new, low-cost, compact AMP-Edge Connector Block. It allows freedom of arrangement, with small area displacement.



Its open construction provides aeration to prevent moisture entrapment.

For more information on
AMP-Edge Connectors, contact:

AMP

AMP Incorporated

General Office: Harrisburg, Pa.

AMP Inc. Harrisburg, Pa. 17105. Canada - AMP - Montreal, N. Y., 10000. Mexico - AMP - Mexico City, D.F. 06700. Europe - AMP - London, W. 1A. France - AMP - Paris, 15. Germany - AMP - Frankfurt, 6050. Italy - AMP - Milan, 20121. Japan - AMP - Tokyo, 100. Australia - AMP - Sydney, N.S.W. 2000. New Zealand - AMP - Auckland, 1010. South Africa - AMP - Johannesburg, 2001. India - AMP - Bombay, 400002. Singapore - AMP - Singapore, 05. Hong Kong - AMP - Hong Kong, 05. Taiwan - AMP - Taipei, 100. Korea - AMP - Seoul, 150. Philippines - AMP - Manila, 1000. Thailand - AMP - Bangkok, 10110. Malaysia - AMP - Kuala Lumpur, 50000. Indonesia - AMP - Jakarta, 10110. Singapore - AMP - Singapore, 05. Hong Kong - AMP - Hong Kong, 05. Taiwan - AMP - Taipei, 100. Korea - AMP - Seoul, 150. Philippines - AMP - Manila, 1000. Thailand - AMP - Bangkok, 10110. Malaysia - AMP - Kuala Lumpur, 50000. Indonesia - AMP - Jakarta, 10110.

CIRCLE 14 ON READER-SERVICE CARD FOR MORE INFORMATION

If it's worth
engineers'
time...



Mil. Spec.

Mil. Spec.

...it's worth
engineered
electronic wire

Belden
WIREMAKER FOR INDUSTRY
SINCE 1902
CHICAGO

6-8

Magnet Wire • Lead and Fixture Wire • Power Supply Cords, Cord Sets and Portable Cord • Aircraft Wires
Welding Cable • Electrical Household Cords • Electronic Wires • Automotive Wire and Cable

CIRCLE 15 ON READER-SERVICE CARD FOR MORE INFORMATION

Meetings

Nov. 26-30: Third International Automation Exposition.

Trade Show Building, New York, N. Y. Clinic sessions will be offered in electronic computers, process automation, machine tool automation, office automation, automatic materials handling, servomechanisms, electromechanical components, and electronic components. More than a hundred exhibitors will participate in the clinics. A two-day "Senior Officer Conference on Office Automation" directed by Gordon L. Mattson and sponsored by Fordham University School of Business will be held. For information, write to Richard Rimbach Associates, 845 Ridge Ave., Pittsburgh 22, Pa.

Dec. 3-4: Second Midwest Symposium on Circuit Theory.

Michigan State University. Symposium will consist of four sessions: Topology and Circuit Theory, System Analysis and Synthesis, Circuit Theory and Applications, and the Place of Circuit Theory in Education. A talk on "Engineering Education for the Future" will be given by Dr. J. D. Ryder on Monday evening. Papers will also be presented by engineers in the education field. Contact for further information, IRE, 1 West 79th St., N. Y., N. Y.

Dec. 5-7: Second IRE Instrumentation Conference.

Biltmore Hotel, Atlanta, Ga. Sponsored by the Professional Group on Instrumentation and the Atlanta Section of the IRE. Sessions will be devoted to industrial applications, missile range instrumentation, and the application of solid state devices. For further information, contact the IRE, 1 E. 79th St., New York, N. Y.

Dec. 10-12: Eastern Joint Computer Conference.

Hotel New Yorker, New York, N. Y. Sponsored by the IRE, AIEE, Association for Computing Machinery. "New Developments in Computers" is the theme of the meeting. In addition to an extensive program of technical papers, the meeting will feature exhibits by many manufacturers in the computing field. For information, contact Al Forman, Room 639, 480 Lexington Ave., New York 17, N. Y.

Dec. 12: Information Theory and the Written Word.
New York Academy of Science, New York, N. Y.
Lecture discussion by J. R. Pierce. Sponsored by
the New York Chapter of Technical Writers and
Editors. For more information, write to J. A. Lippke,
ELECTRONIC DESIGN, 19 E. 62nd St., New York 21,
N. Y.

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. 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.

Sherraton-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.

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Rate	10	10-MTG 6226-02	Syn- chro	2-9/16	400~	.3	6,500	-	26	26	.24	4500	26V 400~	23	-	
Rate	10	10 6677-01	Face	1-3/8	Mech. Driven	-	-	-	-	-	.41	8000	18V 400~	50	-	
Rate	10	10-MTG 6231-01	Syn- chro	2-3/16	400~	.26	19,400	14	26	26	.34	8000	26V 400~	23	7°	
Rate	10	10-MTG 6226-04	Syn- chro	2-15/16	400~	.3	6,500	6.2	26	26	.45	4000	18V 400~	50	-	
Rate	10	6229-03	Syn- chro	2-1/8	400~	.25	10,500	6.0	26	26	.3	4000	18V 400~	12	-	
Rate	10	6229-02	Syn- chro	1-5/8	400~	.25	10,000	6.0	26	26	01-5.5 ø2 .115	4000	18V 400~	12	0-5°	
Rate	10	6229-05	Face	2-1/8	400~	-	10,000	6.0	26	26	.3	4000	18V 400~	12	-	
Tachometer Squirrel Cage Rotor	10	10-TG 6676-01	Syn- chro	1-1/16	Mech. Driven	-	-	-	-	-	.3	4500	6.3V 100~	-	-	
Tachometer Squirrel Cage Rotor	15	15 5151-01	Syn- chro	1-13/16	Mech. Driven	-	-	-	-	-	1.3	4500	115V 400~	50	-	
A.C. Tachometer D.C. Motor	15	15-MTG 6276-01	Syn- chro	3-7/16	D.C.	2	11,000	-	28 D.C.	-	.25	5000	115V 400-1200~	25	15°	
Damping	21	D 5851-01	Face	2-11/16	400~	3.5	7,500	40	115	115	.022	6500	26V 400~	-	-	
D.C. Tachometer	12	12-D 8301-02	Face	2-1/4	Mech. Driven	-	-	-	-	-	2.7	8000	P.M.	-	-	
						Phase 1 Output Voltage	Phase 1 Output Current	Phase 2 Output Voltage	Phase 2 Output Current	Output Frequency	Speed At Rated Output	Type	Insulation	Torque Input		
Dual Output	10	6702-01	Syn- chro	1-5/8	Mech. Driven	67	.011 A	1.4	.150 A	400~	12,000	P. M.	-			
A.C. Power	17	6951-03	Syn- chro Spec.	1-9/16	Mech. Driven	24	.85 A	24	.85 A	420~	12,600	P. M.	3.5 oz./in.			
Reference	25	23-TG 6776-01	Syn- chro	4	Mech. Driven	40	.0375 A	40	.0375 A	35~	2,100	P. M.	-			

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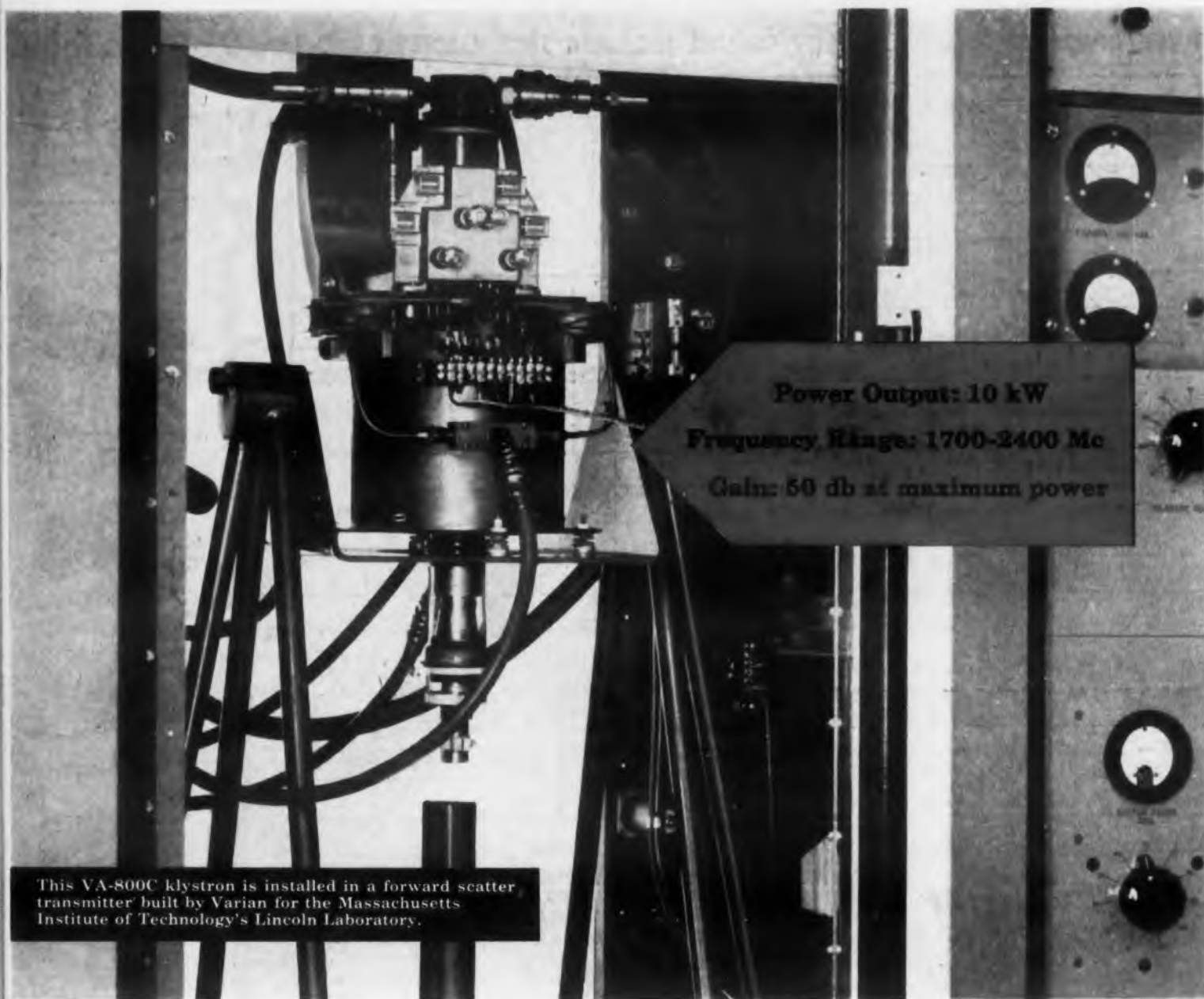
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CIRCLE 17 ON READER-SERVICE CARD FOR MORE INFORMATION

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.

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. Kunstadt, Radio Corporation of America, Defense Electronic Products, Camden 2, N. J.

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.

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.

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.



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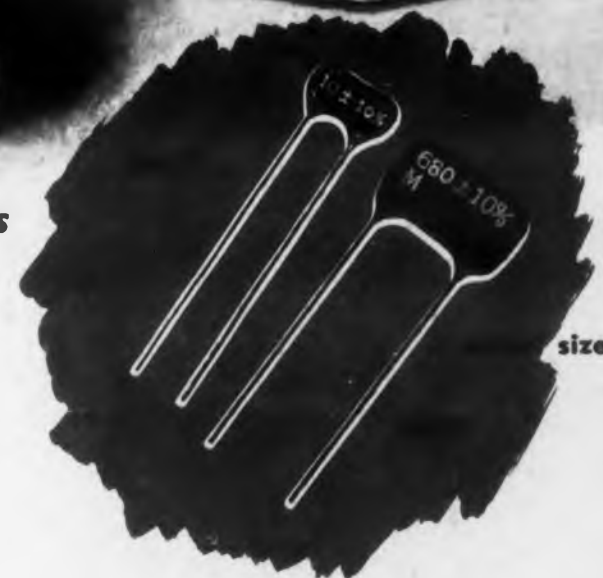
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Fig. 1. Typical rectifiers used in opening dc relay coils from ac supply sources



Rectifiers and Circuits for DC Relays

F. W. Parrish

Chief Design Engineer
International Rectifier Corp.

THIS article deals with rectifiers for relay applications including some of the less well known circuits and applications.

Semiconductor rectifiers of all types have been used in power supplies for relays and contactors for many years. At present selenium rectifiers, either in cartridge form, diode form, or in small sized open stacks are the most widely used. However, germanium and silicon power diodes are fast receiving acceptance and wide usage in relay circuits. Copper oxide rectifiers are still used also, especially in the meter-move-

ment-type contact-making relays.

The largest single use of relay rectifiers is to supply power to the operating coils of relays. Available types of selenium and silicon rectifiers for this purpose are shown in Fig. 1. Where only ac is available as in many applications, ac relays would normally be used if possible. However, the life of an ac relay is much less than that of a dc type. The ratio has been estimated at about 5 to 1. Moreover, dc relays close less violently than ac relays (resulting from the absence of the high current surge in ac relays prior to the closing of the

magnetic circuit) and are therefore quieter and maintain accurate adjustment for longer periods of time. Accordingly, there is often considerable advantage gained by using dc relays; in which case, rectifiers must convert the ac line current to dc.

Semiconductor rectifiers are inherently well adapted to relay applications for the following reasons: (1) For a given coil current, they are smaller than most tube rectifiers; (2) They provide efficient long life service when properly applied to the individual relay coils; (3) No filament supply is required as would be neces-

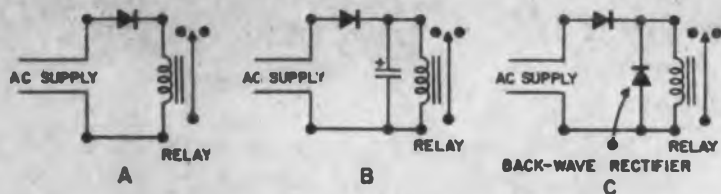


Fig. 2. Three circuits for supplying dc power to relay coils from ac source.

- (A) Simple half-wave circuit for relays using copper ring to prevent chatter.
- (B) Half-wave circuit with smoothing capacitor for coils without copper ring.
- (C) Circuit employing "back-wave" rectifier to give steady current through coil.

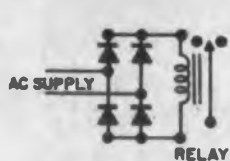


Fig. 4. Single-phase full-wave bridge relay supply.

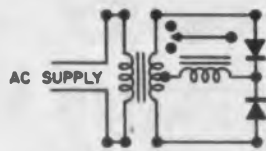


Fig. 5. Single-phase full-wave relay supply.

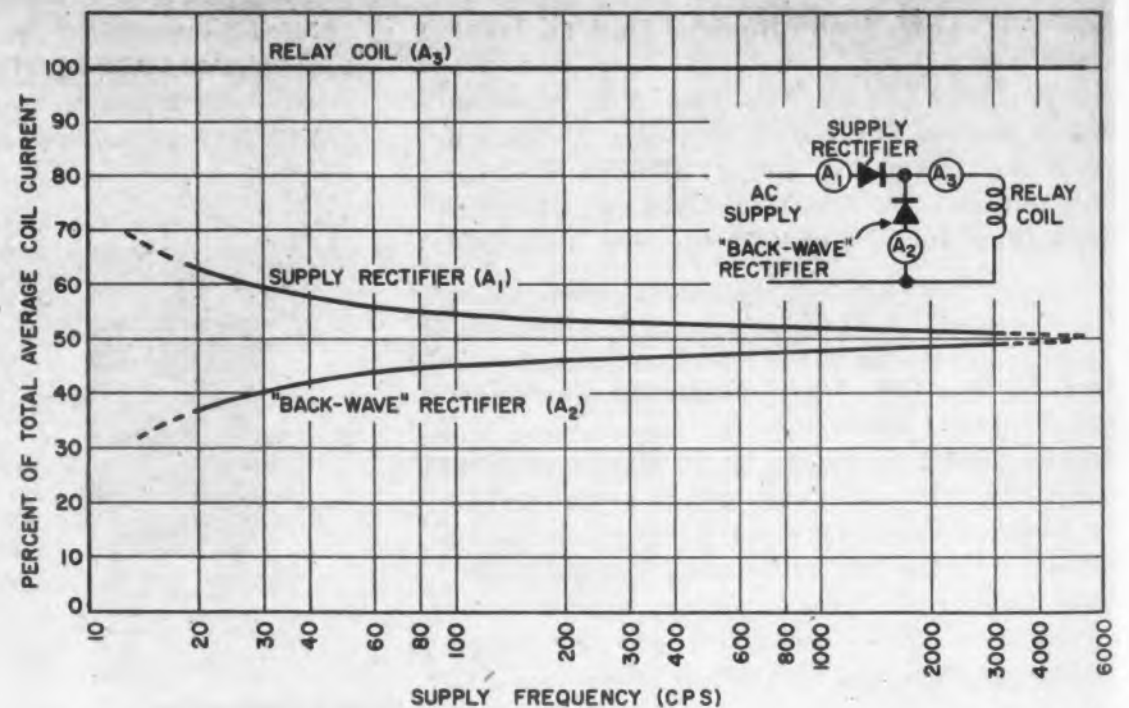


FIG. 3 RECTIFIER AND RELAY COIL CURRENT - FREQUENCY CHARACTERISTICS - "BACK-WAVE" RECTIFIER CONNECTION.

Fig. 3. Rectifier and relay coil current-frequency characteristics—"back-wave" rectifier connection.

sary for most vacuum tube rectifiers; (4) They are available for all voltage ratings; and (5) They are more rugged and less susceptible to shock and vibration than are vacuum tube rectifiers.

Preventing Chatter

Half-wave rectifiers can sometimes be used to supply dc power to relay coils. The simple half-wave rectifier, shown in Fig. 2a, was probably the first type of rectifier used in this service and is still used occasionally. However, most dc relays will chatter or buzz considerably when used on half-wave rectified power (unless specifically designed for that duty) unless some auxiliaries are used to prevent it. A large copper ring is often mounted on the relay core beside the coil when a relay is to be operated from a half-wave voltage supply. As the magnetic field in the relay coil collapses during the non-conducting half cycle, transformer action generates a current in this copper ring (which performs as a single turn secondary winding) and holds the relay armature closed until the next conducting half cycle.

Another method of preventing chattering has been to place a capacitor across the relay coil (Fig. 2b). In this way, the capacitor will be charged approximately to its point of maximum energy storage during the conducting half cycle and will discharge this energy to the relay coil during the non-conducting half cycle, and in that way, prevent chatter of the relay armature.

The third method, which is gaining increasing acceptance to accomplish the same results, is the use of what has been termed a "back-wave" rectifier (Fig. 2c). This rectifier, similar to the one which supplies power to the relay coil is connected across the coil as shown. No current will flow through this "back-wave" rectifier during the conducting half cycle; but, during the blocking half cycle, it provides a low resistance path for flow of current from the collapsing magnetic field of the relay coil. The relay armature is thus held closed without buzzing or chattering. Advantages of the "back-wave" rectifier over the copper ring and the capacitor are as follows: (1) time constant of the relay is not altered as much as with the copper ring; (2) weight is generally less; (3) current drawn through the main rectifier during the conducting half cycle is considerably less than when a capacitor is used across the relay, because it is not necessary to supply energy to charge the capacitor in addition to operating the

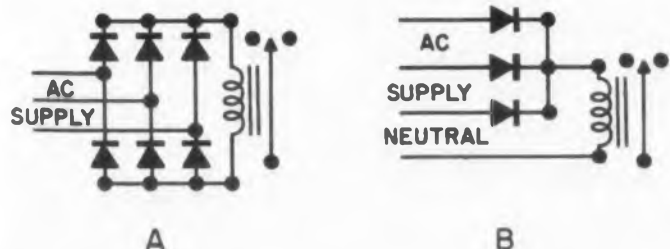


Fig. 6. Polyphase relay supply circuits. (A) Three wire bridge circuit. (B) Four-wire bridge circuit.

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relay; and (4) the main rectifier may have a current capacity approximately 60 per cent of the coil current, and the "back-wave" rectifier about 40 per cent (Fig. 3).

Coil Voltage

When the simple half-wave rectifier is used, the relay coils should be designed to operate at approximately 40 per cent of the ac line voltage. With a capacitor across the coil, the coil should be designed to operate at approximately full line voltage. With a "back-wave" rectifier, the coil should be designed for 40 per cent line voltage.

Other Circuits

To minimize the smoothing problem a full-wave bridge type rectifier (Fig. 4) is commonly employed. If additional smoothing is required, a small capacitor can be used as a filter, connected across the relay coil; however, without the capacitor, the bridge acts as its own "back-wave" rectifier to help maintain a smooth flow of current through the relay coil, even during the time the waveform dips to zero.

A full-wave rectifier (Fig. 5) could also be used; however, a center-tapped ac supply is generally not available. Therefore, the bridge type is more popular. It is to be noted the current smoothing action of the

"back-wave" current path is not obtained with the full-wave circuit. Where polyphase ac power is available, polyphase rectifiers similar to those shown in Fig. 6 can be used.

Voltage multiplier circuits to obtain power for relay operation can also be used where only low voltage ac is available and where it is necessary to operate a higher voltage relay coil. Common voltage multiplier circuits are shown in (Fig. 7).

Special Rectifier Applications

There are some other uses for rectifiers in relay applications, which are not as commonly known as those

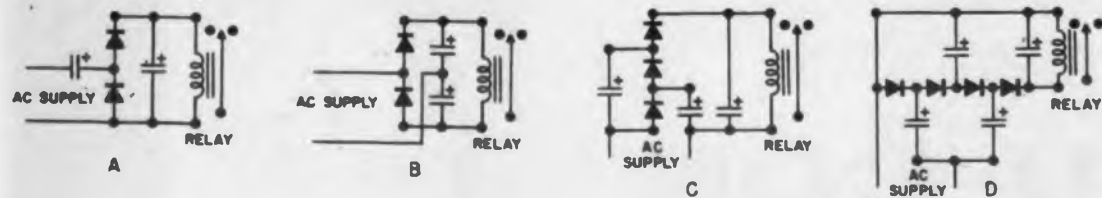


Fig. 7. Voltage-multiplier circuits for relay applications. (A) Half-wave doubler, (B) Full-wave doubler, (C) Tripler (D) Quadrupler.

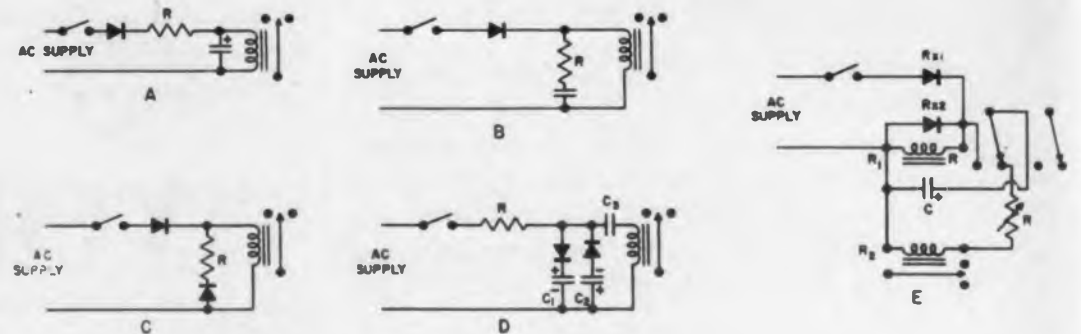


Fig. 9. Circuits for time-delay operation of dc relays.

- (A) Time delay pickup of dc relay. A variable resistor will permit varying the delay time.
- (B) Time delay drop-out of dc relay. A variable resistor will permit varying the drop-out delay time.
- (C) Time delay drop-out of dc relay using "back-wave" rectifier. (maximum delay is less with this circuit than with capacitor.)
- (D) Time delay pickup of ac relay. (may be adjustable by using a variable resistor at R.)
- (E) Instantaneous pickup followed by time-delay drop-out of relay R_2 after completion of cycle of Relay R_1 .

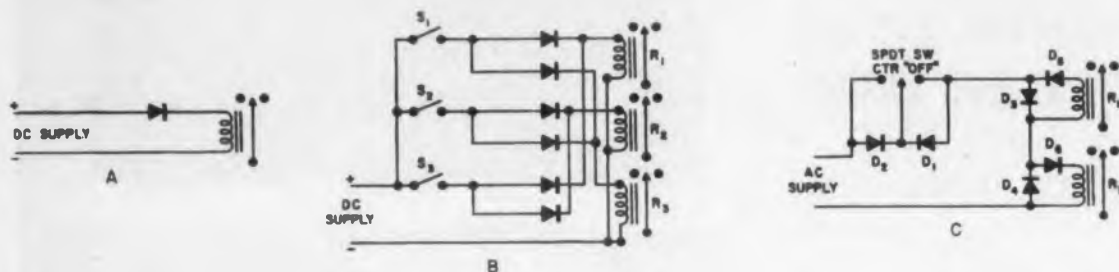


Fig. 8. Selective relay operating circuits.

- A. Simple blocking valve to prevent relay operation if polarity is reversed.
 - B. Selective relaying from dc supply where
 - S_1 operates R_1 & R_3 only
 - S_2 operates R_2 & R_3 only
 - S_3 operates R_1 & R_2 only
 - C. Selective relaying from an ac supply where
 - (1) Shorting diode D_1 permits D_2 to rectify the supply and operate R_2 .
 - (2) Shorting diode D_2 operates R_1 similarly.
- If impedance of relay coils is high compared to forward resistance of D_1 and D_4 , D_5 and D_6 may be omitted.

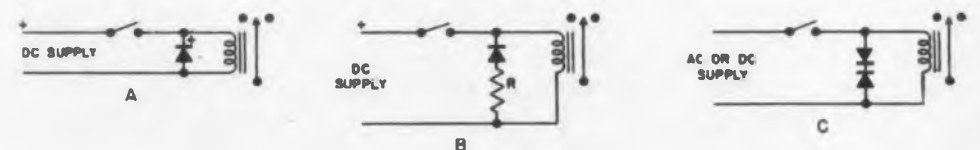


Fig. 10. Relay contact protection circuits for inductive loads. The circuit to use depends upon the load conditions.

ust described. One such use is as blocking valves. While these have sometimes been used to replace reverse-current protection relays, their principal use is in selective relaying and to provide a simple means of polarizing a relay. Some examples of the uses of blocking valves for selective relaying and polarity sensitive relays are shown in Fig. 8.

Relay rectifiers are also used in timing circuits where a time delay is required in the pickup and drop out of relay coils. Fig. 9a shows the circuit of a time-delay pickup dc relay. The relay picks up when the charge on the capacitor equals the minimum pickup voltage of the relay. A similar arrangement is shown in Fig. 9b, but in this case the time delay is on drop out. The relay coil is directly across the line in this case, so it will pick up as soon as the energizing contacts are closed. However, the capacitor will charge more slowly through resistor *R*. Then, when the circuit is opened, it will discharge slowly through the resistance of the relay coil and the series resistor to give the required time delay. Another form of the delayed drop-out relay is to use the rectifier in a manner similar to the "back-wave" rectifier, but with a resistor in series as shown at Fig. 9c. In this case the relay coil should be selected to have very high inductance, and the "back-wave" rectifier should be selected for the lowest possible forward resistance. These two parameters will provide the maximum possible delay in drop-out; then, drop-out time is adjusted by varying the resistor in series as shown.

One method of using rectifiers (Fig. 9d) provides a time delay pickup for an ac relay. It utilizes the charging rates of capacitors to limit the output voltage for the desired pickup time delay.

Still another use of time delay relays is to provide for the initiation of a new circuit function after a predetermined interval following the completion of a previous function. In Fig. 9e rectifier *R₁* operates relay *R₁* and also charges capacitor *C*. After relay *R₁* is de-energized, the stored energy in capacitor *C* closes relay *R₂* and holds it closed until the charge on the capacitor decays to the drop-out voltage of the relay.

Other important uses of rectifiers with relays involve the protection of relay contacts when used with inductive loads. The three basic circuits for arc suppression and contact protection are illustrated in Fig. 10. Arcing at relay contacts can cause pitting, sticking, or welding, and general deterioration. Propitious use of rectifiers as arc suppressors can minimize or eliminate these conditions and greatly increase relay life. For detail design methods for arc suppressors readers are referred to Ref. 3.

References

1. Relay Engineering (Handbook) Struthers-Dunn, Inc.
2. "Simplification of Control Circuits," W. H. T. Holden, *Electrical Manufacturing*, April 1956, Vol. 57, No. 4, Page 82.
3. "Arc Suppression With Semiconductor Devices," F. W. Partridge, *Electrical Manufacturing*, June 1956, Vol. 57, No. 6, Page 17.

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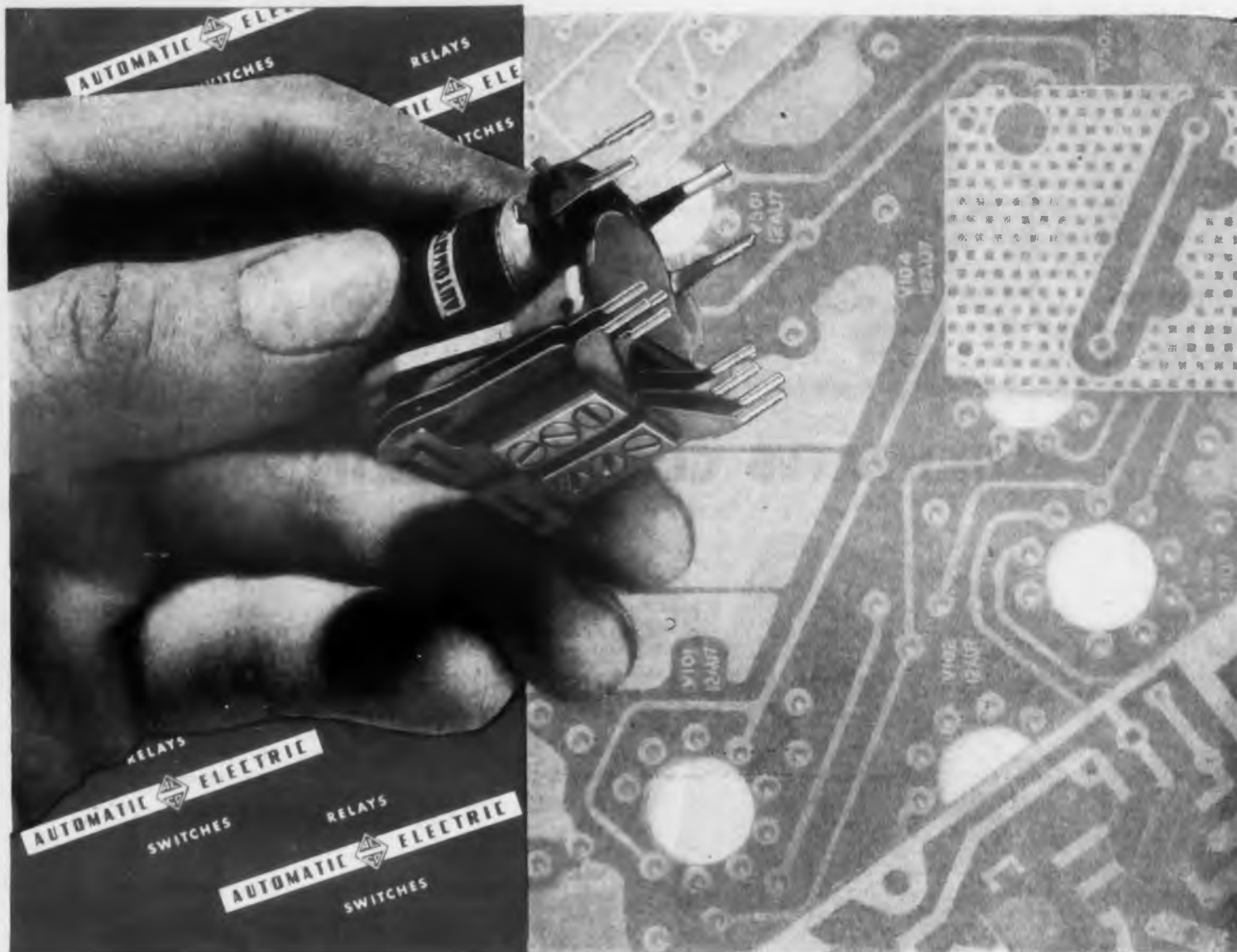
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Two models of the design, a 100-turn unit and a 1000-unit, are being manufactured by Gretsch Products, Inc., 11846 Mississippi Ave., Los Angeles 25, Calif. Terminal linearity of the 100-turn Model 303 is 0.01 percent while that of the 1000-turn Model 302 is 0.005 percent. Both units feature high input impedance with low output impedance. Switching is so arranged that no transients occur.

Autotransformer T_1 of Fig. 2 shows how a 10-turn unit is constructed with 20 taps, equally spaced, and connected to the corresponding fixed contacts on switch S_1 . R_1 and R_2 are resistance windings on the special potentiometer. Winding ends are insulated so that they are electrically isolated from each other but mechanically close enough so that the arrangement forms a continuous card covering the full 360 degrees. The switch S_1 has four movable contacts which all move in synchronism with the potentiometer shaft so that with one clockwise revolution of the shaft, the movable contacts advance the distance of one fixed contact. Printed silver switches and precious metal wipers assure long life and reliability. The 1/4 in. shaft is precision-ground and mounted in ball bearings. The units are not appreciably affected by change of altitude or humidity and resist shock and vibration, unless of a very extreme nature.

An interesting application of this transducer is the automatic positioning of a machine tool from digital information with a simple control system. Fig. 3 shows a simplified diagram of a system where a lead screw having 10 threads to the inch permits carriage travel of 10 in. with an absolute positioning accuracy of 0.001 in. If a 1000-turn Rotary RatioTran and suitable gearing is used, the 10 in. travel can be extended. For more data turn to the Reader's Service Card and circle 22.

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120 million operations, without a single readjustment or relubrication! That's what you get from this rugged, improved Series SQPC Relay, because it features a special heavy-duty bearing and bearing pin. Also a recess in the bearing plate retains an adequate supply of lubricant for long-term lubrication of the bearing pin.

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1. The sections of the terminals that insert into the printed circuit board are NOT brazed or welded into place, but are integral parts of the coil terminals and contact springs—thus preventing internal loss in conductivity or continuity.
2. Terminal design permits direct plug-in of the relay into a printed circuit board, ready to be secured in place with any acceptable soldering technique.

Usually the desired contact spring combination, or pile-up, is sufficiently large so that additional mounting (support) of the relay is not necessary.

SQPC Miniature Printed Circuit Relays are available with many different contact spring arrangements, and for a multitude of applications. Springs can be made of phosphor-bronze, "Bronco" metal, or other special-purpose materials, as required.

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To get complete details, write: Automatic Electric Sales Corporation, 1033 West Van Buren St., Chicago 7, Illinois. In Canada: Automatic Electric (Canada) Ltd., Toronto. Offices in principal cities.

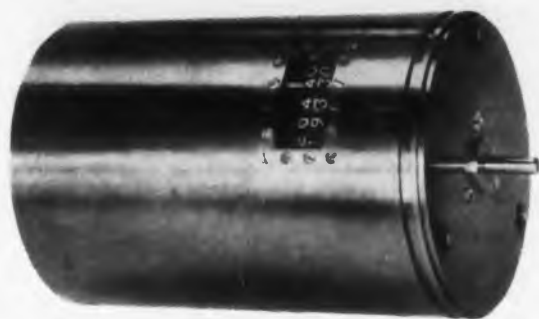
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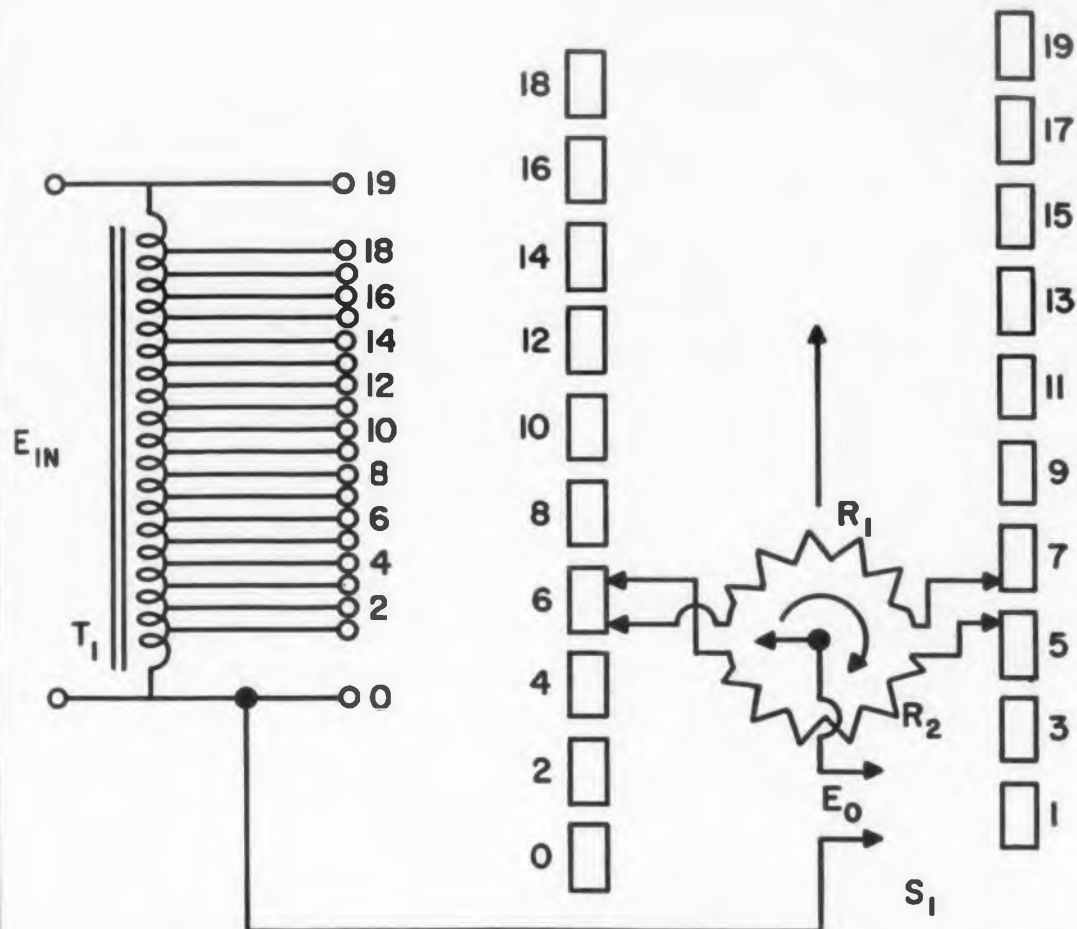


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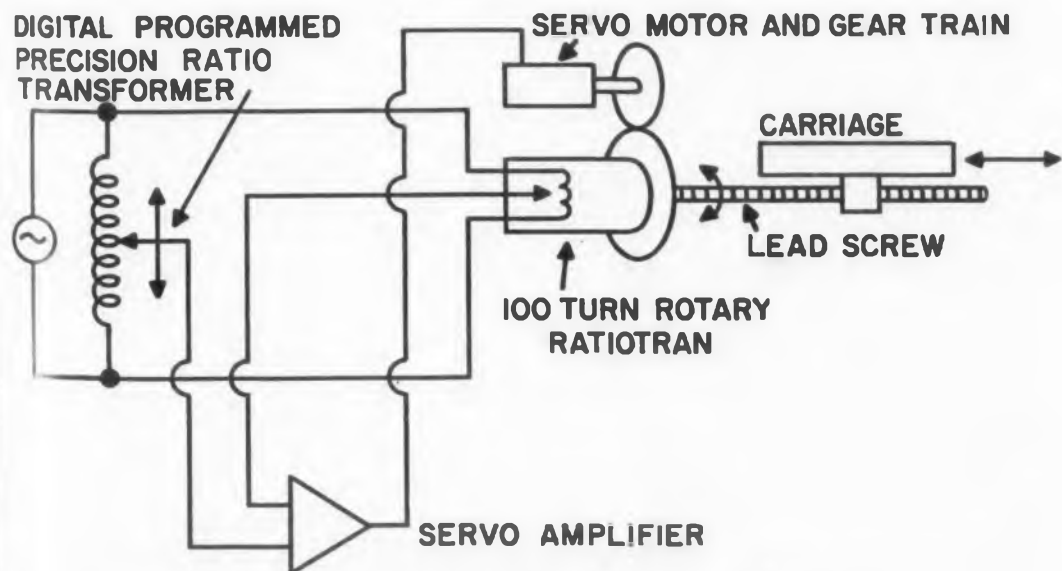
Transformer



Suitable for gear trains and servo systems.



Potentiometer on this 10-turn unit, ratio 0.300, are adjacent so that wiper arm bridges the gap and contacts the section being entered before it breaks contact with the section being left.



Simplified diagram of servo system for precise carriage movement.



Stupakoff METAL-BONDED ALUMINA TERMINALS



Right—Sample of a Stupakoff Alumina Terminal in test rig, torsion-tested to destruction. The failure occurred in the ceramic, not in the bond.

Left is similar terminal before testing.

Amazing bond-strength, and unequalled high-temperature ceramic-to-metal adherence are two outstanding characteristics of Stupakoff Alumina Terminals. Available in six standard stock sizes and many special designs, these terminals provide assurance of stronger, tighter, soft-soldered assemblies. The alumina body is a Stupakoff development, processed under rigidly controlled conditions.

The new Stupakoff metal-bond technique (patent applied for) should not be confused with the ordinary silver metallizing process. This is not a plating, but an intimate bonding of ceramic and metal. Its effectiveness is proved by the photograph at the left, showing the results of a typical torsion test. Ultimate failure of the terminal occurred in the ceramic and not in the bond.

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Temperature Compensation Method For Transistor Amplifiers

Albert N. DeSautels

Minneapolis-Honeywell Regulator Company

DESIGNERS of transistor amplifiers have invariably experienced premature power gain losses when extremes of a temperature range are approached. This article presents one method of alleviating these losses by using temperature-sensitive resistance in an inverse feedback loop. Experimental data verifying the effectiveness of this method are presented for three-stage direct-coupled and r-c coupled transistor amplifiers.

In general, gain losses are due to characteristics inherent in the component concerned and, as such, are not conveniently alterable. It then becomes necessary to counteract, to the extent possible, those conditions which contribute to gain deterioration with temperature change.

Theory of Compensation

The method utilized for illustrative purposes consists of a series combination of temperature-sensitive resistance and a d-c blocking capacitor in a shunt feedback loop (the principle involved would apply to either shunt or series feedback). The theory behind this method of compensation is straightforward. The feedback loop as shown in Fig. 1 consists of three units: a resistance, R ; a d-c blocking capacitor, C ; and a negative temperature coefficient resistance, T . The resistive value of negative-temperature-coefficient (ntc) resistance decreases exponentially as temperature rises and increases exponentially as temperature falls. A popular example of ntc resistance is the thermistor. A resistance with a positive-temperature-coefficient (ptc)

such as one wound with Balco wire, tends to increase almost linearly with temperature increase.

Component R of Fig. 1 is the feedback-controlling resistance at room and elevated temperatures. It is either a fixed resistance value or a ptc resistance. The value of R is determined by the amount of feedback to be introduced at room temperature. This feedback should be sufficient to reduce the power gain at room temperature by an amount substantially greater than the loss suffered by the uncompensated amplifier at the temperature extreme. This should be about 15 db for the germanium-transistor, three-stage amplifier. Of course, the greater the amount of degeneration introduced, the more power gain available for compensation.

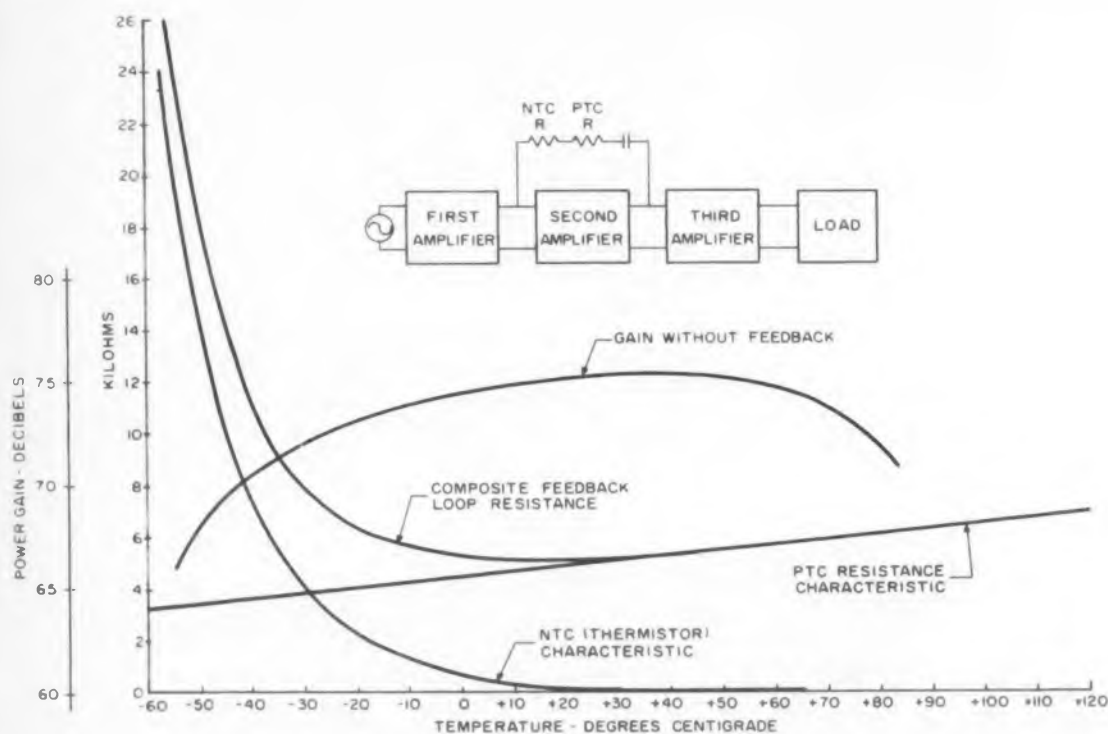


Fig. 2. Temperature characteristics of feedback loop components.

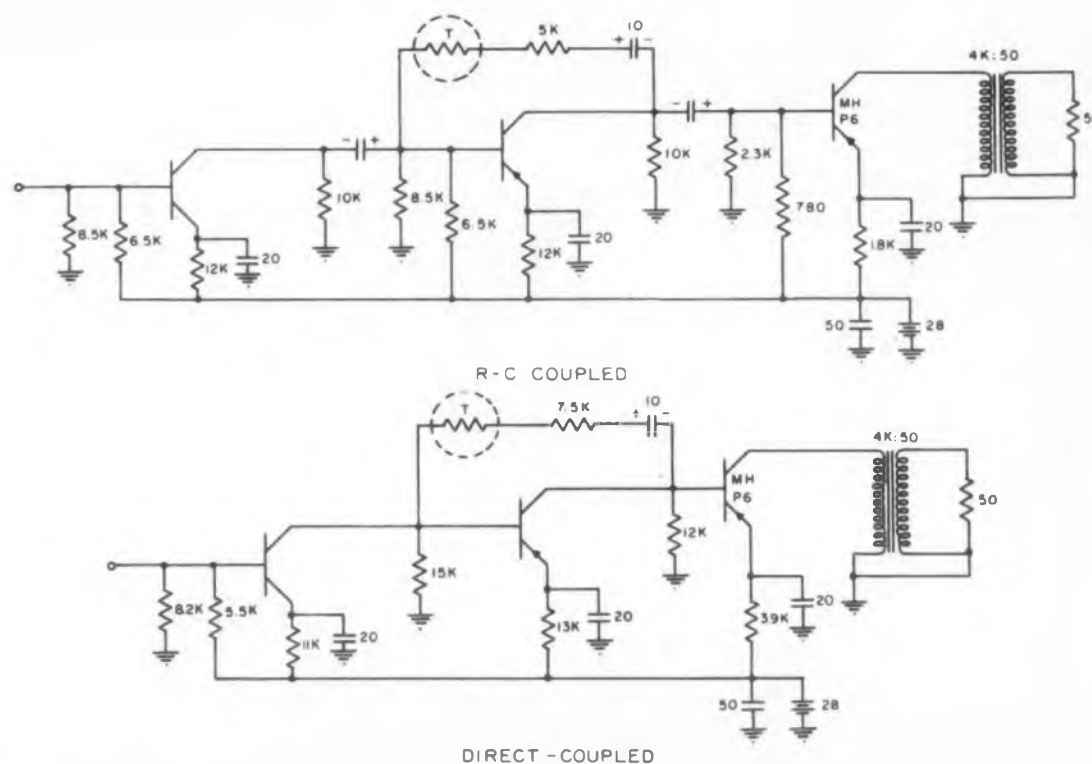


Fig. 3. Schematics of experimental three-stage amplifiers.

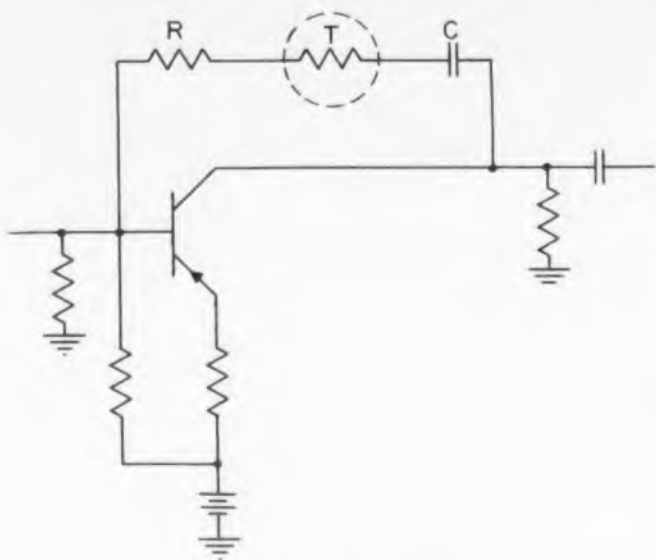


Fig. 1. Simplified schematic showing feedback loop.

Compensation for low-temperature gain losses can be achieved by utilizing negative-temperature-coefficient characteristics, while high-temperature compensation is attained using positive-temperature-coefficient characteristics. The curves of Fig. 2 show the relationship between low-temperature characteristics of the feedback loop resistances and the gain characteristic of a three-stage, r-c coupled, uncompensated transistor amplifier. Note that an exponential decrease in gain is experienced with reduced temperatures. The coefficient of the thermistor should be such that the low-temperature characteristic of the composite a-c feedback loop resistance will be the approximate antithesis of the uncompensated amplifier gain characteristic. Under these circumstances, as temperature decreases, the feedback degeneration will decrease exponentially, with a resulting exponential increase in amplifier gain. This increase should compensate for the normal low-temperature gain losses.

This general theory is equally applicable to compensation for high-temperature gain losses. In this case, the compensating element in the feedback loop would be a positive-temperature-coefficient resistance. This resistance would increase as temperature increases, thus tending to reduce the degenerative effect of the feedback loop. The curves of Fig. 2 also show the relationship between high-temperature characteristics of the feedback loop resistances and the gain characteristic of the three-stage, r-c coupled, uncompensated amplifier.

Experimental Results

The three-stage, r-c coupled and direct-coupled amplifiers used for the experimental verification are shown schematically in Fig. 3. Design was based on typical operating points for all three stages of the r-c coupled amplifier. Operating points for the direct-coupled amplifier were selected as feasible for ac-



TYPICAL OPERATION

(Frequencies up to 175 Mc per tube)

	Class-C CW or FM Phone	Class-C AM Phone	Class AB, R-F Linear
D-C Plate Voltage	2000 volts	1500 volts	2000 volts
D-C Screen Voltage	250 volts	250 volts	350 volts
D-C Grid Voltage	-90 volts	-100 volts	-50 volts*
D-C Plate Current	250 ma	200 ma	
Zero-Sig D-C Plate Current			100 ma
Max-Sig D-C Plate Current			250 ma
Screen Current	25 ma	25 ma	15 ma max
D-C Grid Current	27 ma	17 ma	
Peak R-F Grid Voltage (approx.)	115 volts	121 volts	50 volts
Driving Power	2.8 watts	2.1 watts	0 watts
Plate Power Output	410 watts	250 watts	325 watts max

*Adjust grid voltage to obtain specified zero-signal plate current

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4CX300A functions at full ratings through 500 megacycles, and operates over a wide range of plate voltages — 500 to 2000 volts — with power inputs from 125 to 500 watts.

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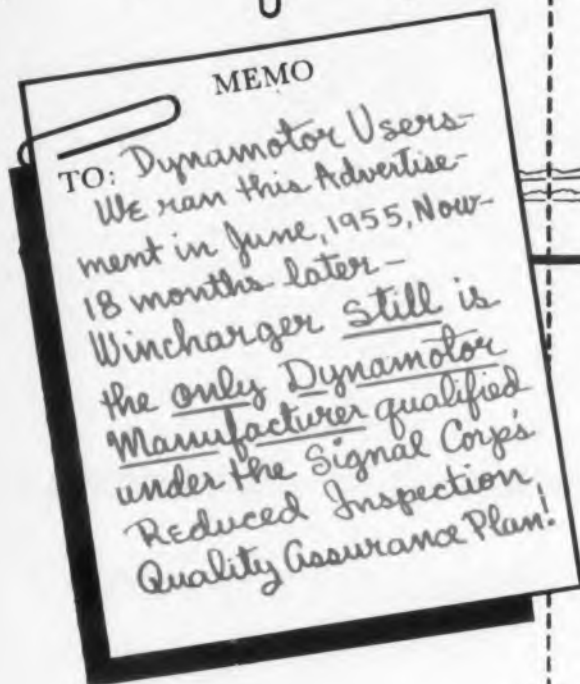


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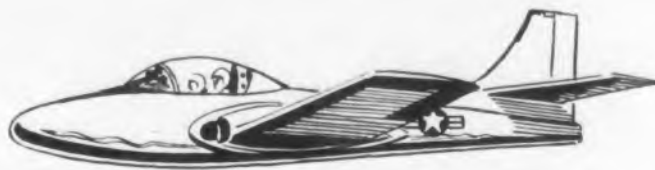
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ceptable circuit operation with a 28 v d-c supply. The inverse feedback loop was arbitrarily placed between collector and base of the second stage. It could just as well, from a practical viewpoint, have encompassed all three stages by placing it between third-stage collector and first-stage base. Room temperature power gain was reduced 12 to 15 db by the feedback loop. The thermistor unit selected had a room-temperature value of about 250 ohms. Since the open-loop gain of the direct-coupled amplifier is greater than that of the r-c coupled amplifier, a higher value of R is required for the direct coupled amplifier to maintain the same feedback ratio for both amplifiers. The p-n-p transistors used represent the standard product of four different manufacturers.

The compensating effect of the thermistor is clearly evident in the four graphs of Fig. 4. These graphs present a comparison of the low-temperature gain characteristics of the amplifiers with thermistor feedback and fixed resistance feedback.

Through use of a combination of ntc resistance and ptc resistance in a feedback loop, it is possible to obtain flatter response over a wider temperature range. Fig. 5 presents experimental curves depicting three-stage power gain for an r-c coupled germanium transistor amplifier without feedback and with composite feedback. The composite obviously has the advantage of flat response over a fairly wide temperature range.

Thus, in addition to advantages of stability and linearity associated with degenerative feedback, a flat gain characteristic over an appreciably wide temperature range can be conveniently obtained for a transistor amplifier.

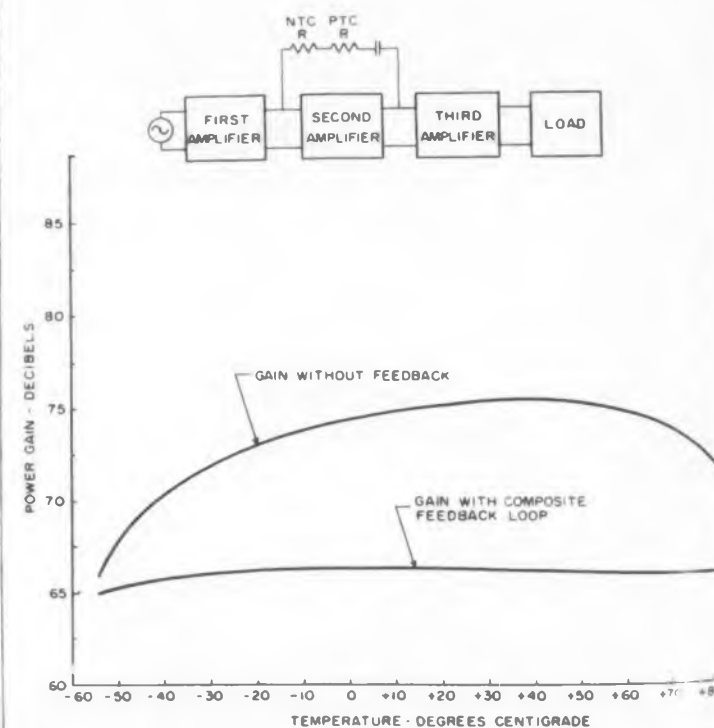


Fig. 5. Temperature characteristics of three-stage, r-c coupled transistor amplifier gain with and without feedback.

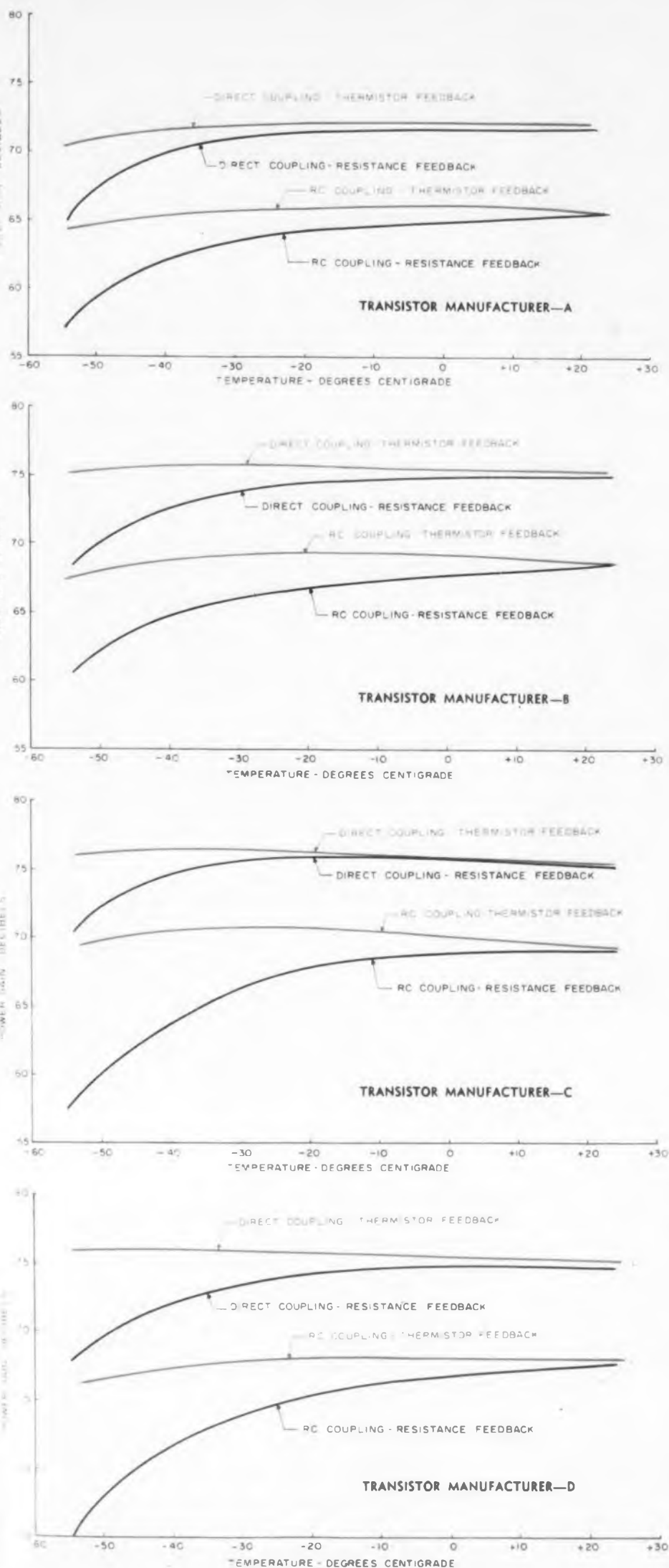


Fig. 4. Low temperature gain characteristics of four different manufacturer's transistors in a three-stage transistor with thermistor feedback and fixed resistance feedback. Legend:

1. Direct coupling thermistor feedback
2. Direct coupling resistance feedback
3. R-c coupling thermistor feedback
4. R-c coupling resistance feedback

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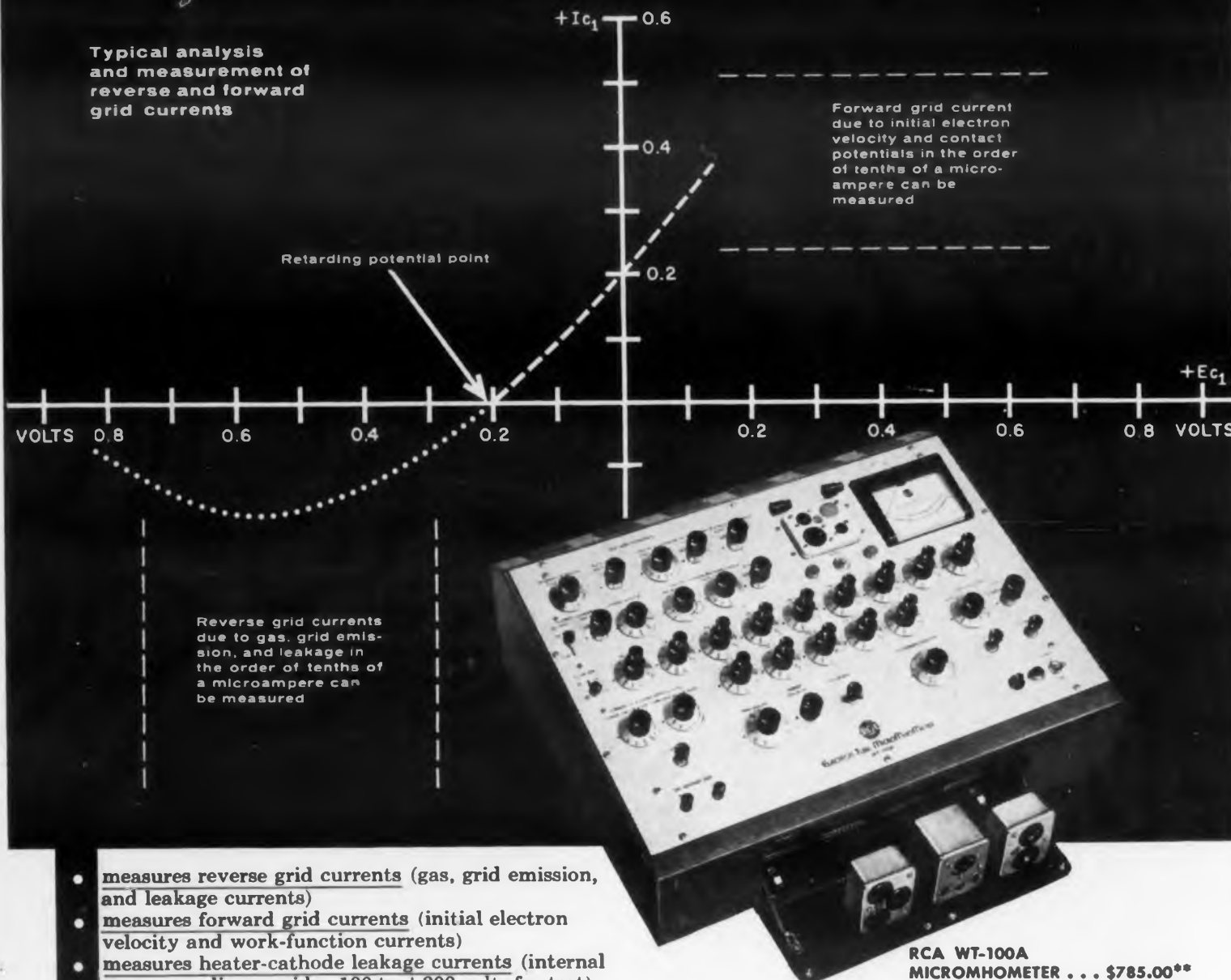


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42 Microsec

A DELAY line recently developed for aircraft electronic applications will give pulse delay of 42 μsec . It incorporates the basic properties of magnetostriction of nickel, and is shown in Fig. 1. The unit shown has 15 pickup coils from which delayed pulse outputs may be obtained. The input pulse is applied to the "launching coil" as shown in Fig. 2. Delay of output from each pickup coil is adjustable precisely by micrometric screws, with stability of position in time within 0.05 μsec .

This precision delay line is manufactured by Del-time, Inc., 608 Fayette Ave., Mamaroneck, N. Y., and is only one of a line of magnetostrictive devices they have developed. This particular line weighs 1.5 lb. The spaced output pulses are generated from a single pulse fed into a crystal matrix. By suitably biasing the individual crystals, a pulse code may be obtained as shown in Fig. 2.

The Model 103 Delay Line, shown in Fig. 3, provides infinite time-delay settings by means of individual pickup coils positioned and locked in place along the slotted and calibrated microsecond delay scale. Extra pickups to a maximum of 20 can be added without noticeable reduction of output due to loading. Closest juxtaposition of pickups is about 1 μsec .

These lines are particularly applicable for high access rate temporary storage for computers, replacing drum-type storage; time or frequency determining elements of passive nature, digital circuitry and registers, etc.

For additional information on this product, fill out the Reader's Service Card and circle No. 28.

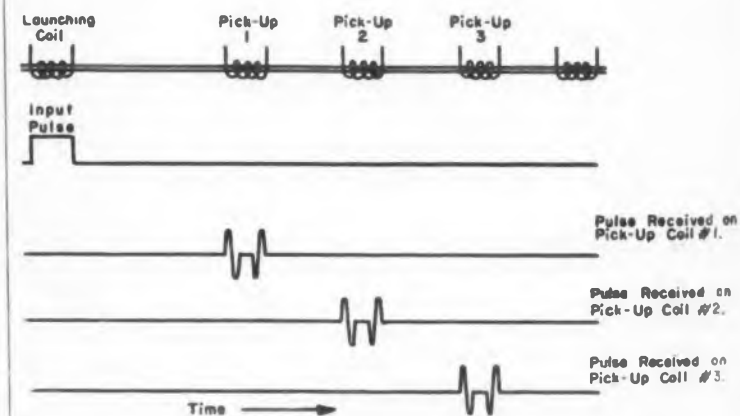


Fig. 2. Typical output pulses, showing how they are spaced in time depending upon physical location of pickup coils.

Delay Line

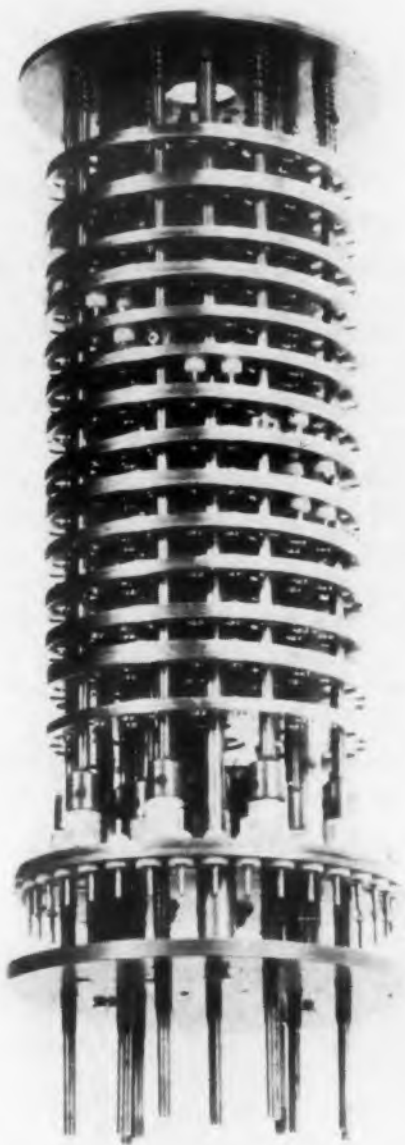


Fig. 1. Model 117 Magnetostrictive Delay Line before potting. Fifteen delayed outputs can be obtained.

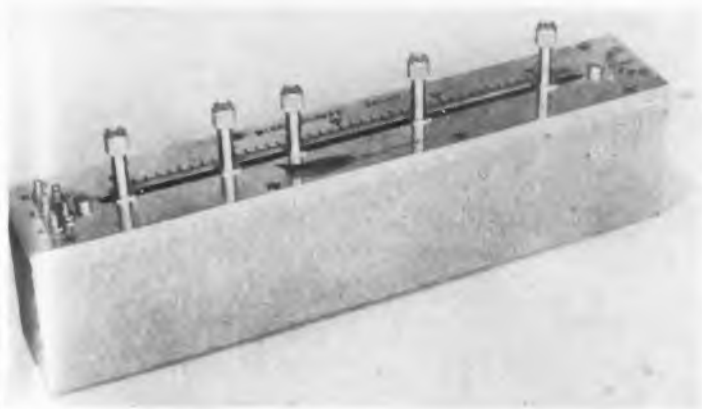
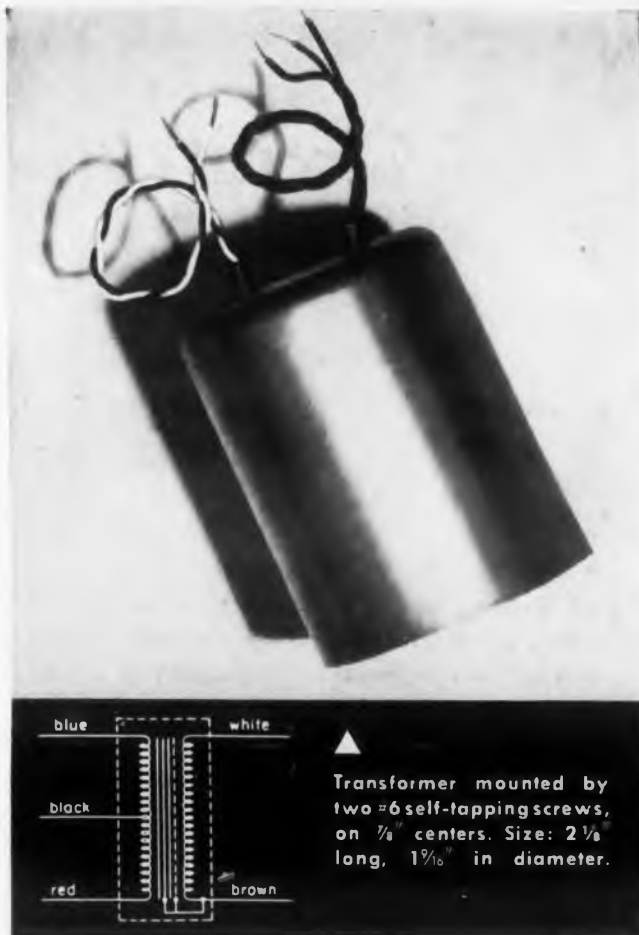


Fig. 3. Delttime Model 103 Delay Line which can be fitted with up to 20 pickup coils with delays up to several milliseconds.



Transformer mounted by two #6 self-tapping screws, on $\frac{1}{8}$ " centers. Size: $2\frac{1}{8}$ " long, $1\frac{1}{16}$ " in diameter.

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Circuitry For Photodiodes

PHOTODIODES are particularly useful where phenomena sensing is required in areas inaccessible to ordinary mechanical sensing devices. Circuitry for using photodiodes is shown and described in this article.

Sensing with photodiodes can be accomplished using either reflected or transmitted light. The useful light wavelengths for the Sylvania IN77A photodiode, for example, extend from the near ultraviolet into the infrared. In some light sensitive materials this could be an important factor. The light-sensitive region for the IN77A photodiode is shown in Fig. 1.

In the circuitry shown here, transistors were selected for amplifiers because it was felt that in most applications for the photodiodes space would probably be an important consideration.

Detection and Counting

The circuit of Fig. 2 is one to perform the function of material detection or counting. The photodiode output is fed into a two-stage, dc coupled, common-collector amplifier. With the light levels probably available, no voltage amplification will be necessary. This allows the construction of a transistor amplifier with minimum components and yet more than sufficient power gain to operate a moderately sensitive control relay. Potentiometer R_2 acts as a gain control by balancing out the effect of the no-signal dark current of the photodiode which at 45 v will be on the order of $50\mu\text{a}$. If mechanical counting through the control relay is undesirable, electronic counting can be used by replacing the relay with a 1K resistor and using the pulse output to trigger counting tubes or some other electronic counting device.

Position Indicator

Shown in Fig. 3 is a circuit for using photodiodes as a position indicator or position controller. The circuit input uses two photodiodes to control the input voltage. The amplifier output uses a complementary transistor pair to drive a dc control motor. The effect of an increased (or decreased) light intensity on either photodiode will drive the control meter in the direction given by the activated photodiode. The photodiode potentiometers should be adjusted for no motor movement when both diodes are exposed to a light source. This circuit set-up is advantageous, for example, in automatic production operations where obstructions or a complex material shape obviates use of stationary feeders or welders. As the material to be worked interrupts the light beam to the first photo-

John Grant
Field Engineering
Electronics Division
Sylvania Electric Products, Inc.

diode, the feeder or welder could start moving toward the object, perform its function on interception and then retract as the second photodiode is cleared by the object worked on. This system also makes it unnecessary to stop the feeder mechanism if the work can be done fast enough or if the feeder programming is set at the proper speed.

Speed Control

The circuits of Fig. 4 are similar to that of Fig. 2. They can be used as a speed control as follows: The circuit at (A) has a capacitive delay on relay closing, and the circuit at (B) has a capacitive delay on relay opening. Other component values than those listed are the same as in Fig. 2. With the values of capacitance shown, the times of relay delay in closing and opening are both approximately 1 sec.

Circuit Advantages

The advantages of the circuits discussed are as follows:

1. *Size.* The photodiodes employed in the circuits are only about 1 in. by 1/10 in. in size;
2. *Voltages.* Low voltage values can be used which conserve space and are not dangerous;
3. *Non-interruption.* The objects being counted need not be stopped or retarded in order to be sensed;
4. *Response Time.* The frequency response time of the photodiodes extends into the tens of kilocycles;
5. *Remote circuitry.* It is possible to take advantage of the small size of the photodiodes and place the rest of the circuitry at some distant point where space is not at a premium;
6. *Life.* Life of a semiconductor device exceeds that of a mechanically-tripped relay.

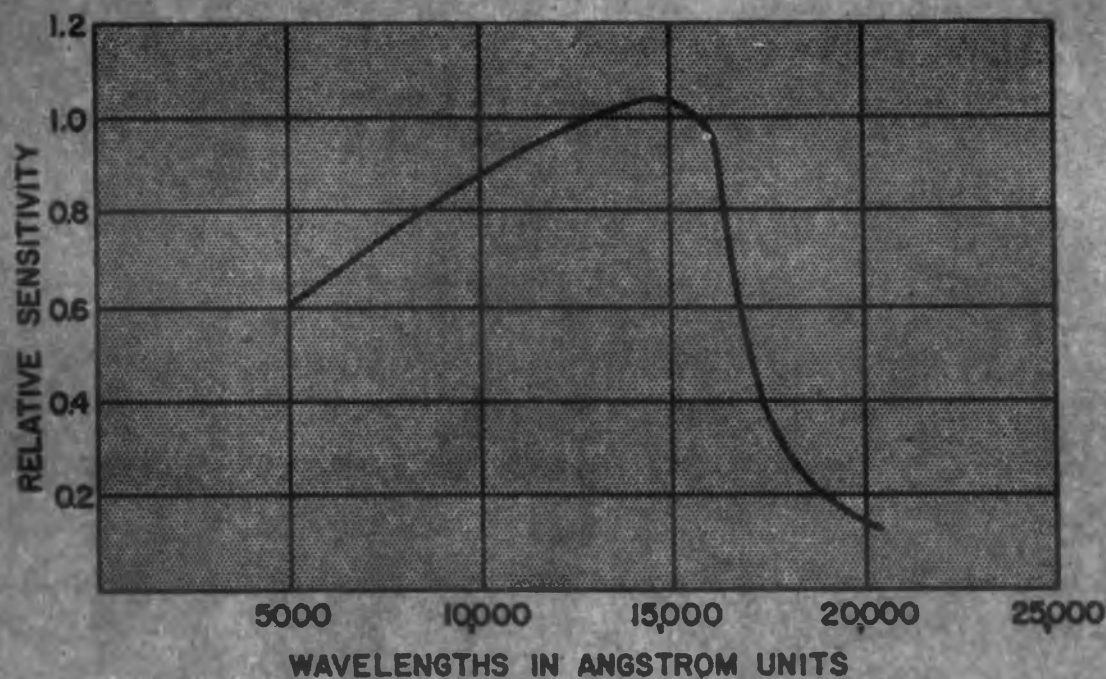


Fig. 1—Wavelength-sensitivity curve for Sylvania IN77A photodiode.

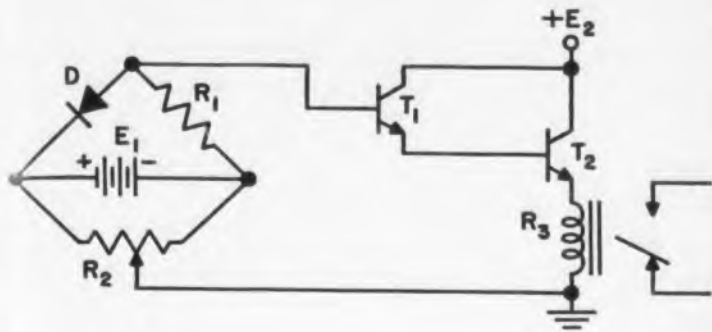


Fig. 2—Photodiode circuit for detection and counting. Components: D —1N77A photodiode; E_1 —22-45 v; E_2 —6-12 v; T_1 , T_2 —2N35 transistors; R_1 —100K; R_2 —50K pot.; R_3 —Sigma 400G relay.

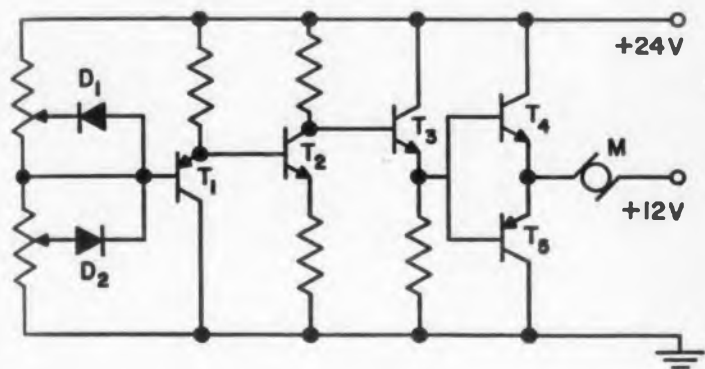


Fig. 3—Position indicator circuit. Components: D_1, D_2 —1N77A photodiodes; T_1 —2N34; T_2 —2N35; T_3, T_4 —2N95 power transistors; T_5 —2N68 power transistor; M —dc control motor (approx. 200-300 ma full speed).

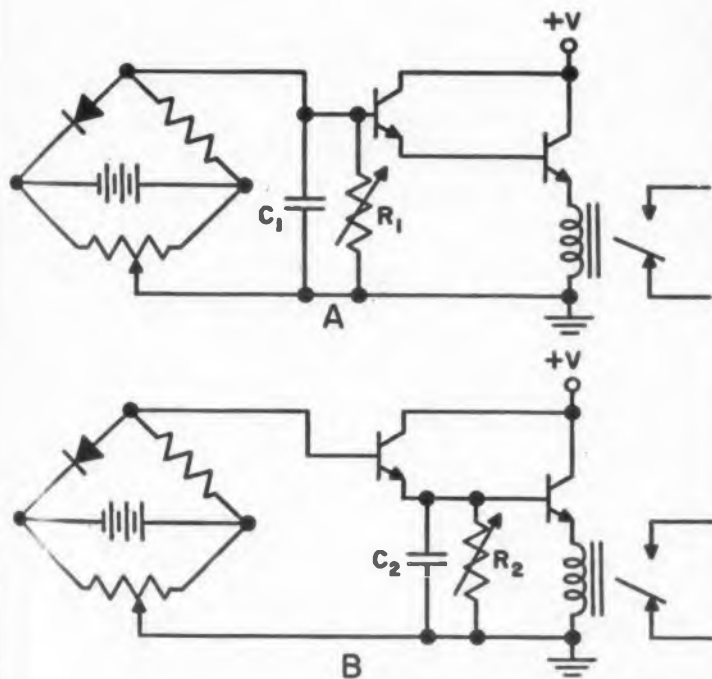


Fig. 4—Speed control circuit. (A)—Delay on relay closing; (B) Delay on relay opening. Components: C_1 —4 μ ; R_1 —1M fine time control; C_2 —100 μ f; R_2 —100K fine time control.



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Insulated



Non-Insulated

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Wire Sizes: #14 to #18



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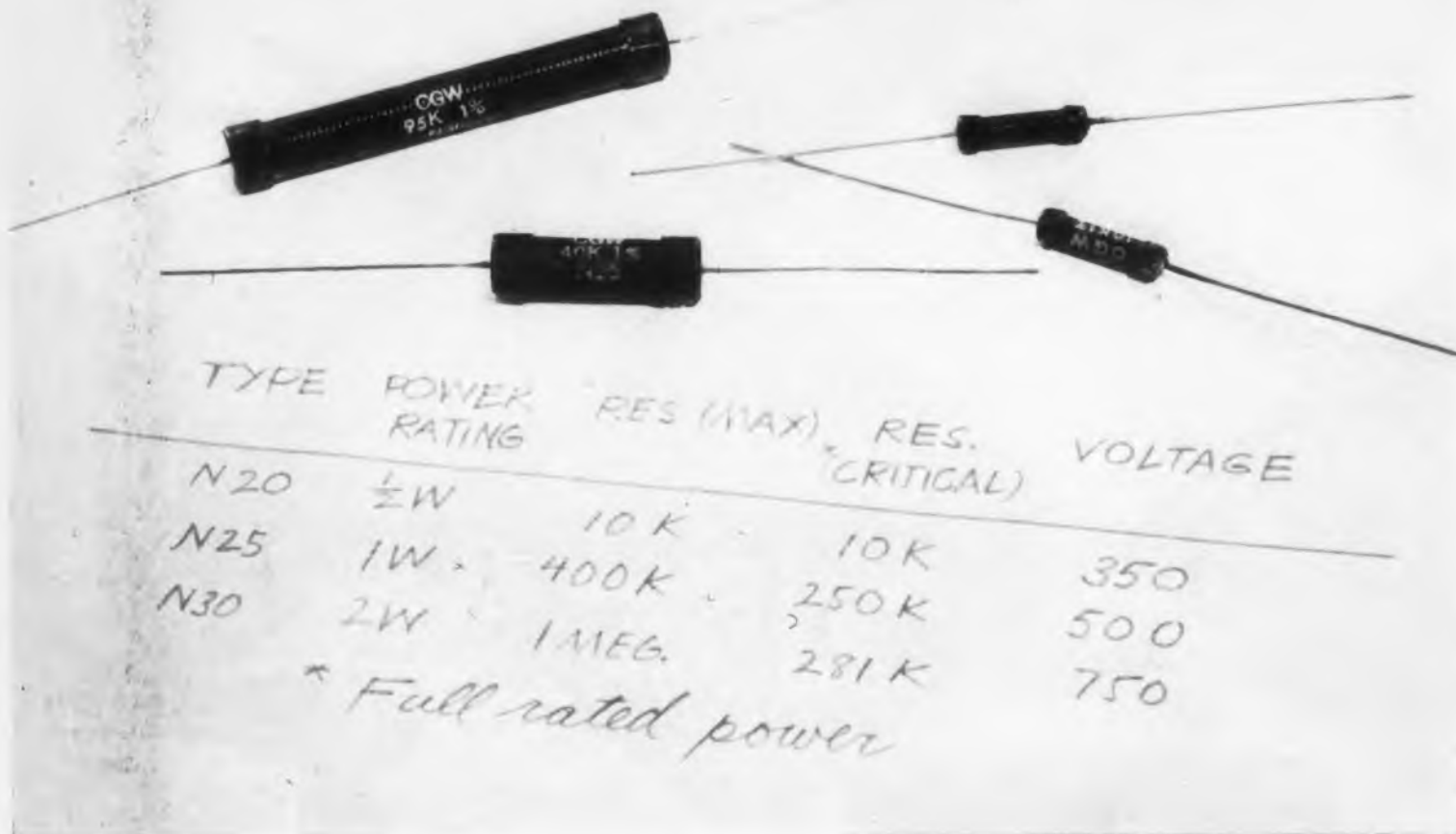


Left: With an Interlock Plug and Jack securely mounted, test begins with platen vibrating at 10 cycles per second. Right: at 50 cycles per second, camera stops motion to show plug still locked in its jack! Tested for 18 hours at an amplitude of .06 inch and at a varying frequency from 10 to 50 to 10 cycles per second, conductive quality remained steady with no current interruption during vibration.



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Corning scientists have developed a new 600 ohms per square resistive film. This new film, which is integrally bonded to the glass core, increases the resistance values for each Type N size as noted above. This table shows you the new ratings.

With this development, you also get a much improved temperature coefficient. It can be guaranteed to ± 300 ppm/ $^{\circ}$ C. over the temperature range of -55° C. to $+105^{\circ}$ C. referenced to 25° C.

You get these noninductive resistors in standard tolerances of 1%, or closer if you wish. They are stable, have low voltage coefficients and noise levels so low they are difficult to measure. The

film and the core are impervious to moisture. Even rough production handling and thermal shock of soldering will not alter values. Corning Type N Resistors meet or exceed MIL-R-10509A specifications.

You can use them in circuits where other precision resistors are unsuitable or in the place of costly wire-wound resistors. With their stable, noninductive, low-noise characteristics, you can use them in test equipment, high-frequency circuits—wherever you're working with low-signal, high-gain amplifier stages.

Our catalog sheet details complete information. We'll send it to you with samples and very interesting price lists at your request. Write us or circle this publication's reader service number.

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CHANGES in the frequency of uhf oscillators can be measured with a particularly high degree of accuracy by this test unit, recently declassified by the USAF and now available commercially. Known as the Model 5004 Stalo^o Stability Tester, the instrument, although originally developed for measuring radar local oscillator stability, can be used as a laboratory device for more general applications where precise measurement of drift or rate of drift information is needed. Frequency behavior can be monitored continuously and meter readings are shown instantly. Heretofore, the measuring procedures were both involved and time consuming so that a behavior pattern of the oscillator being observed could change before the values were determined.

Front panel drift meter indications are the end product of interesting circuitry. The signal under test drives a quantizer circuit which develops output pulses of constant width and constant amplitude. These two factors are held constant so that only changes in the total number of pulses quantized are significant. The quantizer output is integrated by coupling the pulses through a diode to a capacitor, and the voltage level on the integrator capacitor is used to drive the drift meter. A frequency change causes a change in the number of pulses quantized, and hence a change in the voltage level of the integrator. The drift meter is calibrated in cps. Sensitivity is better than 2 cps, at S-band, with this counter type discriminator.

In addition to drifting, the circuit under test usually is being frequency modulated at a certain rate. The quantizer output is therefore filtered, detected and displayed on another meter to give the rate of drift. The calibration of this second meter is in kc/sec.

S-, L- and X-band signals usually measured are too high in frequency to be used to drive the

*Word contraction for stabilized local oscillator.

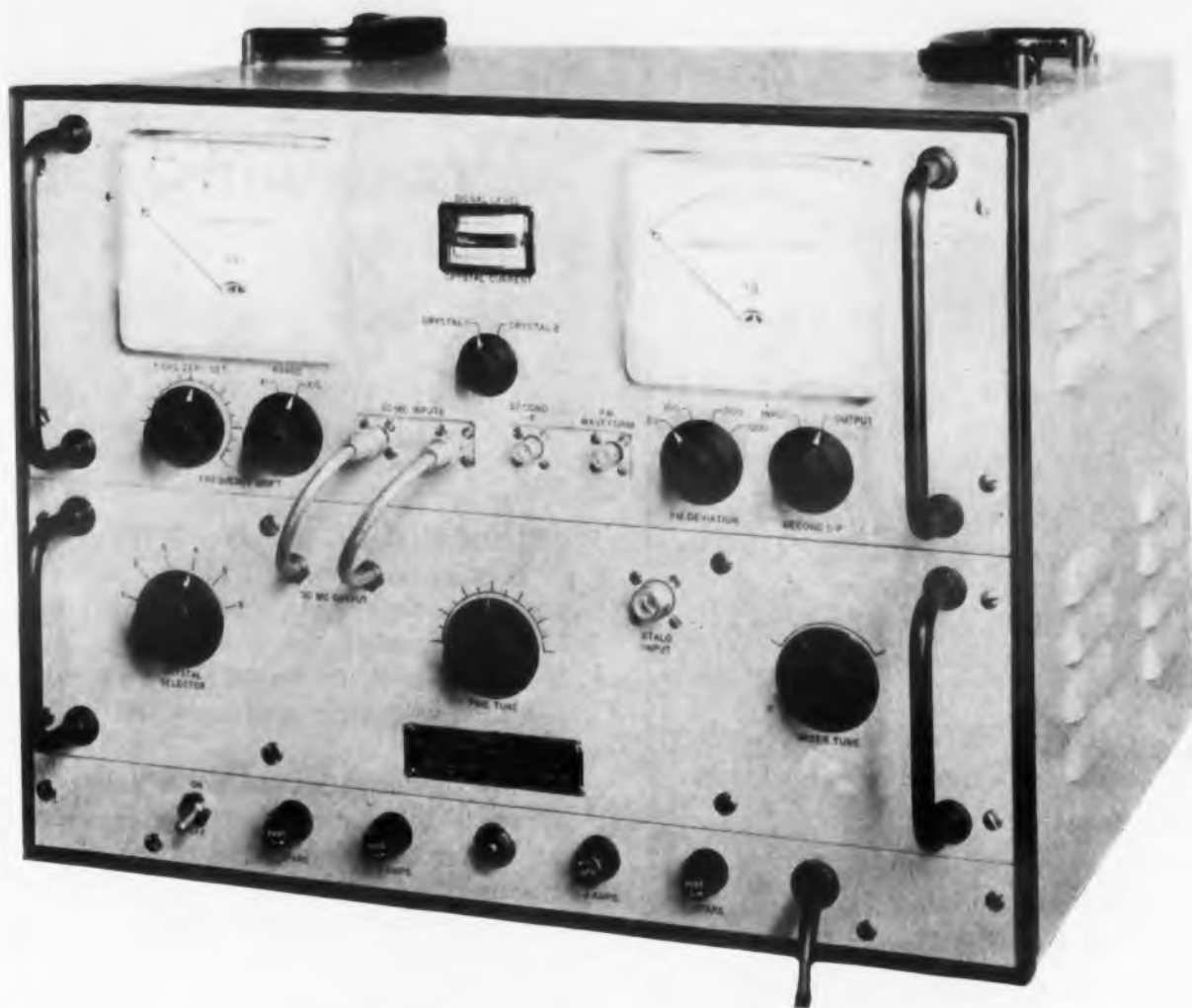
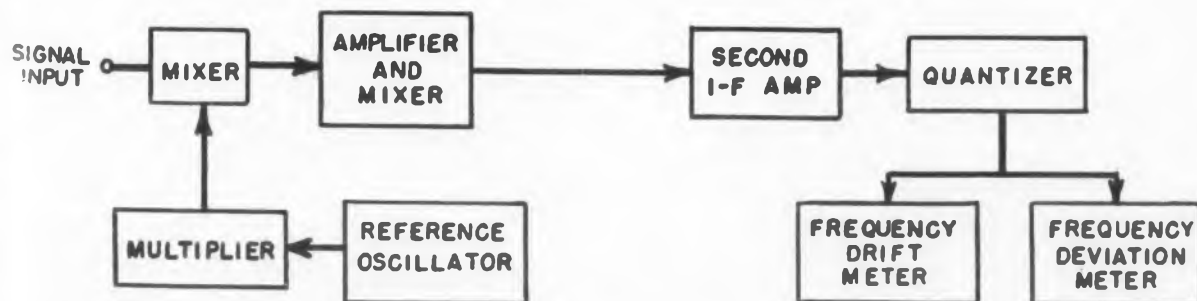


Photo: Front Panel View, Stalo Stability Tester

quantizer. They are, accordingly, beat with a crystal-controlled reference oscillator in a hybrid junction mixer to produce a 30 mc signal. This is amplified in an if amplifier and further reduced in a second detector and mixer to give an output that can vary between 30 and 230 kc, depending upon the signal under test. This latter signal, which preserves the drift information of the original signal, drives the quantizer.

The output of the instrument may also be viewed on an oscilloscope or spectrum analyzer. The test instrument is manufactured by Laboratory For Electronics, Inc., 75 Pitts St., Boston 14, Mass.

For more information on this stability tester, fill out the Reader's Service Card and circle 32.



Line Drawing: Simplified Block Diagram, Stalo Stability Tester

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LABORATORY TYPE

ELECTRICAL SPECIFICATIONS

Input:	105-125 v. 50-400 cps
Output:	325-525 VDC, 0-200 ma DC 6.3v. 10 amp AC
DC Regulation:	0.15% or 0.3 v. (whichever is greater) against line 0.25% or 0.5 v. (whichever is greater) against load
Internal Impedance:	less than 6 ohms
Ripple and Noise:	less than 3 mv rms

Two models available; Model PS-L425 in 325-525 VDC range, Model PS-L225 for 125-325 VDC. Designed for dependable, continuous heavy-duty operation. Protected against external overloads or internal failure. Electronic control; substantially free from noise and hum signals. All transformers and chokes hermetically sealed. Designed for standard 19" relay rack mounting.



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Output:	300 v. 150 ma DC 6.3 volts 6 amp AC
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Producing 3D

A SCHEME has been developed for producing true 3D in a volume by the localized glow discharge between two wires. The wires are closely positioned but skew. A switching means must be provided for rapidly distributing this glow throughout the volume.

Glow discharge is used as the light-point. Although this glow has a finite size, it is small compared to the size of the viewing volume. Its position in the volume is controlled by the electrical connections to small wires threading the volume. Switching of these connections moves the glow to any desired point in the viewing space.

A set of three plane parallel wires, *a*, *b*, and *c*, is at right angles to a set of three other plane parallel wires, *s*, *t*, and *u* (Fig. 1), to illustrate the basic principle. Planes of the two sets of wires are spaced a small distance apart so that none of the wires are in direct contact. The system is housed in a gas environment, neon for example, at suitable pressure. Connections from each of the wires are brought out from this environment to switches *X* and *Y*, and the arms of these switches are connected to a suitable source of electrical energy in series with resistor *R*.

Wires *c* and *s* are connected to the source. These wires, then, act as elements of a gas diode, so that a glow discharge occurs at region *P* where the wires are closest. If the arm of switch *X* is moved to wire *t*, the glow is transferred to the region *Q* between wires *c* and *u*. Similarly, moving the arm of switch *Y* moves the glow correspondingly. Glow intensity is controlled by varying resistor *R*.

If a larger number of parallel wires is added to each set, so that there are *n* in each direction, there will be *n*² points similar to *P* and *Q* where a glow discharge may occur. The plane defined by these *n*² points is equivalent in function to the screen of a cathode-ray tube.

Visual Patterns

By stacking n of these planes and adding suitable switching means, the glow discharge may be made to appear at any of n^3 points in cubical space. (See Fig. 2.) To produce the 3D pattern, it is necessary to control the switching in some periodic fashion.

Obvious applications of this patented concept by Martin Rudefer, Wantash, L.I., N.Y., are: radar, sonar, field phenomena, radiation patterns, transient phenomena, intensity modulation in four-dimensions.

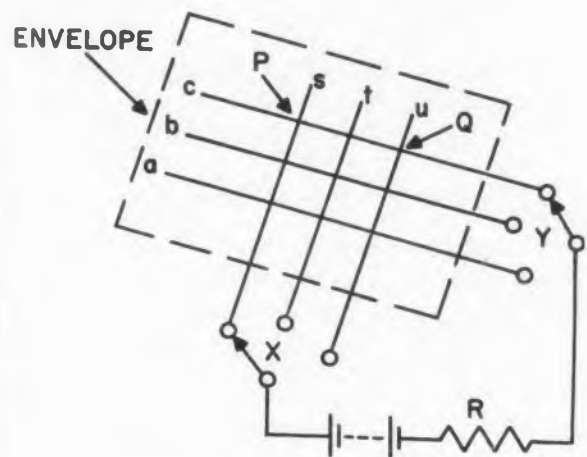


Fig. 1 Planar glow at wire proximity junctions

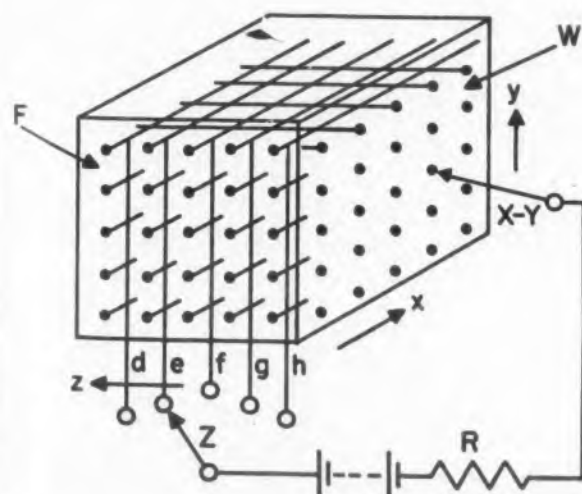
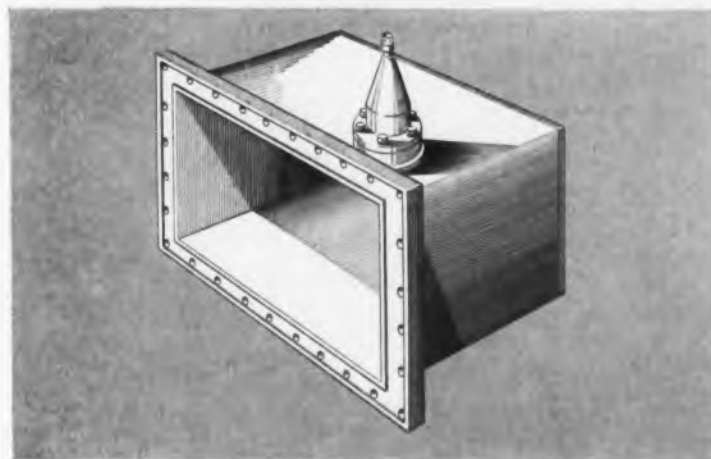


Fig. 2 3D glow at wire proximity junctions

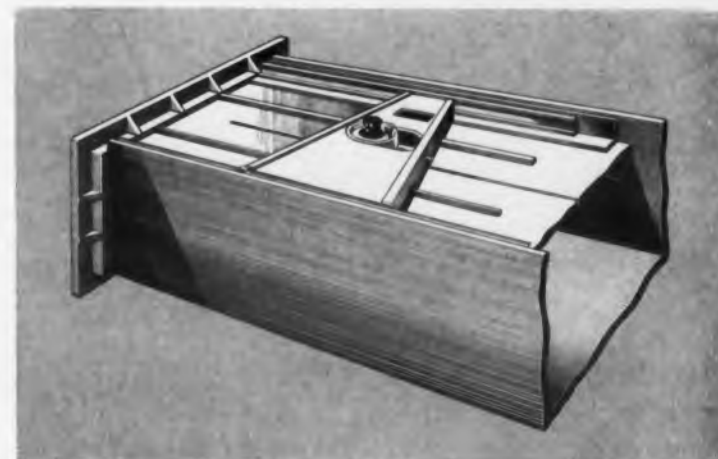
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Transistorized Power Sources

For DC to AC and DC to DC Conversion*

Robert R. Smyth and Marvin G. Schorr

Consultants

Power Sources, Inc.
Arlington, Massachusetts

COMPLETELY transistorized power circuits are now available for conversion from dc to ac and for step-up of dc voltage level. Need for mechanical vibrators or rotating machinery is eliminated, with resultant reduction in size, weight, and shock sensitivity and increase in reliability, operating life, and efficiency. Transistor power source is unharmed by short circuit load. Operation of circuits and performance results are described in this article.

Methods of Power Conversion

In providing electrical power for nearly all forms of vacuum tubes, circuits, and components, dc and ac potentials are usually required well above the standard battery and dc line supply voltages. Mechanical vibrators and rotary converters are commonly used to convert the low-level dc to pulsating dc or to an alternating sinusoid. Voltage level can then be raised by normal transformer step-up techniques, and filtered to provide high-voltage dc.

The mechanical vibrator has a relatively short service life of at best about 2000 hours, and its make-and-break contacts give rise to electrical interference noise. Both vibrators and rotating machinery are susceptible to shock and vibration, with rotary converters suffering the further disadvantages of bulk, relatively low efficiency of about 60%, and the requirement for periodic maintenance.

A new and improved solution to the problem of converting dc voltage level involves the use of a transistor power oscillator to interrupt the low-level dc

source. Fig. 1 shows both internal and external appearance of a typical transistor power converter developed by Power Sources, Inc. of Arlington, Mass. Transistors, driven in push-pull, replace the customary mechanical element, and the power converter circuit can thus withstand the full shock and vibration limits of the transistors themselves. By using transistors, weight and volume of the power converter can usually be reduced, and power efficiency increased to as high as 85%. The most spectacular advantage of the transistor power converter, however, is its increase

in operating life. Power converter life is limited only by the basic components themselves and may be 50,000 hours or more under suitable conditions.

Basic Transistor Oscillator

The basic transistor oscillator used for power conversion is shown in Fig. 2. The transistors operate in push-pull, with the transformer windings arranged to provide positive feedback from the collector of each transistor to its emitter. The operation of the circuit can be described with the aid of the transformer B-H

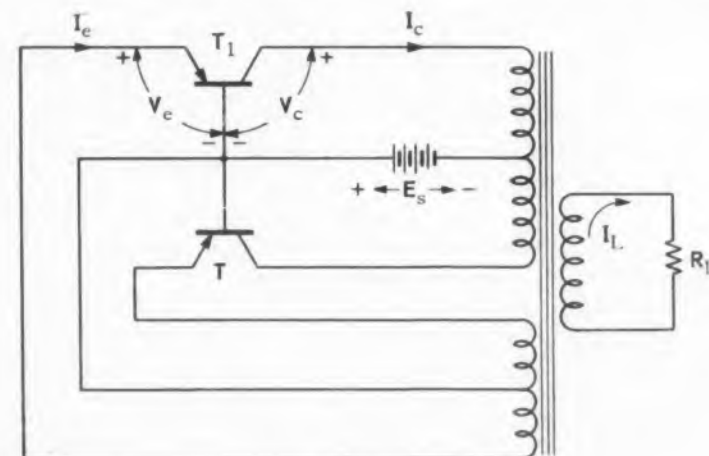


Fig. 2. Basic transistor oscillator circuit

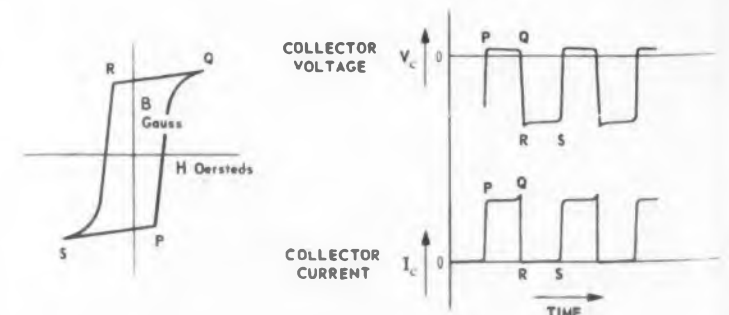


Fig. 3. B-H curve for transformer core and resultant oscillator waveform

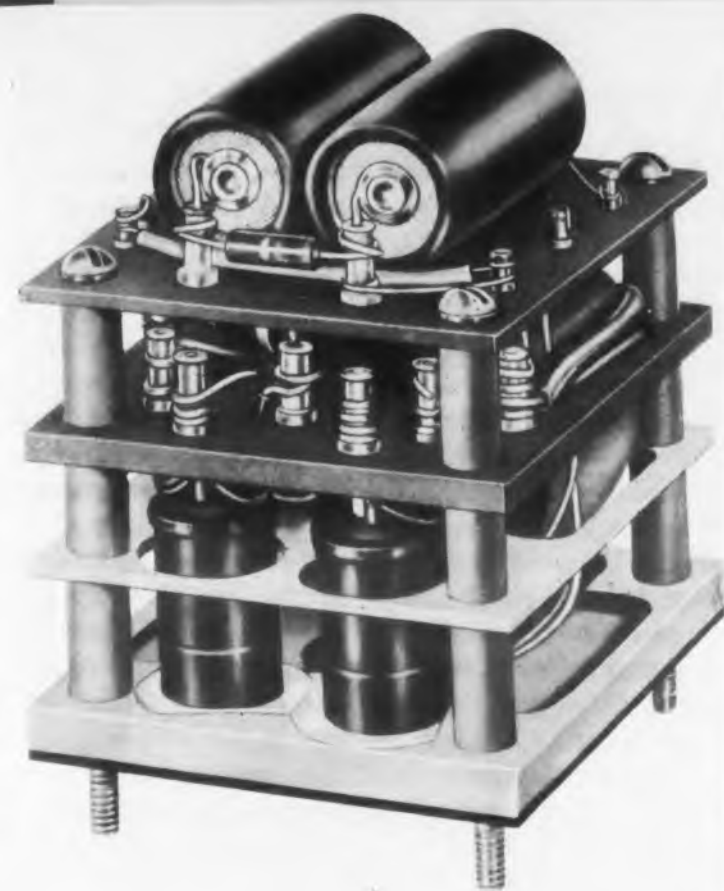


Fig. 1. Typical transistor power converter for 24 v dc input and producing 30 watt output. It fits into a standard MIL-T-27 can measuring only 3-1/16 x 3-3/16 x 2-5/8 in. The entire unit weighs only 14 ounces.

curve and the waveforms of Fig. 3. Assume transistor T_1 is non-conducting, T_2 conducting, and the transformer core saturated at the point P on the B-H curve.

When T_1 starts to conduct, a voltage is developed across the primary winding, inducing a voltage in the feedback windings that drives the emitter of T_1 positive and causes increased conduction. Thus, the current increases rapidly until the collector of T_1 is driven to the saturation region of its characteristics. When this occurs the primary voltage can no longer increase and a condition of quasi-stable equilibrium is maintained. During this equilibrium period, the voltage drop in the transistor is very small, and the full battery voltage appears across half the primary.

As long as T_1 can supply a collector current equal to the total of reflected load current, reflected emitter current, and transformer exciting current, this condition will be maintained. With a resistive load, the reflected load and emitter currents remain almost constant. The exciting current is small as long as the core remains unsaturated.

With a constant voltage across the transformer primary, the magnetic flux must increase according to the relation:

$$E = N \frac{d\phi}{dt}$$

Development work on transistor power converters has been supported by the Power Sources Branch, Signal Corps Engineering Laboratories, Fort Monmouth, New Jersey.

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320-ES	.320	.113	5/16	1-15/16	.148	10-32	1/4	5/32	11/16	1500	30 A.	20
330-ES	.330	.116	1/2	1-7/8	.148	10-32	1/4	5/32	7/16	1500	30 A.	20
375-ES	.375	.116	1/2	1-7/8	.148	10-32	1/4	3/16	7/16	2500	30 A.	20
450-ES	.450	.150	1/2	2-1/8	.203	1/4-28	3/8	1/4	11/16	2500	60 A.	35
500-ES	.500	.150	1/2	2-1/8	.203	1/4-28	3/8	1/4	11/16	2500	60 A.	35
625-ES	.625	.150	1/2	2-1/8	.203	1/4-28	3/8	5/16	11/16	2500	60 A.	35

*40% R.H. - sea level - 60 cycles R.M.S. per MIL-T-27 Test Method.
†Rated maximum terminal rotational torque in inch lbs.

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Thus during the flat portion of the voltage wave, the core flux increases from P to Q on the B-H curve. During this interval there will be a slight increase in the exciting current requirement, but this represents only a small fraction of the total collector current and can be readily supplied by transistor T_1 .

Eventually at point Q , the transformer core reaches saturation and the required exciting current increases rapidly to a greater value than can be supplied. As a result, the primary voltage decreases, reducing the emitter voltage and decreasing the collector current. Thus transistor T_1 shuts off regeneratively, ending the half cycle. As the flux collapses from point Q to R , voltage is induced in the winding which biases transistor T_2 to conduction, thereby initiating the next half cycle. During this interval, operation is identical except that T_2 conducts until the core is driven to negative saturation, represented by point S on the B-H curve.

Typical collector voltage and current waveforms are shown in Fig. 3. These pertain to a circuit operating with a properly designed transformer into its optimum load. The waveforms are desirably square except for the spike at the end of the current waveform, which represents the additional exciting current required as the core approaches saturation. Since the collector of a transistor is bottomed during its complete conduction interval, transistor dissipation is low.

DC to DC Transistor Power Converter

A complete transistor power converter is shown in Fig. 4, and includes a full-wave bridge rectifier and filter in the transformer output circuit. Because of the high-frequency components in the essentially square-wave output of the transistor oscillator, the size of the required filter is small.

An additional circuit has been added because the basic transistor oscillator of Fig. 2 is generally not self-starting, particularly under load. The resistor from the common base lead to the negative supply voltage produces sufficient base bias current to cause oscillation. Once the circuit is oscillating, the diode clamps the bases at ground. The resistor value depends on both the load current and the transistor gain. Generally speaking, the necessary bias current is much smaller than the base current when the transistors are

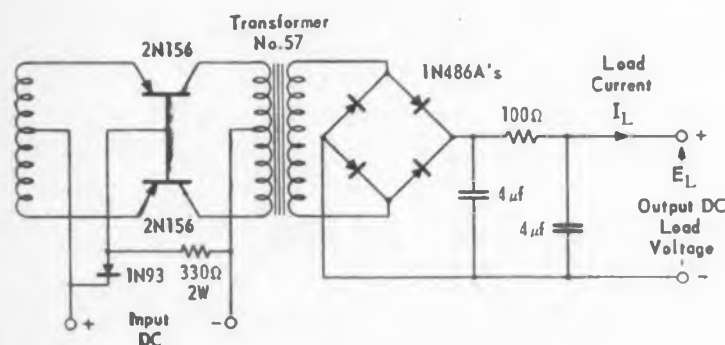


Fig. 4. Circuit of DC to DC transistor power converter

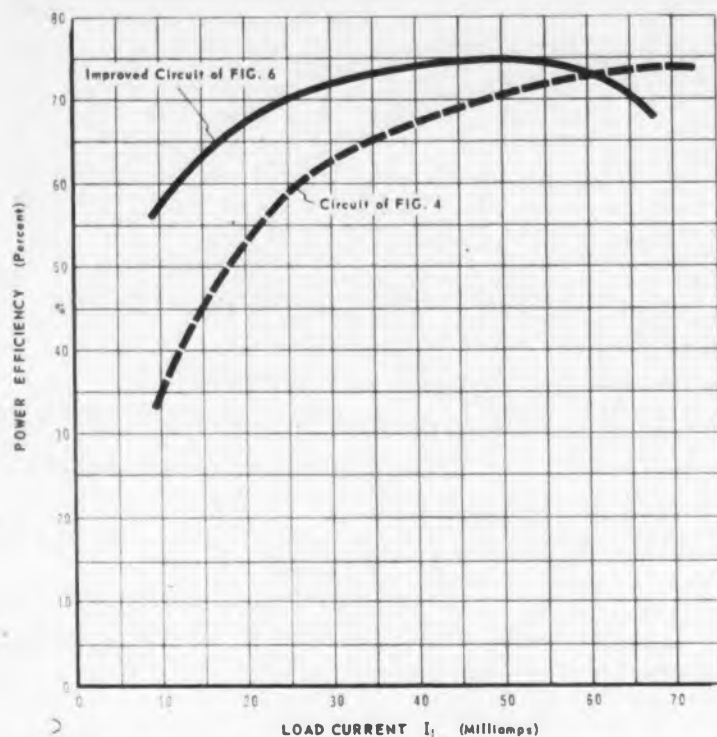


Fig. 5. DC to DC power conversion efficiency vs. load current

oscillating. Consequently, the loss in the resistor is small compared with the load power, causing a negligible decrease in efficiency.

Conversion Efficiency

The power converter of Fig. 4 has a dc-to-dc power efficiency shown by the dashed curve of Fig. 5. Efficiency is maximized at about 60 ma load current. Below the design load, increased transistor losses cause a sharp decrease in efficiency.

To achieve more efficient circuit performance, the modified transistor oscillator of Fig. 6 can be used. The output circuit and unlabeled components are the same as corresponding components of Fig. 4. The circuit of Fig. 6 employs one additional transistor and two diodes to lower the input collector current. The common base lead of transistor T_1 and T_2 is returned to the negative voltage supply through the emitter-collector circuit of the control transistor T_3 . Until it is biased on, transistor T_3 acts as high impedance, preventing the flow of base current in the oscillator transistors.

For T_1 or T_2 to conduct, the base must rise to a voltage slightly greater than the base voltage of T_3 . This biases T_3 on, causing T_3 to present a low impedance to the oscillator transistor. The emitter-to-base voltage of the conducting oscillator transistor is effectively reduced by the amount its base must rise. Transistor losses are thereby reduced, resulting in the improved efficiency curve shown solid in Fig. 5.

Transistor Converter Design

Oscillator Frequency: The frequency of transistor oscillation is, within broad limits, subject to the choice

of the designer. The maximum upper limit is set by response of the transistors themselves. To preserve high efficiency, the rise and fall times of the transistor responses must be short compared to the period of oscillation.

In practice, the oscillator frequency is determined principally by transformer and filter design. The size and weight of these two components can be minimized by operating at as high a frequency as possible. Transformer core losses, however, increase roughly with the square of frequency. For most practical core materials, the loss is prohibitive for frequencies much about 1000 cps. There seems to be a rather broad region in the neighborhood of 400 cps in which an optimum balance can be obtained between core loss and magnetic component size. It has been found desirable to design higher power units to operate below 400 cps. Satisfactory operation of low power units has been obtained up to 1 kc.

Transistor Characteristics: The proper operation of the circuit is not critically dependent on any transistor characteristic. Nearly all of the commercially available power transistors have been successfully employed without selection or close matching. However, since transistor losses determine both the efficiency and maximum obtainable power output, it is desirable that the current gain characteristic be as high as possible and the input resistance and collector resistance kept low. The maximum power output and efficiency occur with the largest possible supply voltage which can be up to half the rated collector voltage. For the common 12 and 24 v batteries, collector ratings of 30 to 60 v are sufficient.

Present power converters use germanium transistors. It is possible that future converters may incorporate silicon transistors with an increase in temperature operating range gained at a slight loss in efficiency.

Transistor collectors not only do not dissipate power but actually deliver power back to the transformer. This peculiar behavior results from the fact that collector characteristics pass through zero, as shown in Fig. 3, and allow the collectors to be driven positive with respect to their bases. The collectors can be overdriven without appreciable loss in efficiency, thus re-

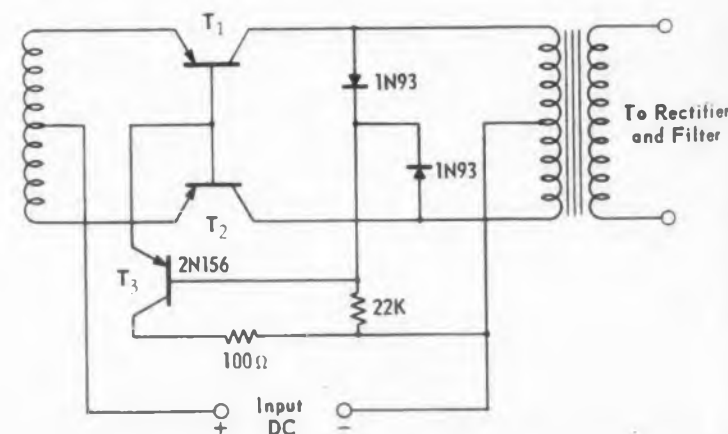


Fig. 6. Modified oscillator circuit for improved regulation

ducing the criticalness of feedback requirements and the effect of transistor mismatch.

Transformer Design: In design of the transformer, the principal requirement is that the core hysteresis curve exhibit a sharp break at saturation. Other qualities, such as low exciting current, low core loss, and high saturation flux density, are desirable as in other transformer applications. Transformer leakage inductance must be limited to avoid large spikes on the collector waveform when the transistor shuts off. These peaks may exceed the collector breakdown voltage and cause transistor failure.

As in the design of standard transformers, the number of primary turns is a compromise between demands of reducing both the exciting current and the copper loss. In design of the transistor power converter, operating frequency is an additional consideration, with the lower limit of the oscillator frequency being set by economical design of the transformer. Oscillator frequency is found to be proportional to supply voltage, and inversely proportional to the primary turns, the core cross-section, and the saturation density.

Typical Converter Performance

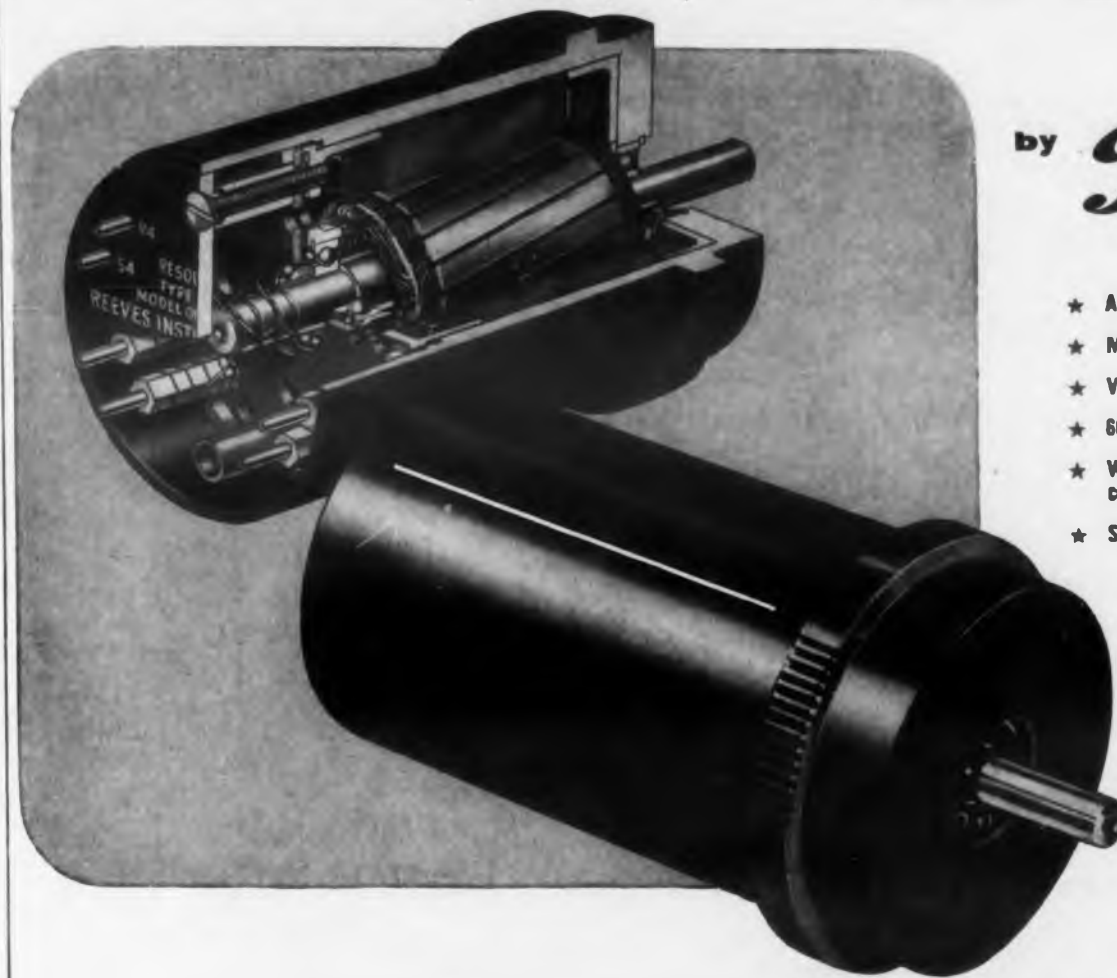
A performance feature of the transistor power converter is that it cannot be overloaded to destruction. A short or overload at the output merely causes the transistor oscillation to cease. With the self-starting circuit employed, oscillation begins as soon as the overload is removed.

With present transistors, power converters of the type described are best employed on input dc voltages ranging from 12 to 30. If less than 12 v excitation is used, power losses in the transistors will result in excessively low efficiency; excitations greater than 30 v may result in voltage breakdown of the transistors.

Dc output powers of up to 200 w can be produced, using present-day transistors with 24 v dc input. Output power is derated linearly for lower input excitations. As shown in Fig. 1, a typical converter developed by Power Sources, Inc. fits a standard MIL-T-27 transformer can (3-1/16" x 3-3/16" x 2-5/8") and produces 30 w output for 24 v dc input. Dc output voltage and current is determined by selection of the transformer turns ratio. Converters can be operated in parallel for power increase, or in series for voltage increase. The unit shown in Fig. 1 is hermetically sealed, weighs only 14 ounces, and can be supplied with plug-in header, solder terminals, or flexible leads.

Transistor power sources can perform without interruption and within specifications under shock and vibration loadings in excess of 1000 g's. Dc to dc power conversion efficiency is between 60 and 85%. Output power regulation is within $\pm 10\%$ from zero to full rated load current. Improved regulation can be provided through special design. Output ripple is less than 1%. Transistor power converters will perform within specifications over a temperature range from -55 to +165 F at the case mounting.

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- ★ With or without booster amplifier compensation.
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2EV56

Designing Iron-Core Inductances

With Superimposed Direct Current

J. H. Davis

Airpax Products Co.,
Baltimore 20, Md.

Table I—The Design of Iron Core Inductance with Superimposed Direct Current

EI Lam.	A_c (cm ²)	$R_c \times 10^{-6}$ (microhms)	l_c (cm)	Figure of Merit	
				C_T	C_R
187	0.23	44	4.14	16.6	34.6
375	0.91	45	7.32	130	136
21	1.61	33	8.26	355	280
* 50	1.61	44	7.62	310	243
* 56	2.04	39	8.56	468	327
*625	2.52	35	9.53	680	426
* 68	3.05	32	10.49	940	540
* 75	3.62	26	11.43	1.4x10 ³	710
* 11	4.94	22.3	13.34	2.3x "	1050
* 12	6.45	19.5	15.25	4.0x "	1460
*112	8.19	15.7	17.15	6 x "	2060
*125	10.07	14.0	19.05	8.5x "	2700
30	12.19	12.4	22.86	12 x "	3460
14	10.07	12.5		9 x "	2850
*138	12.20	10.6	20.96	13 x "	3750
16	13.60	11	23.95	15 x "	4100
* 13	14.50	11.2	22.86	16.5 "	4340
*175	19.80	10.3	26.70	27 "	6200
36	17.03	6.6	27.90	27 "	6600
19	19.74	4.3	33.00	42 "	9540
F14	.23	149	3.18		19
EE24-25	.406	59	5.08	33.8	53
EE26-27	.91	59	6.67	103	118
*EI-212	29.15	7.0	32.39	63 x10 ³	11000

*Scrapless core of square cross section

DESIGN of iron-core inductors energized by ac only is relatively straightforward. Electro-magnets energized by dc, with relatively no ac component can also be designed with fairly straightforward procedures. Here, a procedure has been evolved for designing inductors carrying appreciable amounts of both ac and dc. Little tailoring is required from the design resulting from this procedure to the final design.

Four basic assumptions have been made:

1. Voltage, current and flux waveforms are sinusoidal.
2. Alternating rms value of flux density, B_{ac} and dc flux density, B_{dc} can be added directly.
3. Incremental permeability, $\Delta\mu$, is a linear function of B_{ac} and B_{dc} . Values of $\Delta\mu$ are found empirically.
4. Quality factor, $Q = \omega L/R_i$ is greater than five. Starting points are the five basic equations of electricity and magnetism:

$$L = N \frac{d\phi}{dI} 10^{-8} \text{ henry}$$

$$e = N \frac{d\phi}{dt} 10^{-8} \text{ volt}$$

$$\phi = \frac{F}{R} \text{ maxwell}$$

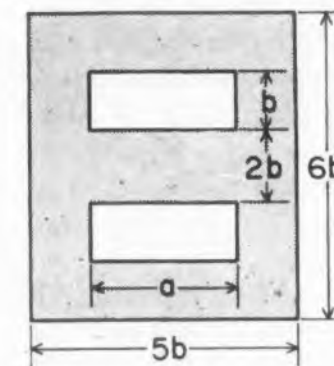
$$F = 0.4 \pi NI \text{ gilbert}$$

$$R = \frac{1}{A_c \mu} \text{ (all dimensions in cm)}$$

Magnetic flux is a function of the ampere turns and the reluctance of the magnetic path in iron and in air. By mathematical analysis, it can be proven that

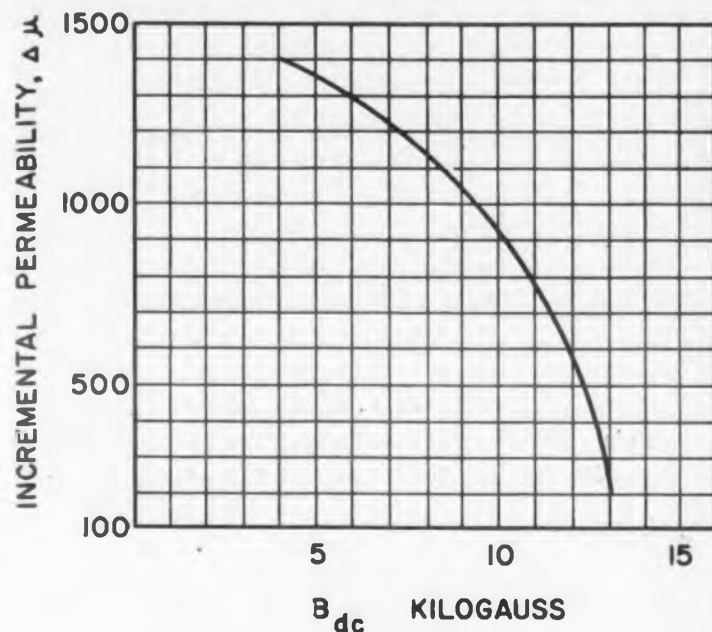
$$B_{max} = B_{acm} + B_{dc} \\ = \frac{0.4 \pi NI_{ac} \sqrt{2}}{G} + \frac{0.4 \pi NI_{dc}}{G}$$

where G is a function of the mean length of the uniform magnetic path, cm, the mean length of the gap



Typical core lamination showing dimensions a and b.

Direct current flux density B_{dc} vs Incremental permeability, $\Delta \mu$ for $B_{ac} = 200$ gauss at 120 cps. Similar curves are available for higher values of B_{ac} .



in the magnetic path, cm, and the incremental permeability. Then the ratio:

$$\frac{B_{acm}}{B_{dc}} = \frac{I_{ac}}{I_{dc}} \sqrt{2} \quad (1)$$

Then, for every reactor, given a value of dc and a ripple voltage, the value of B_{ac} and B_{dc} flux densities is a constant.

Fringing of magnetic flux over the air gap is about 15 per cent and cannot be neglected. Stacking factor is about 0.94. To take care of these effects, B_{max} should be multiplied by 0.8. Then

$$0.8 B_{max} = B_{acm} + B_{dc} \quad (2)$$

Solving equations 1 and 2 for B_{dc}

$$B_{dc} = \frac{0.8 B_{max}}{1 + \sqrt{2} \frac{I_{ac}}{I_{dc}}} \quad (3)$$

For B_{max} use:

11,000 gauss for 4 per cent silicone steel Anisotropic (ATA)

15,000 gauss for 4 per cent silicone steel isotropic (Hipersil)

2000 gauss for Mumetal

5000 gauss for 4750 alloy or Carpenter 49

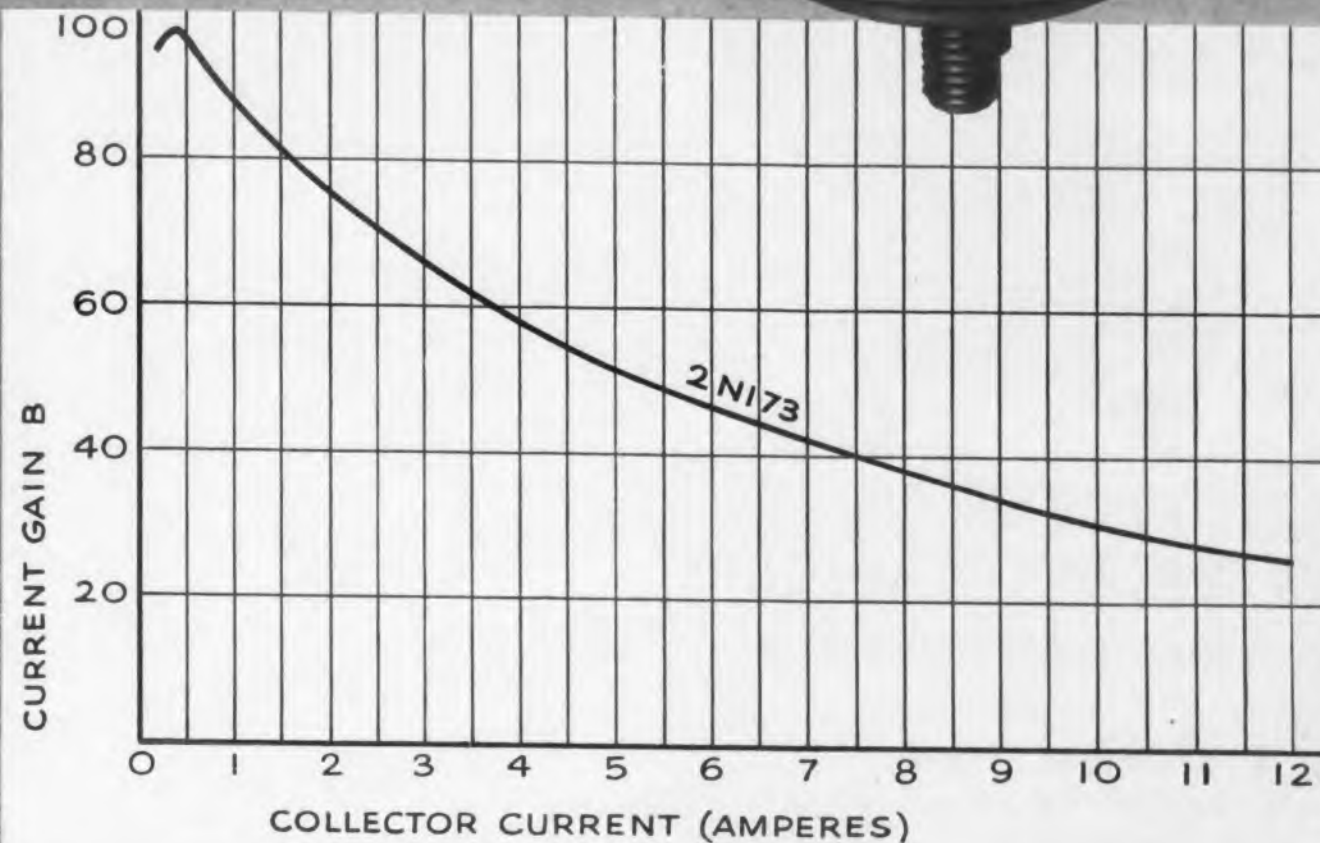
Minimum value of turns is established by:

$$N = \frac{LI_{dc} 10^8}{A_c + B_{dc}} \quad (4)$$

A value of $L + 10$ per cent is practical to take care of production and core properties variation.

Core size A_c depends upon: (1) the number of turns that can be accommodated in the winding space, and (2) the maximum temperature rise permissible at a certain specified ambient temperature. Assuming now

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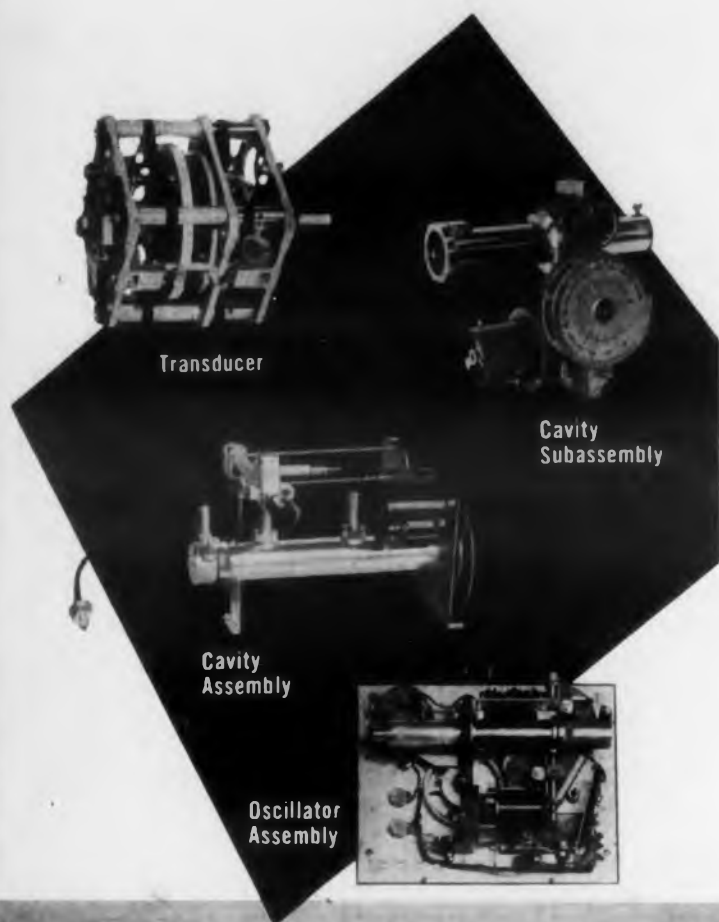
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Properties (25°C)	2N173	2N174
	12 Volts	28 Volts
Maximum current	12	12 amps
Maximum collector voltage	60	80 volts
Saturation voltage (12 amp.)	0.7	0.7 volts
Power gain (Class A, 10 watts)	38	38 db
Alpha cutoff frequency	0.4	0.4 Mc
Power dissipation	55	55 watts
Thermal gradient from junction to mounting base	1.2°	1.2° °C/watt
Distortion (Class A, 8 watts)	5%	5%

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that the net winding space is occupied by a single turn of copper bar of cross section $A_w F_w$ and of length m :

$$R_w = N^2 R_c \quad (5)$$

where

$$R_c = \frac{1.12 l_m}{A_w F_w} 10^{-6} \text{ ohms} \quad (6)$$

Resistivity of copper, ρ , in Equation 6 has been assumed to be 10.4 ohms/ft/cm at 25 C. Value of F_w for 1500-v insulation will vary from 0.3 to 0.6 for core cross-sections from 0.14 to 3 sq in. Equation 5 is useful in finding R_w at a glance without knowing the actual A.W.G. wire size being used.

Maximum temperature rise also limits R_w . Looking at the geometrical configuration of a scrapless lamination, Fig. 1, the relations for a square stack are:

$$\begin{aligned} A_c &= 4 b^2 \\ a &= 3 b \end{aligned}$$

Assuming the finished reactor has the same dissipating area as a homogenous body of dimensions $(a + 2b)$ by $(2a)$ by $(2b)$, then $1/2$ the dissipating area = $52 b^2$. If the maximum insulation temperature rise is 50 C at an ambient of 25 C (MIL-T-27 Class R) then it can be shown that the maximum value of N permissible is:

$$N = \frac{1}{1} \sqrt{\frac{A_c}{R_c}} \quad (7)$$

Combining equations 4 and 7, the figures of merit C_R and C_T are obtained. Size of stamping is then determined from Table 1 using:

$$\begin{aligned} C_R &\geq \frac{L I_{dc}}{B_{dc} \sqrt{R_w}} 10^8 \\ &\geq \frac{A_c}{\sqrt{R_c}} \end{aligned} \quad (8)$$

$$\begin{aligned} C_T &\geq \frac{L I_{dc}^2}{B_{dc}} 10^8 \\ &= \frac{A_c^{3/2}}{\sqrt{R_c}} \end{aligned} \quad (9)$$

If scrapless laminations are used, Equations 8 and 9 are constant. Other types of core laminations will be running lower in temperature rise if $W_T = A_c$.

Sample Problem

Required: An inductance of 2 henry at I_{dc} of 0.750 amp. Maximum voltage drop not to exceed 25 v. Will be used in a choke input filter of 400 v dc at a supply frequency of 60 cps. Ripple voltage equals $400 \times 0.63 \times 0.707 = 180$.

Required:

Step 1.

$$I_{ac} = \frac{180}{6.28 \times 120 \times 2} = 0.120 \text{ amp}$$

$$I = 0.752 \times 122 = 0.760 \text{ amp}$$

Step 2.

$$\frac{B_{ac}}{B_{dc}} = \frac{0.120 \times 2}{0.750} = 0.225$$

$$1 + \frac{B_{acm}}{B_{dc}} = 1.225$$

Using 4 per cent silicone steel ATA 0.014 at $B_{max} = 10,000$ gauss

$$B_{dc} = \frac{0.8 B_{max}}{1.225} = 6500 \text{ gauss}$$

$$B_{ac} = 8000 - 6500 = 1500 \text{ gauss}$$

Step 3.

$CT = 2 \times 0.7602 \times 108 = 17.8 \times 103$
From Table I use $EI = 13$. But since we are liable to end up with a too hot reactor, use the next size, $EI = 175$.

Step 4.

$$N = \frac{2 \times 0.750 \times 108}{19.76 \times 6500} = 1170 \text{ turns}$$

Step 5.

$$R_w = N^2 R_c = 1170^2 \times 10.3 \times 10^{-6} = 14 \text{ ohms}$$

$$\text{Dc voltage drop} = 14 \times 0.750 = 10.5 \text{ v}$$

Step 6.

$$G = 0.4 \times 3.14 \times N^2 \times 19.76 = 0.170 \text{ cm}$$

from Fig. 2, $v = 1280$ at 6500 gauss. The greater B_{ac} will result in $\Delta\mu > 1280$. In practice, the gap has to be adjusted to get the optimum results and hence the highest L . However, using $\Delta\mu = 1280$ is very conservative.

$$l_g = 0.170 - \frac{26.67}{1280} = 0.170 - 0.020 = 0.150 \text{ cm} = 0.059 \text{ in.}$$

or a gap of about 0.029 in./per leg. Final adjustment of gap will be necessary.

Step 7.

The AWG wire to be used is found from the relationship $AWG = 50 - 10 \log$

$$\frac{A_w F_w}{4N}$$

or Cir Mil of Wire

$$= \frac{0.88 \times l_m N}{R_w}$$

where A_w is in inches l_m is in inches.

Solving for $EI = 175$ AWG, No. 21 wire will do. With 0.040-in. spool and 0.15-in. kraft paper over the winding and using 0.005-in. layer insulation, we end up with 1310 turns. Checking: We find $R_w = 1310^2 \times 10.3 \times 10^{-6} = 17.8$ voltage drop still within limit.

Max. watts dissipated = $17.8 \times .7602 = 10.2$ watts. A_c in $\text{cm}^2 = 19.76$. Therefore, the temperature rise is within limits.

$$L = 2.46 \text{ henries}$$

$$B_{dc} = 9700 \text{ gauss}$$

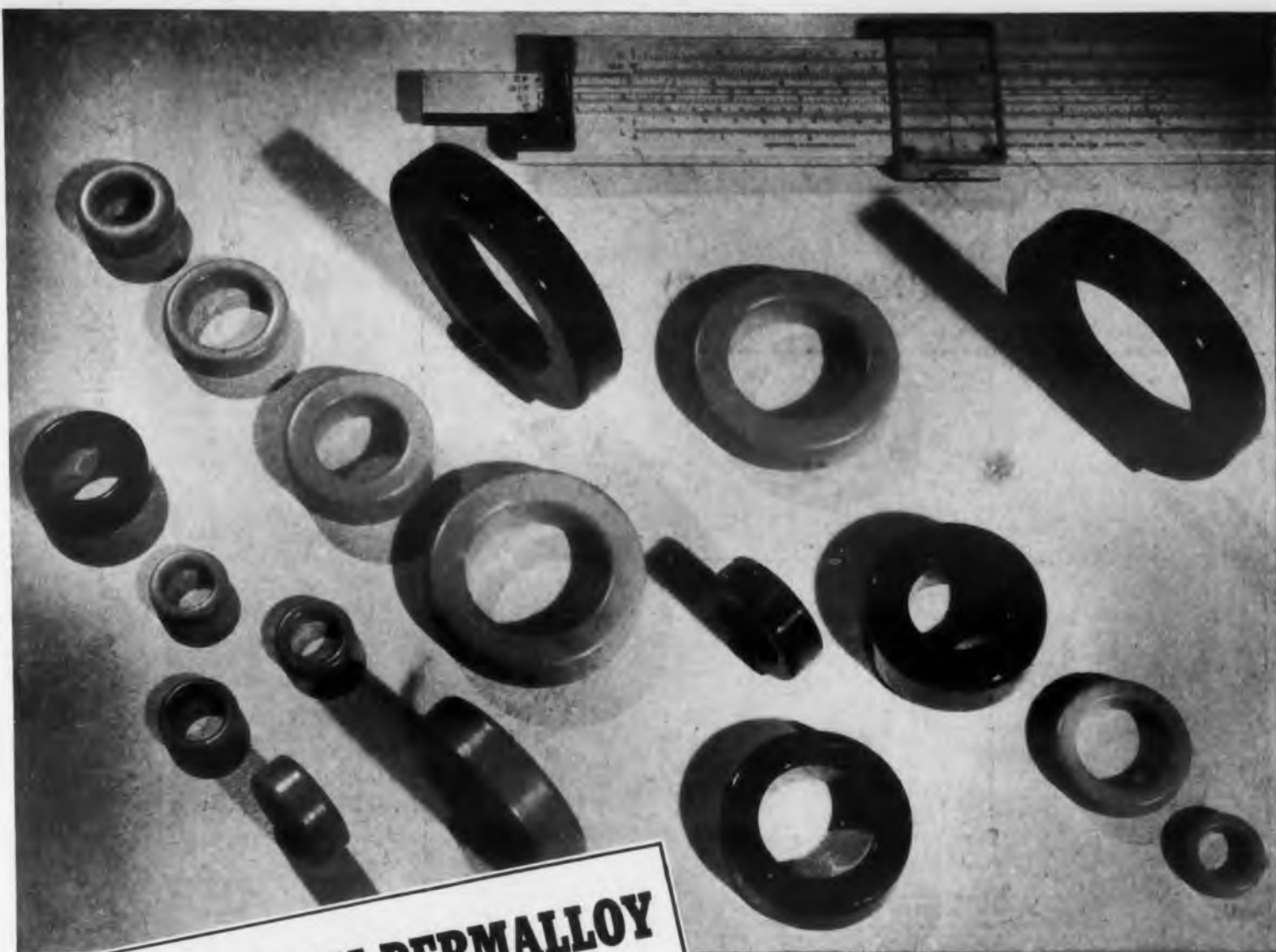
$$B_{ac} = 1660 \text{ gauss}$$

$$B_{dc} + B_{ac} = 11360 \text{ gauss}$$

B_{max} is still within safe operating flux density.

Nomenclature

A_c	= CORE CROSS SECTION, CM^2
A_w	= GROSS COIL WINDING AREA OF LAMINATION, CM^2
B	= FLUX DENSITY OF MAGNETIC PATH, GAUSS.
B_{max}	= MAXIMUM WORKING FLUX DENSITY OF CORE MATERIAL GAUSS.
B_{ac}	= ALTERNATING RMS VALUE OF FLUX DENSITY, GAUSS.
B_{acm}	= MAXIMUM VALUE OF AC FLUX DENSITY, GAUSS.
B_{dc}	= DIRECT CURRENT FLUX DENSITY, GAUSS.
CR, CT	= FIGURES OF MERIT OF A STACK LAMINATION.
D	= TOTAL DISSIPATING AREA OF WOUND COIL AND CORE IN IN^2 .
E_{max}	= MAXIMUM VOLTS
E	= VOLTS, RMS.
e	= INSTANTANEOUS VOLTS OF A SINUSOID WAVE FORM.
f	= FREQUENCY, CPS, OR FUNCTION.
F_w	= WINDING SPACE FACTOR.
F	= MAGNETO MOTIVE FORCE, GILBERTS.
H	= MAGNETIZING FORCE, OERSTEDS.
I	= CURRENT AMPS.
I_{dc}	= DIRECT CURRENT, AMPS.
I_{ac}	= RMS CURRENT, AMPS.
i	= INSTANTANEOUS CURRENT OF A SINUSOID WAVE FORM.
I_{max}	= MAXIMUM VALUE OF CURRENT OF A SINE WAVE.
K	= STACKING FACTOR OF LAMINATIONS.
l_m	= MEAN LENGTH OF WINDING (ONE TURN) IN CM.
l_c	= MEAN LENGTH OF UNIFORM MAGNETIC PATH, CM.
l_g	= MEAN LENGTH OF GAP IN MAGNETIC PATH, CM.
L	= INDUCTANCE IN HENRIES.
N	= NUMBER OF TURNS.
Q	= QUALITY FACTOR
R_c	= RESISTANCE OF COPPER BAR OCCUPYING NET AVAILABLE WINDING SPACE.
R_t	= TOTAL EQUIVALENT RESISTANCE OF INDUCTOR.
R	= RELUCTANCE OF MAGNETIC PATH SUBSCRIPT, R_i = IRON, R_a = AIR.
W_t	= TOTAL LOSS (IRON AND COPPER) WATTS.
R_w	= WINDING RESISTANCE IN OHMS.
w	= $2\pi f$
μ	= PERMEABILITY
μ_0	= PERMEABILITY IN AIR.
μ_i	= PERMEABILITY OF IRON.
$\Delta\mu$	= INCREMENTAL PERMEABILITY OR AC PERMEABILITY.
ρ	= RESISTIVITY OF COPPER.
Φ	= MAGNETIC FLUX.
Φ_{max}	= MAXIMUM MAGNETIC FLUX OF A SINUSOIDAL WAVE SHAPE.
	= TEMPERATURE RISE IN CENTIGRADE ABOVE NOTED AMBIENT.



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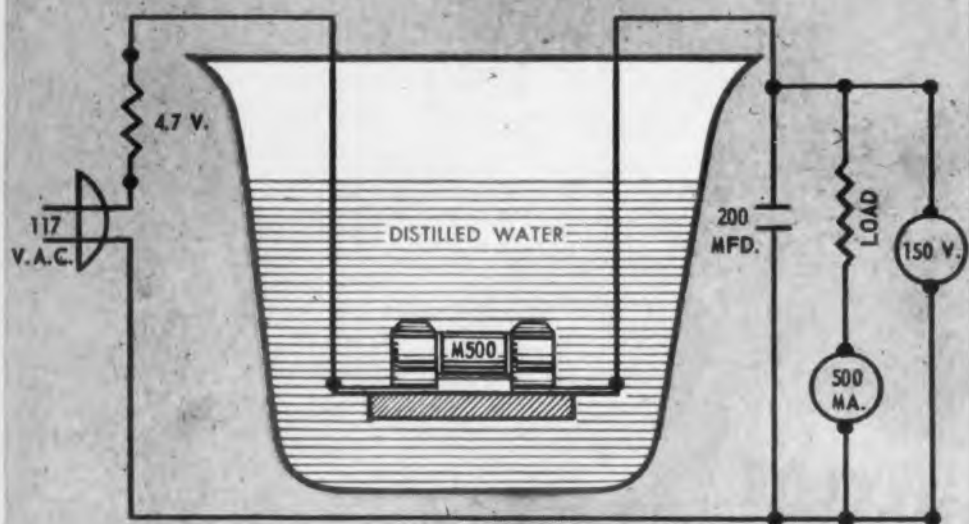
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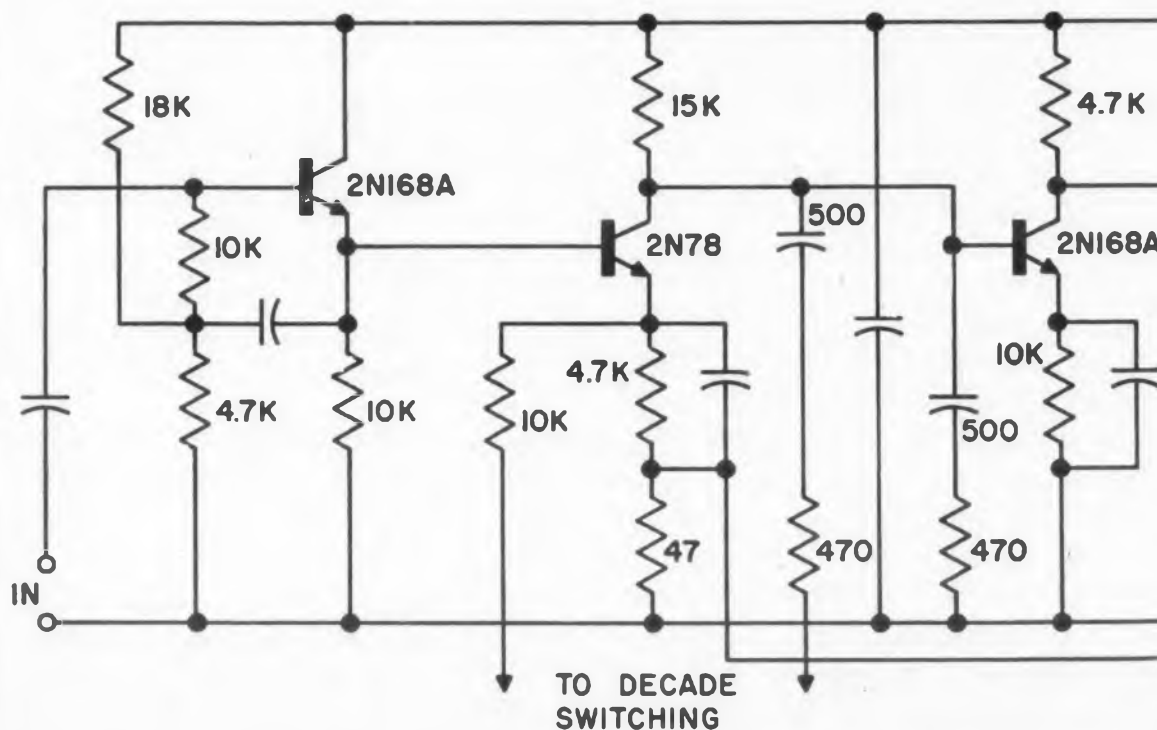
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NO power cord but no long battery life, small size, transistor reliability, and broad band pass add up to make this AC Decade Amplifier a neat laboratory tool. No polarity need be observed in connecting it to measuring equipment.

Designed and manufactured by Burr-Brown Research Corp., Route 4, Box 139, Tucson, Arizona, the amplifier is powered by nine type "C" flashlight cells with an approximate life of 1000 hours. Battery replacement is no problem since fresh standard type-c flashlight cells are easily obtained.

The instrument is decaded in gains of X10 and X100 and is accurate to plus or minus .2 db at 1 kc. Gain change, on both ranges is less than 0.3 db throughout battery life. It has a frequency response of from 1 cps to 800 kc. The low B voltages needed for transistors make possible dc coupling which results in good low frequency response.

The equivalent short-circuit noise resistance on both ranges is approximately 1500 ohms. The equivalent rms input short circuit noise voltage in



AC Decade Amplifier

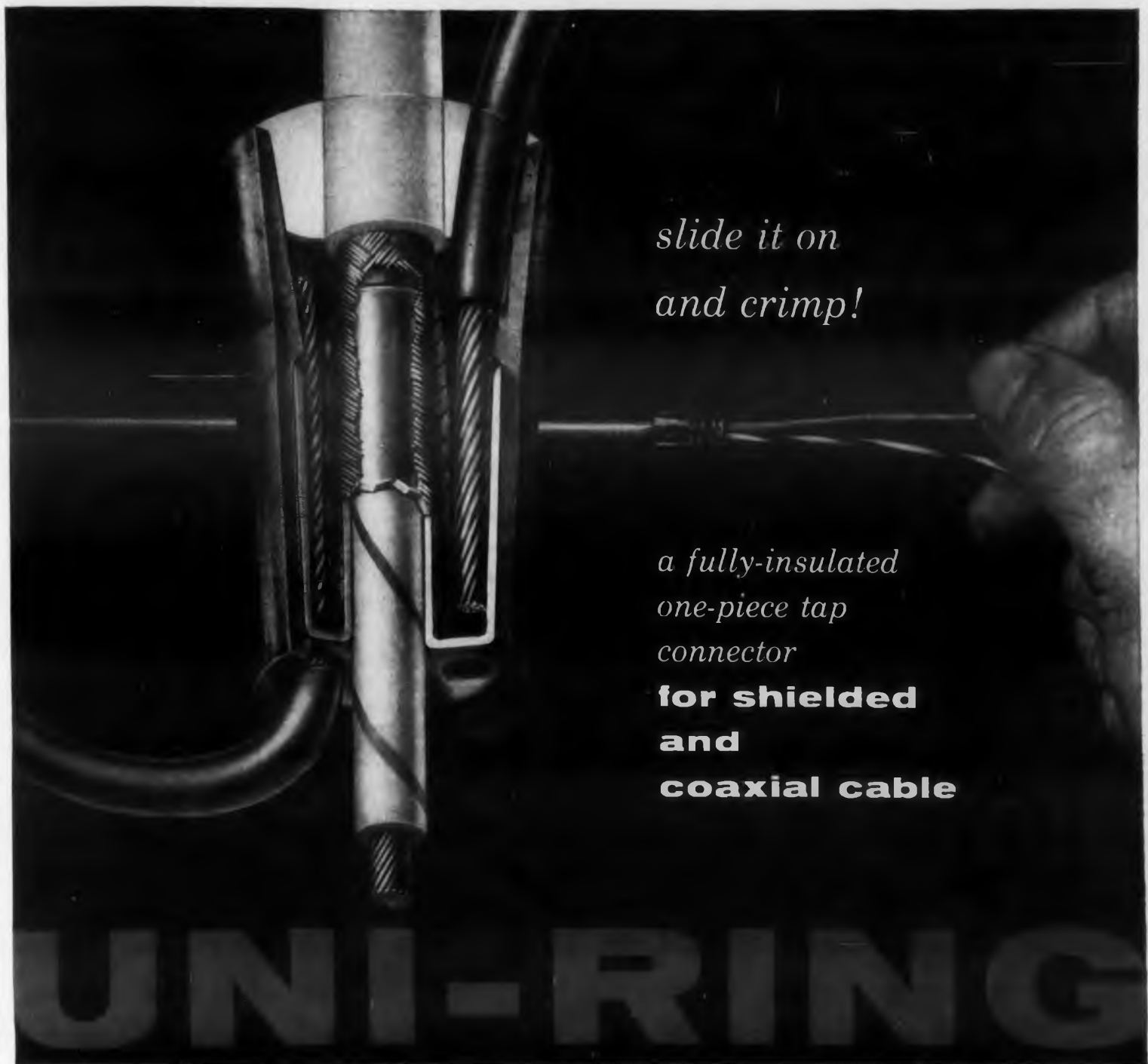
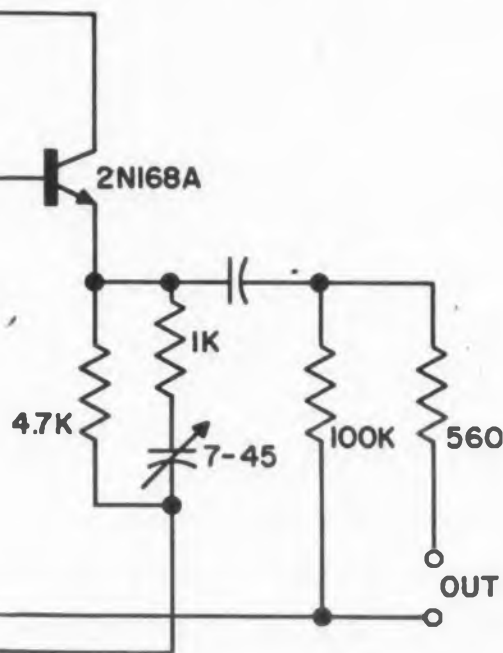
various bandwidths is therefore approximately as follows:

Bandwidth	Noise
20 kc	0.7 μ v
200 kc	2.2 μ v
800 kc	4.5 μ v

For input signal generator impedances in excess of 1000 ohms the noise figure may be taken as 6 db or less.

Input impedance for the amplifier is approximately 100,000 ohms shunted by 35 μ f for both gain ranges. The maximum dc voltage which may be impressed across the input terminals is 150 v. The maximum open-circuit output voltage is 1.2 v rms.

Weight of the amplifier is 2-1/2 lbs including batteries. Its dimensions are 7-9/16 in. x 3-7/8 in. x 3-9/16 in. This is the first of a series of transistorized lab instruments. Also available now is a square wave generator. For further information turn to the Reader's Service Card and circle 42.



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Bandwidth Curves for Designing Amplifier Stages

Harold D. Webb

Assoc. Professor, Electrical Engineering Dept.
University of Illinois

DESIGNERS would often like to know what the overall bandwidth of two or more cascaded L-C stages would be where they are tuned to the same center frequency but have unequal individual bandwidths. Presented here are curves for use in amplifier design work of this nature.

Usually in the design of L-C coupled vacuum tube amplifiers for use at radio frequencies or intermediate frequencies, the per stage bandwidth requirements are determined on the basis of n stages all alike, or on the basis of some rules for a special sort of design, such as stagger tuning. Frequently, however, for the design based on n stages exactly alike, the individual stages do not all have the same bandwidth, so the well known relation for the half-power, or 3 db down, bandwidth for n stages, $B_t = B_1 \sqrt{2^{1/n} - 1}$, does not apply. For this relation B_t represents the overall half-

power bandwidth and B_1 represents the half-power bandwidth for each of the n stages. For the cases considered here, bandwidth means half-power bandwidth unless otherwise specified.

The curves of Fig. 1 are for two cascaded L-C stages having bandwidths B_1 and B_2 such that $B_2 = bB_1$, where $b \geq 1$, in order to avoid duplication. The overall bandwidth is represented as B_t . In the figure two curves are plotted: one is B_t/B_1 versus b , and the other is skirt selectivity versus b . The skirt selectivity is defined as the bandwidth of the amplitude versus frequency response 30 db down (from the response at f_0) to the bandwidth 3 db down, and is calculated on the basis of constant Q over the amplitude response curve. Fig. 2 is included in order to aid in defining terms. From this figure the half-power or 3 db down bandwidth is $f_{1-3} - f_{1-3}$,

and the 30 db down bandwidth is $f_{2-30} - f_{1-30}$.

The curves of Figs. 1, 4, and 5 were worked out on the basis that the amplitude versus frequency response is determined entirely by the interstage network, i. e., there are no feedback effects which influence the response curve shape.

An example showing how to use Fig. 1 follows. There is given a two-stage L-C coupled amplifier, without feedback, for which both stages are resonant at 1 mc. The individual stage bandwidths are 100 kc and 160 kc. The individual stage voltage gains at 1 mc are 12 and 22, respectively. What is the overall bandwidth, and what is the skirt selectivity?

First of all, the tube transconductances are not frequency sensitive in the frequency range considered, and, therefore, the voltage gains do not effect the response curve shape. The overall bandwidth may then

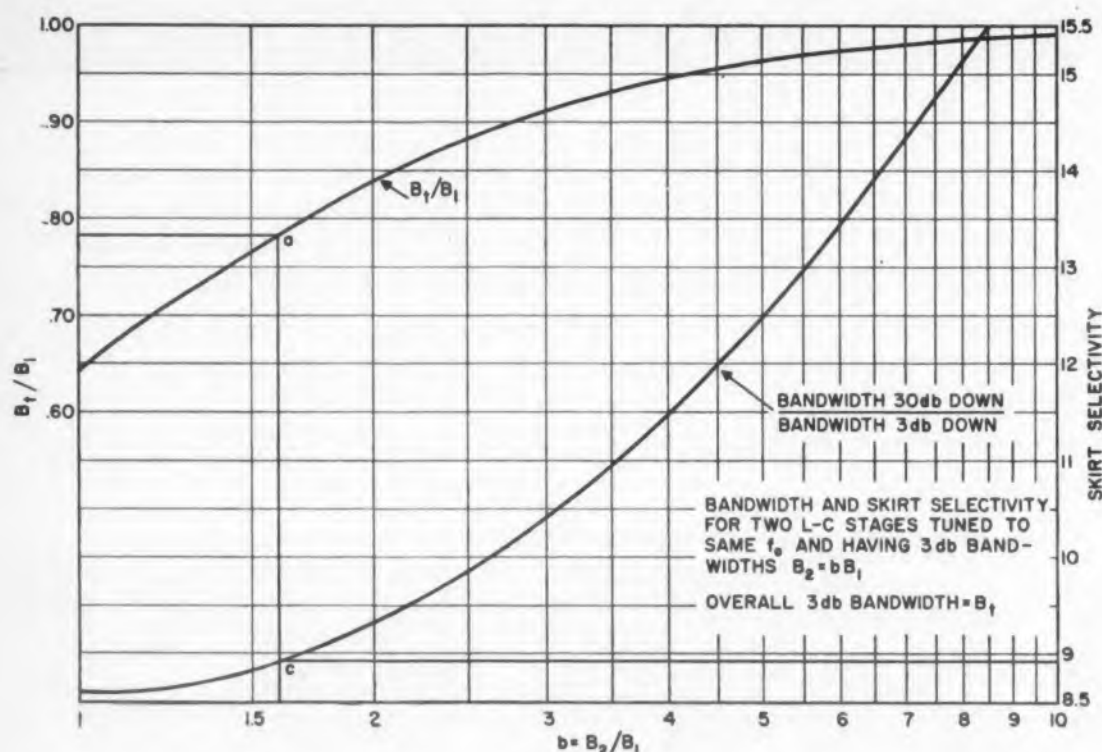


Fig. 1. Design curves for L-C amplifier stages.

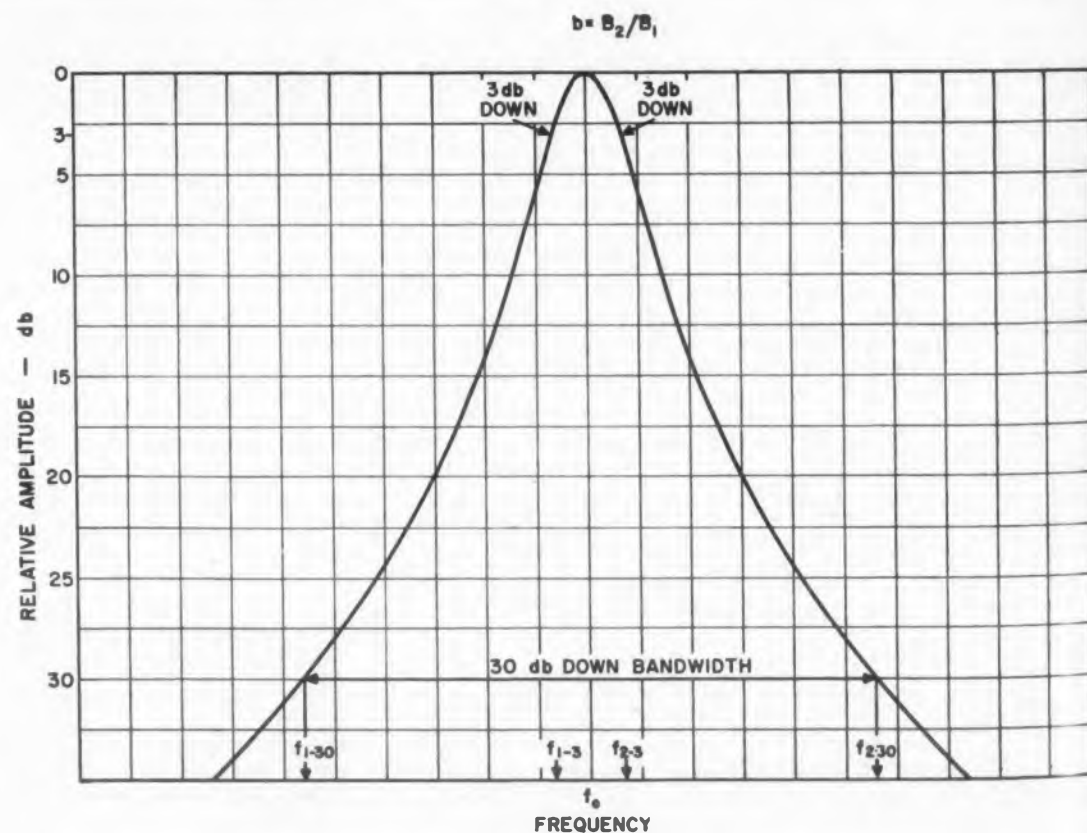


Fig. 2. L-C coupled response for two stages.

be determined from Fig. 1. First find $b = B_2/B_1 = 1.6$. Enter Fig. 1 along the abscissa for $b = 1.6$. Move upward to point *a* on curve $B_1/B_2 = 0.782$, or $B_1 = 0.782$ mc.

To find skirt selectivity enter Fig. 1 at 1.6 for b , move upward to point *c* on the selectivity curve, then move to the right, and read the ordinate 8.92. At 30 db down the overall response curve will be 8.92 times as wide as at the 3 db down points, or $8.92 \times 0.782 = 6.97$ mc wide.

The essential circuit diagram of the amplifier is as shown in Fig. 3, in which the heater circuits are omitted. The individual stage half-power bandwidths may be determined from $B = f_0/Q$, where $Q = R/L\omega_0 = RC\omega_0$. For this definition of Q the R , L , and C are effective parallel, or total shunt, values.

Figs. 4 and 5 are worked out for three stages of bandwidths B_1 , B_2 , and B_3 , such that $B_2 = \gamma B_1$ and $B_3 = \delta B_1$, where $\gamma \geq 1$ and $\delta \geq 1$. Fig. 4 shows B_1/B_2 versus δ for various values of γ , and Fig. 5 shows skirt selectivity versus δ for various values of γ . The curves for $\gamma = \infty$ are the same as those in Fig. 1.

As an example showing how to use Figs. 4 and 5, assume an amplifier with three L-C coupled stages, without feedback, each tuned to 1 mc, with individual bandwidths of 100 kc, 135 kc, and 220 kc. Find the overall bandwidth and skirt selectivity.

Let $B_1 = 100$ kc, $B_2 = 220$ kc, and $B_3 = 135$ kc. Then $\delta = 1.35$ and $\gamma = 2.2$. The bandwidth ratio B_1/B_2 may be found by interpolation between the curves for $\gamma = 2$ and $\gamma = 3$. Enter the graph at $\delta = 1.35$ and move upward, to point *d* which is 0.2 times the distance between the curves for $\gamma = 2$ and $\gamma = 3$, then move to the left and read the ordinate as 0.676. The interpolation is not accurate because, as is obvious from the curves of Fig. 4, the curves for various values of γ are not uniformly spaced, but the accuracy is probably good to two significant figures. Since $B_1/B_2 = 0.676$, $B_1 = 0.676$ mc.

To find the skirt selectivity, enter Fig. 5 at $\delta = 1.35$ and move upward to 0.2 times the distance between the curves for $\gamma = 2$ and $\gamma = 3$ at point *g*, then read the ordinate as 6.32. The width of the overall response curve 30 db down is 6.32 times the width at 3 db down. The complete amplifier circuit diagram would be as in Fig. 3 with a third stage added.

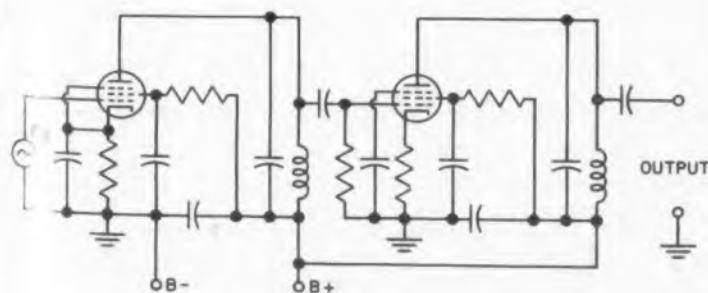
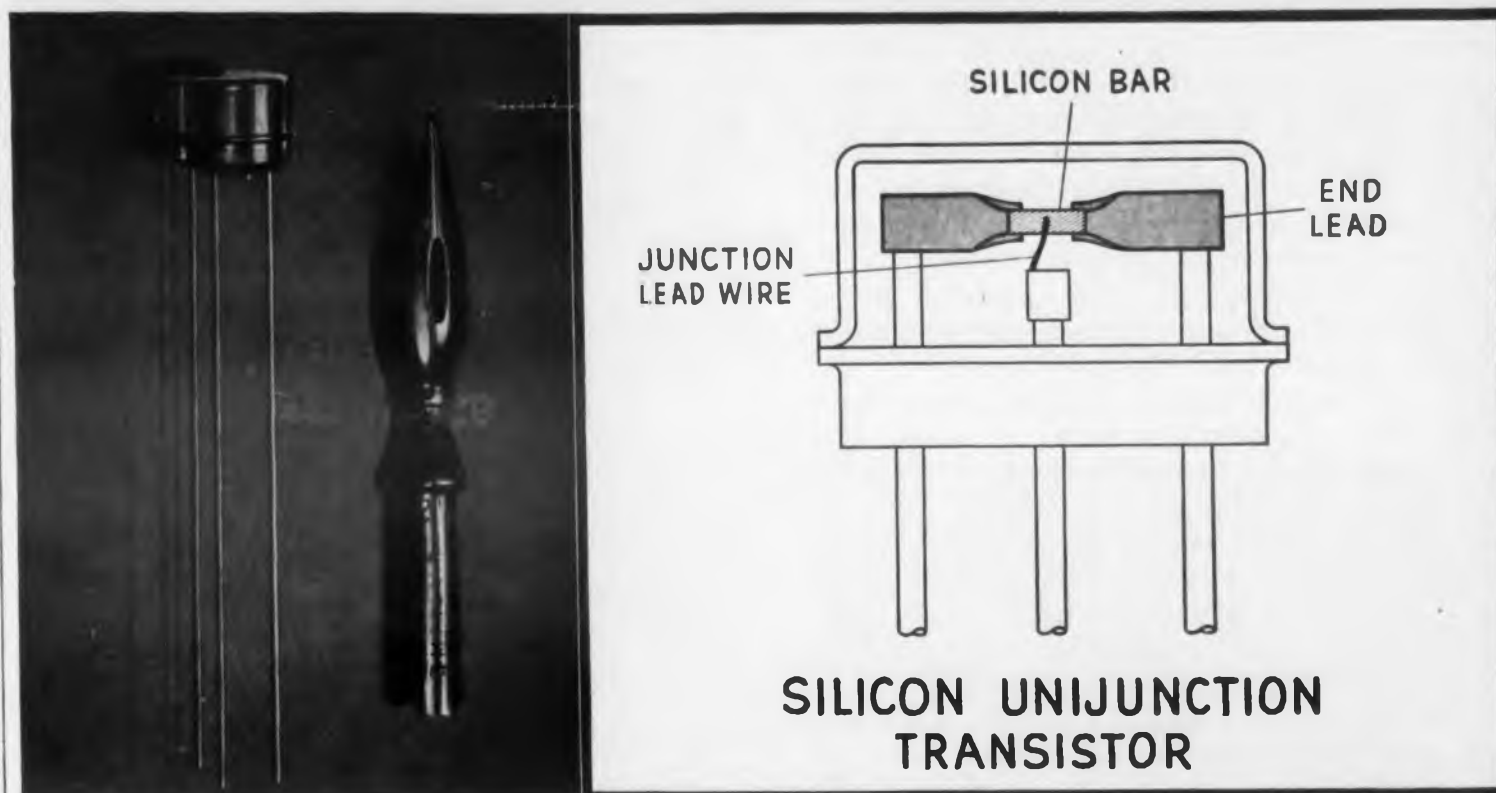


Fig. 3. Circuit diagram for two L-C coupled stages.

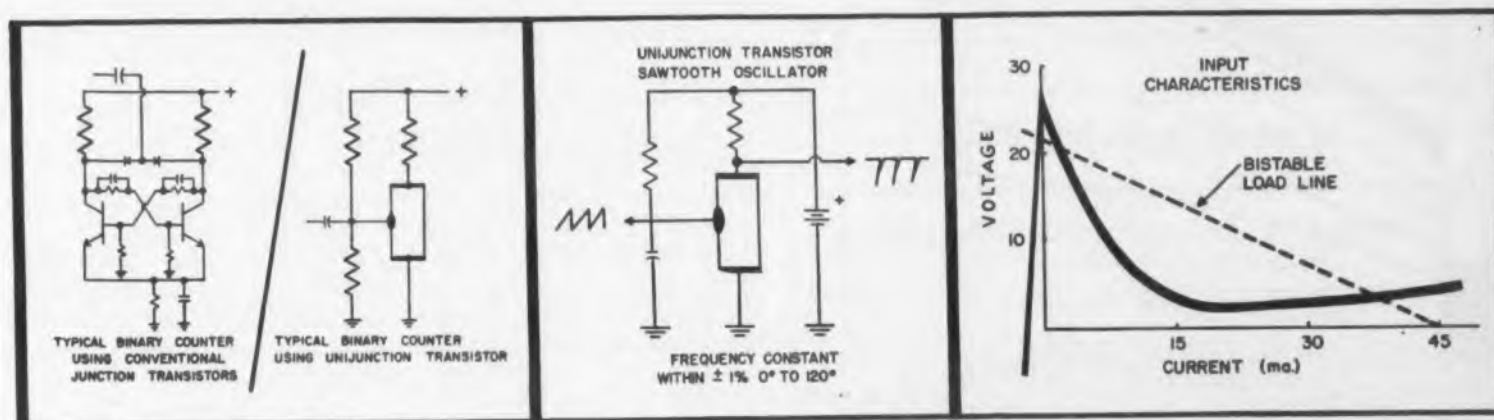
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New General Electric Silicon Unijunction Transistor simplifies circuitry...improves reliability!

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junction transistor with the desirable characteristics of point contact transistors. Its dependable high-temperature performance is commended for missile, electronic switching and relay applications. For further information on the Unijunction Transistor, call or write: *General Electric Co., Semiconductor Products Department, Section X74116-15, Electronics Park, Syracuse, New York.*



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CIRCLE 44 ON READER-SERVICE CARD FOR MORE INFORMATION

The curves of Figs. 1, 4, and 5 also apply to uncompensated R-C coupled stages, such as those used in audio and video amplifiers. For this case the low frequency and high frequency responses are considered separately. For the high frequency response, consider the bandwidth from some arbitrary "midband" frequency, say 1 kc, out to the upper half-power frequency. Then the bandwidths 3 db down and the skirt selectivity compared to the "midband" frequency are determined as for the L-C case.

For the low frequency part of the response, use the same "midband" reference as above and read B_i/B_1 from the proper curve. The lower half-power frequency is then the highest individual lower half-power frequency divided by B_i/B_1 . As an example, suppose that the lower half-power frequencies for two cascaded R-C stages are 100 and 50 cps. To find the overall lower half-power frequency, let $b = 100/50 = 2$. Enter Fig. 1 at $b = 2$ and find $B_i/B_1 = 0.838$. The overall lower half-power frequency is then $100/0.838 = 119$ cps. Fig. 6 is included to show the meaning of the terms for the R-C coupled case.

If the low frequency end is neglected, the bandwidth and skirt selectivity are determined as for the L-C coupled case.

Another manner in which the curves of Figs. 1, 4, and 5 may be used is as follows. Suppose that a two stage amplifier has been designed to give a certain bandwidth, but more gain is required and a third stage must be added. Suppose further that a small decrease in overall bandwidth may be tolerated. Fig. 1 may be used to find the bandwidth of the second stage after the overall bandwidth for two stages and the

bandwidth for one stage are measured. Then Fig. 4 may be used to find the bandwidth required for the third stage. As an example of this case, suppose the overall bandwidth for the two stages is 1.1 mc, and the bandwidth of one of the stages is 1.4 mc. A third stage must be added such that the overall bandwidth is 1 mc.

From Fig. 1, using $B_i/B_1 = 1.1/1.4 = 0.786$, $b = 1.63$, or $B_2 = 1.63 \times 1.4 = 2.28$ mc.

Now go to Fig. 4. Again use 1.4 mc as reference, and let $B_i/B_1 = 1/1.4 = 0.714$. Let $\gamma = 2.28/1.4 = 1.63$. From Fig. 4 determine $\delta \approx 2.32$. Therefore, $B_3 \approx 2.32 \times 1.4 \text{ mc} \approx 3.25 \text{ mc}$.

Still another manner in which the curves may be used would be to design for a certain bandwidth and a certain skirt selectivity. Suppose, for example, that an overall skirt selectivity for three stages is to be 8. From Fig. 5 it is seen that one set of values that will give this condition is $\gamma = 5$ and $\delta = 3$. These values are then entered into Fig. 4 to find individual bandwidths that will give the desired overall bandwidth. This approach may not be too useful, since usually one desires the lowest skirt selectivity that is feasible.

By means of the examples shown, it is seen that the curves of Figs. 1, 4, and 5 may be used to advantage in the design of L-C and R-C coupled amplifiers.

Fig. 5. Skirt selectivity curves.

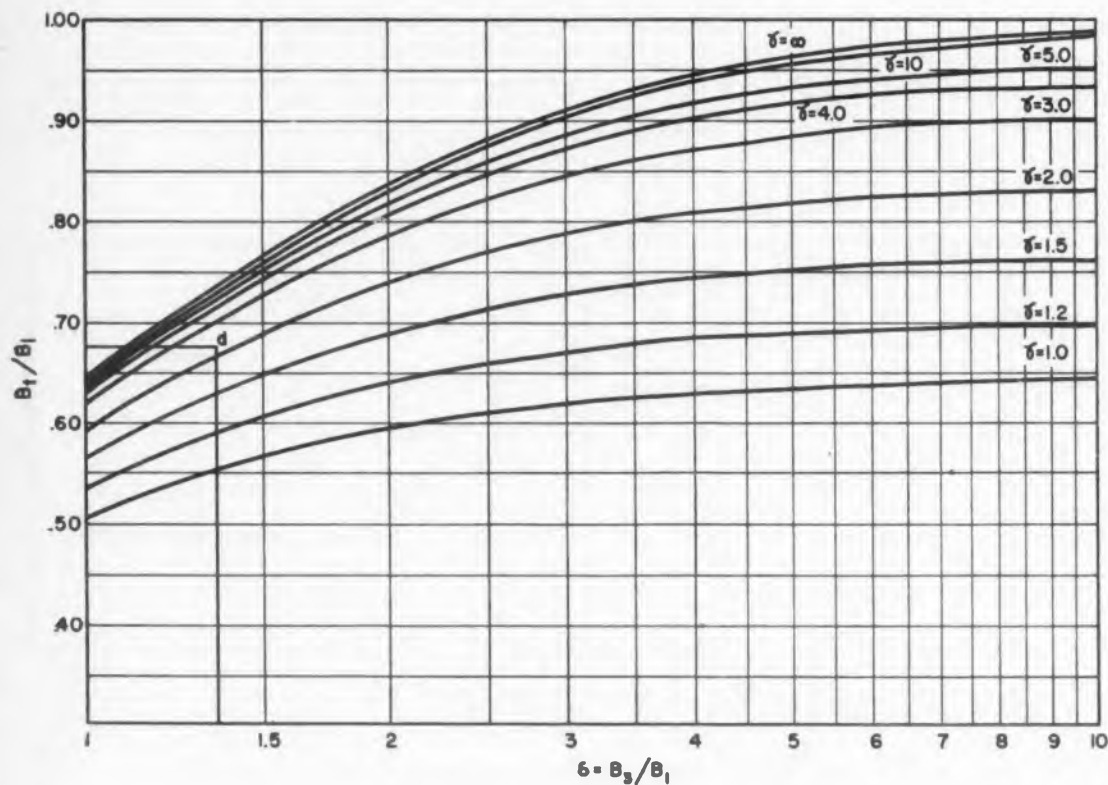
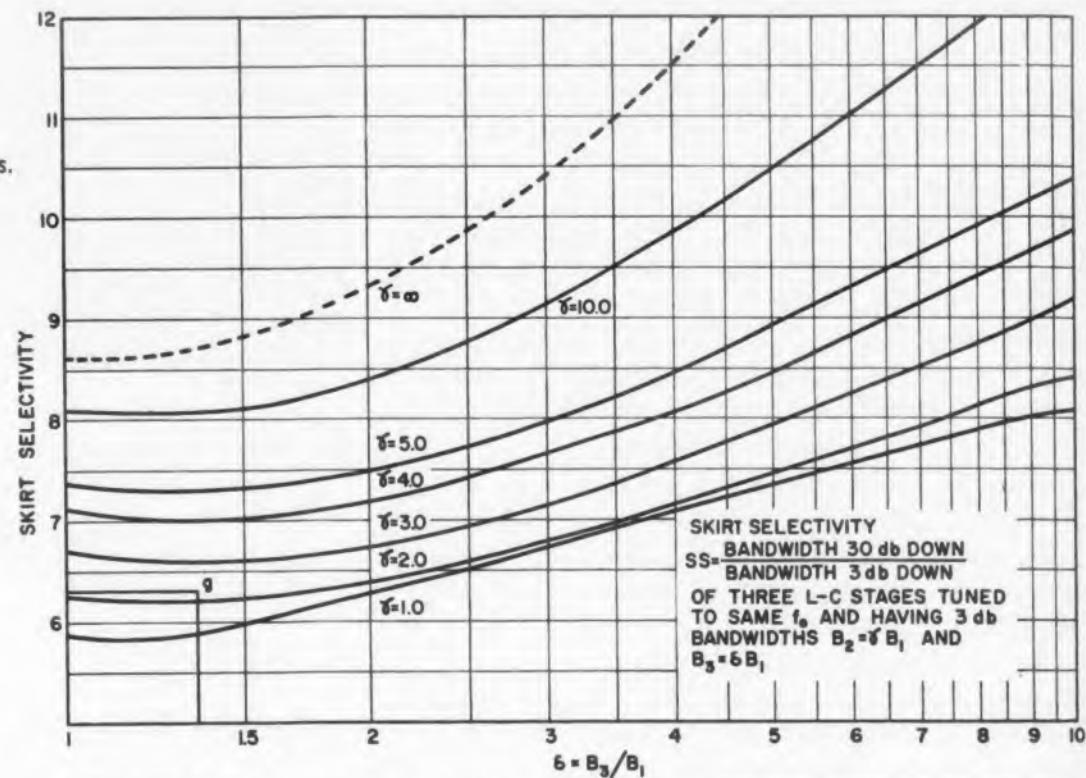


Fig. 4. Design curves for determining bandwidth of three L-C stages tuned to the same center frequency.

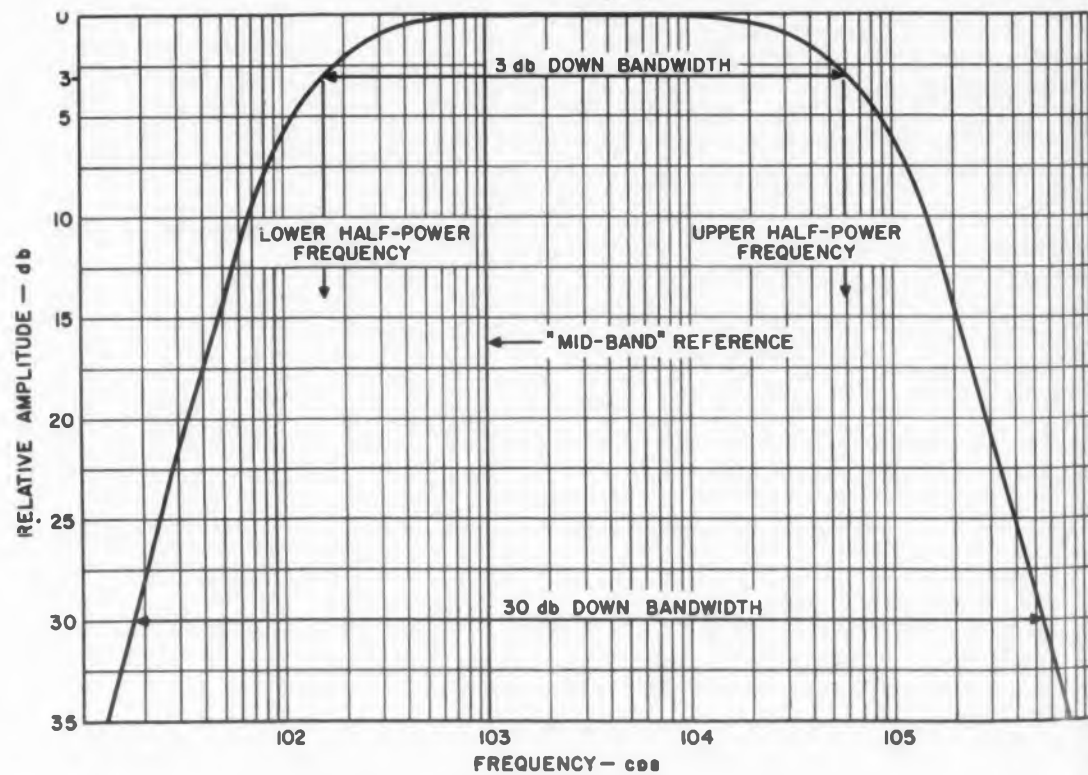


Fig. 6. R-C coupled response for two stages.

CALCULATIONS

The manner in which the curves of Figs. 1, 4, and 5 were calculated is shown below.

Gain of a single L-C coupled stage may be represented as

$$A = \frac{g_m}{2\pi CB \sqrt{1+Q^2(f/f_o-f_o/f)^2}} \tan^{-1} Q(f/f_o-f_o/f) \quad (1)$$

where g_m is the tube transconductance, C is the total effective shunt capacitance, B is the half-power bandwidth $= f_o/Q$, $Q = R/L\omega_o$ where R and L are effective parallel values, and

$$2\pi f_o = 1/\sqrt{LC}$$

Since only the magnitude is considered here, the phase angle is disregarded. For a given stage design $g_m/2\pi CB$ is taken as a constant. The amplitude response curve shape is then determined by

$$1 + Q^2(f/f_o - f_o/f)^2 \quad (2)$$

The half-power bandwidth for two stages in cascade is found when

$$|A_t| = \frac{|A_f|}{\sqrt{2}} \quad (3)$$

where A_t is the overall gain and

$$|A_f| = \frac{g_{m1} g_{m2}}{4\pi^2 C_1 C_2 B_1 B_2} \quad (4)$$

This occurs when

$$2 = [1 + Q_1^2(f'/f_o - f_o/f')^2][1 + Q_2^2(f'/f_o - f_o/f')^2] \quad (5)$$

where f' denotes the particular frequency for which this is true. Equation 5 is true at two frequencies, f_1 and f_2 , related such that $f_1 f_2 = f_o^2$. Then

$$Q_1^2(f'/f_o - f_o/f')^2 = Q_1^2 \left(\frac{f_2 - f_1}{f_o} \right)^2 = B_t^2/B_1^2 \quad (6)$$

where

$$B_t = f_2 - f_1 \quad (7)$$

Then

$$[1 + B_t^2/B_1^2][1 + B_t^2/B_2^2] = 2 \quad (8)$$

By letting $B_2 = bB_1$, a double quadratic in B_t/B_1 is obtained which is solved for various values of b . To avoid duplication $b \geq 1$.

To get the skirt selectivity, first find B_{t-so}/B_1 from

$$\left[1 + \frac{B_t^2 - 30}{B_1^2} \right] \left[1 + \frac{B_t^2 - 30}{b^2 B_1^2} \right] = 1000 \quad (9)$$

Then skirt selectivity $= B_{t-so}/B_1$ for various values of b . This procedure was used for Fig. 1.

To calculate Fig. 4, the equation for B_t becomes

$$[1 + B_t^2/B_1^2][1 + B_t^2/B_2^2][1 + B_t^2/B_3^2] = 2 \quad (10)$$

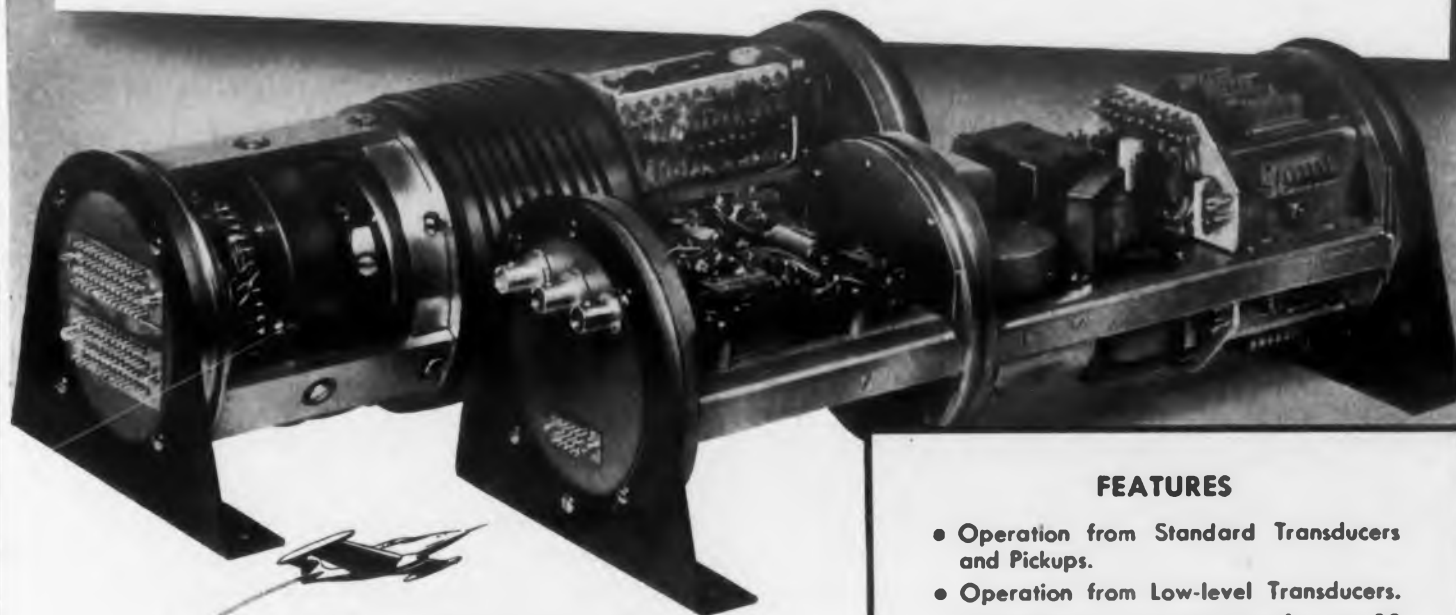
Letting $B_2 = \gamma B_1$ and $B_3 = \delta B_1$, a sixth degree equation in B_t/B_1 is obtained. By assigning values to γ , a quadratic in δ is obtained which is readily solved by assigning various values to B_t/B_1 , which must be within proper limits to give positive values of δ^2 .

The skirt selectivities for Fig. 5 are found in a similar manner by setting the left hand side of Equation 10 equal to 1000.

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New Products

Voltage-Reference Secondary-Standard



A new ultra-stable secondary-standard voltage-reference source combines a dc voltage source with five decade switches as incremental voltage dividers. The continuous dc reference outputs of ± 100.00 v have initial accuracy of .01 per cent and maximum drift of .02 per cent *per year*.

Output voltage is selectable between +111.112 and -111.112 in discrete steps of 1 mv; minimum resolution steps of 10 μ v are obtainable when a precision 100:1 attenuator is used.

Power input is 150 w, 95 to 125 v, 50 to 60 cps, ac. Epsco, Inc., Dept. ED, 588 Commonwealth Ave., Boston 16, Mass.

CIRCLE 46 ON READER-SERVICE CARD FOR MORE INFORMATION

Breadboard Components For Servo Systems



A line of standard electromechanical breadboard parts has been manufactured to meet government standards. The parts are precision designed for close tolerances. Aluminum parts are anodized; stainless steel parts are passivated.

Included in the product line are: grid plates, shaft hangars, shaft couplings, shaft hardware, electric and electro-mechanical limit stops, dial assemblies, gears and differentials, magnetic clutches and ball and disc integrators.

Helipot Corp., Dept. ED, Newport Beach, Calif.

CIRCLE 47 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistor Plugboard For Instant Circuits



Instant circuits for transistor circuit design consist of a number of individual units, each of which comprises a basic circuit element, signal source or test instrument.

Bread-boarding is eliminated since the instant circuit system permits circuits to be set up by means of color coded pin tip leads and pin jacks connected to circuit elements. Range of components include: potentiometers, fixed resistors, capacitors, inductors, transformers, speakers, transistor and tube sockets, batteries, meters, tie points, signal sources and test instruments.

Instant Circuits, Dept. ED, 32-44 Francis Lewis Blvd., Flushing 58, N.Y.

CIRCLE 48 ON READER-SERVICE CARD FOR MORE INFORMATION

Slotted Lines Cover VHF-UHF Range



Two slotted lines offered by this firm permit measurements to be made over the entire vhf-uhf range. The Type FT-LMM covers 80-300 mc and has a residual vswr of 1.03:1; probe location can be read to an accuracy of ± 1 mm. The Type FT-

LMD covers 300-3000 mc and has a vswr of 1.02:1; its probe location can be read to an accuracy of ± 0.1 mm. Both lines have their own built-in detectors and indicators.

Instrument Div., Federal Telephone and Radio Co., Dept. ED, 100 Kingsland Rd., Clifton, N.J.

CIRCLE 49 ON READER-SERVICE CARD FOR MORE INFORMATION

Direct Frequency Meters Can Read up to 10 Kc



These frequency meters are direct indicating panel instruments which can be made for any frequency from 40 to 10,000 cycles. The accuracy 0.25 per cent of center

scale reading, and they are available for any input between 80 and 500 v. The meters can be made with a maximum frequency range of ± 20 per cent from any specified center frequency.

The center frequency is a null reading, and therefore independent of voltage. Current consumption is between 2 and 4 ma.

Gary Wells Co., Dept. ED, 3 Park Row, New York 38, N.Y.

CIRCLE 50 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistor Oscillator Crystal-Controlled



A new portable, crystal-controlled transistor oscillator employs a pair of transistors and a diode feedback system in a battery-operated unit. Output frequencies of 1, 2 and 5 mc are available by rotating a selection switch. An external crystal jack is provided to furnish other frequencies

falling between 1 and 5 mc.

Three frequency adjustments are provided. Output is 0.25 v at 1000 ohms impedance level. Dimensions are 2 x 1-3/4 x 4-1/2 ins., and weight is 12 oz.

Kay Electric Co., Dept. ED, 14 Maple Ave., Pine Brook, N.J.

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Ferrite Cores

Are Temperature Stable

Ferrite cores with a temperature coefficient of initial permeability of .02 percent/C maximum, from 20 to 80 C and an initial permeability of 200 are being produced.

Special pressing techniques has made possible the production of a ferrite tuning core with uniform permeability along its entire length. Different types of cores cover the frequency range from 2 kc to 100 mc.

Communication Accessories Co., Dept. ED, Hickman Mills, Mo.

CIRCLE 52 ON READER-SERVICE CARD

Television Camera Tube

Has High Sensitivity

A new television camera tube, the Diamond Utilicon 600, has extremely high sensitivity. Surface characteristics are such as to provide more uniform background shading and black to white contrast. Resolution capability is 600 lines. Side tubulation has been eliminated thus permitting rotation to obtain maximum horizontal resolution. The tube is readily interchangeable with tubes used in customary industrial television cameras.

Diamond Power Specialty Corp., Dept ED, Lancaster, O.

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Oscillographic Paper

Faster, Thinner

High-contrast, thinner photo-recording paper, Du Pont Lino-Writ 4, will record high oscillographic frequencies at faster paper travel rates.

The paper is 25 per cent thinner and has approximately 25 per cent greater sensitivity than other Du Pont photo-recording papers. The ability to record higher frequencies at faster paper travel rates allows greater trace stretch-out, thereby permitting easier data analysis. Either regular or rapid-stabilization processing methods may be used. The paper will be produced in standard sizes for all popular oscillographic machines.

E. I. Du Pont de Nemours & Co., Dept. ED, Wilmington, Del.

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case history No. 5 of
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You're a jet fighter pilot streaking home to your carrier 200 miles distant . . . somewhere in the dead of night . . . above a pea-soup fog. No margin for error here . . . minutes, yards mean the difference between success and failure. Yet you're guided unerringly every second of the flight. Safely . . . swiftly you let down to home base—thanks to TACAN (Tactical Air Navigation).

Federal Telecommunication Laboratories specified the Model VC11 JFD Variable Trimmer Piston Capacitors in its TACAN development program for the U. S. Navy and U. S. Air Force. Used in the Ferris discriminator circuit of the IF amplifier, the VC11 is used in adjusting critical band pass frequencies to prevent adjacent channel interference. Compactness . . . stability . . . shock-resistance . . . imperviousness to temperature variations . . . — these are a few of the reasons why today Federal Telephone and Radio Co., Hoffman Laboratories, Inc., and Stromberg-Carlson Co. (A Division of General Dynamics Corporation), are building JFD VC11 Capacitors into TACAN equipment.

The VC11 is one of 50 miniature and subminiature trimmer capacitors upgrading performance in today's most sensitive printed and conventional electronic circuits. Wouldn't you like to see how they can help you on *your* project?



ACTUAL SIZE

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The logarithmic converter Model 60 is used with the autograf X-Y recorder in applications where dc

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F. L. Moseley Co., Dept. ED, 409 N. Fair Oaks Ave., Pasadena, Calif.

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Indicating Light

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This neon indicating light assembly, the No. R115, is designed for use with taper pin terminals, but extends only 1-1/16 in. back from the front of the panel when installed. A special nut is used which features extra-deep knurling for quick and positive assembly. A black anodized aluminum body and an inside-fluted lucite cap lend a neat, attractive appearance.

Drake Manufacturing Co., Dept. ED, 1713 W. Hubbard St., Chicago 22, Ill.

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Aluminum Wire Terminal

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A new terminal for aluminum wire terminating has a terminal barrel containing a cartridge with oxide-removing compound that is sealed with a wire-size color-coded, removable plastic plug. The tongue end of the barrel is provided with an inspection hole to ascertain if leads are fully inserted. This inspection hole is equipped with a plastic sealing plug. The terminal is made of tin-plated aluminum to insure high conductivity and corrosion resistance, and is designed to accommodate wire sizes 8-4/0.

Aircraft-Marine Products Inc., Dept. ED, Harrisburg, Pa.

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Solder which is richer in indium has a higher bonding-holding strength, while the lower indium content solder is harder, higher melting, and has better electrical conductivity and tensile strength. Twelve different alloys can be supplied, with melting temperatures ranging from 243 to 599 F. Indium-containing solders need no special equipment for their use.

Alpha Metals, Inc., Dept ED, 56 Water St., Jersey City, N. J.

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"Kelon-T" (teflon) electrical spaghetti sleeving insulation combines excellent electrical and mechanical properties. Unaffected by a wide range of ambient temperatures, pressure, altitude, and humidity, the spaghetti tubing resists moisture, abrasion, and corrosive chemicals at high and low temperatures. It remains completely serviceable from -90 to +250 C. It has good dielectric constant, and power factor is constant over an extremely wide frequency range.

The spaghetti allows assembly by the most modern soldering techniques. It does not become embrittled due to aging under ambient temperatures. Applications include sheathing for hook-up wire, and insulation for solder functions and terminals in electronic components. Non-electrical applications include instrument tubing.

The spaghetti is available in a variety of standard colors in cut lengths or on spools of 200 ft length or longer. Sizes available range from No. 26 to No. 8, and larger. Special sizes are available to order.

Stamban Engineering Co., Dept. ED, 11617 W. Jefferson Blvd., Culver City, Calif.

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NEWS

Heat resistance, low friction of TEFLON® solves design problem in miniaturization of potentiometers

Du Pont ZYTEL® provides needed insulation in strong, lightweight parts

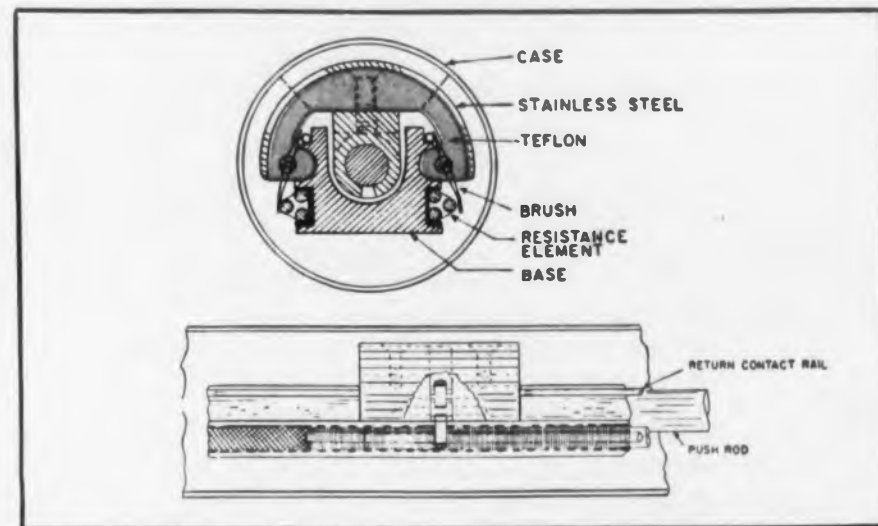


Marking electrodes, housed in Du Pont "Zytel" nylon resin, trace impulses on electro-sensitive paper. "Zytel" is used because of its insulating properties and its strength in thin sections. (Recorder manufactured by Alden Electronic & Impulse Recording Equipment Co., Alden Research Center, Westboro, Mass.)

With the Alden 30-channel recorder, up to 30 machines can be monitored remotely and their records studied for optimum scheduling, and downtime. Tiny motion switches mounted on the machines and activated by machine motions transfer electrical currents to the recorder. The currents then activate electrodes that mark out lines on electro-sensitive paper, providing a permanent record of operating cycle, and downtime.

One of the problems in developing the recorder was to find a material to house the marking electrodes. It had to be lightweight, strong, provide good insulating properties, and be economical to produce.

The manufacturer solved the problem with Du Pont "Zytel" nylon resin. This engineering material is strong, even when molded in thin sections. The metal inserts form an integral part of the marking electrodes because "Zytel" can be injection-molded around these inserts. With this method there are fewer parts, and assembly costs are reduced. The holders of "Zytel" can be produced in a variety of attractive colors.



Cross section of typical dual rectilinear potentiometer with insulation of "Teflon." Du Pont "Teflon" protects the core from heat and friction.

Miniaturization in guided missiles and other airborne equipment necessitates improvement in design and insulation of potentiometers. Du Pont "Teflon" tetrafluoroethylene resin fills the insulation requirements. A trunnion pin fitted into two shoes of "Teflon" holds the double-leaf brush in the new line of high-temperature potentiometers manufactured by the Pacific Scientific Company, Los Angeles, California.

The importance of "Teflon" in this application stems from its high heat resistance and low coefficient of friction. In use, this potentiometer must operate at temperatures as high as

400°F. and intermittently to 550°F. "Teflon" insulates the potentiometer and protects the core. The movement of the sleeve calls for a material with a low coefficient of friction. "Teflon" solves this problem, too.

"Teflon" offers a combination of electrical, chemical and mechanical properties that makes it well suited for use in high-frequency, high-temperature and some high-voltage applications; in applications such as this, where miniaturization and compactness of design are essential; and for uses where equipment is exposed to corrosive action.

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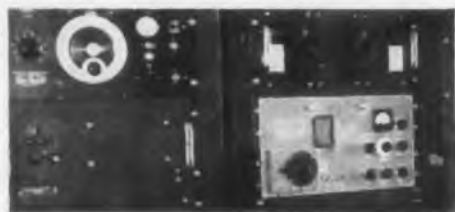
Greenwich, Connecticut

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

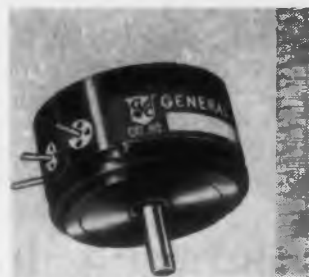
General Engineering Laboratories

American Machine & Foundry Company

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Greenwich, Connecticut

Rotary Potentiometer

±0.3% Linearity



The PRA120 1-1/8 in. Servo-Mount Rotary Potentiometer achieves ±3% resistance tolerance, and ±0.3% independent linearity. Standard operating temperatures are -65 to 275 F. Rotation is 360 deg continuous. Standard electrical angle is 350 ±2 deg. All dimensions conform to RETMA standards.

The PRA120 is available in 100 ohm to 50,000 ohm models and features exceptional stability during rugged operating conditions. It is designed to meet MIL-E-5272 and MIL-R-12934.

Potentiometer Div., General Controls Co., Dept. ED, Glendale, Calif.

CIRCLE 66 ON READER-SERVICE CARD FOR MORE INFORMATION

Selenium Rectifiers

Line of 45 v Units



A line of 45 v selenium rectifiers is available in standard sizes from 11/16 in. to 2 in. square. The cells exhibit high stability and very low reverse or "leakage" current, making them valuable for use in magnetic amplifiers.

The rectifiers are designed to permit significant savings in cost and space by requiring fewer cells to achieve a desired voltage rating. They are manufactured in both commercial and radio-TV types.

Components Div., Federal Telephone and Radio Co., Dept. ED, 100 Kingsland Rd., Clifton, N.J.

CIRCLE 67 ON READER-SERVICE CARD FOR MORE INFORMATION

Metallized Film Capacitor

Self-Healing



A new principle of self-healing is responsible for a capacitor with high reliability and small size for a wide range of ratings.

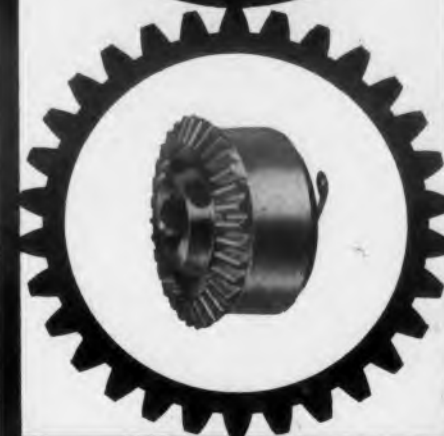
Operating temperature range is -65 C to +125 C. Insulation resistance is 50,000 megohm-mfds at 25 C. The units are furnished in hermetically sealed tinned brass cases, glass to metal seals, bath tub or rectangular cases, single or multiple sections.

Dearborn Electronic Laboratories, Dept ED, 231 La Salle St., Chicago 4, Ill.

CIRCLE 68 ON READER-SERVICE CARD FOR MORE INFORMATION

HYCOR

Miniature
**MAGNETIC
CLUTCHES**



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.

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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 69 ON READER-SERVICE CARD

An Engineer Speaks Out...



...about Buying Design Breadboards

When you purchase a breadboard, the prime considerations should be flexibility, ease of assembly, precision and price.

You get more flexibility, easier, quicker assembly, higher precision, and greater value for your dollar with Servoboard® electro-mechanical assembly kits than with any other breadboard on the market.

There are over 250 standard precision parts (hangers, clutches, couplings, etc.) in the Servoboard line—more parts than in any other breadboard array. Only the Servoboard kits offer such exclusive precision parts as: 4 different adapter gears, calibrated inertia load discs, pulse discs... only Servoboard offers a complete line of spur and pinion gears... and only Servoboard offers you 14 pre-bored hangers which accept over 150 standard electronic servo components. With Servoboard, you have the kind of flexibility to mock-up and test any type of servosystem or component that requires a combination of electrical and mechanical parts.

The rigid, tapped mounting board is one of many Servoboard exclusives. You get maximum ease and speed of assembly because the tapped board lets you assemble components at any angle, from the top—where you can see what you are doing.

Here's another Servoboard bonus. In addition to breadboarding pilot models, Servoboard precision parts also serve as permanent, integral components of a system or instrument. When a system design has been mocked-up and tested with Servoboard, you can place your order with us for production quantities of the same Servoboard parts tested and proven on the prototype. These components will perfectly match design specifications for the production run of the new system.

Murder in the Model Shop
Send now for your free copy of this new, thrilling detective story.



Lloyd Knight

Manager of Engineering Services

Electro-mechanical Control Systems and Components for Industry by

SERVO CORPORATION
OF AMERICA

Lloyd Knight, Dept. K-23
Servo Corporation of America
10-20 Jericho Tpke., New Hyde Park, L.I., N.Y.

Please send me my free copy of "Murder in the Model Shop."
Name.....
Title.....

CIRCLE 70 ON READER-SERVICE CARD

Abrasion Resistant Cables

Have Teflon Jackets



A new line of cables, which have Teflon jackets in addition to Teflon dielectric, is now available in nominal diameters up to .420 in.

The jackets are treated to provide abrasion resistance and also have the normal ability of

Teflon to resist solvents and withstand temperatures ranging from minus 300 F to plus 392 F.

Federal Telephone and Radio Company, Dept. ED, 100 Kingsland Rd., Clifton, N. J.

CIRCLE 71 ON READER-SERVICE CARD FOR MORE INFORMATION

Test Point Connector

For Printed Circuit Board



A female test point receptacle for printed circuit wiring will accept and hold a standard .080 test probe. Molding body is Mineral filled Melamine and is designed for

right angle mounting. Six floating type contacts are made of spring temper phosphor bronze, gold plated over silver for low contact resistance and ease of soldering.

DeJur-Amsco Corporation, Dept. ED, 45-01 Northern Blvd., Long Island City 1, N.Y.

CIRCLE 72 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Resistor

For Printed Circuits



A new type of flexible power resistor is specially designed for printed circuits. The element is wound

on a flexible fiberglass core. The sleeving, also of fiberglass, is heavily saturated with silicone to pass requirements for above chassis mounting.

Tapered-semi-tubular terminals have been designed particularly for soldering in printed circuit boards. They eliminate "popping-out" problems experienced with solid type terminals. Five watt resistors in values up to 2500 ohms and 10 watt units to 5000 ohms are available.

Lectrohm, Inc., Dept. ED, 5560 Northwest Highway, Chicago 30, Ill.

CIRCLE 73 ON READER-SERVICE CARD FOR MORE INFORMATION



KLIXON C4391
Hermetically
Sealed Thermostat



KLIXON C4344
Hermetically
Sealed
Thermostat

Beryllium copper springs provide the

...**High Fatigue Resistance**

...**Non-Magnetic Properties**

required in these dependable

KLIXON Motor Relays and Thermo-Snap* controls, that's why...

I-S Springs "click" with KLIXON!*



Klixon Current Type Motor Starting Relays, noted for quiet operation and trouble-free service, employ I-S precision-made Beryllium Copper compression-type springs. Klixon Thermo-Snap Controls, sealed against dirt, oil and atmospheric pressures, use I-S Beryllium Copper switch blades to provide long trouble-free life.

*Thermo-Snap and KLIXON are Registered Trademarks of Metals & Controls Corporation

Specify I-S Beryllium Copper Springs for—

- High strength
- Exceptional resistance to fatigue
- High conductivity
- Corrosion resistance
- Stability at temperature extremes
- Reduced space needs

IF YOUR PROBLEM INVOLVES SPRINGS... Consult I-S. Our engineering experience—ranging from household refrigeration to jet aircraft—is available to aid you in the design and development stage. For recommendations on specific applications, just call or write outlining your requirements. Consult Sweet's Product Design File or write for a copy of the new I-S General Catalog.

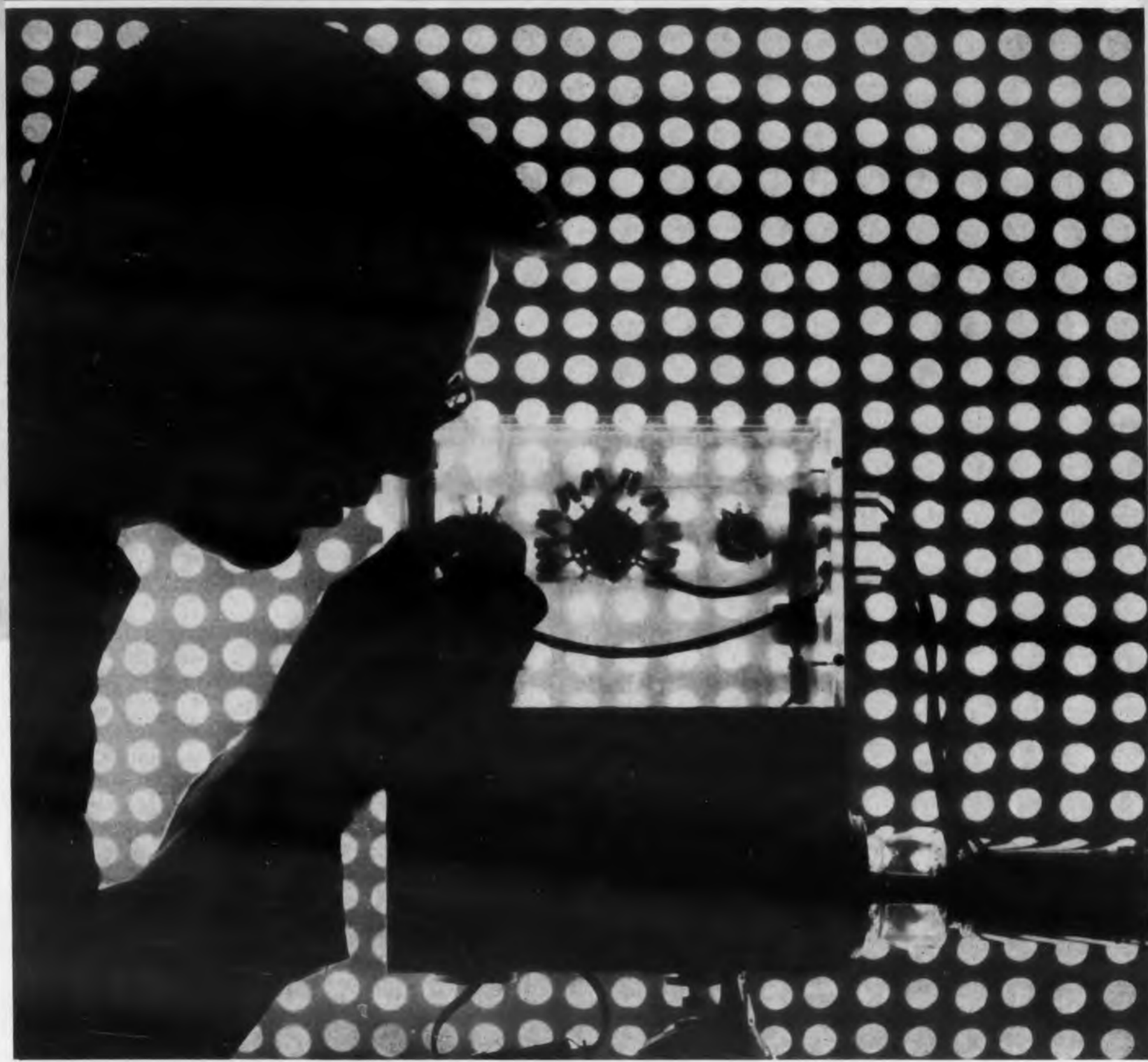
INSTRUMENT SPECIALTIES CO. INC.

270 Bergen Blvd., Little Falls, N.J.
Telephone: Little Falls 4-0280



CIRCLE 74 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC WEEK



A HAYDEN PUBLICATION

October 8, 1956

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.

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IT CAN MEASURE THE CHARGE
BETWEEN YOUR FINGERS

CURTISS-WRIGHT DYNAMIC CAPACITOR ELECTROMETER

FOR STABLE AMPLIFICATION OF LOW-LEVEL DC SIGNALS

Measures currents as low as 10^{-16} amp. • Extremely high input impedance . . . 10^{15} ohms. • Low drift — less than ± 1 mv per 24 hours. • Uses dependable, durable dynamic capacitor. • Accuracy of $\pm 1\%$ full scale. • Only 19"x10"x12"

The Curtiss-Wright Dynamic Capacitor Electrometer is ideal for measuring minute currents or voltages from high impedance sources. There is no 60 cps interference since the Dynamic Capacitor Electrometer operates at 1,000 cps. The instrument can be used to measure static charges, potentials of floating grids, insulation leakage currents, capacitor dielectric leakages; and to study transistors and diodes. Its ruggedness, reliability, and high sensitivity make it especially suited for use in the nuclear field as a component in reactor control systems and in industrial control systems employing radioisotopes as energy sources. It can be used for pH determination, and in mass spectrometry. In biophysics and medicine it may be used to measure cell potentials, skin potentials, streaming potentials, injury potentials, and nerve impulses. Besides providing an indication on its own meter, it will operate any standard recorder. For details, write Nuclear Equipment Sales Dept., Curtiss-Wright Corporation, Electronics Division, Carlstadt, N. J. Unit price only \$1,075.



CIRCLE 75 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitor Kit For Transistor Circuits



This kit is comprised of high-capacitance sub-miniature ceramic capacitors for transistor circuits. It contains six each of six types of capacitors ranging from 0.005 mfd to 0.1 mfd GMV. These units are from 13/64 in. sq up to 17/32 x 21/32 in. max, with thickness from 0.090 to 0.110 in. max. They have radial No. 26 leads and are normally used from 5 to 40 C.

Mucon Corp., Dept. ED, 9 St. Francis St., Newark 5, N.J.

CIRCLE 76 ON READER-SERVICE CARD FOR MORE INFORMATION

Delay Line Continuously Variable



This continuously variable delay line covers the entire delay range from zero to maximum delay by a single shaft, in ten turns. The unit may be locked at the desired delay for use in equipment with a fixed delay. Attenuation is less than 1 db. Resolution is better than .001 μ sec, and termination is external. Maximum delay is .70 μ sec, and maximum rise time is .060 μ sec. Impedance is 500 ohms. Outside dimensions are 6 17/32 x 5/8 x 1 1/4 and the Model 403 meets all applicable Mil-Specs.

ESC Corporation, Dept. ED, 534 Bergen Blvd., Palisades Park, N. J.

CIRCLE 77 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistor Line From 4 to 15 Watts

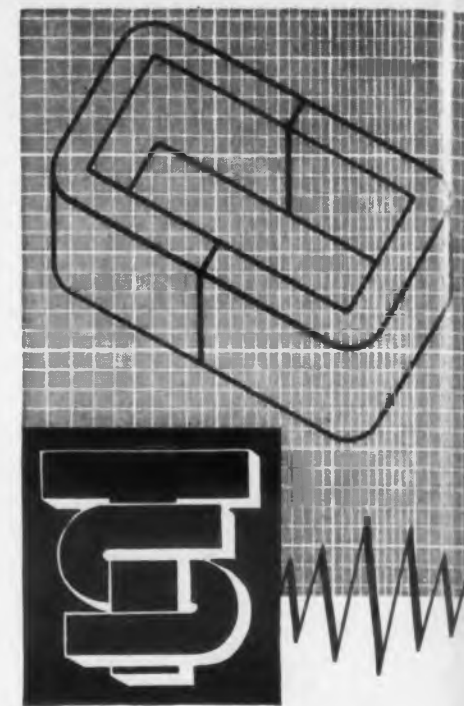


The Square Ohm or bath-tube type of unit is made in five sizes as shown by the photographs. These range from 7/8 in. through 1 1/8 in., 1 3/8 in., 1 5/8 in. and 2 1/16 in., covering the ranges from 4 w to 15 w.

The B P W type units are manufactured in three sizes as shown, B P W 1, 1A and 2.

Bradford Components, Inc., Dept. ED, 33-35 Bishop St., Bradford, Pa.

CIRCLE 78 ON READER-SERVICE CARD FOR MORE INFORMATION



wound cores

THOMAS & SKINNER offers 4 mil and 12 mil tape-wound cores for transformers, reactors and filters. The 4 mil is particularly recommended for 400-cycle applications at flux densities of 15,000 gauss and higher. The 12 mil is designed for 60-cycle applications.

All T&S tape-wound cores are magnetically inspected at a flux density of 15,000 gauss. Magnetic inspection at other densities will be made on request.

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 core best suited for your application.

Write today for
Bulletin WC-356.



Specialists in magnetic materials



CIRCLE 79 ON READER-SERVICE CARD

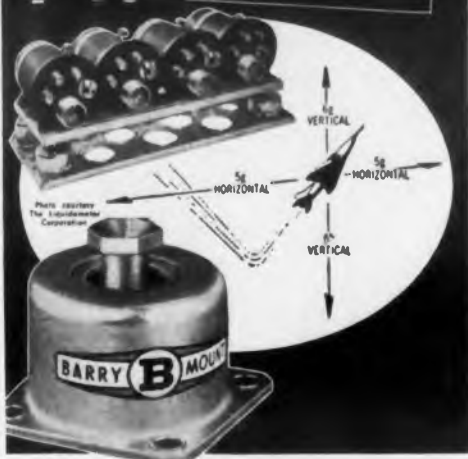
PROVED...

protection under high-g

SUSTAINED ACCELERATION

of the new

F-10 CLASSIFIED



"Only All-Angl Barry Mounts gave effective isolation..."

*One of the newest and hottest fighter aircraft now flying gives its electronic equipment such a terrific slam, when afterburners are turned on or off, that sustained accelerations bottom out MIL-spec mounts — making vibration protection *nil*.

But in this same aircraft, All-Angl Barry Mounts protect the power units of Liquidometer's four fuel-gaging systems, maintaining vibration isolation under sustained accelerations up to 6g vertical and 5g horizontal.

- ▶ In any mounting position
- ▶ Through every attitude of aircraft or missile
- ▶ Under sustained high-g acceleration . . .

. . . All-Angl Barry Mounts give assured protection of reliability. Write for Data Sheet 956-01 giving details. For specific recommendations, call your Barry Sales Representative.

Barry's new Western Division, in Burbank, California, offers fast, on-the-spot design and prototype service, and production of special systems.

BARRY B MOUNT
BARRY CONTROLS
INCORPORATED
SOLE REPRESENTATIVES IN ALL PRINCIPAL CITIES

775 BEASANT STREET, WATERTOWN 72, MASSACHUSETTS
CIRCLE 80 ON READER-SERVICE CARD

Trimming Potentiometer

High Resistance



Trimpot Model 207 Hi-R is a high resistance unit, 100 K, featuring a power dissipation of 2 w, high temperature operation of 175 C, and a precision wire-wound element with low temperature coefficient resistance wire.

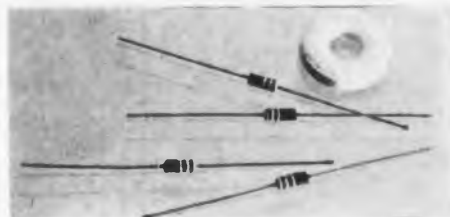
Subminiature in size, these units can be stacked seven deep in less than 2 sq in. of front panel space. Provided is a screwdriver adjustment over 25 turns, with a self-locking shaft for stable settings.

Bourns Laboratories, Dept. ED, 6135 Magnolia Ave., Riverside, Calif.

CIRCLE 81 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicon Junction Diodes

Feature Quick Recovery



Quick recovery subminiature silicon junction diodes, 1N625, 1N626, 1N627, 1N628 and

1N629, afford a combination of high speed, high voltage and high temperature.

They can be used instead of vacuum or germanium diodes in most fast-switching or high frequency circuits. All types are packaged in a one-piece, fusion-sealed glass envelope.

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

CIRCLE 82 ON READER-SERVICE CARD FOR MORE INFORMATION

Hermetically Sealed Relays

Has No Contact Contamination



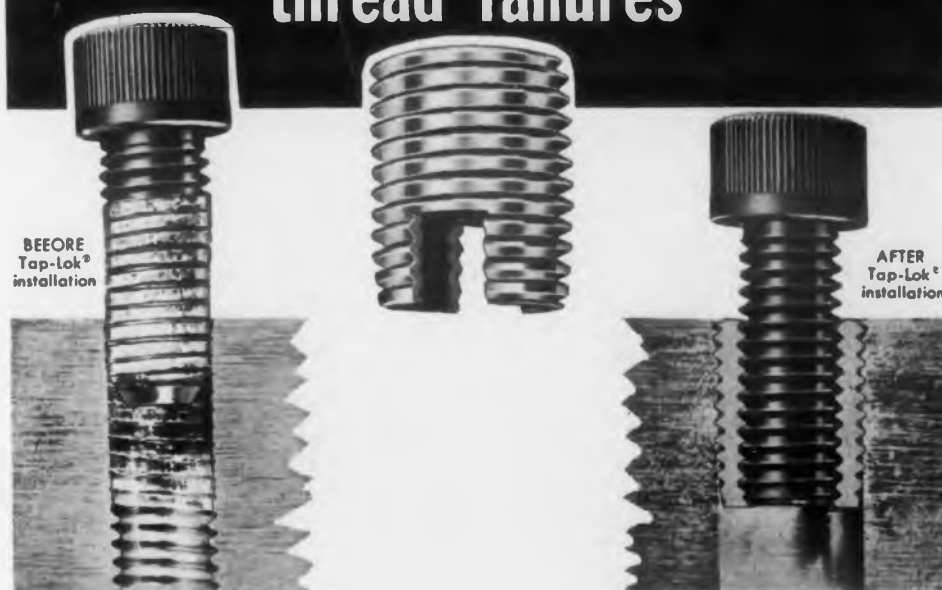
The possibility of contact contamination is eliminated in a new relay which has hermetically and individually sealed contacts. The relay designated F-70334-1 uses a magnetically operated Glaswitch which is isolated from all other parts of the unit.

The relay is available with coils designed for use at 6, 12, 24 or 48 v dc. Contacts are normally open or normally closed, and are rated at 0.5 amperes inductive or resistive at 28 v dc.

Revere Corporation of America, Dept. ED, Wallingford, Conn.

CIRCLE 83 ON READER-SERVICE CARD FOR MORE INFORMATION

This ounce of prevention *cures* thread failures



**in non-ferrous metals, plastics, etc.
... Tap-Lok, the self-tapping insert**

Fabricators of aluminum, magnesium, plastics, etc., have found that Tap-Lok Inserts provide the most practical solution to the problem of increasing the thread-holding strength of comparatively weak materials.

The Tap-Lok Insert is designed as a permanent fastener in materials which are machinable but of insufficient shearing strength to sustain applied loads in threads tapped directly into them.

These internally and externally threaded bushings of steel or brass increase shear area and allow full utilization of the tensile strength of threaded fasteners in the materials in which they are used.

Their unique self-tapping feature substantially reduces assembly costs by eliminating separate tapping operations, hole preparation, secondary staking.

Used widely as original equipment, Tap-Lok Inserts are also ideal for salvage and repair of stripped threads.

Send for your free copy of our new 12 page booklet on Tap-Lok Inserts.
Also manufacturers of Groov-Pins for positive locking press fit.

GROOV-PIN CORPORATION

1125 Hendricks Causeway

Ridgefield, New Jersey

Representatives in principal cities throughout the U. S. A.

IN CANADA: Metal and Wood Fastening Devices Co., Valois, Montreal

CIRCLE 84 ON READER-SERVICE CARD FOR MORE INFORMATION





MicroMatch
 directional couplers
 monitor ANTRAC
 right . . . here!



The Army's multi-channel AN/TRC-24 transmitter relies on Micro-Match Directional Couplers for continuous RF Power monitoring and VSWR indication. They give positive confirmation of the transmitter and antenna system's performance.

MicroMatch Directional Couplers give your transmitters these invaluable features at extremely low cost. Their output is essentially independent of frequency over the range of 20 to 2000 megacycles. They are adjusted to produce full scale meter deflection at power levels of 1.2 watts to 120 KW. Accuracy of power measurement is $\pm 5\%$ of full scale.

WRITE FOR OUR 50-page catalog.



**WHEN MICROMATCH IS BUILT IN -
 YOU KNOW WHAT'S GOING OUT**



M. C. JONES ELECTRONICS CO., Inc.
BRISTOL, CONNECTICUT

CIRCLE 85 ON READER-SERVICE CARD FOR MORE INFORMATION

400 Cps Motors

Induction and Hysteresis Types



Type FC motors are compact 400 cps units for applications where size, weight, and high performance are the governing factors. Protection

for military environmental specifications has been considered in the design. They can be wound as follows: three phase, two pole or four pole; and two phase, two pole or six pole. Both three phase and two phase units can be operated single phase with a suitable phasing capacitor (not furnished). Overload protection can be supplied.

The motors can be supplied with induction or hysteresis rotors. The induction rotor will provide a unit with more output than a unit with a hysteresis rotor, but the hysteresis unit will operate at synchronous speeds. Characteristics can be readily modified to cover a wide range of application requirements. The motors can be furnished with integral planetary gear reducers. They are also available for operation at frequencies other than 400 cps.

Weight of these units is 11.5 oz, and size is 1.675 in. diam x 2-29/32 in. long (including shaft).

Globe Industries, Inc., Dept. ED, 1784 Stanley Ave., Dayton 4, Ohio.

CIRCLE 86 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistorized Scalers

With Decade Counters



The transcaler series is a line of completely transistorized scalars and counters for laboratory or field use. These instruments range from a basic

scale of 128 to 1 mc decade units. Use of transistors throughout yields light weight, small size, and low power drain. Automatic count-up and count-down circuitry is included in some models.

The basic Model, 7002-A of the series features 0.7 μ sec pulse pair resolution, a mechanical totalizer, manual selection of input pulse polarity, and ability to operate 150 hours off an optional self-contained battery supply.

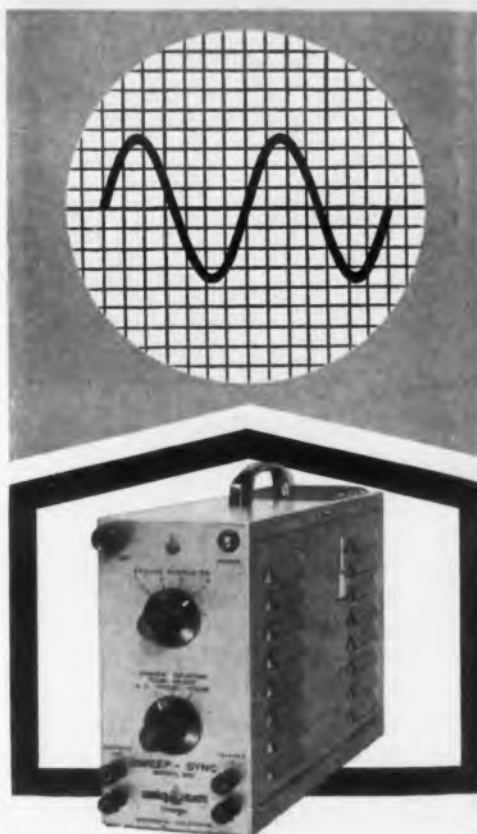
La Roe Instruments, Inc., Dept ED, P.O. Box 5906, Bethesda 14, Md.

CIRCLE 87 ON READER-SERVICE CARD FOR MORE INFORMATION

the SWEEP-SYNC

lets you scan
without distraction

—ADJUSTS THE CRO SWEEP
AUTOMATICALLY DURING
WAVESHAPe CHECKING



No more fiddling with oscilloscope controls every time you change frequencies. A SWEEP-SYNC hooked up to your CRO adjusts automatically to each new frequency. You get an ideal display throughout continuous scanning. You never lose the display of a preset number of cycles. With no distracting sweep control changes needed, you can concentrate on productive work, and get much more done.

Trigger input—any waveshape 5 cps to 100,000 cps. Output is sawtooth, approximately 10 V.P.P. Applications include sine wave, pulse and square wave testing. The SWEEP-SYNC saves time in circuit development, production testing and waveshape monitoring ... makes many visual techniques practical. Occupies only 4" of front panel width. Write for literature.



CHADWICK HELMUTH COMPANY

472 East Duarte Road
Monrovia, California

CIRCLE 88 ON READER-SERVICE CARD

STEMAG PRESENTS THE FIRST CAPLESS* FILM RESISTOR



1w Regular Carbon Film Resistor with end caps. 1w 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 89 ON READER-SERVICE CARD

High-Power Power Supply Regulated Multiple Output



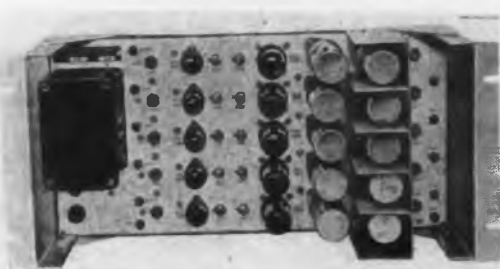
Model M224 multiple output power supply produces three independent, regulated voltages. Brief specifications are: Output No. 1 is 0 to 5.5 kv dc negative with respect to ground at 0.5 amp; regulation and ripple is 0.05 per cent for all outputs; drift is less than 0.05 percent per day. The regulation and drift hold for ±10 per cent line voltage variations and for load variations from 0 to full load. Response time is 1 ms.

The second output is 0 to 1500 v dc negative with respect to output No. 1 at ±50 ma dc. The third output is rated 0 to 2000 v dc positive with respect to output No. 1 at 10 ma dc.

Manson Labs., Dept. ED, 207 Greenwich Ave., Stamford, Conn.

CIRCLE 90 ON READER-SERVICE CARD FOR MORE INFORMATION

Video Distribution Amplifier Designed For Color Signals



Type 1316, an extremely compact video distribution amplifier for color

signals, packs 5 identical amplifiers on a single 8 3/4 in. chassis of standard RETMA 19 in. width, and weighs 17 lbs. The channels feature low differential gain and phase characteristics, and low crosstalk. Differential gain is less than 2 percent (0.17 db) at 50 percent duty cycle. Differential phase is less than 0.3 degree at 50 per cent duty cycle. Crosstalk between channels is less than -60 db from 60 cps to 3.6 mc. The output is source terminated by 75 ohms.

Inputs may be used separately or bridged. The input capacitance of 1 μohm is neutralized so that 75 ohm coaxial lines may be terminated properly and all 5 inputs bridged together without affecting the line characteristics. Type 1316 has a self-contained heater transformer and requires an external 250 to 285 v, 250 ma plate supply.

Tel Instrument Electronics Corp., Dept ED, 728 Garden St., Carlstadt, N.J.

CIRCLE 91 ON READER-SERVICE CARD FOR MORE INFORMATION

PROVEN Design Techniques
 make your
**COMPLEX AUDIO
 FILTER CONSTRUCTION**
 routine at
CHICAGO STANDARD



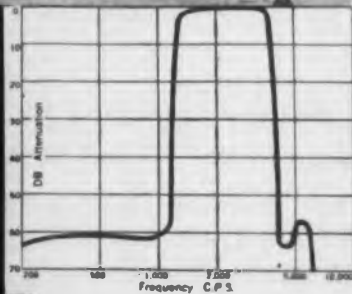
**BUILT
 TO YOUR
 SPECIFICATIONS**
 or available as
 stock units.

Chicago Standard's years of experience in building thousands of filters have made possible a degree of skill in engineering and workmanship that can solve your difficult audio filter problems quickly . . . to your complete satisfaction.

Proven techniques of space utilization and mechanical design result in superior internal construction and efficient, compact, light-weight filters.

Proven design principles result in optimum coil and circuit performance. Reliable operation under extreme conditions is assured by:

1. High efficiency core materials.
2. Chicago's high strength ceramic terminals.
3. High dielectric strength insulation.



FREQUENCY RESPONSE
 Typical
 Band-Pass Filter



**CHICAGO STANDARD
 TRANSFORMER
 CORPORATION**



3501 Addison Street, Chicago 18, Illinois

EXPORT SALES: Roburn Agencies, Inc.

431 Greenwich Street, New York 13, New York

Write Today

outlining your filter requirements and for information on stock units.

CIRCLE 92 ON READER-SERVICE CARD FOR MORE INFORMATION

Insulating Bonding Tape

Highly Chemical Resistant

Affording high tensile, mechanical and impact strength, this new bonding tape has excellent dielectric qualities and high thermal stability with no distortion or elongation. The tape has great resistance to mild acids, alkalies, oil and grease.

Composed of hundreds of parallel fiberglass yarns uniformly coated and impregnated with special polyester resin, the tape bonds and protects wires permanently and can be used as a structural component. The tape may be wound around wires, as with ordinary tape, and the end can be heat-sealed by a soldering iron, eliminating knots. The material readily lends itself to knotting and tying, where desired.

When cured, the bonding tape becomes a homogeneous, machinable mass that is impregnated not just on the surface but all the way through. Recommended curing time is 3 hrs at 125 C, or less at higher temperature.

Varflex Corp. Dept. ED. Rome, N. Y.

CIRCLE 95 ON READER-SERVICE CARD

Battery-Operated Motor

Used in Unattended Recorders

This "Elix" motor has small size (1-1/2 x 1-1/4 x 2-3/8 in. high) and negligible current demands. Utilizing the power of a flashlight battery, it requires no outside source of current. It is used on many recording instruments and chart drives and left unattended for months. For example, a large number of water level recorders of the U.S. Geological Survey which are placed all over the United States are operated by the motor.

Motion of the motor is controlled by a four jewel balance and a rust-proof hair spring which can be regulated to very close timing requirements. Motor voltages are available for 1-1/2, 4-1/2, 6, and 12 v dc. Output speeds range from 1 rev/hr to 1 and 2 rev/day. Torque varies from 0.5 in. oz to 9 in. oz continuous duty, depending on the speed of the output shaft. The motor is enclosed in a dust-proof case.

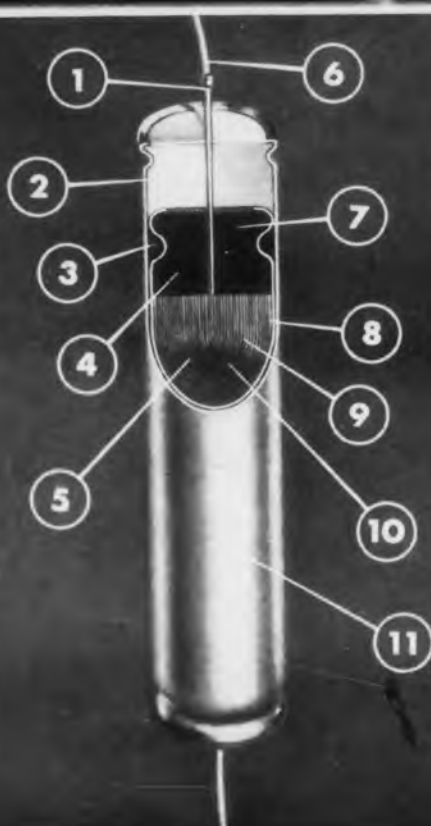
El Products Corp., Dept. ED, P.O. Box 41, New York 63, N. Y.

CIRCLE 96 ON READER-SERVICE CARD

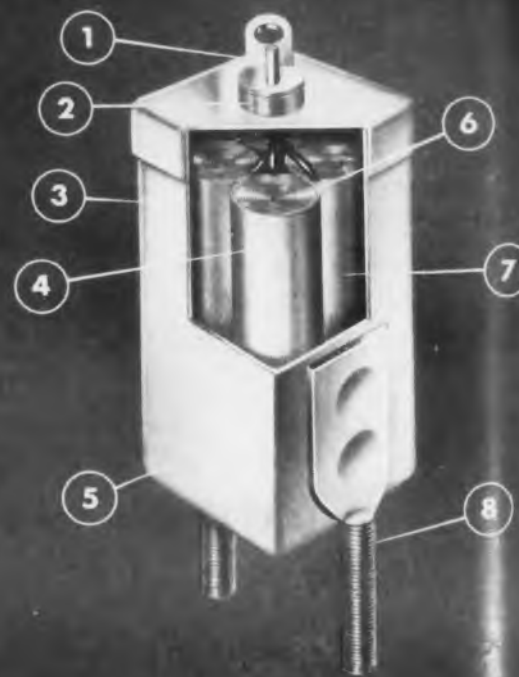
CIRCLE 98 ON READER-SERVICE CARD >



CAPACITORS



HIGH TEMPERATURE TANTALYTIC CAPACITOR — TUBULAR — features: 1 — Tantalum lead, 2 — Teflon[®] bushing, 3 — Mylar[®] insulating sleeving, 4 — Insulation, 5 — Paper and tantalum foil roll, 6 — Solderable nickel lead, 7 — Rubber bushing, 8 — Double metal case construction, 9 — Non-acid electrolyte, 10 — Plain and etched foil, 11 — Polar or non-polar construction.



HIGH TEMPERATURE TANTALYTIC CAPACITOR — RECTANGULAR — features: 1 — Tantalum stud, 2 — Silicone bushing, 3 — Polar or non-polar construction, 4 — Paper and tantalum foil rolls, 5 — Silver-plated metal case, 6 — Plain and etched foil, 7 — Non-acid electrolyte, 8 — Mounting stud (optional).

[®]DuPont Co. Trade Mark

General Electric Tantalytic* capacitors operate at +125 C ambient for 1000 hours at full rated voltage

To help you solve difficult space problems in design functions demanding high reliability miniaturized equipment capable of operating in ambient temperatures ranging from -55C to +125C at full rated voltage, General Electric offers a variety of shapes and sizes of high temperature Tantalytic capacitors.

The Tantalytic capacitor is built for at least 1000 hours operation at +125C with no more than 20% loss in capacity. Below +125C, capacitor life is extended in proportion to the reduction in ambient temperature.

Whatever your capacitor requirements might be, there is a General Electric sub-miniature capacitor for most applications. Take, for example, the metal-clad tubular capacitor - mineral oil impreg-

nated, built to MIL-C-25A - often applied to "work horse" applications in military electronic circuits. Or, capacitor pulse forming networks, adhering to strict capacitance tolerance and temperature range, are engineered for missiles and radar equipment.

New permafil capacitors, built to meet the characteristic "K" requirements of MIL-C-25A, are now available in rectangular case styles. These solid dielectric capacitors can withstand the violent shock and vibration found in today's missile and airborne electronic systems.

For assistance with capacitor applications contact your General Electric Apparatus Sales Engineer or write to the General Electric Company, Section 442-40, Schenectady 5, New York.

*Registered Trade Mark of General Electric Co.

Progress Is Our Most Important Product

GENERAL ELECTRIC



METAL-CLAD TUBULAR CAPACITORS - +85C, mineral oil impregnated. Built to MIL-C-25A. Ratings: .001 to 1.0 uf, 100-600 v. d-c. Tol: $\pm 5\%$, $\pm 10\%$, or $\pm 20\%$. Write for GEC-1390.



PERMAFIL RECTANGULAR solid dielectric in case styles CP50, CP60, and CP70 series. Built to electrical requirements of characteristic "K", MIL-C-25A. Ratings: .01 uf to 10 uf; 100 v. d-c to 1500 v. d-c, Temp. range: -55C to +125C.



CAPACITOR PULSE FORMING NETWORKS - for missiles and radar equipment. Capacitance tolerance: +7% (at +25C). Temp. range: -55C to +125C. Write for GEA-4996.

Insulating Resin

Of Flexible Epoxy

A flexible epoxy insulating resin, "Scotchcast" CRP235, is offered for production line casting of coils and other electrical components. It withstands extreme temperature changes without cracking because of modifications in the resin molecules, allowing them to "give" with expanding and contracting metals. Because of its inherent flexibility the resin is capable of absorbing severe physical shocks, even heavy blows from a hammer, without cracking. Molecule modifications are made without sacrificing low viscosity, heat resistance, moisture resistance, adhesion to metals, and electrical properties characteristic of epoxy resin, according to the manufacturer.

The resin has a viscosity of from 1500 to 2000 centipoise at room temperature or about the consistency of transmission grade oil SAE 140. When warmed to 140 F before pouring, it has a viscosity of 60 centipoise, low enough to provide excellent impregnation.

Two companion resins are also offered: "Scotchcast" No. CRP 241, which is filled, and "Scotchcast" CRP 239, a dipping resin. "Scotchcast" resins are packaged in 1, 5, and 55 gallon containers.

Minnesota Mining and Manufacturing Co., Dept. ED, 900 Fauquier St., St. Paul 6, Minn.

CIRCLE 99 ON READER-SERVICE CARD

Bonding Label

Oil Resistant

A new pressure-sensitive, oil resistant label grips with increasing tightness under heat exposure. This smooth-surface label resists attack from heat, oil, grease, dirt, and many chemicals and acids. A primary heat bond occurs after five hours exposure at 300 F.

An absolute heat bond, takes place after 16 hours exposure at 300 F. Under conditions of absolute bonding, the label surfaces become hard and smooth and labels which had been tinted with silver or black inks are not visibly affected.

Avery Adhesive Label Corp., Dept. ED, Monrovia, Calif.

CIRCLE 100 ON READER-SERVICE CARD

← CIRCLE 98 ON READER-SERVICE CARD

SMALL but **HUSKY**



The Husky Multipole Relay, small and compact is designed for positive and reliable operation and is doing a dependable, long-life job in many vitally important military and commercial applications.

Available in two frame sizes (single and double coil) providing 2,3,4 and 6 PDT contact combinations. Standard contacts are silver alloy, rated as high as 15 amperes single break or 30 amperes double break, at 24 volts DC or 115 volts AC non-inductive.

Open style dimensions vary from 1 3/8" long, 1 3/8" wide, 2" high for 2 PDT to 1 3/8" long, 3" wide, 2 1/4" high for 6 PDT. Dimensions for hermetically sealed units are slightly larger. Actual dimensions depend on type of enclosure and termination specified.

Features: pin-type hinge, contacts molded in thermosetting plastic, large size contacts and specially designed coil for quiet, efficient operation.

Operating voltages up to 230 volts, 60 cycle AC and up to 120 volts DC. Maximum coil resistance is 5,600 ohms. Weight varies from 5.5 ounces for 2 PDT to 7 ounces for 6 PDT (open style).

Write for SERIES 2100 bulletin.

Your relay problems will receive prompt consideration by our engineers.

Price Electric
CORPORATION
1500 CHURCH ST., FREDERICK, MARYLAND



CIRCLE 102 ON READER-SERVICE CARD FOR MORE INFORMATION

Longitudinal Counter

Accurate to Tenths of a Minute



The Model 2216 counter provides longitudinal readings in tenths of a minute divisions. Beginning at 0 degrees West, the counter increases in West readings to 179 deg. 59.9', where it transfers to the equivalent of 180 deg. East,

declining in East readings back to 0 deg. The counter is reversible at any point in the complete cycle. Clockwise rotation of the input shaft increases West readings from the 0 degree starting reference.

Twelve counting drums are utilized in conjunction with an automatically operated, two-position mask containing six windows in each position to provide complete readings in either direction.

The 2216 is capable of high or low speed operation for applications requiring longitudinal angular measurements.

Bowmar Instrument Corp., Dept ED, Pennsylvania St., Fort Wayne, Ind.

CIRCLE 103 ON READER-SERVICE CARD FOR MORE INFORMATION

Enlarger-Projector-Plotter

For Film and Microfilm



This unit offers many facilities in work with film. It has a continuously variable magnification ratio of from 1.5X to 125X. Projecting upon a horizontal plastic-covered charting surface, it is usable for any type of plotting or viewing purpose. A printing frame and sensitized paper roll cassettes can be supplied for use as an enlarger.

A geneva movement film transport mechanism moves the film rapidly for viewing as a motion picture, or the film can be advanced frame by frame and can remain stationary for prolonged study.

An automatic exposure timer can be provided for use when the unit is used as an enlarger. The projected picture is automatically kept in sharp focus throughout the entire magnification range by means of a servo system. The projected image can be moved on both the X and Y axes throughout the entire width and at the panel board.

Although this unit is designed for military use, it can be supplied for commercial applications.

Nemeth, Inc., Dept. ED, 2223 So. Carmelina Ave., Los Angeles 64, Calif.

CIRCLE 104 ON READER-SERVICE CARD FOR MORE INFORMATION

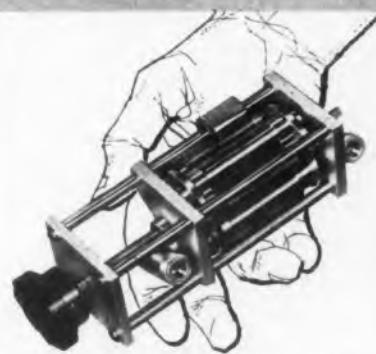
**PRECISION
ATTENUATION
to 3000 mc!**

**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 105 ON READER-SERVICE CARD

NEW

ultra-thin CHASSIS-TRAK "DETENT" cabinet slides



give
easier access
and mounting
for
electronic equipment

Chassis-Trak "Detent" slides tilt down as well as up to give you ready access to any part of the instrument. Front panel trigger control locks chassis in 7 different tilting positions. Solid bearing surfaces are permanently dry lubricated, glide smoothly without brinnelling or peening under loads up to 175 lbs. Ideal solution to shock or vibration problems. Standard unit accommodates 17" chassis in standard width cabinets 11" to 25" deep. Meets JAN 50-hour salt spray requirements. Now used in many military installations. Available in light, medium, heavy-duty and roller slide models.

Write Dept. ED-1 for
equipment bulletin D-151A

CHASSIS-TRAK CORPORATION
305 SOUTH WEBSTER
INDIANAPOLIS, INDIANA

CIRCLE 107 ON READER-SERVICE CARD

Servo-Amplifiers Subminiatures

Designed to operate at high efficiency and to occupy minimum space, this line of servo amplifiers comprises both transistor and vacuum tube types.



Transistor models include 1 w and 3 w units using silicon transistors, and 6 w and 9 w units using germanium transistors to provide high-power output.

The units are designed for use with 400 cps servo motors and vary in size from 6 to 12 cubic ins., and in weight from 4 to 5 ozs.

Vacuum tube models include a 5 w rugged amplifier and precision summing amplifier that handles up to seven inputs at an accuracy of ± 0.05 per cent, and provides a 90 degree phase shift if desired.

Maxson Instruments Div., The W. L. Maxson Corp., Dept. ED, 47-37 Austell Pl., Long Island City 1, N.Y.

CIRCLE 108 ON READER-SERVICE CARD FOR MORE INFORMATION

Accelerometer Used in Flight Control



A potentiometer-type accelerometer, the Model DDL was developed specifically for transonic and supersonic guided missiles and aircraft flight control applications. It is a dual-damped low-range instrument with unusually good resistance to severe vibration and shock accelerations. Dual damping is accomplished by the use of a permanent magnet and a silicon fluid. Output of the potentiometer is linear. The wiper, attached to a movable mass, is positioned along the winding as G forces displace the mass. Ratio of resistance unbalance varies directly with the magnitude of acceleration.

Range is ± 0.1 to ± 8 G, or up to ± 30 G with reduced damping. Linearity is within 1 per cent of full scale from a straight line whose slope is within 2 per cent of ideal slope. Damping can be preset to any point between 0.5 and 1.0 critical. The potentiometer is rated 2 K to 20 K, 1/3 w continuous duty. Size of the accelerometer is 2-1/4 x 3-1/2 x 3-1/4 in.

Genisco, Inc., Dept. ED, 2233 Federal Ave., Los Angeles 64, Calif.

CIRCLE 109 ON READER-SERVICE CARD FOR MORE INFORMATION

Here's How DIT-MCO Analyzers Have Helped Leading Aircraft and Missile Manufacturers Solve Complicated Circuit Testing Problems:

- Human errors in testing
- Complicated test procedures
- Inconclusive test results
- Time-consuming hand tests
- Insulation damage due to chafing or clamping
- Wire shields shorted to conductors
- High resistance short circuits
- Other hard-to-find flaws
- Difficulty in locating errors in test circuit
- Time lost searching through wiring diagrams

*Dit-Mco does the testing!
Detects, classifies and
locates every wiring flaw!*

Cuts testing time up to 90%!

*Dit-Mco finds them all—
even in multiple circuitry!
Checks every wire against
every other wire in the
test circuit.*

*Exclusive matrix chart
tells exactly where
error is located!*

These are just a few of the testing problems DIT-MCO has helped solve. Today, DIT-MCO tests assure the absolute accuracy of electrical systems in most major production and maintenance operations... more quickly and economically than was ever before possible. There's an automatic, universal, fast, versatile, simple to operate DIT-MCO Circuit Analyzer to meet every testing requirement. So —



**if your product involves electrically complex circuitry
DIT-MCO Can Help You Make It
Faster and Better at Less Cost!**

Write today for complete information:

ENGINEERS:

DIT-MCO needs executive calibre sales and design engineers right now! Excellent opportunity with respected organization on the move. Work with key men in aircraft and missile industries. Write today!

Partial List of DIT-MCO Users:

Bell Aircraft Corporation, Texas Div. • Bendix Aviation Corporation, Sidney, New York • Boeing Airplane Company, Seattle, Washington and Wichita, Kansas • American Bosch Arma Corporation • Douglas Aircraft Company, Tulsa, Oklahoma • Fairchild Aircraft Division • Goodyear Aircraft Corporation • Martin, Baltimore • Naval Ordnance Laboratory, White Oaks, Maryland • Northrop Aircraft, Inc. • Motorola, Inc. • Temco Aircraft Corporation • Trans World Airlines • Convair • Chance Vought Aircraft • Servomechanisms, Inc. • Radio Corporation of America • Pacific Mercury Television Mfg. Corp.

DIT-MCO, INC.
Electronics Division

Box 11-20, 911 Broadway
Kansas City, Missouri

CIRCLE 110 ON READER-SERVICE CARD FOR MORE INFORMATION

SIZE 8 (R1000 Series)

.750 x 1.240 inches, weighs 1.75 oz.
Available as transmitters, control transformers, resolver and differentials.
Max. error from EZ 10 minutes.

SIZE 11 STANDARD (R900 Series)

1.062 x 1.766 inches, weighs 4 oz.
Available as transmitters, control transformers, repeaters, resolvers and differentials for 26V and 115V applications. Max. error from EZ 10 minutes.

SYNCHROS

STANDARD AND SPECIAL

SIZE 11 SPECIAL (R500 Series)

Same basic dimensions and applications as standard Size 11 Synchros. Conforming to Bu. Ord. configurations with max. error from EZ of 7 minutes.

PRECISION RESOLVER (R587)

Size 15. With compensating network and booster amplifier, provides 1:1 transformation ratio, 0° phase shift, 5 minute max. error from EZ.

"PANCAKE" SYNCHROS

2.478 x 1.078 inches, weighs 11 oz.
Available as transmitters, control transformers, resolvers, differentials and linear induction potentiometers. Max. error from EZ 2½ minutes. Suitable for gimbal mounting.

All these Kearfott Synchros are constructed of corrosion resistant materials, thus enabling them to be operated under adverse environmental conditions.



ALL PHOTOS 3/4 SIZE

KEARFOTT COMPONENTS INCLUDE:

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

Send for bulletin giving data of Counters and other components of interest to you.

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. Vinedo Avenue, Pasadena, Calif.

CIRCLE 112 ON READER-SERVICE CARD FOR MORE INFORMATION

Tape Transport Mechanism

Has Precise Speed Settings



A new series of tape, transport mechanisms feature specially designed circuitry for changing speed and compensation simultaneously. A front panel control permits precise setting of speed of special hysteresis synchronous motor.

Tape speeds are 15, 30 and 60 inches per second, with starting time of approximately one second at 15 inches per second, 3 seconds at 30 inches per second; 5 seconds at 60 inches per second. Stopping time is 0.1 second at all speeds. Flutter and wow is under 0.1 per cent rms. Recorder heads, erase heads and reproducer heads are contained in one plug-in assembly.

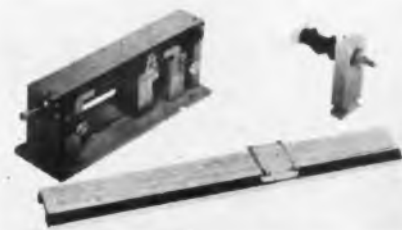
The mechanisms are available in any combination of channels up to 28.

Telectro Industries Corp., Dept. ED, 35-18 37th St., Long Island City 1, N.Y.

CIRCLE 113 ON READER-SERVICE CARD FOR MORE INFORMATION

Limit Stops

Offered in Three Types



This firm offers three basic types of limit stops in its "Servoboard" line of assembly components.

The "Wafer Limit Stop" is used when the load is comparatively light and a small number of turns are to be controlled. It sets the limits of shaft rotation (up to 17 turns) by the number of angular wafers placed on a shaft. Each wafer permits 300 deg rotation.

The lead screw mechanical stop is used when a large number of turns are to be controlled, when the load may be heavy, or when severe shock is expected as shaft rotation is halted. Three models are available, differing only in length and maximum number of turns permitted: 1-60, 1-120, and 1-150.

The lead screw electro-mechanical stop is used to protect against sudden shocks created as either limit is reached. This is accomplished by the addition of a limit switch to each limit stop to cut off power to the driving just before either limit is fully reached. The unit will allow from 1 to 100 turns.

Servo Corp. of America, Dept. ED, 20-20 Jericho Turnpike, New Hyde Park, N.Y.

CIRCLE 114 ON READER-SERVICE CARD FOR MORE INFORMATION

CHICAGO MAGNETIC

solves problems in

TRANSFORMERS TUNED FILTERS

creative engineering

such as this*

Paired Filters



Matched

to tolerances of 0.1% through a temperature cycle of -67° F. to +190° F.

*designed and manufactured for a specific application in aircraft glidepath equipment.

CHICAGO MAGNETIC CONTROL

1616 NORTH DAMEN AVENUE
CHICAGO 47, ILLINOIS
CIRCLE 115 ON READER-SERVICE CARD



Malco IS YOUR
BEST SOURCE
FOR
SOLDERING LUGS
TERMINALS
PRINTED CIRCUIT
HARDWARE



HERE'S WHY:

- Specialized high production techniques afford lowest possible unit cost.
- Precision tooling, rigid quality control assure tolerances to critical specifications.
- Ample stocks of over 1000 different parts permit prompt delivery.
- Malco specializes in a complete line of small stampings for Radio-TV, electrical/electronic and automotive industries.
- Our line includes terminals and printed circuit hardware in loose or in chain form for automatic insertion.

Let Malco show you how you can save on production time and costs. Contact us today.



Request handy reference catalog containing specifications on standard and custom-made lugs, terminals, corona rings, pins, contacts and similar stampings.

Malco TOOL and MANUFACTURING CO.
4027 W. Lake St., Chicago 24, Ill.
CIRCLE 117 ON READER-SERVICE CARD

Sealed Switch
Glass Insulated



This hermetically sealed switch is designed to meet demands for reliability in electronic equipment. It features rigid mechanical design making use

of low-loss glass insulation, solid molybdenum contact points, solid coined-silver contact arm, hardened shafts and wear surfaces.

The switch is rated at 3 amperes at 115 volts inductive load, and withstands 5 G vibrations from 5 to 2000 cps. It may be operated at temperatures as high as 350 F without damage to functional portions of the switch. When panel mounted, it is explosion, splash, and drip proof. It may be flange soldered into hermetically sealed units permitting internal switching without the necessity of bringing out leads.

The switch is available in a variety of terminal designs and mountings.

Farnsworth Electronics Co., Pacific Div., Dept. ED, 815 So. San Antonio Rd., Palo Alto, Calif.

CIRCLE 118 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistor Power Supply
With Efficiencies to 90%

The "Hycon-Verter," a transistor magnetic power supply, is designed to replace small vibrators, inverters, or dynamotors. Size is only 2 x 2-1/2 x 3 in., and weight is 1-1/2 lb.

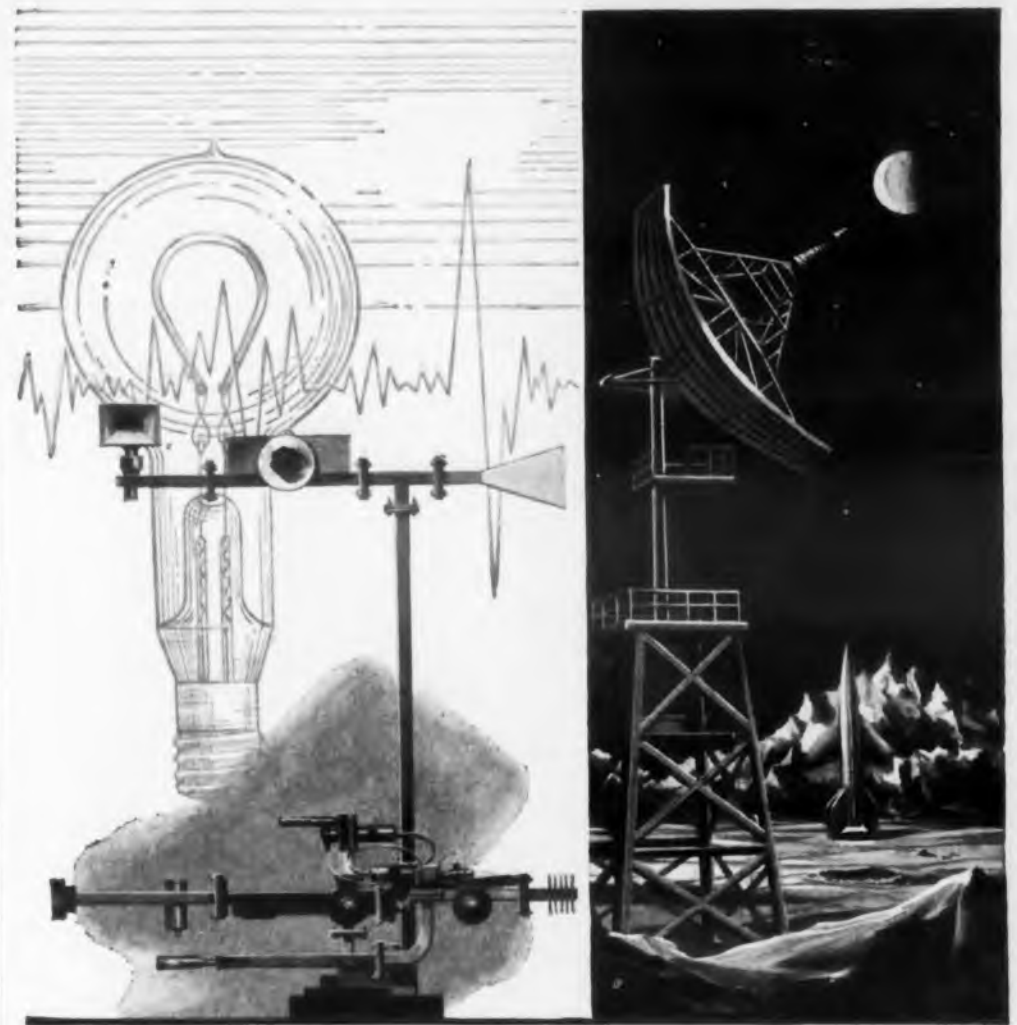


The unit has a 24 v dc input, and it provides outputs of 115 v 400 cps and 150 v dc with a 25 w load rating. It supplies ac power for gyroscopes, servo motors, and magnetic amplifiers; and it supplies high voltage dc for mobile applications such as walkie-talkie units, vehicular, aircraft and marine communications, and allied electronic equipment. It also is useful as an ac power source to synchros and similar units. Efficiencies of as much as 90 per cent minimize heat dissipation problems.

Other advantages include explosion-proof characteristics resulting from the unit's hermetic seal, and an almost total absence of radio and acoustic noises.

Hycon Mfg. Co., Dept. ED, 2961 E. Colorado St., Pasadena, Calif.

CIRCLE 119 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

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the **QUICK** answer to
Stressed Panel Fastener
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SPF®

**HIGH STRENGTH
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FASTENER**



SPF eliminates shortcomings of other methods of securing removable structural panels...

- gives all the advantages of a thread plus continuous thread engagement
- overcomes cross-threading and stripping
- fastens and unfastens in less than a full turn
- compensates for "warping" or "spring-back" of panels
- saves on structural weight and maintenance time
- provides positive clamping force of a bolt
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Get a quick answer to your stressed panel fastening problems. Write for Catalog No. SPF 56 today!

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61 Spring Valley Road, Paramus, N. J.

WEST COAST OFFICE: 5410 WILSHIRE BLVD., LOS ANGELES, CAL.
CIRCLE 122 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Phasemeter

Has 0.1% Accuracy



The Model 901 Phasemeter permits direct reading of phase differences between sinusoidal voltages from 0 to 360 degrees, with provision for sense indica-

tion to avoid 180 degree ambiguity.

Phase angle is measured to an absolute accuracy of 0.1 degree, with incremental accuracy of .01 degree, at all frequencies from 30 to 20,000 cps. Accuracy of the instrument is independent of secondary standards.

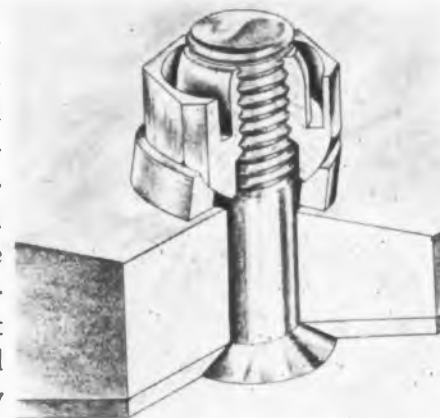
W. L. Maxson Corp., Dept ED, 47-37 Austell Pl., Long Island City 1, N. Y.

CIRCLE 123 ON READER-SERVICE CARD FOR MORE INFORMATION

Hex Locknut

Fastens Non-Parallel Surfaces

A line of counterbored, self-aligning, hexagon locknuts is offered for fastening applications involving non-parallel surfaces. These Type LH2395 fasteners save cost and weight and eliminate many machining, milling, and other operations.



The nut, varying the ball joint principle, has a base with a convex seat which mates with an alloy steel concave seat washer. The nut tilts 8° in any direction from centerline to compensate for angular misalignment of fastening surfaces. The parts will withstand high bursting pressures. Tightening the bolt in the normal manner automatically seats the nut in the base and adjusts it to the proper angle.

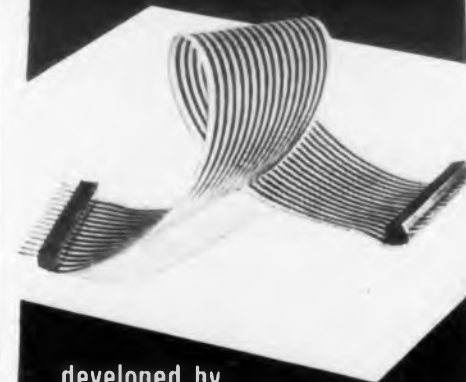
The device provides positive protection against the nut loosening due to vibration, and it offers extended reusability. Performance is to AN-N-10 and/or MIL-N-25027 (ASG) specifications for temperatures up to 550 F. LH2935 parts are adaptable to either short or long thread bolts by the incorporation of a counterbore in the nuts.

Thread sizes for the locknut are 10-32, 1/4-28, and 5/16-24.

Elastic Stop Nut Corp. of America, Dept. ED, Union, N.J.

CIRCLE 124 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW!
Flexible Kel-F
PRINTED
CIRCUIT
CABLES



developed by

Sanders Associates, Inc.

By means of an exclusive Sanders process, the versatile plastic Kel-F can now be laminated with copper in thin sheets to provide a flexible printed circuit cable. This unique development introduces an entirely new concept in the fabrication of multi-conductor cables or wiring harnesses. Excellent electrical and mechanical properties are supplied for operation over a wide range of environmental conditions. The complete encapsulation of the conductors in Kel-F ensures maximum protection against moisture. Glass cloth can also be included in the laminations for increased strength and high temperature stability.

FEATURES

- Excellent dielectric strength
- High degree of flexibility
- Lighter, thinner than many cables
- Maximum environmental protection
- Adaptable to many connectors
- Multi-layer construction available
- Suitable for chassis harnesses
- Wiring errors are eliminated
- Easily mounted

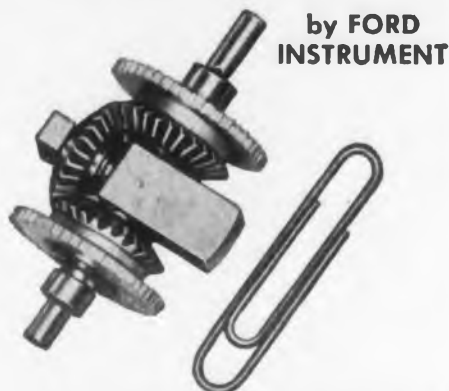
Write for engineering bulletin to Dept. ED11



CIRCLE 125 ON READER-SERVICE CARD

ON THE SHELF!

SINGLE SPIDER GEAR DIFFERENTIALS



by FORD INSTRUMENT

AVAILABLE IN FOUR SIZES:
1/8", 3/16", 1/4", and 5/16" Shaft Diameters

NOTE! Prices of 1/8" units have been drastically reduced.

GUARANTEED SHIPMENT WITHIN:

(WITHOUT END GEARS)	TYPE
1 WEEK for units with set shaft lengths*	A
3 WEEKS for units with shaft lengths to customer specs	B
(WITH END GEARS)	
4 WEEKS for units with stock end gears	C
8 WEEKS for units with end gears to customer specs	D

(SUBJECT TO PRIOR SALE)

*Note: 5/16" units are not stocked with set shaft lengths.

Ford Instrument produces single spider gear differentials to highest military and commercial standards, for extreme accuracy in addition and subtraction, and in servo loop applications. Seven ways superior. Call or wire W. Mohr, Component Sales Division (STillwell 4-9000) for prices, or check and mail coupon below, stating quantity. Data bulletin with performance curves and characteristics will be sent with the prices.



Component Sales Division ED FORD INSTRUMENT COMPANY

DIVISION OF SPERRY RAND CORPORATION
31-10 Thomson Avenue, Long Island City 1, N. Y.

Please send me prices on the following:

Circle size of unit desired:

1/8" 3/16" 1/4" 5/16"

Circle category for type of units needed:
(Check two if both apply)

A **B** **C** **D**

I want _____ (number) units:

Name _____

Position _____

Company _____

Street _____

City _____ State _____

CIRCLE 127 ON READER-SERVICE CARD

Glass Trimmer Capacitor

Has Linear Curve



A new precision glass trimmer capacitor with a linear tuning curve has a capacity range of 0.5 to 4 mfd.

Measuring only 3/4 in. deep behind the

chassis, the capacitor, No. 682014, features lack of negative increments in the tuning curve making it ideal for critically tuned rf circuits and high Q tuned circuits. Minimum Q is 500 at 50 mc. Temperature coefficient of capacitance in 50 ppm per degree C.

Adjustment tongue is .029 in wide; the mounting has a standard bushing 8-32 thread. Constructed of glass tubing with a coating of metal bonded to it, the trimmer has a silver-pleated Invar core and wire terminal.

Corning Glass Works, Dept. ED, Corning, N. Y.

CIRCLE 128 ON READER-SERVICE CARD FOR MORE INFORMATION

Arithmetic Control Unit

For Computer Use



A transac arithmetic control unit occupies one-third cubic foot and weighs under twelve pounds.

It operates on a 3 v potential and employs direct-coupled cir-

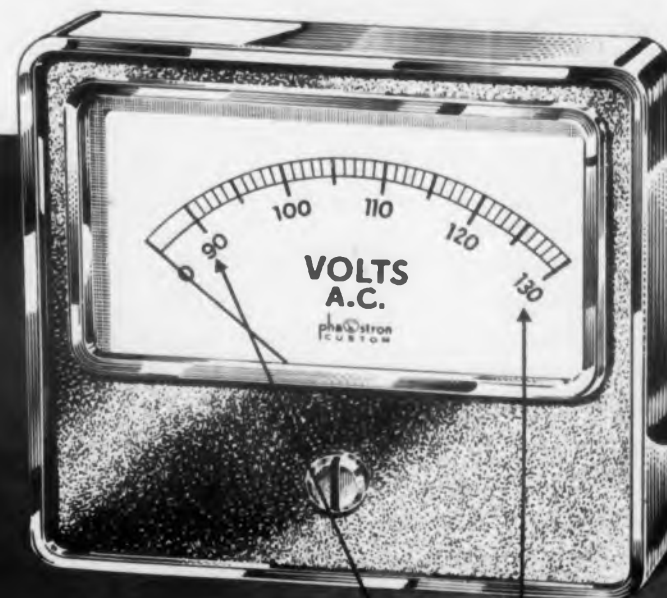
cuitry. The unit contains nearly 1000 transistors, 300 resistors, and 12 capacitors permanently dip-soldered into plug-in printed circuit cards. Each card provides all the necessary functions for one binary digit including add, subtract, multiply, divide, square root, shift right, shift left, sign magnitude and absolute magnitude.

Ten math cards and seven control cards are plugged into the 10 in. unit to provide all the arithmetic processing facilities between conventional input and output devices. The unit adds two numbers in 1.5 μsecs and multiplies in 15 μsecs. A row of lights display the results.

Philco Corp., Dept. ED, 4700 Wissahickon Ave., Philadelphia, Pa.

CIRCLE 129 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW PHAOSTRON EXPANDED SCALE AC Voltmeter



Available now from distributors in 90V to 130V Range, AC Rectifier Type in all custom styles and sizes.

3 1/2" and 4 1/2" rectangular meter



2 1/2" or 3 1/2" square meter



6" rectangular meter



2 1/2" or 3 1/2" round meter

NOW!... all the time-tested proven Phaotron features... PLUS UP TO TEN TIMES GREATER READABILITY for greatly increased accuracy!

Phaotron has squeezed down that under 90V portion of the scale, where you don't need it, and expanded the section where you need it most—between 90 and 130V. Precisely calibrated 1 volt scale increments provide greater reading accuracy. Wide frequency range—linearity—true rms reading and Phaotron craftsman construction.

Phaotron Custom Panel Meters, with expanded scale, 90V to 130V AC rms, are available in nine types at your Parts Distributor. For special requirements, write to the Product Development Department for practical recommendations.

PHAOSTRON

PHAOSTRON INSTRUMENT & ELECTRONIC CO., 151 PASADENA AVE., SOUTH PASADENA, CALIF.

CIRCLE 130 ON READER-SERVICE CARD FOR MORE INFORMATION

the **QUICK** answer to
Stressed Panel Fastener
problems...

CAMLOC

SPF®

**HIGH STRENGTH
ROTARY
FASTENER**



SPF eliminates shortcomings of other methods of securing removable structural panels...

- gives all the advantages of a thread plus continuous thread engagement
- overcomes cross-threading and stripping
- fastens and unfastens in less than a full turn
- compensates for "warpage" or "spring-back" of panels
- saves on structural weight and maintenance time
- provides positive clamping force of a bolt
- prevents deflection under loads



Get a quick answer to your stressed panel fastening problems. Write for Catalog No. SPF 56 today!

CAMLOC

"Specialists in fasteners for Industry"

FASTENER CORPORATION
61 Spring Valley Road, Paramus, N. J.

WEST COAST OFFICE: 5410 WILSHIRE BLVD., LOS ANGELES, CAL.
CIRCLE 122 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Phasemeter

Has 0.1% Accuracy



The Model 901 Phasemeter permits direct reading of phase differences between sinusoidal voltages from 0 to 360 degrees, with provision for sense indica-

tion to avoid 180 degree ambiguity.

Phase angle is measured to an absolute accuracy of 0.1 degree, with incremental accuracy of .01 degree, at all frequencies from 30 to 20,000 cps. Accuracy of the instrument is independent of secondary standards.

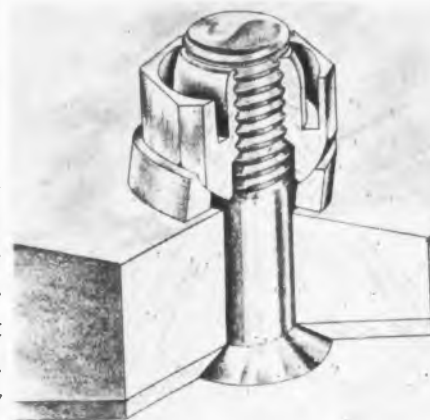
W. L. Maxson Corp., Dept ED, 47-37 Austell Pl., Long Island City 1, N. Y.

CIRCLE 123 ON READER-SERVICE CARD FOR MORE INFORMATION

Hex Locknut

Fastens Non-Parallel Surfaces

A line of counterbored, self-aligning, hexagon locknuts is offered for fastening applications involving non-parallel surfaces. These Type LH2395 fasteners save cost and weight and eliminate many machining, milling, and other operations.



The nut, varying the ball joint principle, has a base with a convex seat which mates with an alloy steel concave seat washer. The nut tilts 8° in any direction from centerline to compensate for angular misalignment of fastening surfaces. The parts will withstand high bursting pressures. Tightening the bolt in the normal manner automatically seats the nut in the base and adjusts it to the proper angle.

The device provides positive protection against the nut loosening due to vibration, and it offers extended reusability. Performance is to AN-N-10 and/or MIL-N-25027 (ASG) specifications for temperatures up to 550 F. LH2935 parts are adaptable to either short or long thread bolts by the incorporation of a counterbore in the nuts.

Thread sizes for the locknut are 10-32, 1/4-28, and 5/16-24.

Elastic Stop Nut Corp, of America, Dept. ED, Union, N.J.

CIRCLE 124 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW!
**Flexible Kel-F
PRINTED
CIRCUIT
CABLES**



developed by
Sanders Associates, Inc.

By means of an exclusive Sanders process, the versatile plastic Kel-F can now be laminated with copper in thin sheets to provide a flexible printed circuit cable. This unique development introduces an entirely new concept in the fabrication of multi-conductor cables or wiring harnesses. Excellent electrical and mechanical properties are supplied for operation over a wide range of environmental conditions. The complete encapsulation of the conductors in Kel-F ensures maximum protection against moisture. Glass cloth can also be included in the laminations for increased strength and high temperature stability.

FEATURES

- Excellent dielectric strength
- High degree of flexibility
- Lighter, thinner than many cables
- Maximum environmental protection
- Adaptable to many connectors
- Multi-layer construction available
- Suitable for chassis harnesses
- Wiring errors are eliminated
- Easily mounted

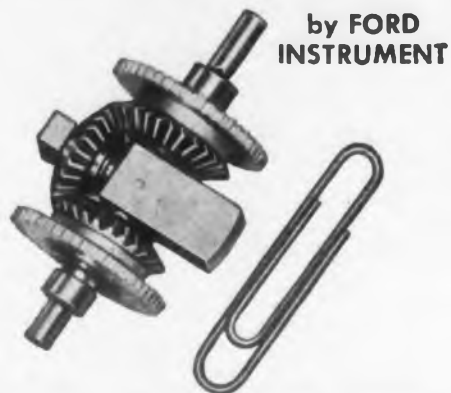
Write for engineering bulletin to Dept. ED11



CIRCLE 125 ON READER-SERVICE CARD

ON THE SHELF!

SINGLE SPIDER GEAR DIFFERENTIALS



by FORD INSTRUMENT

AVAILABLE IN FOUR SIZES:
1/8", 3/16", 1/4", and 5/16" Shaft Diameters

NOTE! Prices of 1/8" units have been drastically reduced.

GUARANTEED SHIPMENT WITHIN:

(WITHOUT END GEARS)	TYPE
1 WEEK for units with set shaft lengths*	A
3 WEEKS for units with shaft lengths to customer specs	B
(WITH END GEARS)	
4 WEEKS for units with stock end gears	C
8 WEEKS for units with end gears to customer specs	D

(SUBJECT TO PRIOR SALE)

*Note: 3/16" units are not stocked with set shaft lengths.

Ford Instrument produces single spider gear differentials to highest military and commercial standards, for extreme accuracy in addition and subtraction, and in servo loop applications. Seven ways superior. Call or wire W. Mohr, Component Sales Division (Stillwell 4-9000) for prices, or check and mail coupon below, stating quantity. Data bulletin with performance curves and characteristics will be sent with the prices.



Component Sales Division ED FORD INSTRUMENT COMPANY

DIVISION OF SPERRY RAND CORPORATION
31-10 Thomson Avenue, Long Island City 1, N. Y.

Please send me prices on the following:

Circle size of unit desired:

1/8" 3/16" 1/4" 5/16"

Circle category for type of units needed:
(Check two if both apply)

A **B** **C** **D**

I want _____ (number) units:

Name _____

Position _____

Company _____

Street _____

City _____ State _____

CIRCLE 127 ON READER-SERVICE CARD

Glass Trimmer Capacitor Has Linear Curve



A new precision glass trimmer capacitor with a linear tuning curve has a capacity range of 0.5 to 4 mufds.

Measuring only 3/4 in. deep behind the

chassis, the capacitor, No. 682014, features lack of negative increments in the tuning curve making it ideal for critically tuned rf circuits and high Q tuned circuits. Minimum Q is 500 at 50 mc. Temperature coefficient of capacitance in 50 ppm per degree C.

Adjustment tongue is .029 in wide; the mounting has a standard bushing 8-32 thread. Constructed of glass tubing with a coating of metal bonded to it, the trimmer has a silver-pleated Invar core and wire terminal.

Corning Glass Works, Dept. ED, Corning, N. Y.

CIRCLE 128 ON READER-SERVICE CARD FOR MORE INFORMATION

Arithmetic Control Unit For Computer Use



A transac arithmetic control unit occupies one-third cubic foot and weighs under twelve pounds.

It operates on a 3 v potential and employs direct-coupled cir-

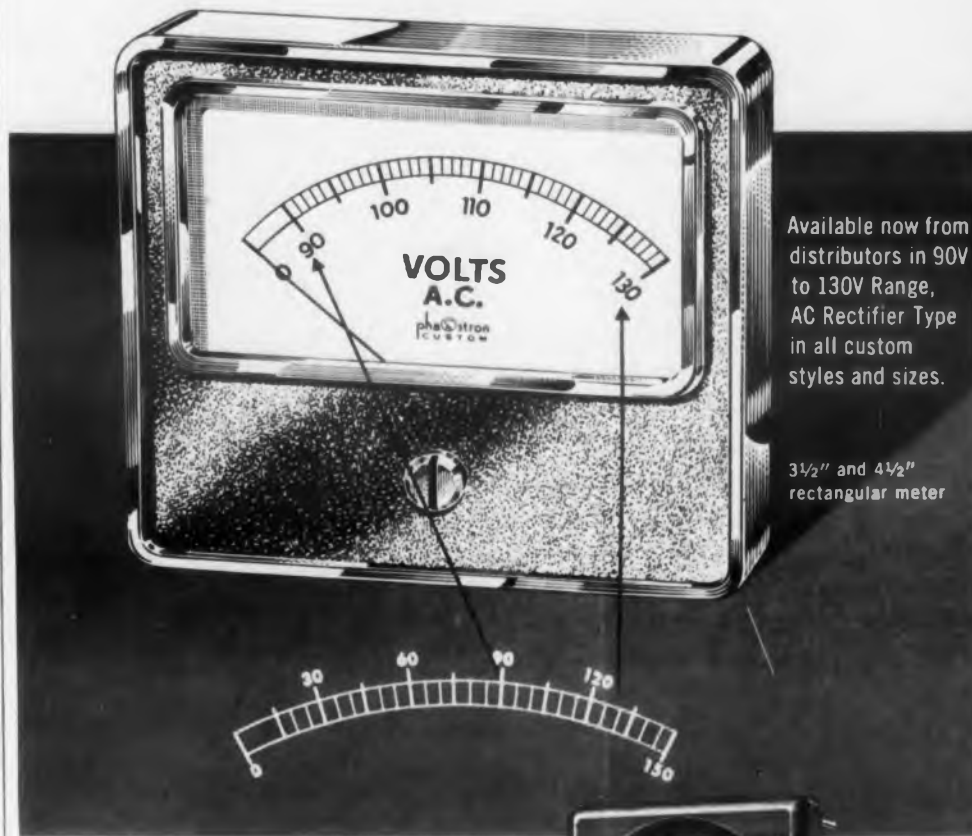
cuitry. The unit contains nearly 1000 transistors, 300 resistors, and 12 capacitors permanently dip-soldered into plug-in printed circuit cards. Each card provides all the necessary functions for one binary digit including add, subtract, multiply, divide, square root, shift right, shift left, sign magnitude and absolute magnitude.

Ten math cards and seven control cards are plugged into the 10 in. unit to provide all the arithmetic processing facilities between conventional input and output devices. The unit adds two numbers in 1.5 usecs and multiplies in 15 usecs. A row of lights display the results.

Philco Corp., Dept. ED, 4700 Wissahickon Ave., Philadelphia, Pa.

CIRCLE 129 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW PHAOSTRON EXPANDED SCALE AC Voltmeter



Available now from distributors in 90V to 130V Range, AC Rectifier Type in all custom styles and sizes.

3 1/2" and 4 1/2" rectangular meter

NOW!... all the time-tested proven Phaotron features... PLUS UP TO TEN TIMES GREATER READABILITY for greatly increased accuracy!

Phaotron has squeezed down that under 90V portion of the scale, where you don't need it, and expanded the section where you need it most—between 90 and 130V. Precisely calibrated 1 volt scale increments provide greater reading accuracy. Wide frequency range—linearity—true rms reading and Phaotron craftsman construction.

Phaotron Custom Panel Meters, with expanded scale, 90V to 130V AC rms, are available in nine types at your Parts Distributor. For special requirements, write to the Product Development Department for practical recommendations.



2 1/2" or 3 1/2" square meter



6" rectangular meter



2 1/2" or 3 1/2" round meter

PHAOSTRON

PHAOSTRON INSTRUMENT & ELECTRONIC CO., 151 PASADENA AVE., SOUTH PASADENA, CALIF.

CIRCLE 130 ON READER-SERVICE CARD FOR MORE INFORMATION

Press-Fit Connectors

Simplify Breakaway Connections

Simply drilling chassis holes and then press-fitting Teflon-insulated "Press-Fit" contact receptacles and feed-thru plugs, respectively, provides breakaway connections for any assembly. Typical uses are: Multiple plugs and receptacles for interconnected yet readily disconnected pieces of equipment; plug-in coils and forms; plug-in crystal diodes, flybacks and other TV components; unitized sub-assemblies.

Type SKT-1 contact receptacle with 0.218 in. diam face and 0.185 in. diam. Teflon body bushing, may be conveniently mounted as close as 5/16 in. between centers. The rear lug facilitates soldered connections. Companion Type FT-M-2 feed-thru plug of corresponding face and body diameters, provides the contact pin that engages with the contact receptacle, and a 1-1/2 in. ductile pigtail lead. Metal parts are silver-plated with gold flash. Available in 8 different colors.

Sealectro Corp., Dept. ED, Fayette Ave., Mamaroneck, N. Y.

CIRCLE 132 ON READER-SERVICE CARD

Telemetering System

For Computer Use

A new system of telemetering instruments which can totalize several flow measurements, correct for such factors as temperature, pressure, specific gravity and super compressibility in fluids, provide a corrected flow value.

A variety of types are available to perform averaging, totalizing, multiplying, and dividing computations involving the basic measured variables listed above. In addition, systems which will extract square root values, obtain the square of the reading, or compensate for a particular mathematical law can be supplied.

In a typical system, indicating or recording telemeter receivers retransmit the uncorrected flow values to a totalizing electronic instrument. At this stage, corrections for static pressure, temperature, and specific gravity are made, and the corrected total is recorded and integrated if desired.

The Bristol Co., Dept. ED, Waterbury 20, Conn.

CIRCLE 133 ON READER-SERVICE CARD

CIRCLE 135 ON READER-SERVICE CARD

Why they come to

UNITED ELECTRONICS



*TYPE 3B24WA

Ruggedized version of JAN 3B24W rectifier.

Height 4.8125 Diam 1.5625

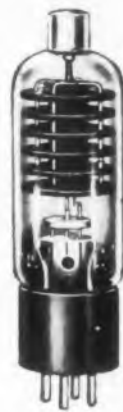
MAX ELECTRICAL RATINGS

Ef 5 volts epx 20 kv
If 3 amps ib 300 ma

Ib 60 mAdc

SHOCK RATING 450 G

employs bonded thoria tungsten core filament



TYPE 582, Half-Wave

High vacuum rectifier for use in airborne equipment where gas tubes give short life on 400 cps or higher source.

Height 5.75 Diam 1.57

MAX ELECTRICAL RATINGS

Ef 2.5 volts If 5 amps
55,000 ft. epx 9 kv

ib 1 amp Ib 200 mAdc
i surge 5 amps tk 40 (min.) sec.

SHOCK RATING 300 G



TYPE 583 Clipper Diode-Rectifier

Designed under latest concepts of rugged and reliable objectives, UNITED type 583 has the industry's esteem for good performance.

Height 4.875 Diam 1.445

MAX ELECTRICAL RATINGS

epx 17 kv ib 8 amps

Ib 65 mAdc

SHOCK RATING 375 G



TYPE 596 Full Wave Rectifier

Reliable, high altitude (60,000 ft.) version of JAN 1641

MAX DIMENSIONS

Height 5.75 Diam 2.250
Ef 5 volts If 3 amps

TYPICAL RATINGS

cond input choke input

epx 2300 v 2750 v

ib 825 mAdc 360 ma

Ib 275 mAdc 275 mAdc



TYPE 589 Rectifier-Clipper External Anode Type

Designed for oil or air operation weights only 3/4 oz. and has SHOCK RATING of 300 G, Ef 6.3 V; If 1.65 Aac length less leads 1.875

MAX ELECTRICAL RATINGS

Clipper Rectifier

epx 10 kv 16 kv

ib 8 amps .250 amp

Ib .020 Adc .065 Adc

These reliable tubes were all originated and developed by UNITED ELECTRONICS COMPANY. Types indicated by (*) embody "bonded thoria tungsten core filament" developed by UNITED and available only in tubes made by this company. This filament is essentially non-fracturable. Its emissivity life is far superior to that provided by ordinary thoriated tungsten.

Write for new 40-page booklet.

UNITED ELECTRONICS, 42 Spring Street, Newark 4,

Originators and Manufacturers

with

LEADERSHIP IN

extreme test

CRITERION TUBES

Manufacturers of modern electronic equipment have encountered instrumentation problems, demanding unprecedented performance of electron tubes.

They have come to UNITED ELECTRONICS, where they find unique engineering initiative, and an ever growing *success experience* in their quest for better tubes. They find here a refreshing atmosphere of knowledge, practicality and friendliness. They find here, minds that are not too inhibited by precedent and outmoded concepts of design approach. **RESULT:** New **EXTREME-TEST CRITERION TUBES** which, understandably, other tube manufacturers are trying hard to copy.



TYPE 554 Rectifier-Clipper
External Anode Type

Designed for oil or air operation
Has max length (minus leads) of
1 1/2 inches. **SHOCK RATING 300 G**
Ef 6.3 volts; If 3.5 Aac

MAX ELECTRICAL RATINGS

Clipper	Rectifier
epr 16 v	18 kv
ib 12 a ps	.470 amp
ib 60 m dc	150 mAdc



TYPE 576-A
Rectifier-Clipper

Ruggedized and up-rated version
of our type 576 good for 500 mo
lb without forced air.

MAX ELECTRICAL RATINGS

Clipper	Rectifier
epr 25 kv	25 kv
ib 14 amps	2.5 amps
ib .030 Adc	.500 Adc
Ef 5.4 volts	5 volts
If 15 amps	14 amps



***TYPE 705WA**
Half Wave Rectifier

Here again UNITED engineers
came up with a much needed im-
provement over JAN type 705A.
This tube has a **SHOCK RATING**
due to bonded thoria filament and
graphite anode in enormously rug-
ged assembly.



***TYPE 561**
Rectifier-Clipper

This is a low impedance compan-
ion to our famous X-80. Has same
filament characteristics as X-80 but
rated for epr of 30 kv.

MAX ELECTRICAL RATINGS

Clipper	Rectifier
epr 30 kv	30 kv
ib 80 amps	2.7 amp
ib .075 amp	.860 amp



***TYPE X-80**
Rectifier-Clipper

Employs exclusive UNITED bonded
thoria filament and powerful rug-
ged graphite anode.
Height 9.75 Diam 3.63

MAX ELECTRICAL RATINGS

Clipper	Rectifier
epr 40 kv	40 kv
ib 80 amps	2.5 amps
ib .075 amp	.800 amp
Ef 11.5 volts	If 15.5 amps

Epoxy Resin Preforms
Joins Metals, Non-Metals

Formula "800" Epoxy Resin Pre-
forms will bond by thermal setting
without the application of pressure to
the pieces joined. Formula "800" is a
natural or amber-colored powder at
room temperature. It is fluid at 248 to
302 F. It is furnished in preforms for
easy, convenient assembly of the fin-
ished product from parts that are to
be joined. A self-contained catalyst
makes possible a preform in almost
any desired shape.

The preforms bond, join, and pot
metal to metal, metal to non-metals,
and non-metals to non-metals. They
are used for hermetic sealing, for
metal-to-metal ceramic joining, sealing
in lead wires and capacitors, and for
making temporary tools, jigs, and fix-
tures. The company has available
hundreds of dies from which pre-
forms are fabricated to meet standard
use.

Atlas E-E Corp., Dept. ED, 47 Pros-
pect St., Woburn, Mass.

CIRCLE 136 ON READER-SERVICE CARD

Tin Clad Nickel Strip
For Germanium Cradles

A composite metal consisting of
pure tin solder clad on one side only
to pure type 330 electronic grade
nickel. Each layer of metal is of uni-
form thickness. The metals are in-
separably bonded by a solid phase
bonding process.

Employed for transistor germanium
cradle supports, tin clad nickel can
be used for tin solder application re-
quiring close tolerances. These are
three standard single-clad ratios, 5 to
95, 10 to 90, 20 to 80. Overall thick-
nesses range from .005 in. to .015 in.
widths from .02 in. to 3 1/4 in.

Metals & Controls Corp., Dept ED,
General Plate Division, Attleboro,
Mass.

CIRCLE 137 ON READER-SERVICE CARD

COMING JANUARY 1st
DESIGN '57

Yearly Feature Issue of ED

← CIRCLE 135 ON READER-SERVICE CARD

PRECISION
Continental Connectors

mechanical connect and disconnect
SCREWLOCK* CONNECTORS



**subminiature and
miniature Series 20**

Available in various contacts (7 thru 104 for Series 20; 7 thru 50 for Series SM20). With or without aluminum hoods. For #20 AWG wire. Current rating: 5 amps. Voltage breakdown: 2100V, RMS.

*Pat. No. 2746022

POLARIZING SCREWLOCKS*

Screwlocks provide a secure contact even under severe vibration conditions. They also eliminate the need for prying, "rocking" or forcing the connector when disconnecting the plug from the receptacle.



connectors with polarizing screwlocks

Easy Release—Series E-Z 16

Individually spring loaded pin contacts assure quick release with low insertion force and practically no disengagement force. 12, 18, 24 or 34 contacts for #16 or #12 AWG wire, or solderless wiring taper pin.



Hermetic Seal—Series H-20

Mates with Series 20 receptacles. For #20 AWG wire. Current rating: 5 amps. Voltage breakdown: 2200V, RMS. Plug contacts individually compression-sealed in glass.



High Voltage—Series 14

Available in 7, 9, 10, 15 and 18 contacts. High barriers around pins prevent arcing up to 4500 volts. Contacts are gold plated over silver. Current rating: 10 amps.



Technical data on these connectors, and special designs requiring the use of sub-miniature, printed circuit, hermetic seal, pressurized, high voltage or power connectors are available on request. Write today for complete catalog.

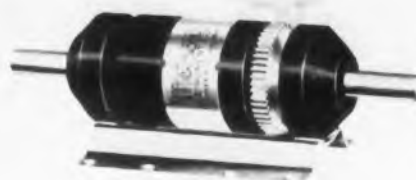
Electronic Sales Division
DeJUR—Amsco Corporation,
45-01 Northern Boulevard, Long Island City 1, N. Y.

DeJUR

CIRCLE 139 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Differential

With Anti-Backlash



These miniature differentials have small size and long life. They have ball-bearing shaft supports that are foot

mounted.

The differentials will add or subtract two rotating inputs, or angular inputs and will control relative speeds, obtaining wide speed ratios between shafts, or reversing and changing speeds without disconnecting the power source.

Thirty-four ratios between 1:1 and 27:1 are available, with sealed construction and hardened gears for long life. Backlash between in-line shafts is 4 degrees or less measured at the low speed shaft.

Metron Instrument Co., Dept. ED, 432 Lincoln St., Denver, Colo.

CIRCLE 140 ON READER-SERVICE CARD FOR MORE INFORMATION

PNP Germanium Transistor

A Low Noise Unit



The 2N23M is a low noise transistor for use at audio and ultrasonic frequencies. Available in commercial quantities, it is a pnp germanium diffused alloy junction unit, hermetically

sealed in a resistance welded metal case with glass-to-metal seals to secure the 1-1/2 in. leads. The unit is designed for high gain ($B = 70$) low-to-medium power applications (150 mw).

Maximum ratings are: collector dissipation, 150 mw; collector voltage, -45 v; collector current, -20 ma; ambient operating temperature, 55 C; and ambient storage temperature, 85 C. Typical characteristics measured at 1 kc and 25 C are: collector voltage, -6 v; emitter current, 1 ma.

Marvelco Electronic Div., National Aircraft Corp., Dept ED, 3411 Tulare Ave., Burbank, Calif.

CIRCLE 141 ON READER-SERVICE CARD FOR MORE INFORMATION

**WILL CHANGES IN THE GROWTH of the
Magnetic Tape Market Affect
Requirements?**

FIND OUT IN DESIGN '57—JAN. 1ST ED

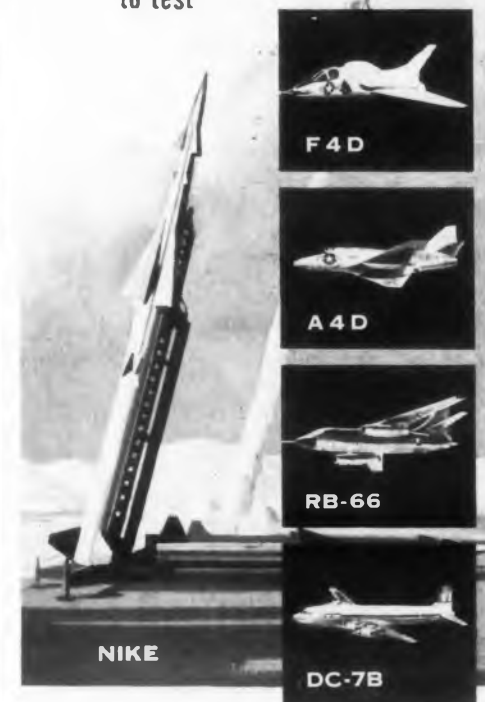
Do you
think about
Angular
Acceleration?

DOUGLAS



does...

and uses Statham
Angular Accelerometers
to test



Statham unbonded strain gage liquid rotor angular accelerometers offer a simple, reliable means for the study of the rotary motion of a test body under conditions where a fixed mechanical reference is not available. For static and dynamic measurements in ranges from ± 1.5 to $\pm 3,000$ rad/sec², four standard models are offered.

Please request Bulletin AA2

Statham

LABORATORIES
LOS ANGELES 64, CALIFORNIA

CIRCLE 142 ON READER-SERVICE CARD

Designed for Dependability in Transistor Circuits



NEW MALLORY MERCURY BATTERIES

Unique snap-together cell design brings new economy to Mallory Mercury Batteries—provides long life and constant discharge features—operating costs even lower than ordinary batteries. Triples usual life expectancy in transistor radios. Miniature 15, 22.5 and 45 volt batteries now available as well as special voltages and configurations.

MALLORY SUBMINIATURE CAPACITORS

Newly developed Type TNT tantalum capacitors . . . another Mallory "first" . . . offer ratings never before possible in a case only 0.145" diameter by 3/8" long. Five different values: 80 mfd. at 6 volts; 50 mfd. at 6 volts; 25 mfd. at 15 volts; 15 mfd. at 30 volts; and 8 mfd. at 50 volts.

For technical facts, write to

P. R. MALLORY & CO. INC.

Indianapolis 6, Indiana

Trade Mark
Patent applied for

P. R. MALLORY & CO. Inc.
MALLORY

CIRCLE 144 ON READER-SERVICE CARD

Klystron Power Supply Internal Pulse Modulation



A versatile, precision instrument this klystron power supply, Model ZS1B5, features internal pulse modulation. It has a maximum delivered power of 250 w at 3600 v. This power rating permits the operation of a more extensive list of Klystrons.

Electronics & X-Ray Division, Dept ED, F-R Machine Works, Inc., 26-12 Borough Pl., Woodside 77, N.Y.

CIRCLE 145 ON READER-SERVICE CARD FOR MORE INFORMATION

Lamination Shapes Standard Units Offered



Four nickel-iron laminations are offered for immediate delivery by this firm. The shapes are UI-312, F-21, DU-1, and DU-37.

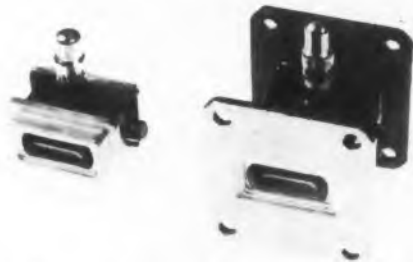
These laminations are made substantially burr free and flat for precision stacking. They are "Performance-Guaranteed," meeting high magnetic standards. They are especially valuable for applications requiring high initial or high maximum permeabilities.

Magnetics, Inc., Dept. ED, Butler, Pa.

CIRCLE 146 ON READER-SERVICE CARD FOR MORE INFORMATION

TR Tube

Saves 50% in Size



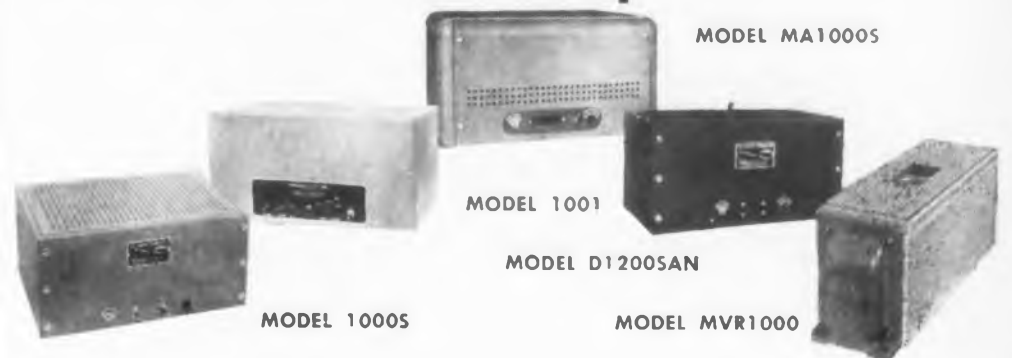
The tube type 6795, a Bantam TR tube (left), is nearly 50 per cent smaller than a comparable component (right). The tube is for radar sets, serving as an electronic switch permitting the equipment alternately to send and receive signals with one antenna.

Sylvania Electric Products, Inc., Dept. ED, 1740 Broadway, New York 19, N.Y.

CIRCLE 147 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW FIVE 1000 VA REGULATORS

... ONE FOR EVERY APPLICATION



MODEL 1000S—Automatic wide-range electronic regulation with the original Sorensen frequency insensitive circuit incorporating the safety diode. Regulation $\pm 0.1\%$.

MODEL MA1000S

MODEL 1001

MODEL D1200SAN

MODEL 1000S

MODEL MVR1000

If you want 1000 VA capacity in a low-cost magnetic voltage regulator with 0.5% regulation, choose the new, economical and compact MVR1000. If you need 1000 VA but with 0.01% regulation, choose Model 1001. For any requirement, any application, Sorensen has exactly the right 1000 VA unit . . . standard models meeting special requirements.

MODEL MA1000S — For unattended installations requiring extremely dependable automatic line regulation. This tubeless unit offers stable long-life performance with minimum maintenance. Regulation $\pm 0.5\%$ over wide frequency range.

Sorensen offers you the widest possible range of characteristics—and a complete line which includes AC regulators, DC supplies, frequency changers, tubeless regulators and supplies, high voltage supplies, and meter calibrators. For research and industry, call on Sorensen—the authority on controlled power.

MODEL 1001 — Developed from unique, dependable Sorensen regulating circuit, refined for ultra-precise $\pm 0.01\%$ regulation.

MODEL D1200SAN — $\pm 0.25\%$ regulation for 400 cycle industrial and aircraft requirements up to 1200VA.

SEND FOR CONDENSED CATALOG

New and more complete—gives condensed specifications on a wide range of units for a variety of applications. Be sure you have all available information when you specify—send for your copy today.

MODEL MVR1000 — New low cost compact magnetic voltage regulator for less exacting applications. Fully automatic $\pm 0.5\%$ regulation with fast response time.

Sorensen

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

CIRCLE 148 ON READER-SERVICE CARD FOR MORE INFORMATION

The answer to your current project ...or your next one... may be easier with one of these Special-Application Instruments



If you think Stromberg-Carlson makes telephones only for office or home conversation, you should know how many instruments we offer for specialized jobs.

Shown above are just a handful, developed for somebody's special project.

Suspended-type 'phones, great space-savers; used either in dial or manual service.

Remote-control instruments, such as we make to work with dictating machines. "Press-to-talk," "Press-to-receive" and "Press-to-control" handsets, very popular in two-way radio applications. "1574" telephones, with a special key for transferring calls (or other functions) from one line to another.

NEW CATALOGUE, with complete description of all special-project instruments, sent you on request. Or for a specific problem, just write



STROMBERG-CARLSON COMPANY

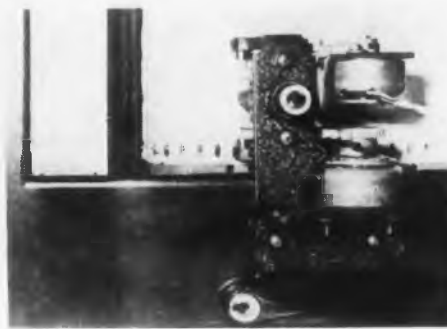
A DIVISION OF GENERAL DYNAMICS CORPORATION

Telecommunication Industrial Sales • 116 Carlson Rd. • Rochester 3, N. Y.

CIRCLE 149 ON READER-SERVICE CARD FOR MORE INFORMATION

Automatic Counter

Also Prints Results



This compact device automatically counts and then at some particular time prints the count. Known as the Model RI-4 "Identichart," it can be caused to

print at regular intervals so that it is possible when reviewing the chart to determine the number of counts in any particular time period. The unit is ideally suited as a print-out device for integrators, and mounting can be provided for all popular makes of recorders. It can also be supplied as an independent unit for printing on a card or adding machine tape.

The RI-4 can be supplied with as many as 8 digits so that a maximum count of 100 million is possible. The counting circuit and printing circuit are independent of each other, so that counting can continue. Both the counting solenoid and the printing solenoid can be supplied for any dc voltage from 24 v to 220 v, and rectifiers can be supplied for use on ac, if desired.

To simplify installation, the RI-4 is supplied in kit form, including a plexiglass window for the recorder and a plexiglass cover for the printer.

Royson Engineering, Dept. ED, Hatboro, Pa.

CIRCLE 150 ON READER-SERVICE CARD FOR MORE INFORMATION

Sine Wave Oscillator

From 9 Cps to 100 Kc



Waveforms, Inc. announces the addition of a new general purpose sine wave oscillator to its instrument line.

The Model 401 sine wave oscillator features wide tuning range, 9 cps to 100 kc, an accuracy of 2 per cent with 1/2 per cent stability, a flat response of 1/2 db, and distortion of 1/2 per cent.

At full output the instrument delivers 20 v open circuit or 1/2 into 600 ohms. Output level is controlled by a logarithmic calibrated potentiometer in tandem with a 100:1 attenuator.

Waveforms, Inc., Dept ED, 333 Sixth Ave., N.Y., N.Y.

CIRCLE 151 ON READER-SERVICE CARD FOR MORE INFORMATION

KEL-F® Plastic grade 500

New fluorocarbon plastic formulation provides wire insulation that can withstand continuous operating temperature up to 175°C.

KEL-F PLASTIC, Grade 500—like all the molding compounds in the KEL-F fluorocarbon series—is notable for its extreme resistance to high temperatures, chemical attack, humidity and abrasion.

Of special interest to the electrical field is the higher heat-aging level of wire coatings with the new Grade 500. Tests on wire insulation indicate a continuous operating range of temperatures up to 175°C. Samples of coated wire exposed to temperatures as high as 190°C. for extended periods of time (2-3 months) still maintain relatively high voltage breakdown values.

TWO TYPES AVAILABLE

GRADE 500-F, a less crystalline type that resists embrittlement by high temperatures. Recommended for general wire and cable insulation, hook-up wire, thin wall tubing, and spaghetti.

GRADE 500-R, possesses same general properties as F type, only a slightly more rigid formulation. Recommended for use in connector insulation and for coil forms.

MOLDABILITY

The new Grade 500 permits extrusion of high molecular weight coatings and thin wall tubing that resist embrittlement when exposed to higher temperatures.

TECHNICAL SERVICE

Our Technical Customer Service staff will be happy to work with you in developing specific applications for the new Grade 500. Send for your copy of the first report on KEL-F PLASTIC, Grade 500. Write:

THE M. W. KELLOGG COMPANY

Subsidiary of Pullman Incorporated
Chemical Manufacturing Division
P. O. Box 469, Jersey City, N. J.



Ⓜ KEL-F is the registered trademark of The M. W. Kellogg Co. for its fluorocarbon products.

CIRCLE 152 ON READER-SERVICE CARD

versatility



unlimited...

Advanced design concepts call for components to be conceived, developed, tested and proven with new and critical end applications in view. Every unit in the IMC line of AC and DC subfractional, servo and gear motors, fans, blowers and dynamotors is built for widest diversity in final use. The motor segment of the IMC line best typifies the flexibility of the entire catalog. Both fan-cooled and non-cooled units in horsepower ratings from 1/1000 to 1/10 are available immediately, with a variety of gear ratio options depending on specific needs.



IMC's blowers are found in combination with the company's motors, in an impressive array of industrial and military equipment. Standard IMC motor-blower units are readily adaptable for high ambient temperature operation, and are impregnated for protection in humid atmospheric situations.

Full engineering specifications on all units in the line are available on request.



**Induction
Motors Corp.**

570 Main St., Westbury, L. I. N. Y.
EDgewood 4-7070

Automatic Program Controller

Fatigue Tests



An automatic program controller for Baldwin-Sonntag fatigue testing machines can be preset: (a) To 10 static load levels in either tension or compression and/or (b) 10 dynamic load levels, each of which can be set (c) For any number of load cycles up to 999,999, (d) Sequenced in any desired preset order of load levels for (e) any preset number of sequences.

Load levels can be set on any values up to machine capacity.

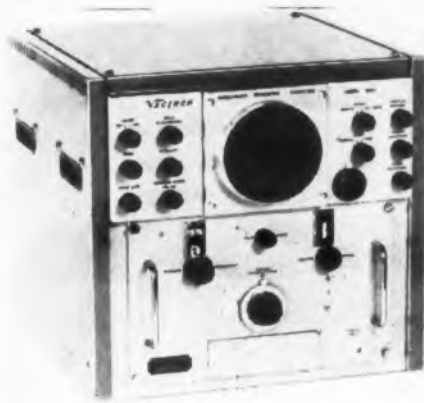
Baldwin-Lima-Hamilton Corp., Dept. ED, Philadelphia 42, Pa.

CIRCLE 155 ON READER-SERVICE CARD FOR MORE INFORMATION

THE ELECTRONICS INDUSTRY LOOKS AHEAD SEE DESIGN '57—JAN. 1 ISSUE ED

Microwave Spectrum Analyzer

Range in X-Band



This complete instrument provides precision coverage of the 8500 mc to 9660 mc portion of the X band. A direct reading klystron tuning dial and a wave-meter is calibrated in actual

signal frequency. It includes a special if amplifier with modified cascode input stages, tracked repeller voltage and a precision calibrated 80 db input attenuator.

The unit has separate brightness and intensity controls for signal and baseline, plus a two-position if gain switch. The "frequency difference" control permits direct incremental frequency measurements from 100 kc to 5.0 mc on the displayed signal against either an electrical or mechanical index.

Model SA30X5 is available for standard rack mounting or as a portable package weighing less than 80 pounds.

Vectron, Inc., Dept. ED, 1583 Trapelo Rd., Waltham 54, Mass.

CIRCLE 156 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Regulated Power for

- METER CALIBRATION
- MULTI-STAGE AMPLIFIERS
- COMPUTERS



*Oregon
Electronics*

MODEL PR 300

A dependable voltage reference! Long and short term stability is excellent, internal noise and ripple is extremely low. Low internal impedance. The PR 300 adapts itself perfectly where a medium power source is required.

SPECIFICATIONS

Voltage Outputs:

No. 1, Regulated:

10 to 310 volts variable in 1 volt steps. Potentiometer to vary voltage between any 1 volt step.

150 milliamperes maximum at any voltage setting.

No. 2, Stabilized:

0 to —150 volts continuously variable

5 milliampere maximum.

0 to 50 kilohms impedance.

Ripple and noise less than 2 millivolts peak to peak.

No. 3, Unregulated:

6.3 volts, 3 amperes CT.

Stability of regulated output:

Long term: \pm 100 parts per million.

Short term: \pm 50 parts per million per hour.

Regulation:

Output voltage variation no load to full \pm .01%

Output voltage variation for 10% line voltage change,

\pm .002% or 5 millivolts.

Recovery time: 0.2 milliseconds

Output impedance:

At DC, less than .5 milliohms.

At 10 KC, less than .1 ohm.

At 200 KC, less than .5 ohm.

Write or wire at once for complete technical details.

*Oregon
Electronics*

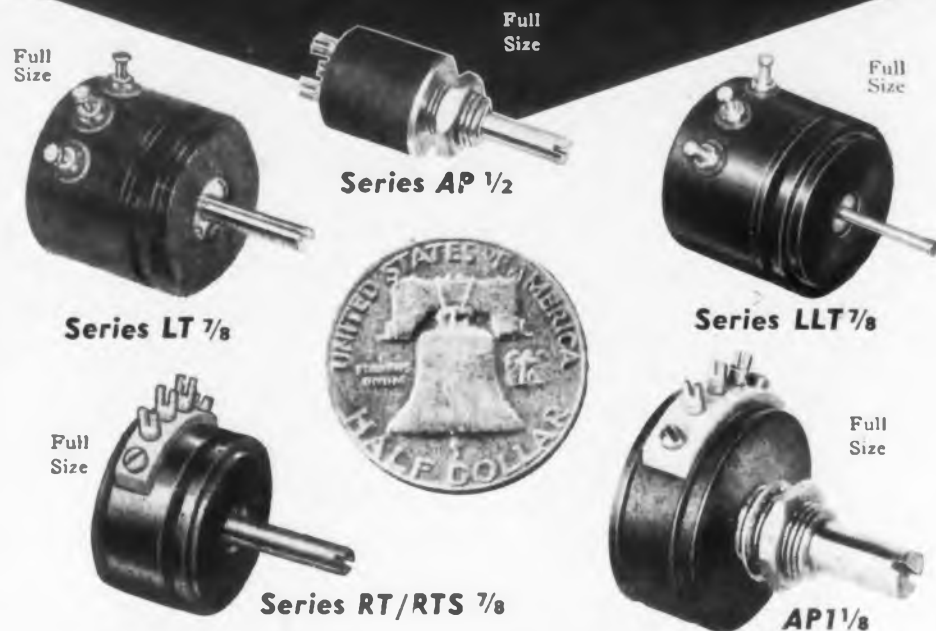
2232 EAST BURNSIDE STREET
PORTLAND 15, OREGON

BEI mont 6-9292

MANUFACTURERS OF SPECIAL ELECTRONIC EQUIPMENT

CIRCLE 157 ON READER-SERVICE CARD FOR MORE INFORMATION

when you need a
SMALLER "POT"
Try these for size and reliability...



Waters miniature and micro-miniature wire-wound precision potentiometers

are famous for accuracy, ruggedness, dependability and fast delivery in commercial and military uses. They are precision-machined, with anodized aluminum bodies, line-reamed phosphor bronze, ball or jewel bearings, centerless-ground stainless steel shafts, and gold-plated fork terminals; fully sealed and fungus-proofed. To meet your requirements Waters pots can be furnished ganged, tapped, servo or bushing mounts, with various electrical and mechanical angles, optional shaft locks, anti-rotation pins, O rings, and custom shaft or servo dimensions.

Series AP 1/2 — 2 watts continuous at 80°C; resistances 10 to 100,000 ohms, 5% tolerance standard; diameter 1/2", depth 1/2" standard, weight 1/4 ounce; fully sealed for potting.

Series LT/LLT 7/8 — One watt at 80°C; resistances 100 to 100,000 ohms, ball or jewel bearing, for use in computers, servos, and selsyns where minimum torque is required. Weight is only 1/2 ounce; MAXIMUM torque is 0.01 inch-ounce per section. Ganging to six decks, internal clamps hold 7/8" diameter. Standard linearity 0.5%, on special order 0.25% above 1K; toroidal winding allows winding angles to 360°, standard is 354°.

Series RT/RTS 7/8 — 3 watts continuous at 80°C; resistances 10 to 100,000 ohms; diameter 7/8", depth 3/8", weight 1/2 ounce; standard linearity 2%.

Series AP1 1/8 — 4 watts continuous at 80°C; resistances 10 to 150,000 ohms; diameter 1 1/8", depth 1/2", weight less than 3/4 ounce; standard linearity 1%.

Waters has advanced facilities for the design and manufacture of miniature toroidal potentiometers and windings for use in equipment of special design.

Write today for complete information on all Waters potentiometers.

Waters
MANUFACTURING, inc.

APPLICATION ENGINEERING OFFICES
IN PRINCIPAL CITIES

Wayland, Massachusetts
P. O. Box 368, So. Sudbury, Mass.



CIRCLE 159 ON READER-SERVICE CARD FOR MORE INFORMATION

Type F Crossbar Switch

High Speed Selection



This new switch offers a simplified high speed logic, and is available in a number of matrix arrangements. The Type F switch offers a flexible high-

speed means of selecting information remotely from a large number of sources (up to 1200 per switch) without the necessity of scanning intermediate points.

Closely-held timing tolerances make it possible to operate the switch at high speeds with little lost time for commutation.

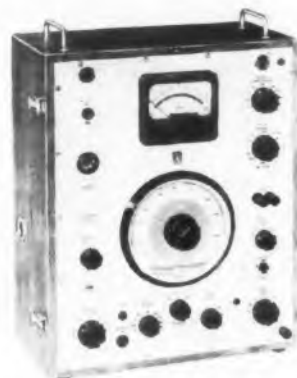
Due to the balanced nature of connections within the Crossbar, the thermoelectric potentials generated by the switch are held to a very low value. In the range of 25 C to 50 C, the thermoelectric potential is less than .01 mv per degree C.

James Cunningham, Son & Co., Inc., Dept. ED
Rochester 8, N.Y.

CIRCLE 160 ON READER-SERVICE CARD FOR MORE INFORMATION

1/3 Octave Filter Set

Has Many Uses



The 1/3 octave filter set, Model BL-1609, made by Bruel & Kjaer, is designed for sound and vibration analysis, measurement of sound transmission and reverberation time, and, in general, any audio signal analysis or telemetry data reduction. It consists of 27 flat-topped filters of 1/3 octave bandpass width with seven additional filters available as optional equipment to cover the frequency spectrum of 14 cps to 36,000 cps. Besides the bandpass filters, the instrument contains standardized weighting networks for overall loudness measurements in phons and a linear bandpass. The filter response is within ±2 db of the linear level.

The filters can be manually selected by means of a 50 position switch or automatically scanned by an external drive motor. The stepping switch is a non-shorting type, and, accordingly, the output of all filters can be simultaneously transmitted to readout equipment.

Brush Electronics Co., Dept. ED, 3405 Perkins Ave., Cleveland 14, Ohio.

CIRCLE 161 ON READER-SERVICE CARD FOR MORE INFORMATION



Illustrated above—Johnson's new nylon insulated banana plug. Below—a cutaway view of the new nylon insulated tip plug... two of the toughest, most durable connectors available today!

Look at these features:

- Shock-proof nylon insulating handles—won't chip or crack with the hardest usage.
- provides high voltage insulation.
- Highly resistant to extremes of heat, cold and moisture.
- Special design for simplified solderless connection of up to 16 gauge stranded wire.
- Economical—simple, functional engineering design gives you top quality at low cost.

SPECIFICATIONS

BANANA PLUG—nickel-plated brass construction with nickel-silver springs. Spring plug is .175" diameter, fits all standard banana jacks. **TIP PLUG**—recessed metal head is fully insulated, preventing exposure of metal surfaces when tip plug is engaged in any standard tip jack. Metal parts are brass, nickel-plated. Pin is .081" diameter—fits all standard tip jacks. Available in 11 bright colors to match Johnson nylon tip jacks.

Also New

NYLON TIP JACK AND INSULATING SLEEVE

Complete assembly includes a standard nylon tip jack with a threaded nylon insulating sleeve. Ideal for patch cards, this assembly is also excellent for panel mounting, where an insulated rear connection is desired.



Investigate today! Write for prices, further information.



E. F. JOHNSON COMPANY
2331 SECOND AVE. S.W. • WASECA, MINN.

CIRCLE 162 ON READER-SERVICE CARD

DRIFT FREE DC μ V AMPLIFIER



MODEL 111

The **KAY LAB MODEL 111** amplifier provides the lowest drift of any commercially available broadband d-c amplifier. The unique circuit incorporates **KAY LAB's** proven chopper amplifier system to provide unsurpassed dynamic performance — unaffected by load or gain changes. Available in a single-unit cabinet or a six-amplifier rack-mountable module only 19 inches wide, the **Model 111** is ideal for data reduction facilities, or as a strain gage amplifier, recorder driver amplifier, or general purpose laboratory amplifier.

SPECIFICATIONS

- ± 2 μ v equivalent input drift
- Integral power supply
- ± 35 V, ± 40 ma output
- 100,000 Ω input impedance
- 0 to 1000 gain in ten steps
- $\pm 1\%$ gain accuracy
- 5 μ v peak equivalent input noise
- Price (Single) Amplifier \$550.00

Representatives in All Major Cities



57 5 KEARNEY VILLA ROAD
SA DIEGO 11, CALIFORNIA

CLE 164 ON READER-SERVICE CARD

Variable Pressure Brush Air-Operated



A new type of slip ring assembly has a unique construction which provides continuously variable remote control of brush pressure by means of a miniature air cylinder built into the brush house assembly.

This system gives continuous compensations which permits low wear on both brush and ring surfaces to attain minimum noise levels. It is adaptable to applications

requiring either high or low brush pressure, and has extended life at all speeds.

This variable brush pressure can be incorporated into strain gage and thermocouple slip ring assemblies and power slip ring units.

Electro-Miniatures Corp., Dept. ED, 1060 Elm Ave., Ridgefield, N. J.

CIRCLE 165 ON READER-SERVICE CARD FOR MORE INFORMATION

Stroboscope Synchronizer For Vibration Testing



Slip-Sync, an instrument which permits watching of shake tests in slow motion, or stopped in any selected cyclic position, is used in vibration testing of electronic equipment.

The unit automatically synchronizes stroboscopic lights with vibration exciters. This is accomplished by controlling the time-position of the flash with respect to the shake frequency signal. Both phase and amplitude of the vibration are observable.

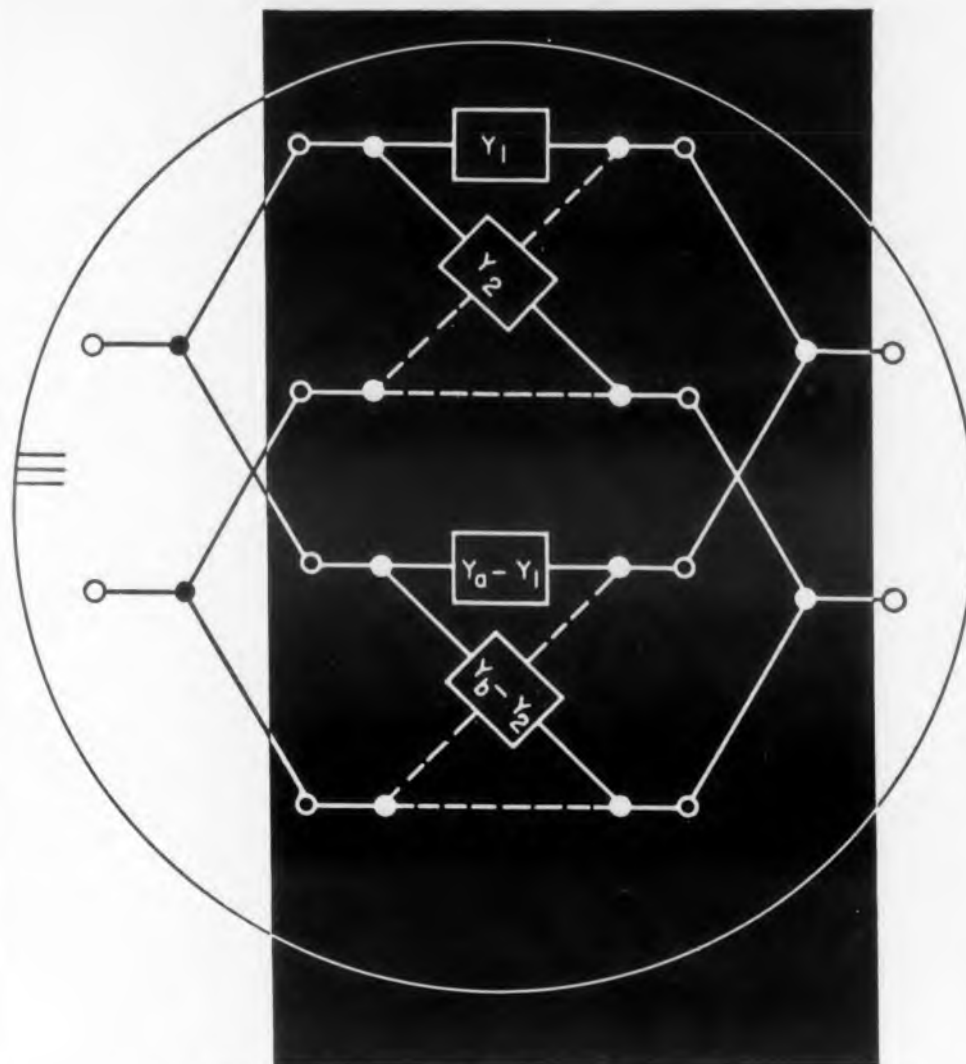
Slow motion rate is continuously adjustable from 1/3 to 3 cps by front panel control. Range is from 5 to 10,000 cps with instantaneous response. Input amplitude range is 100 to 1 (40 db). A lightweight unit, it features printed wiring and ready access.

Chadwick-Helmuth Co., Dept. ED, 472 East Duarte Rd., Monrovia, Calif.

CIRCLE 166 ON READER-SERVICE CARD FOR MORE INFORMATION

**DOES THE COMPUTER INDUSTRY Need More
Specialized Equipment?**

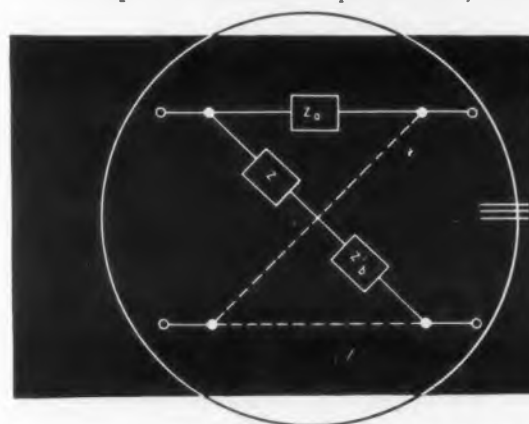
READ DESIGN '57—JAN. 1ST ED



NETWORK SYNTHESIS* AT HUGHES

Network Synthesis may be defined as mathematical techniques by which physical systems can be designed to give optimum characteristics.

Brune, Cauer, Darlington, Foster, Guillemin and others established the framework for network synthesis. Today in the Hughes Research Laboratory there is an intensive program to build upon this structure. As part of this continuing effort it is the intention of the Laboratory to work on lumped and distributed parameter systems, both passive and active.



Those who would assist in this important project should have advanced work in complex function theory, continued fractions, matrix theory, combinatorial topology, or modern network synthesis. If this is an area in which you are qualified, please write us about your education and experience. Your inquiry will receive prompt, confidential attention.

* See, e.g., "A General RLC Synthesis Procedure" Proceedings of the IRE, February 1954, by Louis Weinberg, Sc.D., Head, Network Synthesis Group, Hughes Research Laboratory.

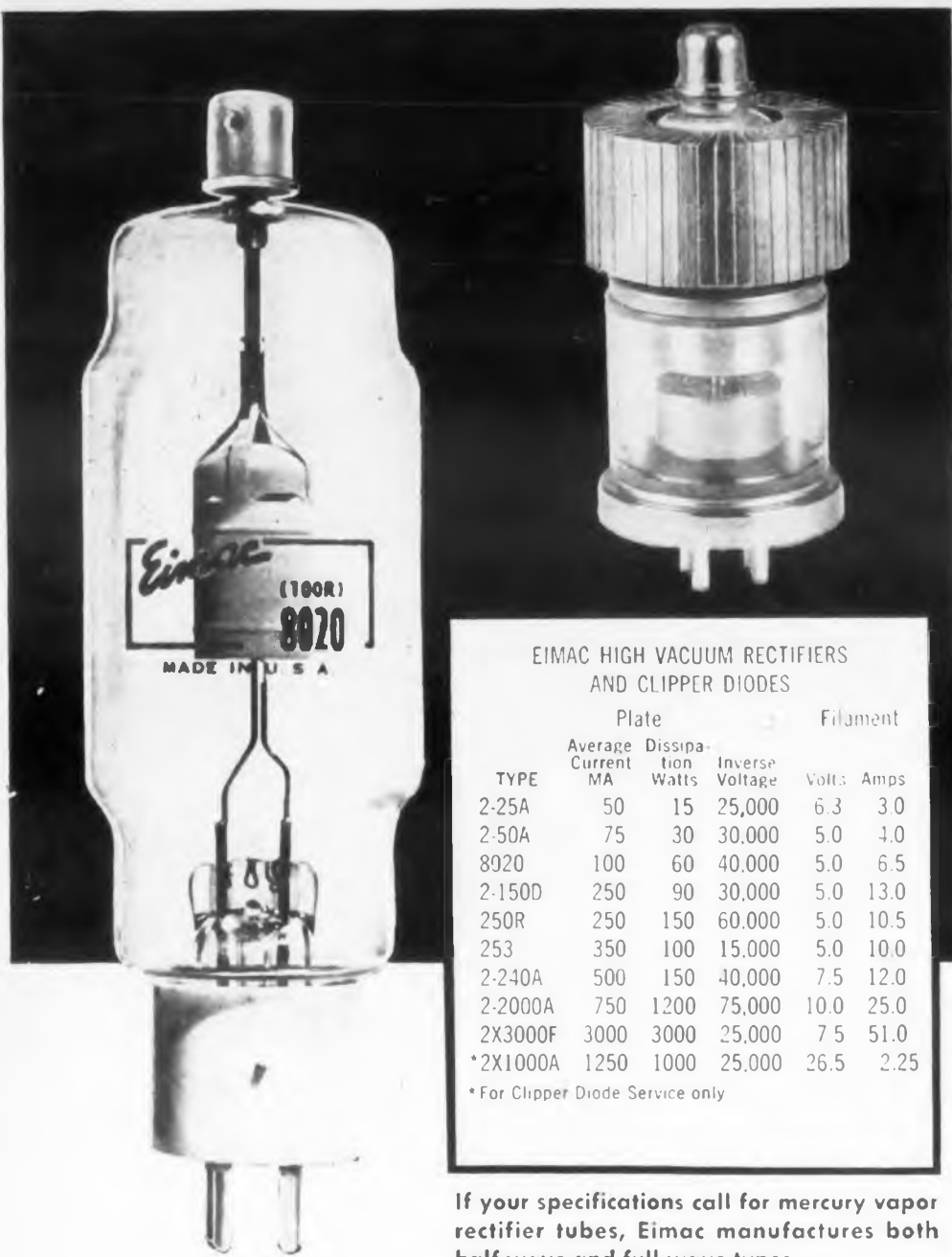
HUGHES

RESEARCH & DEVELOPMENT LABORATORIES

Scientific Staff Relations

HUGHES AIRCRAFT COMPANY

Culver City, Los Angeles County, California



EIMAC HIGH VACUUM RECTIFIERS AND CLIPPER DIODES

TYPE	Plate		Inverse Voltage	Filament	
	Average Current MA	Dissipation Watts		Volts	Amps
2-25A	50	15	25,000	6.3	3.0
2-50A	75	30	30,000	5.0	4.0
8020	100	60	40,000	5.0	6.5
2-150D	250	90	30,000	5.0	13.0
250R	250	150	60,000	5.0	10.5
253	350	100	15,000	5.0	10.0
2-240A	500	150	40,000	7.5	12.0
2-2000A	750	1200	75,000	10.0	25.0
2X3000F	3000	3000	25,000	7.5	51.0
*2X1000A	1250	1000	25,000	26.5	2.25

* For Clipper Diode Service only

If your specifications call for mercury vapor rectifier tubes, Eimac manufactures both half wave and full wave types.

Eimac's High Vacuum Rectifiers Handle Peak Inverse Voltages from 15,000 to 75,000 Volts

Used in standard rectifiers and special applications involving extreme ambient temperatures, high operating frequencies, or high peak inverse voltages, Eimac's broad line of high vacuum rectifiers and clipper diodes is the finest in the industry, both electronically and physically.

Superior exhausting techniques, high quality materials, clean electrode design and absence of internal insulators minimize chances of contamination and arc-over. These, and other production and design features, are assured by Eimac's high standards of quality control.

For additional information, contact our Technical Services Department.



CIRCLE 169 ON READER-SERVICE CARD FOR MORE INFORMATION

High Current DC Supply

Fast Response



This regulated dc power supply is designed for high-current applications requiring fast recovery time. A 1-1/2 amp unit, its response is 0.4 ms NL to FL, 0.25 ms FL to NL, enabling use with computers, and quick-response laboratory applications.

The Model 3-1.5 MB unit supplies 0 to 300 v dc at 1-1/2 amp, continuously variable without switching. It supplies a variable bias voltage of 0.145/155 v dc at 5 ma, and an external 6.3 v ac output at 10 amp. High-voltage output is floating, and may be used as either a positive or negative source.

Regulation for 300 v 1500 ma output is 100 mv change NL to FL. For line voltage of 105 to 125 v ac, the regulation is 0.15 per cent change of output voltage. Ripple for 300 v 1500 ma output is below 3 mv rms.

Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena, Calif.

CIRCLE 170 ON READER-SERVICE CARD FOR MORE INFORMATION

Ignitron Tube

With Thermostat Control



An improved ignitron tube, the type WL-5822-A is offered for control applications, such as control of frequency-changer resistance welders. It directly replaces the WL-5822 and is a sealed, stainless steel jacketed, water cooled, mercury pool tube capable of intermittent ignitor service. It has a 1200 v or 1500 v max anode voltage rating with 1500 amp or 1200 amp max anode current.

The tube features a provision for thermostatic control which, when equipped with suitable thermostatic switches, conserves cooling water consumption and simultaneously protects the tube and associated equipment from overloads and overheating. Overall size, including leads, is 25 in. x 4-1/4 in. diam. The unit weighs only 8-1/4 lb.

Westinghouse Electronic Tube Div., Dept. ED, Box 284, Elmira, New York.

CIRCLE 171 ON READER-SERVICE CARD FOR MORE INFORMATION

WHAT IS THE TREND in Printed Circuits? Transistors?

WATCH FOR DESIGN '57—JAN. 1ST ED



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.

Here is a unique handbook — authoritative — informative — up-to-the-minute — which will serve every electronic engineer. Its content embraces the entire transistor field.

The content of the handbook is divided as follows:

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 size 9" x 12" pages for easy readability. Each section individually indexed.

#193 Cloth Bound, 288 pp., \$9.95

Another RIDER published book for more transistor information

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. The subject is made completely understandable to all.

Soft Cover, 144 pp., 5 1/2 x 8 1/2", illus. #160 Only \$2.70

Buy these books at your electronics parts jobber or bookstore, or mail this coupon today for prompt delivery.

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116 West 14th Street, New York 11, N.Y.

Enclosed is \$_____ Please rush books checked.

— #193 Transistor Engineering Reference Handbook \$9.95

— #160 Fundamentals of Transistors \$2.70

Name _____

Company _____

Address _____

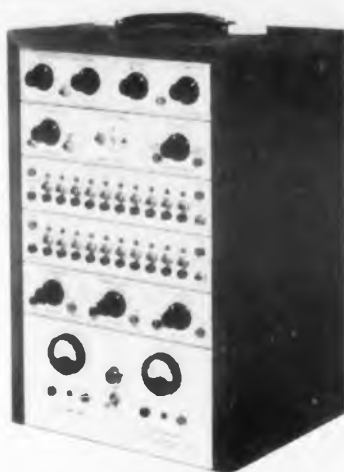
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CIRCLE 172 ON READER-SERVICE CARD

TRANSISTORIZED

PULSE TEST EQUIPMENT

by *Navcor*



NAVCOR'S new series of 100A building blocks are basically designed as portable bench top test equipment. Each NAVCOR logic block unit is completely transistorized and stabilized over wide operating ranges . . . and the built-in power supply utilizes only two voltages to power up to 15 plug-in units. Individual units can be readily interconnected by back panel 'patch board' plugs to build-up a complete data handling system.

As test equipment, or as integral components of industrial control or data handling systems—the NAVCOR 100A series of pulse generating and programming test equipment can be used in all projects involving magnetic logic and switching transistor circuits up to 200 KC. All standard logic functions are available including pulse generators, standardizers, delays, counters, and shift registers.



Specification sheets available!

NAVIGATION COMPUTER CORP.

1621 SNYDER AVE.
PHILADELPHIA 45, PA.
PHONE: HOward 5-7700

CIRCLE 174 ON READER-SERVICE CARD

Microwave and UHF Components

Immediate Field Operation



A custom-line of microwave and uhf components, including standard as well as job-engineered complex units, is now available. Typical examples are cavities, mixers, duplexers, multipliers, rotary joints, twists, bends and others.

Ranging from dc to over 40,000 mc, components can be furnished to specifications.

J-V-M Engineering Co., Dept. ED, 4633 South Lawndale, Lyons, Ill.

CIRCLE 175 ON READER-SERVICE CARD FOR MORE INFORMATION

Mercury Switch Pulser

Has Adjustable Rise Time



Designed for calibration and stability measurements involving scintillation spectrometry circuits, the N-101 mercury switch pulser has a continuously adjustable rise time of .03 - 0.5 μ sec.

Output delivers up to 10 ma, max 22 v, at either polarity and is continuously variable with 0.1 per cent linearity. It has a battery pulse source and a stability of 0.1 per cent per day after initial warm-up.

Hammer Electronics Co., Inc., Dept. ED, Princeton, N.J.

CIRCLE 176 ON READER-SERVICE CARD FOR MORE INFORMATION

Blower

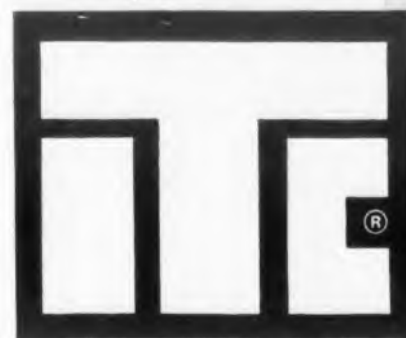
Weighs 5-1/4 Oz



The Model BC910B-1 is a subminiature blower utilizing a 1 in. diam motor. It is designed especially for cooling airborne electronic equipment where space requirements are critical, and it weighs just 5-1/4 oz. It operates at 115 v 400 cps at 20,000 rpm. The 1/250 hp single phase motor, with a 0.22 mfd capacitor, delivers 8 cfm at 1 in. back pressure.

Induction Motors Corp., Dept. ED, 570 Main St., Westbury, L.I., N.Y.

CIRCLE 177 ON READER-SERVICE CARD FOR MORE INFORMATION



- Threshold voltage adjustment
- Fixed gain adjustments

THERE'S A TIC TRIMMER POT

- Critical magnetic and electric bias

for every application

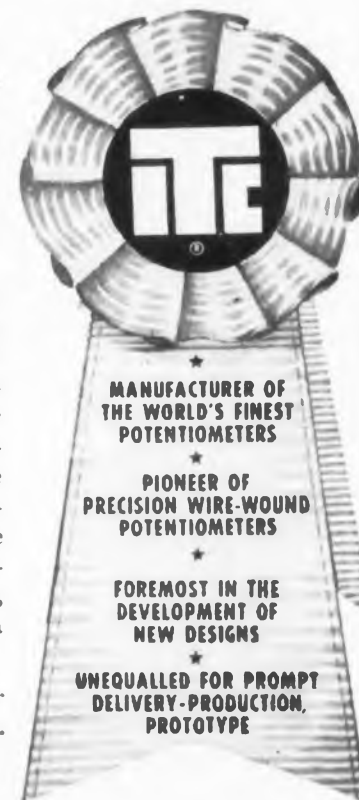
- Balancing adjustments
- Padding
- Adjusting scale factors
- Parameter compensation
- Fixed reference circuits

TIC manufactures in production quantities the most complete line of precision trimmer potentiometers in the industry. Common to all TIC trimmers is the unexcelled TIC quality construction and advanced design. The wide selection of sizes and shapes, in addition to the wide range of power and temperature capabilities, permit selection of units of maximum compatibility with a specific application.

The TIC Trimmer Potentiometer Line includes units from 1/2 inch to 1 inch in size . . . 50 to 100K ohms in resistance . . . -55° C to +145° C temperature range . . . power ratings up to 4 watts. Advanced mechanical design provides extremely precise, stable adjustments under all forms of adverse environmental conditions.

TIC was the originator of the high stability subminiature trimmer pots. For example the original metal-film potentiometer, the TIC RFT Metfilm, represents the outstanding advance high stability trimmer potentiometer design. The RFT contains a resistance element of metallic film that provides infinite resolution for ultra-fine trimming. Compactness of the RFT permits stacking 7 to the square inch. Latest addition to the TIC Trimmer Line is the new low cost RWT which, like the RFT, provides adjustment by use of a 25-turn lead screw.

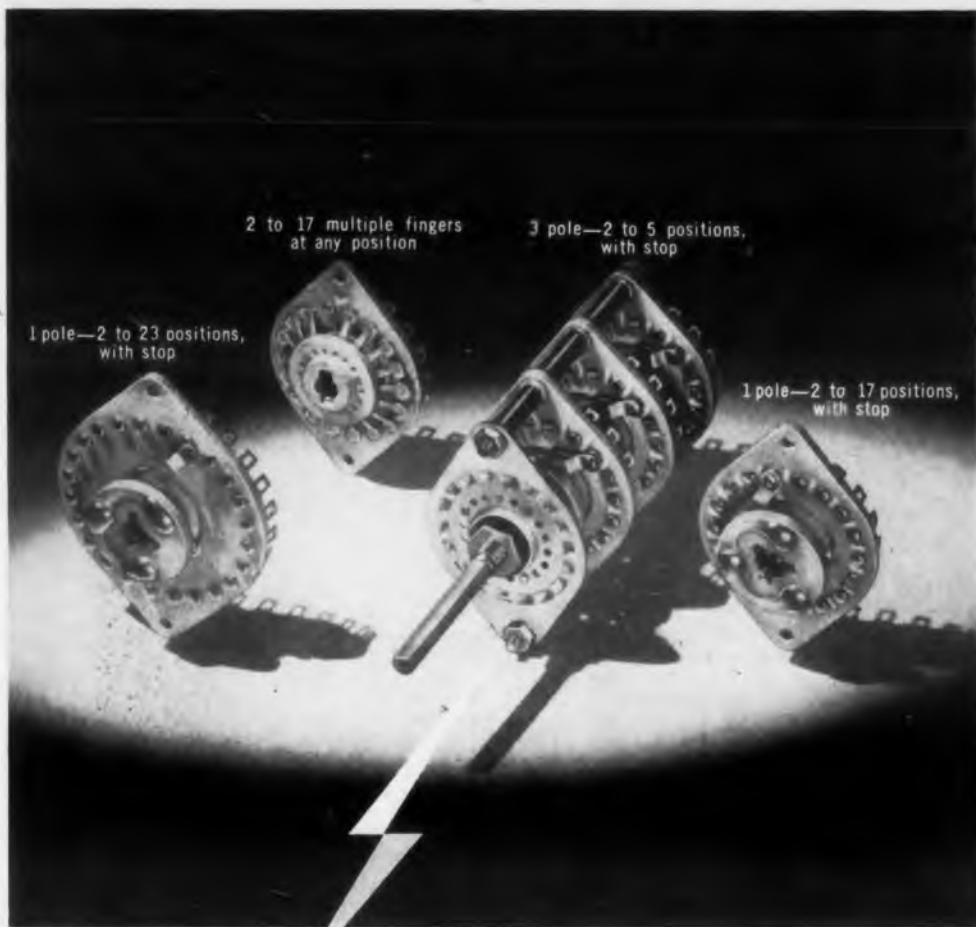
Complete information on the TIC Trimmer Potentiometer Line is available upon request.



TECHNOLOGY INSTRUMENT CORP.

553 Main Street, Acton, Mass., COLonial 3-7711.
West Coast Mail Address, Box 3941, No. Hollywood, Calif., POplar 5-8620

CIRCLE 178 ON READER-SERVICE CARD FOR MORE INFORMATION



More contact combinations within medium-duty power range

Meets the requirements of...

Transmitters

Industrial controls

Laboratory testing

Other military and commercial applications

Centralab Series PA-230 Rotary Power Switch (7½ amps. — 115 v.a.c.)

- ◊ Wafers can be stacked up to 20 sections per switch.
- ◊ Grade L-5A Steatite sections have low loss factor. Operating voltages up to 3000 volts R.M.S., 60 cps, between electrical circuits.
- ◊ Available in a number of switching configurations, shorting or non-shorting.
- ◊ Smooth-operating, roller-bearing index insures minimum of 25,000 operating cycles.
- ◊ Square rotor shaft prevents "play" in rotation — provides pin-point accuracy.
- ◊ Coined silver contacts, for better current-carrying characteristics.

Write for Technical Bulletin EP-74,
for complete engineering data.

Centralab

A DIVISION OF GLOBE-UNION INC.

960K East Keefe Ave. • Milwaukee 1, Wisconsin
In Canada: 804 Mt. Pleasant Road, Toronto, Ontario



CIRCLE 179 ON READER-SERVICE CARD FOR MORE INFORMATION

Regulated Inverter Lightweight Unit



This small, light, closely regulated inverter produces high wattage per weight and volume. Input is 24 to 30 v dc at 4.5 amp max. at -55 C. Ambient temperature

range is -55 C to +71 C. Output is 115 v 400 cy 1, 2, or 3 phase, 20 to 40 watts.

The complete unit weighs 3 3/4 lbs and measures 6.69 in. L x 2.87 in. W x 3.89 in. H.

John Oster Manufacturing Co., Dept. ED, Avionic Div., Racine, Wis.

CIRCLE 180 ON READER-SERVICE CARD FOR MORE INFORMATION

Digital Indicator In Miniature



A new digital indicator features high readability while requiring a minimum of panel space.

Permitting direct reading of signals from a

variety of transducers, the Model 756 incorporates an electronic null balance servo system driving a precision set of geared number wheels. Numbers are 7/16 in. high.

Performance Measurements Co., Dept. ED, 15301 W. Mc. Nichols Rd., Detroit 35, Mich.

CIRCLE 181 ON READER-SERVICE CARD FOR MORE INFORMATION

Crystal Oven Weighs Less than 1 Oz



The JK0-10 miniature crystal oven, designed for an HC-6U holder, weighs less than 1 oz. It has a temperature stability of ±0.25 C at constant ambient temperature, and ±0.5 C over an ambient range of -55 to 75 C.

The unit features a noval base, an easily detachable cover, new heater binding tape, and low inductance winding. It is made in a choice of heater voltages from 6.3 v to 48 v, ac or dc for greater

flexibility.

James Knights Co., Dept. ED, Sandwich, Ill.

CIRCLE 182 ON READER-SERVICE CARD FOR MORE INFORMATION

CUSTOM FLEXIBILITY

IN READY-MADE GEAR SYSTEMS

The Link 012 Gear Box



Link Hi-Precision Gear Boxes deliver the performance range you've come to expect from costly custom systems.

Light, compact, these Model 012 Gear Boxes are built to the closest tolerance for "minute" backlash, longest service life.

Ratios range from 10:1 to 3125:1, and Link's adapter kits integrate the gear box with commonly used servo motors. Dual output models are also available for many of these ratios.

OTHER MODEL 012 FEATURES

- Lifetime lubrication— with temperature resistant silicon
- Input speeds to 12,000 rpm @ .05 hp
- Output rated at 120 in/oz at slow turning shaft
- Less than .25° backlash at slow shaft
- Precision ball bearings throughout
- Friction torque of .004 oz/in at input shaft

Whether you design computer, nuclear, radar or communication controls, instruments, motor drives or simulators, turn to Link — write Dept. ED for complete catalog.

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

LINK AVIATION, INC.

BINGHAMTON, NEW YORK



CIRCLE 183 ON READER-SERVICE CARD

PORTABLE
TRANSISTOMETER
(COMPLETELY TRANSISTORIZED CIRCUIT)



COMPLETE
KIT
\$67.50

MODEL 101

SCALES: calibration, high beta, collector cut-off current, low beta.

..... sequence prevents meter damage—permits beta and I_{CO} measurements without removal of unit under test.

FEATURES

- Measures characteristics of both NPN and PNP junction transistors with accuracy of $\pm 5\%$
- Measures beta 0.50 and 0.250
- Measures collector cut-off currents (I_{CO}) 0.50 microamperes
- All functions are controlled by a single switch
- Useful for laboratory and development requirements as well as production testing, incoming inspection, and servicing
- Permits rapid testing with one switch setting for units having like polarity
- Battery operation, (very low current drain) protects transistors against damage from surges and provides complete portability (Wt. less than 6 lbs.)
- Eyeleted and electro-tin plated etched circuit board for mounting and wiring of components (including meter connections)
- All components of the highest quality and latest design
- Designed for maximum ease of assembly, wiring, and operation
- All components guaranteed for one year if used in accordance with instructions (meter and batteries 90 days under normal usage)
- Complies with the latest requirements for transistor testing

Both of transistor under test is compared with a known attenuation factor using a sub contained signal source and linear amplifier. Potentials and biases for all measurements based on established standards.

ORDER BY MAIL \$67.50

(POSTPAID IN U.S.)

Includes transistor reference material and complete simplified assembly and operating instructions

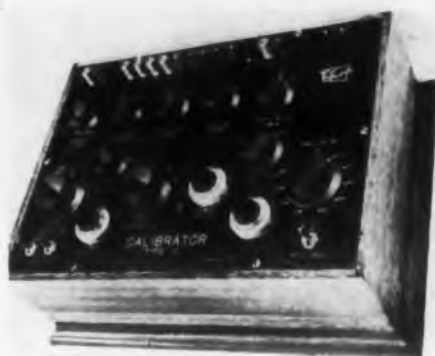
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Dept. Ed-1, 10416 National Blvd.,

CURSON
Los Angeles 34, California COMPANY

CIRCLE 184 ON READER-SERVICE CARD

Strain Gages
For Four-Arm Systems



A new instrument for the universal calibration of wire strain gages, their transducers, and thermocouples has been designated the Type C calibrator.

It will calibrate 1, 2, or 4-arm systems without complicated hookups. Employing the electrical equivalent method of calibration makes dead-weight testing necessary only once for each transducer.

Allegany Instrument Co., Dept ED, 212 Durham Ave., Metuchen, N. J.

CIRCLE 185 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Friction Clutch

Has Fast Response Time



A magnetic clutch for applications in low power servo mechanisms meets military specifications. Standard

models are designed to operate on 24 v dc delivering a minimum torque of 50 oz in. Response time is within 3 milliseconds. Endurance tests reveal no reduction in performance when tested at rated load and high speed for one million cycles.

Dynamic Instrument Corp., 59 York Ave., Westbury, L.I., N.Y.

CIRCLE 186 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Differential

Has Planetary Gears



This planetary gear reducer has been adapted as a mechanical differential device. By mounting the internal

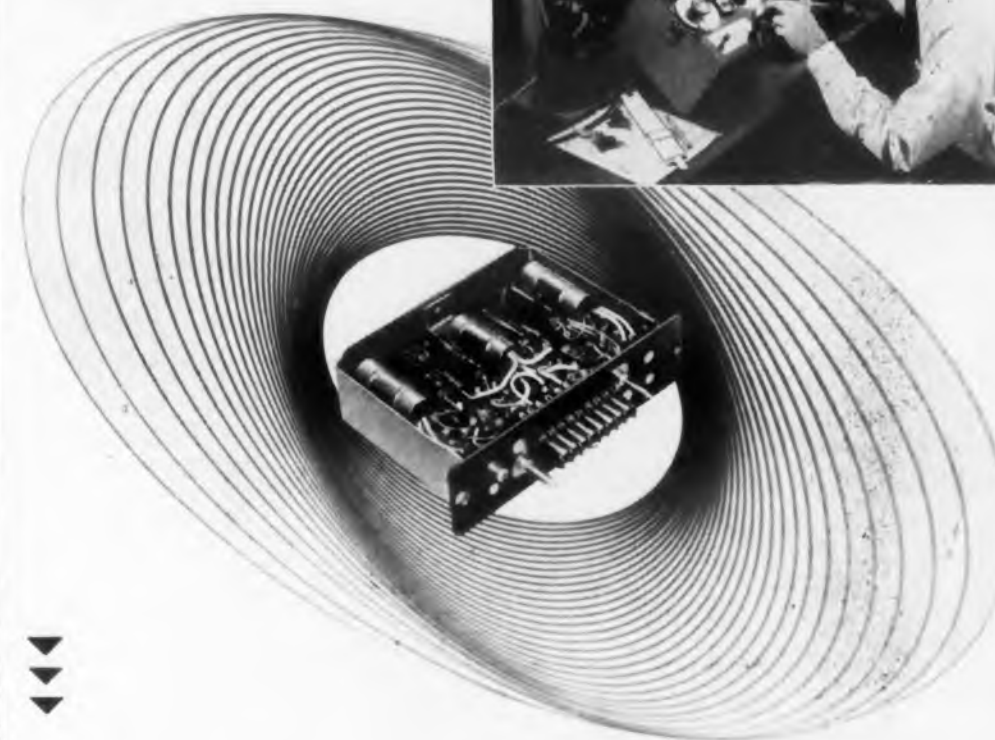
gear freely, it may be driven independent of the input shaft and the resultant speed at the output shaft will be the difference between the speed of the input shaft and the speed of the internal gear.

Globe Industries, Inc., Dept ED, 1784 Stanley Ave., Dayton 4, Ohio.

CIRCLE 187 ON READER-SERVICE CARD FOR MORE INFORMATION

**To the engineer capable
of original thinking...**

Highly accurate AiResearch electronic amplifier used in precision analogue computer networks. Built to withstand 50 G's vibration, has over 20 megohm input impedance and less than 1 ohm output impedance.



The Garrett Corporation has built an outstanding reputation for pioneering because of engineers whose minds are not shackled to the past... or even the present. We concentrate on the future.

If you're the sort of engineer to whom an obstacle is only a challenge, you'll be interested in working with us. You'll have the finest research and laboratory facilities at your disposal... have your choice of location among the Los Angeles, Phoenix and New York areas.

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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



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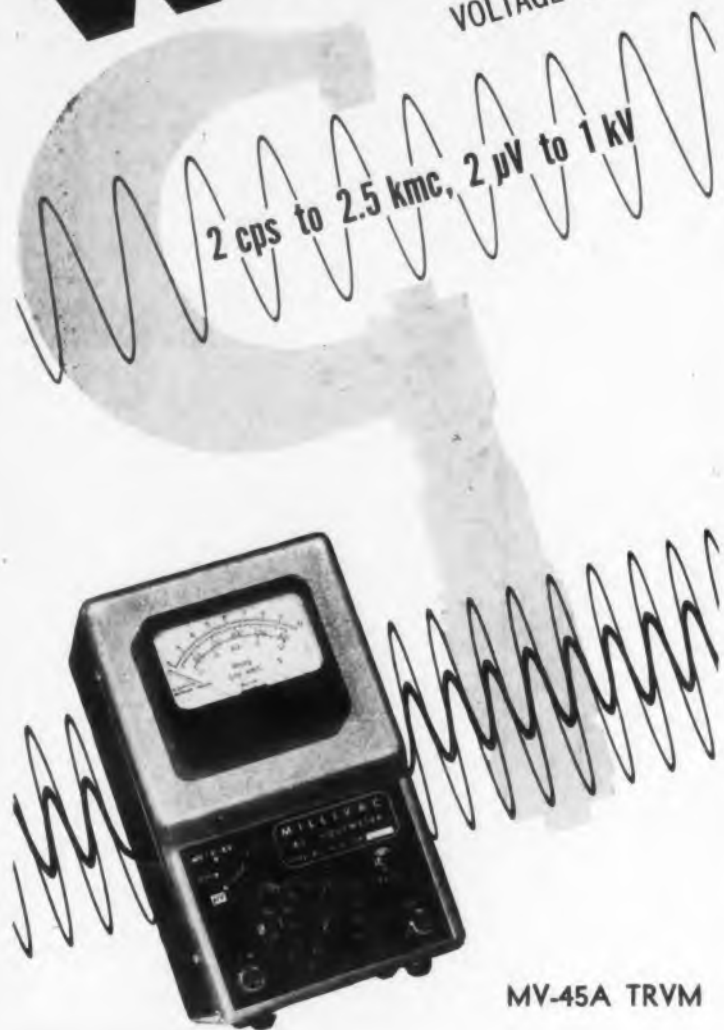
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CIRCLE 188 ON READER-SERVICE CARD FOR MORE INFORMATION

WIDE

FREQUENCY and VOLTAGE COVERAGE



MV-45A TRVM

Introducing . . .

the NEW MV-02B VTVM and the MV-45A TRVM (TRANSISTOR VOLTMETER)

The addition of these high quality AC voltmeters to our line extends even further our unrivaled coverage of unusually high frequency and voltage measuring ranges.

TYPE	FREQUENCY	VOLTAGE	ACCURACY
MV-02B VTVM	2 cps — 250 kc	0.7 mV — 1 kV	2% through entire frequency range
MV-12B VTVM	20 cps — 250 kc	0.7 mV — 1 kV	2% through entire frequency range
MV-22B VTVM	20 cps — 10 mc	70 μV — 1 kV	3½% through entire frequency range
MV-18C VTVM	1 mc — 2.5 kmc	1 mV — 1 kV	5% below 100 mc, 7% below 200 mc, rest 5% with calibration chart
MV-45A TRVM	20 cps — 150 kc	2 μV — 1 kV	2% below 100 kc, 5% above

TOMORROW IS OUR YESTERDAY

Millivac
Instrument Corp.

BOX 997, SCHENECTADY, NEW YORK
CIRCLE 189 ON READER-SERVICE CARD FOR MORE INFORMATION

Proportional Voltage Bridge

Checks Synchros, Servos



The SB-10 proportional voltage bridge measures the electrical error of CX, TX, CDX, and CT synchros in accordance with MIL-S-16892 and SAE-APP-461. It is also used to measure the positional accuracy of a servo loop containing synchros without introducing loading errors and without attaching to any shaft in the servo.

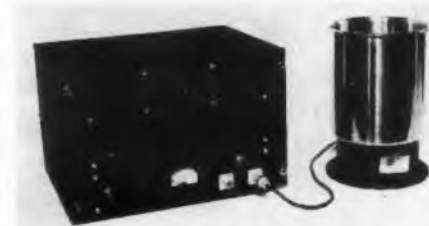
The device is a passive comparison bridge of high accuracy. Its elements are carefully aged, sealed in oil, and matched against NBS primary standards. Each of its three arms have resistances of 50 K. Angular accuracy is given as 10 sec of arc max. Rotation is in steps of 5 deg, continuous throughout 360 deg. The bridge is hand set to each angle by a detent switch.

Theta Instrument Corp., Dept. ED, 204 Market St., E. Patterson, N.J.

CIRCLE 190 ON READER-SERVICE CARD FOR MORE INFORMATION

Ultrasonic Cleaner

For Printed Circuits



A low frequency ultrasonic cleaner is suitable for small parts cleaning, removal of radioactive con-

tamination and printed circuit cleaning. The standard unit consists of an electronic generator delivering up to 100 watts of energy to crystal transducers mounted on a one gallon stainless steel tank.

Two cleaning tanks may be used alternately without disconnecting either one so that one tank may be used for removing large amounts of soil and the other may be used for final cleaning, or two different solutions may be used. The controls are on off-on switch, a frequency adjusting knob and a toggle switch to operate either transducer.

Alcar Instruments, Inc., Dept ED, 17 Industrial Ave., Little Ferry, N. J.

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HOW FAR WILL COMPUTERS Penetrate Industrial Applications in '57?

READ DESIGN '57—JAN. 1ST ED

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assemblies
successfully**

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pioneer in micro-miniature circuitry, offers complete assemblies in any quantity. Write today and describe the coax solutions you require. With Microdot cables and over 300 Connectors, our engineers can quickly and economically supply guaranteed solutions giving you superior environmental performance and operating characteristics.

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CIRCLE 193 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 15, 1956

USING
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Consider the advantages of

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NYLON FLAT BRAIDED TAPES and NYLON LACING CORDS

- Fungus-proof
- Stronger—ties easier, faster, tighter
- Knots will not slip

MEETS NEW GOVT. SPEC. Mil-T-713A

Tapes are available in both Nylon and Dacron and in wax, wax-free and resin-coated finishes.

New TEFLON COATED FIBERGLASS TAPES WITHSTAND TEMPERATURES UP TO 600°

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CIRCLE 194 ON READER-SERVICE CARD FOR MORE INFORMATION

Designers like

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| ✓ | ELECTRIC RESET |
| ✓ | LOW POWER CONSUMPTION |



OF SODECO ELECTRIC IMPULSE COUNTERS

Sodeco Electric impulse counters can be operated in electronic circuits—their power requirements are so low. And, they offer immediate, remote electric reset. Small wonder they're the favorite of designers everywhere.

Designers also like . . .

- SPEED** Sodeco Counters Count up to 25 impulses per second
- COMPACTNESS** Model shown measures only 1- $\frac{3}{8}$ " x 2- $\frac{3}{8}$ " x 4- $\frac{3}{8}$ " and is suitable for flush mounting.

Sodeco Electric Impulse Counters are available in 4, 5 & 6 digit models, secondary contacts, and either electrical or mechanical single-stroke toggle reset; or without reset.

Write for full
information on
the Sodeco line.

LANDIS & CYR, INC.

45 WEST 45TH STREET • NEW YORK 36, N. Y.

CIRCLE 195 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 15, 1956

Spectrum Analyzer

Has Broadband RF Heads



A broadband spectrum analyzer, Model L701A, with broadband rf heads, combines superior specifications with simplicity of design.

The broadband heads permit operation with one head in the range from 950 to 16,000 mc. This microwave receiver affords great sweep width, good display, and all controls are convenient.

Electronics and X-Ray Division, Dept. ED, F-R Machine Works, Woodside, N.Y.

CIRCLE 196 ON READER-SERVICE CARD FOR MORE INFORMATION

Rack Cooling Fan

Only 5-1/4 in. High



The Model 3E40 Rack Cooling Fan Unit, for electronic cabinets, fits standard 19 in. racks but occupies a space only 5-1/4 in. high. It has RETMA notching

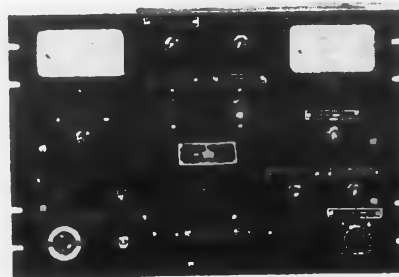
for ready installation and is complete with filter and 5-1/4 x 19 in. stainless steel grill. No color matching is required. Air delivery is 140 cmf.

McLean Engineering Laboratories, Dept. ED, Princeton, N.J.

CIRCLE 197 ON READER-SERVICE CARD FOR MORE INFORMATION

30 Kv Power Supply

Laboratory Instrument



Model 922 is a 30 kv regulated power supply designed specifically as a laboratory instrument. It is supplied on a single chassis 19-1/4 x 18 x

14-1/4 in. high, with provision for remote control operation and for external interlock.

The supply requires 105-125 v 60 cps, consumes 300 va and delivers from 0 to 30 kv dc at 0 to 0.5 ma.

Telectro Industries Corp., Dept. ED, 35-18 37th St., Long Island City 1, N.Y.

CIRCLE 198 ON READER-SERVICE CARD FOR MORE INFORMATION

PANEL SPACE LIMITED? SPECIFY

DIALCO 2-Terminal Sub-Miniature Pilot Lights

COMPACT
RUGGED
OMNIDIRECTIONAL
PLASTIC DOMES
COMPLETELY
INSULATED

Also available
with "Taper-Tab"
quick-connect
terminals

BACK
of panel
insertion

OR
FRONT
of panel
insertion



△ Dimming
and
◁ Non-dimming
types

Also 1-Terminal Pilot Lights

for use on grounded
circuits. Available
with binding screw
or soldering terminal.

DIALCO's expanded line of sub-miniature lights conform to all applicable Mil Specs. Use T-1 $\frac{3}{4}$ midget incandescent lamps—1.3 to 28 V. Spring mounted *Lens-with-Message* is readily positioned *after* installation . . . Mount from *back* of panel in 15/32" clearance hole; or from *front* of panel in 17/32" hole . . . 7 lens colors . . . Shown approx. actual size (top to bottom): No. 134-3830-375-6 . . . No. 101-3830-951 . . . No. 101-5030-951 . . . No. 109-3830-111 . . . No. 111-3830-111 . . . No. 107-1930-951.

Complete details in Brochures L-156 A and L-157.

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CIRCLE 199 ON READER-SERVICE CARD FOR MORE INFORMATION

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**SUPERSENSITIVE
RELAY**



NEW!

Simpson

METER RELAYS

of improved design and reliability

**Less than 50 Millimicrowatts
Control Up to One Watt!**

Here is a line of improved Meter Relays that offers lower costs, plus circuit simplification for many alarm, control, and limit setting applications. The new design features platinum alloy contacts and increased contact force which minimizes sticking and provides extreme reliability. Simpson Meter Relays are a nonlocking type, currently available in 2" DC and 3" AC and DC models. Write for new Technical Bulletin No. 17, today.

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Bach-Simpson Ltd., London, Ont.

INSTRUMENTS THAT STAY ACCURATE



CIRCLE 201 ON READER-SERVICE CARD FOR MORE INFORMATION

Barometric Switch

With Altitude Accuracy of 100 Ft



With this barometric switch, the user presets the altitude and the switch will operate within 100 ft of that height. Greater accuracy can be supplied on special order. The switch is temperature compensated, ruggedly built to resist shock and vibration, and has hermetically sealed contacts. It is valuable for air ordnance application and for material drops by parachute.

Clifford Manufacturing Co., Dept. ED, 152 Grove St., Waltham 54, Mass.

CIRCLE 202 ON READER-SERVICE CARD FOR MORE INFORMATION

Sealed Switch Series

Variety of Actuators



This precision snap-acting switch is sealed against moisture, dust, oil, and corrosive gases. Known as the 2HB series switch, it has a silicone boot that seals the clearance space around the operating pin, and

the cover is sealed to the base with a thermosetting resin.

The switch is available with a variety of actuators, permitting a wide range of actuating devices.

Unimax Switch Div. of The W. L. Maxson Corp., Dept. ED, Ives Rd., Wallingford, Conn.

CIRCLE 203 ON READER-SERVICE CARD FOR MORE INFORMATION

Free Gyro

Unusually Rugged



Model 3416 free gyro features a cast steel frame mounted solidly inside a structural outer shell having an integral CG mounting flange and offering insensibility to mounting and dynamic loads. Shock specification is 50 g in all axes.

Drift rate is less than 18 minutes of arc per min. The potentiometer pickoffs, which supply outputs of up to 70 v for telemetering and control operations, have a linearity of ± 0.5 per cent and resolution of .09 degree.

G. M. Giannini & Co., Inc., Dept. ED, 918 East Green St., Pasadena 1, Calif.

CIRCLE 204 ON READER-SERVICE CARD FOR MORE INFORMATION



**versatile 16-speed
recording system**

New Brush direct writing oscillograph with dual channel amplifier mounts in convenient console for table or bench use. Widest range of chart speeds available in system of this type permits excellent readability of a wide variety of signals. Speed may be changed instantaneously from local or remote locations by exclusive electrically controlled chart drive transmission. For booklet write Brush Electronics Company, Dept. J-11, 3405 Perkins Avenue, Cleveland 14, Ohio.

BRUSH ELECTRONICS COMPANY
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CIRCLE 205 ON READER-SERVICE CARD FOR MORE INFORMATION

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NEWS NOTES

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Describes how ultra-reliable, compact FERRISTORS* can be used to perform many vacuum tube functions. Gives elementary FERRISTOR* circuitry and basic data, plus complete diagrams for 14 useful circuits (amplifiers, oscillators, gating, ring counter, etc.). FERRISTOR* technical data, literature and price lists included. Write today for your free copy; please address Dept. D-11.

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VARFIL
Sleeving and Tubing...

and get these **5**
BIG Advantages

- HIGHER DIELECTRIC RETENTION
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- MORE HEAT RESISTANCE
- AVAILABLE IN COILS
- CAN BE AFTER-TREATED

Even under the most severe operating conditions, Varfil Sleeving and Tubing retains its average dielectric strength. Twist it, tie it, bend it, wrap it, knot it. Remains just as pliable as when you started. Won't crack, peel or suffer dielectric loss. Heat Varfil 2000 hours at 110° C.—1,000 hours at 125° C.—and even for extensive periods at 150° C. It won't break down. Can be after-treated in baking and varnishing operations. Reacts better than other oleoresinous materials and synthetic coated tubings. Available in handy coils so you can cut the exact lengths you need . . . no waste. Standard colors. Wide range of sizes. Exceeds or meets all A.S.T.M. specifications.

AVAILABLE IN FOLLOWING NEMA CLASSES

- CLASS B-A-1 1000 VOLTS AVERAGE
- CLASS B-B-1 5000 VOLTS AVERAGE
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- CLASS B-C-2 1500 VOLTS AVERAGE

Varflex CORPORATION
Makers of Electrical Insulating Tubing and Sleeving

SEND TODAY FOR FREE SAMPLE FOLDER

VARFLEX Corporation, 514W. Court St., Rome, N.Y.

Tape Rule Is Read from Dial



The "Rulo-Matic" shows complete measurements to fractions of an inch on a vernier dial. Upper graduations on the dial shown 1/16 in. fractions,

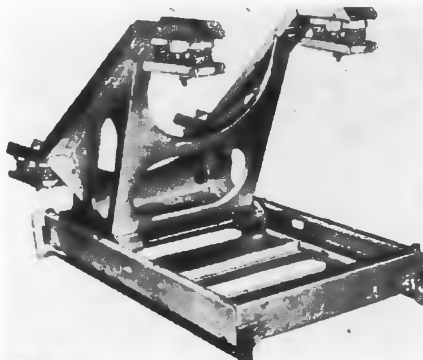
with main fractions on the lower side.

The triple coated white-face tape is counter-balanced with an inner return spring for smooth operation. Oiling and cleaning pads are built in to clean and oil the blade each time it is used. A small serrated steel wheel scribe is contained in the case for marking measurements. A movable end-clip on the tape compensates for "butt" or "hook" measurements. The "Rulo-Matic" is furnished in a die cast, highly polished, chrome plated case.

Frederick Post Co., Dept. ED, 3650 N. Avondale Ave., Chicago 18, Ill.

CIRCLE 209 ON READER-SERVICE CARD FOR MORE INFORMATION

Vibration Mounting Has Movable Suspension



Electronic equipment and delicate mechanical components are easily mounted in this rack with minor modifications. Vibrations isolation is over 90 per cent at

frequencies of 30 cy per second and higher.

The resilient members and the equipment center of gravity are in the same diagonal plane. This eliminates rocking and tipping modes.

Model 1374-3 is designed to support radar indicator and scope weighing 37 lbs, but may be modified for other loads. The rack and pinion device with locking handles facilitates alignment of equipment by the operator while in flight.

Robinson Aviation, Inc., Dept ED, Airborne Division, Teterboro, N.J.

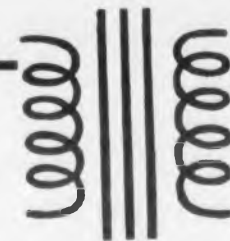
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ARE THE RESULTS OF RESEARCH AND DEVELOPMENT PROGRAMS for Guided Missiles

Beginning to Affect Suppliers?

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WE MAKE THE KIND OF TRANSFORMERS YOU NEED



When dependable performance and long life are essential requirements of your transformer application—tell your problem to an Acme Electric transformer engineer. Chances are that sometime during our 39 years of manufacturing experience and development of more than 20,000 transformer designs we have had to solve a similar problem. Whether your need is for Miniature Pulse Transformers, Power Supply units or Power transformers up to 750 KVA, there's an experienced Acme Electric engineer to help you.



This filament Transformer was designed with particular stress on insulation. This design is insulated for 20 KV.



This Plate Transformer features a porcelain connection panel which in turn, is hermetically sealed to case.



This Saturable Reactor is simple and practical in design for easy installation and high performance.

ACME ELECTRIC CORPORATION
9010 WATER ST. CUBA, NEW YORK

Acme Electric
TRANSFORMERS

CIRCLE 211 ON READER-SERVICE CARD FOR MORE INFORMATION

MB shakers for any vibration testing program



One pound to over twelve thousand pounds . . . that's the range of force outputs in the wide group of MB shakers. (On the way are models for up to 500,000 pounds force!)

MB Exciters operate over wide frequency ranges, and generate rectilinear motion at high ac-

celeration levels. They give reliable data.

If you're working on projects that call for environmental vibration tests, fatigue testing or noise determinations . . . contact MB, the leading authority in this growing field. Send for Bulletin 420-B.

MB manufacturing company
A DIVISION OF TEXTRON INC.
1058 State Street, New Haven 11, Conn.

CIRCLE 208 ON READER-SERVICE CARD FOR MORE INFORMATION

True Hermetic Sealing
assures Maximum Stability in

AMPERITE RELAYS and REGULATORS

Simplest • Most Compact • Most Economical



STANDARD

PROBLEM? Send for
Bulletin No. TR-81

Also — Amperite Differential Relays: Used for auto-
matic overload, under-voltage or under-current protection.

Thermostatic DELAY RELAYS

2 to 180 Seconds



MINIATURE

- Actuated by a heater, they operate on A.C., D.C., or Pulsating Current.
- Hermetically sealed Not affected by altitude, moisture, or other climate changes.
- Circuits: SPST only — normally open or normally closed.

Amperite Thermostatic Delay Relays are compensated for ambient temperature changes from -55° to $+70^{\circ}$ C. Heaters consume approximately 2 W. and may be operated continuously. The units are most compact, rugged, explosion-proof, long-lived, and — very inexpensive!
TYPES: Standard Radio Octal, and 9-Pin Miniature.

consume approximately 2 W. and may be operated continuously. The units are most compact, rugged, explosion-proof, long-lived, and — very inexpensive!
TYPES: Standard Radio Octal, and 9-Pin Miniature.

BALLAST REGULATORS

Amperite Regulators are designed to keep the current in a circuit automatically regulated at a definite value (for example, 0.5 amp.)
For currents of 60 ma. to 5 amps. Operate on A.C. D.C., Pulsating Current.



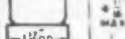
16 1/2 L



13 00 MAX

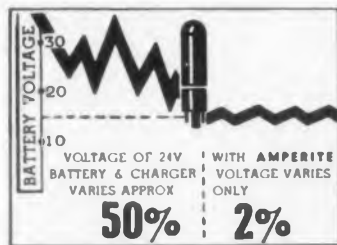


13 00 MAX



13 00 MAX

Hermetically sealed, they are not affected by changes in altitude, ambient temperature (-55° to $+90^{\circ}$ C.), or humidity. Rugged, light, compact, most inexpensive.



Individual inspection and double-checking assures top quality of Amperite products.

Write for 4-page Bulletin No. AB-51

AMPERITE CO., Inc.

561 Broadway, New York 12, N. Y.

Telephone: CAnal 6-1446

In Canada: Atlas Radio Corp., Ltd.

50 Wingold Ave., Toronto 10, Ont.



CIRCLE 213 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Clutch & Brake

Dry Powdered Iron Unit



Model #10 clutch is a lightweight unit with a torque rating of 80 in.-oz at 5000 rpm, and an output inertia of 1.85 gm. cm². Speed of response is in the order of 2 msec.

Since the excitation coil is fixed, slip rings and external bearings are not required.

This unit has only two moving parts. Precision ball bearings are used throughout.

The clutch offers either on-off or proportional control up to 100 per cent slip. Ratings apply for either direction of rotation.

Electomic Mechanisms, Inc., Dept ED, P.O. Box 1156, Greenwich, Conn.

CIRCLE 214 ON READER-SERVICE CARD FOR MORE INFORMATION

Amplitude Modulator

Range 9.15 to 9.65 K Mc



A new X band Gyruline, Model X-234, affords a ten-time increase in operating power level compared to most previous models.

This microwave amplitude modulator operates over a frequency range of 9.15 to 9.65 k mc, has a continuous power dissipation rating of 10 w and a maximum attenuation of 30 db.

Cascade Research Corp., Dept ED, 53 Victory La., Los Gatos, Calif.

CIRCLE 215 ON READER-SERVICE CARD FOR MORE INFORMATION

Differential Transformer

Four Channel System



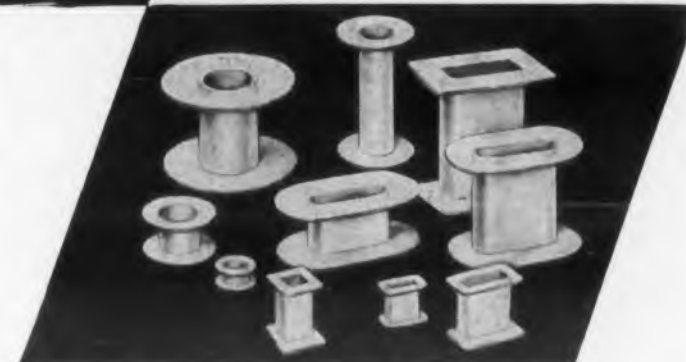
The Model 52 four channel linear variable differential transformer system is a standard 19 in. rack mounted

chassis which can excite up to four LVDT transducers from zero to 10 v rms. The internal oscillator is a unitized plug-in unit which can operate at any frequency between 9 kc and 22 kc.

Micro Gee Products, Inc., Dept. ED, 6100 W. Slauson Ave., Culver City, Calif.

CIRCLE 216 ON READER-SERVICE CARD FOR MORE INFORMATION

GRC small nylon coil bobbins



NOW available from stock

NOW Gries offers a wide variety of nylon coil bobbins from stock. Automatically mass produced at low cost—ready for use. Stock sizes from $1/4$ " diameter x $1/4$ " long minimum up to $7/8$ " diameter x $7/8$ " long—round, square, rectangular, oval shapes. Check Gries for your bobbin needs—either from stock—or to your size, shape and material specifications on special order.

Wide range of shapes and sizes

1-pc. Nylon molding speeds winding

Irregular shapes and special materials to order

Accurate, uniform, ready-for-use

WRITE FOR FULL INFORMATION

GRIES REPRODUCER CORP.

WORLD'S FOREMOST PRODUCER OF SMALL DIE CASTINGS

40 Second Street, New Rochelle, N. Y. NEW Rochelle 3-8600

CIRCLE 217 ON READER-SERVICE CARD FOR MORE INFORMATION



NEW SWITCH for high-speed commutating

The mercury jet
DELTA SWITCH

- no contact bounce
- long life

Unique multi-position rotary switch for data sampling where application demands high speed (as many as 10,000 samples per second), long life and low noise. Ideal for thermocouple sampling and strain gauge monitoring to a high-speed analog to digital converter or oscilloscope display.

Operates satisfactorily from 1,200 to at least 6,000 rpm. Contact resistance approximately .25 ohm. Noise levels of less than 10 microvolts in most applications. Flexible dwell time.

Complete technical information available upon request.



NORWOOD CONTROLS

UNIT OF DETROIT CONTROLS CORP.

932 Washington St., Norwood, Mass.

Copyright 1956 by Detroit Controls Corp.

CIRCLE 218 ON READER-SERVICE CARD FOR MORE INFORMATION

**Greater
Sensitivity...**

PLUS EXTRA-LONG LIFE



LICON*

TYPE 10 BASIC SWITCH
with standard 1" mounting

Here's extreme sensitivity and extra-long life—both in one precision basic switch! Movement differentials as low or lower than .0005" can be had, and Licon's new serpentine mechanism has been tested for over ten million repetitions without failure. Fatigue problems and switch replacements are cut . . . performance improved. Made of the finest materials to highest quality standards, Licon has a variety of adapters for appliances, aircraft and in-plant equipment. 15 amp rating.

*Trademark

Write for LICON BULLETIN

ILLINOIS LICON

SWITCH AND CONTROL DIVISION

2501 N. Keeler Avenue,
Chicago 39, Illinois

TOOL WORKS

CIRCLE 219 ON READER-SERVICE CARD FOR MORE INFORMATION

Preset Decade Counter

Has High Acceptance

Direct reading Model 101A Preset Decade Counting Unit is designed to provide an output pulse at a selected number at rates in excess of 40,000 counts per sec. If reset is not required, they are capable of counting at a 100,000 cps rate. These units are readily cascaded and Model 101A is of the coincident type with an 11 pin base, pulse output and O reset.



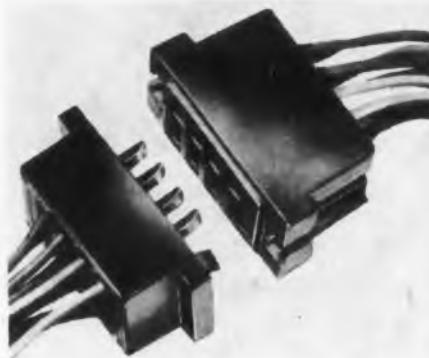
The input requirements are a negative pulse, 75 to 100 v peak. The rise time is 1 μ sec max. with a duration of at least 2 μ sec. Input impedance is 100 μ f in series with 16,000 ohms. The preset coincidence output positive pulse is approx. 50 v peak. Reset to O is instantaneous by opening grid circuit or by application of 70 v pulse at least 15 μ sec wide.

Computer-Measurements Corp., Dept. ED, 5528 Vineland Ave., North Hollywood, Calif.

CIRCLE 221 ON READER-SERVICE CARD FOR MORE INFORMATION

Plug and Receptacle

Feature Fast Assembly



These low-cost units feature fast, simple assembly for use in appliances, electronics, machinery, or any application requiring multiple circuit hook-ups. Crimped terminals for snap-in assembly eliminate time-consuming soldering and cut assembly costs. Terminals are available individually or in reels for automatic machine assembly to wires; rating is up to 15 amp per terminal.

The units are molded from a Molex compound, UL approved, which provides good electrical and physical properties, plus dimensional stability and low moisture absorption.

Molex Products Co., Dept. ED, 9515 Southview Ave., Brookfield, Ill.

CIRCLE 222 ON READER-SERVICE CARD FOR MORE INFORMATION

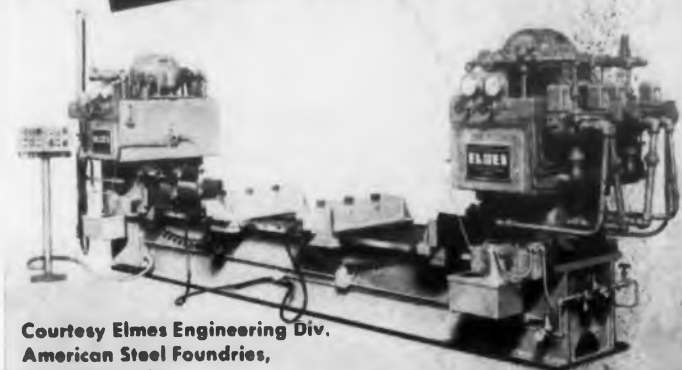
**AUDIO
INSTRUMENTS & CONTROLS
AIRCRAFT ELECTRONICS**

**Your Customers
List Their
Requirements**

READ DESIGN '57 JAN. 1ST ED

ELECTRICALLY POWERED COMPONENTS T-H-A-T M-O-V-E NEED

*Koiled Kords



Courtesy Elmes Engineering Div.
American Steel Foundries,
Cincinnati, Ohio

Koiled Kords retractile cords extend and retract as needed always returning to their neat out-of-the-way springlike coil.

The double-end tube reducing hydraulic press illustrated above shows how well Koiled Kords serve on moving equipment. In positioning the machine the cords extend and retract as needed with no looping, drooping, dangling, tangling cords to get in the way.

Koiled Kords retractile cords are available from one to thirty-seven conductors. Special cords can be made to specification. Write for the latest Koiled Kord Catalog No. 556.

© 1956

Koiled Kords

INCORPORATED

BOX K, NEW HAVEN 14, CONN.

Manufactured by Whitney Blake Co., New Haven 14, Conn.
*Koiled Kords is a trade mark of KOILED KORDS, INC.

CIRCLE 223 ON READER-SERVICE CARD FOR MORE INFORMATION

Fastener Problems

ESNA a collection
of problems
and
solutions

FREE FASTENER PROBLEM MANUAL

Three dozen pages of instructive fastening ideas in this new compilation of problems solved by standard and special ESNA self-locking nuts and Rollpin. Weight reducing ideas, assembly simplifications, cost cutting and many others.

When we began illustrating our ads with fastener problems submitted by customers and details of the solutions worked out by ESNA engineers, it was suggested that we collect the series in a handy reference form. Its popularity among design engineers has led us to produce this, our fourth and newest edition. There is no charge, just send your name, title, firm and address to Dept. N15-1157.

**ELASTIC STOP NUT CORP.
OF AMERICA**



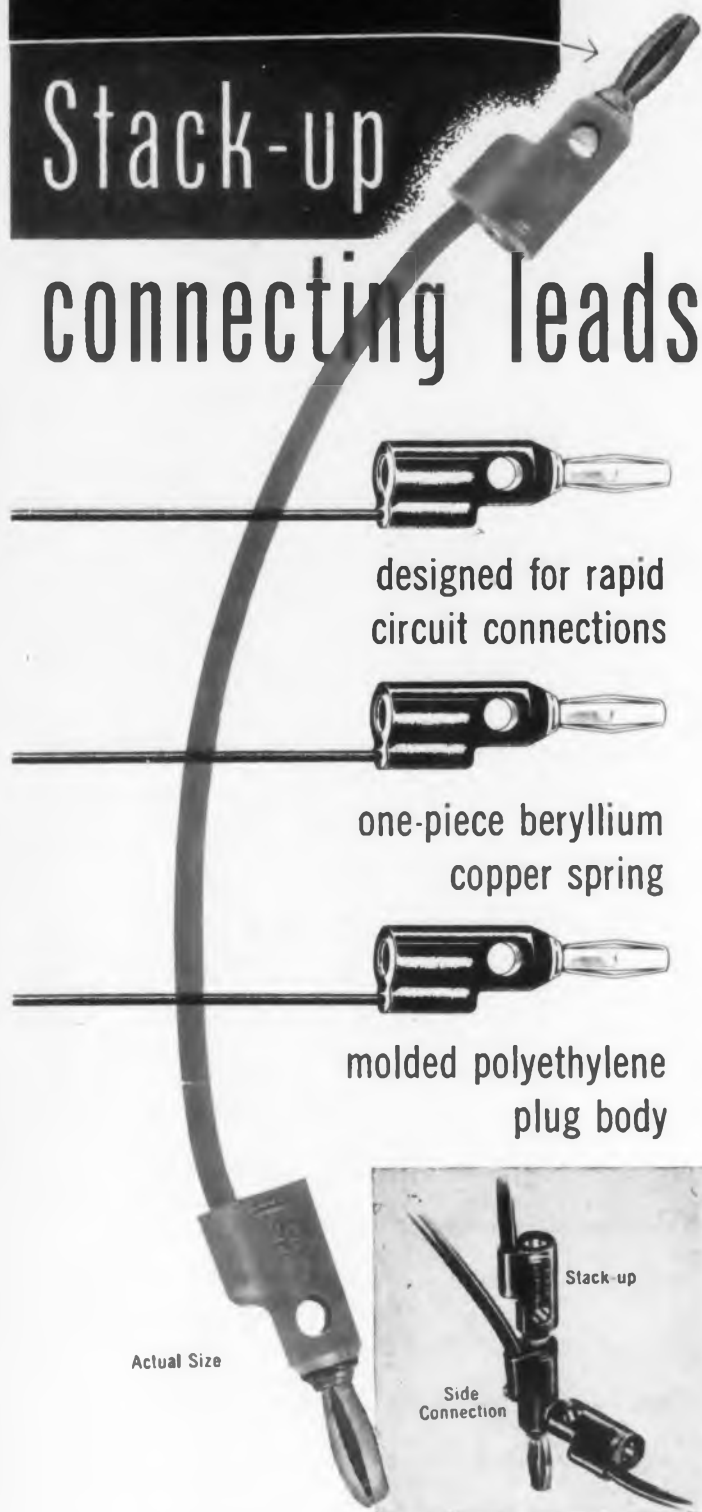
2330 Vauxhall Road, Union, New Jersey

CIRCLE 220 ON READER-SERVICE CARD FOR MORE INFORMATION



PATCH-CORDS

Stack-up connecting leads



designed for rapid
circuit connections

one-piece beryllium
copper spring

molded polyethylene
plug body

Actual Size

Side
Connection

Stack-up

Now in coded colors, Red, Black, Green, Orange, Blue, Yellow, Brown. Six standard lengths, 4"-8"-12"-18"-24"-36". Parallel operation of several instruments are easily made. Stack-up connection permits stacking as many leads as desired at one point.

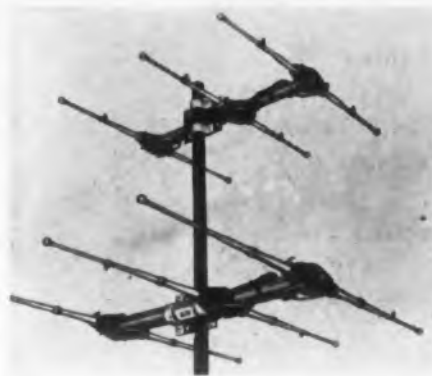


POMONA Electronics CO., INC.
1126 WEST FIFTH AVENUE
POMONA, CALIFORNIA

CIRCLE 225 ON READER-SERVICE CARD FOR MORE INFORMATION

Communication Arrays

Precision Tuned



These communication arrays are designed to specific requirements and employ standard or modified components. Standard arrays are fully integrated, hair-pin resotated, precision-tuned, matched and calibrated; and provide 75 per cent reduction in precipitation static.

Telrex Labs., Dept. ED, Asbury Park, N.J.

CIRCLE 226 ON READER-SERVICE CARD FOR MORE INFORMATION

Portable Frequency Changer

60 to 320-1000 Cps



A new frequency changer converts 50 or 60 cycle line power to any desired frequency between 320 and 1000 cps.

The unit is portable and is designed to replace rotating equipment.

The Model FCR 250 provides frequency regulation within ± 1 per cent. Regulation of $\pm .01$ per cent is available with auxiliary frequency standard fixed at 400 cycles. Voltage regulation is within ± 1 per cent.

Sorensen and Co., Dept. ED, 375 Fairfield Ave., Stamford, Conn.

CIRCLE 227 ON READER-SERVICE CARD FOR MORE INFORMATION

Frequency Deviation Meter

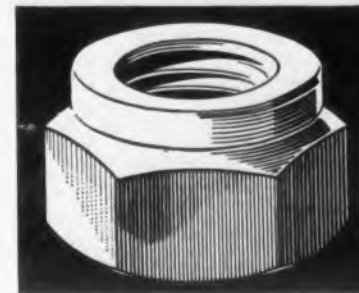
Measures AM or FM



Type FT-FMV frequency deviation meter, which measures fm or am characteristics over a range of 20 to 600 mc carrier frequencies, has the capability of simultaneously indicating the incidental am in an fm signal being measured and, conversely, the incidental fm in an am signal.

CIRCLE 228 ON READER-SERVICE CARD FOR MORE INFORMATION

Specify standard **FLEXLOC** microsize locknuts



- One-piece, all-metal construction
- Resilient locking section
- Controlled locking torque
- Lock and stop nut in one
- Every thread carries its full share of the load
- Made to Class 3B fit

Smaller than regular FLEXLOCs of the same nominal diameter, FLEXLOC microsize locknuts make possible smaller mating joints and flanges. Standard materials are brass (plain or cadmium plated) and aluminum (plain or chemically treated), for temperatures to 250°F; alloy steel and 18-8 stainless steel, for temperatures to 550°F. They are available in sizes #0 through #4 at your industrial distributor's. See him for details. Or write for literature, samples, information on other materials. Flexloc Locknut Division, STANDARD PRESSED STEEL CO., Jenkintown 12, Pa.

STANDARD PRESSED STEEL CO.

FLEXLOC LOCKNUT DIVISION

SPS

JENKINTOWN PENNSYLVANIA

CIRCLE 229 ON READER-SERVICE CARD FOR MORE INFORMATION



Type 908-R X-Y Dial Drive
on a Type 1208-B Oscillator

Proportional Sweep Voltage with Automatic Sweep

The new G-R Types 907 and 908 X-Y Dial Drives provide a sweep voltage proportional to shaft position, as well as automatic sweep, when attached to oscillators equipped with Type 907 or 908 Dials.

The X-Y Dial Drives include a low- or a high-speed synchronous motor drive and a potentiometer to supply the sweep voltage, the latter being used to drive the independent variable axis of an x-y plotter, an oscilloscope or a separate channel on a single-axis recording system.

Four models of the X-Y Dial Drives are available, each priced at \$55.00.

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 37

CIRCLE 230 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 15, 1956

New Miniature POWER OUTLETS For Small Electrical and Electronic Units SHOWN FULL SIZE

- SMALLEST MADE
- TAKE STANDARD PLUG
- MOUNT FROM TOP OR BOTTOM OF FLAT BRACKET
- CHOICE PRE-WIRED STYLE, OR WITH SOLDERING TERMINALS
- PHENOLIC BLOCK HAS BARRIER TO PREVENT SHORTS

AC and DC



No. 221 (above) with soldering terminals and steel bracket with #6 clearance mounting holes. Also No. 222 with 6-32 tapped mounting holes. No. 223 (left) with 8" #14 or #16 plastic wire leads and steel bracket with #6 clearance mounting holes. Also No. 224 with 6-32 tapped mounting holes.

KULKA ELECTRIC MFG. CO., Inc.

Manufacturers of Electrical Wiring Devices
MOUNT VERNON, N. Y.

CIRCLE 231 ON READER-SERVICE CARD FOR MORE INFORMATION

Brew Delay Lines

Distributed Constant
Lumped Constant
Ultrasonic



Here are some reasons why you can be sure your requirements will be fully satisfied when you come to Brew for delay lines:

- custom built to your specifications
- wide experience in all type lines
- advanced packaging techniques
- special manufacturing and testing procedures
- modern facilities and skilled personnel
- exacting quality control
- continuous research and development program

Send us your specifications or send for Catalog 54 giving the complete Brew story.

BREW

Richard D. Brew and Company, Inc.
Concord, New Hampshire
design - development - manufacture

CIRCLE 232 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

Accurate Relay

Has High Repeatability



A new type 3-pole double throw relay, Model RL-503-ES has been developed for aircraft power control systems and applications requiring accuracy of pull-in and drop-out, high repeatability, resistance to vibration and small size.

The relay can be adjusted for 20 v pull-in and between 9 and 19 v drop-out.

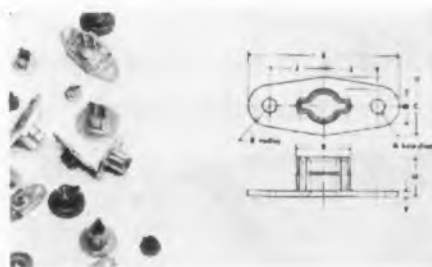
The maximum variation is 1 v in pull-in and drop-out voltage over the ambient temperature range of -60 C to +125 C. Contact ratings are 2.5 amps inductive and 4 amps resistive at 30 v. Coils range from 1/10 ohm to 6400 ohms. It has an electrical life of 100,000 operations at 5 amps 120 v ac.

Joseph Pollak Corp., Dept. ED, Freeport St., Boston 22, Mass.

CIRCLE 233 ON READER-SERVICE CARD FOR MORE INFORMATION

Self-Locking Nuts

In Complete Line



These self-locking metal nuts can be reused repeatedly without impairing their locking ability, and they are easily installed with standard tools, such as pliers and hex wrenches.

The nuts are now available for screw sizes ranging from No. 4 through 5/16 in. They are precision-threaded and have crimped ribs on two sides. As a screw is inserted, the nut is spread apart slightly, exerting a concentrated torque which grips the screw but cannot harm the threads. The nuts are usually made of cadmium-plated spring steel, although other materials can be used. Applications include automotive, electronic, machine tool, and appliance uses.

Con-Torq, Inc., North & Judd Mfg. Co., Dept. ED, New Britain, Conn.

CIRCLE 234 ON READER-SERVICE CARD FOR MORE INFORMATION



Increase winding speeds...

No spool returns...

Reduce machine downtime

MAGNA-PAK

NEW DISPOSABLE CONTAINERS FOR ESSEX "EXTRA TEST" MAGNET WIRE

Now! All the proven advantages of Essex "Extra Test" Magnet Wire are yours... plus the new, important convenience of MAGNA-PAK. Simplifies handling, providing long, continuous lengths of magnet wire at constant tension, and assures production speedup for your winding department. The non-returnable no-deposit MAGNA-PAK containers are palatized for shipment thus simplifying storage. Distinctive labeling permits fast, accurate identification.

The following MAGNA-PAK sizes are available:
No. 30, 500 lbs.; No. 15, 250 lbs.; No. 12 (metal or fibre pail), 100 lbs.



ESSEX EXTRA TEST MAGNET WIRE

DIVISION ESSEX WIRE CORPORATION
Fort Wayne 6, Indiana

MANUFACTURING PLANTS — Birmingham, Alabama; Anaheim, California; Fort Wayne, Indiana; Detroit, Michigan.

SALES OFFICES AND WAREHOUSES*

Birmingham, Ala.	Fort Worth, Texas	*Portland, Oregon
*Chicago, Illinois	Hartford, Conn.	Rochester, New York
Cleveland, Ohio	Indianapolis, Ind.	*Saint Louis, Mo.
Dallas, Texas	Kansas City, Mo.	*San Francisco, Calif.
Dayton, Ohio	*Los Angeles, Calif.	Upper Darby
Detroit, Michigan	Milwaukee, Wis.	(Philadelphia), Pa.
Fort Wayne, Indiana	*Newark, N. J.	Seattle, Washington

CIRCLE 235 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
1440-70 FIRST NATIONAL
BANK BLDG.
CINCINNATI 2, OHIO
GARfield 1-1700



Publishers of the authoritative *Engineers' Job Directory*

CIRCLE 237 ON READER-SERVICE CARD FOR MORE INFORMATION

SANGAMO "GY" FLATPAK



Small Size
High Efficiency
Fast Starting
High Power
Output

compact, efficient, dynamotor

The **FLATPAK** is a rugged, precision engineered dynamotor that is designed for mobile radio and general commercial use. It is of laminated field design, and its compact size makes it ideal for applications where space is a problem. Available in ratings through 110 watts continuous duty and 300 watts intermittent duty. Output to 650 volts.

Bulletin 1530 gives full information on these and other Sangamo Dynamotors. Mail the coupon for your copy.

SG56-6

SANGAMO Generators, Inc.

Dept. D, Springfield, Ill.

Please send me Dynamotor Bulletin 1530.

NAME _____

COMPANY _____

ADDRESS _____

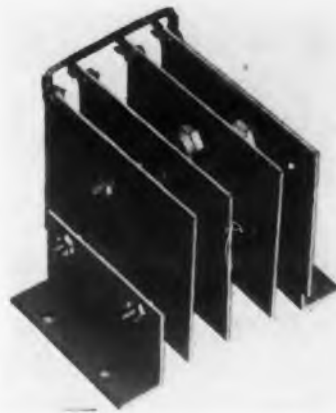
CITY & STATE _____

DYNAMOTORS
•
ROTARY CONVERTERS
•
MOTOR GENERATORS
•
GAS ENGINE GENERATORS
•
SPECIAL DC MOTORS

CIRCLE 238 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicon Power Rectifier

High Operating Voltage



This type of silicon power rectifier has advantages over other metallic rectifiers. It features 99 per cent efficiency, compared to 75 per cent for selenium, and 4 per cent regulation compared to 15 per cent for selenium. It has a high forward current with a low voltage drop,

and a low reverse current which gives it magnetic amplifier quality. It has high operating temperature, 190 C and up to 120 C ambient, and operating voltage up to 600 piv. Small in size and easy to fan-cool, the unit is hermetically sealed and exhibits no aging effects.

Sanford Miller Co., Dept. ED, 691 Bedford Ave., Brooklyn 6, N.Y.

CIRCLE 239 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

Broadband Microwave Signal

In Single Package



A broad-band microwave signal source, Type No. S771A, features a direct reading frequency dial that offers one knob control from 950 to 2000 and 1900 to 4000 mc.

The unit combines a power supply, klystron, klystron cavity, modulator, variable rf attenuator and an automatic reflector voltage tracking system for efficient, versatile operation. Output power across the band is high enough for most attenuation measurements.

Electronics & X-Ray Division, Dept. ED, F-R Machine Works, Inc., 26-12 Borough Pl., Woodside 77, N.Y.

CIRCLE 240 ON READER-SERVICE CARD FOR MORE INFORMATION

In 24 Hours—

You now have an opportunity to readily explore the unlimited horizons opened to your designs by using **INDIANA** permanent magnets in your new product development work. These magnets are immediately available from stock . . . in a broad range of sizes suitable for experimental work. All magnets are **HYFLUX Alnico V** . . . provide uniform, high energy in every application. See what **INDIANA** permanent magnets can do for your designs. Write or telephone, today.

you can have
permanent magnets
in your
laboratories
for your
experimental
work

INDIANA PERMANENT MAGNETS

Write for
INDIANA
Cast Catalog
No. 11-M11

THE INDIANA STEEL PRODUCTS
COMPANY
VALPARAISO, INDIANA

WORLD'S LARGEST MANUFACTURER OF PERMANENT MAGNETS
CIRCLE 241 ON READER-SERVICE CARD FOR MORE INFORMATION

Newest Cathode Alloys



**SUPERIOR'S CATHALOYS'
SIMPLIFY ALLOY SELECTION,
PROLONG VACUUM TUBE LIFE**

If you are searching for a better cathode alloy, Superior's new Cathaloy series can provide the answer. These alloys, carefully controlled by Superior, and available only from Superior, offer important functional advantages not obtainable in other cathode alloys. Get the complete catalog giving detailed specifications. Write Superior Tube Co., 2050 Germantown Ave., Norristown, Pa.

**FOUR TYPES AVAILABLE . . .
THREE ACTIVE, ONE PASSIVE**
CATHALOY A-30.¹ Long life, very low interface impedance.
CATHALOY A-31. Long life even under varying heater voltage.
CATHALOY A-32.² The all-round active alloy. Durable, shock resistant. Ideal for ruggedized tubes.
CATHALOY P-50. Only passive alloy commercially available in both Weldrawn⁴ and Lockseam⁵ form.

¹Cathaloy is a trademark of Superior Tube Co., Reg. U.S. Pat. Off.
²Cathaloy A-30 is manufactured under U.S. patents
³Patent applied for
⁴T.M. Reg. U.S. Pat. Off., Superior Tube Co.
⁵Manufactured under U.S. patents

Superior Tube
The big name in small tubing
NORRISTOWN, PA.

Johnson & Hoffman Mfg. Corp., Mineola, N.Y.—
an affiliated company making precision metal stampings and deep-drawn parts

CIRCLE 242 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • November 15, 1956



For standard PLASTIC PARTS

kurz-kasch

write for catalogs, specifications, prices or samples.

Kurz-Kasch, Inc. • 1415 S. Broadway • Dayton 1, Ohio
 BRANCH SALES OFFICES: New York, Mt. Vernon MO 4-4866 • Rochester, Hillside 0626 • Chicago, Merrimac 7-1830 • Detroit, Jordan 6-0743 • Philadelphia, Hilltop 6-6472 • Dallas, Lakeside 6-5233 • San Gabriel, Cal., Atlantic 7-9633 • St. Louis, Parkview 5-9577 • Atlanta, Exchange 5516 • Toronto, Oliver 7986 • Beverly, Mass., Phone: 65
 CIRCLE 244 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.

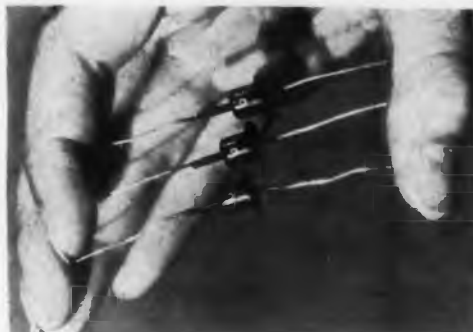
The **A.W. HAYDON COMPANY**
 227 NORTH ELM STREET
 WATERBURY 20, CONNECTICUT

PREFERRED WHERE PERFORMANCE IS PARAMOUNT

Write for Bulletin AWH TD402 describing 6400 Series DC, 11400 Series AC, 24300 Series 400 Cycle.
 CIRCLE 245 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicon Rectifiers

Low Current Types



Expansion of the GE line of low current silicon rectifiers includes three new types, 1N536, 1N539 and 1N540 which

meet military requirements. Respectively rated at max. peak inverse voltages of 50, 300 and 400 v. maximum allowable rms voltages are 35, 210 and 280 v respectively.

Ambient operating temperature for the series is from -65 to 165°C , with storage temperature rated at -65 to 175°C . Maximum rated output current is 750 ma, at 50°C ambient. Full forward voltage drop is a max. of 0.5 v at 150°C .

General Electric, Dept ED, Syracuse, N. Y.

CIRCLE 246 ON READER-SERVICE CARD FOR MORE INFORMATION

HOW WILL COLOR TV Affect the Component Parts Picture?

GET YOUR COPY OF DESIGN '57—JAN. 1ST ED

Portable Scaler

Features Reliable Economy



Compact in 24 lbs, exceptional in reliability, this portable scaler Model 2101 fills the need for a general purpose instrument. The scaler has a built-in timer to collect counting rate data without auxiliary equipment.

The instrument operates with a detector even where the slope of the

high voltage against the counting rate curve fails to form a true plateau, permitting lower energy gamma rays to be screened out. It also measures anything giving out pulses, depending upon the detector used.

Berkeley Div., Beckman Instruments, Dept. ED, 2200 Wright Ave., Richmond, Calif.

CIRCLE 247 ON READER-SERVICE CARD FOR MORE INFORMATION

ELCO
SCREWS

... Ask a man who has used them

Elco Screws are Good Screws



REMEMBER ELCO

THREAD-CUTTING SCREWS

Many modern assemblies, particularly in plastics and soft metals, make use of these vital fasteners. ELCO is equipped to produce all standard types and sizes (or specials if desired) in any quantities, at economical prices, and usually for prompt delivery. Send prints for quotation. Write for free package of samples.

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 248 ON READER-SERVICE CARD FOR MORE INFORMATION

AUTOMATIC silicon power rectifiers

MAXIMUM PERFORMANCE IN *Midget* SIZE



TYPICAL VALUES AT 100°C

Type No.	P. I. V. (volts)	Average DC Output Current (mA)	Reverse Leakage At Rated P. I. V. (μ A)	Mounting
1N440	100	300	0.03	Pigtail Leads
1N441	200	300	0.075	"
1N442	300	300	0.10	"
1N443	400	300	0.15	"
1N444	500	300	0.18	"
1N445	600	300	0.20	"
1N530	100	300	0.30	"
1N531	200	300	0.75	"
1N532	300	300	1.00	"
1N533	400	300	1.50	"
1N534	500	300	1.80	"

TYPICAL VALUES AT 100°C

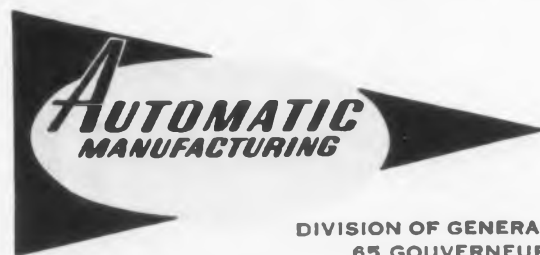
Type No.	P. I. V. (volts)	Average DC Output Current (mA)	Reverse Leakage At Rated P. I. V. (μ A)	Mounting
1N535	600	300	2.00	Pigtail Leads
1N560	800	300	1.50	"
1N561	1,000	300	2.00	"
1N550	100	500	.05	Stud-Mount
1N551	200	500	.10	"
1N552	300	500	.15	"
1N553	400	500	.20	"
1N554	500	500	.25	"
1N555	600	500	.30	"
1N582	800	500	1.50	"
1N563	1,000	500	2.00	"

● Now, improve all your equipment designs . . . here from one complete source, both stud mount and pigtail rectifiers . . . designed for dependable operation at ambient temperatures in the range of -55°C to $+150^{\circ}\text{C}$.

Twenty-two types are now available in quantity.

- These All-Welded units perform efficiently at all frequencies encountered in power applications — have negligible reverse currents — withstand severe atmospheric conditions — have excellent resistance to shock and vibration — display no aging characteristics over extended periods of time.
- Quality Automatic Silicon Rectifiers are particularly suited for magnetic amplifier and power supply applications which require superior forward conductance, low reverse leakage currents and exceptionally high efficiencies and rectification ratios. Their small size and light weight make them ideal for use in all types of miniaturized equipment.

- Write today for performance data sheets giving complete technical details.



MASS PRODUCERS OF
ELECTRONIC COMPONENTS

DIVISION OF GENERAL INSTRUMENT CORPORATION
65 GOUVERNEUR STREET NEWARK 4, N. J.

TV Tubes

90 Deg Deflection

Type 14NP4 and 14NP4A are directly-viewed picture tubes of rectangular glass construction for portable TV sets.

A new bulb design permits 90 deg deflection which increases picture area and decreases tube length by 2 in. The over-all length of each tube is 14-1/4 in. The spherical faceplates are made of neutral gray glass, minimizing reflections and improving picture contrast. Both types have an external conductive coating that provides a filter capacitor when grounded. The 14NP4A has a metal-backed screen for increased picture brightness.

The tubes employ low-voltage electrostatic focus and magnetic deflection; anode voltage is 12,000 v. Both tubes are 10-9/16 in. high, and 13-1/16 in. wide.

Westinghouse Electric Co., Tube Div., Dept. T-070-ED, Box 284, Elmira, N. Y.

CIRCLE 252 ON READER-SERVICE CARD

Vinyl Tubing

Fungus Resistant

Modifications of Hyflex and Transflex electrical tubings provide a line of tubing meeting all requirements of the MIL-I-631C specification. The new vinyl tubings have fungus resistance while retaining flame resistance and clarity.

They are approved for both Class I and Class II (fungus resistance) in both Grade A and Grade B (general and low temperature) as well as for Categories 1 and 2 (self-extinguishing) for both temperature grades.

The tubings are available in both clear and colored vinyl. Colors include black, white, red, blue, green and yellow.

Lengths of 500 and 1000 ft are wound on spools and 50 and 100 ft lengths are coiled. Tubing sizes range from number 24 to 2 in.

Minnesota Mining & Mfg. Co., Irvington Div., Dept. ED, 6 Argyle Pl., Irvington 11, N. J.

CIRCLE 253 ON READER-SERVICE CARD

◀ CIRCLE 251 ON READER-SERVICE CARD

Precision Power Supplies

Transistor Regulation

Transistor regulated dc power supplies, manufactured to the customer's specifications offer an unusually high degree of stability.

Sizes and weights of the units are about 1/5 to 1/3 those of comparable vacuum tube regulated supplies.

Equipment can be supplied to meet any requirement within the following range of characteristics: power output: up to 2.5 kva; dc voltage: 1 v to 2.5 kv; Current: 0-20 amp; regulation: 0.05 per cent; stability: 0.01 per cent for 24 hours; ripple: 0.002 per cent; ambient temperature: -55 +85 C Storage, -55 to 71 C operating; ambient temperatures to 150 deg can be accommodated where the output power requirement permits the use of silicon transistors.

Transval Engineering Corp., Dept. ED, 10401 Jefferson Blvd. Culver City, Calif.

CIRCLE 255 ON READER-SERVICE CARD

Remote Positioning Control

With Plug-In Modules

This system enables both positioning and proportioning control, plus monitoring of remote equipment over one circuit.

Bi-directional positioning is effected by polarized dc signals transmitted from a supervisory control panel to a remote slave receiver. Quantitative data on the control function is transmitted from the slave unit back to a meter on the supervisory panel. Visible and audible alarm, as well as fail-safe, lock-out, and hold-out features, can be added.

The systems are available with or without transducers for telemetering, and with pilot operators up to several horsepower rating. Overall accuracy of the metering system is guaranteed better than 2 per cent.

Sparks-Withington Co., Sparton Control Systems Div., Dept. ED, Jackson, Mich.

CIRCLE 256 ON READER-SERVICE CARD

how large is small?

DAVEN'S NEW MINIATURE WIRE WOUND RESISTORS PROVIDE AS MUCH AS 400K RESISTANCE IN $\frac{1}{4}$ " X $\frac{5}{16}$ " SPACE

DAVEN's fully encapsulated, miniature, precision wire wound resistors offer the design and development engineer the solution to critical space limitation problems. DAVEN's advanced techniques provide the needed resistance value in a minimum of space, without sacrificing reliability. Where space conservation is a prime factor in your design, specify DAVEN miniature wire wounds.

Types and Specifications

Type	Dia.	Length	Max. Ohms	Max. Watts
1274	3/16	3/8	100K	0.25
1273	1/4	5/16	400K	0.25
1283	1/4	5/16	400K	0.25
1284	1/4	27/64	.5 Meg.	0.25
1250	1/4	1/2	900K	0.33
1170A	7/16	1/2	1.2 Meg.	0.50
1170	1/2	1/2	1.8 Meg.	0.50

• Fully encapsulated • Meet and exceed all humidity, salt water immersion and cycling tests as specified in MIL-R-93A, Amendment 3 • Operate at 125°C continuous power without de-rating • Can be obtained in tolerances as close as $\pm 0.02\%$ • Standard temperature coefficient is $\pm 20\text{PPM}/^\circ\text{C}$.



THE **DAVEN** co.

524 West Mt. Pleasant Ave.
Route 10, Livingston, N. J.

Special temperature coefficients can be supplied on request.

Write for our new resistor catalog.

CIRCLE 257 ON READER-SERVICE CARD FOR MORE INFORMATION



THIS MAN CAN HELP YOU

Eliminate cost of incoming magnet wire inspection!

This inspector acts as customers' agent in the Anaconda magnet wire mill.

Result: Anaconda Magnet Wire complies with such exactness to specifications that many customers have felt it possible to *eliminate incoming inspection* . . . at considerable savings in money, time and manpower.

More than this, customers say Anaconda quality control pays off in smoother winding room performance . . . and helps them produce a consistently high quality product at lowest cost.

Talk to the Man from Anaconda about a trial run of Anaconda Wire to prove it to yourself. Call or write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York. 56322B

ASK THE MAN FROM **ANACONDA**[®]
FOR **MAGNET WIRE**

◀ Inspector checks finished enameled wire to insure customers' requirements are met.

CIRCLE 260 ON READER-SERVICE CARD FOR MORE INFORMATION

**STABLE
DC POWER
SUPPLY**



**PRECISION
DIFFERENTIAL
VOLTMETER**



**.05% INSTRUMENT
CALIBRATOR**



MODEL 406

Range—0 to 530 volts at 0 to 100 ma.
Stability—.01% short term; .05% per day.
Regulation—.01% for 20% line voltage change or 100 ma load change; ripple less than 1 mv.
Resolution—2 mv. over entire range via Coarse, Fine, Vernier controls.
Meter—Selectively reads output voltage or current or bias voltage.
Auxiliary Outputs—0 to -225 volts bias supply with .02% line regulation; 6.3 voc @ 3 amp. **\$245**

MODEL 800

Accuracy—now increased to .05% of actual reading from 500 to 10 v; .1% below 10 v. Calibrated against standard cell.
5-dial precision decade attenuator.
500 volt search range—(10 megohm VTVM) establishes value of unknown voltage to within 3%.
2 calibrated null ranges—10-0-10 and 1-0-1 volt. Input impedance infinite at null.
High resolution—500 volts spread out over 80 ft. of effective scale length.
Printed circuits—light, strong, aluminum construction; illuminated meter **\$315**

**These two new jf tools
do three basic jobs faster,
more accurately, at less cost**

"This is terrific!" is the engineer's instant reaction when they see this new 3-way system work. Each instrument performs at laboratory levels of precision on its own job... the Model 800 as a voltmeter, and the Model 406 as a high resolution dc power supply. Used together they are all you need to calibrate your dc instruments to .05% accuracy. They're portable so it's easy to check fixed installations or at instrument issuing points. Low cost and broad application make this pair a sound investment for single department or total plant use. Fast, simple operation and Fluke's exclusive "direct read-out" saves time and eliminates reading error, thus allowing use by semi-skilled personnel.

Write for full details on 3-way use of these two new instruments from John Fluke. Arrange for an early demonstration in your own shops.

Electronic tools *for* Industry

JOHN FLUKE MANUFACTURING CO., INC. *Jf* **1111 W. Nickerson St., Seattle 99, Washington**

CIRCLE 261 ON READER-SERVICE CARD FOR MORE INFORMATION

Oldham Couplings

For Controls and Computers



Though made for precision instrument, computer, and control applications, Oldham couplings can compensate for shaft parallel misalignment, .03 in. max, or for expansion. They permit components to be removed from equipment without the necessity of removing shafts.

Features include no loose parts, a maximum backlash of 10 minutes of arc, and all-stainless-steel construction. The couplings are available in five models to take 3/16, 1/4 and 5/16 shaft diameters, and 3/16-1/4 and 1/4-5/16 in. shaft combinations.

Ford Instrument Co., Dept. ED, 31-10 Thomson Ave., Long Island City 1, N.Y.

CIRCLE 262 ON READER-SERVICE CARD FOR MORE INFORMATION

L Band Waveguides

Range From 1120 to 1700 Mc



A line of L band equipment, containing large precision waveguide components is now being manufactured in production quantities. It uses 6.660 in. x 3.410 in. waveguides for optimum performance over the frequency range from 1120 to 1700 mc.

Electronics & X-Ray Division, Dept. ED, F-R Machine Works, Inc., 26-12 Borough Pl., Woodside 77, N.Y.

CIRCLE 263 ON READER-SERVICE CARD FOR MORE INFORMATION

**WHAT ARE THE LATEST TRENDS in
Instrumentation?**

BE SURE TO READ DESIGN '57—JAN. 1ST ED

Pulse Oscillator From 100 Cps to 3.3 Mc



The Model 3420B pulse oscillator is a wide range trigger generator producing pulses at repetition rates from 100 cps to 3.3 mc. The instrument is particularly useful as a clock pulse generator, for flip-flop resolving time studies.

Two separate blocking oscillator output pulses, each available positive or negative, are provided in a half-period relationship enabling, by mixing, such waveforms as alternate positive and negative pulses.

Output pulses are approximately 0.1 μ sec wide from an impedance level of less than 250 ohms, and with amplitude variable to 25 v open circuit.

Electro-Pulse, Inc., Dept ED, 11861 Teale St., Culver City, Calif.

CIRCLE 265 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

Transformer Line For Selenium Rectifiers



These power supply transformers, designed for ac operation or for dc use for selenium rectifiers, are ideal for heavy current, low voltage operation. Eight transformers are available for applications where special filament transformers were contemplated. The variable tap arrangement with the proper rectifier gives a wide range of applications

for voltages between 3.3 dc v output to 43.5 dc output and a maximum of 22.5 adc, depending upon the transformer.

Chicago Standard Transformer Corp., Dept. ED, 301 W. Addison St., Chicago 18, Ill.

CIRCLE 266 ON READER-SERVICE CARD FOR MORE INFORMATION

PROBLEM #6



Experienced engineers throughout the country have shown a marked preference for Peerless products. They know the Peerless engineering staff is uniquely qualified to solve any transformer problem quickly and efficiently. Matchless experience is the result of a long history of successfully designing transformers to unusual and difficult specifications. Such experience combined with rigid quality controls and the most advanced production techniques achieves uniform quality and dependability in all Peerless products.

Design an hermetically sealed 400 cps output transformer for use in a servo amplifier with a high degree of feedback ($\mu\beta=100$). Frequency response to be linear within 3 db from 200 cps to 170,000 cps, with no dips or peaks. Primary impedance to be 6,000 ohms, center-tapped, with a maximum DC resistance of 60 ohms. Primary OCL to be 4 henrys minimum when measured at 30V, 400 cps, and with 7.5 ma of DC flowing through the total winding. Secondary impedance to be 500 ohms, center-tapped, with a maximum DC resistance of 6 ohms. Secondary rated output to be 140V@ 400 cps into a 500 ohm load. Transformer efficiency to be 95% minimum. Ambient temperature range to be from -55°C to $+105^{\circ}\text{C}$. Maximum altitude to be 70,000 feet. Casing to be in accordance with the applicable requirements of MIL-T-27, with preferred dimension limits to be $2\frac{1}{2}'' \times 2\frac{3}{4}'' \times 2\frac{1}{4}''$.

SOLUTION BY PEERLESS

Output Transformer: 400 cps, high level, hermetically sealed.

Construction: Grade 1, Class B, MIL-T-27.

Maximum Altitude: 70,000 feet.

Duty Cycle: Continuous.

Life: Greater than 10,000 hours.

Ambient Temperature: -55°C to $+105^{\circ}\text{C}$.

Primary: Three terminal, center-tapped winding, 6000 ohms nominal impedance.

Primary Resistance: 45 ohms.

Primary OCL: 5 henrys, measured at 30V, 400 cps, with a 7.5 ma, DC, through winding.

Secondary: Three terminal, center-tapped winding, 500 ohms nominal impedance.

Secondary Resistance: 5 ohms.

Rated Operating Level: 140V, 400 cps across 500 ohm secondary load.

Efficiency: 96%.

Frequency Response: 200 cps—300,000 cps, flat within 1.0 db, and 200 cps—550,000 cps, flat within 3.0 db. Smooth response, no discontinuities.

Dimensions: $2\frac{1}{2}'' \times 2\frac{3}{4}'' \times 2\frac{1}{4}''$ high $+\frac{1}{8}''$ terminals.

Consult Peerless for the best solution to your quality transformer requirements.

PEERLESS
Electrical Products



A DIVISION OF



9356 Santa Monica Blvd., Beverly Hills, Calif. • 161 Sixth Avenue, New York 13, N.Y.

CIRCLE 264 ON READER-SERVICE CARD FOR MORE INFORMATION

New! From John Fluke . . . Precision POTENTIOMETRIC DC VOLTMETER MODEL 801

DIAL the lighted decimal

- Four potentiometric ranges 500, 50, 5, .5 volts
- Accuracy .05% of input voltage from 500 to .1 volts
- Four null detector ranges of 10, 1, .1, .01 volts, full scale
- Infinite input resistance at null
- Eight search and VTVM ranges from 500 to .01 volts
- Five dials and the lighted decimal give you fast, direct read-out

3 4 5 2 3
3 4 5 2 3
3 4 5 2 3
3 4 5 2 3

\$440



The Model 801 DC Voltmeter is a new development in the growing John Fluke line of electronic measuring equipment. Here is a simplified potentiometer. Use it for calibration and stability measurements of regulated power supplies; for instrument calibration; for DC voltage measurements of standard cells, computers, batteries, tube circuits, photocells, thermo-couples, and strain gauges. Use it, too, for calibration of direct current shunts, or, with shunts it becomes a precise current measuring instrument. The .05% accuracy, convenience, and portability of the Model 801 make it the economical and unit-packaged replacement for conventional potentiometers.

Lasting precision is assured in the Model 801 by matched, wire-wound resistors, printed circuitry, and the shock-mounted, thermally-shielded standard cell. The easy-to-use control layout eliminates reading error. Management will see the value of a compact, self-

contained unit that is fast and simple to use, even by unskilled personnel. Here is a portable unit that can serve anywhere in the plant, or it can be taken directly to a fixed installation.

The Model 801 offers every laboratory and production line another John Fluke instrument of high accuracy at low cost. Get the full story . . . write for complete catalog specifications. Or call for a Fluke representative to give you a demonstration in your own plant.



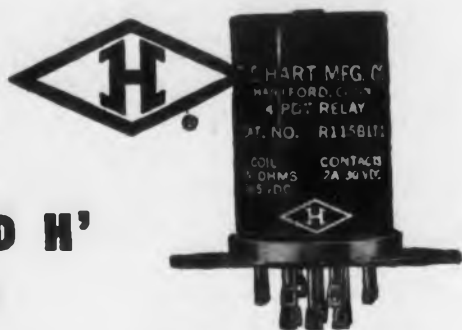
Electronic Tools for Industry

JOHN FLUKE MANUFACTURING CO., INC.

1111 W. Nickerson St., Seattle 99, Washington

CIRCLE 267 ON READER-SERVICE CARD FOR MORE INFORMATION

Versatile 'DIAMOND H' Relays



Handle Many Different Jobs

"Diamond H" Series R hermetically sealed aircraft type relays perform outstandingly over such a broad area that they are frequently used to do many different types of jobs in a given application. For example, they give excellent reliability in dry circuits yet will carry up to 10 amperes in power circuits... or even 20 amperes for reduced life requirements.

Savings inherent in uniform size and mounting arrangements for one relay family can be multiplied by the lower inventory of spare parts needed when a single model is used for two or more functions. Matching or surpassing requirements of USAF Spec. MIL-R-5757B as well as important provisions of MIL-R-25018, tens of thousands of Series R 4 PDT and DPDT relays are in use, engineered for:

Various brackets of vibration resistance from 10 to 2,000 cps, temperature ranges from -65° to $+200^{\circ}$ C, coil resistances from 1 to 50,000 ohms, operational shock resistance of 30, 40 or over 50 "G" and mechanical shock resistance to 1,000 "G", contact capacities from 350 V., D. C., 400 MA, to 10 A., at 30 V., D. C., as well as signal circuits.

For complete information, send for a copy of Bulletin R-250.

THE HART MANUFACTURING COMPANY

210 Bartholomew Avenue, Hartford, Conn.

CIRCLE 270 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC ENGINEERS EVERYWHERE!



● Heed a colleague who never did, and ask for your FREE MUELLER CATALOG of ELECTRIC CLIPS AND INSULATORS. Do it today, while you're still young! You'll make better connections in the future, with this handy illustrated index of electric clips for every type of quick test connection.

We've been making newer and better clips since 1908 and recently designed the world's only truly miniaturized test clip. It's called the "Mini-gator", and is so inexpensive we'll send you a free sample along with the catalog.

THE "MINI-GATOR"



Shown actual size

WRITE FACTORY—FREE "MINI-GATOR" AND CATALOG

Mueller Electric Co.

1580H EAST 31st STREET • CLEVELAND 14, OHIO

CIRCLE 271 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

VHF Receiver

272

R-9903 is a 4-page folder which illustrates and describes the Servoflight R 5200 VHF communications receiver. The receiver combines qualities needed for both communications and laboratory use—wide frequency range, high accuracy, maximum sensitivity, high frequency stability—and provides automatic noise limiter, squelch, continuous tuning without switching and continuous operation. Servo Corporation of America, 20-20 Jericho Tpke., New Hyde Park, N.Y.

Standard Reflections; Coaxial Lines

273

Two data sheets, one on standard reflections and a second on coaxial slotted lines are now offered. The first sheet covers standard reflections for calibrating slotted line impedance meters and standardizing reflectometers in the frequency range of 2600 to 18,000 mc. The second sheet describes Model 230 Type N and Model 230B 7/8 in. coaxial slotted lines of the parallel plane type for the frequency range of 300 to 4000 mc. Both data sheets contain specification tables and prices. Narda Corp., 160 Herricks Rd., Mineola, N.Y.

Resistor Catalog

274

A 20-page catalog, No. LC-1030BX, for the line of wire wound, fixed, accurate encapsulated resistors. The catalog includes a Military Specification tabulation. Information includes line drawings of the products, as well as descriptive tabulations. Aero-vox Corp., Cinema Engineering Div., 1100 Chestnut St., Burbank, Calif.

Brush Springs

275

Data for the design of constant-pressure brush springs for rotating electrical machinery is described in Bulletin 310P. The 20-page illustrated booklet discusses physical and operational characteristics, design principles and application limitations of the spring. Actual brush holder applications are described and illustrated, and complete design procedures and charts are presented. Hunter Spring Co., Neg'ator Div., Lansdale, Penn.

Pulse Transformer

276

Application to a variety of circuit applications is assured design and production engineers in this bulletin on pulse transformers. Different core materials and variations in windings and sizes allow the rapid production of a number of series and types within each series, all encapsulated, to fit many standard circuits. Also offered are custom-wound pulse transformers to fit special circuits such as transistor, printed and military types. Technitrol Engineering Co., 2751 N. 4th St., Philadelphia 33, Penn.

Technical Data

277

Recently released are technical bulletins describing the Model 5692 Digital Flow Meter and Series 5910 Inline Readout. Included in the bulletins are description, basic design, features and specifications. Beckman Instruments, Inc., Berkeley Div., 2200 Wright Ave., Richmond 3, Calif.

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 280 ON READER-SERVICE CARD FOR MORE INFORMATION

flexible couplings with ZERO BACKLASH



Series #1 Actual Size

- precision-made
- low inertia
- high flexibility
- versatile
- long life
- moderate cost
- meet JAN-MIL specs

For exacting requirements, you're sure of best results with precision-made Renbrandt Flexible Servo-Couplings. They have zero backlash and low inertia, and they do not introduce velocity variations between driving and driven shafts. Available in a variety of sizes for 1/16" through 1/2" shafts in all combinations. Widely used for servo-mechanisms, computers, and for all precision applications.

Specify Renbrandt Flexible Couplings. Fast delivery on prototype or production orders. Send for complete catalog.

Renbrandt, Inc.
98B Kirkland Street
Cambridge 38, Mass.

Tel.: TRowbridge 6-6560



Tinymite Coupling Actual Size

Low cost for general application. Thousands of sizes. 1/2" dia. x 11/16" long. For 1/4" and/or 3/16" shafts. No backlash. Insulated.

Renbrandt

CIRCLE 281 ON READER-SERVICE CARD FOR MORE INFORMATION

Instrument Counters

282

Illustrations, descriptions and dimensional data on the "Y" instrument counters are given in Bulletin 400. The instruments can be used as read-out indicators on navigation instruments, missile tracking instruments, radar controls, computers, and for other instrument and electronic applications. The 6-page brochure contains detailed diagrams of 5 counter models and a number of "Y" instrument wheels. Several design considerations are suggested. Durant Mfg. Co., 1993 No. Buffum St., Milwaukee 1, Wisc.

Power and Gas Tubes

283

A revised 24-page booklet on power and gas tubes contains technical data on 175 types. Listed are vacuum power tubes, rectifier tubes, thyratrons, ignitrons, magnetrons, and vacuum-gauge tubes. Each type is covered by a thumb-nail text description, charted dimensions, ratings, operating values, and a base or terminal-connection diagram. Photographs of representative tube types in each family are shown. The price of this booklet, PG101C, is 20 cents. RCA Tube Div., Harrison, N.J.

Subminiature Electrolytics

284

The maximum rated operating temperatures of a line of subminiature electrolytic capacitors has been increased to 85 C. Bulletin 320A gives a complete list of the expanded capacitance ratings in these subminiature transistor capacitors at voltages of from 1 to 50 v dc. Sprague Electric Co., 347 Marshall St., No. Adams, Mass.

Resistors

285

A 4-page brochure on precision wire wound resistors has been issued. The brochure tabulates resistance sizes, wattage ratings and mounting dimensions (length and diameter, terminal thickness and center hole clearance). Tables also show whether resistor style is inductive or non-inductive, and the number of sections of the bobbin. Other information such as resistance wire and operating characteristics is included. DMeter Mfg. Co., Inc., 22024 Larkin Plaza, Yonkers 2, N.Y.

WHAT IS NEEDED by the Manufacturer of Communication Equipment in '57?
READ DESIGN '57—JAN. 1ST ED

For Better Electrical Contacts Contact Makepeace



CROSSBAR FOR MINIATURE RELAYS



SPOT LAY



RAISED LAY—Contact metal and base metal cold rolled to temper

All Makepeace contacts are of the highest quality, corrosion resistant, lasting and made to rigid specifications. Whatever your problem write our engineering department for literature or consultation.

D. E. MAKEPEACE COMPANY
Division of Union Plate and Wire Co.
Attleboro, Mass.

CIRCLE 286 ON READER-SERVICE CARD FOR MORE INFORMATION

New booklet* describes latest uses for Straits Tin in major industries



New booklet contains up-to-the-minute information about one of our most useful metals—Straits Tin from Malaya. Explains how tin's properties help each major industry, gives specific examples of new applications solving manufacturing problems. Sixteen pages, fully illustrated, factual and concise.

Send for your free copy now

*Prepared especially for busy executives, materials selectors, design and production engineers. Your copy awaits your request.

The Malayan Tin Bureau
Dept. 12 L, 1028 Connecticut Avenue
Washington 6, D.C.

Please send me a free copy of the new booklet, "STRAITS TIN FROM MALAYA, Its New Importance to American Industry."

Name and Position _____

Company _____

Street _____

City _____ Zone _____ State _____

CIRCLE 287 ON READER-SERVICE CARD FOR MORE INFORMATION



Effective new shielded room requires no maintenance

Filtron, Inc.—electronic components manufacturer—selected Armorply panels for a shielded room that's easy to assemble, move, or alter in shape with *ordinary labor*. Special compression joints end need for soldering in this room, erected by Shielding, Inc. And Armorply requires no maintenance; gives effective shielding and a neat appearance for decades. (Armorply available with copper, lead, aluminum or other metal faces.) For full information and a free Armorply sample, write: Dept. ED11-15-56.

Weldwood® Armorply®

UNITED STATES PLYWOOD CORPORATION
CIRCLE 290 ON READER-SERVICE CARD FOR MORE INFORMATION

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 291 ON READER-SERVICE CARD FOR MORE INFORMATION

Freeze-Drying Equipment 292

Freeze-drying equipment for laboratories is the subject of a 36-page catalog. Freeze-drying units, vacuum gauges and pumps, bath coolers, refrigerated centrifuges, and related equipment are listed and described. Many of the items are illustrated and all are priced. Arthur S. LaPine & Co., 6001 S. Knox Ave., Chicago 29, Ill.

ESI Short Form Catalog 293

A variety of precision impedance and comparison bridges, decade resistance and capacitance standards, and high linearity decade voltage dividers are described in a recent short form catalog. Included in the 8 pages are illustrations, prices and brief specifications. Electro-Measurements, Inc., 7524 S.W. Macadam Ave., Portland 1, Ore.

Contacts and Metals 294

Complete assemblies, contacts, contact materials and a variety of precious metals are described in a recent catalog. The booklet contains details on solid and clad precious and base metals, industrial metals, electrical contacts, contact parts and assemblies, thermostat metal, thin gauge metals, gold filled, rolled gold plate and others. Metals & Controls Corp., General Plate Div., Attleboro, Mass.

Precision Potentiometers 295

Technical Bulletin 63 covers a number of single and multi-turn wire-wound precision potentiometers in 6 pages. Applications are stated and specifications are set forth in tables. Clearly labeled photographs and diagrams show dimensions and construction. Electromath Corp., 190 Henry St., Stamford, Conn.

Basic Modular Hole Patterns 296

A system for assembling chassis cabinets from mechanically marked, prefabricated forms is outlined in 8-page Catalog A. Modular hole patterns and standard stock items are listed. Illustrations show forms and parts and how they are assembled. Circle Dot Mfg. Corp., P.O. Box 364 Shalvoys Lane, Danbury, Conn.

**WHAT NEW PROGRAMMING METHODS Are
Causing Major Design Changes?
READ DESIGN '57—JAN. 1ST ED**



Licked by a lightweight?

Being knocked out by a pint-sized competitor?

Maybe they are already using **MPB's** *

such as these  BALL BEARINGS ACTUAL SIZE

A postcard will bring you complete data
on 500 types and sizes.

Lead with your left, and write!



MINIATURE PRECISION BEARINGS, INC.
7 Precision Park, Keene, N. H.

CIRCLE 297 ON READER-SERVICE CARD FOR MORE INFORMATION



another
product surprise
from

Helipot...

standard
electromechanical
breadboard parts

We're in full-scale production of a complete new line of Beckman® standard electromechanical breadboard parts... for industry, science, education... wherever there's experimental, developmental or prototype work.

Our new 24-page catalog gives you photos, dimensional drawings, specifications, ordering information, price lists... everything you need for *easy ordering of all your standard electromechanical breadboard parts.*

➔ Why wait? Send for your copy of Catalog 1155

Beckman® **Helipot** Corp., Newport Beach, Calif.
a division of Beckman Instruments, Inc.

816
CIRCLE 298 ON READER-SERVICE CARD FOR MORE INFORMATION

CORNING FIXED GLASS CAPACITORS

available through

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Use Taps to Compensate Potentiometer Loading Errors

BY JACK GILBERT
Norden Laboratories Division,
Norden-Ketay Corporation

Reprinted from August 1956
CONTROL ENGINEERING

Beckman

Hellpot Corp., Newport Beach, Calif.
a division of Beckman Instruments, Inc.

CIRCLE 301 ON READER-SERVICE CARD FOR MORE INFORMATION

Terminal Blocks 302

An entire line of terminal blocks and terminal block kits is set down in Catalog 556. Complete as to technical description, specifications and current prices, the catalog is accompanied by a new selectro chart designed to pinpoint quickly the best block for each application. Suggestions are made for combinations of various types of terminals within the same block for most convenient terminating of high current, control and power circuits. The 8-page booklet includes high pressure solderless connectors, screw type, solder lug, and feed-thru terminals. Curtis Development & Mfg. Co., 3250 N. 33rd St., Milwaukee 16, Wis.

Twist-Mount Capacitors 303

A comprehensive booklet, Form TMR-1, lists all of the firm's twist-mount electrolytic capacitors in 18 pages. The capacitors described are designed for 85 C operation and are available in single, dual, triple and quadruple units. Pyramid Electric Co., 1445 Hudson Blvd., N. Bergen, N.J.

Electronic Equipment 304

A 16-page short form catalog, SF 9901 describes various electronic systems, equipment and components. Included are building blocks, amplifiers, electro-mechanical assembly kits, a spectrum signal generator, infrared radiation standard, dead reckoning tracer, high frequency direction finder, VHF communications receiver, and other instruments. Servo Corporation of America, 20-20 Jericho Tpke., New Hyde Park, N.Y.

Vibration Pickups and Preamplifiers 305

Vibration pickup preamplifier BL-1606 and its vibration pickups BL-4305 are illustrated and described in a 4-page folder. The literature gives detailed specifications and complete data on product design, operation and application. Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

Plastic-Enclosed Thermostats 306

Two thermostats unit types are presented in MC-137, a 4-page illustrated brochure. The units, a standard cartridge-type thermostat and a rectangular model, are encased in plastic for use in highly humid or corrosive environments. Complete specifications for units with current ratings up to 5 amp, 230 v ac are given. Fenwal Inc., Ashland, Mass.

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Junior Sized: 24" x 24" x 34"
Temp. range to 1000°F.

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Model	Internal dimensions	Temperature range
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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



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CIRCLE 311 ON READER-SERVICE CARD FOR MORE INFORMATION

Filter Set

312

A single-page catalog sheet illustrates and describes the 1/3 octave filter set BL-1609. The set consists of 27 flat-topped filters of 1/3 octave band pass width with seven additional filters available as optional equipment. The literature lists specifications and design, and operating and installation information which suggests various applications. Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

Tantalum Electrolytics

313

Aided by graphs and illustrations, Bulletin GEC-808C describes Tantalytic capacitors for low-voltage, ac and dc applications. The 6-page folder gives typical test data and ample application information. A table lists standard ratings. General Electric Co., Schenectady 5, N.Y.

Carrier Amplifier

314

Applications and features of the 1-127 carrier amplifier are set forth in a 4-page bulletin, 1550B. Illustrations and specification tables are included. Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

Tape Converters

315

Two tape recorders—perforated to magnetic and magnetic to perforated—are the topic of an illustrated folder. Each device is discussed with reference to characteristics, applications and performance. Remington Rand Univac, Div. of Sperry Rand Corp., 315 Fourth Ave., New York 10, N.Y.

Precision Potentiometers

316

The single-turn 1-7/16 in. diameter series 5400 precision potentiometer is the subject of Data Sheet 54-44. The sheet is illustrated and lists specifications, construction, coil characteristics and available modifications. Helipot Corp., Newport Beach, Calif.

Ferramic Magnetic Cores

317

Ferramic magnetic cores S-1 and S-3 are treated in Bulletins MT-103 and MT-104 respectively. Graphs and tables are used to show magnetic properties and specifications. General Ceramics Corp., Keasbey, N.J.

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BY WATERMAN



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Since the introduction of Waterman RAYONIC 3MP1 Tube for miniaturized Oscilloscopes, Waterman has developed a rectangular Tube for multi-trace oscilloscopy. Identified as the Waterman RAYONIC 3SP, it is available in P1, P2, P7 and P11 screen phosphors. The face of the Tube is 1 1/2" x 3" and the over-all length is 9 1/2". Its unique design permits two 3SP Tubes to occupy the same space as a single 3" round tube, a feature which is utilized in the S-15-A TWIN-TUBE POKETSCOPE. On a standard 19" relay rack, it is possible to mount up to ten 3SP tubes with sufficient clearances for rack requirements. Thus 3SP RAYONIC tube is ideal for multitrace oscilloscope work.

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Write for 40-page catalog on complete line, containing application examples, specifications, installation instructions and engineering data. Ask for samples, too.

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CIRCLE 321 ON READER-SERVICE CARD FOR MORE INFORMATION

Spring Manufacturing Facilities 322

Special facilities, spring products and the "cross-curving" process used in manufacturing springs are described in a booklet. Illustrated are several steps in spring manufacture, such as tool and die making, precision bench work, strip steel cutting, induction heat treatment for shaping spring ends, laboratory testing and inspection. Sandvik Steel, Inc., Sandsteel Spring Div., Fair Lawn, N.J.

Plastic Injection Molding 323

Facilities for custom plastic injection molding are set forth with text and illustration in a 12-page brochure. Described is equipment for molding polystyrene, acetate, butyrate, polyethylene and other thermo-plastic materials into small precision or very large forms. The Morningstar Corp., 156 Sixth St., Cambridge 42, Mass.

American Standards 324

A booklet tells in 19 pages how standards are made. The history, membership, work, and aims of an organization for this purpose are clearly outlined. The brochure contains diagrams to show the many boards and offices which cooperate in national standardization. A glossary at the back of the booklet defines terms common to standards personnel. American Standards Association, 70 E. 45th St., New York 17, N.Y.

Power Supply and Bridge Control 325

Price, specification and other information on the model 9293-B power supply and bridge control is available in a data sheet. The unit is designed to operate cells for gas chromatography or gas analysis. A photograph and schematic diagram provide illustrations. Gow-Mac Instrument Co., 100 Kings Rd., Madison, N.J.

Gas Chromatography 326

Bulletin 831 describes the model K-3 Kromo-Tog chromatographer. The 4-page brochure offers recommendations for building up the basic unit to suit specialized needs. Illustrated, listed and priced are all needed accessories including fractionating columns designed and coiled for the K-3 and both activated solid and partition type adsorbents for all chromatographic analysis. Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Penna.

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MODEL 3535R

**0-500MA, 0-300V, 0.03% Regulation,
3MV.RMS Ripple, 0.1OHM IMPEDANCE**

Two completely independent supplies. Positive and negative terminals of each supply isolated from chassis. Either end of each supply may be grounded independently. 2 stage DC amplifier for each supply. Both supplies may be stacked in series to give 0-600 volts at 0-500MA. Full 500MA available from each unit over entire range of output voltage. Output voltage continuously variable without switching. Vernier control 5 volts on each supply. 2 AC outputs—6.3V at 10 AMPS each.

Write for complete descriptive literature Dept. PS

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GREEN INSTRUMENT COMPANY

161 Putnam Ave., Cambridge, Mass.

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MODEL 6505A

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5201 Walnut Street Garland, Texas

CIRCLE 331 ON READER-SERVICE CARD FOR MORE INFORMATION

Portable Vibration Meter

332

The type 1-128 vibration meter is featured in Bulletin 1566. Illustrated, the 4-page pamphlet describes the instrument's construction, features, operation and uses and lists specifications in a table. Brief coverage is given to several vibration pickups. Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

Mercury Plunger Relays

333

An engineers' file folder contains complete information on a line of mercury plunger relays and related products. It includes load ratings and contact data, coil characteristics, diagrams and illustrations, and general information. Ebert Electronics Corp., 212-26 Jamaica Ave., Queens Village 28, N.Y.

Tubing Metals

334

Data Memorandum 1 lists 121 metals and alloys used in small diameter tubing. The analyses are grouped into carbon, alloy and stainless steels, nickel and nickel alloys, copper and copper base alloys, glass sealing alloys, reactive metals and nickel cathode materials. Superior Tube Co., 1521 Germantown Ave., Norristown, Penna.

Control Devices for JIC Standards

335

A 12-page publication describes application features of control devices built to meet standards. The illustrated bulletin gives product data on the machine tool relay, oil-tight push button, solenoid, limit switch, magnetic starter, plugging switch, and pneumatic time-delay relay. General Electric Co., Schenectady 5, N.Y.

Performance Testing Facilities

336

A brochure points to a military approved environmental testing facility. Readiness to run functional and qualification tests on electronic, fuel, hydraulic and mechanical components and systems is announced. Parameters, Inc., 195 Herricks Rd., Garden City Park, P.O. New Hyde Park, N.Y.

WHAT ADVANCED COMPONENTS and Assembly Methods are in Sight?

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USE McLEAN CABINET COOLING FANS

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Bandwidth	10 mc	2 mc	10 mc
Voltage Gain	90 db	110 db	90 db
Input Imped.	50 ohms	50 ohms	50 ohms
Input VSWR less than	1.3:1	1.3:1	1.3:1



For further information contact:

INSTRUMENTS FOR INDUSTRY, INC.
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CIRCLE 340 ON READER-SERVICE CARD

Electronic Counters 341

Two frequency meters, a preset counter and a time interval meter receive full-page treatment in a recent folder. In addition to a complete description, there is an illustration, price, and list of specifications given for each instrument. Westport Electric, 149 Lomita St., El Segundo, Calif.

Socket Screws 342

An illustrated folder describes a complete socket screw line in 4 pages. Socket head cap screws, button head socket screws and shoulder screws are listed. Also in the folder are a line of N.P.T.F. pressure plugs available in standard sizes from 1/16 to 1 1/4 in. The Cleveland Cap Screw Co., Box 202, 2917 E. 79th St., Cleveland 4, Ohio.

Attenuator Pads 343

Bulletin 56 is a 2-page list of specifications for the 502 and 503 attenuator pads. These pads cover the frequency range of 1000-10,000 mc and are designed for high power. The bulletin lists prices. Weinschel Engineering, 10503 Metropolitan Ave., Kensington, Md.

Instrument Cases 344

A line of drawn aluminum instrument cases complying with Spec Mil-T-945A and Mil-Std-108C is announced in a 4-page brochure. Illustrations, specifications and tables of sizes combine to describe a variety of types. Instrument Cases, Inc., 510 Garfield St., Glendale 4, Calif.

Recording Oscillograph 345

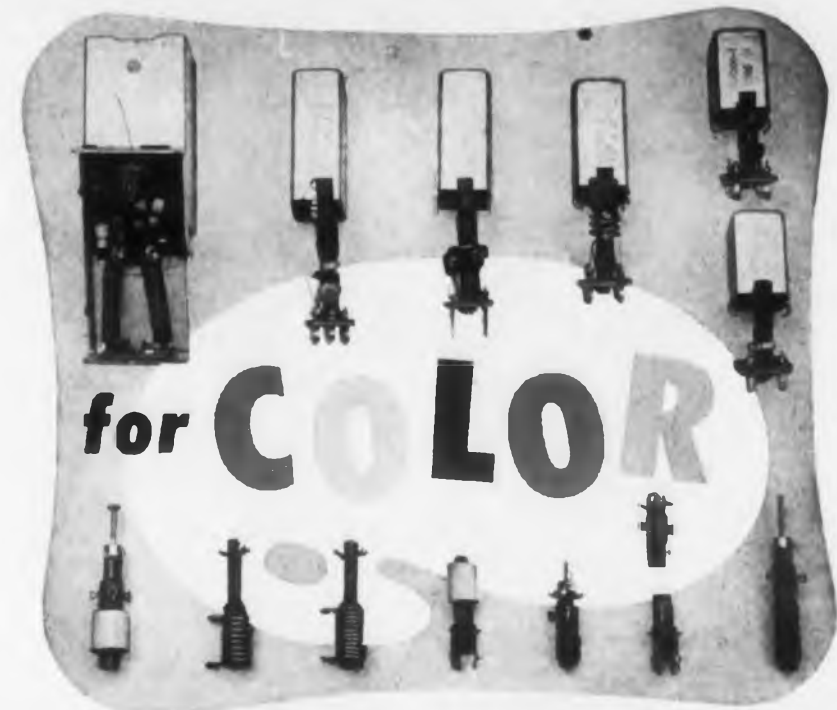
Text, photographs, diagrams, and specification tables give extensive coverage to recording oscillograph 5-114 in a 16-page booklet. The bulletin, 1500D, also describes the series 7-300 galvanometers, related equipment, and repair services. Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

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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.

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Model 2100

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Meets all applicable requirements of the IRE, SMPTE and ASA — \$295.

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830 Galindo Street
All prices f.o.b. Concord, California

Write for specification sheets on the above instruments and the complete Donner line of advanced instrumentation
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Capacitors

351

A 4-page bulletin GEC-1346A, has been issued describing high-frequency Pyranol capacitors, generally designed for power-factor improvement in circuits operating at frequencies from 500 to 12,000 cy per sec. The majority of applications of the high-frequency capacitors are with induction heating equipment for melting, forging and hardening operations. These capacitors are also used for series applications on the load side of a high-frequency generator, where they supply a reactive component to the generator windings and tend to neutralize its reactance. General Electric Co., Schenectady 5, N. Y.

Potentiometers

352

A 20-page 1956 precision potentiometer catalog has been released and prepared as a complete technical digest of the company's line of precision potentiometers. There is an introductory section giving details on engineering, laboratory and production facilities and five separate product sections. Detailed description, technical data, dimensional drawings, specifications alternates and power rating curves are included.

The Gamewell Co., Precision Potentiometer Div., Newton Upper Falls, Mass.

Flexible Plastic Tubing

353

A 28-page manual T-97 gives formulations on Tygon flexible tubings and cites the applications and limitations of each. The illustrated booklet has charts and tables giving physical properties and chemical resistance, 63 bore and wall size combinations, available lengths and packaging data. The U.S. Stoneware Co., Plastics & Synthetics Div., Akron 9, Ohio.

Chart of Epoxy Resins

354

A complete chart has been published giving physical and electrical data of formulated epoxy resins which include 27 systems. Included in the chart are room temperature set, heat cured, filled, unfilled, resilient and rigid resins. Noteworthy is the multiple choice of hardener for several epoxy resin systems, offering fast or moderate cure, with and without safety hardeners. Furane Plastics, 4516 Brazil St., Los Angeles 39, Calif.

Ball Bearings

35

A 30-page reference catalog has been published describing small precision instrument ball bearings. The manual, written by Ralph S. Blanchard, Jr., Professor of Mechanical Engineering, Northwestern University, stresses such considerations as types of bearings available, materials, components, engineering standards, tolerances and the computation of dynamic and static loads. An outstanding feature is a series of Engineering Bulletins bound into the back which give detailed information normally obtainable only by factory correspondence. Shattuck, Clifford & McMillan, Inc., 143 Newbury St., Boston 16, Mass.

DC Power Supplies

356

A booklet has been published describing fixed-output constant voltage dc power supplies. The illustrated booklet gives technical data for six, standard-design, regulated dc power supplies for intermittent, variable, and pulse loads, or high-amperage loads. These dc power supplies combine a constant voltage transformer, a germanium power rectifier and high-capacitance filter without choke. Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill.

Metrology

357

Three papers presented at the Symposium on Engineering Dimensional Metrology in England have been reprinted. The subjects discussed are large scale metrology, working on engineering dimensional metrology at the National Physical Laboratory, and a new precision internal measuring machine. Engis Equipment Co., 431 S. Dearborn St., Chicago 5, Ill.

Caloric-Flowmeter

358

A 4-page brochure describing function, construction, and operation of the electrocaloric flowmeter listing the advantages of this instrument has been issued.

A cut-away view illustrates the construction of the smooth-bore flow cell while a simple diagram shows the principles of operation. Standard sizes and materials are listed and complete mechanical and electrical specifications are furnished. Industrial Development Labs., Inc., 17 Pollock Ave., Jersey City 5, N. J.

Plug-In Components 359

A 4-page quick index guide covering basic components for plug-in unit construction. This illustrated booklet contains a complete series of hardware components necessary to mount, house, fasten, connect and monitor electronic or electrical circuitry, and gives complete prices and specs on each component. Alden Prods. Co., 117 N. Main St., Brockton 64, Mass.

Process Instruments 360

Process instruments for precision analysis, measurement and control are covered in bulletin 491. An electrolytic hygrometer, infrared analyzer, leak detector, flow colorimeter, micro-microammeter, gas analyzer and the pH control systems and 111 data system are illustrated and described in 4 pages. Beckman Instruments, Inc., 2500 Fullerton Rd., Fullerton, Calif.

Molded Plastics 361

An 8-page booklet has been published on the properties, applications and manufacture of molded plastics. Included in the booklet are a comparison table of characteristics and applications, specification tables, and illustrated descriptions of a variety of appliances and molding facilities. General Electric, 1 Plastics Ave., Pittsfield, Mass.

Magnetic Memories 362

Technical bulletin MM-1 is the first of a series of articles on ferramic square hysteresis loop materials for design, development and production personnel. The bulletin covers basic operation of magnetic cores, operation of coincident current memory, and operation with reference to a particular core. Diagrams are included. General Ceramics Corp., Keasbey, N.J.

Precision Potentiometers 363

Recently published is a pictorial bulletin which traces the growth of electroplating techniques. The bulletin gives the metal finishing requirements of the electronics, electrical, aircraft, and bearing industries and contains a list of Federal specifications for which the company is approved. The Summit Finishing Co., Thomaston, Conn.

Standard Alternators 364

Designed for field maintenance personnel, a 6-page folder has been released describing the simplified step-by-step maintenance and repair procedures of standard alternators. The illustrated booklet also offers design, operating and application information on the alternator. 14 steps are pictured, with detailed text supplementing each photograph. Other illustrations show alternators installed. Leece-Neville Co., 1374 E. 51st St., Cleveland 3, Ohio.

Non-Activated Liquid Rosin Flux 365

A 2-page technical bulletin gives a complete description of the No. 100 non-activated rosin flux, its uses and properties, and methods of application. Included is a graph showing the concentration-density relationship of the 100 and 400 flux thinners. Alpha Metals, Inc., 56 Water St., Jersey City, N.J.

Metal Fasteners 366

Purchasing data for a variety of bolts, nuts, screws, washers and other metal fasteners is listed in a revised catalog. Also included are extensive listings of standards, weights, design and other information of interest to the metal fastener buyer. Sterling Bolt Co., Chicago, Ill.

Balanced Mixers 367

Catalog No. C-756 describing microwave components and balanced mixers. The 12-page catalog included diagrams and a simplified method of ordering standard balanced mixers and mixer elements. Microwave Development Labs., Inc., 92 Broad St., Babson Park, Wellesley 57, Mass.

Glass 368

"Primitive Art To Improve Today's Products," a 4-page bulletin recently issued illustrates the application of decorative glass. It discusses the four major points designers should know when considering decorative glass for product restyling-dramatic 3-D decoration, deluxe decoration, colorful cold colors and tempered glass for all applications. Croname Glass Studios, 3701 N. Ravenswood Ave., Chicago 13, Ill.

Kearfott FERRITE MICROWAVE COMPONENTS

KEARFOTT FERRITE DUPLEXERS

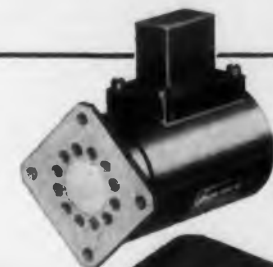
Improvements in recovery time, reduction in insertion loss and excellent magnetron isolation are performance benefits offered by Kearfott Ferrite Duplexers — designed to meet specific radar space requirements.



A Faraday rotation type unit is illustrated. A type and configuration is available for your requirements.

KEARFOTT FERRITE ISOLATORS

For superior performance KEARFOTT ISOLATORS custom designed to fit the exact combination of characteristics, available space and configuration for your radar system. For high or low power — for broad or narrow band use and with db ratios of isolation to insertion up to 150 to 1.



FARADAY ROTATION ISOLATOR



DIFFERENTIAL ABSORBER ISOLATOR



DIFFERENTIAL PHASE SHIFT ISOLATOR

Kearfott offers 3 types of Ferrite Isolators to assure the optimum performance of all microwave applications.

KEARFOTT FERRITE ATTENUATORS AND SWITCHES

Ferrites offer new circuit possibilities and product improvement for AGC and electronic switching of R.F. energy. Kearfott designs, precisely tailored to your most exacting requirements, assure maximum performance and reliability with minimum weight.



The 30 db variable attenuator illustrated, requires less than 3 watts control power.

Write for information on multi-purpose R.F. Test Sets. Available from stock — for X-Band, Ku Band and C Band

Kearfott's complete Microwave engineering and fabrication facilities are at your command. Inquiries on your Microwave problems will be treated in confidence.



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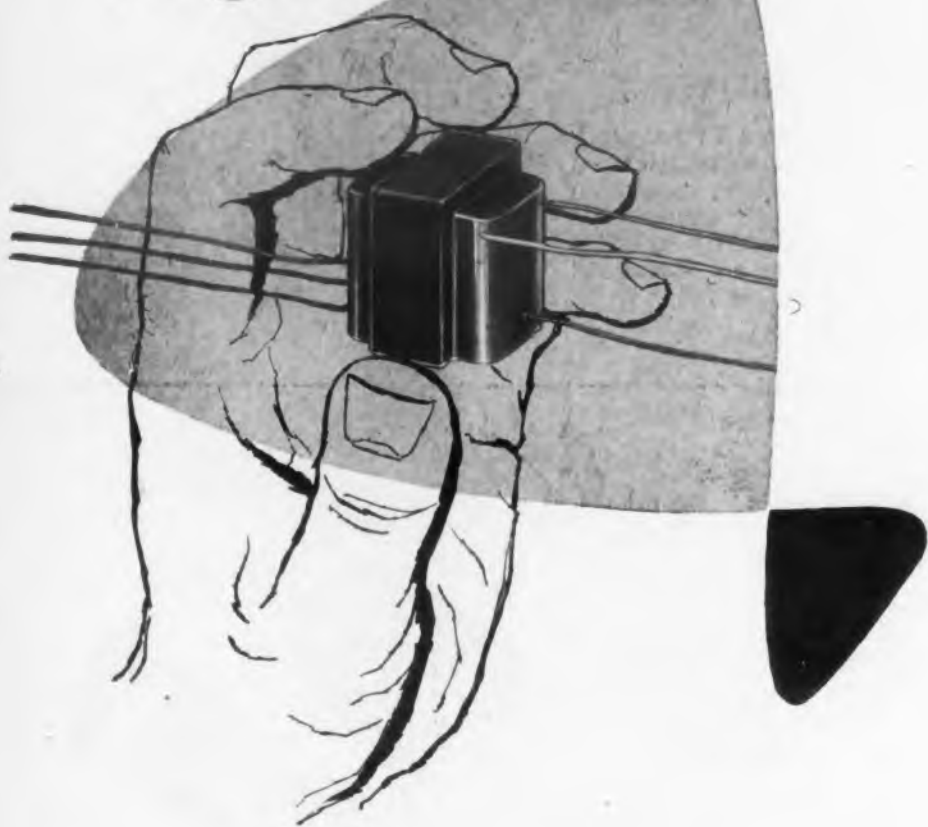
MIDWEST OFFICE
188 W. Randolph St.
Chicago, Ill.

SOUTH CENTRAL OFFICE
6115 Denton Drive
Dallas, Texas

CIRCLE 369 ON READER-SERVICE CARD FOR MORE INFORMATION

HEY!

...know a good place
to get EPOXYS?



Wheeler's new epoxy resin cast electronic components...including inductors, transformers, and subminiature assemblies of tuned circuit elements...offer the following specific advantages:

- Extremely wide ambient and internal temperature tolerance.
- Exceptional mechanical and physical stability...freedom from cracking, deformation, chemical or physical changes, and deterioration under service conditions.
- Exceptional electrical properties without tendency to deteriorate.
- High resistance to humidity, chemicals and other contaminants.
- Flexible leads and/or terminals.
- Elimination of hermetically sealed cans.
- Elimination, in many cases, of mountings.
- Further steps in miniaturization.

Wheeler's equipment for the casting of epoxys complements already very complete engineering and production facilities in the field of custom transformers, coils, amplifiers and electronic assemblies for military and civilian service. Here is your logical source for both development assistance and experienced production.

THE WHEELER 
INSULATED WIRE COMPANY, INC.
Division of Sperry Rand Corporation
1131 EAST AURORA STREET • WATERBURY 20, CONNECTICUT

CIRCLE 370 ON READER-SERVICE CARD FOR MORE INFORMATION

Molybdenum Compounds 371

Bulletin Cbd-9 has been published summarizing all available information on the formation, formula, chemical properties, and uses of organic complexes and organometallic compounds of molybdenum. The bulletin lists 30 poly-basic organic acids and polyhydroxyl compounds which form complexes with molybdate salts or oxides. Thirty-two references to sources of more complete information. Climax Molybdenum Co., Dept. 1, 500 Fifth Ave., New York 36, N. Y.

Fluxes And Solders 372

A 4-page folder has been issued which simplifies the proper selection of corrosive and non-corrosive fluxes for all metal joining from alnico to zinc. Included in the folder are a flux selection chart that pinpoints the right flux for the specific metal, plus detailed tables of ASTM Standard Solders and Fed. Specifications for soft solders. Anchor Metal Company, Inc., 244 Boerum St., Brooklyn 6, N. Y.

Mass Spectrometer for Gases 373

Bulletin 488 has been published containing information on RF Gas Analyzer. The unit is described as a compact mass spectrometer which combines analytical versatility, and simplicity with ease of operation, portability and performance. Important basic information in exploratory work such as oil well mud logging and pilot plants are just a few of the many uses of interest to engineers. Beckman Instruments, Inc., Scientific Instruments Div., Fullerton, Calif.

Standards 374

A 56-page booklet recently published describes wiring, power switchgear, radio, electrical measuring instruments, rotating machinery, transformers, regulators and reactors, electron tubes, conduit components for electronic equipment and preferred voltage ratings. American Standards Association, 70 E. 45th St., New York, N. Y.

**Portable...
Versatile...
Temperature
Test Chamber**

**MODEL TC-2
TEMPERATURE
TEST CHAMBER**

**\$550.00
F.O.B. LOS ANGELES**

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CORPORATION**
12411 W. Olympic Blvd.
Los Angeles 64, Calif.

For ambient temperature tests in the LABORATORY or on the PRODUCTION LINE, the Model TC-2 Temperature Test Chamber is ideal. Interchangeable extra test trays may be ordered to eliminate loading delays in continuous production tests, or for convenience in special test work.

Range: -65° to +350° F.
Heater: Electric strip heater
Coolant: Dry ice, 15 lbs. capacity
Control: Adjustable thermostat & selectable heat inputs
Load Capacity: 600 cubic inches of test materials
Power: 115V, 5 amp. 50-60 cycle
Overall Size: 48" x 16½" x 12"
Weight: 62½ lbs.

CIRCLE 375 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistors 380

Bulletin B-4 has been published describing deposited carbon resistors. The 4-page catalog includes data on construction, applications, types, dimensions, performance and tolerance. Also included are charts and graphs. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Timers 381

An 8-page brochure has been issued with current information and specifications describing the company's standard line of electronic timers. Included in this line are delay, and repeat cycle, and interval timers. G. C. Wilson & Co., 1915 Eighth Ave., Huntington, W. Va.

Relays 382

A 20-page relay sales catalog, C-7, has been issued showing a broad range of relay types of most manufacturers. Types include telephone, keying, midget, hermetically sealed, steppers, motor starters, timers, and sensitive relays in practically all popular contact arrangements and coil ratings. Relay Sales, Inc., Box 186, W. Chicago, Ill.

Germanium Diodes 383

Bulletin No. G-60 has been issued describing subminiature gold bonded germanium glass diodes. The units are hermetically sealed and resist contamination of moisture and have welded junctions to insure stable characteristics. Radio Receptor Co., 240 Wythe Ave., Brooklyn 11, N. Y.

Technical Language Glossary 384

A glossary of technical terms which describes the technology of coating blueprint and diazotype reproduction papers has been published by the Association's Research and Standardization Committee. National Association of Blueprint & Diazotype Coaters, 1001 Connecticut Ave., N. W., Washington 6, D. C.

Precision Metal Finishing 385

Recently published is a pictorial bulletin which traces the growth of electroplating techniques. The bulletin gives the metal finishing requirements of the electronics, electrical, aircraft, and bearing industries and contains a list of Federal specifications for which the company is approved. The Summit Finishing Co., Thomaston, Conn.

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

Watch for further
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**Wayne
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Specialists in
RF Measurement

Exclusive Sales & Service in U.S.A.

MARCONI Instruments • 44 NEW STREET • NEW YORK 4, N. Y.

CIRCLE 386 ON READER-SERVICE CARD FOR MORE INFORMATION

BRIEF SPECIFICATION:

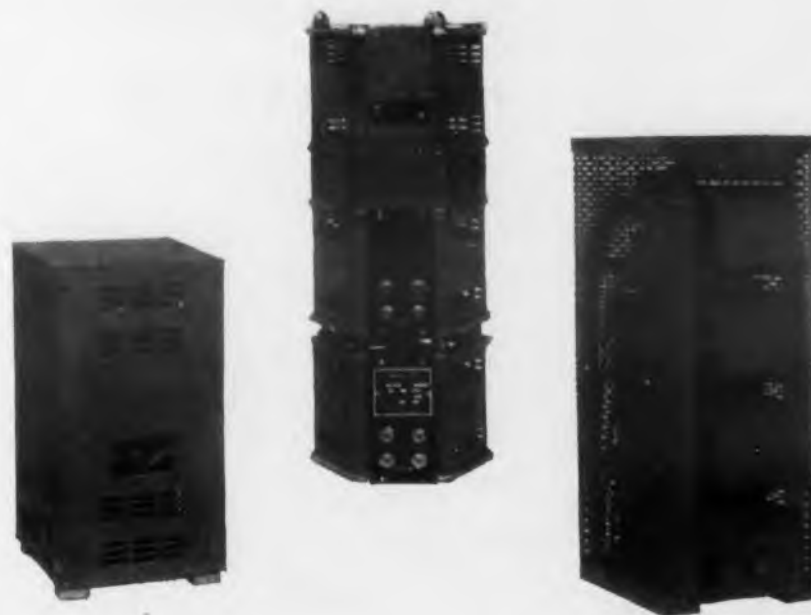
Frequency range: 8690-9840 Mc
VSWR: better than 1.1:1
Insertion loss: 0.1 db
Power range: 10-200 watts, mean.
Accuracy: $\pm 2\%$

PRICE \$1450.

Immediate Delivery

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 387 ON READER-SERVICE CARD FOR MORE INFORMATION

Shallcross

for **precision resistors**

SINCE 1929

AKRA-OHM Precision Wirewounds



Bulletin L-35

High-quality, yet moderately-priced precision resistors suitable for the majority of applications. Reverse-pi wound on accurately-machined ceramic bobbins. Coated, if desired, with moisture-resistant varnish. Std. tolerance—1%, 0.5%, 0.25%, 0.1%, and 0.05%. Meets MIL-R-93A. Five mounting styles available.

"P" TYPE Encapsulated Wirewounds



Bulletin L-30

Small, hermetically-sealed resistors at a truly low price. Unmatched stability for critical applications. Std. tolerance—same as Akra-Ohm types above. Meet and exceed MIL-R-93A requirements including salt water immersion tests. Radial leads, axial leads, or lug type terminals.

CASTOHM® Ceramic Power Resistors



Bulletin L-29

Unusually light-weight wirewound power resistors with a unique integral core and coating having exceptional resistance to thermal shock and excellent heat conductivity. Ten humidity-resistant, tab-terminal styles available with ratings from 8 to 225 watts at 350°C. hot-spot. Meet MIL-R-10566, Amendment 1.

CMP and MP Miniature Power Wirewounds



Bulletin L-36

Lead-mounting, miniature power wirewounds for crowded chassis or printed circuits. MP types enclosed in a Fiberglass sleeve and coated with silicone-impregnated ceramic. CMP types encased in ceramic tube with ends hermetically sealed with silicone cement. Designed to MIL-R-26B. 3 to 10 watt sizes available.

SPECIALS



Bulletin L-37

Hermetically-sealed Steatite resistors, Ayrton-Perry resistors, high-voltage surge resistors, card-type resistors, multi-section bobbin resistors, and many other special types are regularly produced to individual specifications.

SHALLCROSS MANUFACTURING COMPANY, 524 Pusey Ave., Collingdale, Pa.

CIRCLE 390 ON READER-SERVICE CARD FOR MORE INFORMATION

X-Ray Diffraction

391

A 4-page brochure has been released discussing the basic theory (Bragg's Law), definitions, analytical advantages and applications in metallurgy, chemistry, mineralogy, physiology, pathology and biology. Included are typical patterns of fundamental methods of crystal study—Laue, rotating crystal, and powder method. Two x-ray diffraction units are illustrated to describe the "building block" principle for acquiring the unit. General Electric, X-Ray Dept., Milwaukee 1, Wisc.

Aluminum Alloys

392

A 176-page booklet, "Alcoa Aluminum Handbook," has been issued which presents data on aluminum alloys and mill products in an easy-to-read tabular form. The reference handbook contains information essential to a manufacturer on aluminum and alloy standards as well as properties, sizes, and tolerance of mill products usually produced for them. Aluminum Co. of America, 1501 Alcoa Building, Pittsburgh 19, Pa.

Optical Supplies

393

A catalog has been published describing a line of miniature taps, dies, screws, drills, and tools. The catalog contains dimensional data on all popular sizes from the range of 56 to 160 threads per in. as well as prices of stock items and an outline of their special order facilities. Engineers working with small threads will find this information interesting. J. I. Morris Co., 394 Elm St., Southbridge, Mass.

Nameplates

394

A 4-page brochure has been published describing a new method of manufacturing nameplates. The process etches markings through enameled surfaces. The process was designed and engineered to comply with military standards and will withstand 300 cycles on the taber abraser with a CS-17 Calibrase wheel carrying a 1000 gram load. Photo Chemical Products, 4790 Walton Ave., New York 51, N. Y.

fully engineered packaged power supplies

--ready-to-install components



Model 3-150X
Output: 200-300 V.D.C.
0-150MA



Model 1-20X
Output: 150 V.D.C.
0-20 MA



Model 4-200X
Output: 300-400 V.D.C.
0-200MA

dressen-barnes sub-chassis mounting units

The Model "X" regulated power supplies save designing time... are easily and quickly installed... cost less than units you can build yourself. Quality Dressen-Barnes construction, and freedom from maintenance. Eight stock models available in outputs from 100-500 V.D.C. . . . current from 20-300 MA —and each model has an adjustable output range. Ripple on all models is below 10 MV. Specials built to your order.

Write for literature on Model "X" units.

dressen-barnes

DRESSEN-BARNES CORP., 250 N. Vinedo Ave., Pasadena 8, Calif.

CIRCLE 395 ON READER-SERVICE CARD FOR MORE INFORMATION

Bobbins and Washers 400

A 4-page technical bulletin has been issued containing maximum and minimum wall thicknesses, core lengths and sizes, and flange sizes on nylon bobbins; and maximum and minimum thicknesses, outer and inner diameters, and tolerances on nylon washers for a wide range of electrical uses. Sample bobbins and washers will be sent with each catalog. Cosmo Plastics Co., 3239 W. 14th St., Cleveland 9, Ohio.

Diodes 402

Catalog 56S, an 8-page brochure contains information useful to the standards engineer, designer and purchasing agent for silicon diodes. In addition to 56S, two new sheets describing the new IN53A broad-band, high burnout millimeter detector and MA-571 barreter for accurate millimeter power measurements are inclosed. Microwave Associates Inc., 22 Cummington St., Boston 15, Mass.

Microwave Tubes 403

A new brochure has been offered describing a line of microwave tubes and equipment. Included are specifications for various microwave gas control tubes, together with a description of each and its application. Illustrations of the test equipment are also included, plus a description and uses for each piece of equipment. Roger White Electron Devices, Inc., 4th Ave., Haskell, N.J.

Wire Wound Resistors 401

Catalog data bulletin B-5 has been offered giving comprehensive data on types, construction, tolerance, dimensions, temperature coefficient, derating, etc., of the series BW insulated wire wound resistors. Included in the description are detailed charts and graphs. International Resistance Co., 401 N. Broad St., Philadelphia, Pa.

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 405 ON READER-SERVICE CARD FOR MORE INFORMATION

* build
reliability into
every circuit

Specify *BIRTCHER KOOL KLAMPS (T.M. REG)

MATERIAL
Heat treated silver alloy or Beryllium #25.

FINISH
Silver none—beryllium copper silver plated to Navy Spec. 46P5.

SIZES
Modifications available for all sub-miniature and miniature tubes and components.

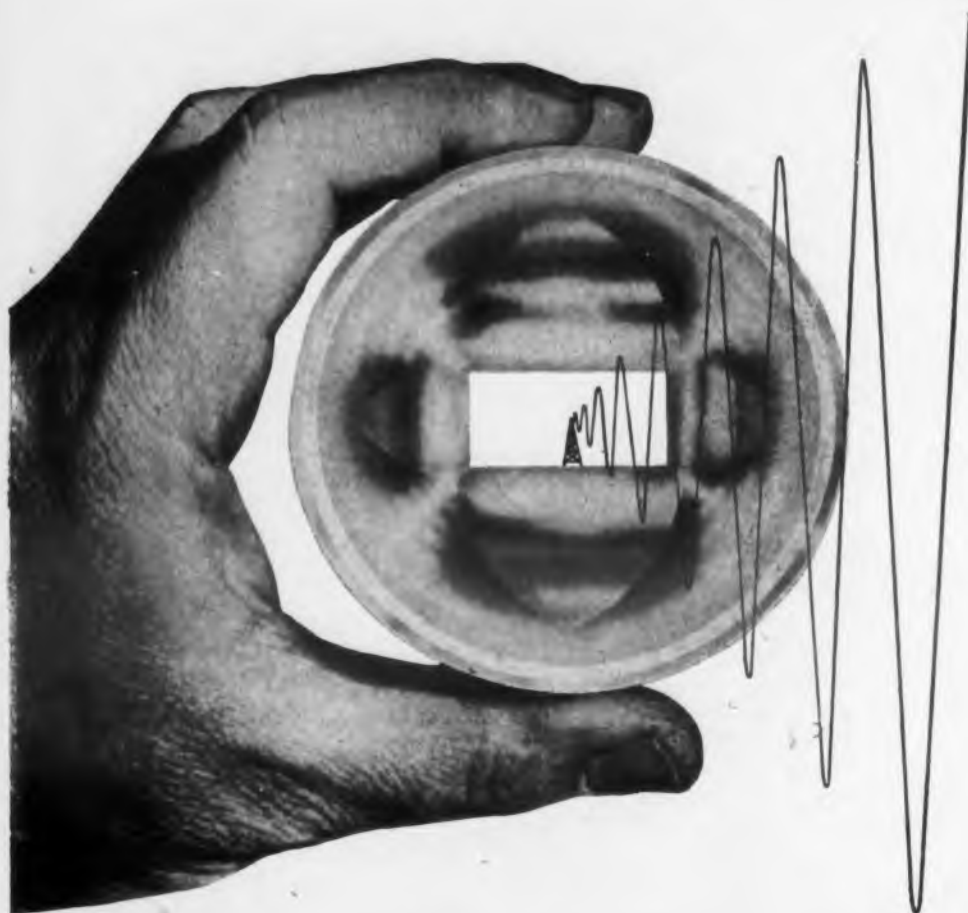
Excessive heat is the number one cause of tube failure. Birtcher KOOL KLAMPS, made of 99½% pure tempered silver, can reduce tube temperatures by as much as 40° C while holding them secure against shock and vibration. Available also in beryllium copper where temperature is less critical.

THE BIRTCHER CORPORATION

INDUSTRIAL DIVISION	4371 Valley Blvd., Los Angeles 32, Calif.
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Write for catalog

CIRCLE 404 ON READER-SERVICE CARD FOR MORE INFORMATION



for your waveguides • transitions • couplers

look into **GAR-FORMING** from a microwave point of view

You'll see this unique part-forming process gives you the fine surface finish and absolute accuracy that keeps transition losses low and gives identical characteristics, part for part.

Gar-forming is an advanced electroforming process. It produces intricate internal shapes with an inside precision and finish unobtainable with any other method. For the first time, it makes it possible to produce a wide variety of solid and thin-wall parts in configuration and materials that are particularly suitable for microwave components. The price of Gar-forming is equally low for experimental, prototype, or production runs. Send us your specifications — we'll be glad to demonstrate the advantages of Gar-forming in your particular application.



Send today for full information **GAR PRECISION PARTS, INC.**
5 LUDLOW STREET, STAMFORD, CONNECTICUT

CIRCLE 410 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistor Hearing Aids 411

Technical Bulletin No. 7 provides designers of transistor hearing aids with specifications and other vital information.

The energizers for transistor hearing aids are depolarized with mercuric oxide. This permits the energizers to deliver an unusually high output per unit volume. Physical and chemical properties are discussed. National Carbon Co., 30 E. 42nd St., New York 17, N. Y.

Self-Clinching Fasteners 412

Bulletin CL-356 has been made available describing a line of load-carrying threads which can be obtained in thin steel, brass, copper or aluminum sheets, with self-clinching nuts. Installed in drilled or punched holes with standard tools, the nuts are available in a wide range of thread sizes and types. Penn Engineering & Mfg. Co., Doylestown, Pa.

Grooving Machines 41

Illustrated Bulletin 76-C, has been published, presenting the modernized Model No. 48-U universal power grooving machine. Full details and specifications for this machine as well as for the hand operated and giant power groovers are included along with step-by-step illustrations of single and lock seaming. Niagara Machine & Tool Works, 683 Northland Ave., Buffalo 11, N. Y.

Products For Research 415

A new Catalog Digest has been offered describing the company's products for research, development, and production. Described are the instruments designed for applications requiring accurate high speed spectrum or waveform analysis. Each instrument is illustrated. Panoramic Radio Products, Inc., 9 So. Second Ave., Mount Vernon, N.Y.



Fastest Voltage Regulator Available THE CURTISS-WRIGHT LINE REGULATOR

The Curtiss-Wright Model EE 100 Distortion Eliminating Voltage Regulator provides faster recovery time than any other regulator on the market—less than 1/50th cycle, or 330 microseconds. It also reduces typical power line distortion to less than 0.3%. Capacity is 1.4 KVA.

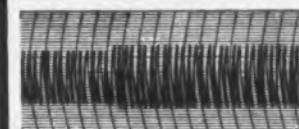
Now being installed in a rapidly growing number of laboratories and production test departments, it provides simpler, more accurate calibration of meters, better design of transformers, synchros and motors . . . easier testing with fewer rejects, more accurate measurement of magnetic properties and receiver sensitivity . . . better a.c. computer performance, elimination of fast line transient effects. Write for details.

Electronic Component & Instrument Sales Department

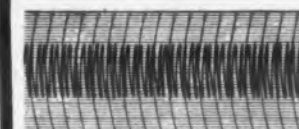


CIRCLE 416 ON READER-SERVICE CARD FOR MORE INFORMATION

Simultaneous recordings of response to step change in 60 cps voltage.



Typical electromechanical regulator output. Recovery time over 4 seconds.



Curtiss-Wright DEVR output. Full recovery 330 microseconds.

Ceramic Capacitors 420

A 6-page catalog describing the line of ceramic capacitors has been announced. Rigidly inspected, to ensure that electrical properties are maintained, ceramics are intended for use in circuits where capacitance must not change with changes in temperature such as in critical rf tuning and resonant circuit applications. Skottie Electronics, Inc., Peckville, Pa.

Wire Wound Resistors 422

A catalog has been made available describing the super Davohm encapsulated precision wire wound resistors. Included are charts on resistance change vs temperature change of various alloys, wattage derating curves, and illustrations of the various resistors (miniature, military, lug and axial types) in the line. The Davenco., Livingston, N.J.

Electrolytic Grinding 421

Engineering Bulletin No. 300 has been released for electrolytic grinding. Titled "Suggestions for Modification of Standard Grinding Machinery To Anocut Electrolytic Grinding Equipment," it outlines the procedures in adapting any standard grinder. It is complete with cutaways, views and parts recommendations. Anocut Engineering Co., 631 W. Washington Blvd., Chicago 6, Ill.

Embossed Metals 423

A 4-page bulletin, "CroRoto Embossed Pattern Metals For Contemporary Design," has recently been issued. This bulletin discusses the use of stock embossed patterns for decorative trim and functional metal parts illustrating some of the many patterns available. It describes production facilities and finishes recommended. CroRoto Division, Croname, Inc., 3701 N. Ravenswood Ave., Chicago 13, Ill.



Metal Case
(Type 908)

Fairchild now gives you a choice of metal or phenolic case 10-turn precision potentiometers. The rigidity of metal case construction provides *maximum* life and sustained accuracy. The phenolic case units offer the high accuracy and reliability needed to meet normal life requirements at a lower cost. To select the best unit for your application, write for more information on both metal and phenolic case potentiometers today.

TWO NEW 7/8", TEN-TURN POTENTIOMETERS

Fairchild Type 907 Phenolic and Type 908 Metal Case Precision Potentiometers are 7/8"-diameter units with 3600° electrical rotation. Type 907 has a linearity range of 0.1% to 0.50%; Type 908 has a linearity range of 0.05% to 0.25%. Both are rated at 2 watts at 40°C. Standard units rated to +85°C; higher temperature requirements can be obtained on special order. Resistance ranges from 100 to 100K ohms.



Phenolic Case
(Type 907)

Write: Dept. 140-79N, Fairchild Controls Corp., Components Division, 225 Park Avenue, Hicksville, Long Island, New York. West Coast: 6111 E. Washington Blvd., Los Angeles, California.

FAIRCHILD
PRECISION POTENTIOMETERS
and COMPONENTS

CIRCLE 424 ON READER-SERVICE CARD FOR MORE INFORMATION



Whether you're designing a new product or redesigning an existing one, chances are that the Acro switches can ease your path. You see, no other line of snap-action switches comes in so many standard types. Hence, you can, in all probability, profit from the important savings of being able to use a production line Acro switch for your special needs. Too, there may be the opportunity to improve your products' performance . . . to solve production bottlenecks . . . to lower costs. Why not find out today? Write us and one of our sales engineers will call.

ACRO-
SNAP ACTION
micro-switches
Can Meet Most Requirements

OFTEN REDUCE COSTS, TOO

Write for
CATALOG

This 36-page switch catalog belongs in every design engineer's file. It gives operating characteristics, dimensions and other specifications for nearly 100 types of Acro switches. Write for your copy today.



The Biggest Line of Little Switches

ACRO SWITCH DIVISION

ACRO
MANUFACTURING COMPANY



COLUMBUS 16, OHIO

Plants at Columbus and Hillsboro, Ohio

REPRESENTATIVES IN ALL PRINCIPAL CITIES

CIRCLE 425 ON READER-SERVICE CARD FOR MORE INFORMATION



The NEMS-CLARKE Shieldmounts, designed and manufactured by us, have become the standard for the industry. All types are recommended by equipment manufacturers because of these features: Spring temper phosphor bronze, obtainable silver plated, blackened or unfinished • perforated for riveting directly to chassis or terminal board • excellent heat dissipating qualities.

NEMS-CLARKE has the facilities to design and produce equipment to your specifications.

NEMS CLARKE

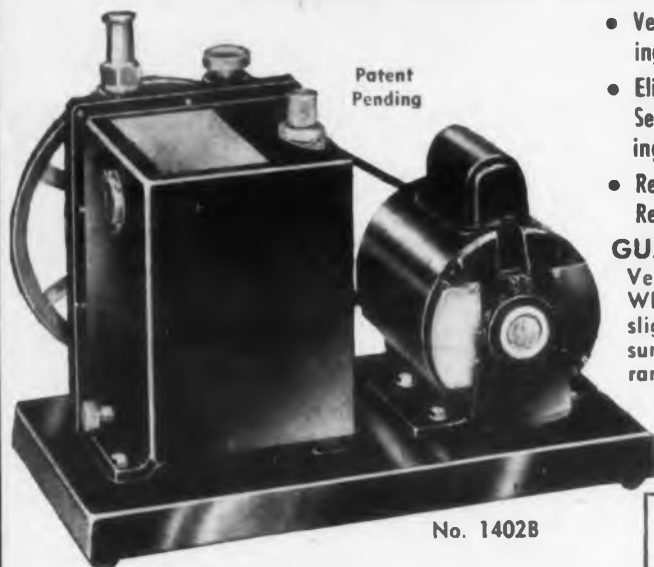
Incorporated
919 JESUP-BLAIR DRIVE SILVER SPRING, MARYLAND

For further information write Dept. T-3

CIRCLE 429 ON READER-SERVICE CARD FOR MORE INFORMATION

LARGE CAPACITY — HIGH VACUUM DUO-SEAL PUMP

TWO-STAGE CONSTRUCTION WITH
VENTED-EXHAUST
AVAILABLE WITHOUT EXTRA COST



Patent Pending

No. 1402B

- Vented Exhaust Permits Pumping of Most Condensable Vapors
- Eliminates Use of Traps or Oil Separators in Systems Containing Water or Other Condensables
- Reduces Number of Oil Changes Required

GUARANTEED VACUUM

Vent closed, 0.1 micron. When the vent is open, only slightly higher ultimate pressures result—usually in the range of 1 micron.

FREE AIR CAPACITY

140 liters/minute
(5 cubic feet)

Illustration shows the 1402B Duo-Seal Pump equipped with Vented Exhaust.

PAT. NO. 2,337,849
1402B. DUO-SEAL VACUUM PUMP, Motor Driven. For 115 Volts, 60 Cycles, A.C. Each, \$310.00

1402C. DUO-SEAL VACUUM PUMP, Motor Driven. For 230 Volts, 60 Cycles, A.C. Each, \$310.00

1402D. DUO-SEAL VACUUM PUMP, Motor Driven. For 115 Volts, D.C. Each, \$380.00 For attached Belt Guard, add \$17.50 to above price.

1402. DUO-SEAL VACUUM PUMP. Unmounted. With pulley, but without motor, belt, or base. Each, \$240.00

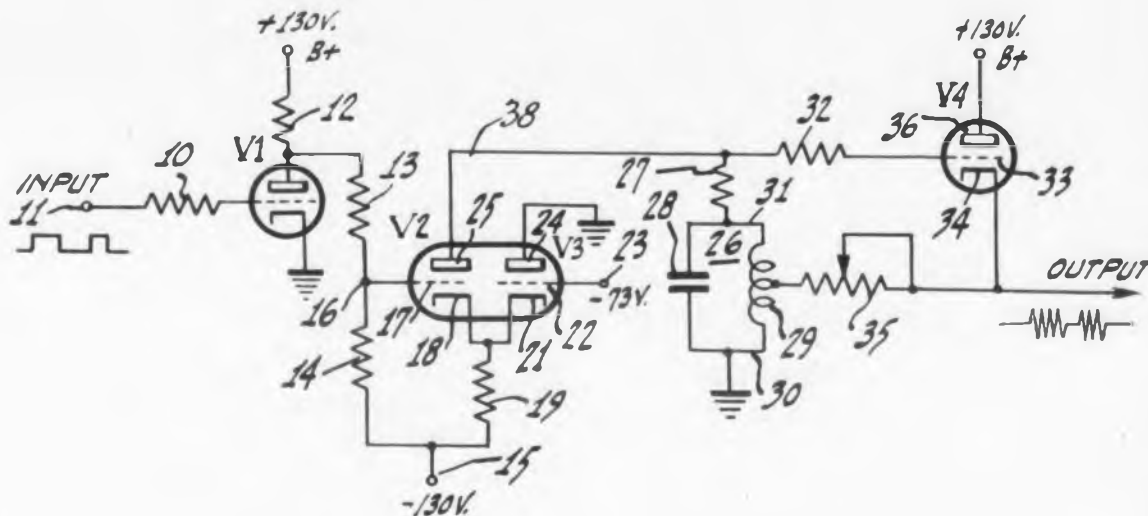
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Patents



Pulsed Oscillators

Patent No. 2,741,701 J. S. Harris (Assigned to Radio Corp. of America)

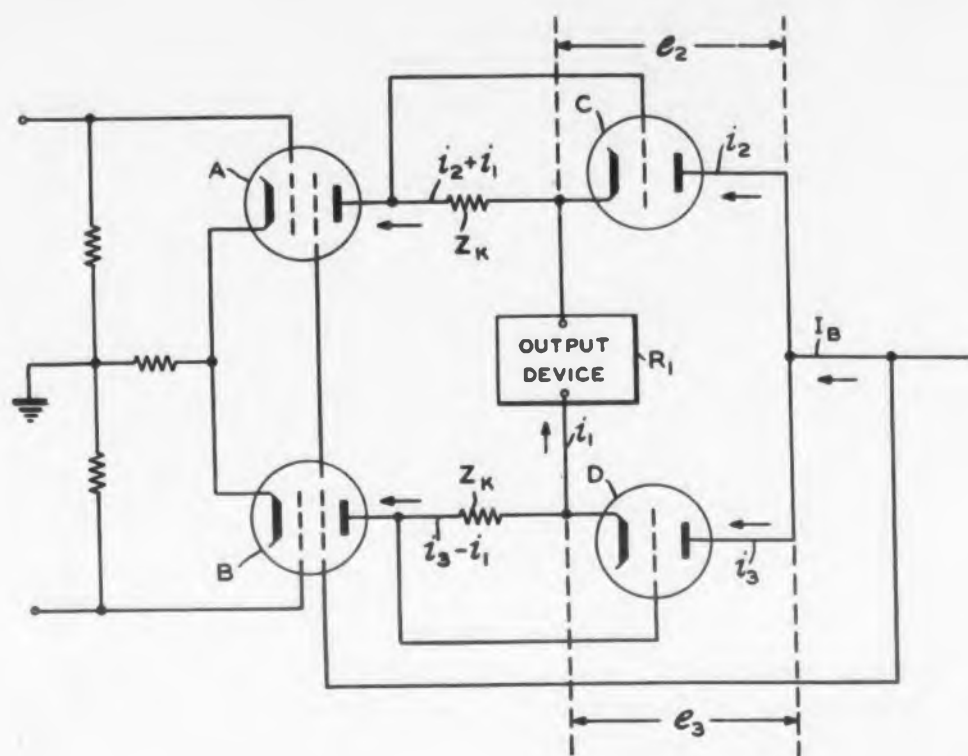
Pulsed oscillators are used in radar, loran, printing telegraph and many other devices and circuits. These pulsed oscillators should start without generation of a transient and should be able to terminate their oscillation without a transient. Another desirable feature in such oscillators is that the oscillations be sustained and that the amplitude of oscillation remain constant. The circuit illustrated in the figure provides a pulsed oscillator free of the undesirable characteristics enumerated.

The circuit components of the pulsed oscillator are apparent from the figure. The tube V3 is normally biased for conduction for example, by a grid bias of -71 v. The tube V2 is biased to non-conduction by a grid potential of about -85 v provided at the terminal 16 by a voltage divider formed by the resistors 12, 13 and 14. Under this condition the oscillation circuit 26 generates its oscillations. The amplifier tube V4 feeds back energy to the oscillation circuit, to maintain sustained oscillations of fixed magnitude. When the tube V2 becomes conductive, the cathode potential increases on tube V2 and V3, which automatically bias the latter tube to non-conductive condition. With the tube V2 conducting, the dc through the tube and the inductor 29 of the oscillation circuit 26 in the plate circuit of the tube is such that oscillation

ceases. The tube V3 is a stabilizing element to limit the potential of its cathode to above -73 v and hence prevent the cathode of tube V2 from falling below this potential. Increase in potential of about 20 v on the grid of tube V2 renders this tube conducting.

With the tube V1 biased for conduction, the current through this tube maintains the potential at terminal 16 and hence on the grid of tube V2 at about -86 v so that the latter tube is non-conductive and oscillations are generated. A negative input pulse on the grid of the tube V1 renders this tube non-conducting, with the result that the potential at the tap 16 and grid 17 of tube V2 is raised to about -65 v or above cut off, and tube V2 becomes conductive and oscillations are terminated.

In order that the oscillator generate oscillations without the formation of transients when oscillations cease, it is necessary that the amplitude of the current through the inductor 29 drawn by the tube V2 must have a value which is equal and opposite to the instantaneous current in the inductor 29, as a consequence of the oscillations in the oscillation circuit 26. In addition a feedback timing element is used (not shown in the figure) or it may be accomplished by a modified circuit shown and described in the patent. The circuit described provides an oscillator which is free of transients even though the input signal is of random occurrence and of variable duration.



Direct Coupled Amplifier Circuit

Patent No. 2,740,849 W. D. Cannon (Assigned to The Western Union Telegraph Company)

A well known direct coupled amplifying circuit uses a pair of discharge tubes having their plates connected to a potential supply through coupling resistors, with the output or load being connected between the plates of the tubes. A resistance coupled amplifier retains its linearity at low frequencies. The patent points out that the efficiency of such a circuit is a little over 7% with considerable energy being dissipated in the plate resistors. A circuit is described in the patent and shown in the figure which increases the efficiency of this type of amplifier by about three times.

The circuit is shown in the figure using balanced screen grid tubes A and B and having their cathodes connected together. A common cathode resistor is used. Instead of supplying a plate resistor, the circuit uses a coupling triode C and D in each plate circuit of the tubes A and B. A resistor Z_k is provided between the cathode of each triode, and the plate of the screen grid tube with the grid of each triode being connected with the plate of the former tube. The output or load R_l is provided between the cathodes of the two triodes. With this circuit, the efficiency is increased by about three times or to about 20% without any increase in the energy supplied by the power supply. The resistor component Z_k is selected in accordance with the dynamic

impedance of the coupling tube C and D. If the dynamic impedance of these tubes is in the neighborhood of 2500 ohms, then the resistor Z_k should have a value between 5 and 20% of the dynamic impedance. If the coupling tube has a low dynamic impedance of about 750 ohms, then the resistive component Z_k should be between 40 and 60% of the dynamic impedance of the coupling tube.

The resistive component Z_k may be a resistance, as shown in the figure, or it may be an impedance network including an inductance having a resistor in parallel therewith and a second resistor in series with the parallel elements. The network also may be an inductor, resistor and capacitor connected in parallel with a second resistor in series with the parallel elements. These networks improve the efficiency of the circuit at higher frequencies. Various other networks may be substituted for the resistor Z_k for securing different frequency responses from the circuit.

Voltage Reference Network

Patent No. 2,743,152. James T. Carleton. (Assigned to Westinghouse Electric Corp., East Pittsburgh, Pa.)

A voltage regulator circuit utilizing a magnetic amplifier in conjunction with a diode operating in the region of Townsend discharge. The magnetic amplifier is arranged to present a high impedance to the reference diode and the non-linear characteristics of the diode provide the voltage regulation.

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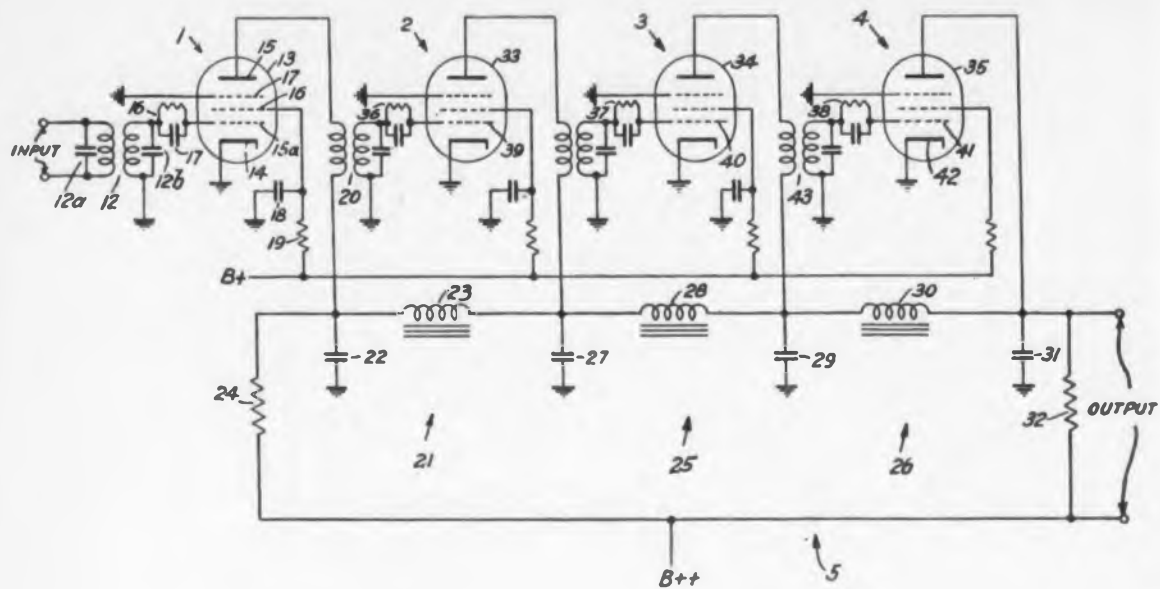
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Logarithmic Amplifier Detector

Patent No. 2,729,743. J. S. LeGrand. (Assigned to International Telephone and Telegraph Corp.)

The circuit shown is an amplifier which provides a dc output signal which is proportional to the logarithmic value of the ac input signal. In circuits previously designed, the response time has been of an appreciable value with the result that inaccuracies result. Such circuits also would be more useful if the band width could be increased.

The circuit illustrated is a cascade amplifier having four stages with a tube for each stage. The circuit may have additional stages. The output of each stage is coupled by a transformer to the control grid of the next succeeding stage. In addition, the output of each tube is connected with a delay line comprising a series of capacitors and inductors 22, 23, 27, 28, 29, 30, and 31, with terminal resistors 24 and 32. Each section of the delay circuit provides a time delay comparable to the transit time through each stage of the amplifier.

With this circuit, when there is no input signal each tube passes maximum plate current, since there is essentially no grid bias. Upon application of input signal, the grid and cathode function as a detector of the input signal and increase the bias on the grid. The average value of current through the last tube will decrease. Increasing the input signal results in decreasing plate current through this tube until a point is reached when the last stage is saturated so that its output signal remains substantially constant.

With further increases in the amplitude of the input signal, the third stage and thereafter the second stage each pass

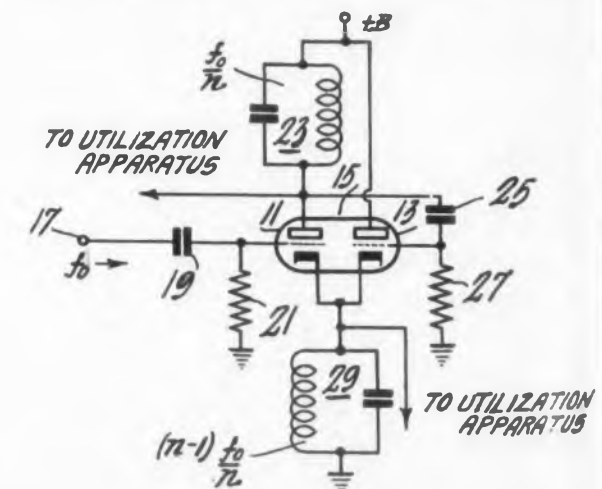
through the same cycle as the last stage until they also reach their saturation points and their output signals remain constant. The resultant output signal across terminal resistor 32 of the delay line has an amplitude which is proportional to the logarithm of the input signal.

Regenerative Frequency Dividers

Patent No. 2,738,423. G. C. Sziklai (Assigned to Radio Corp. of America)

Frequency dividers find particular usefulness with a colored television circuit. In such a circuit, a frequency divider takes a sample of the high frequency and from it reproduces the line frequency and the vertical deflection frequency so that the sampling frequency is synchronized with the line and field frequency of the television circuit. Such a divider circuit should be able to maintain a stable frequency and use simple components. The circuit of the patent has these advantages as well as providing a circuit which will operate at a much higher frequency than multivibrators which are commonly used for this purpose.

The circuit uses a dual triode 11, 13 with the high frequency of the sample being



applied to the control grid of the first triode. A tuned circuit 23 is in the plate circuit of the first triode section and it is coupled through a condenser 25 to the control grid of the second triode section 13. A tuned circuit 29, in the cathode circuit of the two triode sections, is tuned to a different frequency. The two frequencies are heterodyned together to produce the desired frequency at the anode and output terminal of the first triode section. As an example, if the input frequency f_0 is 10,000 cycles, and circuit 23 is tuned to 2000 cycles, this frequency, which is a noise component, is applied to the control grid of the second triode section. The second section multiplies this frequency to 8000 cycles, which is heterodyned with the input 10,000 cycles to result in the desired 2000 cycle frequency.

The patent also describes a modification of the basic circuit of the figure, in providing a third tuned circuit in the anode circuit of the second triode. This tuned circuit is tuned to a multiple of the frequency of the tuned circuit 23. This particular frequency may be a second output frequency as well as the heterodyned frequency at the anode of the first triode section of the triode 11.

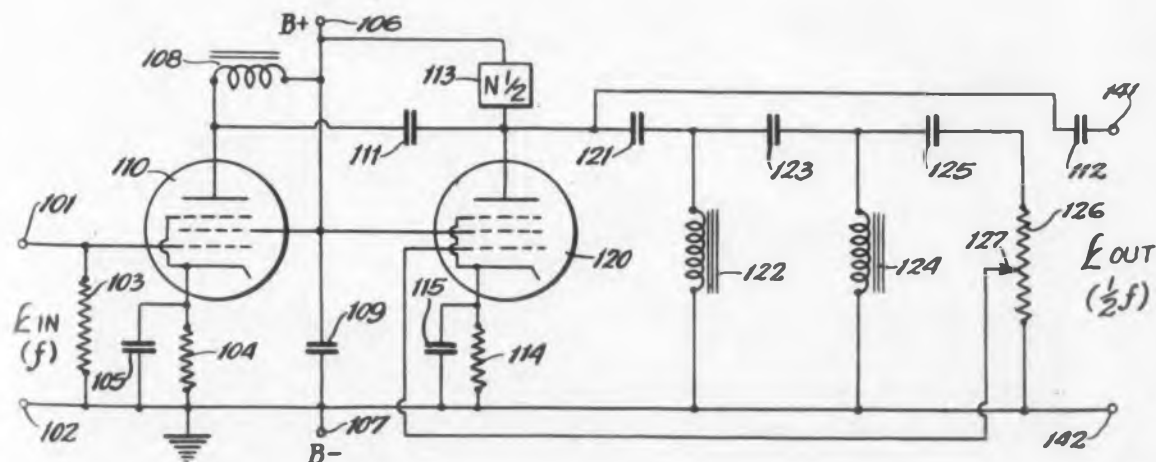
Frequency-Dividing Circuit

Patent No. 2,739,240. W. L. Hughes. (Assigned to Iowa State College Research Foundation, Inc.)

Multi-vibrators have been used for frequency dividing; however, their output wave form is not sinusoidal. There are uses for a frequency divider with a sinusoidal or approximately sinusoidal output. Frequency dividers have been devised which give this form of output wave but they have been unstable circuits. Variation in supply voltage, input potential or input frequency will "unlock" the circuit and fail to give the desired output.

The circuit shown in the figure is a stable frequency divider circuit which gives a sinusoidal output wave at a fractional frequency with respect to the input frequency. The input frequency is applied to the terminals 101 and 102 and to the control grid of the tube 110. The output is taken from the anode of the second tube 120 at the output terminals 141, 142. A reactive network is provided in the output of the second tube 120, the last element of which is a voltage divider 126. A feedback connection from this voltage divider to the control grid of the tube 120 is provided by the sliding contact 127. A non-linear resistor 113 is inserted in the anode circuit of the second tube 120. For an output frequency of $1/2$ of the input frequency, the resistor has a potential drop which is proportional to the square root of the current through the resistor. Three thyrite disks in series have been used to provide this characteristic.

A circuit for obtaining an output frequency of $1/3$ of the input frequency is essentially similar to that shown in the figure excepting that resistors may be used in the network in place of the inductors 122, 124 of the figure illustrated. The non-linear resistor in this circuit has a characteristic such that the potential drop across the resistor is the cube root of the current through the resistor. This circuit differs from that of the figure in another respect namely, the non-linear resistor is connected between the anode of the second tube and ground. A circuit is also illustrated for obtaining a frequency of $1/5$ or $1/7$ of the input frequency. For an even integer of the input frequency, the non-linear resistor is connected so that it not only carries the alternating component of the current but also carries a dc component. It is for this reason that in the circuit of the figure the non-linear resistor 113 is connected in the anode circuit of the second tube.



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Horizontal Deflection System For Television Receiver

Patent No. 2,74,070 W. A. Ogletree (Assigned to Philco Corporation)

The width of the picture of a television receiver is affected by the supply potential, by the adjustment of the brightness of the picture or any variation in the brightness of the picture from the received signal. Some television receivers derive their second anode potential for the cathode ray tube from the deflection yoke current which also is affected by the supply voltage. It is desirable, therefore, that a receiver be stabilized so that the variations enumerated will not affect the width of the received picture.

In the circuit illustrated, the horizontal output transformer 14 has a condenser 28 connected between junction 27 and the B+ supply so that the boost B+ potential is developed at this point. Tube 18 is a damping tube and tube 19 provides a high voltage rectification for the second anode potential. The horizontal sweep oscillator 10 applies its frequency to the horizontal deflection yoke 16 through an amplifier tube 12. The amplifier tube has a screen grid, the potential of which is controlled

by a variable resistance tube 22 connected with the cathode of the latter tube.

If the voltage supply potential should vary it would also vary the boosted B+ potential at the junction 27. This potential is applied to the control grid of a control tube 21 through resistors 25, 26 and 24. A change in the boosted B+ voltage controls the current through the control tube and changes the potential on the conductor 29. The potential of this conductor is applied to the control grid of the regulator tube 22 thereby varying the plate resistance of this tube. This in turn varies the potential on the screen grid of the amplifier 12 to maintain constant current which stabilizes the picture width and the second anode potential.

If the beam current through the picture tube 20 should vary, the current through the resistors 32 and 30 will vary and change the potential at the junction point d. The change in potential of point d is applied to the control grid of the control tube 21 through resistor 31 and changes the potential of the connection 29. This results in a change in the potential on the grid of the variable resistance tube 22 and a change in plate resistance of the tube 22. The potential of the screen grid of the amplifier tube

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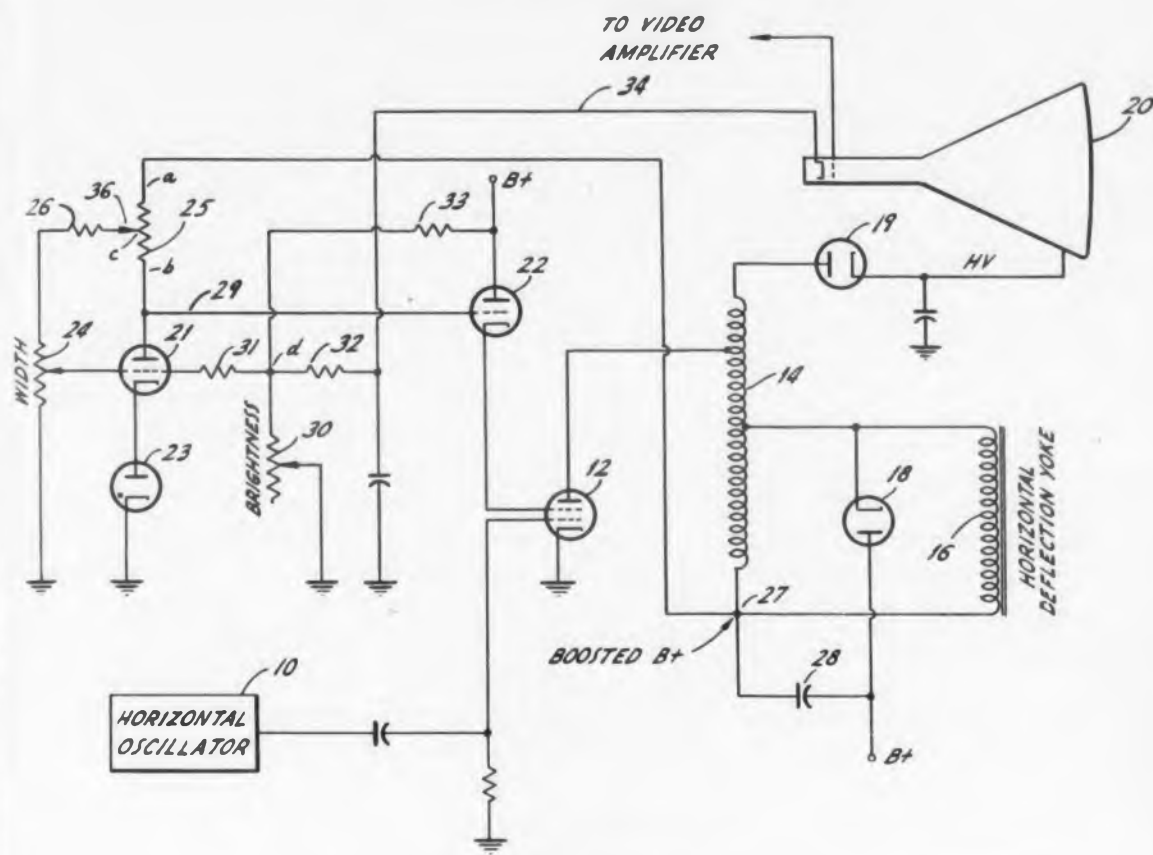
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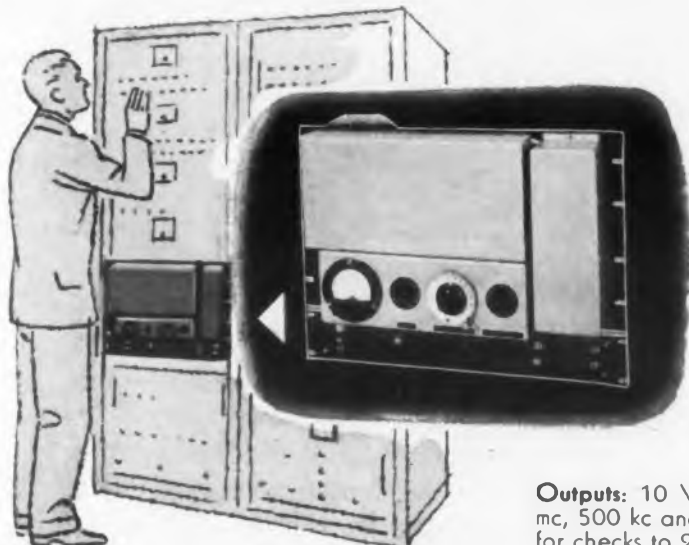
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is varied accordingly, as previously described. The picture width is therefore stabilized, irrespective of the change in the brightness value of the received signal. Likewise adjustment of the contact on the

resistor 30, to change the brightness of the picture, also changes the potential of the point d, and in like manner stabilizes the picture width upon any variation of the brightness control.



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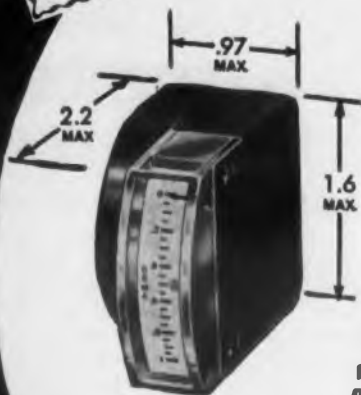
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Lloyd P. Hunter, McGraw Hill Book Co., 330 W. 42nd St., New York 36, N.Y. Price: \$12.00

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John L. Stewart. J. Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 480 pages, \$9.50.

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Television Engineering, Principles and Practice, Vol. II, "Video Frequency Amplification."

S. W. Amos and D. C. Birkinshaw. Philosophical Library, 15 East 40 Street, New York 16, N.Y., 270 pages, \$15.00.

This volume describes the fundamental principles of video-frequency amplifiers, and examines factors which limit their performance at the extreme of the passbands. A variety of circuits is described; particular attention is paid to the use of feedback. A section deals with the special problems of camera-head amplifiers. Mathematical derivations are included where necessary.

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C. K. Smoley & Sons, Inc., Chautauqua, N. Y. 424 pages; Price \$12.00.

This is a revised and enlarged edition of Smoley's Four Combined Tables, which contains tables of Logarithms and Squares, Slopes and Rises, Logarithmic Trigonometric Tables, and Segmental Functions. Designed as a reference book, the electronics design engineer may find the use of the tables a time-saver in mathematical calculations.



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Operating Features of Power Amplifiers with AC Plate Supply, O. M. Minina, D. E. Polonnikov (6 pp, 9 figs).

Such amplifiers are frequently used in servo work because of their simplicity and phase-sensitive properties. Experiments at the Institute of Automation and Telemekhanics of the USSR Academy of Sciences have shown that at heavy plate loads the plate and screen-grid circuits carry inverse currents which reduce the efficiency and output power of the amplifier and increase its time constant. The authors propose five practical remedies to minimize this effect—keep the plate current low, increase the control-grid resistance, employ rectifier elements (without filters) in the plate circuit of the tube, use rectifier elements in the screen-grid circuit, and use special tubes having high inverse resistance.

General Condition of Minimum Mean Squared Error in Dynamic Systems, V. S. Pugachev (7 pp).

Derivation of a necessary general condition under which one random function can be approximated by another in a manner producing a minimum mean-squared error. This general condition leads to equations that define optimum dynamic systems of various classes. Many similar equations, derived by Wiener, Zadeh, Booton, Davis, Preston, and others

are shown to be particular cases of the general equation derived in this article.

Graphic-Analytic Method of Plotting the Current-Voltage Characteristic of a Two-Terminal Network Containing a Transistor, N. I. Brodovich, (5 pp, 8 figs).

This method employs the static characteristics of the transistor to plot the characteristic of transistor switching circuits and of transistor dc amplifiers. Reference is made to an article by C. A. Krause, "Transistor Negative Resistance Characteristics," *Radio-Electronic Engineering*, May 1954.

Balanced-Bridge Electronic DC Amplifier Stages, A. A. Sokolov (9 pp, 8 tables).

Extensive tables of design equations for most widely used "standard" balanced-bridge two-tube dc amplifier stages employing triodes. These equations agree quite well with experimental data.

Electronic Analogue Computer for Investigations of Prolonged Automatic Regulation Processes (2 pp, 1 fig).

News Item: Latest analogue computer produced by the Institute of Automation and Telemekhanics of the USSR Academy of Science is the EMU-6. It

Delay Unit Employing Magnetic Recording, V. A. Ivanov (5 pp, 6 figs).

Delay units are frequently used in the simulation of automatic-regulation systems to reduce the order of a differential equation, thereby reducing in turn the number of simulator elements. Automatic-regulation processes usually have very low frequencies, from .001 to 5 or 10 cycles, and the time delays required range from .05 seconds to 20 minutes. One way of doing it is to store the signal in a capacitor, which is discharged after a set interval with a rotary switch. However, to produce the wide range of time delay indicated above, a large number of capacitors would be required and this would result in a very bulky device.

Another method is to record the signal on tape and reproduce it after a specified time delay, varied by changing the speed of the tape. This is shown in Fig. 1, in which is produced a magnetic recording of a carrier (500-2000 cycles) amplitude-modulated by the input signal. Frequency modulation can also be employed.

Figs 2 and 3 show the recorded signal (left) and reproduced signal. In Fig. 2 the reproduction error reached 5 per cent, in Fig. 3 it is reduced to 1.5 per cent. The delay time is stable within 0.1 per cent.

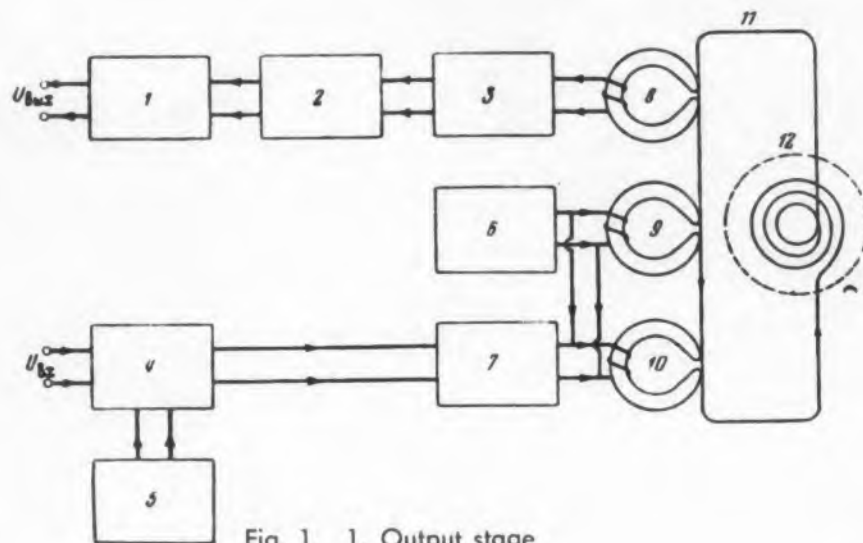


Fig. 1. 1. Output stage
2. Detector
3. Amplifier
4. Modulator
5. Carrier-frequency oscillator
6. Bias-frequency oscillator
7. Power amplifier
8. Playback Head
9. Erase Head
10. Recording Head
11. Magnetic tape
12. Endless tape magazine

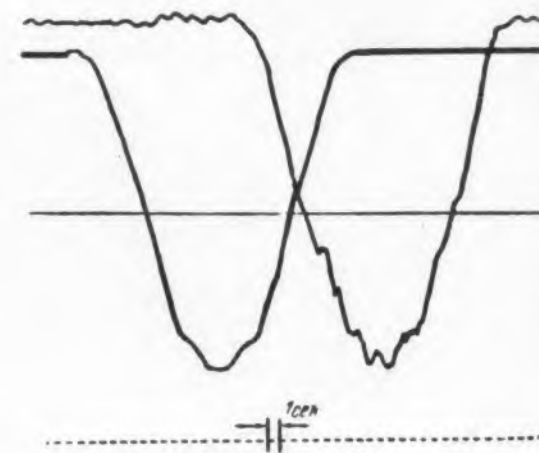


Fig. 2



Fig. 3

What The Russians Are Writing

J. George Adashko

differs from the earlier model (EMU-5, see *ELECTRONIC DESIGN* July 15, 1956) in that it can investigate processes lasting up to 1.5 hours. This is accomplished by reducing the leakage between the summing point and the output of the solution amplifier and by reducing the grid current of the first tube of the dc amplifiers.

Design of Circuits within Directly-Heated Semiconductor Thermistors. N. P. Udalov (3 pp, 7 figs).

Investigation of the current-voltage characteristics of such thermistors leads to the suggestion that increasing the heater current is equivalent to increasing the ambient temperature. This means that a set of characteristics plotted at one value of heater current can be used to plot characteristics at other values of current.

Connection between the Equivalent Amplification Factor of a Non-Linear Element and its Characteristic Curve, Ya. Z. Tsytkin (4 pp, 2 figs, 1 table).

This brief communication gives equations with which the amplification factor can be determined approximately, in explicit form, from the characteristic curve of the non-linear element.

Device for Integration of Slowly-Varying Functions of Time, Specified in the Form of an Angle of Rotation, I. P. Pal'tov (14 pp, 8 figs, 2 tables).

A dc motor used alone, or in conjunction with a tachometer generator in a feedback loop, is one of the most widely used devices with which a time function, given in the form of an angle can be integrated. The author developed a more accurate device, employing a servo system with "on-off" control and an eddy current motor in the feedback loop. The relative error produced by such a device is on the order of several tenths of one percent, and fluctuations in supply voltage and load do not affect the results.

Any type motor can be employed in the integrator, and the motor can be controlled with either sliding contacts, or vibrating contacts. Analysis shows the latter to be more accurate since it produces more readily the high-frequency low-amplitude pulse-width modulation on which the operation of the scheme is based.

Other Articles in this Issue:

"Magnetic Alloys for Cores of Magnetic Amplifiers and their Behavior under Simultaneous Magnetization with DC and AC Fields," O. N. Aven (6 pp, 7 figs, 4 tables); "Simulation of Water Hammer in Header Pipes of Hydroelectric Stations," A.A. Pervozvanskii, R.A. Poluetkov (14 pp, 10 figs); Bibliography on Mathematical Computation with Analogue Computers, 1947-1954 (conclusion); Book review.



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Effect of Large Fluctuations on Electronic Relays, V. I. Tikhonov, (12 pp, 9 figs).

Probability-distribution density functions are calculated for the lengths of relay pulses and for the intervals between pulses in the case of a stationary fluctuating voltage applied to a relay. The average number of relay operations and of coincidence counts is obtained for the combined action of periodic pulses and random fluctuations.

Analysis of Toroidal Tuned Cavities using Curvilinear Coordinates, V. L. Patrushev, (9 pp, 2 figs).

Summarizes the theoretical calculations that result from the application of the method of curvilinear coordinates to a toroidal tuned cavity with a tuning rod of arbitrary thickness.

The Schwarz-Christoffel transformation is used to map the outlines of the toroid in the (z, r) plane, Fig. 1, left, onto the (ξ, η) plane as shown in the right side of the figure. Analytical expressions are derived for the transformations, and a graph is given with which the parameters of the curvilinear system η_1 and η_2 can be readily obtained from the known values of r_1/z_0 and h/z_0 .

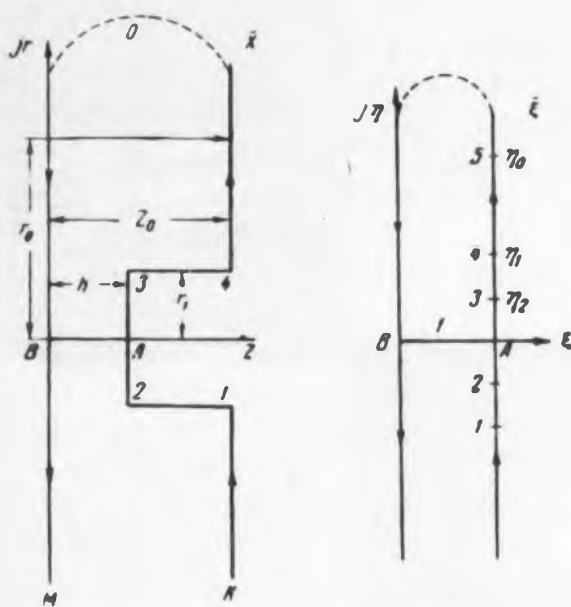


Fig. 1

On the Theory of Periscopic Antenna Systems, L. B. Tartakovski, A. M. Pokras, (11 pp, 15 figs).

Analysis of a periscopic antenna with a parabolic radiator. The analysis is based on introducing phase and amplitude corrections to previously known equations and on the reduction of the quadratures involved to simple Bessel-function series. The gain of the antenna system is expressed in terms of the field distribution on the radiator. The role of the effective dimension of the radiator and of several other details is also discussed. Refers to articles by V. C. Jakes, *Proc. IRE*, 1953, 272-274; Greenquist and Orlando, *Proc. IRE*, 1954, 1173-1178; Drexler, *Proc. IRE*, 1954, 1022; and Crosby, *Convention Record IRE*, 1954, 71.

Russian Translations

What the Russians are Writing

—Continued

Radiotekhnika I Elektronika No. 2 1956

Bent Waveguides of Constant Cross Section, B. Z. Katsenelenbaum, (15 pp, 3 figs, 1 table).

A waveguide of constant but arbitrary transverse cross section with ideally-conducting walls is bent about a circular arc and an arbitrary electromagnetic wave is propagated from the straight portion into the curved one. The field in the waveguide can be represented in the form of a superposition of the waves propagated in the straight portion. The coefficients of this superposition satisfy a system of first-order ordinary differential equations. An explicit expression can be derived for the amplitudes of all the parasitic waves that occur in the straight-line portions of a waveguide having a slight bend or break. Reference is made to papers by S. E. Miller, "Waveguide as a Communication Medium," *BSTJ*, 1954, p 1209; and W. J. Albersheim, "Propagation of TE_{01} Waves in Curved Waveguides," *BSTJ*, 1949, p 1.

Fluctuations of Space Charge Cloud in Cylindrical Magnetrons, Part I. (Theoretical) V. P. Tychinski & Iu. T. Derkach, (12 pp, 5 figs).

The power-balance method is used to prove the instability of the static state of the cloud during the formation of synchronous layer. A diagram, based on the Hartree equation, is obtained for the frequency spectrum of the oscillations. The effect of wave dispersion in the electron stream on the oscillation spectrum is qualitatively discussed.

The second part of the article will be devoted to a description of experiments that are in agreement with the theory developed. Numerous references are made to American articles on magnetrons.

Action of Amplitude Limiter, M. E. Zhabotinski, Iu. L. Sverdlov, (8 pp, 7 figs).

A limiter, as shown in Figs. 1 and 4, can be considered as consisting of a non-linear element (1) followed by a narrow-band filter (2). The plate-to-cathode capacitances C_{ak} usually restrict the effectiveness of the limiter and result in parasitic phase modulation of the output signal. An LC network is proposed to neutralize this parasitic capacitance, and calculations are given to show the extent of its effectiveness.

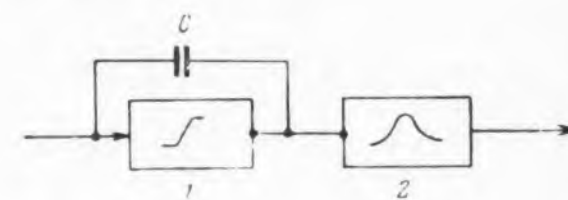


Fig. 2

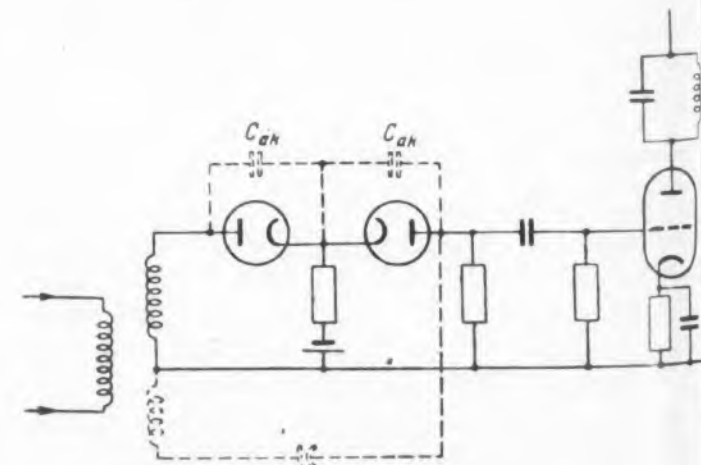


Fig. 3

Use of Chebyshev Polynomials in the Analysis of Stopped Transmission-Line Discontinuities. Ia. M. Tuover, N. I. Strutinski, (19 pp, 8 figs).

Two transmission lines with unequal characteristic impedances can be matched with transformers in which the characteristic impedance changes in several steps from one terminal value to the other. Usually such a transformer consists of several electrically-equal lengths of transmission line, and the characteristic impedance values of each step are so chosen that the local reflection coefficients between steps are proportional to the Newton binomial-expansion coefficients, 1-2-1, 1-3-3-1, 1-4-6-4-1, etc.

An analogy exists between the calculations used to obtain the total field radiated by an array of linear antenna elements (where Chebyshev polynomials are extensively used) and the effect produced by successive reflections at transmission-line discontinuities. The author shows that the use of Chebyshev polynomials (of the first kind) to approximate the transition between the two lines results in greater gain and smoother distribution of the values of the local reflection coefficients than obtained with a binomial distribution.

Noise Stability of Systems with Correcting Codes, V. I. Siforov, (12 pp, 5 figs, 4 tables).

Statistical study aimed at obtaining the relationship between the noise stability of a communication system that employs a correcting code and the parameters of this code. (A "correcting code" is one containing supplementary symbols which detect and correct noise-produced errors.) Refers to work by Shannon, Hamming, Laemmel, Reed, Silverman-Balsler, and G. A. Barnard.

Radiation of Electromagnetic Waves by Uniform Motion of Electric Charges in the Vicinity of Obstacles or Inhomogeneities, V. B. Braginski, (8 pp, 4 figs).

When electric charges move at uniform speed past inhomogeneities in waveguides or vacuum tubes, the accelerated motion of the induced charges produces electromagnetic radiation. Perturbation methods are used in the analysis of the resultant waves. Refers to Slater's Microwave Transmission (Russian Translation, 1947).

Other Articles in This Issue:

Transmitting Television Tube Employing Photoconductance. I. L. Artem'ev, V. K. Sokolov, S. K. Temiriazeva (8 pp, 9 figs), a summary of this article will appear in a future issue of ELECTRONIC DESIGN; The Cold-Electrode Ionic Pump and its Characteristics, E. M. Reikhrudel', G. V. Smirnitkaia, O. I. Borisenko (7 pp, 9 figs); Secondary Emission from Antimony-Cesium Cathode at Low Primary Electron Energies, E. S. Mashkova, (2 pp, 4 figs).

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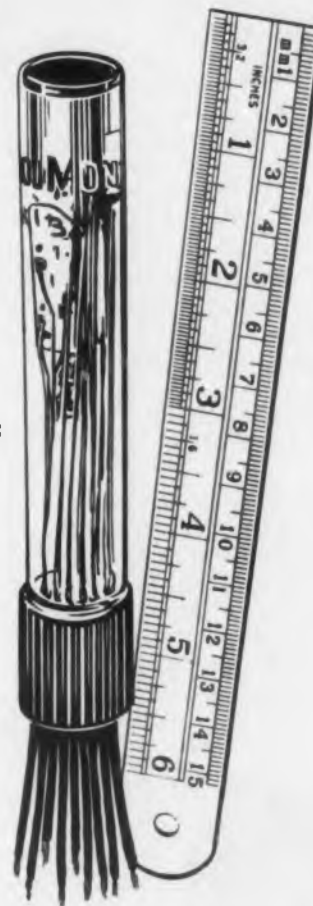
In addition to its small size and superb operating characteristics, the Type K1382 is unusually rugged. This tube has been designed for the roughest service under the worst climatic conditions. The tube base is potted and all leads jacketed to permit operation under severest humidity without leakage between leads. Laboratory performance can be obtained from this tube even when it is being dropped as a probe into a drill hole far underground.

As in other Du Mont multiplier phototubes, the linear box-type dynode structure is used. This means optimum electron collection greatly improving signal-to-noise ratio. Also, long leakage paths minimize noise and dark current. Dark current is only 0.1 ua at 105 v/stage and 25°C.

The small size and excellent performance of the new Type 1382 mean an extra bonus to users in the geological surveying field where, for example, its extra gain permits much longer signal transmission from underground locations before signal level becomes too low to be useful. It should be exceptionally useful in medical physiological probing. Batteries of these tubes may be used for speedier diagnostic procedure. In addition, the small size will help greatly in the miniature and portable designs that can function at least as well as laboratory equipment.

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Average gain:	300,000 at 105 v/stage
Maximum dark current:	0.1 ua max. at 105 v/stage and 25°C
Photocathode sensitivity:	40 ua/lumen
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Maximum outside diameter:	no greater than $\frac{3}{4}$ "
Physical Characteristics:	potted base, jacketed leads



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Engineers change jobs for many reasons. Here is a typical example of the reasons why many engineers have selected the Westinghouse Electronic Tube Division in Elmira, N. Y. as the place to advance their engineering careers, and why they like the Elmira area as a place for pleasant family living:

"It took me several years to realize that selecting the right job in the right location is really a "family affair." Unless the wife and kids are happy, too, there's not much sense in sticking with a job . . . no matter how interesting the work is.



"About a year ago, we decided that "big city" life was not doing our family any good. Marge had made a few good friends, but didn't feel she had grown "roots." Our two youngsters, Billy and Linda, were nervous and high-strung . . . with no good place to play. My salary was pretty fair, but the high cost of city living ate it up quickly.

"That's when I started looking around for an opportunity that would enable us to live in more congenial surroundings. We checked into several offerings, but none seemed to suit us.

"Then I saw an advertisement for openings in the Westinghouse Electronic Tube Division in Elmira, N. Y. It sounded like the kind of work I wanted, so I phoned Bob Jarrett, the employment supervisor, and arranged for an interview. That was our lucky day!

"After traveling to Elmira and talking with Mr. Jarrett, I found that my E.E. degree and previous experience qualified me for a position in the Camera Tube Design Section. With a little instruction, I could qualify for several other jobs, too.

"Mr. Jarrett explained about the Westinghouse pension and insurance plan. It was the kind of protection I needed for my family.

"He also told me there would be a 3%

general increase in salary each Fall for the next three years, quarterly cost of living adjustments, and periodic review of my work to determine merit increases. Because the Electronic Tube Division is new and expanding rapidly, the chances for promotion are unusually good.

"I liked the looks of the clean little city, the attractive residential areas, and rolling wooded hills all around. About a mile from the plant, I spotted a super golf course!

"When I asked Bob Jarrett about outdoor activities, he said there was wonderful fishing, boating and swimming in the Finger Lakes, about 25 to 30 minutes' drive. (Lots of Westinghouse folks have summer cottages there and commute to work).

"Well, to make a long story short, I received an offer through the mail in a few days that seemed mighty attractive. When I took Marge and the kids to see what Elmira was like, they fell in love with the place!

"My work at Westinghouse this past year has been richly rewarding. Plenty of design problems to challenge my engineering training and experience. Working together as a team, my colleagues and I are making significant contributions in the field. I'm finally advancing my engineering career.

"As for Marge and the kids, let her tell about that . . .



"Well, like most engineer's wives I'd be willing to live wherever Jim's work took him. But when Billy and Linda came along, it was different. I wanted them to grow up in a community where there were good schools, churches, and clean wholesome surroundings.

"When Jim accepted a position with the Westinghouse Electronic Tube Division and we moved to Elmira, I knew we had found exactly what we wanted.

"Everyone seemed so friendly and anxious

to help us get acquainted. The folks at Westinghouse helped us locate a darling little home . . . only 6 minutes' drive from doorstep to plant!

"I was invited to join the Newcomer's Club . . . so I got acquainted quickly. And we were soon made to feel at home in one of the many churches.

"Elmira is large enough to have all kinds of organizations and cultural interests . . . community concerts, Little Theatre, camera club, bird-watching, bowling, sailing, hiking and bridge. Yet, it's small enough to be close to fields and forests.

"Jim seems so much more relaxed now. He's working hard at Westinghouse because he loves it, but here he can enjoy the things he was missing in the "big city."

"I've found many fine places to shop . . . modern department stores, super-markets, and everything! Our living costs are down, too. Jim grew a grand vegetable garden in our back yard . . . and I'm getting interested in raising flowers.

"Both the children have grown taller and huskier since we left the "big city," and they've lost their high-strung temperament.

"This is real family living, and we are all growing "roots" in the community, thanks to Jim's decision to work at Westinghouse."

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In submitting information concerning your background, phone collect to Westinghouse Electronic Tube Division, Elmira 9-3611 and ask for Robert M. Jarrett. (After 5 p.m. or weekends, phone collect Elmira 9-2360). If you prefer, write a letter to Mr. Jarrett, Dept. T-22, giving basic information, and ask any questions you wish.

Russian Translation

What the Russians A

Radiotekhnika No. 4

Certain Generalizations of the Kotel'nikov Theorem,
I. T. Turbovkch (10 pp).

The Kotel'nikov theorem makes possible representation of any time function with a limited spectrum in terms of discrete values of this function, at certain values of time. The article extends this theorem to time functions having an unlimited frequency spectrum and determines the error that results from approximately expanding such a time function into a Kotel'nikov series.

New Hybrid Junctions for High Frequencies, A. A. Lvovich (8 pp, 7 figs).

Hybrid junctions of the type shown in Fig. 1 are widely used to parallel two hf oscillators without producing mutual coupling between them. Figs. 2 and 3 show similar circuits developed by the author to enable four generators to supply a single load (Z_H). These circuits are analyzed and it is shown that their efficiency is quite high.

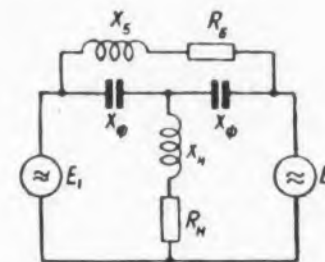


Fig. 1

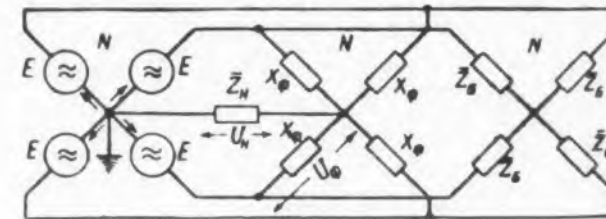


Fig. 2

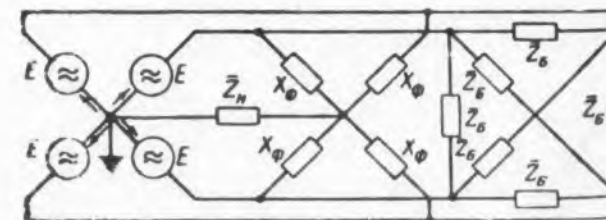


Fig. 3

Are Writing

Continued

Calculation of Principal Parameters of Electron Tubes Used to Measure Acceleration, L. A. Goncharskii (8 pp, 3 figs).

Vacuum tubes are used as acceleration transducers for various purposes, for example in mechanical-vibration testing. One of the electrodes of such a tube is usually a high-inertia mass that can be displaced relative to the remaining electrodes. The author discusses the differential equations and the structural features of several variants of such tubes.

Noise Stability of a Filtering Auto-Correlation Receiver for Pulse Signals, V. I. Chaikovskii (7 pp, 2 figs).

Discussion of methods of obtaining optimum signal-to-noise ratio at the output of a filtering auto-correlation receiver, such as discussed by Lee, Chatham and Wiesner in *Proc. IRE*, 38, Oct. 1950, "Application of Correlation Analysis to the Detection of Periodic Signals in Noise."

Low-Pass Piezoelectric Filter, Ia. I. Velikin, Z. Ia. Gel'mont, E. V. Zeliakh (8 pp, 5 figs).

The technical literature contains adequate treatment of piezoelectric bandpass and rejection filters, but not of high-pass and low-pass filters. This is the second of a series of articles (the first, covering high-pass filters, was published in the March 1955 "Radiotekhnika") covering analysis and design procedures for filters of a modified m-derived type.

On the Theory of a Spiral Line Covered by a Cylindrical Semiconducting Coating, E. G. Solov'ev, L. V. Belous (5 pp, 3 figs).

Such a structure is used as a delay line in traveling-wave tubes to prevent parasitic oscillations. The author employs straightforward transmission-line equations to obtain the variation of line attenuation with the thickness of the semi-conducting layer, and with the values of the conductivity, delay time, and frequency. The theoretical results were experimentally confirmed.

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A possible Method of Improving the Definition of Television Images, V. F. Samoilov, V. M. Rodionov (5 pp, 5 figs).

The device shown in Fig. 4 increases the contrast of the weaker details of the image without affecting the stronger video signals. This is done by differentiating the television signal, delaying the derivative signal by a time approximately equal to the transmission time of a single image element, comparing the delayed and undelayed derivative signals, and amplifying the television signal only if the delayed and undelayed derivatives differ in sign. This procedure is illustrated in Figs. 5a and 5b, respectively, for a weak detail and a strong signal front.

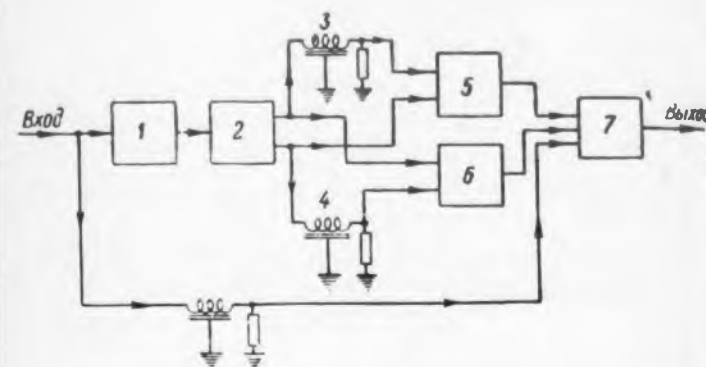


Fig. 4—1. Differentiating circuit for TV signal. 2. Amplifier. 3, 4. Identical delay lines. 5, 6. Combined multiplication and limiting circuits. 7. Mixer.

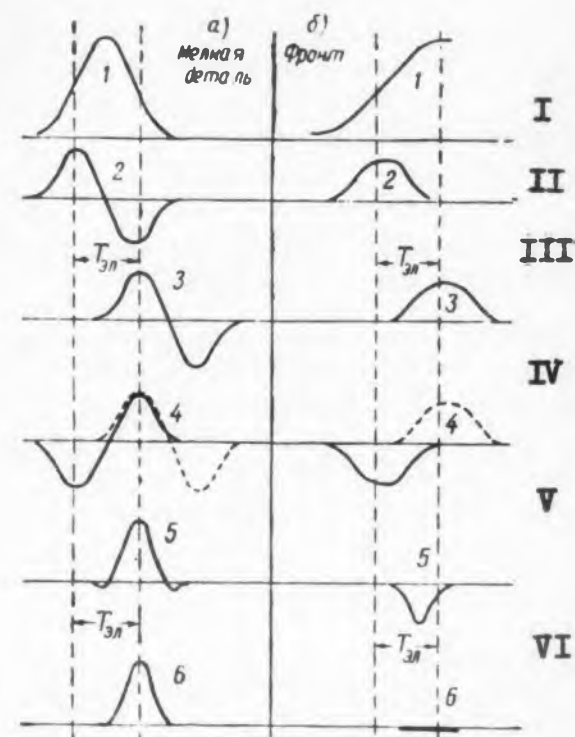


Fig. 5. a—weak detail, b—rising front of stronger signal. I—original signal, II—derivatives of signals, III—delayed derivatives, IV—comparison of original and delayed derivatives, V—multiplication of delayed and undelayed derivatives, VI—limiter passes only positive pulses, which correspond to a signal whose derivative changes sign. This positive pulse is added to the original signal to increase the definition.

Analysis and Design Procedure for Oscillators employing Triodes, Tetrodes, and Pentodes. M. S. Neiman (9 pp, 7 figs).

Conventional oscillator design begins with specified values of the ac power, plate voltage, and cutoff angle (or maximum value of plate current); the properties of the plate tank circuits are not taken into consideration. It would be more correct to specify not the ac power, but the useful power. Furthermore, the plate voltage and cutoff angle should be chosen so as to prevent excessive losses in the anode tank circuit from reducing the overall efficiency of the oscillator. This loss may occur in low-power, short-wave, or pulse oscillators. The equations given here lead to several optimum procedures, depending on the design objectives specified (maximum efficiency, definite plate-to-grid voltage ratio, etc.).

Cancellation Method for Reducing Non-Linear Distortion, A. A. Gorbachev (8 pp, 2 figs, 1 table).

Fig. 6 shows a novel method of reducing non-linear distortion from the output stage of an amplifier. Essentially, a voltage proportional to the distortion is separated from the output, reversed in phase, and applied to the load circuit, thereby cancelling the distortion component of the load voltage.

This method has several advantages over the use of negative feedback in that there is no need for applying an amplified useful-signal voltage to the input of the non-linear stage, and that it is easy to make the output impedance of the amplifier quite low. The cancellation method can therefore be used in those cases where excessive phase shift makes negative feedback inapplicable. A shortcoming of the method is increased complexity, which makes its use practical only in high-power amplifiers.

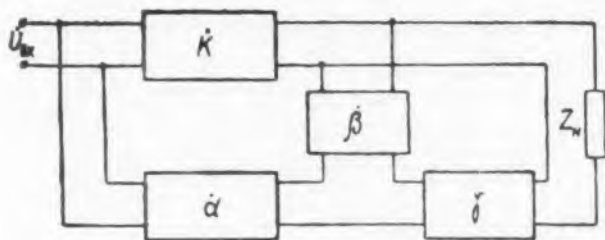


Fig. 6. Block diagram of cancellation circuit for non-linear distortion. U_i —input voltage, Z_L —load impedance, K —non-linear amplification, α , β , γ —cancellation circuit.



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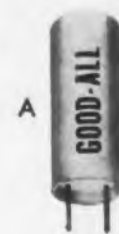
Write or phone for consultation on specific design problems or to secure detailed specifications on the various capacitor types shown.



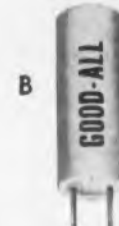
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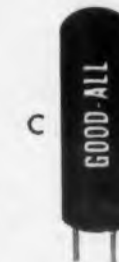
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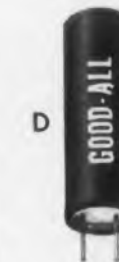
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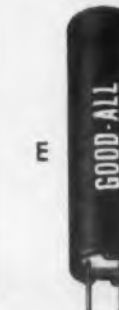
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MOLDED IN EPOXY



MOLDED BAKELITE
CASE (cylindrical)



MOLDED BAKELITE
CASE (with locating key)



EPOXY COATED
CERAMIC DISCS



MEMO

FROM: The Engineering Staff at N J E

TO: Electronic Design Engineers

SUBJECT: A Few Calm Words About **TRANSISTORS**

Those of us who have been around this wild and woolly world of electronics for a decade or two are naturally conservative about each new "miracle" that comes along. The latest is the transistor.

Here at NJE, we have worked long and hard—and successfully—to transistorize power supplies appropriately. We are impressed with our early results...but we are not ready to junk every other technique we know.

A few calm words are in order—

*The transistor will not cure the common cold, or any other common ailment—such as marginal design, line surges, or pulse loads.

*Above about a kilowatt, the expense of a pure-transistor technique becomes prohibitive. A combination of mag-amps and transistors looks best at higher levels.

*Although the basic circuitry is exceptionally simple (see typical diagram, below), parameters must be carefully restricted to avoid component selection and serious instability.

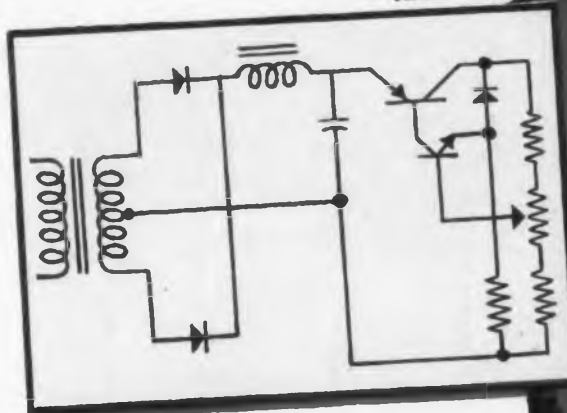
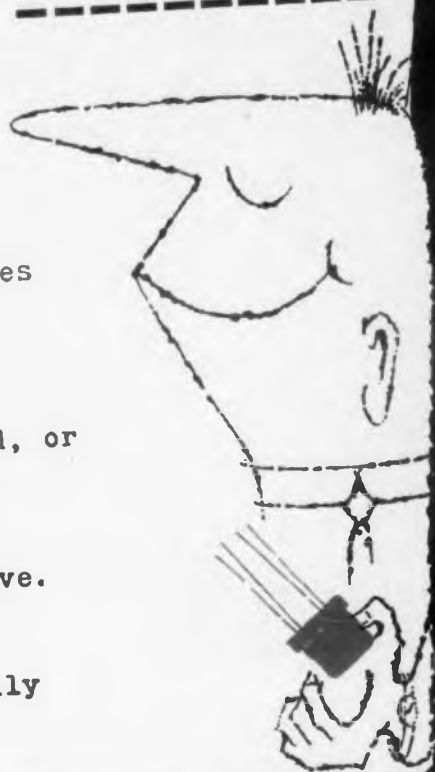
On the positive side, however:

*Transistors offer very precise regulation, low ripple, and zero-lag transient behavior at voltages below 50 volts at high efficiency.

*Size, weight, and heat reductions are often startling.

*Reliability and resistance to shock and vibration is generally greatly improved by replacing vacuum tubes with transistors.

Don't get us wrong, now—we love progress. We love transistors, too. If you think transistorization will solve your power supply problems, we want to show you what we can do... but all we offer is solid, conservative engineering...no miracles.



Abstracts—German

Grid Current Components in Power Amplifiers

In the design of power amplifiers operating in the grid current region, accurate knowledge of the direct current, fundamental and harmonic components of the grid current is essential in determining input power, grid dissipation and overall efficiency.

In order to compute the general expressions for the various grid current components, a simple power law has been assumed for the grid voltage versus grid current characteristic:

$$i_g = C e_g^n \quad (1)$$

By replotting the actual i_g vs e_g tube characteristic using logarithmic scales for both voltage and current, (1) becomes a straight line, if the simple power law holds, and n can be read off as the slope of the line.

The grid operating conditions are depicted in Fig. 1. Table 1 shows all quantities expressed as functions of the peak grid current I_{gm} and half the grid current flow angle φ_0 . The cosine of this angle equals the ratio of grid bias to maximum grid voltage E_{gm} . This is based on the assumption that grid current begins to flow when the instantaneous grid voltage is zero.

Only integral values of n are considered up to n equal to 3. By plotting the desired grid current component as a function of n with the use of Table 1, it is possible to interpolate for any intermediate value of the exponent. The formulae for n equalling 1, 2, and 3 were obtained by development of the sine and cosine functions into powers of half the grid flow angle. Abstracted from an article by W. Knappe, "Grid Current Analysis," *Frequenz*, vol 10, pp 44-50; February 1956.

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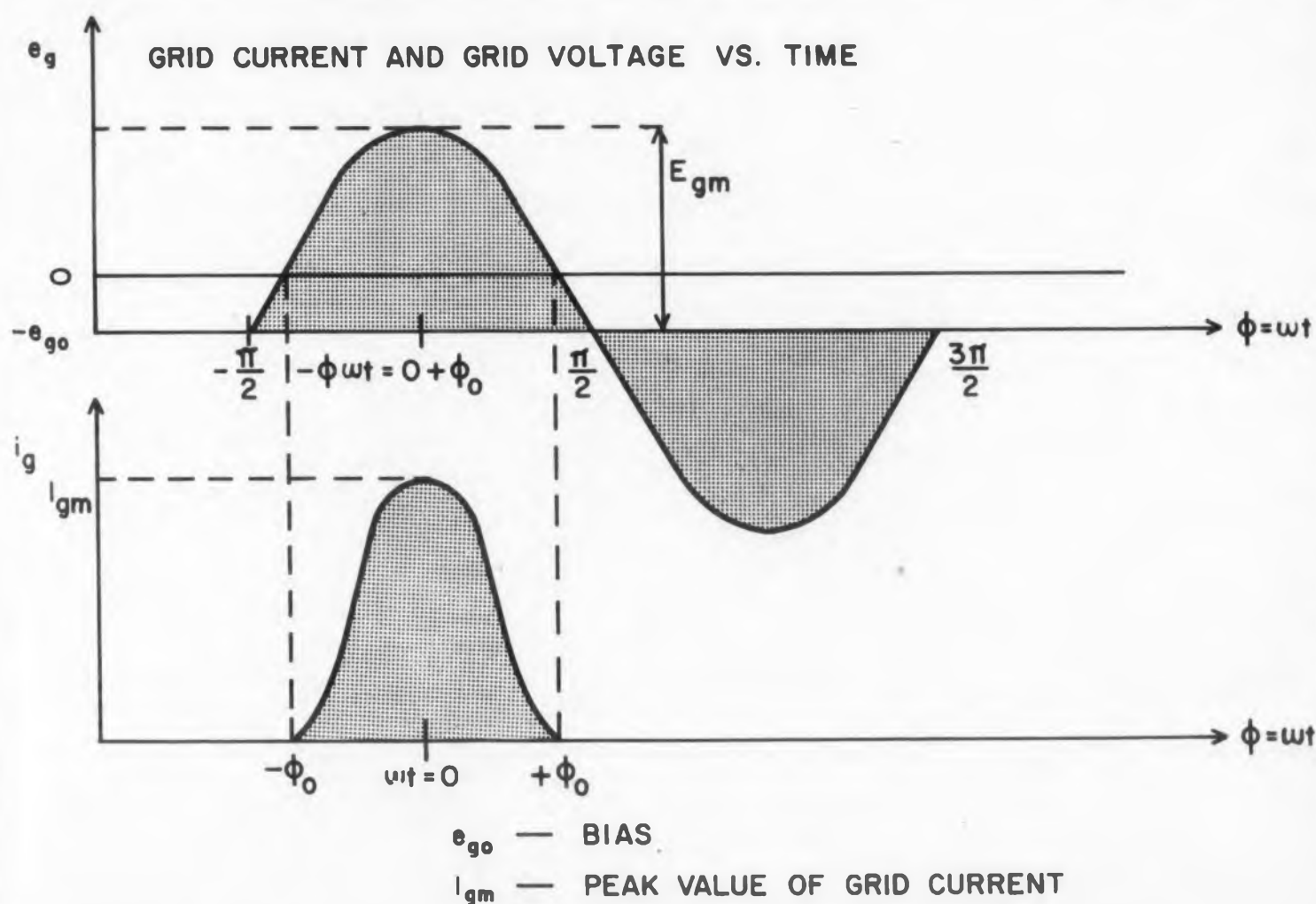
"POWER SUPPLY ENGINEERS: In a rut? Want to work at the forefront of the electronic power supply field? Our expansion is limited only by the size of our hand-picked engineering staff. Excellent compensation, recognition, security. Stimulating colleagues and challenging jobs. Write to T. C. Gams, Director of Research, for telephone or personal interview. Will consider capable Circuit Engineers with only nominal power supply background for rapid training and development in this essential and challenging field."

Table 1

	n = n	n = 0	n = 1	n = 2	n = 3
DC Component	$\frac{I_{gm}}{2\pi a^n} \int_{-\phi_0}^{+\phi_0} b^n d\phi$	$I_{gm} \frac{1}{\pi} \phi_0$	$I_{gm} \left(\frac{2}{\pi} \phi_0 - \frac{1}{90} \phi_0^3 + \frac{1}{5040} \phi_0^5 \dots \right)$	$I_{gm} \frac{4}{315\pi} (42\phi_0 - \phi_0^3 \dots)$	$I_{gm} \frac{16}{35\pi} \phi_0 \dots$
Amplitude of Fundamental	$\frac{I_{gm}}{\pi a^n} \int_{-\phi_0}^{+\phi_0} b^n \cos \phi d\phi$	$I_{gm} \frac{2}{\pi} \sin \phi_0$	$I_{gm} \left(\frac{4}{\pi} \phi_0 - \frac{7}{45} \phi_0^3 + \frac{11}{1260} \phi_0^5 \dots \right)$	$I_{gm} \frac{8}{315\pi} (42\phi_0 - 4\phi_0^3 \dots)$	$I_{gm} \frac{32}{35\pi} \phi_0 \dots$
Amplitude of Second Harmonic	$\frac{I_{gm}}{\pi a^n} \int_{-\phi_0}^{+\phi_0} b^n \cos 2\phi d\phi$	$I_{gm} \frac{1}{\pi} \sin 2\phi_0$	$I_{gm} \left(\frac{4}{\pi} \phi_0 - \frac{5}{9} \phi_0^3 + \frac{17}{180} \phi_0^5 \dots \right)$	$I_{gm} \frac{8}{315\pi} (42\phi_0 - 13\phi_0^3 \dots)$	$I_{gm} \frac{32}{35\pi} \phi_0 \dots$
Amplitude of Third Harmonic	$\frac{I_{gm}}{\pi a^n} \int_{-\phi_0}^{+\phi_0} b^n \cos 3\phi d\phi$	$I_{gm} \frac{2}{3\pi} \sin 3\phi_0$	$I_{gm} \left(\frac{4}{\pi} \phi_0 - \frac{11}{9} \phi_0^3 + \frac{77}{180} \phi_0^5 \dots \right)$	$I_{gm} \frac{8}{315\pi} (42\phi_0 - 26\phi_0^3 \dots)$	$I_{gm} \frac{32}{35\pi} \phi_0 \dots$
Square of RMS Grid Current	$\frac{I_{gm}^2}{2\pi a^{2n}} \int_{-\phi_0}^{+\phi_0} b^{2n} d\phi$	$I_{gm}^2 \frac{1}{\pi} \phi_0$	$I_{gm}^2 \frac{4}{315} (42\phi_0 - \phi_0^3 \dots)$	$I_{gm}^2 \frac{3}{8\pi} \phi_0 \dots$	

$a = (1 - \cos \phi_0)$
 $b = (\cos \phi - \cos \phi_0)$

$\cos \phi_0 = \frac{e_{g0}}{E_{gm}}$



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Design With Ferristors

VACUUM tubes may be effectively replaced by magnetic amplifiers¹ in many high frequency circuit applications. The Ferristor, a type of saturable reactor, consists of two windings of fine wire on a tiny iron core, all encased in resin. The small core can be saturated by minute currents in either winding. Circuits employing the Ferristor, as a vacuum tube substitute, have the characteristic of long-life reliability despite exposure to shock, vibration, or moisture effects.

An amplifying circuit may be converted into a current discriminator by adding positive resistive feedback, shown in Fig. 1. The output voltage E_o draws current through the control winding and feedback resistor in a direction that re-enforces the input current. As the input current rises from zero to the point where

saturation begins, the output voltage remains almost constant. When the Ferristor begins to saturate, the gain from input to output rises sharply, shown in Fig. 2. At a certain point, the feedback loop gain becomes greater than one and the control current and output voltage increase rapidly in a regenerative circuit until the Ferristor is fully saturated. At this point, the gain from input to output decreases again to nearly zero and further increases in input current have no effect. When the input current decreases to a value slightly lower than that at which sudden saturation occurred, the total current in the control winding becomes too low to maintain saturation. At this point, the output voltage begins to drop, and a reverse regenerative action returns the circuit to the original unsaturated state. Owing to this action, the circuit switches rapidly

back and forth from one to another of two comparatively constant states as the input current rises and falls. Since the state it assumes depends upon whether the input current is above or below a certain value, the circuit is called a "current discriminator."

Other circuits, representative of Ferristor applications, are: the one-shot multivibrator, the ring counter, the two-stage amplifier, the balanced amplifier, the free-running multivibrator, and the crystal-controlled oscillator. Some of these circuits are shown here. Abstracted from *Electronic Design With Ferristors, Data File 110, Berkeley Div., Beckman Instruments, Inc., 2200 Wright Ave., Richmond 3, Cal.*

1. Fast Magnetic Amplifier, *Electronic Design*, Jan. 1, 1956, pp 46-47.

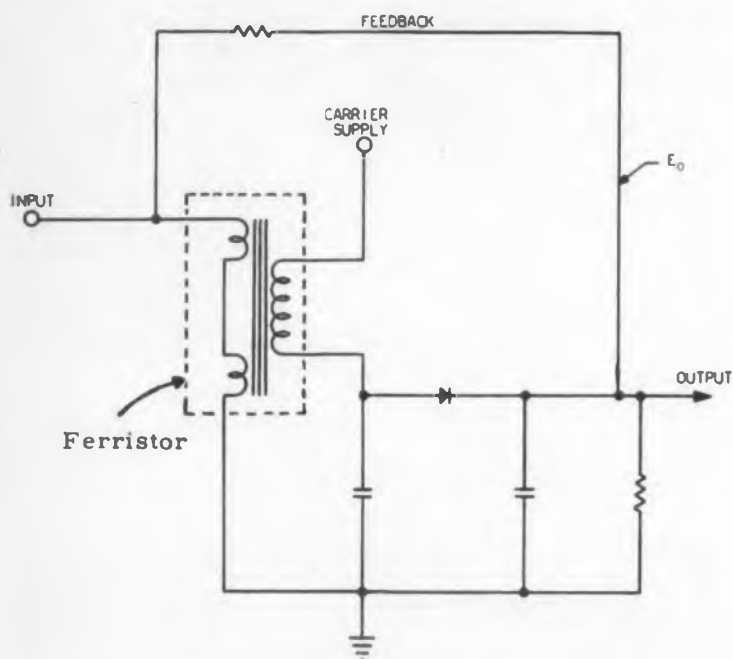


Fig. 1. Current Discriminator Circuit

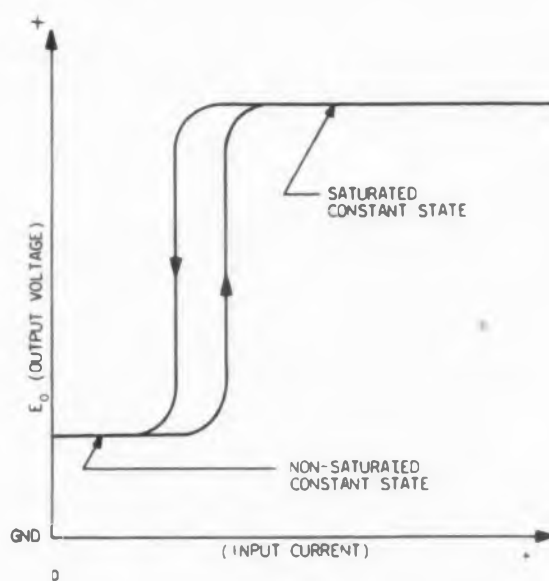
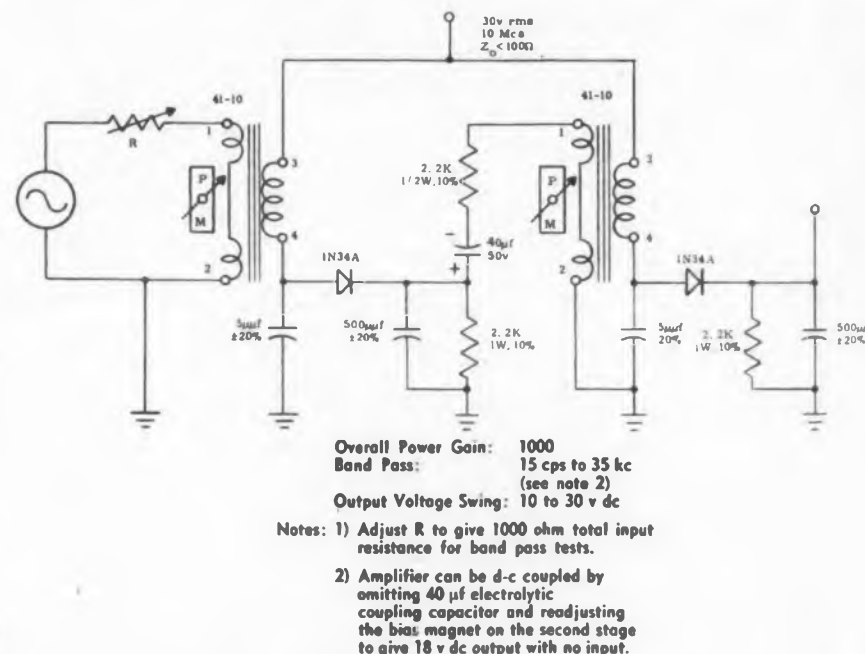


Fig. 2. Current Discriminator Saturation Curve



Overall Power Gain: 1000
 Band Pass: 15 cps to 35 kc
 (see note 2)
 Output Voltage Swing: 10 to 30 v dc

Notes: 1) Adjust R to give 1000 ohm total input resistance for band pass tests.
 2) Amplifier can be d-c coupled by omitting 40 µf electrolytic coupling capacitor and readjusting the bias magnet on the second stage to give 18 v dc output with no input.

Fig. 3. Two-Stage Amplifier

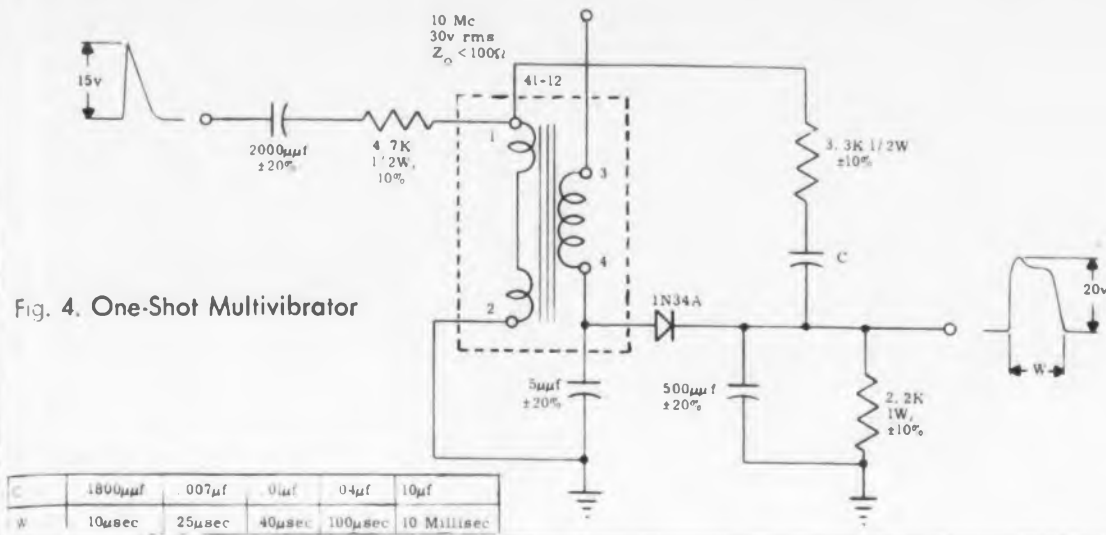


Fig. 4. One-Shot Multivibrator

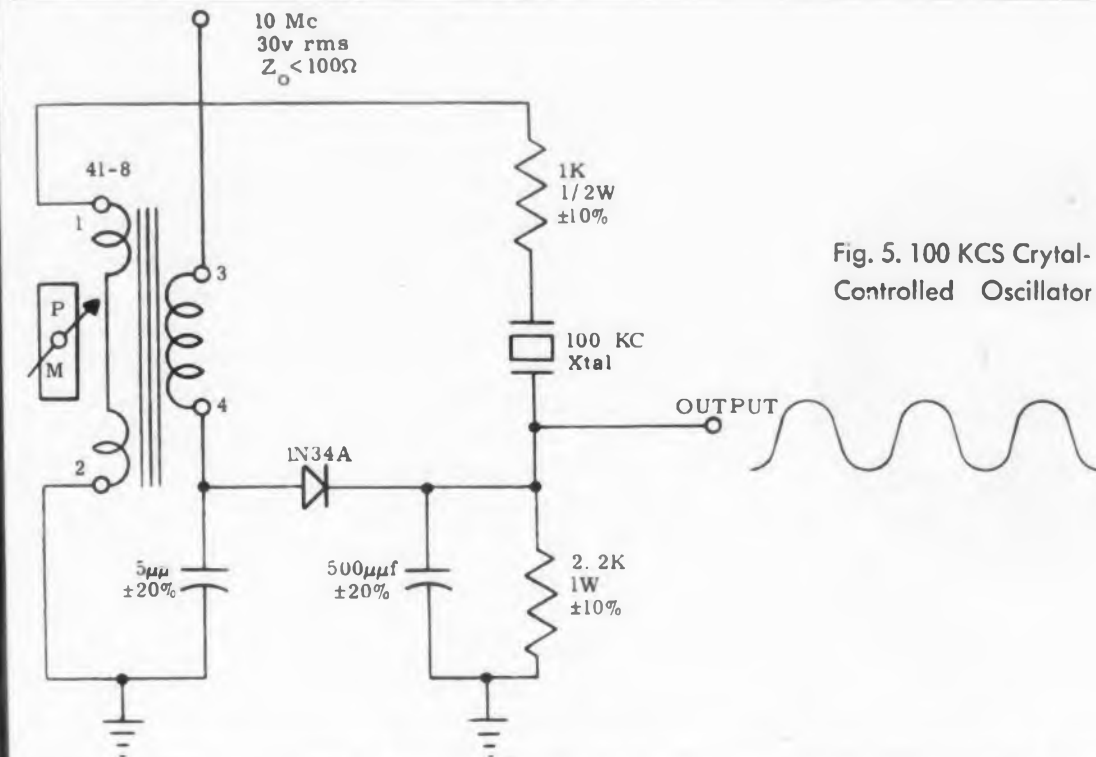


Fig. 5. 100 KCS Crystal-Controlled Oscillator

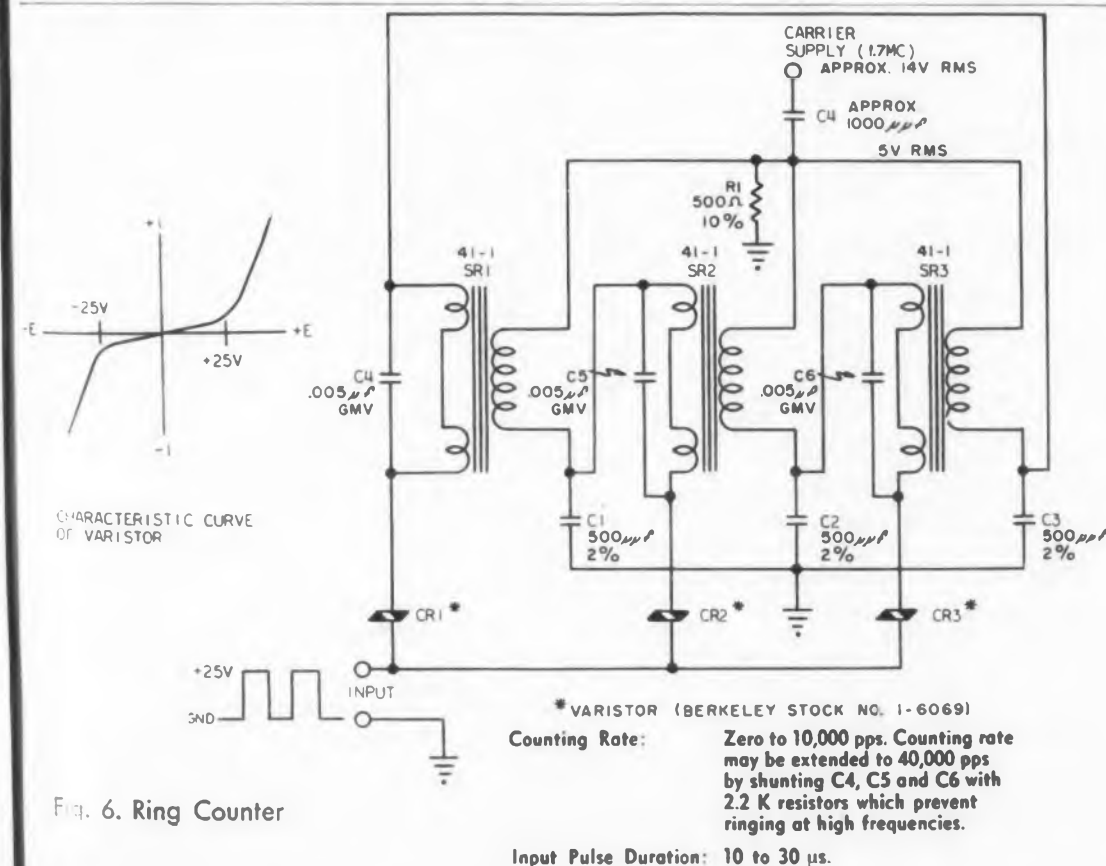


Fig. 6. Ring Counter

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FROM: HAYDEN PUBLISHING STAFF

RE: THIRD ANNUAL AUDIT OF BRAND RECOGNITION



Thanks to you, our subscribers, Hayden Publishing has once again published its annual Brand Recognition Study. From the 3027 questionnaires sent out to a cross section of the men in the electronic industries, 979 answers were received. This is an extraordinary response on such a long and intricate questionnaire, and we appreciate your cooperation in taking the time to fill it out.

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CIRCLE 456 ON READER-SERVICE CARD FOR MORE INFORMATION

Abstract



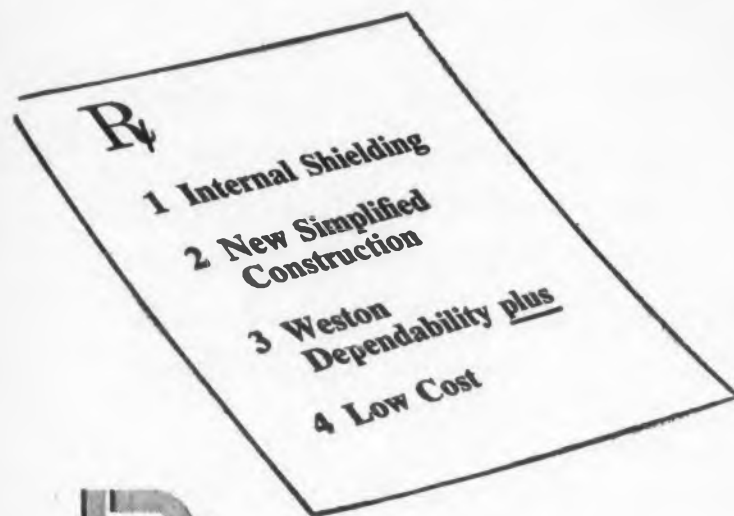
Reliability

IN many instances, resistor elements heretofore available have been unsuitable for the highest degree of reliability required today in critical applications. A resistor must be considered unreliable if its resistance value goes outside arbitrarily specified limits under anticipated operating conditions, even when its life may not be unduly shortened thereby or when open-circuit does not occur. High humidity over extended periods has been a factor in resistor unreliability, and Allen-Bradley set about to improve resistor characteristics under such operation conditions.

Unpredictable failures have occurred with film-type resistors but composition resistors have been generally reliable as long as they are not subjected to extreme humidity over extended periods. The approach taken by Allen-Bradley to improve reliability under such conditions was to develop an improved hermetically-sealed composition resistor. The results of their efforts are shown in the table for the new types, ES and TS.

The Type ES resistor element is centrally disposed in a ceramic tube whose inner wall ends are metallized. The solder seal to the lead wire is recessed below the edge of the tube. This recessed seal serves a practical function in that it becomes more difficult for an assembly operator to melt the solder around the seal than if the seal were flush with the end of the tube. Outside body dimensions are 0.560 in. long by 0.225 in. diam.

With the Allen-Bradley Type TS resistor, which has its resistive element centrally disposed in a metallized ceramic tube, the solder seal is made on the tube ends rather than inside the tube itself. Body dimensions for the TS resistor are 0.210 in. long by 0.107 in. diam.



WESTON
INSTRUMENTS

of Resistors

The performance limits established for the Type ES resistor are shown in the table, as compared to the requirements of MIL-R-11A and MIL-R-10509A. Note, particularly, the improvement gained in the humidity characteristic and the moisture resistance test. The prime purpose, of course, was to initially isolate the resistor from deleterious humid environmental conditions. The data shown is the result of a test for 1000 hours at 100% relative humidity at 55 C, as contrasted to MIL-R-11A, of only 250 hours at 90 to 95% relative humidity at +40 C. All resistors in this test, which comprise resistance values in the entire range of 10 ohms to 22 megohms, changed less than 1%. Changes of less than 1% compared to an allowable 5% were obtained with the moisture resistance test of MIL-R-10509A. Besides these small resistance changes under high humidity, the sealed resistor has been stabilized in many of its other characteristics, as shown.

The performance limits on the Type TS

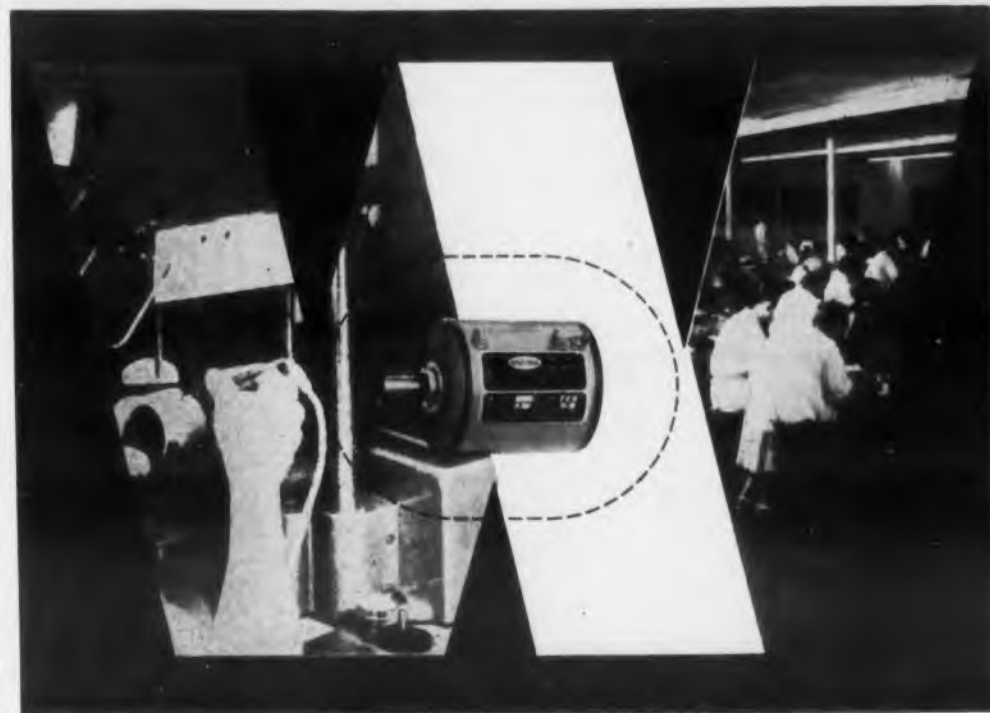
resistor are also listed in the table as compared to the minimum requirements for higher powered resistors under the military specifications. Although the maximum operating temperature is limited to +110 C, this is not a serious handicap in the use of such a resistor if it is borne in mind that for those applications of miniaturization where such small size is required, high electric loads and ambients are not usually encountered for extended periods of time.

These new resistors described are not a "cure-all" in regard to the problem of reliability of resistors, of course, since there can exist conditions under which almost any component will fail if improperly applied.

From a paper entitled "Hermetically Sealed Composition Resistors," presented by A.C. Pfister, Research Engineer, Allen-Bradley Co., at The National Conference On Aeronautical Electronics in Dayton, May 14-16, 1956.

**Table of Performance Data,
Allen-Bradley Resistors, Types ES and TS**

Test Procedure As Per MIL-R-11A or MIL-R-10509A Where Applicable	Maximum Changes Allen-Bradley			
	Type ES	Type TS	MIL-R-11A	MIL-R-10509A
Humidity Test	1%	1%	10%	
Moisture Resistance Test	1%	1%		5%
Temperature Cycling	1%	1%	3%	1%
Short-time Overload	1%	1%	2.5%	0.75%
Effect of Soldering	1%	1%	3%	0.5%
Load Life	6%	6%	6%	
1 watt at 70 C				
Derate to Zero at 165 C				
Vibration	1%	1%	1%	



Spectrol's* problem: to join .0006" nickel wire to gold-plated brass

and how a weldmatic solved it

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Metals require no preconditioning... constant output assures uniform welds. Speed of operation is limited only by operator response time.

*SPECTROL... Electronics Division of Carrier Corporation, manufacturers of high-precision single- and multi-turn potentiometers... one of many leading users of Weldmatic stored-energy welders.

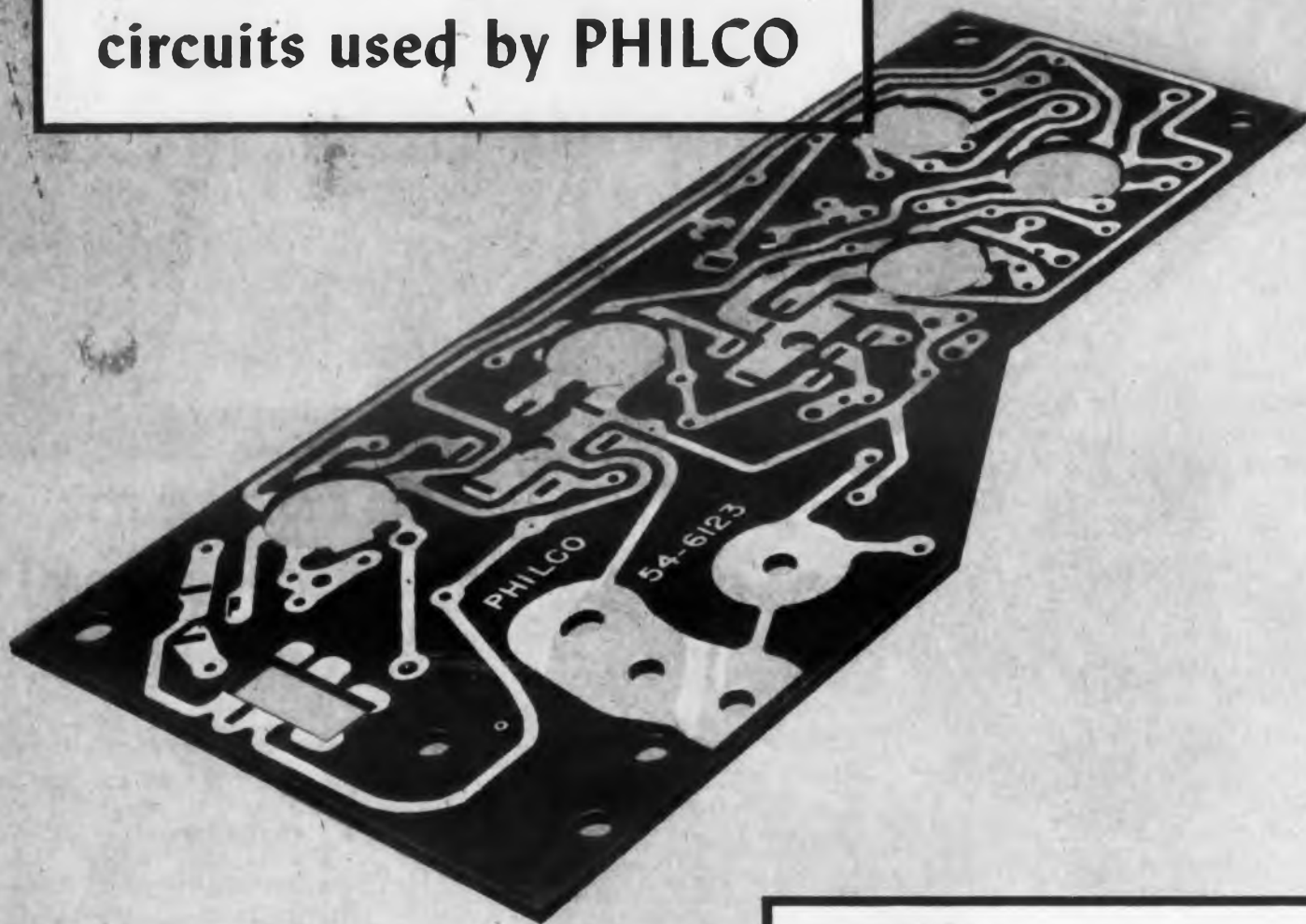
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Missile Electronics Reliability

IN ANALYZING a recently manufactured group of missiles, knowledge became available on individual components sustaining failures during routine missile checkout, with all components being exposed to approximately the same extent of test time of about 19 hours per missile. Since a study indicated that failures appeared to be random in nature and distribution during these tests, the random failure law can be used to define the expected reliability for each family of components.

Thus: Component Reliability = $P_x = e^{-t/T} = e^{-tf/h}$
where:

P_x = Probability of no failure in a component group

t = Time at which reliability is measured

T = Mean-time-to-failure

f = Average component failures per missile

h = Average hours per missile (19 hours)

And: Missile Reliability

$(P) = P_1 \cdot P_2 \cdot P_3 \cdot P_4 \cdot P_5 \dots \dots \dots P_x$

From the above probability expression, Table 1 has been prepared to show the relative rates of component failures sustained in this group of missiles, giving percent contribution to total failures, the reliability per hour and the reliability expression (P_x) for each major group of components. Electronic system failures account for 76 percent of all missile failures, and that solder joints and wiring, subminiature tubes, and relays are responsible for about 50 percent of all electronic failures. Resistors, potentiometers and capacitors together represent only 12 percent of all electronic failures in these particular missiles.

Figure 1 shows the respective contribution of individual component reliabilities to overall missile reliability, as a function of cumulative hours of missile operation. Data in both Table 1 and Figure 1 are independent of the component part population per missile, and merely define the relative rates of failure expected during checkout of these missiles. Abstracted from *Reliability Indices For Missile Electronic Component Parts*, T.S. Bills, Applied Physics Lab., The Johns Hopkins University, *Electronic Applications Reliability Review, RETMA*, 11 West 42 Street, New York 36, N.Y., Sept. 1956.

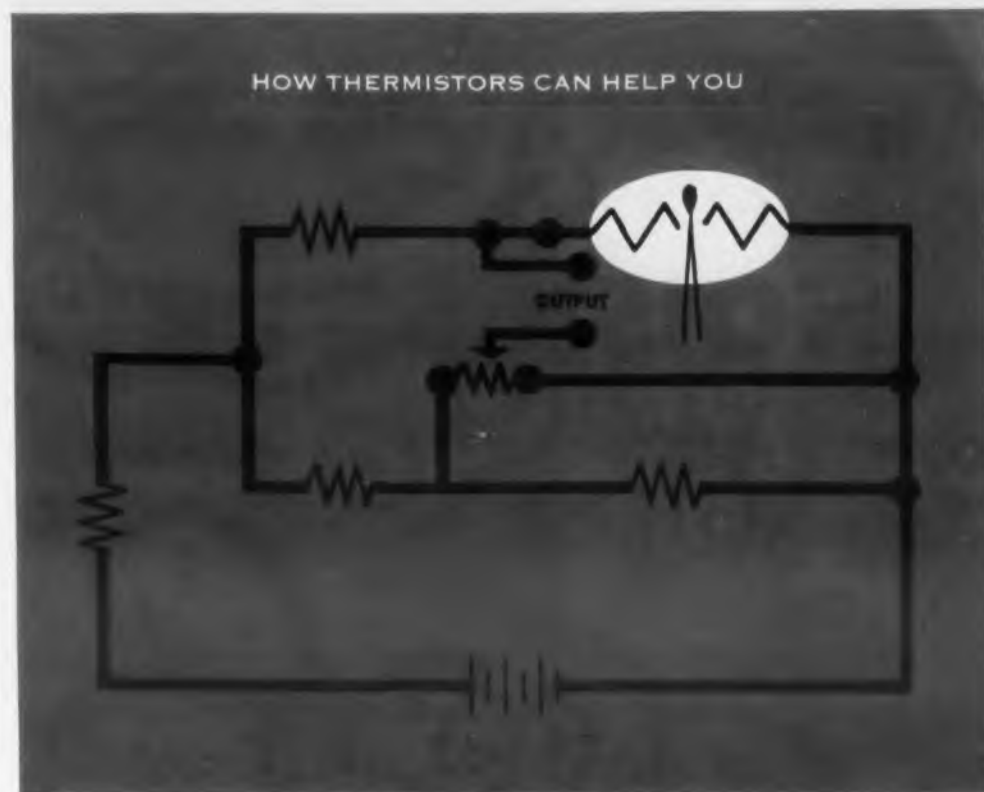
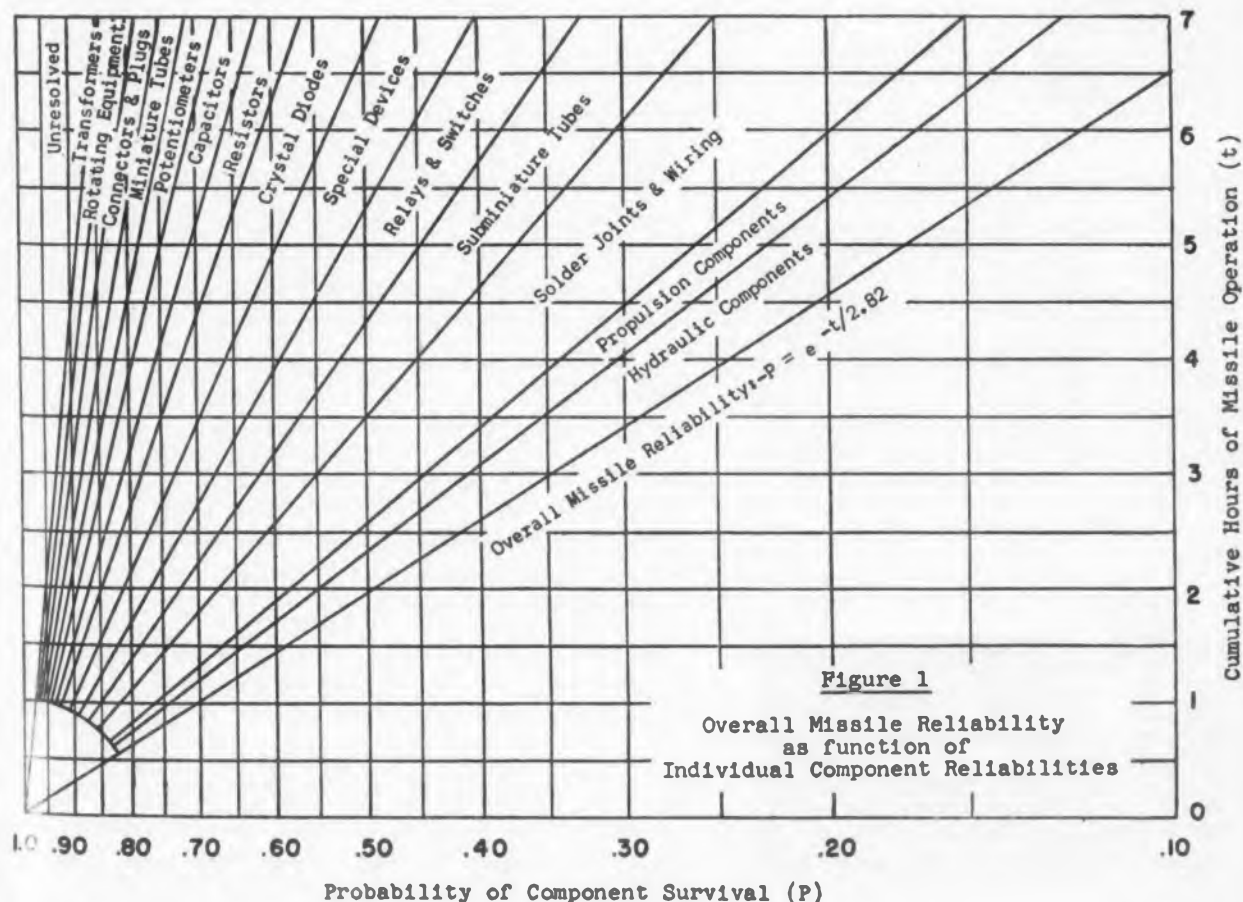
Abstract

TABLE I

Component Failure Proportions in a Guided Missile Program
Cumulative Testing Time (h) = 19 Hours Per Missile

Component Part	Failures Per Missile (f)	% of All Failures	Reliability Per Hour	Reliability $P_x = e^{-tf/h}$
Unresolved	.453	6.7	.9764	$e^{-1/42}$
Transformers	.071	1.1	.9962	$e^{-1/266}$
Rotating Equipment	.119	1.8	.9938	$e^{-1/160}$
Connectors & Plugs	.143	2.1	.9925	$e^{-1/133}$
Miniature Tubes	.143	2.1	.9925	$e^{-1/133}$
Potentiometers	.167	2.5	.9913	$e^{-1/114}$
Capacitors	.214	3.2	.9888	$e^{-1/89}$
Resistors	.238	3.5	.9875	$e^{-1/80}$
Crystal Diodes	.428	6.3	.9778	$e^{-1/44.5}$
* Special Devices	.525	7.8	.9728	$e^{-1/36.3}$
Relays & Switches	.548	8.1	.9716	$e^{-1/34.8}$
Subminiature Tubes	.715	10.5	.9632	$e^{-1/26.7}$
Solder Joints & Wires	1.380	20.4	.9302	$e^{-1/13.8}$
Propulsion Comps.	.477	7.0	.9753	$e^{-1/40}$
Hydraulic Comps.	1.142	16.9	.9420	$e^{-1/16.7}$
Total Electronic	5.144	76.1	.763	$e^{-1/3.7}$
Total Mechanical	1.619	23.9	.918	$e^{-1/11.8}$
Each Missile	6.763	100.0	.700	$e^{-1/2.82}$

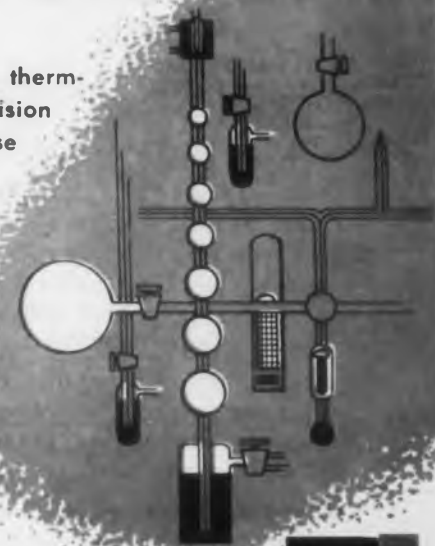
* Note: Special devices include klystrons, magnetrons, accelerometers, inverter governors, and multiplexing switches



Measuring Low gaseous Pressures with GLENNITE® Thermistors

A GLENNITE bead thermistor can now be adapted by simple circuitry into a precise manometer capable of measuring pressures from 50 to 2000 microns. Lincoln Laboratory of M.I.T. recently used such a system based on the principle that thermistor dissipation varies with the conductivity of surrounding gases. In the circuit shown above the self-heated thermistor is differentially cooled by the changing of the gas pressure in the system. This action causes an imbalance in the wheatstone bridge circuit. The information can be correlated to determine gaseous pressure with an accuracy of 1/10 of 1% over the entire range from 50 to 2000 microns.

For a more detailed explanation of this thermistor application write to Thermistor Division for your personal copy of "Rapid, Precise Measurements of Krypton Adsorption and the Surface Area of Course Particles" by Dr. Arthur Rosenberg of Lincoln Laboratory.



Thermistor Division

Gulston Industries, Inc.

METUCHEN, NEW JERSEY

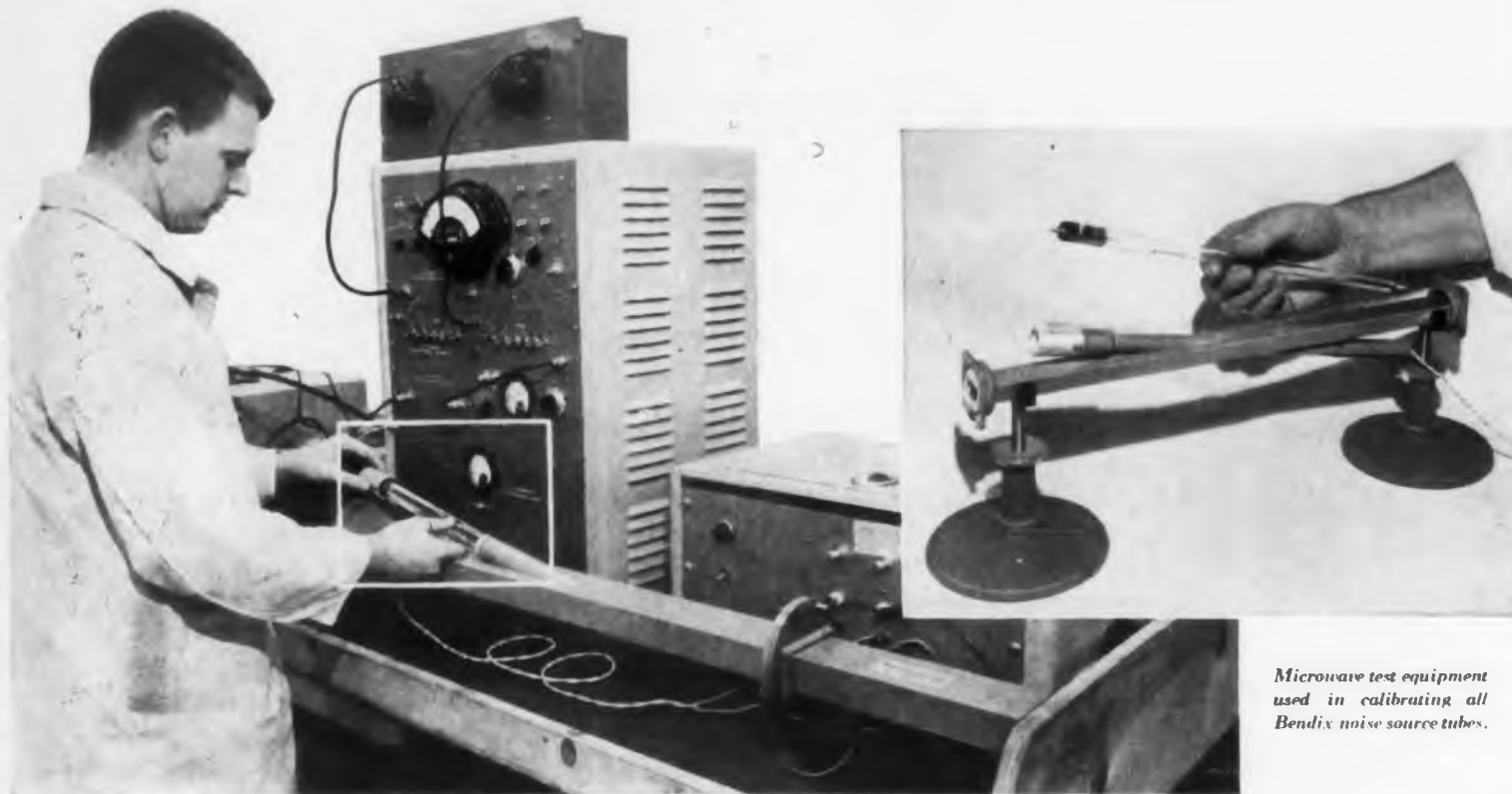
CIRCLE 459 ON READER-SERVICE CARD FOR MORE INFORMATION

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NOISE SOURCE TUBES

Offer unusual stability plus freedom from ambient temperature corrections



Microwave test equipment used in calibrating all Bendix noise source tubes.

As measured sources of noise power in microwave equipment, Bendix Red Bank noise source tubes offer several distinct advantages.

First, temperature changes and fluctuations in noise output present no problems with these tubes, because we make them so that no correction in noise figures is necessary over the range from $-55^{\circ}\text{C}.$ to $+85^{\circ}\text{C}.$ Next, our precise quality control works to close tolerances that produce unusual stability and long life—far beyond that usually found in noise source measuring equipment.

Finally, as can be seen in the table at right, Bendix Red Bank noise source tubes cover an extremely wide range of frequencies, so that there is no difficulty in finding a type to meet any specific need.

If you have any sort of application in measuring noise and sensitivity in microwave receiving equipment, check with us for the most efficient answer. Write RED BANK DIVISION, BENDIX AVIATION CORPORATION, EATONTOWN, NEW JERSEY.

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.
Canadian Distributor: Aviation Electric Ltd., P.O. Box 6102, Montreal, Quebec

Bendix Type	RETMA No.	Wave-guide No.	Frequency KMC	Anode Current MA	Nom. Tube Drop Volts	Nom. Noise Rating db	Mount Type
TD-10	6356	RG49/U	3.95-5.85	250	70	15.2	10°E
		RG50/U	5.85-8.20				
TD-11	6357	RG25/U	8.20-12.40	200	75	15.2	10°E
TD-12	6358	RG48/U	2.60-3.95	250	80	15.2	10°E
TD-13	6359	RG53/U	18.00-26.50	200	65	15.2	10°E
TD-18	6684	RG91/U	12.40-18.00	200	70	15.2	10°E
TD-21	—	RG69/U	1.12-1.70	250	65	15.2	90°H
TD-22	—	RG48/U	2.60-3.95	250	45	15.2	90°H
TD-23	—	RG52/U	8.20-12.40	200	115	18.0	10°E
TD-24	—	WR 229	3.30-4.90	250	65	15.2	10°E



CIRCLE 460 ON READER-SERVICE CARD FOR MORE INFORMATION

Abstracts

Report Briefs

Transistor At High Current Densities

At high current densities the simple theory of the junction transistor is no longer valid, in view of the fact that in the transistor base the minority concentration ceases to be everywhere negligible with respect to the majority concentration. One consequence of this is that the base loss drops fairly quickly to half its initial value as the current density is raised; another consequence is that the emitter loss gradually increases. The increase in emitter loss continues long after the base loss has become constant, the net result being that the total losses go on increasing and that the current amplification factor falls off. The higher the equilibrium concentration of majority charge carriers in the emitter the slower the rise of emitter losses with current density; as a result of this, excessive losses are not incurred until higher current densities. Where p-n-p alloy transistors are concerned, this higher concentration can be obtained by the use of gallium-indium alloy as acceptor material for the emitter instead of the usual pure indium. *Abstract summary, Transistor At High Current Densities, Stieltjes and Tummars, Philips Technical Review, North American Philips Co., Inc., 750 South Fulton Ave., Mt. Vernon, N.Y., July 1956, pp 61-68.*

Diode Mixer Analysis

Discussed is a method for calculating the mixer admittance matrix Y' which results when the ohmic impedance is connected in series with a diode mixer described by an admittance matrix Y . There are no restrictions on the frequency dependence of the ohmic impedance nor on the number of harmonic sidebands considered. The equations are worked out in detail for the "low Q " case in which signal, image, and intermediate frequencies are considered, and it is shown that Y' in this case is "nearly low Q ." Explicit formulas have been derived for calculating the elements of Y' when Y represents the parallel combination of a nonlinear conductance and capacitance. In general, these formulas are cumbersome, but three special cases have been considered in detail. *PB 111786 An Analysis of the Diode Mixing Consisting of Nonlinear Capacitance and Conductance and Ohmic Spreading Resistance, A.C. Macpherson, NRL Report 4607, OTS, US Dept. of Commerce, Washington 25, D.C., Feb. 1956, 16 pp.*

VOR Ground Discontinuity Effect

Tests were conducted atop a high bluff along the Lake Michigan shore to determine the effect of an abrupt ground discontinuity on the course accuracy of a vhf omnirange. Satisfactory operation is obtained when the antenna is located 4 ft above the terrain and not less than 63 ft from a ground discontinuity. Distance from antenna to ground discontinuity must be increased to 125 ft if the antenna is raised to 14 ft above the terrain. Equations describe some phenomena observed. *PB 121228 Effect of a Ground Discontinuity On a VOR, Anderson and Frederick, CAA TDC, Bulletin 278, OTS, US Dept. of Commerce, Washington 25, D.C., May 1956, 20 pp. 50 Cents.*

Vernier Timer Measures Millisecs

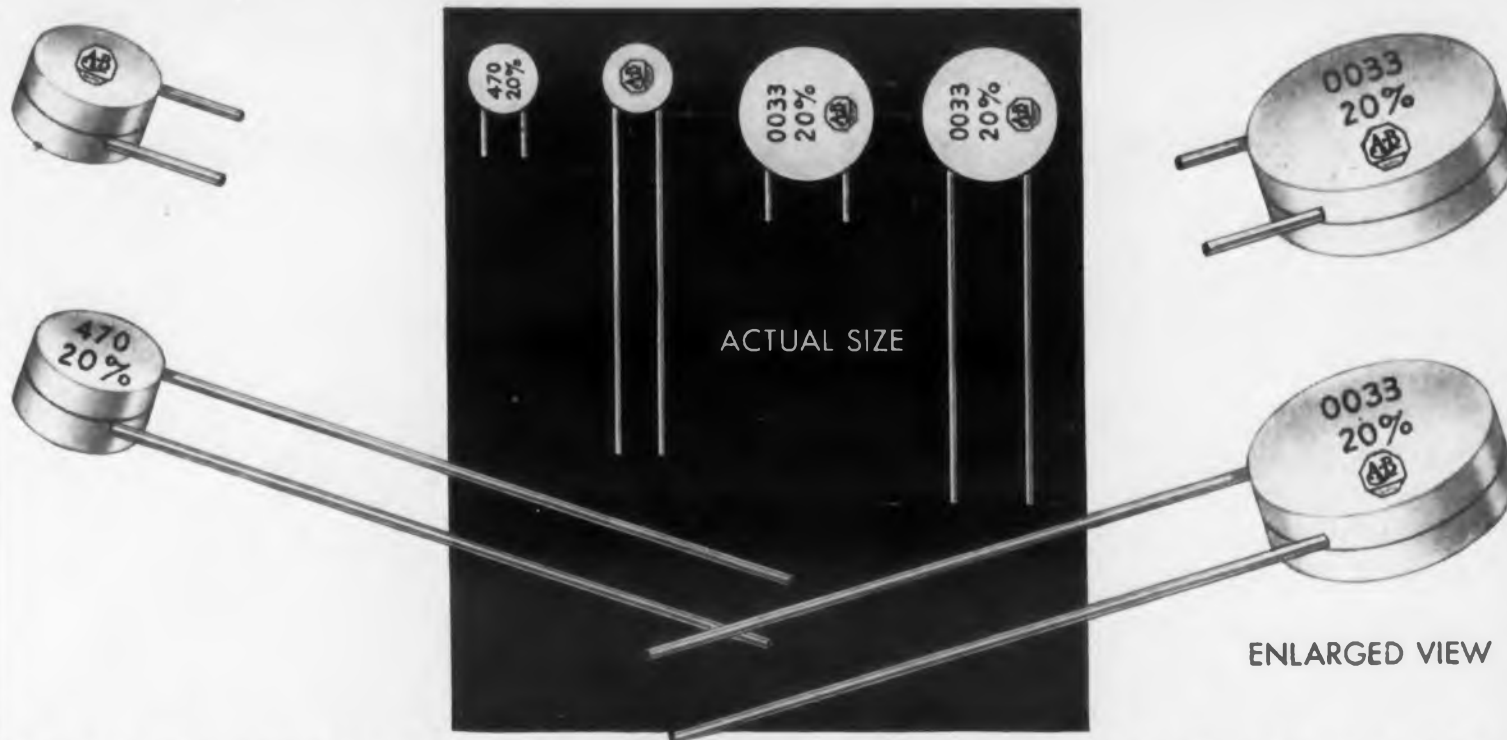
Developed at NRL, a vernier timer uses magnetic disc recording and is capable of measuring in true time the position of a shaft when its position is proportional to time. A prototype of the timer has been built, using two magnetic discs. The timer measures intervals from 10 to 20,000 msec, with an accuracy of ± 1 msec., and largely dependent on the constancy of the frequency supply to the disc drive motor. *PB 121099 A Vernier Timer, J. P. O'Connor, NRS Report 4741, OTS, US Dept. of Commerce, Washington 25, D.C., April 1956, 16 pp, 50 Cents.*

Substitute For Hi-Nickel Alloy

Sendust powder cores exhibit excellent magnetic properties (low eddy current, hysteresis, and residual losses, coupled with high permeability) indicate their usefulness as a future substitute for high nickel alloys used in loading and filter coils, such as 2-81 molybdenum-permalloy. *PB 121166 Sendust Powder Magnetic Cores: A Non-Strategic Substitute For Powdered High Nickel Alloys, E. Adams, NOL, OTS, US Dept. of Commerce, Washington 25, D.C., June 1953, 19 pp. 50 Cents.*

AF Materials Research

Two hundred and five abstracts of USAF research in adhesives, metallurgy, analysis and measurement, biochemistry, textiles, petroleum products, plastics, packaging, protective treatments and rubber are contained. This research was conducted during the period from July 1954 to June 1955. *PB 111648S A Review of the Air Force Materials Research and Development Program, Mary M. Sokol, USAF Wright Air Development Center, OTS, US Dept. of Commerce, Washington 25, D. C. Feb. 1956, pp. 137, \$3.50.*



Ceramic Encased Capacitors for Continuous Operation AT 150 C AMBIENT TEMPERATURE

These Allen-Bradley capacitors are encased in a ceramic shell—an excellent insulation. They can, therefore, be mounted adjacent to "live" parts without danger of leakage or voltage breakdown. They are available in RETMA and MIL values from 2.2 to 3300 mmfd.

Allen-Bradley encased capacitors are rated at an ambient temperature of 150 C (continuous operation at 500 volts d-c). Ordinary uninsulated capacitors have a maximum ambient temperature rating of only 85 C. Also at a given capacitance at 25 C, Allen-Bradley encased capacitors, over a temperature range from minus 55 C to plus 150 C, will not vary more than plus or minus 30%. These encased capacitors are uniform in configuration

and dimensions, a feature of great value in automatic assembly operations. Being completely free of wax, sticking together and gumming up of production machinery are eliminated.

Since the ceramic shell takes the place of the usual resin coating, there is no resin on the lead wires, making it possible to solder closer to the dielectric disc with resultant lower series inductance. These capacitors can be supplied with long or short leads for manual or automatic assembly operations.

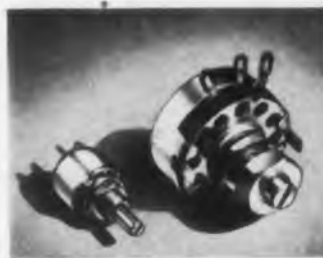
Allen-Bradley encased capacitors are another contribution to the military effort to obtain superior electronic components. Send for data on these ceramic encased capacitors, today.

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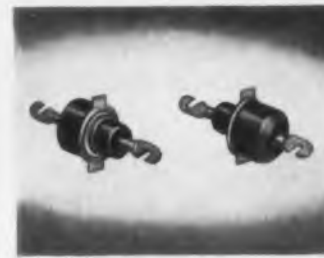
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Ferri-Cap Feed-thru Filters
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Please send me technical data on the A-B ceramic encased capacitors.

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HOW FAST CAN AMERICA STRIKE BACK?



America's defense is keyed to halt aggression almost as soon as it starts. In seconds, bombers of our Strategic Air Command, guided by a *new bombing and navigational system*, will be able to take to the air, seek out, and smash any threat of war aimed in our direction.

Heart of this new bombing and navigational equipment is an electronic computer, built by IBM. With a speed and accuracy never before possible, this computer sifts through reams of flight and target data, translating them into vital facts for a safe and successful mission.

Careers unlimited

If you are an engineer or a technician, perhaps you would like to work on similar computers for business, government and science—as well as for defense. IBM offers unequalled career opportunities in this virtually “unlimited” field of electronics.

Many IBM benefits

In addition to excellent starting salaries and on-the-job training with pay, IBM offers a chance for rapid promotion through its individual merit recognition 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.

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IBM Laboratories at Endicott, Owego, Poughkeepsie and Kingston, N. Y., and San Jose, Calif.



DATA PROCESSING
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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.

Connectors

MIL-C-8384A (USAF), CONNECTORS, ELECTRICAL, (MOLDED BODY) AND ACCESSORIES, 7 JUNE 1956.

Electrical, molded-body, multicontact connectors and their accessories as used in electronic equipment are covered in this spec. This spec has been prepared to assure that the connector made by one manufacturer will be interchangeable with the connectors of the same design and size made by any other manufacturer.

Solenoids

MIL-S-004040B (USAF), GENERAL SPECIFICATION FOR SOLENOID, 3 MAY 1956.

The general requirements for solenoids used in aircraft to actuate various devices for electric power are covered by this spec. Solenoids are either Type I, continuous duty, or Type II, intermittent duty, and either Class A, in which the mechanical force is presented as direct movement in a plane parallel to the longitudinal axis of the coil, or Class B, which impart a mechanical force perpendicular to the longitudinal axis of the coil. This limited coordination spec has been prepared by the Air Force, based upon currently available technical information, but the spec is not approved for promulgation as a revision of MIL-S-4040A.

Transistors

MIL-T-25380A (USAF), TRANSISTORS, PHOTOTRANSISTORS, SEMICONDUCTOR DIODES, AND PHOTODIODES, 17 MAY 1956.

Semiconductors for use in Air Force electronic equipment are covered by this spec. The class into which each semiconductor falls is indicated on the individual specs. Terms and symbols used in this spec and related semiconductor specs, concerning semiconductors, are defined.

Resistors

The Air Force has issued the following specs covering variable wirewound resistors of the low operating type. These specs are to be used for the procurement of replacement parts and not for new design.

MIL-R-26979, RESISTOR TYPE RA-15
MIL-R-26980, RESISTOR TYPE RA-24
MIL-R-26981, RESISTOR TYPE RA-40
MIL-R-26982, RESISTOR TYPE RA-50
MIL-R-26983, RESISTOR TYPE RA-60
MIL-R-26984, RESISTOR TYPE RA-75

Capacitors

MIL-C-18312 (NAVY), AMENDMENT 1, CAPACITORS, FIXED, PAPER DIELECTRIC, METALLIZED PAPER CONSTRUCTION, DIRECT CURRENT, HERMETICALLY SEALED METALLIC CASE, 28 MAY 1956

The tab type of construction has been deleted from the spec. The tables showing the characteristics of styles CH04, CH05, CH10, CH53, and CH54 capacitors have been revised.

RETMA RS-164, FIXED PAPER DIELECTRIC CAPACITORS IN TUBULAR NON-METALLIC CASES, AUGUST 1956

The dimensional and electrical characteristics of fixed capacitors in tubular non-metallic cases whose performance characteristics can be met with paper and/or film dielectric or equivalent are described by this standard. A typical RETMA type designation for capacitors meeting this standard is RCP10W6504K. Copies of this standard may be obtained from Engineering Department, RETMA, 11 West 42nd Street, New York 36, N.Y. for 50 cents each.

RETMA RS-165, CERAMIC DIELECTRIC CAPACITORS, CLASSES 1 AND 2, 1000 THROUGH 7500 VOLTS RATING, AUGUST 1956

Class 1 capacitors are a type specifically suited for resonant circuit application or any other application where high Q and stability of capacitance characteristics are essential. A typical RETMA type of designation for Class 1 capacitors is R1CC20U2J470G15. Class 2 capacitors are specifically suited for by-pass and coupling or where Q and stability of characteristics are not of major importance. R2CC20Y5Y221M15 is a typical designation for Class 2 capacitors. Copies of this standard may be obtained from RETMA for 80 cents.

Standards Book

Standards are linked with the achievements of scientific research and technological innovation and with high production efficiency in the age of automation in a 370-page book, entitled "National Standards in a Modern Economy." Edited by the late Dickson Reck, professor, School of Business Administration, University of California, the book is the work of 34 noted authorities in the field of standards. Publishers are Harper and Brothers, New York. Copies may be obtained from ASA at \$5 each.

Procurement

MIL-E-17189B, SPECIAL PROVISIONS FOR OFFSHORE PROCUREMENT OF ELECTRONIC EQUIPMENT, 3 MAY 1956

Supplementary requirements to basic specs covering equipments for offshore procurement are established by this spec. A procedure is outlined for the selection of parts. Instruction books are to follow MIL-M-16616, with exceptions as indicated in the spec.

What Does VACUUM Do For a Relay?



1 A high vacuum positively insures clean contacts that stay clean. The high temperature processing required to achieve an insulating vacuum drives off all vapors that might contaminate the contacts. The permanent vacuum then keeps the contacts clean during their storage and service life since all sources of contamination (such as organic matter, metallic oxides, etc.) are excluded from the evacuated contact enclosure. Contact resistance actually tends to improve with use.

2 A high vacuum permits antennas, pulse forming networks, and dc circuits to be switched "hot" if necessary without the danger of sticking or welding. The arc time is less than in any other interrupting medium. Since there is nothing to burn or to ionize, arcing ceases as soon as the contacts are parted enough so that field emission is no longer possible.

3 A high vacuum is excellent high voltage insulation permitting the construction of small, efficient contact actuating mechanisms that resist vibration and shock forces.

In Jennings' Transfer Relays this high vacuum is combined with an efficient magnetic circuit that has no air gap losses except those of the armature itself. Sufficient contact pressure is provided by the small 5 to 10 watt coil to permit rf current ratings of 10 to 15 amperes and contact resistances of less than .01 to .02 ohms.

Two new transfer relays have recently been developed by Jennings. The type JGF-RE2 relay is a 10 kv, 10 ampere RE2 vacuum relay enclosed in a rugged gas-filled container so that it can be mounted in exposed locations. The Type RE4 relay is for higher operating voltages up to 25 kv. It has a 5 watt actuating coil and like all Jennings transfer relays it has a simple flange mount so that the high voltage terminals can be sealed into a pressurized or oil filled container with the low voltage terminals and the coil accessible from the outside.

If you have difficult switching requirements that cannot be easily met by conventional relay types, we would like the opportunity of suggesting a suitable vacuum relay. Literature mailed upon request.



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

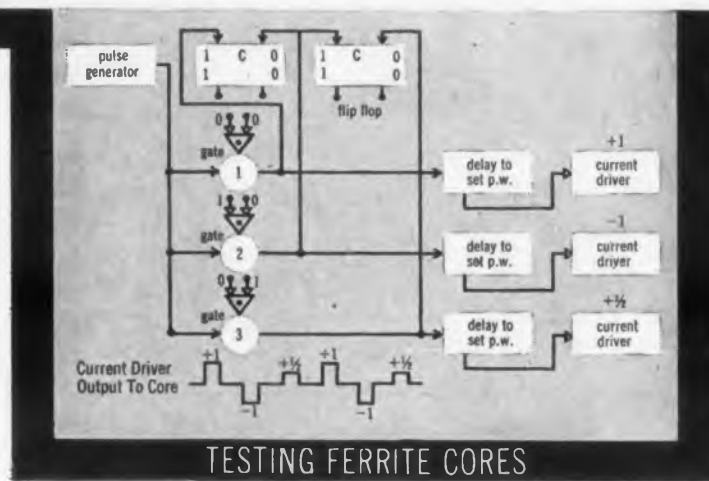
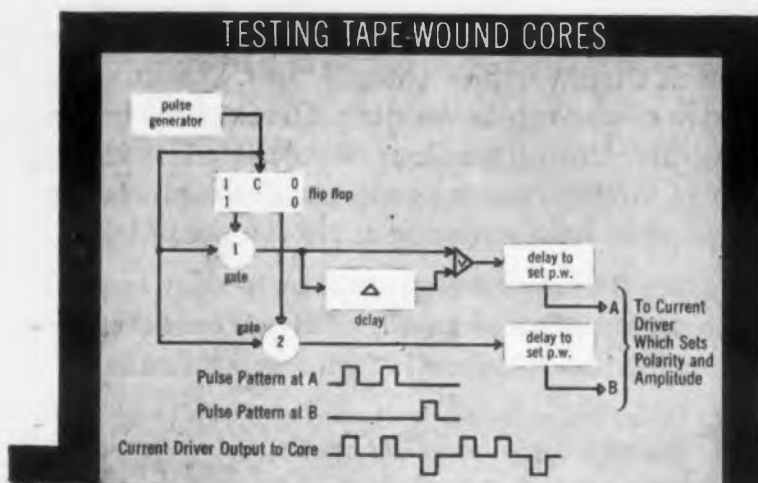
CIRCLE 463 ON READER-SERVICE CARD FOR MORE INFORMATION

modern methods for testing cores

The future of magnetic cores in information handling systems is already well assured. Their high reliability, fast action, small size, and low power consumption stimulate the imagination of more and more engineers working in data processing, weapons systems, and control. And every day finds these new components included in more new designs.

One problem still facing those who want to exploit these exciting properties is the lack of precise uniformity in cores made on a production basis. For as Burroughs has found through 5 years of working with the pioneers in core applications, uncertainties still exist. And before cores become standardized, many changes will probably be made. Those who want to take advantage of the great potential in this new component now must use reliable test procedures which precisely check the tolerances of each core, and are versatile enough to check for the new core specifications of tomorrow.

Burroughs Pulse Control Systems answer this need for leading manufacturers and users of cores by simulating the actual conditions under which each core produced will eventually operate. When conditions require a change in core operating characteristics, the testing system is changed at will, in a matter of minutes, to meet the new requirements.



Shown here are typical examples of how these core manufacturers, including Burroughs own core production department, use Burroughs Pulse Control Systems to check tape wound and ferrite cores. An interesting booklet describing core testing in greater detail is yours for the asking. But if you want to test another component by digital techniques, just send us your problem. We'll be glad to work it out, at no cost, and show you how Burroughs Pulse Control Systems can save you hours of engineering time and production headaches.

BURROUGHS

Electronic Instruments Division • 1209 Vine Street • Philadelphia 7, Pa.

CIRCLE 464 ON READER-SERVICE CARD FOR MORE INFORMATION

Coils, Transformers

MIL-C-15305A, COILS, RADIO FREQUENCY; AND TRANSFORMERS, INTERMEDIATE AND RADIO FREQUENCY, AMENDMENT 1, 17 JULY 1956

Procurement of coils and transformers of a specific design require additional data to give detailed electrical and mechanical requirements, tolerances, and applicable additions and exceptions to the general requirements and tests specified in this spec. A paragraph has been added indicating the information to be furnished with preproduction samples.

Standard Samples of Nickel Oxide

Two new standard samples of nickel oxide powder are now available from the National Bureau of Standards, Washington 25, D. C. Although designed primarily as spectrographic standards, they are also useful as chemical standards. Analyzed and certified for nine minor and trace elements, the standards are intended for checking and calibrating spectrochemical and chemical methods employed in the analysis of nickel, particularly cathode-grade material.

Signal Corp Equipment

MIL-P-11268C (SIG C), AMENDMENT 2, PARTS, MATERIALS, AND PROCESSES USED IN SIGNAL CORPS EQUIPMENT, 16 AUGUST 1956

Seven specs have been added to the list of applicable specs. These specs cover cable, resistors, and rectifiers. Three tables have been added to specify various styles of capacitors for specs MIL-C-62, MIL-C-5, and MIL-C-25. The requirements for lamps, selenium rectifiers, resistors, electron tubes, and shock isolators have been revised.

Transistors

MIL-T-19500 (SHIPS), TRANSISTORS, 7 MAY 1956

This is a general-purpose spec covering transistors for use in electronic equipment. The individual transistor specs govern in cases of conflicts. A color code for designating types of transistors is established. Transistor terms are defined as are transistor symbols.

Capacitors

MIL-C-25102A (USAF), CAPACITOR, FIXED ELECTROLYTIC, TANTALUM, 20 APRIL 1956.

Tantalum, electrolytic capacitors suitable for use in filter and by-pass circuits where large excesses of capacitance over the nominal capacitance can be tolerated are covered in this spec. This spec is a graded spec having characteristics and grades covering ranges in temperature and vibration respectively. The characteristic, capacitance, working voltage, and grade of capacitor used should be based upon the application in which the capacitor is to be used. A typical type designation of a capacitor meeting this spec is CW12B101A1.

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Silicone News

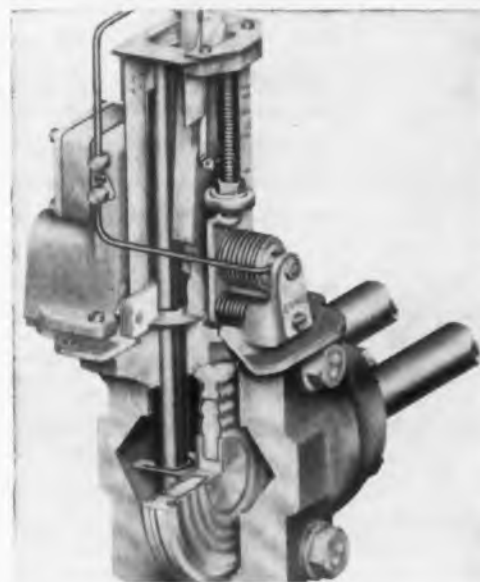
FOR DESIGN ENGINEERS

PRODUCT DESIGNERS SWITCH TO SILICONE DAMPING FLUIDS

Designers who have used Dow Corning 200 Fluid to dampen vibration, generally specify it for subsequent designs. For example, the new Foxboro Type 13A differential pressure Cell Transmitter is the most recent of several Foxboro units to contain 200 Fluid.

In place of the conventional single diaphragm, engineers at the Foxboro Company, Foxboro, Mass., adopted a twin-diaphragm capsule. Made up of two stainless steel diaphragms welded to a stainless steel core, the capsule is filled with Dow Corning 200.

The silicone fluid helps protect the diaphragms from overranges and permanent distortion. It also helps eliminate line disturbances ("noise") that otherwise interfere with flow measurements and have to be filtered out.



Non-gumming and non-corrosive, Dow Corning 200 Fluid has a negligible vapor pressure and retains a near constant viscosity over the operating temperature span of the transmitter.

No organic fluid approaches Dow Corning 200 Fluid for uniformity of damping over a wide temperature span. For example, when temperatures increase from -40 to 160 F, the damping effect of silicone fluid decreases in the ratio of 3 to 1 compared to 2500 to 1 for organic oils. No. 105

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



NEW FLUROSILICONE RUBBER RESISTS FUELS, OILS, SOLVENTS

A new kind of heat and cold resistant rubber, fluorosilicone rubber, has been developed by Dow Corning research chemists working in conjunction with the Materials Laboratory of Wright Air Development Center. Identified as Silastic LS-53, this new rubber has outstanding resistance to swelling in contact with jet fuels, gasoline, high aromatic oils and many solvents.

Silastic LS-53 resembles conventional silicone rubbers in that it has comparable tensile strength, ultimate elongation and compression set, and remains rubbery at temperatures from -80 to 400 F. However, the solvent resistance of this new fluorosilicone rubber is far superior to regular silicone rubbers.

Illustrating resistance to jet fuels, O-rings made of Silastic LS-53 swelled only 20 per cent when immersed for 70 hours in an aromatic test fuel at room temperature. As shown in the table, one of the best general purpose silicone rubbers swelled over 200 per cent under the same condition.

The properties of the new fluorosilicone rubber suggest increased serviceability and reliability for rubber components exposed to extreme heat or cold, and to solvents. Presently limited to use in essential Air

SILASTIC LS-53, OIL AND FUEL RESISTANCE*

Test Fluid	Silastic LS-53 Vol. Change, %	Silicone Rubber Vol. Change, %
ASTM No. 3 Oil 70 hrs. @ 300 F	+5	+65
ASTM Ref. Fuel B [†] 24 hrs. @ 70 F	+20	+225
Jet Engine Oil [‡] 70 hrs. @ 350 F	+5	+30
Hydraulic Fluid [§] 24 hrs. @ 160 F	+11	+163

*All samples cured 24 hours at 300 F
†MIL-R-2136, Type III

‡MIL-1-7808
§MIL-D-5504

Force applications, Silastic LS-53 should also have a wide range of applications in the commercial aircraft, chemical, petroleum and automobile industries. No. 106
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METER-RELAYS: Construction and Operation

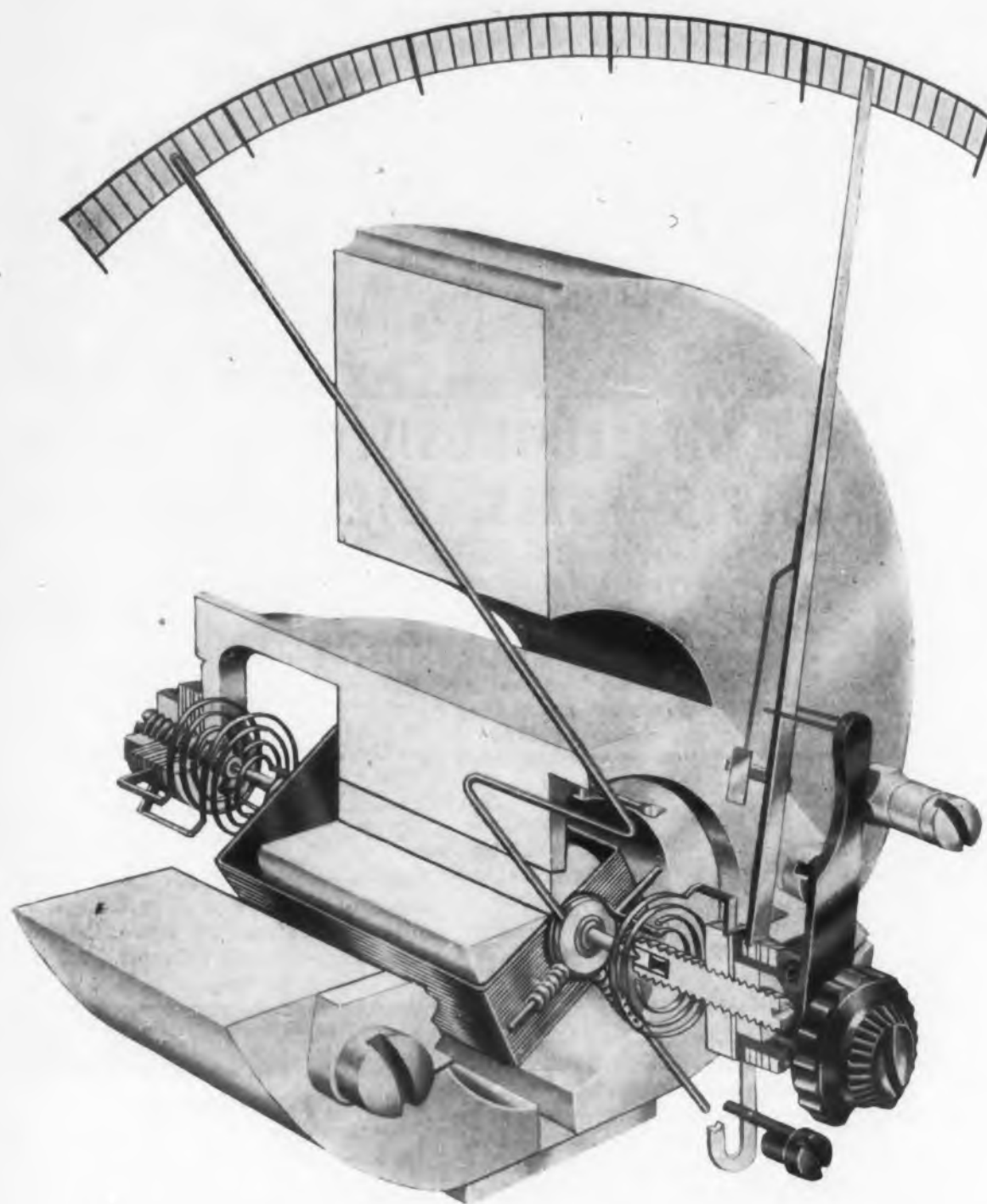
Adjustable pointer with plate contact, foreground, is mounted in bracket. Moving pointer, with contact, is part of conventional D'Arsonval-type meter movement. The moving coil and pointer assembly is pivoted in cushioned jewels, and rotates in the flux of a permanent magnet. The coil is connected to hairsprings.

Since the torque of the moving coil is too low for reliable contact operation, locking coil (wound on the moving coil) develops additional torque to close contacts with 1 to 3 grams pressure. Reset can be manual or automatic. It consists of opening the locking circuit. Built-in spring action kicks contacts apart forcibly. Meter-relays can be built with two adjustable pointers for high-low control.

Write for 40-page Catalog 4B for circuitry, specifications and prices.



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0-100 Microamperes, D.C.
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